

VOL. 72 PARTS 1-4 PAGES 1-480

Records of the Zoological Survey of India

A Journal of Indian Zoology

**Issued by The Director
Zoological Survey of India, Calcutta**

RECORDS
OF THE
ZOOLOGICAL SURVEY
OF INDIA

Vol. 72 (1-4)



सत्यमेव जयते

Edited by the Director, Zoological Survey of India

1977

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Z. S. I. LXXII

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PRINTED IN SANGAM PRESS LTD., 17/B MOTHURUD, POONA 29
AND PUBLISHED BY THE CONTROLLER OF PUBLICATIONS,
CIVIL LINES, DELHI, 110 006

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ICHTHYO-FAUNA OF GARO HILLS, MEGHALAYA (INDIA)

By

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(With 1 Text-figure)

INTRODUCTION

Apart from a few brief papers (Hora, 1924; 1925, Dey and Singh, 1967) and some scattered references by Day (1889) in the Fauna of British India which altogether constitute a small percentage of its fish fauna, there is as yet no faunistic work on the fishes of Garo Hills. Menon (1962) in his distributional list of fishes of Himalayas has indicated the pattern of fish distribution from the various drainage systems of the Himalayan regions. An assessment of the fish wealth of Garo Hills, however, is not possible from this account.

Garo Hills District, a small tract of land which forms the western district of the newly formed state of Meghalaya has a total area of 8163 Square Kilometres. The greater portion of the district consists of hills which are low in the north, gradually increasing in height to a range of mountains called the Tura Hills, the highest peak of which is about 1400 metres high. But the general elevation of the district varies from 400 metres upwards. Rainfall averages yearly from 250 to 350 cm. Sal and bamboo forests cover large tracts of the district.

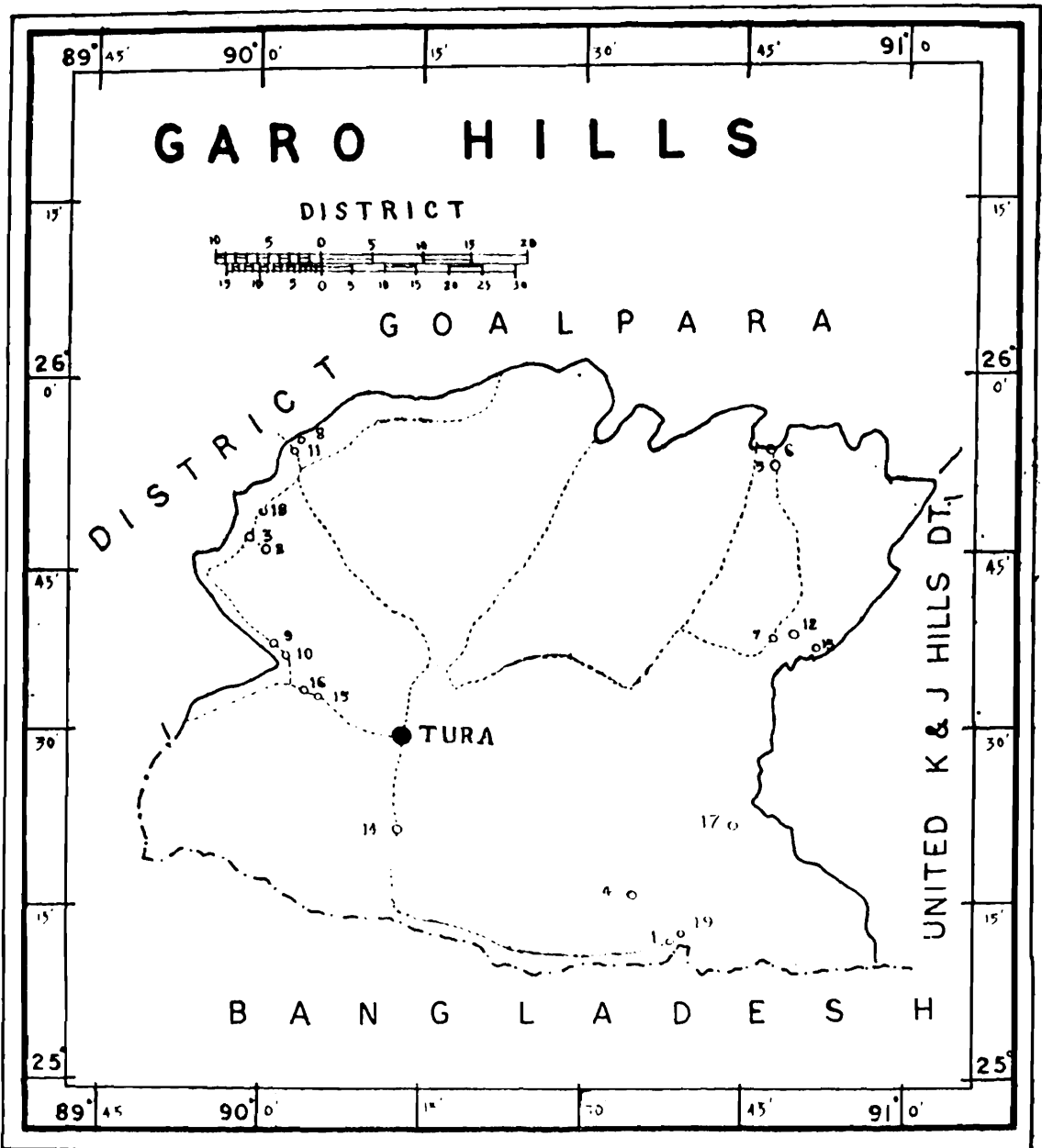
The material on which this report is based has been accumulating in the Eastern Regional Station of the Zoological Survey of India, Shillong for the past seven years and has been brought together by the three surveys indicated below :—

- (1) Garo Hills Survey, Feb.—March, 1965 by Shri A. S. Rajagopal.
- (2) Garo Hills Survey, Feb. 1971 by Dr. G. M. Yazdani.
- (3) Garo Hills Survey, April, 1971 by Dr. R. S. Pillai.

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The bulk of the material (roughly 95%) has been collected by the two later surveys. A total of 454 specimens, belonging to 59 species and 36 genera have been examined by us. The various localities which yielded these collections are listed below and indicated in the map (Text-fig. 1). Although more intensive surveys of the district are likely to increase the number of species further, we believe that more than 80% of the ichthyo-fauna of Garo Hills is represented in the present collections.



Text-fig. 1.— Map of Garo Hills showing the 19 collecting stations. The serial numbers correspond to the localities listed under "List of Collecting Stations."

Three species of fishes recorded in literature as occurring in Garo Hills are not represented in our collection. They are *Aborichthys garoensis* (Hora, 1925), *Psilorhynchus sucatio* (Hora, 1925) and *Noemacheilus montanus* (Dey and Singh, 1967). These included, the total number of species known so far from Garo Hills stands at 62.

Barring a few species which are indicated under the systematic account all form new locality records for Garo Hills. All the species dealt with under 'Systematic Account' have been arranged systematically giving under each species important synonyms, number of examples examined, size range in total length, collecting localities, name of collector, date of collection and its geographical distribution.

We are grateful to the Director, Zoological Survey of India, for giving us the opportunity to work out the fish fauna of Garo Hills. Our thanks are due to Dr. A. G. K. Menon for his help.

LIST OF COLLECTING STATIONS

A total of 19 stations in Garo Hills from where fish collections were made are listed below. These serial numbers have been indicated in the map (Text-fig. 1).

1. Amuka village, 1 Km. from Baghmara.
2. Barabil River near Rajabola.
3. Bamandanga stream, 10 Km. W. of Phulbari.
4. Dabigiri, 5 Km. from Baghmara.
5. Dainadubi forest, 9 Km. S. of Dudhnai.
6. Damra, 6 Km. S. of Dudhnai.
7. Darugiri stream, 5 Km. S. of Forest Bungalow.
8. Gingiram River, 3 Km. from Phulbari.
9. Holaidanga nullah, 19 Km. W. of Phulbari.
10. Khamari village beel, 22 Km. W. of Phulbari.
11. Phulbari, River near Inspection Bungalow.
12. Rongugunt stream, 1 Km. E. of Darugiri Forest Inspection Bungalow.
13. Rongjeng, 10 Km. E. of Darugiri Forest Bungalow.
14. Rongnobak River, 9 Km. S. of Tura.
15. Rongram River, 15 Km. W. of Tura.
16. Rongsong River, 17 Km. W. of Tura.
17. Siju Cave, stream flowing out of the entrance.
18. Singhara River, 8 Km. W. of Phulbari.
19. Someswari River, at Baghmara.

LIST OF FISHES FROM GARO HILLS

The 59 species which have been examined by us are listed below. Three more species are known from Garo Hills in published literature (see Introduction). The general classification of fishes adopted here is that of Greenwood, Rosen, Weitzman and Myers (1966).

Class TELEOSTOMI

Order CLUPEIFORMES

Family CLUPEIDAE

Genus (1) *Gudusia* Fowler

1. *Gudusia chapra* (Ham.)

Order CYPRINIFORMES

Family CYPRINIDAE

Genus (2) *Oxygaster* Van Hasselt

2. *Oxygaster bacaila* (Ham.)

Genus (3) *Barilius* Hamilton

3. *Barilius barila* Ham.

4. *Barilius barna* (Ham.)

5. *Barilius bandelisis* (Ham.)

6. *Barilius bola* (Ham.)

Genus (4) *Danio* Hamilton

7. *Danio aequipinnatus* (McClelland)

8. *Danio dangila* (Ham.)

9. *Danio devario* (Ham.)

10. *Danio* (*Brachydanio*) *rerio* (Ham.)

Genus (5) *Esomus* Swainson

11. *Esomus danrica* (Ham.)

Genus (6) *Rasbora* Bleeker

12. *Rasbora daniconius* (Ham.)

Genus (7) *Acrossocheilus* Oshima

13. *Acrossocheilus hexagonolepis* (McClelland)

Genus (8) *Amblypharyngodon* Bleeker

14. *Amblypharyngodon mola* (Ham.)

Genus (9) *Crossocheilus* V Hass.

15. *Crossocheilus latius latius* (Ham.)

Genus (10) *Chagunius* H. M. Smith

16. *Chagunius chagunio* (Ham.)

Genus (11) *Labeo* Cuvier

17. *Labeo boga* (Ham.)

18. *Labeo calbasu* (Ham.)

19. *Labeo goniis* (Ham.)

20. *Labeo pangusia* (Ham.)
Genus (12) *Puntius* Hamilton
21. *Puntius chola* (Ham.)
22. *Puntius sarana* (Ham.)
23. *Puntius sophore* (Ham.)
24. *Puntius ticto* (Ham.)
Genus (13) *Tor* Gray
25. *Tor tor* (Ham.)
Family COBITIDAE
Genus (14) *Botia* Gray
26. *Botia dario* (Ham.)
Genus (15) *Lepidocephalichthys* Bleeker
27. *Lepidocephalichthys annandalei* Chaudhuri
28. *Lepidocephalichthys guntea* (Ham.)
29. *Lepidocephalichthys menoni* Pillai & Yazdani.
Genus (16) *Noemacheilus* Van Hass.
30. *Noemacheilus botia* (Ham.)
31. *Noemacheilus multifasciatus* Day
32. *Noemacheilus scaturigina* (McClelland)
33. *Noemacheilus sikmaiensis* Hora
Genus (17) *Somileptes* Swainson
34. *Somileptes gangota* (Ham.)
Order SILURIFORMES
Family SILURIDAE
Genus (18) *Ompok* Laeépède
35. *Ompok bimaculatus* (Bloch)
Family BAGRIDAE
Genus (19) *Mystus* Scopoli
36. *Mystus cavasius* (Ham.)
37. *Mystus vittatus* (Bloch)
Family AMBLYCEPIDAE
Genus (20) *Amblyceps* Blyth
38. *Amblyceps mangois* (Ham.)
Family OLYRIDAE
Genus (21) *Olyra* McClelland

39. *Olyra horae* (Prasad & Mukerji)
 Family SISORIDAE
 Genus (22) *Glyptothorax* Blyth
40. *Glyptothorax cavia* (Ham.)
 Genus (23) *Hara* Blyth
41. *Hara hara* (Ham.)
 Family HETEROPNEUSTIDAE
 Genus (24) *Heteropneustes* Müller
42. *Heteropneustes fossilis* (Bloch)
 Family CLARIIDAE
 Genus (25) *Clarias* Gronov
43. *Clarias batrachus* (Lin.)
 Order ATHERINIFORMES
 Family BELONIDAE
 Genus (26) *Xenentodon* Regan
44. *Xenentodon cancila* (Ham.)
 Order CHANNIFORMES
 Family CHANNIDAE
 Genus (27) *Channa* Gronov
45. *Channa orientalis* Bl. & Schn.
46. *Channa punctata* (Bloch)
47. *Channa stewartii* (Playfair)
 Order PERCIFORMES
 Family CENTROPOMIDAE
 Genus (28) *Ambassis* Cuvier
48. *Ambassis baculis* (Ham.)
49. *Ambassis nama* (Ham.)
50. *Ambassis ranga* (Ham.)
 Family NANDIDAE
 Genus (29) *Badis* Bleeker
51. *Badis badis* (Ham.)
 Genus (30) *Nandus* Cuvier
52. *Nandus nandus* (Ham.)
 Family ANABANTIDAE
 Genus (31) *Anabas* Cuvier

53. *Anabas testudineus* (Bloch)
Genus (32) *Colisa* Cuvier and Valenciennes
54. *Colisa fasciata* (Bl. & Schn.)
Family GOBIIDAE
Genus (33) *Glossogobius* Gill
55. *Glossogobius giuris* (Ham.)
Order MASTACEMBELIFORMES
Suborder MASTACEMBELOIDEI
* Genus (34) *Pillaia* Yazdani
56. *Pillaia indica* Yazdani
Family MASTACEMBELIDAE
Genus (35) *Mastacembelus* Scopoli
57. *Mastacembelus armatus* (Lacép.)
58. *Mastacembelus pancalus* (Ham.)
Order TETRAODONTIFORMES
Family TETRAODONTIDAE
Genus (36) *Tetraodon* L.
59. *Tetraodon cutcutia* Ham.

SYSTEMATIC ACCOUNT

1. *Gudusia chapra* (Ham.)

1822. *Clupanodon chapra* Hamilton, *Fish Ganges* : 248, 383.

Material —2 exs., 80 mm & 86 mm, Barabil River, Coll. G. M. Yazdani (purchased), 13. ii. 71.

Distribution —Garo Hills: As above. Elsewhere : Throughout India except Kerala and Tamil Nadu. Bangladesh. Pakistan and Malaya Peninsula.

Remarks —Colouration in our material is similar to *G. variegata* (Day) known from Burma. But based on the depth of body, number of pre-and post-anal scutes we are referring the two examples to *chapra*; recorded from Garo Hills for the first time.

2. *Oxygaster bacaila* (Ham.)

1822. *Cyprinus bacaila* Hamilton, *Fish Ganges* : 265, 384.

Material —1 ex., 85.0 mm, Someswari River at Baghmara, coll. G. M. Yazdani, 19. ii. 71.

* Family status yet to be assigned.

Distribution —Garo Hills : As above. Elsewhere : Throughout India except Kerala, Karnataka and Tamil Nadu. Bangladesh. Burma. Pakistan and Nepal.

3. *Barilius barila* (Ham.)

1822. *Barilius barila* Hamilton, *Fish Ganges* : 267, 384.

Material —(i) 3 exs., 12 to 30 mm, Singhara River, coll. G. M. Yazdani, 12. ii. 71. (ii) 1 ex., 73 mm., Someswari River at Baghmara, coll. G. M. Yazdani, 19. ii. 71:

Distribution—Garo Hills: As above. Elsewhere : India : Manipur, Assam, West Bengal, Delhi, Rajasthan, U. P., Bihar, Orissa, M. P. and Karnataka. Bangladesh.

4. *Barilius barna* (Ham.)

1822. *Cyprinus barna* Hamilton, *Fish Ganges* : 268, 384.

Material —(i) 1 ex., 95 mm., Rongnabak River, coll. G. M. Yazdani, 15. ii. 71, (ii) 13 exs., 17 to 30 mm. Someswari River at Baghmara, coll. G. M. Yazdani, 18. ii. 71.

Distribution —Garo Hills: As above and Siju Cave (Hora, 1924). Elsewhere: India: Assam, W Bengal, Bihar, U.P., Orissa and Rajasthan.

5. *Barilius bendelisis* (Ham.)

1807. *Cyprinus bendelisis* Hamilton, *Journey Mysore*, 3 : 345. pl. 32.

Material —(i) 1 ex., 62 mm. Rongnabak River, coll. G. M. Yazdani, 15. ii. 71, (ii) 10 exs., 23 to 40 mm, stream outside Siju Cave, coll. G. M. Yazdani, 22. ii. 71.

Distribution —Garo Hills: As above and Siju Cave (Hora, 1924). Elsewhere : India : Assam, West Bengal, Bihar, U. P., Rajasthan, Punjab, Tamil Nadu, Karnataka and Orissa. Bangladesh. Pakistan and Sri Lanka.

6. *Barilius bola* (Ham.)

1822. *Cyprinus bola* Hamilton, *Fish Ganges* : 274, 275.

Material —1 ex., 240 mm., Someswari River at Baghmara, coll. G. M. Yazdani, 19. ii. 71.

Distribution —Garo Hills: As above. Elsewhere: India: Assam, W. Bengal, Bihar, U.P., Rajasthan, Punjab and Orissa. Bangladesh. Pakistan. and Burma.

7. *Danio aequipinnatus* (McClelland)

1839. *Perilampus aequipinnatus* McClelland, *Asiat. Res.*, 19: 393, pl. 60, fig. 1.

Material —(i) 8 exs., 47 to 60 mm., Rongram River, coll. G. M. Yazdani, 14. ii. 71 (ii) 1 ex., 45 mm., Darugiri Forest, coll. R. S. Pillai, 11. iv. 71.

Distribution —Garo Hills: As above and Siju Cave (Hora, 1924) Garo Hills (Day, 1889). Elsewhere: India: Sikkim, Assam, Manipur, W. Bengal, Rajasthan, Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh and Kerala. Sri Lanka. Burma. Thailand and Bangladesh.

8. *Danio dangila* (Ham.)

1822. *Cyprinus dangila* Hamilton, *Fish Ganges* : 321, 390.

Material —1 ex., 35 mm., stream at Darugiri Forest, coll. R. S. Pillai, 11. iv. 71.

Distribution —Garo Hills: As above. Elsewhere: India: Manipur, Nagaland, Assam, Meghalaya (Khasi Hills), West Bengal, Bihar. Burma.

9. *Danio devario* (Ham.)

1822. *Cyprinus devario* Hamilton, *Fish Ganges* : 341, 393.

Material —(i) 3 exs., 55 to 60 mm., Barabil River near Rajabola, coll. G. M. Yazdani (Purchased), 13. ii. 71. (ii) 1 ex., 64 mm., Someswari River at Baghmara, coll. G. M. Yazdani, 18. ii. 71.

Distribution —Garo Hills: As above. Elsewhere: Throughout India except Peninsular part. Bangladesh. Pakistan and Burma.

10. *Danio (Brachydanio) rerio* (Ham.)

1822. *Cyprinus rerio* Hamilton, *Fish Ganges* : 323, 390.

Material —(i) 2 exs., 18 and 19 mm., Bamandanga stream, coll. G. M. Yazdani, 12. ii. 71. (ii) 28 exs., 15 to 30 mm., Holaidanganallah, coll. G. M. Yazdani, 12. ii. 71. (iii) 5 exs., 12 to 30 mm., Someswari River at Baghmara, coll. G. M. Yazdani, 18. ii. 71. (iv) 19 exs., 15 to 20 mm., Dabigiri, coll. G. M. Yazdani, 19. ii. 71. (v) 15 exs., 20 to 27 mm., Stream at Dainadubi Forest. coll. R. S. Pillai, 9. iv. 71. (vi) 15 exs., 22 to 28 mm., market at Damra, coll. R. S. Pillai (Purchased), 10. iv. 71.

Distribution —Garo Hills: As above. Elsewhere: Throughout India. Burma.

11. *Esomus danrica* (Ham.)

1822. *Cyprinus danrica* Hamilton, *Fish Ganges* : 325, 390, pl. 16. fig. 88.

Material —(i) 15 exs., 30 to 50 mm., River near Phulbari I. B., coll. A. S. Rajagopal, 21. ii. 65. (ii) 2 exs., 32 & 38 mm., Holaidanga nallah, coll. G. M. Yazdani, 12. ii. 71.

Distribution —Garo Hills: As above. Elsewhere: Throughout India. Bangladesh. Burma. Malaya. Thailand. Pakistan and Sri Lanka.

12. *Rasbora daniconius* (Ham.)

1822. *Cyprinus daniconius* Hamilton, *Fish Ganges* : 327, 329, pl. 15, fig. 89.

Material —2 exs., 48 and 65 mm., Barabil River near Rajabola, coll. G. M. Yazdani, (Purchased), 13. ii. 71.

Distribution —Garo Hills: As above. Elsewhere: Throughout India. Bangladesh. Pakistan. Malaya and Sri Lanka.

13. *Acrossocheilus hexagonolepis* (McClelland)

1839. *Barbus hexagonolepis* McClelland; *Asiat. Res.*, 19. : 270, 336 pl. 41, fig. 3.

Material —(i) 17 exs., 26 to 110 mm., Rongram River, coll. G. M. Yazdani, 14. ii. 71. (ii) 21 exs., 20 to 72 mm., Siju Cave. coll. G. M. Yazdani, 21. ii. 71, 22. ii. 71.

Distribution —Garo Hills: As above. Elsewhere: India: Assam, W Bengal, and Eastern Himalaya. Nepal. Bangladesh. Malaya. Malaya Archipelago. Burma and Thailand.

14. *Amblypharyngodon mola* (Ham.)

1822. *Cyprinus mola* Hamilton, *Fish Ganges* : 334, 392, pl. 38, fig. 92.

Material —1 ex., 72 mm., Barabil River near Rajabola, coll. G. M. Yazdani, (purchased), 13. ii. 71.

Distribution —Garo Hills: As above. Elsewhere: Throughout India. Bangladesh. Burma and Pakistan.

15. *Crossocheilus latius latius* (Ham.)

1822. *Cyprinus latius* Hamilton, *Fish Ganges*: 345, 393.

Material—(i) 1 ex., 103 mm., Singhara River, coll. G. M. Yazdani, 12. ii. 71. (ii) 7 exs., 145 to 175 mm., Someswari River at Baghmara, coll. G. M. Yazdani, 18. ii. 71, 21. ii. 71.

Distribution—Garo Hills: As above. Elsewhere: India : Manipur, U. P., Bihar, W. Bengal, Karnataka. Bangladesh.

16. *Chagunius chagunio* (Ham.)

1822. *Cyprinus chagunio* Hamilton, *Fish Ganges* : 295, 387.

Material—1 ex., 240 mm., Someswari River at Baghmara, coll. G. M. Yazdani, 18. ii. 71.

Distribution—Garo Hills : As above. Elsewhere : India: Assam, W. Bengal, Bihar, U. P., Orissa, Punjab. Bangladesh. Burma. Thailand and Pakistan.

17. *Labeo boga* (Ham.)

1822. *Cyprinus boga* Hamilton, *Fish Ganges* : 286, 386, pl. 28 fig. 80.

Material—1 ex., 142 mm., Someswari River at Baghmara, coll. G. M. Yazdani, 21. ii. 71.

Distribution—Garo Hills : As above. Elsewhere : India : Assam, W. Bengal, U. P., Bihar, Rajasthan, Orissa, Tamil Nadu. Bangladesh. Burma and Pakistan.

18. *Labeo calbasu* (Ham.)

1822. *Cyprinus calbasu* Hamilton, *Fish Ganges* : 297, 387, pl. 2, fig. 83.

Material—1 ex., 170 mm. Someswari River at Baghmara, coll. G. M. Yazdani, 21. ii. 71.

Distribution—Garo Hills : As above. Elsewhere: Throughout India. Bangladesh. Burma. Thailand. S. China and Pakistan.

19. *Labeo gonius* (Ham.)

1822. *Cyprinus gonius* Hamilton, *Fish Ganges* : 292, 387.

Material—1 ex., 170 mm., Someswari River at Baghmara, coll. G. M. Yazdani, 21. ii. 71.

Distribution—Garo Hills : As above. Elsewhere : India: Assam, W. Bengal, Bihar, U. P., Orissa, Andhra Pradesh. Bangladesh and Burma.

20. *Labeo pangusia* (Ham.)

1822. *Cyprinus pangusia* Hamilton, *Fish Ganges* : 285, 386.

Material—2 exs., 135 and 175 mm., Someswari River at Baghmara, coll. G. M. Yazdani, 21. ii. 71.

Distribution—Garo Hills : As above. Elsewhere: India. Assam, W. Bengal, Karnataka. Pakistan.

21. *Puntius chola* (Ham.)

1822. *Cyprinus chola* Hamilton, *Fish Ganges* : 312, 389.

Material—1 ex., 74 mm., Singhara River, coll. G. M. Yazdani, 12. ii. 71.

Distribution—Garo Hills : As above. Elsewhere : Throughout India. Bangladesh. Pakistan and Burma.

22. *Puntius sarana* (Ham.)

1822. *Cyprinus sarana* Hamilton, *Fish Ganges* : 307, 388.

Material—(i) 2 exs., 130 and 148 mm., Singhara River, coll. G. M. Yazdani, 12. ii. 71. (ii) 2 exs., 158 and 172 mm., Someswari River at Baghmara, coll. G. M. Yazdani, 18. ii. 71. (iii) 20 exs., 15 to 35 mm., Stream outside Siju Cave, coll. G. M. Yazdani, 22. ii. 71.

Distribution —Garo Hills: As above. Elsewhere : Throughout India. Bangladesh. Pakistan. Burma. Malaya. Sri Lanka. Thailand and China.

Remarks—Although fairly common in most of the rivers and streams of Garo Hills and collected by us from the stream flowing out of Siju Cave, Hora has failed to record it from around the Siju. The largest specimen collected from Siju was only 35 mm. in total length, although the species attains more than 300 mm. in length.

23. *Puntius sophore* (Ham.)

1822. *Cyprinus sophore* Hamilton, *Fish Ganges* : 307, 388.

Material—2 exs., 70 and 72 mm, beel near Khamari village, coll. G. M. Yazdani, 12. ii. 71.

Distribution—Garo Hills: As above. Elsewhere: Throughout India. Bangladesh. Burma. China and Pakistan.

Remarks—Day (1889) records this species from Khasi Hills and Assam.

24. *Puntius ticto* (Ham.)

1822. *Cyprinus ticto* Hamilton, *Fish Ganges* : 314, 389.

Material—1 ex., 42 mm., Damra, coll. R. S. Pillai, (purchased), 10. iv. 71.

Distribution—Garo Hills : As above. Elsewhere : Throughout India. Bangladesh. Pakistan. Burma. Thailand and Sri Lanka.

25. *Tor tor* (Ham.)

1839. *Barbus hexastichus* McClelland, *Asiat. Res.* 19 : 269, 333.

Material—(i) 4 exs., 80 to 115 mm., Siju Cave, coll. A. S. Rajagopal, 6. ii. 65. (ii) 4 exs., 65 to 75 mm., Siju Cave, coll. A. S. Rajagopal, 7. ii. 65.

Distribution—Garo Hills : As above. Elsewhere: India: Kashmir, throughout the Himalayas, Sikkim and Assam.

Remarks—This species has been recorded by Hora (1924) from Siju Cave.

26. *Botia dario* (Ham.)

1822. *Cobitis dario* Hamilton, *Fish Ganges* : 354, 394,

Material—(i) 4 exs., 58 to 73 mm., Gingiram River, coll. G. M. Yazdani (purchased), 13. ii. 71. (ii) 1 ex., 82 mm., stream outside Siju Cave, coll. G. M. Yazdani, 22. ii. 71.

Distribution—Garo Hills : As above. Elsewhere: India: Assam, W. Bengal, Bihar, U. P., Bangladesh and Pakistan.

27. *Lepidocephalichthys annandalei* Chaudhuri

1912. *Lepidocephalichthys annandalei* Chaudhuri, *Rec. Indian Mus.*, 7 : 442.

Material—6 exs., 30 to 43 mm., stream at Dainadubi Forest, coll. R. S. Pillai, 9. iv. 71.

Distribution—Garo Hills : As above. Elsewhere : India: W. Bengal and “Eastern Himalayas.”

28. *Lepidocephalichthys guntea* (Ham.)

1822. *Cobitis guntea* Hamilton, *Fish Ganges* : 353, 394.

Material—(i) 8 exs., 22 to 76 mm., Holaidanga nallah, coll. G. M. Yazdani, 12. ii. 71. (ii) 4 exs., 50 to 75 mm., Bamandanga stream, coll. G. M. Yazdani, 12. ii. 71. (iii) 1 ex., 70 mm., Barabil River near Rajabola, coll. G. M. Yazdani (purchased), 13. ii. 71. (iv) 1 ex., 65 mm., Gingiram River, coll. G. M. Yazdani (purchased), 13. ii. 71. (v) 24 exs., 40 to 65 mm., Damra, coll. R. S. Pillai (purchased), 10. iv. 71. (vi) 15 exs., 46 to 75 mm., stream at Darugiri Forest, coll. R. S. Pillai, 11. iv. 71, 12. iv. 71 and 13. iv. 71. (vii) 3 exs., 60 to 65 mm., stream at Rongjeng, coll. R. S. Pillai, 12. iv. 71.

Distribution—Garo Hills : As above. Elsewhere : Throughout northern India. Bangladesh and Pakistan.

29. *Lepidocephalichthys menoni* (Pillai and Yazdani)
(New species under publication)

Material—(i) 2 exs., 30 to 31 mm., Singhara River, coll. G. M. Yazdani, 12. ii. 71. (ii) 11 exs., 27 to 32 mm., Someswari River, Baghmara, coll. G. M. Yazdani, 18. ii. 71.

Distribution—Garo Hills : As above.

30. *Noemacheilus botia* (Ham.)

1822. *Cobitis botia* Hamilton, *Fish Ganges* : 350, 394.

Material—(i) 2 exs., 64 and 81 mm., Gingiram River, coll. G. M. Yazdani (purchased), 13. ii. 71. (ii) 2 exs., 65 and 72 mm., Barabil River, coll. G. M. Yazdani, (purchased), 13. ii. 71. (iii) 2 exs., 35 mm., Someswari River at Baghmara, coll. G. M. Yazdani, 18. ii. 71.

Distribution—Garo Hills : As above. Elsewhere : India, Punjab, U. P., Bihar, Western Himalayas, W. Bengal, Eastern Himalayas, Assam. Bangladesh and Pakistan.

31. *Noemacheilus multifasciatus* Day

1878. *Nemachilus multifasciatus* Day, *Fish India*, : 617.

1924. *Nemachilus* sp., Hora, *Rec. Indian Mus.* 26 : 28-30.

Material—(i) 3 exs., 25 to 26 mm., Ronsong River, coll. G. M. Yazdani, 14. ii. 71. (ii) 3 exs., 25 to 55 mm., Rongnabak River, coll. G. M. Yazdani, 15. ii. 71. (iii) 1 ex., 70 mm., from inside Siju Cave, coll. G. M. Yazdani, 21. ii. 71. (iv) 3 exs., 31 to 38 mm., from inside Siju Cave, coll. G. M. Yazdani, 22. ii. 71. (v) 1 ex., 45 mm., stream outside Siju Cave, coll. G. M. Yazdani, 22. ii. 71.

Distribution—Garo Hills : As above. Elsewhere : India: W Bengal (Darjeeling), Assam.

Remarks—Hora (1924) has refrained from giving a specific identity to the species of *Noemacheilus* collected from Siju Cave. On the basis of examination of material from Siju Cave and other localities in Garo Hills we have been able to refer Hora's material to the species *multifasciatus*. That this species shows considerable variability in respect of colour pattern, and body profile is illustrated by a comparison of examples collected from inside and outside the cave. The specimens collected from inside the cave from muddy water accumulated on either side, were more depressed while those collected from fast flowing water

outside the cave were not so and these agree with the description of *N. multifasciatus* except in the number of stripes on the dorsal and caudal fins and absence of dark radiating marks from the eye. Although different in colour pattern the juveniles collected from Rongsong River and Rongnabak River (taken along with adults) is referable to *N. multifasciatus* on comparison with juveniles collected from inside the Siju Cave. Juvenile specimens have dorsal bars and a lateral row of spots. Indication of coalescence of the dorsal bars with lateral row of spots is discernible in a few specimens. The base of dorsal fin has, however, three dark bands as in the adult.

32. *Noemacheilus scaturigina* (McClelland)

1839. *Cobitis scaturigina* McClelland, *Asiat Res.* 19 : 436.

Material—13 exs., 23 to 33 mm., Singhara River, coll. G. M. Yazdani, 12. ii. 71.

Distribution—Garo Hills : As above. Elsewhere : India : Eastern Himalayas.

33. *Noemacheilus sikmaiensis* Hora

1921. *Nemachilus sikmaiensis* Hora, *Rec. Indian Mus.*, 22 : 201-202.

Material—1 ex., 27 mm., Someswari River at Baghmara, coll. G. M. Yazdani, 18. ii. 71.

Distribution—Garo Hills : As above. Elsewhere : India: Manipur Burma.

34. *Somileptes gongota* (Ham.)

1822. *Cobitis gongota* Hamilton, *Fish Ganges* : 351-394.

Material—3 exs., 90 to 98 mm., Gingiram River, coll. G. M. Yazdani (Purchased), 13. ii. 71.

Distribution—Garo Hills : As above. Elsewhere : India: Assam, W. Bengal, Meghalaya (Khasi Hills).

35. *Ompok bimaculatus* (Bloch)

1797. *Silurus bimaculatus* Bloch. *Syst-Ichth.*, 11 : 17.

Material—1 ex., 120 mm., Beel near Khamari village, coll. G. M. Yazdani, 12. ii. 71.

Distribution—Garo Hills : As above. Elsewhere : India: Kashmir, Punjab, Rajasthan, U. P., Bihar, Manipur, Assam, W Bengal, Orissa,

M. P. Tamil Nadu, Maharashtra, Kerala, Karnataka. Sri Lanka. Pakistan
Burma. Malaya. Malaya Archipelago. Thailand. Chusan and Yunan.

36. *Mystus cavasius* (Ham.)

1822. *Pimelodus cavasius* Hamilton, *Fish Ganges* : 203, 379.

Material—(i) 4 exs., 85 to 155 mm., Gingiram River, coll. G. M. Yazdani, 13. ii. 71 (ii) 1 ex., 105 mm., Someswari River at Baghmara, coll. G. M. Yazdani, 19. ii. 71.

Distribution—Garo Hills : As above. Elsewhere : India : Punjab, U. P., Bihar, W Bengal, Assam, Orissa, M. P. Tamil Nadu, Karnataka, Gujarat, Maharashtra, Kerala and Rajasthan. Bangladesh. Pakistan. Burma. Thailand. Malaya Archipelago and China.

37. *Mystus vittatus* (Bl.)

1797. *Silurus vittatus* Bloch, *Ichth.* 371.

Material—(i) 2 exs., 85 and 92 mm., Beel near Khamari village, coll. G. M. Yazdani, 12. ii. 71; (ii) 1 ex., 90 mm., Damra, coll. R. S. Pillai, (purchased), 10. iv. 71.

Distribution—Garo Hills : As above. Elsewhere : India : Punjab, U. P., Bihar, W. Bengal, Orissa, Assam, M. P., Tamil Nadu, Rajasthan, and Kerala. Pakistan. Bangladesh. Burma. Sri Lanka and Thailand.

38. *Amblyceps mangois* (Ham.)

1822. *Pimelodus mangois* Hamilton, *Fish Ganges* : 199, 379.

Material—(i) 3 exs., 35 to 37 mm., Someswari River at Baghmara, coll. G. M. Yazdani, 18. ii. 71; (ii) 4 exs., 40 to 50 mm., Damra coll. R. S. Pillai, (Purchased), 10. iv. 71.

Distribution—Gara Hills ; As above. Elsewhere : India : “The Himalayas, found in the Jumna for some considerable distance from the hills, also through Burma to Moulmein”

39. *Olyra horae* (Prashad and Mukerji)

1929. *Amblyceps horae* Prashad & Mukerji, *Rec. Indian Mus.*, 31: 173-174

1971. *Olyra horae*, Pillai & Yazdani, *J. zool Soc. India*, 23 : 135-136.

Material—(i) 1 ex., 76 mm., paddy field at Damra, coll. R. S. Pillai, 10. iv 71; (ii) 2 exes., 54 and 73 mm., stream at Darugir, Forest, coll. R. S. Pillai, 11 iv. 71 and 13. iv. 71.

Distribution—Garo Hills : As above. Elsewhere : Lake Indawgyi, Burma.

40. *Glyptothorax cavia* (Ham.)

1822. *Pimelodus cavia* Hamilton, *Fish Ganges* : 188, 378.

Material—2 exs., 43 and 50 mm., Near Siju Cave, coll. G. M. Yazdani, 23. ii 71.

Distribution—Garo Hills: As above. Elsewhere : India: U. P., Bihar, Assam. Burma.

41. *Hara hara* (Ham.)

1822. *Pimelodus hara* Hamilton, *Fish Ganges* : 190, 378.

Material—2 exs., 58 and 60 mm., Barabil River near Rajabola, coll. G. M. Yazdani (purchased), 13. ii. 71.

Distribution—Garo Hills: As above. Elsewhere : India: U. P., Orissa, W. Bengal, Assam, Nagaland. Burma. Bangladesh.

42. *Heteropneustes fossilis* (Bloch)

1794. *Silurus fossilis* Bloch. *Naturg. Ausland. Fische*, 8 : 46

Material—(i) 1 ex., 120 mm., stream at Darugiri Forest I. B. coll. R. S. Pillai, 10. iv. 71 (purchased); (ii) 1 ex., 160 mm., Beel near Khamari village, coll. G. M. Yazdani, 12. ii. 71.

Distribution—Garo Hills: As above. Elsewhere: Throughout India. Bangladesh. Burma. Pakistan. Sri Lanka. Thailand and Indo-China.

43. *Clarias batrachus* (Lin.)

1758. *Silurus batrachus* Linnaeus, *Syst. Nat.*, 1, ed. 10 : 305.

Material—(i) 2 exs., 130 and 150 mm., stream at Darugiri Forest, coll. R. S. Pillai, (purchased), 10. iv. 71; (ii) 1 ex., 172 mm., beel near Khamari village, coll. G. M. Yazdani, 12 ii. 71.

Distribution—Garo Hills: As above. Elsewhere: India, fresh and brackish waters of the plains of India. Bangladesh. Pakistan. Burma. Sri Lanka. Malaya. Malaya Archipelago. Thailand. Indo-China. Philippines. Hongkong and China.

44. *Xenentodon cancila* (Ham.)

1822. *Esox cancila* Hamilton, *Fish Ganges* : 213, 380.

Material—1 ex., 120 mm., Barabil River near Rajabola, coll. G. M. Yazdani, (purchased), 13. ii. 71.

Distribution—Garo Hills: As above. Elsewhere : India: Gujarat, Maharashtra, Punjab, Rajasthan, U. P., Bihar, W. Bengal, Assam, Z. S. .2

Orissa, M. P., Tamil Nadu, Karnataka, Kerala. Bangladesh. Pakistan. Burma. Sri Lanka. Malaya and Thailand.

45. *Channa orientalis* Bl. and Schn.

1801. *Channa orientalis*, Bloch & Schneider, *Syst. Ichth.* : 496.

Material—(i) 5 exs., 70 to 100 mm., Damra, coll. R. S. Pillai, (purchased), 10. iv. 71. (ii) 1 ex., 73 mm., Dabigiri, coll. G. M. Yazdani, 19. ii. 71.

Distribution—Garo Hills: As above and Siju Cave (Hora, 1924). Elsewhere: Throughout India. Bangladesh. Pakistan. Sri Lanka. Burma. Afghanistan. Malaya. Malaya Archipelago. Thailand. Indo-China and China.

46. *Channa punctatus* (Bloch)

1793. *Ophicephalus punctatus* Bloch, *Naturg. Ausland. Fische* : 139.

Material—(i) 2 exs., 125 and 126 mm., beel near Khamari village, coll. G. M. Yazdani, 12. ii. 71; (ii) 6 exs., 90 to 130 mm.; stream at Darugiri Forest, coll. R. S. Pillai, (purchased), 10. iv. 71, (iii) 1 ex., 115 mm., stream at Darugiri, coll. R. S. Pillai, 11. iv. 71.

Distribution—Garo Hills: As above. Elsewhere: Throughout India. Bangladesh. Pakistan. Burma. Sri Lanka. Malaya. China. Tahiti and Polynesia.

47. *Channa stewartii* (Playfair)

1867. *Ophiocephalus stewartii* Playfair, *Proc. zool. Soc. Lond.*, : 14.

Material—(i) 3 exs., 35 to 65 mm., Someswari River at Baghmara, coll. G. M. Yazdani, 18. ii. 71. (ii) 1 ex., 70 mm., Dainadubi forest, coll. R. S. Pillai, 9. iv. 71. (iii) 1 ex., 123 mm., stream at Darugiri, coll. R. S. Pillai, 11. iv. 71.

Distribution—Garo Hills : As above. Elsewhere : India: Bihar, W. Bengal, Assam, Meghalaya (Khasi Hills).

48. *Ambassis baculis* (Ham.)

1822. *Chanda baculis* Hamilton, *Fish Ganges* : 112, 371.

Material—2 exs., 45 and 46 mm., stream outside Siju Cave, coll. G. M. Yazdani, 22. ii. 71.

Distribution—Garo Hills : As above. Elsewhere : India: Punjab, Rajasthan, U. P., Bihar, W Bengal, Orissa, M. P., Maharashtra. Bangladesh. Pakistan. Burma and Thailand.

49. *Ambassis nama* (Ham.)

1822. *Chanda nama* Hamilton, *Fish Ganges* : 109, 371.

Material—1 ex., 75 mm., Singhara River, coll. G. M. Yazdani, 12. ii. 71.

Distribution—Garo Hills : As above and Siju Cave (Hora, 1924). Elsewhere: India : Punjab, U. P., Bihar, W. Bengal, Rajasthan, Orissa, M. P., Maharashtra. Bangladesh and Burma.

50. *Ambassis ranga* (Ham.)

1822. *Chanda ranga* Hamilton, *Fish Ganges* : 113, 371.

Material—5 exs., 55 to 67 mm., Singhara River, coll. G. M. Yazdani, 12. ii. 71.

Distribution—Garo Hills : As above. Elsewhere : Throughout India. Bangladesh. Pakistan. Burma. Malaya and Thailand.

51. *Badis badis* (Ham.)

1822. *Labrus badis* Hamilton. *Fish Ganges* : 70, 368.

Material—(i) 2 exs., 20 and 28 mm., Holaidanga nallah, coll. G. M. Yazdani, 12. ii. 71. (ii) 1 ex., 50 mm., Barabil River near Rajabola, coll. G. M. Yazdani, (purchased), 13. ii. 71. (iii) 2 exs., 35 and 36 mm., stream near Amuka village, coll. G. M. Yazdani, 14. ii. 71. (iv) 34 exs., 11 to 21 mm., Someswari River at Baghmara, coll. G. M. Yazdani, 18. ii. 71. (v) 1 ex., 58 mm., stream outside Siju Cave, coll. G. M. Yazdani, 22. ii. 71. (vi) 4 exs., 30 to 35 mm., Damra, coll. R. S. Pillai, (purchased), 10. iv. 71. (vii) 1 ex., 45 mm., stream at Darugiri, coll. R. S. Pillai, 11. iv. 71. (viii) 9 exs., 30 to 46 mm., stream at Darugiri, coll. R. S. Pillai, 12. iv. 71 and 13. iv. 71.

Distribution—Garo Hills : As above. Elsewhere : India: Assam, Nagaland, W. Bengal, Bihar, U. P. Burma.

52. *Nandus nandus* (Ham.)

1822. *Coius nandus* Hamilton, *Fish Ganges* : 96.

Material—2 exs., 102 and 112 mm., beel near Khamari village, coll. G. M. Yazdani, 12. ii. 71.

Distribution—Garo Hills : As above. Elsewhere : Throughout India. Burma. Thailand and Malaya.

53. *Anabas testudineus* (Bl.)

1792. *Anthias testudineus* Bloch. *Naturg. Ausland. Fische*, 6 : 121.

Material—3 exs., 95 to 105 mm., stream at Darugiri forest; coll. R. S. Pillai, (purchased), 10. iv. 71.

Distribution—Garo Hills : As above. Elsewhere : Throughout India. Sri Lanka. Burma. Malaya. Malaya Archipelago. Philippines. Thailand. Indo-China. China and Polynesia.

54. *Colisa fasciatus* (Bl. and Schn.)

1801. *Trichogastar fasciatus* Bloch & Schneider, *Ichthyologia* : 164.

Material—(i) 1 ex., 34 mm., Holiadanga nallah, coll. G. M. Yazdani, 12. ii. 71. (ii) 2 exs., 32 to 70 mm., Barabil River near Rajabola, coll. G. M. Yazdani, (purchased), 13. ii. 71. (iii) 1 ex., 44 mm., Damra, coll. R. S. Pillai (purchased), 10. iv. 71.

Distribution—Garo Hills : As above. Elsewhere : India: Orissa, Andhra Pradesh, Tamil Nadu, Assam, Bihar, Punjab and Uttar Pradesh. Bangladesh. Pakistan and Burma.

55. *Glossogobius giuris* (Ham.)

1822. *Gobius giuris* Hamilton, *Fish Ganges*: 51, 366.

Material—(i) 2 exs., 103 and 110 mm., beel near Khamari village, coll. G. M. Yazdani, 12. ii. 71 (ii) 3 exs., 110 and 150 mm., Gingiram River, coll. G. M. Yazdani, 13. ii. 71

Distribution—Garo Hills: As above. Elsewhere : Throughout India. Burma. Sri Lanka. East and South Coasts of Africa. Mauritius. Malaya. Malaya Archipelago. Thailand. China. Japan. Philippines. Melanesia. Polynesia and Australia.

56. *Pillaia indica* Yazdani

1972. *Pillaia indica* Yazdani, *J. Bombay nat. Hist. Soc.*, 69 (1) : 134-135.

Material—(i) 1 ex., 45 mm., stream ca. 4 km. north of Rongjeng, coll. R. S. Pillai, 12. iv. 71. (ii) 4 exs., 40 to 45 mm., stream at Darugiri, coll. R. S. Pillai, 12. iv. 71. (iii) 4 exs., 33 to 67 mm., stream at Darugiri forest, coll. R. S. Pillai, 13. iv. 71.

Distribution—Garo Hills : As above. Elsewhere : India : Khasi Hills (Meghalaya).

Remarks—The nine examples resemble this species (which was described on the basis of specimens from Khasi Hills (Yazdani, 1972) in all respects except the shape and number of caudal rays. The caudal tip in specimens from Khasi Hills is rounded and the fin rays range from 8-10. In the present specimens the median caudal rays

are prolonged with the result that the caudal fin is drawn to almost a point in a lanceolate fashion. The number of rays is also higher, varying from 10 to 11.

This recently created genus could not be accommodated in either Mastacembelidae or Chaudhuridae although it comes closer to the latter. Only further work will establish its correct relation in the suborder Mastacembeloidae (Greenwood *et al*, 1966.)

Our material which was collected from shallow forest streams with plenty of decomposing leaves and mud extends the range of distribution of this hill stream Spiny eel to Garo Hills and to a place of lesser altitude.

57. *Mastacembelus armatus* (Lacép.)

1800. *Macrogathus armatus* Lacépède, *Hist. nat. Poiss.* 283: 286.

Material—(i) 1 ex., 240 mm., Gingiram River, coll. G. M. Yazdani (purchased), 13. ii. 71. (ii) 1 ex., 535 mm., Someswari River at Baghmara, coll. G. M. Yazdani (purchased), 18. ii. 71.

Distribution—Garo Hills: As above. Elsewhere: Throughout India. Bangladesh. Pakistan. Sri Lanka. Malaya. Burma. Thailand and Hainan.

58. *Mastacembelus pancalus* (Ham.)

1822 *Macrogathus pancalus* Hamilton, *Fish Ganges*, 30: 364.

Material—2 exs., 90 and 100 mm., Damra, coll. R. S. Pillai, (purchased), 10. iv. 71.

Distribution—Garo Hills: As above. Elsewhere: Throughout India. Bangladesh. Pakistan.

59. *Tetraodon cutcutia* Ham.

1822. *Tetraodon cutcutia* Hamilton, *Fish Ganges*, 8, 362.

Material—(i) 2 exs., 30 and 31 mm., Barabil River near Rajabola, coll. G. M. Yazdani, (purchased), 13. ii. 71; (ii) 1 ex., 45 mm., Someswari River at Baghmara, coll. G. M. Yazdani, 18. ii. 71.

Distribution—Garo Hills: As above. Elsewhere: India: Orissa, W. Bengal, Assam. Bangladesh.

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EXTERNAL MORPHOLOGY OF *CYBISTER*
TRIPUNCTATUS ASIATICUS SHARP
(COLEOPTERA : DYTISCIDAE)

By
T. G. VAZIRANI

Zoological Survey of India, Calcutta

(With 4 Text-figures)

INTRODUCTION

The family Dytiscidae consists of about 3000, species and is distributed all over the world. We have in India about 200 species which have been recently revised/reviewed in a series of papers by Vazirani (1965-1971.)

The genus *Cybister* Curtis is generally considered to be the most highly evolved member of the family Dytiscidae. Sharp (1882) pointed out that the genus *Cybister* replaces the well known palaearctic genus *Dytiscus* Linnaeus, in the Oriental Region.

Considerable work has been done on the morphology, and life history of the well known palaearctic species, *Dytiscus marginalis* Linn. Several authors have contributed to the publication of a two volume monograph Korschelt (1923-24) which deals with life-history, morphology, anatomy, systematics etc. of the adult and larvae of this species. In this famous work the portion dealing with chitinous structure of the adult has been contributed by Buhlmann (Vol. 1 : 16-79) Balfour-Browne. (1932) has also dealt with the same subject incorporating findings of earlier workers.

There is however lack of corresponding work on our commonest species viz. *Cybister tripunctatus asiaticus* Sharp. The author undertook this problem as a part of his M. Sc. dissertation which was submitted in 1956, for the award of degree, by the University of Bombay. The account of the morphology of the larva was published by the author (1964). Since, then some work has been done such as, on the suckers of the anterior tarsi of male by Datta Gupta and Sindhu (1958); the morphology of the organs of oviposition and copulation in this species was dealt with by Sindhu (1960); while Khattar

(1962) has dealt with the morphology of the head capsule in a related species viz. *Cybister confusus* Sharp.

It will be apparent from the above survey of literature, that there is no detailed account of the morphology of the whole insect as such though attempt has been made by others to make a study of some parts, including the musculature etc. The scope of the present study is to serve the purpose of better understanding of the characters used for systematic studies of the group. A small amount of overlapping or repetition is thus unavoidable, to achieve this object, of the present studies.

The individuals of *Cybister tripunctatus asiaticus* Sharp are large, being 22·0-29·0 mm. and 12·0-15·0 mm. broad. This subspecies is distributed throughout the Oriental Region and is commonly found in ponds and slow running water, that is rich in vegetable and animal matter. It is carnivorous, in both the adult and larval stages, and is predatory on the fish fry in fish nursery ponds where its presence is considered highly undesirable. Eighteen species occur in India. Vazirani (1969) has given a key to the species of this genus known from India. Since then, 2 species previously placed in the synonymy have been re-validated. A revised key to these eighteen species is given at the end.

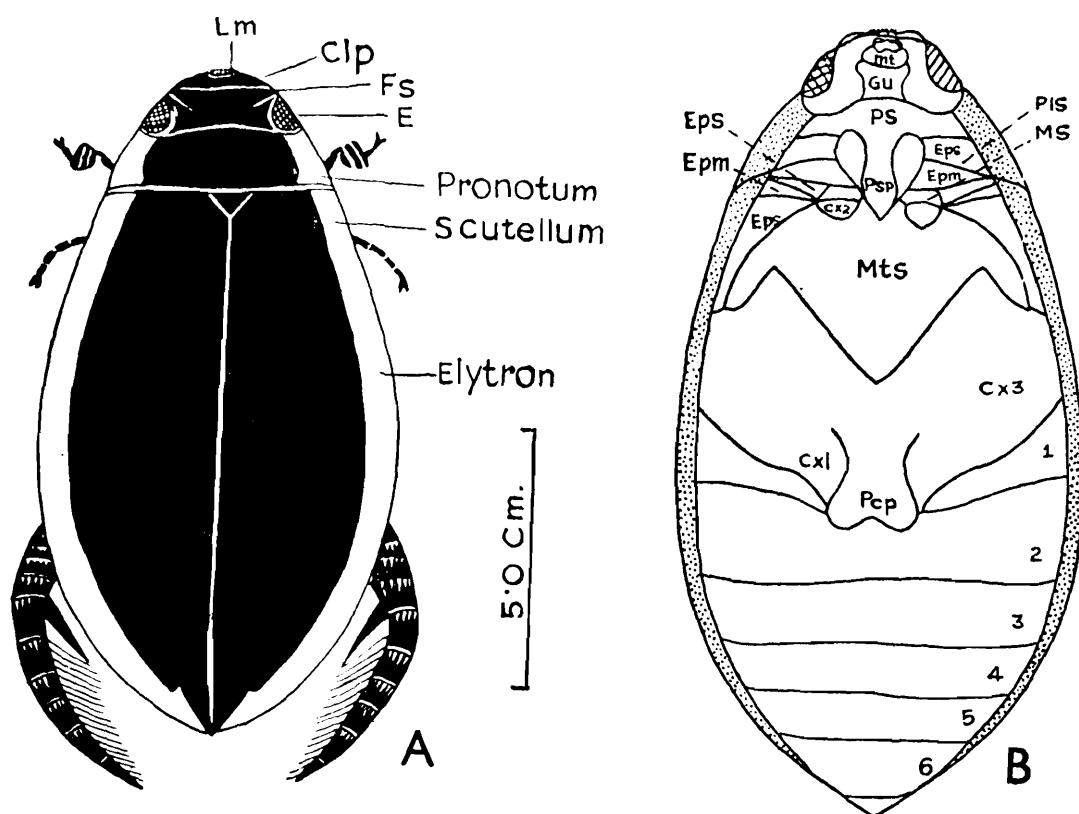
Snodgrass (1935) has been followed for the terminology of various parts except for genitalia, as indicated in the text.

HEAD

(Text-figs. 1A, B, 2A--E.)

Capsule (Text-fig. 1, A, B)—The head is transverse, slightly convex above, subrounded and slightly sloping in front. The anteriormost sclerite, is the labrum (*Lm*), a small transverse plate articulating with the clypeus (*Clp*) by a narrow membrane (anteclypeus or preclypeus of some authors). The anterior edge of this sclerite is slightly concave in the middle, while the lateral edges are convex. Dorsally the labrum is moderately punctured and the concavity of the anterior edge ciliated. The Clypeus (*Clp*) is a well demarcated, small transverse plate, placed behind the labrum. In between the lateral end of the Clypeus and the anterior margin of the eye, there is present a suture on either side which converge backwards but do not meet. These sutures are called the frontal suture (*Fs*) which hypothetically demarcate 'Frons' Thus the respective areas of frons and epicranium are not clearly demarcated. The compound eyes (*E*) are large, subtriangular, broader posteriorly and slightly convex laterally and occupy a greater part of the lateral walls of the capsule. On the back of the head when

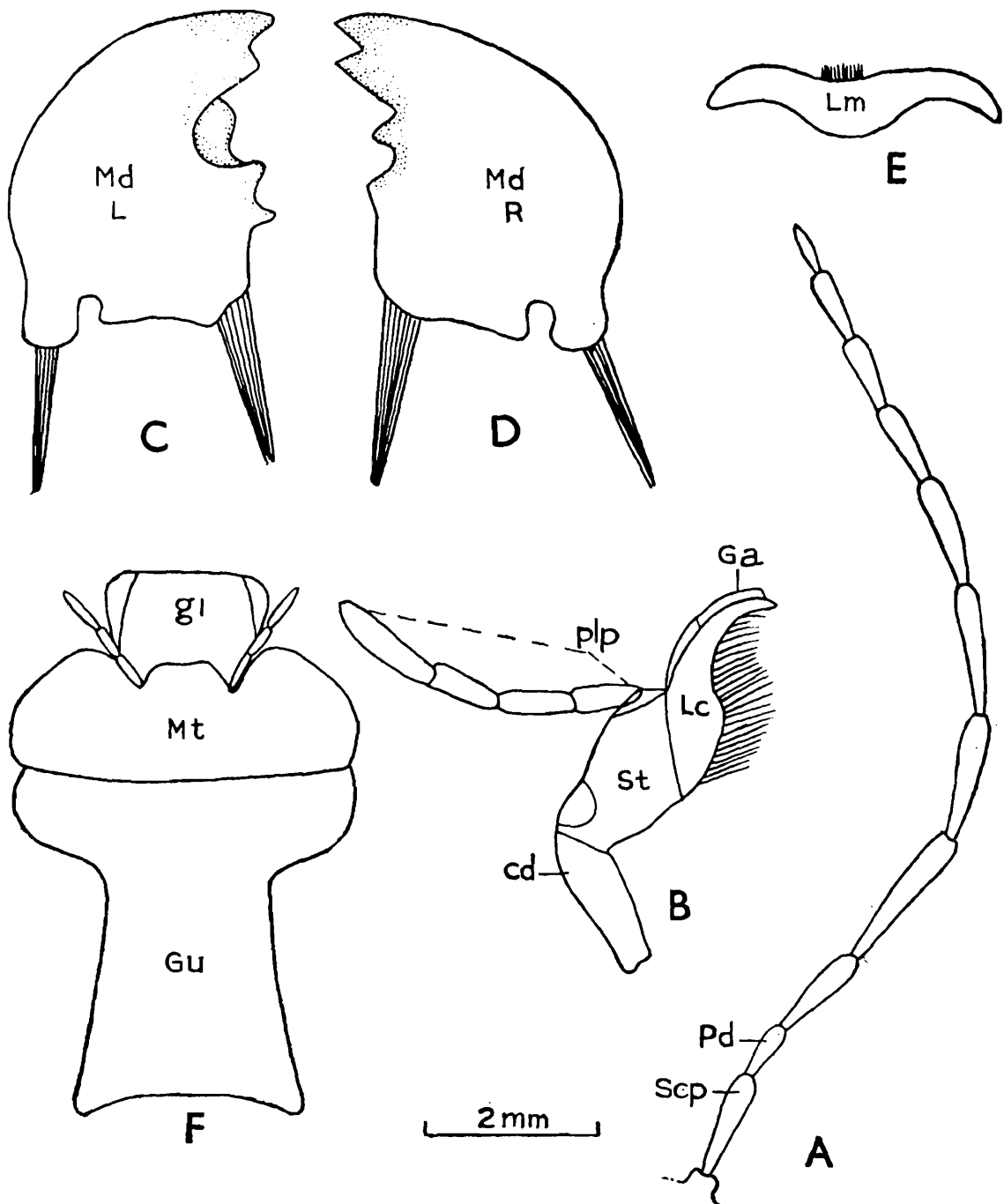
separated from the body, the most prominent feature is the large rectangular occipital foramen. On the ventral side it is bounded by the median large gular sclerite and laterally by the genae.



Text-fig. 1.—*Cybister tripunctatus asiaticus* :
a. dorsal view, b. ventral view (legs removed).

Antennae (Text-fig. 2A)—Each antenna (*Ant*) is a filamentous, 11 segmented organ situated in front of each eye; in state of rest it lies backwards beneath the sides of the head. Each arises from an oval antennarium situated in front of the compound eye and the corner of the labrum. A membrane connects the basal segment with the head capsule. Scape (*Scp*) is the longest basal segment and the pedicel (*Ped*) is about half of its length; the remaining nine segments of the flagellum are longer than the pedicel. All the segments of the antenna are cylindrical.

Mandibles (Text-fig. 2C, D)—The mandibles (*Md*) are heavily sclerotised, triangular and strongly toothed on the inner side. They lie closely above the lacinia and galea. They close upon each other within the preoral food cavity of the head. The mandibles are attached to the head by an articular membrane all round its base, but it is specially hinged to the cranial margin by dorsal and ventral points of articulation. These articulations are of ball and socket type of structures, the condyle of the dorsal articulation being on the cranium and that of the ventral articulation on the mandible.



Text-fig. 2.—*Cybister tripunctatus asiaticus* :

- a. antenna, b. maxilla, c. left mandible, d. right mandible,
e. labium, f. labium and gular sclerite.

Maxillae (Text-fig. 2B)—They lie in a deep groove on each side of the labium and large mandibles. Each maxilla articulates with the cranial margin on the back of head by means of a single process on the base of cardo (*Cd*). The cardo is an elongate sclerite, slightly broader at the distal end. The joint between the cardo and stipes (*St*) is elbow shaped. The stipes is subquadrate in shape and bears on its anterior lateral end, a 4 segmented palpi (*Plp*). The stipes bear two endites, lacinia (*Lc*) and galea (*Ga*), on the inner side of the palpus. The lacinia is a rigid moderately flattened lobe, tapering distally. It lies above the ligula, forming a roof to it. The inner margin bears a fringe of long hairs. The galea (*Ga*) is a relatively soft, thick bilobed

structure with a hood like apical pad. Both lacinia and galea are individually movable.

Labium (Text-fig. 2E)—Lying above the gular sclerite, it is a simple structure. The basal part, the Mentum (*Mt*) is implanted on the gular sclerite, is a transverse plate, about 4 times as wide as long, bisinuated long the anterior margin. The distal part, the Prementum consists of a pair of 3 segmented palpi (*Plp*) and the ligula. The ligula is about twice as wide as long, and a little convex in front; it is composed of the median subrounded lobe glossae (*Gl*) and the lateral subtriangular lobes, paraglossae (*Pgl*).

THORAX

(Text-figs. 1A, B, 3A, B.)

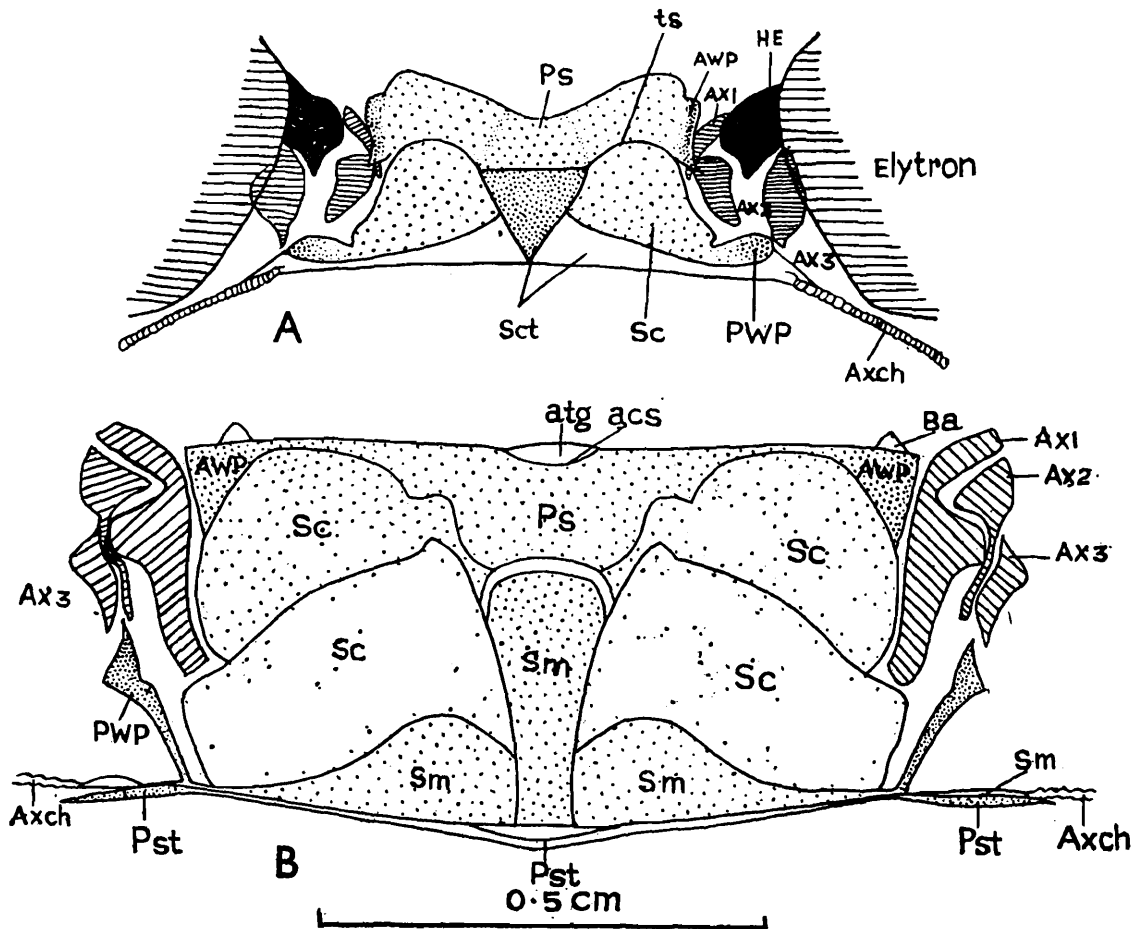
Prothorax (Text-fig. 1A, B)—Pronotum is a large transverse plate, a little more than twice as wide as long and also anteriorly a little narrower. Antero-lateral angles of the pronotum are slightly produced, accomodating the large compound eyes in the lateral concavities of the anterior margin. Posterior angles are also produced backwards over the shoulder of the elytral. On the ventral side, Prosternum (*Ps*) is a transverse plate, produced backwards into a median spathulate shaped, flat, process, 'The Prosternal process' (*Psp*). Lateral to the coxal articulation, the Plural sulcus (*Pls*), is an oblique line dividing the episternum (*Eps*) and the epimeron (*Epm*). The episternum is, roughly a rectangular sclerite, while epimeron is almost triangular.

Mesothorax (Text-figs. 1A, B, 3A, B.)—On the dorsal side, the visible part of the mesothorax, is a small triangular sclerite, mesoscutellum (*Sct*) commonly called the scutellum. The rest of the mesonotum lies hidden under the elytra and can be seen only after their removal. It is smaller than the pronotum or the metanotum. Besides the scutellum, the mesoscutellum is composed of two lateral sclerites, which are less chitinised. Each of the lateral sclerites carries on its outer extremities the Axillary Chord (*Ax ch*). Anterior to the mesoscutellum, separated by prescutal suture (*ts*), lies a less chitinised transverse sclerite, called the Prescutum (*Ps*), which is thickened laterally to form the anterior wing process (*AWP*). On each side of the mesoscutellum is the scutum (*Sc*), with its posterior lateral angle forming the posterior wing process (*PWP*).

Below each elytron, at its base and the median suture, there is a small wing like structure, called the 'alula' (*HE*). It is merely the basal lobe of the elytron.

The elytron and the alula are attached to the mesothorax, through the anterior and posterior wing processes and 3 small irregular sclerites

(Ax_1 , Ax_2 , Ax_3), lying embedded in the membrane connecting the two. This membrane, called the axillary membrane, permits free articulation.



Text-fig. 3.—*Cybister tripunctatus asiaticus* :
a. mesothorax, b. metathorax.

Of the three sclerites, two lie partly below the scutum and the third is closely attached to the elytron.

Mesosternum (*Ms*) is a small irregularly shaped sclerite, lying in between the anterior coxa and posterior coxa on either side of the prosternal process. The episternum (*Eps*) is situated laterally to the mesosternum, progressively narrowing and the epimeron (*Epm*) is a triangular sclerite meeting the mesocoxa of the respective side, on the inner side in a point.

Metathorax (Text-figs. 1B, 3B)—At the anterior margin, in the middle of the metanotum, there is a small tergite, the acrotergite (*atg*) and the groove separating it from prescutum, is the antecostal sulcus (*acs*).

Anteriorly, the tergum of the metathorax is transversely divided by a prescutal suture (*ts*). This area, the prescutum (*Ps*), is a transverse sclerite, narrowed laterally where it is more strongly sclerotised into a triangular, Anterior wing process (*AWP*).

Situated posterior to the prescutum and occupying the median position on the mesonotum is an elongate sclerite, Scutellum (*Sm*), with laterally projecting arms at the base. These arms extend upto the lateral margin of the metanotum, where it is forked into two branches. The anterior branch extends obliquely upwards and is gradually broadened to form the posterior wing process (*PWP*). The other branch gives origin to the axillary chord (*Ax ch*).

The scutum (*Sc*), is divided by the scutellum in the middle and is the largest area on its either side. Each lateral area of scutum is further demarcated by the transverse intrascutal suture.

Postscutellum (*Pst*) is the narrow transverse sclerite, lying behind the scutellum and stretching on either side. This transverse sclerite is lancet-shaped, laterally. They are connected with the epimera of the pleura of the respective segment, which appear in dorsal view.

The wings are attached to the metathorax through the axillary membrane, having three Axillary sclerites embedded in it. Axillary sclerite (Ax_1) is the largest in area, elongate, with two lateral prolongations and lying closely connected with the anterior-wing process and scutum; Ax_2 lies outside it and fits closely to its lateral side; Ax is an irregular sclerite connected with Ax_1 , Ax_2 and the posterior wing process. Situated almost on the top of anterior wing process but a little to the inner side, is a small lip like projecting sclerite, the basalare (*Ba*). Almost directly below the basalare and situated in the membrane is a spiracle, a slit like opening in a small island of chitin.

On the ventral side, metasternum is a large plate (*Mts*), pointed behind in the middle, and extending out laterally into wing shaped structure with parallel sides and then tapering to a point. Anteriorly the metasternum is grooved in the middle to receive the pointed tip of the prosternal process. The metathoracic episternum (*Eps*) is a triangular sclerite, its internal arm reaching the midcoxal cavities. The epimeron (*Epm*) in this case lies above the episternum and is hidden by the epipleurae and is not visible from the ventral surface.

Thoracic appendages

Elytra—Each elytron is a strongly chitinised plate hinged on to the side of the mesothorax. It is superficially with small tubercles in both the sexes and sometimes these tubercles are obsolete. The basic sculpture of the elytra consists of reticulation of more or less regular polygonal cells. When in repose, the elytra meet perfectly along the mid dorsal line, elytral suture. They cover the whole of the abdomen besides the mesothorax and metathorax.

Wings (Text-fig. 4E)—Close to the articulation of the elytron, and hinged with the metathorax on either side, is the membranous wing

which is used for flight. In repose the wing remains folded under the elytron and can not be seen unless the latter is moved outwards. In the unfolded state the outline of the wing is an elongate subtriangle and three margins are discriminated in it namely the anterior or costal margin, outer or external margin and hind or posterior margin.

The wings are firmly attached to the base by means of a complicated articular mechanism, which consists of the anterior most sclerite humeral plate (*HP*), 3 axillary sclerites (*Ax* 1, 2, 3), and less chitinised median plate. The relationship of these articular sclerites with the wing veins is explained below.

The *humeral plate* is a small sclerite giving attachment to the costal vein (*C*).

First Axillary (*Ax*₁) provides attachment to the subcostal vein at its distal end.

Second Axillary (*Ax*₂) is posterior to the *Ax*₁ and irregularly shaped, the anterior distal margin of which provides attachment to the Radius (*R*) and Media (*M*) veins.

Third Axillary (*Ax*₃) is also irregularly shaped and provides attachment to the venal and jugal veins.

Median plate—Proximally the main stem of the Cubitus (*Cu*) is associated with the distal median plate (*m*) of the wing base.

Venation

Venation in Remigial Region—The principal veins of this region are Costa (*C*) Subcosta (*Sc*), Radius (*R*) and Media (*M*).

Costa is a short vein, the base of the wing's anterior margin, and is moderately chitinised. Subcosta is also a short vein, moderately chitinised and connected to the costa along the middle region. Radius is a very strongly chitinised vein, forming the anterior margin of the wing, with it are fused the costa and subcosta. It divides into two veins *R*₁ and *Rs*. *R*₁ is a long and strongly chitinised vein and forms at its apical part a characteristic pterostigmatic area which consists of a peculiar cell, the Radial cell (*Rc*). Radial cell is connected with *R*₁ by means of short vein *r*. The proximal part of *Rc* has disappeared and is represented in the distal region. There branches, *R*₂, *R*₃ and *R*₄₊₅, originate from the Radial cell which forms the Radial Sector (*Rs*) and extend upto the apex of the wing. *R*₂ and *R*₃ form a cell in between and are joined to form *R*₂₊₃, distally, along the costal margin.

Media (*M*) is a long and well chitinised vein, running obliquely on the median part of the wing. Near the base it bifurcates into *M*₁₊₂ and *M*₃₊₄. *M*₁₊₂ is discernible only near its distal and by

means of a very small vein, meeting the Median cell. It is connected with *Rs* by means of a short and curved cross-vein *m—m*. From the Median cell two veins extend to the wing margin. The anterior one may be called the fused M_{1+2} and posterior one M_{3+4} .

Venation in the Vannal Region—Two main veins are referable to this region of the wing, namely, *Cubitus* (*Cu*) and *Postcubitus* (*Pcu*). The *Cu* is a moderately chitinised vein and primarily divided near the base into two branches viz. Cu_1 and Cu_2 . At its proximal end, Cu_2 is fused with *Pcu*. Cu_1 is more chitinised than Cu_2 and is divided into two branches Cu_{1a} and Cu_{1b} are connected through the distal margin of the cubital cell, and Cu_1 and Cu_2 are connected with each other through the proximal margin of the cubital cell (*CC*).

Pcu is a very moderately chitinised, long and simple vein. Posterior fold runs along just behind the postcubitus and separates the Vannus from Jugum.

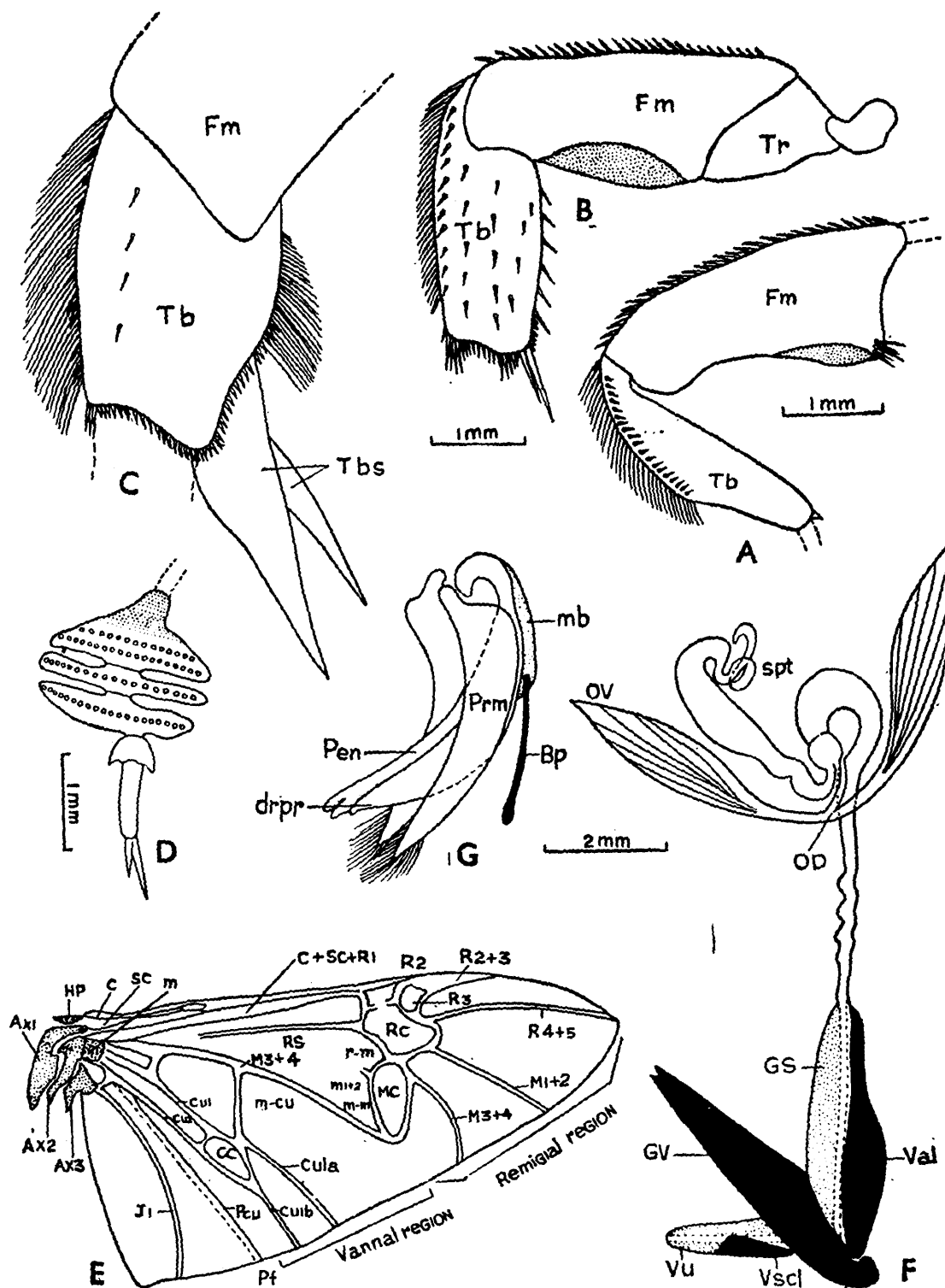
Venation in Jugal region—There is only one Jugal vein, independent, distinct and placed on the median part of Jugal region.

Legs

Anterior leg (Text-fig. 4A, D)—The coxa is globular and fitted into the coxal cavity, trochanter is a small sclerite attached to the posteriorlateral angle of the femur. The femur (*Fm*) is rather flattened with a small group of spines at its base along the inner proximal margin of the anterior face. Along the anterior margin of the anterior face, it is fringed with small hair. There is also another group of small spines along the distal margin of the anterior face.

Each tibia is fringed with sufficiently long hair along the proximal three fourths of the outer margin of anterior face, below and parallel to this row of hair, runs a line of small simple spines. Along the inner margin of the anterior face, is a row of minute hair. The tarsi are five segmented with two unequal tarsal claws. The basal three segments of the male anterior tarsi (Text-fig. 4D) are widened and bear on the ventral side, numerous suckers for holding tight the female. The shape of the expanded three segments together, is rather triangular, convex from above and concave from below. It is fringed with fine long hair on all sides. Each basal tarsal segment of the male is provided with two rows of pedicellate suckers on the underside in the distal half, while the proximal half is provided with fine pubescence. The two subsequent segments are also provided with one row each of pedicellate suckers. Datta Gupta and Sindhu (1958) have studied the suckers in anterior tarsi of male and called them 'papillae' They have also counted their number and given their measurements.

Middle legs (Text-fig. 4, B)—The coxae (cx2) are more or less globular fitting closely in the coxal cavities. Attached to the coxa of each side is the femur (*Fm*) which is strengthened at the base by a



Text-fig. 4.—*Cybister tripunctatus asiaticus* :

- a. anterior leg (without tarsi), b. middle leg (without tarsi),
- c. tibia and tarsi of hind leg, d. tarsi of anterior leg in male,
- e. right wing, f. female genitalia, g. male genitalia.

EXPLANATION OF LETTERINGS IN FIGURES

acs—antecostal suture, *atg*—acrotergite, *Ant*—antenna, *Ax*—axillary sclerite of wing base 1, 2 and 3, *AWP*—anterior wing process, *Ax ch*—axillary chord, *Ba*—

supplementary piece, the trochanter (*Tr*), which forms an intermediate segment between coxa and femur. The femur has a small group of spines at its base along its inner proximal margin of the anterior face and is also provided with a row of spines along the length of the anterior margin of the anterior face. Each Tibia (*Tb*) is fringed with sufficiently long hair along the entire length of the anterior outer margin of the anterior face; below and parallel to this, runs a row of small and simple spines. The distal end of the tibia has strong and sufficiently long spines, along its entire length. Tibia are provided with two long and pointed spurs, the inner one longer than the outer. On the posterior face of each tibia, there is a row of bifid spines. The tarsi are five segmented with two subequal tarsal claws, almost equal in length to the apical tarsal segment. In the male, the basal segments of the mid-tarsi, are provided with a patch of 'sexual' pubescence. This pubescent patch extends to the 2nd segment also but is less broad.

Hind legs (Text-fig. 4C)—Coxae are very wide and flattened, covering a good deal of area between the metasternum and the abdominal sternites, with coxal processes (fig. 2 *Pcp*) dividing the 1st abdominal sternite. The femur (*Fm*) is strongly built and flattened in its distal part over the proximal part of the tibia. The tibia (*Tb*) are provided with hair on either sides (outer and inner); the anterior face is with a row of small scattered spines along its distal end. Tibia are provided with two long and strong subequal spurs; the longer spine is strongly widened at base. Hind tarsi are pentamerous with a dense fringe of hair on both (outer and inner) sides in the male, but only on the inner side in female. There is a single apical tarsal claw in both sexes.

basalare, *C*—Costa, *CC*—cubital cell, *Cd*—Cardo, *Clp*—Clypeus, *Cu*—Cubitus, *Cx*—coxa, *dr pr*—dorsal processes, *E*—Compound eye, *Epm*—epimeron, *Eps*—episternum, *Fs*—frontal suture, *Fm*—femur, *gl*—glossae, *Ga*—galea, *GS*—genital sac, *GV*—genital valves, *HE*—basal piece of elytron, *HP*—humeral plate of wing base, *Lc*—lacinia, *Lm*—labrum, *m*—median plate of wing base, *M*—media, fourth vein of wing, *Md*—mandible, *Mts*—metasternum, *Mt*—mentum, *OD*—oviduct, *Pcp*—posterior coxal process, *Ped*—pedicel, *Pcu*—Postcubitus, *Pen*—penis, *Pgl*—paraglossa, *Plp*—palpi, *Pls*—Pleural sulcus, *Prm*—paramere, *Ps*—prescutum, *PSP*—prosternal process, *Pst*—postscutellum, *PWP*—posterior wing process, *R*—radius, third vein of the wing, *Rs*—radial sector, *Rc*—radial cell, *Sc*—subcosta, second vein of the wing/scutum, *Sct*—meso-scutellum, *Scp*—scape, *Sm*—Scutellum, *Spt*—spermatheca, *St*—stipes, *ts*—prescutal suture, *Tb*—tibia, *Ts*—trochanter, *V Scl*—vulva sclerite, *Val*—valvifer, *Vu*—Vulva.

Terminology used has been adopted from Lindroth and Palmen, 1956 in *Taxonomists's Glossary of Genitalia of Insects*, edited by S. L. Tuxen, pp. 69-76.

ABDOMEN

After the removal of elytra, 8 segments are visible on the dorsal side, progressively reducing in size posteriorly. The terga are bonded on the lateral side by the plural membrane and connected with each other by intersegmental membrane. The plural membrane is provided with a stigmata on either side, corresponding to each segment. The epipleurites of the sternum are also visible from the dorsal side and serve for receiving the elytra.

On the ventral side, six abdominal sterna are visible. The first visible sternite is divided in the middle by coxal processes of the metacoxae. The 1st visible sternite in fact represents the 2nd abdominal segment.

Male genitalia (Text-fig. 4 G)—The penis (*Pen*) or the median lobe is a very strongly curved structure. It tapers a little to the apex, when it is slightly flattened and convex at the tip. Two thin, moderately chitinised dorsal processes (*dr pr*) lie above the penis and terminate just before the apex. The apices of the dorsal processes are flattened and divergent. The parameres (*Prm*) are triangular in shape, less chitinised than the penis and fringed with sensorial bristles on the distal margin. The basal piece is degenerated and represented by a thin strut connected with the membrane between the bases of the parameres; resulting into direct articulation between the parameres and the penis through true condyles. Towards the base, the parameres are connected dorsally by a membrane.

Female genitalia (Text-fig. 4 F)—Ninth segment and the sternum of the eighth segment are modified to form the female genital armature.

The sternum of the eighth segment is split down the middle line and the two halves of it constitute the cloacal valves.

The ninth segment is modified to form the ovipositor, which consists of two moderately chitinised lateral lobes, called the Valvifers (*Val*). They are narrow at the proximal end, broadened post medially and rounded at the distal end, where they are hinged to the more strongly chitinised pair of equally long genital valves (*GV*). The valvifers give support to the genital sac (*GS*), which is connected with the genital valves, from the base about the half of its length. The genital valves are fused together on the dorsal side antemedially, tapering to the apex, where the apices are pointed and notched in the middle.

The vulva (*Vu*) or the vulval lobe, is a small elongate globular structure, consisting largely of expansible membrane, with a median opening at its apex. Towards the base it is supported by a small triangular sclerite, the vulval sclerite (*Vscl*) on each side.

The spermatheca (*Spt*) is a moderately long convoluted tube, joined to the vagina at the point where the median oviduct (*OD*) also opens into it. The vaginal tube opens at the anterior end of the genital sac (*GS*).

Key to Indian species of the genus Cybister Curtis

1. Middle tarsi in male with sexual pubescence on the underside (1) Dorsal side of penis with two chitinous laminate plates. Hind tarsi in female fringed with hairs on the superio-internal side only. .2
 Middle tarsi in male without any sexual pubescence on the underside. Dorsal side of penis with a single chitinous plate, pointed or flat. Hind tarsi in female fringed with hairs on both the sides.. *Cybister (s. str.) laterimarginalis*

2. Pronotum and elytra without distinct yellow border (2) at the most tinged with ferruginous on the sides of pronotum. Penis in male with dorsal chitinous plate narrowed and forming a stem. Hind tarsi in female with one or two claws.
 3 subg. *Melanectes* ...
 Pronotum and elytra with a distinct yellow border. Dorsal chitinous plates of penis in male, not narrowed but generally dilated. Hind tarsi in female with a single claw. .8. subg. *Megaucte*

3. Pronotum & elytra with yellow border (size 14.0 - 16.0 mm) .cardoni s
 Pronotum & elytra without yellow border .4

4. Size small, 13.0 - 15.0 mm dehaani
 Size large, more than 16.0 mm .. 5

5. Pronotum with lateral reddish margin 6
 Pronotum without lateral reddish margin .. 7

6. Tibial spurs of the hind leg reaching the apex of second basal segment of the tarsi; stem of the penis in male more elongate & blunt at apex convexus

1. *Cybister concessor* is an exception.
 2. *Cybister cardoni* with yellow border is an exception.

- Tibial spurs of the hind leg not reaching the apex of the second basal segment of the tarsi; stem of the penis in male less elongate and rounded at apex *posticus*
7. Length 18.0 - 24.0 mm, rather elongate; stem of penis in male distinctly less than half its own length, gonopore smaller (Sri Lanka) *prolixus*
- Length 18.0—21.0 mm, rather oval; stem of penis in male nearly half its own length, gonopore elongate (India, China etc.) *sugillatus*
8. In male, mesotarsi without any sexual pubescence *concessor*
 In male, mesotarsi with sexual pubescence 9
9. A peculiarly deep and coarse series of punctures running parallel to the inner margin of the midcoxal cavities 10
 No such series of punctures 11
10. Metasternum distinctly swollen in the anterior half, length 22.0 - 25.0 mm *rugulosus*
 Metasternum not swollen in the anterior half, length 20.0 - 22.0 mm *dejeani*
11. Elytra with yellow stripe, extending to and including the epipleurae; female without any sexual sculpture on elytra (longitudinal or zig-zag striations) *Tripunctatus asiaticus*
 Elytra with submarginal, yellow lateral stripe but not extending to the epipleurae except at base; female generally with sexual sculpture on elytra 12
12. Ventral side concolorous or nearly so 13
 Ventral side variegated with yellow and black 15
13. Yellow submarginal elytral stripe, broad, nearly $1\frac{1}{2}$ times as wide as on the pronotum, uniformly wide. Male elytra with obsolete tubercles 14
 Yellow submarginal elytral stripe narrower, declining in width towards the apex. Male elytra with distinct tubercles. Size 31.0—36.0 mm. (femora of the anterior and middle legs piceous with black patches on the middle) *guerin*
14. Midclaws, in male, longer than the apical tarsal segment; dorsal laminate plates not reaching the apex of penis. Female with the sexual sculpture consisting of deep irregular short longitudinal striations covering nearly five-sixths of the elytral length and missing along the sutural line except at the base *limbatus*

Midclaws, in male, equal to the apical tarsal segment; dorsal laminate plates reaching the apex of penis. Female with the longitudinal striations covering three-fifths of the elytral length and missing along the sutural line, leaving larger smooth space along the suture than in <i>limbatus</i> .	<i>confusus</i>
15. Abdominal sternites 3-6 black along anterior border	16
Abdominal sternites 3-6 concolorous	17
16. Tip of penis, in male, more concave, not constricted behind the apex; striations on elytra occupying the three-fourths of its own length in female	<i>ventralis</i>
Tip of penis, in male, less concave, more or less constricted behind the apex; striations on elytra occupying one-fourth of its length in female	<i>gracilis</i>
17. Form oval; sexual pubescence, in male, covering not more than basal one and half segments of midtarsi; dorsal laminate plates of penis pointed; striations on the elytra in female extending from base to half its length	<i>cognatus</i>
Form narrower, sexual pubescence, incove ring basal two segments of midtarsi; male, dorsal laminate plates of penis rounded; striations on the elytra in female extending from base to five-sixths of its length.	<i>javanus</i>

ACKNOWLEDGEMENTS

I am thankful to Dr. A. P. Kapur, Director, Zoological Survey of India, for the facilities provided for this work and his kind courtesies. I am also thankful to Dr. S. Khera, Deputy Director, Zoological Survey of India for going through the manuscript and his helpful suggestions.

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FISHES OF THE SUBFAMILIES SETARCHINAE
AND APISTINAE (SCORPAINIDAE)
FROM INDIAN WATERS

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(With 1 Plate)

INTRODUCTION

A systematic review of the subfamilies Setarchinae and Apistinae is given in the paper. The subfamily Setarchinae is represented by two species, *Setarches longimanus* (Alcock) and *S. guentheri* Johnson and the subfamily Apistinae by a single species *Apistus carinatus* (Bloch and Schneider) from Indian seas.

Alcock (1891 : 23) described *Lioscorpius longiceps* Günther basing on a single specimen (108 mm SL) collected from Andaman sea at a depth of 182-220 fathoms and the same was figured and labelled as *Lioscorpius longiceps* var. *longimanus* (Alcock, 1894, pl. 10, fig. 3) which was later included under *Setarches guentheri* Johnson (Alcock, 1899 : 28). Alcock (1899 : 28) pointed out that Günther's *L. longiceps* figure is little different from his specimen and description of *longiceps* Günther does not correspond to its figure. Matsubara (1943 : 372) recognised *longimanus* as a valid species and supported Alcock's contention with regard to Günther's *L. longiceps* figure and description. Eschmeyer and Collette (1966 : 356) clearly stated that the specimen figured by Günther is *Setarches longimanus* and it is based on a specimen collected from Philippine Islands (Günther, 1880 : 52, pl. 17, fig. c) but the description (Günther, 1880 : 40-41) pertains to *Lioscorpius longiceps* Günther collected from Ki Islands. Eschmeyer and Collette (*op. cit.*) synonymised *Lythrichthys eulabes* Jordan and Starks known from off Ose Point, Suruga Bay and *Scorpaenella cypho* Fowler known from March Island, Mollucca passage with *longimanus*.

Eschmeyer and Collette (1966 : 359) clarified the systematic position of *Setarches guentheri* Johnson and recognised it as widely distributed species in the Indo-West Pacific and Atlantic after studying all the

nominal species, *Setarches fidjiensis* Günther (off Matuku, Fiji Islands), *Setarches parmatus* Goode (39° 57' N., 70° 56' W.), *Bathysebastes albescens* Döderlein (off Tokyo), *Scorpaena remigera* Gilbert and Cramer (Hawaii) and *Setarches marleyi* Fowler (Natal). De Beaufort (1962 : 36) treated all Indo-Pacific *Setarches* as a subspecies of *Setarches guentheri* Johnson. The description belongs to *S. guentheri* Johnson and the figure (after Günther) belongs to *S. longimanus* (Alcock).

Day (1875 : 155), Matsubara (1943 : 396), Smith (1957 : 84) and De Beaufort (1962 : 55) recognized only one species, *Apistus carinatus* (Bloch and Schneider) from the Indo-West Pacific under the subfamily Apistinae.

Subfamily SETARCHINAE

Lateral line a continuous trough covered by thin membranous scales. Scales small and cycloid. Cranium thin and cavernous, bones weakly ossified. Second suborbital bone uniformly broad or gradually becoming wider posteriorly, never T-shaped and without spines in adults. Third and fourth suborbital bones absent. No fleshy appendages on head and body. Small slit present behind fourth gill arch. Vertebrae 24. Pyloric caeca 4 or 5 (Eschmeyer and Collette, 1966 : 351).

Distribution.—Indo-Pacific, Atlantic, occurring at depths of about 188–820 metres. During the capture the cranium collapses and the stomach is everted usually by the time the specimens arrive at the surface thus giving an appearance of broad head and straight predorsal profile.

Genus *Setarches* Johnson

1862. *Setarches* Johnson, *Proc. zool. Soc. Lond.*, (2) : 177 (Type-species : *Setarches guentheri* Johnson, 1862).

Dorsal fin with 12 spines and 10–11 soft rays and deeply notched. Anal fin with 3 spines and 5–6 soft rays. Pectoral with 21–22 rays. Preorbital with three moderate spines, the anterior one as long as the posterior. Dorsal surface of the head scaleless. Swim bladder well developed.

Distribution.—Indo-West Pacific and Western Atlantic.

Key to the Indian species of the genus *Setarches*

1. Second preopercular spine reduced or absent, much shorter than first or third.

2nd preorbital spine small, directed downward and backward.

..... *S. longimanus* (Alcock)

2. Second preopercular spine subequal to or longer than first and third. 2nd preorbital spine small, directed antero-laterally. *S. guentheri* Johnson

Setarches longimanus (Alcock)

(Plate I, a)

Lioscorpius longiceps : Günther, 1880 (*nec p.* 40), *Rep. Challenger Zool.*, 1 (6) : 52, pl. 17, fig. c (Philippine islands, *Challenger* Sta. 204); Alcock, 1891. *Ann. Mag. nat. Hist.*, (6) 8 : (R. I. M. S. *Investigator* Sta. 115. Andaman sea 188-220 fathoms).

Lioscorpius longiceps var. *longimanus* Alcock, 1894, *Ill. Zool. Investig. Fish.*, Part 2, pl. 10, fig. 3 (original description by reference to Alcock, 1891, 23; *Type, locality* : Andaman Sea, 188-220 fathoms).

Setarches guentheri : Alcock, 1899, *Cat. Indian Deep Sea Fish.* : 28 (in part).

Setarches longimanus : Matsubara, 1943, *Trans. Sigen. Kenk.*, 2 : 372, figs. 129-135; Eschmeyer and Collette, 1966, *Bull. mar. Sci.*, 16 (2), : 356, figs. 1 and 2. Rama Rao, 1972, *Curr. Sci.*, 41 (7) : 268.

Setarches guentheri longiceps : De Beaufort, *Fish. Indo-Australian Archipelago*, 11 : fig. 7 (in part).

Material examined.—*Andaman and Nicobar Islands* : F. ZSI. 13036, holotype, 108 mm SL, Andaman Sea, Sta. 115, Lat. 11° 31' 40" N., Long. 92° 46' 06" E., 188-220 fathoms, green muddy bottom, bottom temp. 13.3°C., Surface temp. 28.3°C., Agassiz trawl haul, 9.12.1890, R. I. M. S. *Investigator* Coll., F. ZSI. 154/1, one specimen, 101 mm SL., Andaman Sea, Sta. 233, Lat. 13° 17' 15" N., Long. 93° 10' 25" E., 185 fathoms, sandy bottom, bottom temp. 11.9°C., surface temperature 26.1° C, Agassiz trawl haul, 6.12.1897, R. I. M. S. *Investigator* Coll., F. ZSI. 236/1, 243/1, eight specimens, 81-91 mm SL, Sta. 233, R. I. M. S. *Investigator* Coll.; *Sri Lanka* : F. ZSI. 1633/2, five specimens (badly mutilated condition), South of Sri Lanka Sta. 465, Lat. 5° 56' N., Long. 81° 22' E., 109-132 fathoms, globigerina ooze bottom, Agassiz trawl haul, 22.4.1912, R. I. M. S., *Investigator* Coll.; *Philippine Islands* : *Lythrichthys eulabes* Jordan and Starks, F. ZSI. 4216/2 = USNM 99025, 2 specimens, 73 and 84 mm SL, Point Tagolo Light, Lat. 8° 48' N, Long. 123° 31' E., 200 fathoms, 9.8.1909, *Albatross* Coll.

Meristic formula.—D. XII, 10-11; A. III, 5-6; c. 6+6; P. II, 11-14, vi-viii; V I, 5; Tub. Sc. 24-26; GR. 6-7+1+9-12.

Diagnosis.—Second preopercular spine much shorter than first or third, or absent. 2nd preorbital spine small directed downward and backward.

Description.—Proportional dimensions in per cent of standard length based on three specimens measuring from 81.0-108.0 mm. SL. Length of: head 43.2-47.2, snout 12.1-13.6, orbit 10.2-11.7, postorbital head 22.2-24.2, maxilla 24.2-26.0; interorbital width 11.0-11.7, height of head 28.7-35.2, width of head 22.0-24.7, depth of body 28.7-33.0, width of body 14.8-17.6, distance : predorsal 34.0-38.0,

preanal 73.6-79.6, preventral 47.2-49.4, prepectoral 46.2-47.2; Caudal peduncle: length 16.2-18.0, depth 7.7-9.3; longest: simple pectoral ray 22.2-25.3, branched pectoral ray 33.0-38.3, dorsal spine 11.1-14.8, soft dorsal ray 13.4-16.0: length of: caudal fin 22.2-24.7, dorsal fin base 49.4-51.9, anal fin base 12.0-13.6, first dorsal spine 5.6-6.2, second dorsal spine 8.3-9.9, last dorsal spine 9.9-10.2, penultimate dorsal spine 1.6-2.8, ventral fin 17.6-18.7, first anal spine 5.5-7.4, second anal spine 12.0-14.8, third anal spine 14.8-16.0.

Body broad anteriorly, tapering as well as compressed posteriorly. Predorsal profile almost straight, snout broad and blunt, interorbital space broad and flat and occiput flat. Premaxillary processes forming a low elevated triangular area over the snout, without a concavity behind, but joins with the flat interorbital space. Eyes moderate, not elevated. Mouth large and oblique, maxillary reaching the posterior border of the eye, much expanded behind, and its depth less than eye or equal to eye. Jaws subequal, tip of the lower jaw with a symphyseal knob, fitting into the toothless notch of the upper jaw and projects out slightly. Fine villiform teeth on jaws, vomer and nearly uniserial on palatines. Tongue ending in a small free spatulate tip. Nostrils are close to each other, the anterior one slightly tubular with a flap posteriorly, the posterior one rounded and not very close to eye. Gill openings wide, gill membranes free from isthmus and from each other. Pseudobranchiae present. Branchiostegals seven. Gill rakers slender, well developed at the angle, reduced to spiny knobs at the end of the arch. A slit behind the 4th gill arch. Pyloric caeca 4. A small elongated thick walled air bladder is present.

Head large, with cavernous bones and well developed muciferous cavities. Spination of head little developed. Cranial spines small and weak but sharp. Nasal spines very small. Preocular present, supra and postocular absent. Frontal and parietal ridges low and indistinct and ending in a small spine. Pterotic ending in a spinous point, cleithral and supracleithral blunt. Sphenotic, upper and lower post-temporal spines absent. Preorbital with 3 spines, anterior one antrose, the median one smaller, directed downward and backward, posterior retrose; antrose and retrose spines are of equal lengths. Suborbital close to eye; without spinous points. First preopercular spine longest, 3rd shorter than first, second spine very much reduced or absent (much shorter than first as well as third), 4th smaller than third and 5th very much reduced. No Supplemental preopercular spine. Opercle with two divergent spines, ending in a spinous point. Interopercle blunt. Interorbital and postorbital spines absent.

No other skinny appendages on the body except a flap on the posterior edge of the anterior nostril. Scales small and cycloid. Scales absent

on snout, interorbital space, occiput preorbital area, maxilla, mandible throat and interopercle and present behind eyes, on cheeks, opercle and partly on subopercle. Pectoral base, chest and belly with scales. Trunk and tail with small scales extending on to the caudal fin. Lateral line broad, with double tubules forming a continuous trough covered by thin membranous scales.

Head with well developed muciferous cavities. The interorbital space with three very characteristic mucous fossae, a very large elliptical one in the middle, two moderate and oval ones located side by side anteriorly. Two large pores on the snout and behind the eyes. Number of pores small to large along the suborbital, preopercle and lower jaw.

Dorsal spines subequal or equal or shorter than soft dorsal rays. The first two close to each other, 3rd, 4th and 5th isolated. The spines increase gradually from 1st to 3rd, 4th, 5th and 6th longest and subequal, remaining decrease gradually upto 11th, which is smallest and 12th abruptly longer, longer than the first two spines, sometimes equal or subequal to second spine. Dorsal deeply notched before 12th spine. Dorsal membrane between the spines deeply notched. Soft dorsal elongately rounded. First anal spine small, third anal spine longest, soft anal broadly rounded. Vertical fins not elongate, pectoral broad and rounded, the rays increase gradually to the middle and decrease gradually to the lower and reaching on to the soft anal. Ventral short and not reaching to anal. Caudal emerginate.

Colour in alcohol.—Uniform light yellowish colour. Inside the mouth largely dusky, pyloric caeca, hind part of the intestine greyish to black. Fins mostly pale, the membrane between the dorsal spines with grey edges and distal parts of pectoral blackish.

Habitat.—It occurs on the sandy and muddy bottom, at depths ranging from 109–220 fathoms in Indian waters.

Distribution.—Known from Arabian Sea, Andaman Sea, Indonesia, Philippine Islands, South-Eastern coast of Japan, from deeper waters ranging from 180–704 metres. It is likely to occur in many localities in the Indo-Pacific.

Relationships.—It is closely related to *S. guentheri* Johnson but differs from it mainly in the nature of second preopercular spine.

Remarks.—Matsubara (1943, pp. 372–73), while listing the synonymy of *longimanus* Alcock wrongly attached Arafura locality to Alcock's references (1891, p. 23; 1894, pl. 10, fig. 3) instead of Andaman Sea. *Lioscoroius longiceps* Günther was collected from Arafura sea by Challenger at Sta. No. 192 and *longimanus* Alcock was collected

from Andaman sea by *Investigator* at Sta. No. 115. Matsubara's mistake is probably due to oversight. Eschmeyer and Collette (1966, pp. 356 and 359), instead of including *Lythrichthys eulabes* under material examined data of *longimanus* (p. 356), included it under *guentheri* due to oversight.

Setaraches guentheri Johnson

(Plate I, b)

Setaraches g untheri Johnson, 1862, *Proc. zool. Soc. Lond.*, 2 : 177, pl. 23 (Type-locality : Madeira); Alcock, 1899, *Cat. Indian Deep Sea Fish.* : 28 (in part); Herre, 1951, *Philipp. J. Sci.*, 80 (4) : 441 (in part); Smith, 1957, *Ichthyol. Bull. Rhodes Univ.*, 5 : 85, fig. 9; Eschmeyer and Collette, 1966, *Bull. mar. Sci.*, 16 (2) : 357, figs. 1 and 2; Eschmeyer, 1969, *Occ. Pap. Calif. Acad. Sci.*, 79 : 102.

Setaraches g untheri longiceps : Beaufort, 1962, *Fish. Indo-Australian Archipelago*, 11 : 36, fig. 7 (in part).

Material examined.—*Sri Lanka* : F. ZSI. 14131-14133, three specimens, 80-96 mm SL, off Trincomalee, Sta. 201, Lat. 8° 44' 40'' N., Long. 81° 20' 15'' E., 296-320 fathoms, green muddy bottom, bottom temp. 9.4-9.8° C., Surface temp. 29.1° C., Agassiz trawl haul, 16.4 1895, R. I. M. S. *Investigator* Colls.

Meristic formula.—D. XII, 11; A. III, 6; C. 6+6; P. ii-iii, 10-12, vii-ix; V I, 5; Tub. Sc. 23-25; GR. 5-6+1+9-10.

Diagnosis.—Second preopercular spine well developed, subequal to or longer than first and third. 2nd preorbital spine small, directed anterolaterally.

Description.—Proportional dimensions in percent of standard length based on two specimens measuring from 83.0 and 96.0 mm SL. Length of : head 44.8-46.4, snout 13.0-13.7, orbit 11.5-11.9, postorbital head 22.6-23.0, maxilla 22.6-23.0; interorbital width 9.9-10.7, height of head 34.5, width of head 20.8-21.4, depth of body 32.1-33.3, width body 15.5-15.6, distance : predorsal 37.5-39.6, preanal 77.4-80.0, preventral 56.0-56.2, prepectoral 44.8-48.8; caudal peduncle : length 15.6-17.9, depth 9.9-10.7; longest : simple pectoral ray 23.8-24.0, branched pectoral ray 32.1-33.3, dorsal spine 16.6-20.8, soft dorsal ray 16.6; length of : caudal fin 25.0, dorsal fin base 47.6-49.0, anal fin base 12.3-13.0, first dorsal spine 7.1-7.3, second dorsal spine 13.0, last dorsal spine 10.4-11.3, penultimate dorsal spine 4.2-6.3, ventral fin 19.0-23.0, first anal spine 7.3, second anal spine 11.5-11.9, third anal spine 14.6-15.5.

Body oblong and moderately compressed, head large with cavernous bones and with well developed muciferous cavities. Predorsal profile almost straight in preserved specimens. Interorbital broad and flat or gently convex. Occiput flat. Premaxillary process slightly elevated, the elevation being in a line with flat interorbital space. Eyes moderate, mouth large, oblique, maxillary reaching the posterior end of the eye,

much expanded behind, depth less than eye. Jaws subequal, tip of the lower jaw with a small symphyseal knob which fits into the toothless notch of the upper jaw. Fine villiform teeth on jaws, vomer and nearly uniserial on palatines. Tongue small with a spatulate tip. Nostril close to each other, anterior nostril slightly tubular without a flap. Posterior one entire, rounded and not very close to eye. Gill opening wide, gill membranes free from isthamus and from each other. Pseudobranchiae present. Branchiostegals seven. Gill rakers slender, well developed at the angle, gradually reduced to spiny knobs at the end. A slit behind the fourth gill arch. No study was made on the pyloric caeca and air bladder as they were removed from the preserved specimens under study.

Spination of the head little developed, small and weak but sharp. Nasal spines very small, preocular present, supraocular and postoculars absent. Frontal and parietal ridges indistinct and the later ending in a minute spinous point. Pterotic ending in spinous point. Sphenotic, lower and upper post-temporal absent. Supracleithral and cleithral blunt. Preorbital with three spines, anterior and posterior ones antrose and retrose respectively and both are of equal length, the median one small, with anterolateral direction. Suborbital ridge oblique, close to eye, without spinous points. First, second and third preopercular spines well developed and second one subequal to, or longer than first and third. Fourth and fifth blunt and very much reduced. No supplemental preopercular spine. Opercle with two well developed divergent spines, ending in sharp spinous points. Interopercle blunt and no interorbital and postorbital spines.

No other skinny appendages on the body. Scales small and cycloid. Scales absent on snout, interorbital space, occiput, preorbital area, maxilla, mandible, throat and interopercle and present on cheeks, postorbital area, opercle and partly on subopercle. Pectoral base, chest and belly with small scales. Trunk and tail with small scales extending onto the caudal fin. Lateral line broad, with double tubules, forming a continuous trough covered by thin membranous scales. Median and vertical fin pattern is similar to *longimanus*.

Colour in alcohol.—Pinkish in colour, inside the mouth slightly dusky, intestine blackish, fins hyaline and the membrane between the dorsal spines with greyish edge.

Habitat.—It occurs on the green muddy bottom at depths ranging from 296-320 fathoms in the Indian region (Sri Lanka).

Distribution.—It is known from Atlantic, Indian and West Pacific Oceans at greater depths ranging from 200-760 metres but it prefers a depth of about 400 metres. It has been reported from tip of South

Africa, Durban, Natal, Zanzibar, along the east coast of Africa, Ceylon, Indo-Australian Archipelago, Philippines, Japan, Fiji and Hawaii in the Indo-West Pacific regions.

Relationships.—*S. longimanus* (Alcock) is the only known relative of *guentheri*, a world-wide known scorpaenid.

Subfamily *APISTINAE*

Small stingfishes occurring at moderate depths and they are easily distinguishable by their long pectorals with the last ray free. Body oblong and moderately compressed, head bony with few spines, mostly naked, trunk and tail covered with small to medium jagged imbricate ctenoid scales. Mouth small to moderate, oblique, with narrow bands of villiform teeth in jaws, on vomer and palatines. Lateral line normal. Gill membrane free from isthamus and from each other. Branchiostegals seven. A cleft behind the fourth gill arch. Three chin barbels. Air bladder thick with a median transverse constriction.

Distribution.—Indo-Pacific.

Genus *Apistus* Cuvier

1829. *Apistus* Cuvier, *Regne Animal*, Ed. 2, 2 : 167 (Type-species : *Apistus alatus* Cuvier and Valenciennes, 1829 = *Scorpaena carinata* Bloch and Schneider, 1801).
1839. *Pterichthys* Swainson, *Nat. Hist. Fishes*, 2 : 265 (Type-species : *Scorpaena carinata* Bloch and Schneider, 1801)
1849. *Prosopodasys* Cantor, *J. Roy. asiat. Soc. Beng.*, 18 : 44 (Type-species : *Apistus alatus* Cuvier and Valenciennes, 1829).
1858. *Polemus* Kaup, *Arch. Naturg.*, 24 (1) : 333 (Type-species : *Apistus alatus* Cuvier and Valenciennes, 1829).

Dorsal with 15 spines and 9–10 soft rays. Anal with 3 spines and 7–8 soft rays. Pectoral long with 10–11 rays, the lowest ray free from the remaining. Ventral with a strong spine and 5 rays.

Distribution.—Indo-West Pacific.

Apistus carinatus (Bloch and Schneider) (Plate I, c)

1801. *Scorpaena carinata* Bloch and Schneider, *Syst. Ichth.* : 193 (Type-locality : Tranquebar, India).
1803. *Trigla woorah-minoo* Russell, *Fish. Coromandel*, 2 : 45, pl. 160, fig. B (Visakhapatnam, India).
1829. *Apistus alatus* Cuvier (in Cuvier and Valenciennes), *Hist. nat. Poiss.*, 4 : 392 (Type-locality : Pondicherry, India); Günther, 1860, *Cat. Brit. Mus. Fish.*, 2 : 131; Herre, 1951, *Phillip. J. Sci.*, 80 (4) : 422.
1829. *Apistus carinatus* Cuvier (in Cuvier and Valenciennes), *Hist. nat. Poiss.*, 4 : 395 (Type-locality : Tranquebar, India); Day, 1875, *Fish. India*, : 155, pl. 37, fig. 4; Day, 1889, *Fauna Brit. India Fish.*, 2 : 64, fig. 24; Pillay, 1929, *J. Bombay nat. Hist. Soc.*, 33 (1) : 375; Matsubara, 1943, *Trans. Sigen. Kenk.*, 2 : 396; Smith, 1957, *Ichthyol. Bull. Rhodes Univ.*, 5 : 84, pl. 6, fig. E.; De Beaufort, 1962, *Fish. Indo-Australian Archipelago*, 11 : 55, fig. 11.

1829. *Apistus israelitarum* Cuvier (in Cuvier and Valenciennes), *Hist. nat. Poiss.* 4 : 396 (Type-locality : Red Sea).
1904. *Apistus evolans* Jordan and Starks, *Prac. U. S. Nat. Mus.*, 27 : 146, fig. 12 (Type-locality : Tokyo).
1904. *Apistus venenans* Jordan and Starks, *Proc. U. S. Nat. Mus.*, 27 : 148, fig. 13 (Type-locality : Nagasaki).
1908. *Apistus faurei* Gilchrist and Thompson, *Ann. S. Afr. Mus.*, 6 : 176 (Type-locality : Natal coast, 15-30 fathoms).
1910. *Apistus macrolepidotus* Ogilby, *New Fish. Old. Coast* : 108 (Type-locality Queensland; India).

Material examined.—*Bay of Bengal* : F. ZSI. 12581, 12582 and 12585, three specimens, 81.0–85.0 mm SL, off Ganjam coast, fine sandy and muddy bottom, 1889–90, 10 fathoms, Agassiz trawl haul, R. I. M. S. *Investigator* Coll., F. 400/2, one specimen, 78.0 mm SL, off Orissa coast, near the black Pagoda, Lat. 20° 30' N., Long. 87° E., 27.11. 1909, *Golden Crown* Coll., Two specimens, 58.0 and 77.0 mm SL, off Visakhapatnam, Lat. 17° 40' N., Long. 83° 20' E., 10.7. 1963, Otter trawl haul, M. D. *Pratap* Coll., F. ZSI. 1730–32 and 1744 (original of plate 37, fig. 4, *Fish. India*, Day, 1875), four specimens, 67.0–76.0 mm SL, Lat. 13° N., Long. 80° 24' E., date of collection nil, F. *Day* Coll., F. ZSI. 2346/2, two specimens, 57.0 and 58.0 mm SL, Marina Beach, Lat. 13° N., Long. 80° 24' E., 11.8. 1961, ZSI, *Southern Regional Station, Madras* Coll., Three Specimens, 57.0–79.0 mm SL, Kovelong Beach (Madras), Lat. 13° N., Long. 80° 24' E., 5.7. 1966, T. E. *Sivaprakasam* Coll.

Meristic formula.—D. XV, i, 7–9, i–ii (one specimen with XVI); A. III, 6–7, i–ii, C. 5+5; P. i, 8–9, i–ii; V I, 5; VSR. 55–56; TRS. 8/15–18; Tub. Sc. 28–30; Gr. 6+1+10–12 (Scale count of Day, 1875, p. 155 is a lateral scale row count).

Diagnosis.—Pectoral fin elongate, its lowermost ray detached; imbricate, leafy shaped ctenoid scales; a deep blotch between 8th and 13th dorsal spines.

Description.—Proportional dimensions in percent of standard length based on four specimens measuring from 58.0–85.0 mm SL. Length of : head 36.5–39.6, snout 10.0–11.3, orbit 9.0–11.3, post-orbital head 17.7–20.7, maxilla 16.9–17.7; interorbital width 3.2–3.5, height of head, 23.4–24.2, width of head 19.5–21.8, depth of body 27.6–30.6, width of body 18.2–22.4, distance : predorsal 28.2–32.3, preanal 63.8–67.1, preventral 37.0–38.7, prepectoral 33.9–35.1; Caudal peduncle : length 15.3–19.4, depth 9.0–12.1; longest : simple pectoral ray 54.1–69.4, branched pectoral ray 29.9–32.8, dorsal spine 16.5–19.0, soft dorsal ray 18.8–24.2; length of : caudal fin 31.8–34.5, dorsal fin base 60.3–64.5, anal fin base 22.4–24.2, first dorsal spine

10·2-17·2, second dorsal spine 11·8-15·6, last dorsal spine 11·8-15·5, penultimate dorsal spine 8·8-12·1, ventral fin 23·5-30·1, first anal spine 8·0-12·1, second anal spine 9·4-13·8, third anal spine 13·0-17·2.

Body oblong, moderately compressed, predorsal profile with a gentle slope from nape to snout. Premaxillary processes not elevated. Interorbital space narrow with a median groove, the ridges diverging posteriorly and terminating in blunt spines on the flat occiput. Eyes small, directed slightly upward and outward, the upper margin of the pupil on a level with the interorbital ridge. Mouth small and oblique, maxilla narrow anteriorly and broad posteriorly, reaching to the middle of the eye, its depth less than eye. Jaws subequal, lower jaw with a well developed knob at symphysis, fitting into the toothless notch of the upper jaw. Narrow band of villiform teeth in jaws, on vomer and palatines. Tongue free and spatulate. Nostrils close to each other, posterior slit-like, anterior in middle of snout and tubular. Gill opening wide, gill membranes free from isthamus and from each other. Pseudobranchiae present. Branchiostegals seven. Gill rakers long and slender, well developed on the lower arch, reduced to knobs at the end of upper arch. A slit behind the fourth gill arch. Lateral line straight.

Head bony with low ridges and less spiny. Nasal spines minute. Supraorbital rim smooth, preocular region with low bony ridges, and postocular finely ridged. Fronto-parietal ridge slightly elevated ending in a blunt spine. Sphenotic, pterotic and upper post-temporal low ridged, the last one ending in a feeble spine. Supracleithral blunt and cleithral insignificant. Preorbital with two small spines over maxilla and one long retrose spine, almost reaching the posterior border of the maxilla. Suborbital ridge smooth with no spines. First preopercular spine longest and the remaining with blunt projections and some are concealed. No supplemental preopercular spine. Opercle with 2 diverging spines. Interopercle present but concealed. No postorbital and interorbital spines.

Scales characteristic, small, imbricate, ctenoid with irregular jagged hind margin and somewhat leafy in shape. Head naked except a patch of few series of scales at the posterior end of maxilla and below the suborbital ridge. Trunk, tail, chest and belly scaled. Fins naked except the pectoral and caudal base.

No flaps or cirri on the body except the chin with 3 barbels, one long, below mandibular symphysis and 2 lateral. Skin of lower jaw and lower part of preopercle thickly covered with very small pores.

Dorsal spines moderately strong, shorter than soft dorsal rays. The first two spines are close to each other, the first slightly shorter than second. Spines increasing in length to 7th, 8th to 12th subequal, 13th

and 14th shorter and 15th longer; membrane deeply notched. Dorsal rays branched. Anal spines increasing in length from first to third and anal rays branched. Ventrals with a strong spine, short in females and long in males reaching the anal origin, all rays branched. Pectoral long, the first ray reaching the caudal peduncle, the free, rod-like, flexible pectoral ray reaching to the anal, rays branched except the upper and lowermost rays, all the rays well connected by a membrane except the last. Caudal rounded and middle rays branched.

Colour in alcohol.—Body reddish brownish to light brownish or yellowish, belly whitish, pectoral greyish to blackish, upper and lowermost rays whitish, upper half of the spiny dorsal fin membrane greyish, a dark blotch between 8th and 13th dorsal spines. Soft dorsal, anal, ventral and caudal pale (in long preserved specimens) but with 3-4 greyish to blackish cross bands on soft dorsal and caudal, anal greyish and ventrals pale to dusky (in freshly preserved specimens).

Habitat.—It occurs off the coast and generally collected from trawl catches made on muddy, sandy and rocky bottoms.

Distribution.—Bay of Bengal and Arabian Sea (Trivandrum)—a wide spread species in the Indo-West Pacific.

Remarks.—Only one specimen (F. ZSI. 1744) among the present collection shows sixteen dorsal spines and probably this may be an abnormal character. A careful comparison of Day's drawing and his specimens revealed that instead of showing the blotch between 8th and 13th dorsal spines clearly the whole upper half of the spiny dorsal fin membrane was shown with a deep black band.

SUMMARY

A key to the Indian species of the genus *Setarches* Johnson is given. *Setarches longimanus* (Alcock), *S. guentheri* Johnson and *Apistus carinatus* (Bloch and Schneider) are described in detail.

ACKNOWLEDGEMENTS

I am deeply indebted to the following individuals for the guidance and help: Prof. H. S. Chaudhry (Head, Zoology Department, University of Gorakhpur, Gorakhpur), Dr. A. P. Kapur (Director, Zoological Survey of India, Calcutta), Dr. A. G. K. Menon (Superintending Zoologist, Fish Division, Zoological Survey of India, Calcutta), Dr. Willam N. Eschmeyer (Curator, Department of Ichthyology, California Academy of Sciences, San Francisco) and Dr. Daniel M. Cohen (Laboratory Director, Ichthyological Laboratory, National Marine Fisheries Service, Washington).

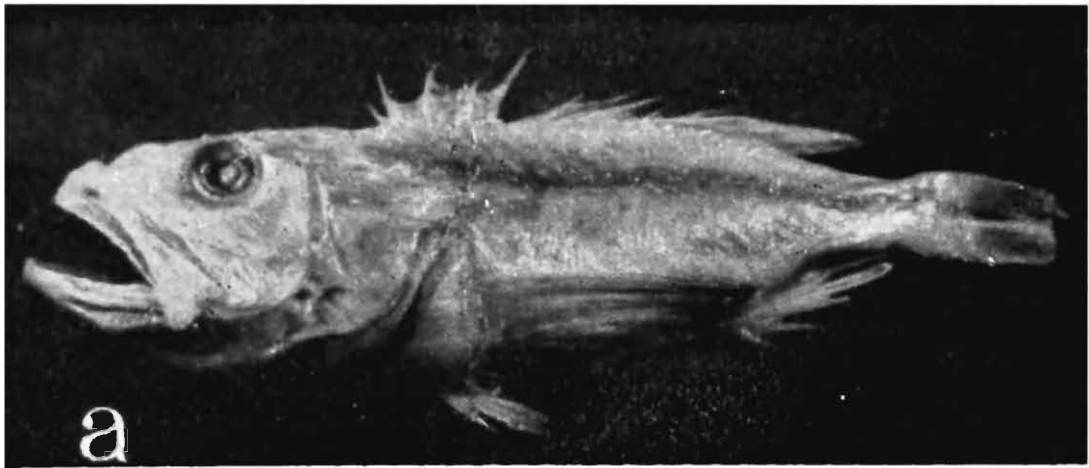
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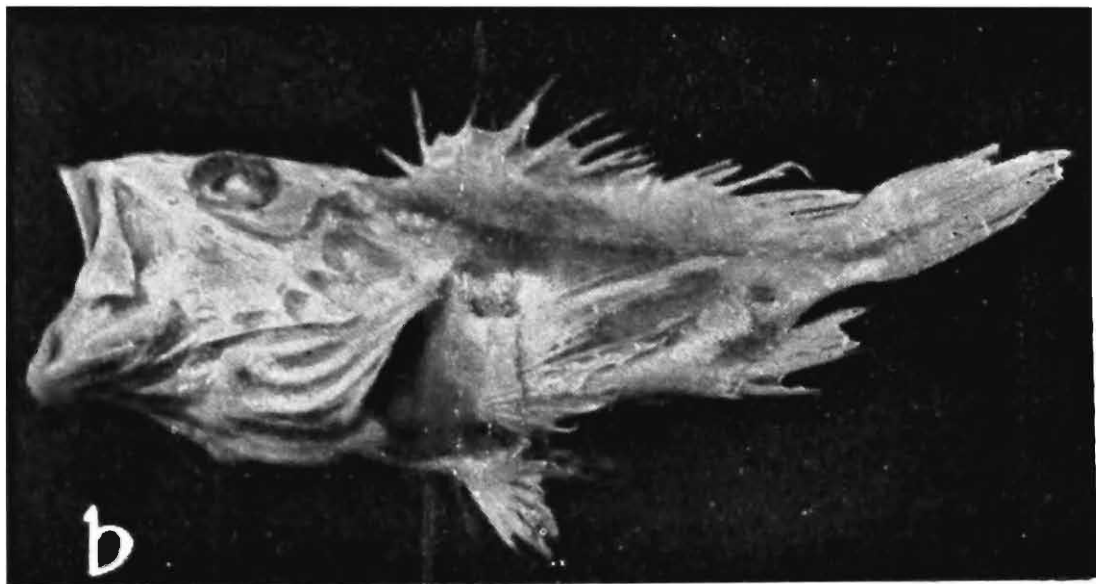
Records of the Zoological Survey of India

RAMA RAO

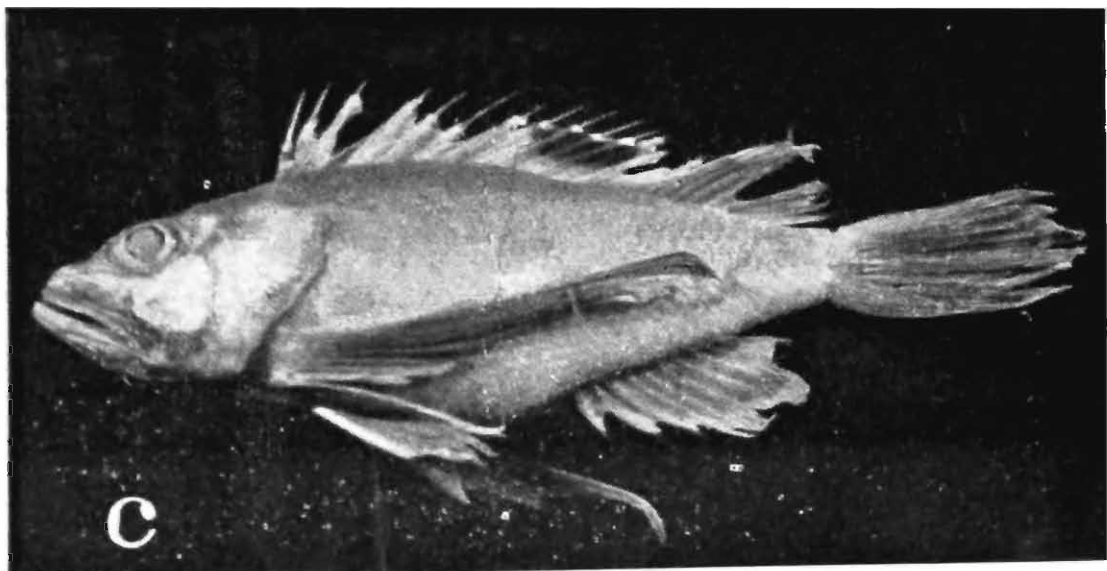
PLATE I



a. *Setarches longimanus* (Alcock) holotype, 108 mm SL, F. ZSI. 13036, Andaman Sea.



b. *Setarches guentheri* Johnson, 80 mm SL, F. ZSI. 14133, off Trincomalee, Sri Lanka.



c. *Apistus carinatus* (Bloch and Schneider) 81 mm SL, F. ZSI. 12585, off Ganjam coast.

VARIABILITY IN SCALES IN CERTAIN SPECIES OF INDIAN REPTILES

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(With 4 Text-figures and 16 tables)

INTRODUCTION

Many workers have done useful work on the variations in scales of reptiles. Bergman (1952) studied the snakes of Java; Amaral (1954) has done a revisionary study on the snakes of Brazil; Bailey (1955) has studied frequency distribution of variations in different characters on the snakes of the genus *Chironius* in South-eastern America; Vanzolini (1955) has made a statistical study of body annuli, tail and body lengths of Brazilian lizards of family Amphisbaenidae; Barton (1956) has done a statistical study of garter snake *Thamnophis brachystoma* (Cope); Loveridge (1958) in his revisionary work on the African snake genera has studied scale counts and sexual dimorphism; Peters (1956) has done useful work on the analysis of sexual variations in scalation, proportions and colouration of South American snake *Dipsas catesbyi* Sentzen; DeSilva (1969) studied the range of individual scale variations and sexual dimorphism in the snakes of Ceylon and Werner (1969) has seen variations in scale counts of lizards *Ophistops elegans*, *Eremias glitlulata* and *Eremias brevirostris* from Southwestern Asia.

In reptiles the variability and difference in means between the two sexes in scale characters has been widely recognised, a detailed study of variability and significance of difference between the means between two sexes in none of the characters of reptiles has been worked out in India. An attempt is made to study this for the following 16 species of reptiles.

OBSERVATIONS

In *Hemidactylus brooki* Gray, *H. reticulatus* Beddome and *H. leichenaulti* Dumeril and Bibron : (A) Number of upper labials (left). (B) Number of upper labials (right). (C) Number of lower labials

(right). (D) Number of lower labials (left). (E) Number of lamellae under first toe. (F) Number of lamellae under fourth toe. (G) Number of dorsal rows of tubercles. (H) Number of preano-femoral or femoral pores (left). (I) Number of preano-femoral or femoral pores (right).

In *Calotes versicolor* (Daudin) and *Calotes rouxi* Dumeril and Bibron : (A) Number of upper labials (left). (B) Number of upper labials (right). (C) Number of lower labials (left). (D) Number of lower labials (right). (E) Number of scales round middle of body.

In *Psammophilus blanfordanus* (Stoliczka) : (A) Number of upper labials (left). (B) Number of upper labials (right). (C) Number of lower labials (left). (D) Number of lower labials (right). (E) Number of scales round middle of body. (F) Number of enlarged chinshields.

In *Mabuya macularia* (Blyth) and *M. carinata* (Schneider) : (A) Number of upper labials (left). (B) Number of upper labials (right). (C) Number of lower labials (left). (D) Number of lower labials (right). (E) Number of lamellae under first toe. (F) Number of lamellae under fourth toe. (G) Number of keels on dorsal scales. (H) Number of scales round middle of body.

In *Riopa punctata* (Gmelin) : (A) Number of upper labials (left). (B) Number of upper labials (right). (C) Number of lower labials (left). (D) Number of lower labials (right). (E) Number of lamellae under first toe. (F) Number of lamellae under fourth toe. (G) Number of scales round middle of body. (H) Number of scales down the back.

In *Cabrita leschenaulti* (Milne-Edwards), *Cabrita jerdoni* Beddome and *Ophisops jerdoni* Blyth : (A) Number of scales round middle of body. (B) Number of longitudinal rows of plates on belly. (C) Number of transverse rows of plates on ventrum. (D) Number of femoral pores (left). (E) Number of femoral pores (right).

In *Elaphe helena* (Daudin) and *Ptyas mucosus* (Linnaeus) : (A) Number of upper labials (left). (B) Number of upper labials (right). (C) Number of lower labials (left). (D) Number of lower labials (right). (E) Number of temporal scales. (F) Number of ventral shields. (G) Number of sub-caudal shields. (H) Number of scales round middle of body.

In *Xenochrophis piscator* (Schneider) : (A) Number of upper labials (left). (B) Number of upper labials (right). (C) Number of lower labials (left). (D) Number of lower labials (right). (E) Number of temporal scales. (F) Number of ventral shields. (G) Number of sub-caudal shields.

In *Echis carinatus* (Schneider) : (A) Number of scales across the forehead. (B) Number of scales round the eye. (C) Number of upper labials (left). (D) Number of upper labials (right). (E) Number of lower labials (left). (F) Number of lower labials (right). (G) Number of ventral shields. (H) Number of sub-caudal shields. (I) Number of scales round middle of body. (J) Number of scales round anal region. (K) Number of scales round neck.

METHODS OF STATISTICAL ANALYSIS

Scale counts of lizards and snakes were taken by using conventional methods depending on the genus concerned (Smith, 1935, 1943; Minton, 1966). The ventral scale counts in snakes were taken, beginning with the first distinctly wider than long scale posterior to the gulars excluding the anal (Schmidt and Davis, 1941).

(A) Standard error of Mean : The standard error of mean has been calculated as follows :

$$\text{S. E. M.} = \frac{\text{S. D.}}{\sqrt{N}}$$

Where S. D. = Standard deviation, based on the formula

$$\text{S. D.} = \sqrt{\frac{\sum X^2}{N-1}}$$

Where X = deviation of any individual figures from the mean for that character and N = No. of specimen.

(B) Coefficient of variability or of variation : The coefficient of variability is defined as the sample standard deviation expressed as a percentage of the sample mean as shown below :

$$\text{C. V.} = \frac{\text{S. D.}}{\text{Mean}} \times 100$$

(C) Comparison of Means of two sexes : For the null hypothesis of no difference, *t* is defined as follows :

$$t = \frac{x_1 - x_2}{\text{Sd}_{x_1 - x_2}} = \frac{d}{\text{Sd}}$$

$$t = \frac{\text{difference between the mean}}{\text{Standard error of difference}}$$

Where *t* cannot reasonably be attributed to chance and the null hypothesis, we assume that *d*, the mean difference is too large because of the population mean n_1 n_2 . Calculation of Sd, standard error of mean depends on :

(1) When sample size being large $n_1 > 30$, $n_2 > 30$.

- (2) When sample size being small
 (A) variances assumed to be equal.
 (B) variances not assumed to be equal.
- (1) Comparison of means of two independent samples (sexes) when samples size being large $n_1 > 30$, $n_2 > 30$.

The test criterion used $t = \frac{d}{Sd}$

The appropriate 'Sd' was computed as follows :

$$Sd = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

Where s_1 is the standard deviation of females and s_2 is the standard deviation of males, and n_1 and n_2 are number of specimen in females and males respectively.

- (2) Comparison of means of two samples (sexes) when samples size being small. The method depends on whether we can assume the unknown variances to be equal or not. The equalibility of variances was examined by the variance ratio test described below :

$$F = \frac{S_1^2}{S_2^2}$$

Where samples (sexes) are so labelled that S_1^2 is greater than S_2^2 . We then compared this F with tabulated value. Since it is a comparison of two samples (sexes), hence, it required a two-tailed test, so we entered the table at half the chosen probability.

- (A) Variance assumed to be equal the test criterion used

$t = \frac{d}{Sd}$ with $n_1 + n_2 - 2$ degree of freedom the Sd was

calculated by the formula

$$Sd = \sqrt{S^2 \frac{1}{n_1} + \frac{1}{n_2}}$$

Where $S^2 = \frac{(n_1 - 1) S_1^2 + (n_2 - 1) S_2^2}{(n_1 - 1) + (n_2 - 1)}$

Where S_1^2 , S_2^2 , n_1 and n_2 are the samples variances and sizes.

- (B) Variances not assemed to be equal.

We computed $t' = \frac{d}{Sd}$

This criterion is not distributed as student 't' the appropriate Sd was computed as below :

$$Sd = \sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}$$

For determining a significant value of t' for a given significant level, the sufficiently accurate approximation given by Cochran and Cox was used :

$$t' = \frac{W_1 t_1 + W_2 t_2}{W_1 + W_2}$$

Where $W_1 = \frac{S_1^2}{n_1}$ and $W_2 = \frac{S_2^2}{n_2}$ and t_1 and t_2 are the values of student's t for $n_1 - 1$ and $n_2 - 1$ degree of freedom, respectively at the chosen level of significance.

RESULTS AND DISCUSSIONS

The results of variability and comparison between the two sexes on the basis of tests of significance of the difference between means in different characters are discussed below separately for all the 16 species studied here.

(1) *Hemidactylus brooki* Gray

(Table 1 Text-fig. 1A)

1. (a) NUMBER OF UPPER LABIALS (left)

Male (N = 49) : The number varies from 8—12. The mean is 10.06 ± 0.12 . 44.90% of males possess 10 left upper labials. The C. V. is 8.22%.

Female (N = 77) : The number varies from 8—11. The mean is 10.04 ± 0.09 . 48.05% females have 10 left upper labials. The C. V. is 7.54%.

The mean number of upper labials (left) does not differ significantly in the two sexes.

(b) NUMBER OF UPPER LABIALS (right)

Male (N = 49) : The number varies from 9—11. The mean is 9.78 ± 0.08 . 65.31% males have 10 right upper labials. The C. V. is 5.62%.

Female (N = 77) : The number varies from 8—11. The mean is 9.87 ± 0.06 . 77.93% females have 10 right upper labials. The C. V. is 5.02%.

The mean number of upper labials does not differ significantly in the two sexes.

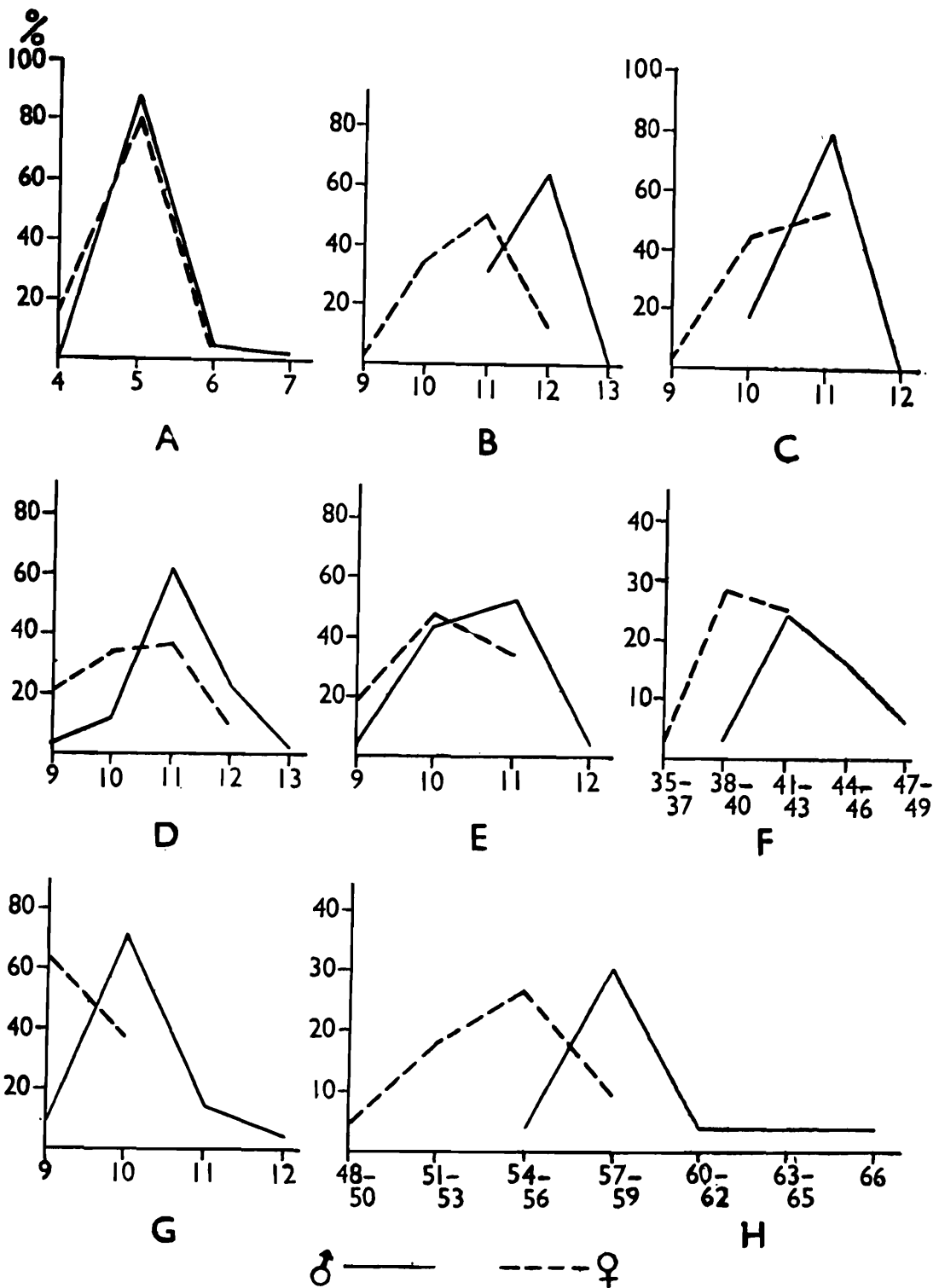
2. (a) NUMBER OF LOWER LABIALS (left)

Male (N = 49) : The number varies from 7—10.

TABLE 1.— *Hemidactylus brooki* Gray. Biometrical constants of certain body parts.

S. No.	Character	No. of samples		Range		Mean \pm S.E.		C.V.		't' value for sex difference
		M	F	M	F	M	F	M	F	
1(a)	Number of upper labials (left)	49	77	8—12	8—11	10.06 \pm 0.12	10.04 \pm 0.09	8.22	7.54	0.14 N.S.
1(b)	Number of upper labials (right)	49	77	9—11	8—11	9.78 \pm 0.08	9.87 \pm 0.06	5.62	5.02	0.93 N.S.
2(a)	Number of lower labials (left)	49	77	7—10	7—10	8.24 \pm 0.10	8.36 \pm 0.08	8.41	8.43	0.94 N.S.
2(b)	Number of lower labials (right)	49	77	7—10	7—10	8.24 \pm 0.08	8.27 \pm 0.06	6.80	6.40	0.30 N.S.
3.	No. of lamellae under first toe	49	77	4—7	4—6	5.02 \pm 0.06	4.86 \pm 0.05	8.61	8.64	2.05 +
4.	No. of lamellae under fourth toe	49	77	7—10	6—9	7.75 \pm 0.14	7.71 \pm 0.09	12.50	10.05	0.24 N. S.
5.	Number of dorsal rows of tubercles	48	73	16—23	17—23	18.92 \pm 0.16	19.31 \pm 0.14	5.81	6.03	1.87 N. S.
6(a)	Number of preano-femoral pores (left)	49	—	6—16	—	10.67 \pm 0.12	—	7.61	—	—
6(b)	Number of preano-femoral pores (right)	49	—	6—16	—	10.59 \pm 0.11	—	7.31	—	—

C. V. = Coefficient of variation; F. = Female; M. = Male; N. S. = Not significant; S. E. = Standard error; + = Significant at 5 per cent level of probability.



Text-Fig. 1.— Graphs to show variations in number of scales in some reptiles from Peninsular India. Vertical axis (Y — axis) represents the percentage of specimen in a particular category; horizontal axis, the number of scales.

(A). *Hemidactylus brooki* Gray (n = 0.49, 0.77) : Number of lamellae under first toe. (B). *Calotes versicolor* (Daudin) (n = 0.62, 0.47) : Number of upper labials (left). (C). *Calotes versicolor* (Daudin) (n = 0.62, 0.47) : Number of upper labials (right). (D). *Calotes versicolor* (Daudin) (n = 0.62, 0.47) : Number of lower labials (left). (E). *Calotes versicolor* (Daudin) (n = 0.62, 0.47) : Number of lower labials (right). (F). *Calotes versicolor* (Daudin) (n = 0.62, 0.47) : Number of scales round middle of body. (G). *Calotes rouxi* Dumeril and Bibron (n = 0.22, 0.11) : Number of upper labials (left). (H). *Calotes rouxi* Dumeril and Bibron (n = 0.22, 0.11) : Number of scales round middle of body.

The mean is 8.24 ± 0.10 . 65.31% males have 8 left lower labials. The C. V. is 8.41%.

Female (N = 77) : The number varies from 7–10. The mean is 8.36 ± 0.08 . 49.35% females have 8 left lower labials. The C. V. is 8.43%.

The mean number of left lower labials does not differ significantly in two sexes.

2. (b) NUMBER OF LOWER LABIALS (right)

Male (N = 49) : The number varies from 7–10. The mean is 8.24 ± 0.08 . 75.51% males have 8 right lower labials. The C. V. is 6.80%.

Female (N = 77) : The number varies from 7–10. The mean is 8.27 ± 0.06 . 72.73% females have 8 right lower labials. The C. V. is 6.40%.

The mean number of right lower labials does not differ significantly in two sexes.

3. NUMBER OF LAMELLAE UNDER FIRST TOE.

Male (N = 49) : The number varies from 4–7. The mean is 5.02 ± 0.06 . 87.76% males possess 5 lamellae under first toe. The C. V. is 8.61%.

Female (N = 77) : The number varies from 4–6. The mean is 4.86 ± 0.05 . 80.52% females possess 5 lamellae under first toe. The C. V. is 8.64%.

The value of t (2.05) for sex difference exceeds the value for t 0.05 (1.96%) at the 5% level of probability, hence it is concluded that the mean number of lamellae under first toe differ significantly in two sexes. (Male— 5.02 ± 0.06 ; Female— 4.86 ± 0.05) The data for both sexes have been represented graphically in Text-fig. 1A.

4. NUMBER OF LAMELLAE UNDER FOURTH TOE.

Males (N = 49) : The number varies from 7–10. The mean is 7.75 ± 0.14 . 53.07% males have 7 lamellae under fourth toe. The C. V. is 12.50%.

Female (N = 77) : The number varies from 6–9. The mean is 7.71 ± 0.09 . 40.26% females possess 7, while the another 40.26% have 8 lamellae under the fourth toe. The C. V. is 10.05%.

The mean number of lamellae under fourth toe does not differ significantly in the two sexes.

5. NUMBER OF DORSAL ROWS OF TUBERCLES.

Male (N = 48) : The number varies from 16—23. The mean 18.92 ± 0.16 . 41.68% males have 18 dorsal rows of tubercles. The C. V is 5.81%.

Female (N = 73) : The number varies from 17—23. The mean is 19.31 ± 0.14 . 60.27% females have 20 dorsal rows of tubercles. The C. V is 6.03%.

The mean number of dorsal rows of tubercles does not differ significantly in two sexes.

6. (a) NUMBER OF PREANO-FEMORAL PORES (left)

Male (N = 49) : This structure is found only in males. The number varies from 6—16. The mean is 10.67 ± 0.12 . 30.61% males have 12 preano-femoral pores in left side. The C. V is 7.61%.

6. (b) NUMBER OF PREANO-FEMORAL PORES (right)

Male (N = 49) : This structure is found only in males. The number varies from 6—16. The mean is 10.59 ± 0.11 . 28.57% males have 11 preano-femoral pores in right side. The C. V is 7.31%.

(2) *Hemidactylus reticulatus* Beddome

(Table 2)

1. (a) NUMBER OF UPPER LABIALS (left).

Male (N = 12) : The number varies from 8—10. The mean is 9.17 ± 0.17 . 66.67% of males have 9 left upper labials. The C. V is 6.29%.

Female (N = 32) : The number varies from 8—10. The mean is 8.91 ± 0.10 . 65.62% of females have 9 left upper labials. The C. V. is 6.60%.

The mean number of left upper labials does not differ significantly in the two sexes.

1. (b) NUMBER OF UPPER LABIALS (right).

Male (N = 12) : The number varies from 8—10. The mean is 9.08 ± 0.15 . 75.00% males possess 9 right upper labials. The C. V is 5.67%.

Female (N = 32) : The number varies from 1—10. The mean is 9.03 ± 0.08 . 78.13% of females have 9 right upper labials. The C. V is 5.25%.

The mean number of right upper labials does not differ significantly in two sexes.

TABLE 2.— *Hemidactylus reticulatus* Beddome. Biometrical constants of certain body parts.

S.No.	Character	No. of samples		Range		Mean \pm S.E.		C.V.		't' value for sex difference
		M	F	M	F	M	F	M	F	
1(a)	Number of upper labials (left)	12	32	8—10	8—10	9.17 \pm 0.17	8.91 \pm 0.10	6.29	6.60	1.31 N.S.
1(b)	Number of upper labials (right)	12	32	8—10	8—10	9.08 \pm 0.15	9.03 \pm 0.08	5.67	5.25	0.30 N.S.
2(a)	Number of lower labials (left)	12	32	7—9	6—9	7.42 \pm 0.19	7.28 \pm 0.13	9.02	10.01	0.58 N.S.
2(b)	Number of lower labials (right)	12	32	7—8	6—8	7.42 \pm 0.15	7.28 \pm 0.10	6.94	7.98	0.73 N.S.
3.	No. of lamellae under first toe	12	32	5—7	5—8	6.33 \pm 0.22	6.19 \pm 0.14	12.31	12.60	0.53 N.S.
4.	No. of lamellae under fourth toe.	12	32	9—11	8—12	9.92 \pm 0.23	9.87 \pm 0.16	7.99	9.19	0.16 N.S.
5(a)	Number of femoral pores (left)	12	—	5—10	—	8.25 \pm 0.37	—	15.61	—	—
5(b)	Number of femoral pores (right)	12	—	3—10	—	8.00 \pm 0.51	—	21.97	—	—

C. V. = Coefficient of variation; F. = Female; M. = Male; N. S. = Not significant; S. E. = Standard error.

2. (a) NUMBER OF LOWER LABIALS (left).

Male (N = 12) : The number varies from 7—9. The mean is 7.42 ± 0.19 . 66.67% males have 7 left lower labials. The C. V is 9.02%.

Female (N = 32) : The number varies from 6—9. The mean is 7.28 ± 0.13 . 50.00% of females have 7 left lower labials. The C. V is 10.01%.

The number of left lower labials does not differ significantly in two sexes.

2. (b) NUMBER OF LOWER LABIALS (right).

Male (N = 12) : The number varies from 7—8. The mean is 7.42 ± 0.15 . 58.33% of males have 7 right lower labials. The C. V is 6.94%.

Female (N = 32) : The number varies from 6—8. The mean is 7.28 ± 0.10 . 59.37% females have 7 right lower labials. The C. V. is 7.98%.

The mean number of right lower labials does not differ significantly in two sexes.

3. NUMBER OF LAMELLAE UNDER FIRST TOE.

Male (N = 12) : The number varies from 5—7. The mean is 6.33 ± 0.22 . 50.00% of males have 7 lamellae under the first toe. The C. V is 12.31%.

Female (N = 32) : The number varies from 5—8. The mean is 6.19 ± 0.14 . 46.88% of females have 6 lamellae under the first toe. The C. V is 12.60%.

The mean number of lamellae under first toe does not differ significantly in two sexes.

4. NUMBER OF LAMELLAE UNDER FOURTH TOE.

Male (N = 12) : The number varies from 9—11. The mean is 9.92 ± 0.23 . 41.67% of males have 10 lamellae under the fourth toe. The C. V. is 7.99%.

Female (N = 32) : The number varies from 8—12. The mean is 9.87 ± 0.16 . 46.88% of females have 10 lamellae under the fourth toe. The C. V is 9.19%.

The mean number of lamellae under the fourth toe does not differ significantly in two sexes.

5. (a) NUMBER OF FEMORAL PORES (left).

Male (N = 12) : This structure is found only in males. The number varies from 5—10. The mean is

8.25 ± 0.37 . 58.33% of specimens have 8 femoral pores on left side. The C. V. is 15.61%.

5. (b) NUMBER OF FEMORAL PORES (right).

Male (N = 12) : This structure is found only in males. The number varies from 3–10. The mean is 8.00 ± 0.51 . 66.67% of male specimens have 8 femoral pores on right side. The C. V. is 21.97%.

(3) *Hemidactylus leschenaulti* Dimeril & Bibron
(Table 3)

1. (a) NUMBER OF UPPER LABIALS (left).

Male (N = 17) : The number varies from 11–14. The mean is 12.23 ± 0.26 . 35.29% of males possess 11, while another 35.20% have 13 left upper labials. The C. V. is 8.92%.

Female (N = 15) : The number varies from 11–15. The mean is 11.80 ± 0.26 . 53.33% of females have 12 left upper labials. The C. V. is 8.59%.

The mean number of left upper labials does not differ significantly in two sexes.

1. (b) NUMBER OF UPPER LABIALS (right)

Male (N = 17) : The number varies from 7–14. The mean is 11.94 ± 0.35 . 64.71% of males have 12 right upper labials. The C. V. is 12.02%.

Female (N = 15) : The number varies from 11–15. The mean is 11.87 ± 0.32 . 53.33% females have 11 right upper labials. The C. V. is 10.50%.

The mean number of right upper labials does not differ significantly in two sexes.

2. (a) NUMBER OF LOWER LABIALS (left).

Male (N = 17) : The number varies from 7–11. The mean is 9.18 ± 0.25 . 52.94% of males have 9 left lower labials. The C. V. is 11.04%.

Female (N = 15) : The number varies from 8–13. The mean is 9.07 ± 0.33 . 46.67% of females have 9 left lower labials. The C. V. is 14.11%.

The mean number of left lower labials does not differ significantly in two sexes.

2. (b) NUMBER OF LOWER LABIALS (right).

Male (N = 17) : The number varies from 7–10. The mean is 8.82 ± 0.20 . 52.94% of males have 9 right lower labials. The C. V. is 9.17%.

TABLE 3.— *Hemidactylus leschenaulti* Dumeril and Bibron. Biometrical constants of certain body parts.

S. No.	Character	No. of samples		Range		Mean \pm S.E.		C.V.		't' value for sex difference
		M	F	M	F	M	F	M	F	
1(a)	No. of upper labials (left)	17	15	11—14	11—15	12.23 \pm 0.26	11.80 \pm 0.26	8.92	8.59	1.14 N.S.
1(b)	No. of upper labials (right)	17	15	7—14	11—15	11.94 \pm 0.35	11.87 \pm 0.32	12.02	10.50	0.14 N.S.
2(a)	No. of lower labials (left)	17	15	7—11	8—13	9.18 \pm 0.25	9.07 \pm 0.33	11.04	14.11	0.27 N. S.
2(b)	No. of lower labials (right)	17	15	7—10	8—13	8.82 \pm 0.20	9.07 \pm 0.33	9.17	14.11	0.66 N.S.
3.	No. of lamellae under first toe	17	15	6—10	6—8	6.94 \pm 0.25	6.40 \pm 0.16	14.83	9.87	1.75 N.S.
4.	No. of lamellae under fourth toe	17	15	10—13	9—14	11.00 \pm 0.23	10.47 \pm 0.29	8.50	10.74	1.45 N.S.
5(a)	No. of femoral pores (left)	16	—	4—15	—	11.69 \pm 0.68	—	23.10	—	—
5(b)	No. of femoral pores (right)	16	—	4—14	—	11.12 \pm 0.87	—	31.30	—	—

C.V. = Coefficient of variation; F. = Female; M. = Male; N.S. = Not Significant; S.E. = Standard error.

Female (N = 15) : The number varies from 8—13. The mean is 9.07 ± 0.33 . 46.67% of females have 9 right lower labials. The C. V is 14.11%.

The mean number of right lower labials does not differ significantly in two sexes.

3. NUMBER OF LAMELLAE UNDER FIRST TOE.

Male (N = 17) : The number varies from 6—10. The mean is 6.94 ± 0.25 . 47.06% of males possess 7 lamellae under first toe. The C. V is 14.83%.

Female (N = 15) : The number varies from 6—8. The mean is 6.40 ± 0.16 . 66.67% of females have 6 lamellae under first toe. The C. V. is 9.87%.

The mean number of lamellae under first toe does not differ significantly in two sexes.

4. NUMBER OF LAMELLAE UNDER FOURTH TOE.

Male (N = 17) : The number varies from 10—13. The mean is 11.00 ± 0.23 . 52.94% of males have 11 lamellae under the fourth toe. The C. V. is 8.50%.

Female (N = 15) : The number varies from 9—14. The mean is 10.47 ± 0.29 . 60.00% of females have 10 lamellae under the fourth toe. The C. V is 10.74%.

The mean number of lamellae under fourth toe does not differ significantly in two sexes.

5. (a) NUMBER OF FEMORAL PORES (left).

Male (N = 16) : This structure is found only in males. The number varies from 4—15. The mean is 11.69 ± 0.68 . 37.50% of male specimens have 12 femoral pores on left side. The C. V. is 23.10%.

5. (b) NUMBER OF FEMORAL PORES (right).

Male (N = 16) : This structure is found only in males. The number varies from 4—14. The mean is 11.12 ± 0.87 . 31.25% of male specimens have 12 femoral pores on right side. The C. V is 31.30%.

(4) *Calotes versicolor* (Daudin)

(Table 4, Text-figs. 1B, C, D, E and F)

1. (a) NUMBER OF UPPER LABIALS (left).

Male (N = 62) : The number varies from 11—13. The mean is 11.74 ± 0.07 . 64.51% of males have 12 left upper labials. The C. V is 4.61%.

Female (N = 47) : The number varies from 9—12

TABLE 4.— *Calotes versicolor* (Daudin). Biometrical constants of certain body parts.

S. No.	Character	No. of samples		Range		Mean \pm S.E.		C.V.		't' value for sex difference
		M	F	M	F	M	F	M	F	
1(a)	No. of upper labials (left)	62	47	11—13	9—12	11.74 \pm 0.07	10.74 \pm 0.10	4.61	6.57	8.13 +++
1(b)	No. of upper labials (right)	62	47	10—12	9—11	10.84 \pm 0.05	10.51 \pm 0.08	3.81	5.19	(3.47) ++
2(a)	No. of lower labials (left)	62	47	9—13	9—12	11.08 \pm 0.09	10.32 \pm 0.13	6.60	8.83	4.69 +++
2(b)	No. of lower labials (right)	62	47	9—12	9—11	10.55 \pm 0.08	10.15 \pm 0.11	5.85	7.11	3.05 ++
3.	No. of scales round the middle of body	62	47	38—48	35—42	43.14 \pm 0.27	39.47 \pm 0.25	4.84	4.35	10.05 +++

The figure in parenthesis is not student t — see text; ++ Significant at 1 per cent level of probability; +++ Significant at 0.1 per cent level of probability.

.C.V. = Coefficient of variation; F. = Female; M. = Male; S.E. = Standard error.

The mean is 10.74 ± 0.10 . 51.06% females have 11 left upper labials. The C. V. is 6.57%.

The value of t (8 13) for sex difference exceeds the value for $t_{0.001}$ (3.384) at 0.1% level of probability,

hence it is concluded that the mean number of left upper labials differ significantly in two sexes (Male 11.74 ± 0.07 ; Female 10.74 ± 0.10). The data for both sexes have been represented graphically in Text-fig. 1B.

1. (b) NUMBER OF UPPER LABIALS (right).

Male (N = 62) : The number varies from 10—12. The mean is 10.84 ± 0.05 . 80.65% males have 11 right upper labials. The C. V. is 3.81%.

Female (N = 47) : The number varies from 9—11. The mean is 10.51 ± 0.08 . 53.19% females have 11 right upper labials. The C. V. is 5.19%.

Here the variance ratio differs significantly, hence 't', was computed. Since the value of 't', (3.47) for sex difference exceeds the value for 't', $t_{0.01}$ (2.701) hence

it is concluded that the mean number of right upper labials differ significantly in two sexes (Male 10.84 ± 0.05 ; Female 10.51 ± 0.08). The data for both sexes have been represented graphically in Text-fig. 1C.

2. (a) NUMBER OF LOWER LABIALS (left).

Male (N = 62) : The number varies from 9—13. The mean is 11.08 ± 0.09 . 61.29% of males have 11 left lower labials. The C. V. is 6.60%.

Female (N = 47) : The number varies from 9—12. The mean is 10.32 ± 0.13 . 36.17% of females have 11 left lower labials. The C. V. is 8.83%.

The value of t (4.69) for sex difference exceeds the value for $t_{0.001}$ (3.384) at 0.1% level of probability,

hence it is concluded that the mean number of left lower labials differ significantly in two sexes (Males 11.08 ± 0.09 ; Females 10.32 ± 0.13). The data for both sexes have been represented graphically in Text-fig. 1D.

2 (b) NUMBER OF LOWER LABIALS (right).

Male (N = 62) The number varies from 9—12. The mean is 10.55 ± 0.08 . 51.61% of males have 11 right lower labials. The C. V. is 5.85%.

Female (N = 47) : The number varies from 9—11. The mean is 10.15 ± 0.11 . 46.81% females have 10 right lower labials. The C. V. is 7.11%.

The value of t (3.05) for sex difference exceeds the value of t 0.01 (2.622) at 1 % level of probability, hence it is concluded that the mean number of right lower labials differ significantly in two sexes (Males 10.55 ± 0.08 ; Females 10.15 ± 0.11). The data for both sexes have been represented graphically in Text-fig. 1 E.

3. NUMBER OF SCALES ROUND MIDDLE OF BODY

Male (N = 62) : The number varies from 38—48. The mean is 43.14 ± 0.27 . 24.19 % of males have 42 scales round the middle of body. The C. V. is 4.84 %.

Female (N = 47) : The number varies from 35—42. The mean is 39.47 ± 0.25 . 27.66 % females have 40 scales round the middle of body. The C. V. is 4.35 %.

The value of t (10.05) for sex difference exceeds the value of t 0.001 (3.384) at 0.1 % level of probability, hence it is concluded that the mean number of scales round the middle of body differ significantly in two sexes (Males 43.14 ± 0.27 ; Females 39.47 ± 0.25). The data for both sexes have been represented graphically in Text-fig. 1 F.

(5) *Calotes rouxi* Dumeril & Bibron

(Table 5, Text-fig. 1 G, H)

1. (a) NUMBER OF UPPER LABIALS (left).

Male (N = 22) : The number varies from 9—12. The mean is 10.14 ± 0.14 . 72.73 % of males have 10 left upper labials. The C. V. is 6.31 %.

Female (N = 11) : The number varies from 9—10. The mean is 9.36 ± 0.15 . 63.64 % of females have 9 left upper labials. The C. V. is 5.39 %.

The value of t (3.53) for sex difference exceeds the value of t 0.01 (2.745) at 1 % level of probability, hence it is concluded that the mean number of left upper labials differ significantly in two sexes (Male 10.14 ± 0.14 ; Female 9.36 ± 0.15). The data for both sexes have been represented graphically in Text—fig. 1 G.

1. (b) NUMBER OF UPPER LABIALS (right).

Male (N = 22) : The number varies from 10—12. The mean is 10.09 ± 0.06 . 90.91 % of males have 10 right upper labials. The C. V. is 2.92 %.

Female (N = 11) : The number varies from 9—10. The mean is 9.54 ± 0.16 . 54.55 % females have 10 right upper labials. The C. V. is 5.47 %.

Here the variance ratio differs significantly, hence

TABLE 5.— *Calotes rouxi* Dumeril and Bibron. Biometrical constants of certain body parts.

S. No.	Character	No. of samples		Range		Mean \pm S.E.		C.V.		't' value for sex difference
		M	F	M	F	M	F	M	F	
1(a)	No. of upper labials (left)	22	11	9—12	9—10	10.14 \pm 0.14	9.36 \pm 0.15	6.31	5.39	3.53 ++
1(b)	No. of upper labials (right)	22	11	10—12	9—10	10.09 \pm 0.06	9.54 \pm 0.16	2.92	5.47	(3.25) ++
2(a)	No. of lower labials (left)	22	11	8—10	8—9	9.00 \pm 0.15	8.64 \pm 0.15	7.67	5.84	1.53 N.S.
2(b)	No. of lower labials (right)	22	11	8—10	8—9	8.95 \pm 0.15	8.91 \pm 0.09	8.07	3.38	(0.18) N.S.
3.	No. of scales round the middle of body	22	11	54—66	48—58	57.77 \pm 0.59	53.36 \pm 0.77	4.78	4.76	4.44 +++

The figure in parenthesis is not student t — see text; N.S. = Not significant; ++ = Significant at 1% level of probability; +++ = Significant at 0.1 % level of probability.

C.V. = Coefficient of variation; F. = Female; M. = Male; S.E. = Standard error.

'*t*' was computed. Since the value of *t*' (3.25) for sex difference exceeds the value for *t*' 0.01 (3.12), hence it is concluded that the mean number of right upper labials differ significantly in two sexes (Male 10.09 ± 0.06 ; Female 9.54 ± 0.16).

2. (a) NUMBER OF LOWER LABIALS (left).

Males (N = 22) : The number varies from 8-10. The mean is 9.00 ± 0.15 . 54.54 % of males have 9 left lower labials. The C. V. is 7.67 %.

Females (N = 11) : The number varies from 8-9. The mean is 8.64 ± 0.15 . 63.64 % females have 9 left lower labials. The C. V. is 5.84 %.

The mean number of upper labials does not differ significantly in the two sexes.

2. (b) NUMBER OF LOWER LABIALS (right).

Male (N = 22) : The number varies from 8-10. The mean is 8.95 ± 0.15 . 50.00 % males have 9 right lower labials. The C. V. is 8.07 %.

Female (N = 11) : The number varies from 8-9. The mean is 8.91 ± 0.09 . 90.91 % females have 9 right lower labials. The C. V. is 3.38 %.

Here the variance ratio differs significantly, hence '*t*' was computed. Since the value of '*t*' (0.18) for sex difference does not exceed the value for *t*' 0.05 (2.12), hence the difference is non-significant.

3. NUMBER OF SCALES ROUND THE MIDDLE OF BODY.

Males (N = 22) : The number varies from 54-66. The mean is 57.77 ± 0.59 . 31.82 % males have 58 scales round the middle of body. The C. V. is 4.78 %.

Females (N = 11) : The number varies from 48-58. The mean is 53.36 ± 0.77 . 27.27 % females have 54 scales round the middle of body. The C. V. is 4.76 %.

The value of *t* (4.44) for sex difference exceeds the value for *t* 0.001 (3.635) at 0.1% level of probability, hence it is concluded that the mean number of scales round the middle of body differ significantly in two sexes (Males 57.77 ± 0.59 ; Females 53.36 ± 0.77). The data for both sexes have been represented graphically in Text-fig. 1H.

(6) *Psammophilus blanfordanus* (Stoliczka)

(Table 6, Text-figs. 2A & B)

1. (a) NUMBER OF UPPER LABIALS (left).

Male (N=9): The number varies from 12-14. The

TABLE 6.— *Psammophilus blanfordanus* (Stoliczka). Biometrical constants of certain body parts.

S.No.	Character	No. of samples		Range		Mean \pm S.E.		C.V.		't' value for sex difference
		M	F	M	F	M	F	M	F	
1(a)	No. of upper labials (left)	9	17	12—14	11—13	12.78 \pm 0.22	11.76 \pm 0.14	5.22	4.78	4.13 +++
1(b)	No. of upper labials (right)	9	17	12—13	11—12	12.11 \pm 0.11	11.47 \pm 0.12	2.75	4.49	3.37 ++
2(a)	No. of lower labials (left)	9	17	11—14	11—14	12.22 \pm 0.32	11.76 \pm 0.22	7.95	7.68	1.20 N.S.
2(b)	No. of lower labials (right)	9	17	11—13	11—13	11.89 \pm 0.26	11.47 \pm 0.15	6.58	5.44	1.49 N.S.
3.	No. of scales round the middle of body	9	17	84—105	79—91	93.56 \pm 1.99	84.82 \pm 0.09	6.37	4.65	4.50 +++
4.	No. of enlarged chin-shields	9	17	4—6	4—5	4.22 \pm 0.22	4.53 \pm 0.12	15.80	11.37	1.32 N.S.

N.S. = Not Significant; ++ = Significant at 1% level of probability; +++ = Significant at 0.1 % level of probability; C.V. = Coefficient of variation; F. = Female; M. = Male; S.E. = Standard error.

mean is 12.78 ± 0.22 . 55.56% of males have 13 left upper labials. The C. V. is 5.22%.

Females (N=17): The number varies from 11—13. The mean is 11.76 ± 0.14 . 64.71% of males have 12 left upper labials. The C. V. is 4.78%.

The value of t (4.13) for sex difference exceeds the value of t 0.001 (3.745) at 0.1% level of probability, hence it is concluded that the mean number of left upper labials differ significantly in two sexes (Male 12.78 ± 0.22 ; Female 11.76 ± 0.14). The data for both sexes have been represented graphically in Text-fig. 2A.

1. (b) NUMBER OF UPPER LABIALS (right).

Male (N=9): The number varies from 12—13. The mean is 12.11 ± 0.11 . 88.89% of males have 12 right upper labials. The C. V. is 2.75%.

Female (N=17): The number varies from 11-12. The mean is 11.47 ± 0.12 . 52.94% of females have 11 right upper labials. The C. V. is 4.49%.

The value of t (3.37) for sex difference exceeds the value of t 0.01 (2.797) at 1% level of probability, hence it is concluded that the mean number of right upper labials differ significantly in two sexes (Males 12.11 ± 0.11 ; Females 11.47 ± 0.12).

2. (a) NUMBER OF LOWER LABIALS (left).

Male (N=9): The number varies from 11—14. The mean is 12.22 ± 0.32 . 44.44% of males have 12 left lower labials. The C. V. is 7.95%.

Female (N=17): The number varies from 11—14. The mean is 11.76 ± 0.22 . 47.06% of females have 11 left lower labials. The C. V. is 7.68%.

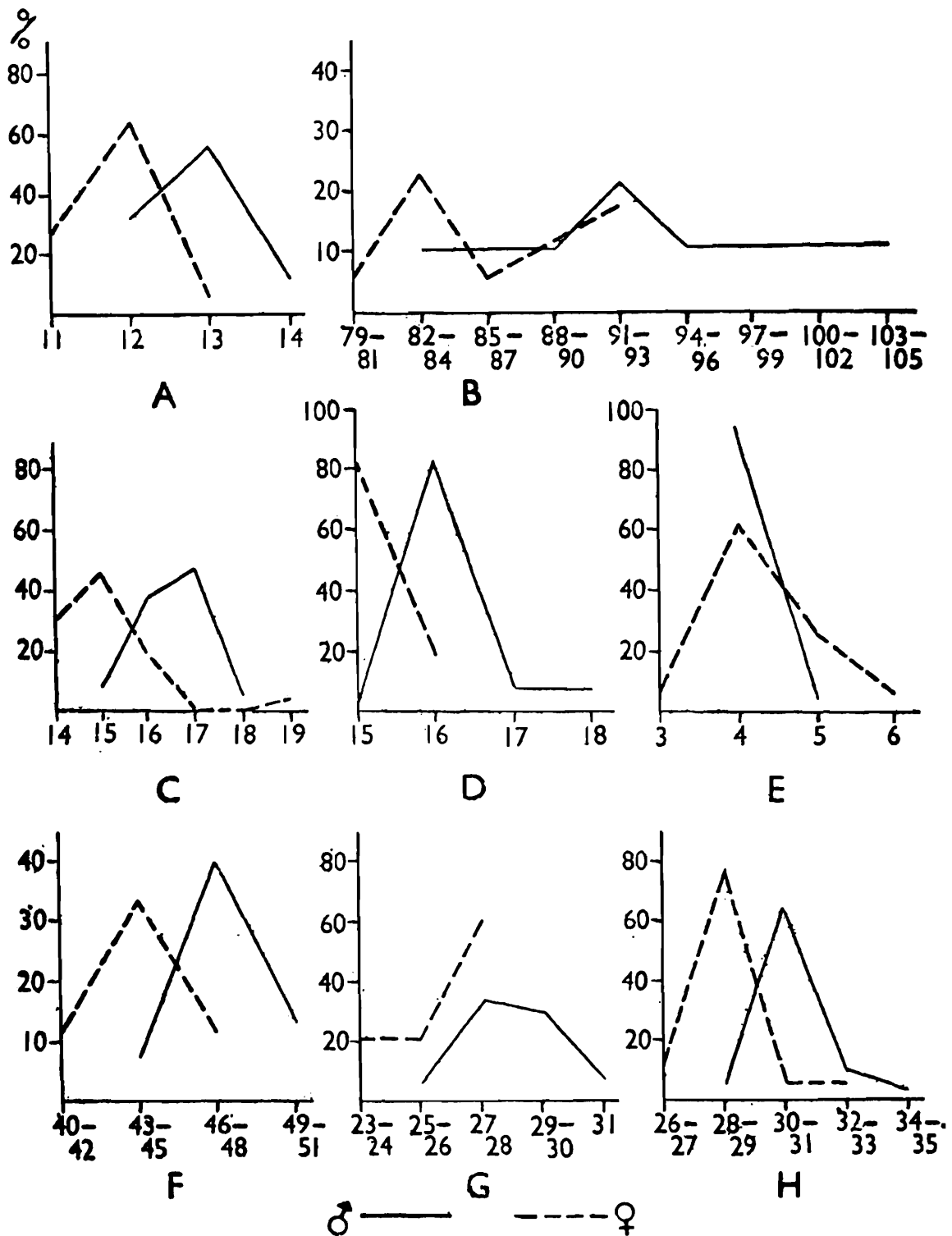
The mean number of left lower labials does not differ significantly in two sexes.

2. (b) NUMBER OF LOWER LABIALS (right).

Males (N=9): The number varies from 11-13. The mean is 11.89 ± 0.26 . 44.44% of males have 12 right lower labials. The C. V. is 6.58%.

Female (N=17): The number varies from 11—13. The mean is 11.47 ± 0.15 . 58.82% of females have 11 right lower labials. The C. V. is 5.44%.

The mean number of right lower labials does not differ significantly in two sexes.



Text-Fig. 2.— Graphs to show variation in number of scales in some reptiles from Peninsular India. Vertical axis (Y — axis) represents the percentage of specimens in a particular category; horizontal axis, the number of scales.

(A). *Psammophilus blanfordanus* (Stoliczka) (n = 0.9, 0.17) : Number of upper labials (left). (B). *Psammophilus blanfordanus* (Stoliczka) (n = 0.9, 0.17) : Number of scales round the middle of body. (C). *Mabuya macularia* (Blyth) (n = 0.23, 0.26) : Number of lamellae under fourth toe. (D). *Mabuya carinata* (Schneider) (n = 0.30, 0.23) : Number of lamellae under fourth toe. (E). *Riopa punctata* (Gmelin) (n = 0.19, 0.33) : Number of lamellae under first toe. (F). *Cabrita leschenaulti* (Milne — Edwards) (n = 0.15, 0.9) : Number of scales round the middle of body. (G). *Cabrita jerdoni* Beddome (n = 0.18, 0.5) : Number of scales round the middle of body. (H). *Ophisops jerdoni* Blyth (n = 0.30, 0.21) : Number of scales round the middle of body.

3. NUMBER OF SCALES ROUND MIDDLE OF BODY.

Males (N=9): The number varies from 84—105. The mean is 93.56 ± 1.99 . 22.22% of males have 91 scales round the middle of body. The C. V. is 6.37%.

Females (N=17): The number varies from 79—91. The mean is 84.82 ± 0.09 . 23.53% of females have 82 scales round the middle of body. The C. V. is 4.65%.

The value of t (4.50) for sex differences exceeds the value for t 0.001 (3.745) at 0.1% level of probability, hence it is concluded that the mean number of scales round middle of body differ significantly in two sexes (Male 93.56 ± 1.99 ; Female 84.82 ± 0.09). The data for both sexes have been represented graphically in Text-fig. 2B.

4. NUMBER OF ENLARGED CHIN-SHIELDS.

Males (N=9): The number varies from 4—6. The mean is 4.22 ± 0.22 . 88.89% of males have 4 enlarged chin shields. The C. V. is 15.80%.

Females (N=17): The number varies from 4—5. The mean is 4.53 ± 0.12 . 52.94% of females have 5 enlarged chin-shields. The C. V. is 11.37%.

The mean number of enlarged chin shields does not differ significantly in two sexes.

(7) *Mabuya macularia* (Blyth)

(Table 7, Text-fig. 2C)

1. (a) NUMBER OF UPPER LABIALS (left).

Males (N=23): The number of upper labials is 7 in all the males.

Females (N=26): The number of upper labials is 7 in all the females.

The mean number of left upper labials does not differ significantly in two sexes.

1. (b) NUMBER OF UPPER LABIALS (right).

Males (N=23): The number of upper labials is 7 in all the males.

Females (N=26): The number of upper labialt is 7 in all the females.

The mean number of right upper labials does nos differ significantly in two sexes.

2. (a) NUMBER OF LOWER LABIALS (left).

Males (N=23): The number varies from 7—8.

TABLE 7.— *Mabuya macularia* (Blyth). Biometrical constants of certain body-parts.

S. No.	Character	No. of samples		Range		Mean \pm S.E.		C.V.		't' value for sex difference
		M	F	M	F	M	F	M	F	
1(a)	No. of upper labials (left)	23	26	7—7	7—7	7.00 \pm 0.00	7.00 \pm 0.00	—	—	0 (N.S.)
1(b)	No. of upper labials (right)	23	26	7—7	7—7	7.00 \pm 0.00	7.00 \pm 0.00	—	—	0 (N.S.)
2(a)	No. of lower labials (left)	23	26	7—8	7—8	7.04 \pm 0.04	7.14 \pm 0.08	2.97	5.59	(1.67) (N.S.)
2(b)	No. of lower labials (right)	23	26	7—8	7—8	7.04 \pm 0.04	7.04 \pm 0.04	2.97	2.78	0 (N.S.)
3.	No. of lamellae under first toe.	23	26	6—9	5—8	6.61 \pm 0.19	6.54 \pm 0.15	13.48	11.62	0.30 (N.S.)
4.	No. of lamellae under fourth toe.	23	26	15—18	14—19	16.48 \pm 0.15	15.04 \pm 0.21	4.43	7.15	5.41 +++
5.	No. of keels on dorsal scales.	23	26	5—7	5—7	5.17 \pm 0.12	5.31 \pm 0.14	11.14	13.86	0.73 N.S.
6.	No. of scales round middle of body	23	26	28—30	27—30	29.30 \pm 0.19	28.81 \pm 0.19	3.16	3.40	1.79 N.S.

The figure in parenthesis is not student t — see text; N.S. = Not Significant; +++ = Significant at 0.1% level of probability. C.V. = Coefficient of variation; F. = Female; M. = Male; S.E. = Standard error.

The mean is 7.04 ± 0.04 . 95.65% of males have 7 left lower labials. The C. V. is 2.97%.

Females ($N = 26$) : The number varies from 7—8. The mean is 7.14 ± 0.08 . 80.77% of females have 7 left lower labials. The C. V. is 5.59%.

Here the variance ratio differs significantly, hence t' was computed. Since the value of t' (1.67) for sex difference does not exceed the value for $t'_{0.05}$ (2.062), hence the difference is non-significant.

2. (b) NUMBER OF LOWER LABIALS (right)

Males ($N = 23$) : The number varies from 7—8. The mean is 7.04 ± 0.04 . 95.65% males have 7 right labials. The C. V. is 2.97%.

Females ($N = 26$) : The number varies from 7—8. The mean is 7.04 ± 0.04 . 96.15% of females have 7 right lower labials. The C. V. is 2.78%.

The mean number of right lower labials does not differ significantly in two sexes.

3. NUMBER OF LAMELLAE UNDER FIRST TOE.

Males ($N = 23$) : The number varies from 6—9. The mean is 6.61 ± 0.19 . 60.87% of males have 6 lamellae under the first toe. The C. V. is 13.48%.

Females ($N = 26$) : The number varies from 5—8. The mean is 6.54 ± 0.15 . 50.00% of females have 6 lamellae under the first toe. The C. V. is 11.62%.

The mean number of lamellae under first toe does not differ significantly in two sexes.

4. NUMBER OF LAMELLAE UNDER FOURTH TOE.

Males ($N = 23$) : The number varies from 15—18. The mean is 16.48 ± 0.15 . 47.83% of males have 17 lamellae under the fourth toe. The C. V. is 4.43%.

Females ($N = 26$) : The number varies from 14—19. The mean is 15.04 ± 0.21 . 46.15% of females have 15 lamellae under the fourth toe. The C. V. is 7.15%.

The value of t (5.41) for sex difference exceeds the value for $t_{0.001}$ (3.51) at 0.1% level of probability,

hence it is concluded that the mean number of left upper labials differ significantly in two sexes (Male 16.48 ± 0.15 ; females 15.04 ± 0.21). The data for both sexes have been represented graphically in Text-fig. 2C.

5. NUMBER OF KEELS ON DORSAL SCALES.

Males ($N = 23$) : The number varies from 5—7.

The mean is 5.17 ± 0.12 . 91.30% of males have 5 keels on dorsal scales. The C. V. is 11.14%.

Females (N = 26) : The number varies from 5—7. The mean is 5.31 ± 0.14 . 84.62% of females have 5 keels on dorsal scales. The C. V. is 13.86%.

The mean number of keels on dorsal scales does not differ significantly in two sexes.

6. NUMBER OF SCALES ROUND MIDDLE OF BODY.

Males (N = 23) : The number varies from 28—30. The mean is 29.30 ± 0.19 . 60.67% of males have 30 scales round middle of body. The C. V. is 3.16%.

Females (N = 26) : The number varies from 27—30. The mean is 28.81 ± 0.19 . 46.15% of females have 28 scales round middle of body. The C. V. 3.40%.

The mean number of scales round middle of body does not differ significantly in two sexes.

(8) *Mabuya carinata* (Schneider)

(Table 8, Text-fig. 2D)

1. (a) NUMBER OF UPPER LABIALS (left).

Males (N = 30) : The number varies from 7—7. The mean is 7. All the males have 7 left upper labials.

Females (N = 23) : All the females have 7 left upper labials.

The mean number of left upper labials does not differ significantly in two sexes.

1. (b) NUMBER OF UPPER LABIALS (right).

Males (N = 30) : All the males have 7 right upper labials.

Females (N = 23) : All the females have 7 right upper labials.

The mean number of right upper labials does not differ significantly in two sexes.

2. (a) NUMBER OF LOWER LABIALS (left).

Males (N = 30) : The number varies from 5—8. The mean is 7.10 ± 0.12 . 66.67% of males have 7 left lower labials. The C. V. 9.31%.

Females (N = 23) : The number varies from 6—8. The mean is 7.30 ± 0.10 . 69.57% of females have 7 left lower labials. The C. V. is 6.44%.

The mean number of left lower labials does not differ significantly in two sexes.

TABLE 8.— *Mabuya carinata* (Schneider). Biometrical constants of certain body parts.

S. No.	Character	No. of samples		Range		Mean \pm S.E.		C.V.		't' value for sex difference
		M	F	M	F	M	F	M	F	
1(a)	No. of upper labials (left)	30	23	7—7	7—7	7.00 \pm 0.00	7.00 \pm 0.00	—	—	0.00 N.S.
1(b)	No. of upper labials (right)	30	23	7—7	7—7	7.00 \pm 0.00	7.00 \pm 0.00	—	—	0.00 N.S.
2(a)	No. of lower labials (left)	30	23	5—8	7—8	7.10 \pm 0.12	7.30 \pm 0.10	9.31	6.44	1.23 N.S.
2(b)	No. of lower labials (right)	30	23	7—8	7—7	7.07 \pm 0.5	7.00 \pm 0.00	3.59	—	(1.52) N.S.
3.	No. of lamellae under first toe.	30	23	6—8	6—10	6.97 \pm 0.12	6.78 \pm 0.20	9.60	14.03	0.87 N.S.
4.	No. of lamellae under fourth toe.	30	23	15—18	15—16	16.17 \pm 0.11	15.17 \pm 0.08	3.66	2.55	(7.41) +++
5.	No. of keels on dorsal scales.	30	23	3—7	3—5	4.60 \pm 0.18	4.22 \pm 0.21	21.04	23.65	1.40 N.S.
6.	No. of scales round middle of body	30	23	30—34	30—34	32.53 \pm 0.27	32.22 \pm 0.28	4.55	3.43	0.79 N.S.

The figure in parenthesis is not student t — see text. N.S. = Not Significant. +++ = Significant at 0.1% level of probability. C.V. = Coefficient of variation; F. = Female; M. = Male; S.E. = Standard error.

2. (b) NUMBER OF LOWER LABIALS (right).

Males (N = 30) : The number varies from 7–8: The mean is 7.07 ± 0.05 . 93.33% of males have 7 right lower labials. The C. V is 3.59%.

Females (N = 23) : The number varies from 7–7. All the females have 7 right lower labials.

Here the variance ratio differs significantly, hence t' was computed. Since the value of t' (1.52) for sex difference does not exceed the value for t' (2.045), hence the difference is non-significant.

3. NUMBER OF LAMELLAE UNDER FIRST TOE.

Males (N = 30) : The number varies from 6–8. The mean is 6.97 ± 0.12 . 56.67% of males have 7 lamellae under the first toe. The C. V is 9.60%.

Females (N = 23) : The number varies from 6–10. The mean is 6.78 ± 0.20 . 43.48% of females have 6 while the other 43.48% have 7 lamellae under the first toe. The C. V is 14.03%.

The mean number of lamellae under the first toe does not differ significantly in two sexes.

4. NUMBER OF LAMELLAE UNDER FOURTH TOE.

Males (N = 30) : The number varies from 15–18. The mean is 16.17 ± 0.11 . 83.33% of males have 16 lamellae under the fourth toe. The C. V is 3.66%.

Females (N = 23) : The number varies from 15–16. The mean is 15.17 ± 0.08 . 82.61% of females have 15 lamellae under the fourth toe. The C. V is 2.55%.

Here the variance ratio differs significantly hence t' was computed. Since the value of t' (7.41) for sex difference exceeds the value for $t'_{0.001}$ (3.71), hence it

is concluded that the mean number of lamellae under the fourth toe differ significantly in two sexes (Male 16.17 ± 0.11 ; Female 15.17 ± 0.08). The data for both sexes have been represented graphically in Text-fig. 2D.

5. NUMBER OF KEELS ON DORSAL SCALES.

Males (N = 30) : The number varies from 3–7. The mean is 4.60 ± 0.18 . 73.33% of males have 5 keels on dorsal scales. The C. V is 21.04%.

Females (N = 23) : The number varies from 3–5. The mean is 4.22 ± 0.21 . 60.87% of females have 5 keels on dorsal scales. The C. V is 23.65%.

The mean number of keels on dorsal scales does not differ significantly in two sexes.

6. NUMBER OF SCALES ROUND MIDDLE OF BODY.

Males ($N = 30$) : The number varies from 30—40. The mean is 32.53 ± 0.27 . 43.33 % of males have 34 scales round middle of body. The C. V. is 4.55 %.

Females ($N = 23$) : The number varies from 30—34. The mean is 32.22 ± 0.28 . 52.17 % of females have 32 scales round middle of body. The C. V. is 3.43%.

The mean number of scales round middle of body does not differ significantly in two sexes.

(9) *Riopa punctata* (Gmelin)

(Table 9, Text-fig. 2E)

1. (a) NUMBER OF UPPER LABIALS (left).

Males ($N = 20$) : The number varies from 7—8. The mean is 7.05 ± 0.05 . 95.00 % of males have 7 left upper labials. The C. V. is 3.16 %.

Females ($N = 33$) : The number varies from 7—8. The mean is 7.03 ± 0.03 . 96.97 % of females have 7 left upper labials. The C. V. is 2.46 %.

The mean number of left upper labials does not differ significantly in two sexes.

1. (b) NUMBER OF UPPER LABIALS (right).

Males ($N = 20$) : The number of right upper labials in all the males is 7.

Females ($N = 33$) : The number of right upper labials in all the females is 7.

The mean number of right upper labials does not differ significantly in two sexes.

2. (a) NUMBER OF LOWER LABIALS (left).

Male ($N = 20$) : The number varies from 7—8. The mean is 7.05 ± 0.05 . 95.00 % of males have 7 left lower labials. The C. V. is 3.16 %.

Females ($N = 33$) : The number varies from 6—8. The mean is 6.97 ± 0.06 . 87.88 % of females have 7 left lower labials. The C. V. is 5.01 %.

Here the variance ratio differs significantly hence t was computed. Since the value of t' (1.41) for sex difference does not exceed the value for $t'_{0.05}$ (2.06), hence the difference is non-significant.

2. (b) NUMBER OF LOWER LABIALS (right).

Males ($N = 20$) : The number varies from 7—7.

TABLE 9.— *Riopa punctata* (Gmelin). Biometrical constants of certain body parts.

S. No.	Character	No. of samples		Range		Mean \pm S.E.		C.V.		't' value fore sex difference
		M	F	M	F	M	F	M	F	
1(a)	No. of upper labials (left)	20	33	7—8	7—8	7.05 \pm 0.05	7.03 \pm 0.03	3.16	2.46	0.36 N.S.
1(b)	No. of upper labials (right)	20	33	7—7	7—7	7.00 \pm 0.00	7.00 \pm 0.00	—	—	0.00 N.S.
2(a)	No. of lower labials (right)	20	33	7—8	6—8	7.05 \pm 0.05	6.97 \pm 0.06	3.16	5.01	(1.41) N.S.
2(b)	No. of lower labials (right)	20	33	7—7	7—7	7.00 \pm 0.00	7.00 \pm 0.00	—	—	0.00 N.S.
3.	No. of lamellae under first toe.	19	33	4—5	3—6	4.05 \pm 0.05	4.33 \pm 0.12	5.68	15.98	(2.14)*
4.	No. of lamellae under fourth toe	19	33	12—15	12—15	13.89 \pm 0.16	14.09 \pm 0.15	6.30	5.98	0.81 N.S.
5.	No. of scales round middle of body	20	33	26—28	24—26	26.50 \pm 0.20	24.70 \pm 0.17	3.35	3.85	6.85***
6.	No. of scales down the back	11	18	63—92	66—71	69.45 \pm 2.52	68.33 \pm 0.41	12.02	2.56	(0.44) N.S.

The figure in parenthesis is not student *t* — see text. N.S. = Not Significant. * = Significant at 5% level of probability. *** = Significant at 0.1% level of probability.

C.V. = Coefficient of variation; M. = Male; F. = Female; S.E. = Standard error.

All males have 7 right lower labials.

Females ($N = 33$) : The number in the females is 7.

The mean number of right lower labials does not differ significantly in two sexes.

3. NUMBER OF LAMELLAE UNDER FIRST TOE.

Males ($N = 19$) : The number varies from 4–5. The mean is 4.05 ± 0.05 . 94.74 % of males have 4 lamellae under the first toe. The C. V. is 5.68 %.

Females ($N = 33$) : The number varies from 3–6. The mean is 4.33 ± 0.12 . 60.61 % of females have 4 lamellae under the first toe. The C. V. is 15.98 %.

Here the variance ratio differs significantly hence t' was computed. Since the value of t' (2.14) for sex difference exceeds the value for $t'_{0.05}$ (2.05), hence it

is concluded that the mean number of the lamellae under first toe differ significantly in two sexes (Male 4.05 ± 0.05 ; Female 4.33 ± 0.12). The data for both sexes have been represented graphically in Text-fig. 2E.

4. NUMBER OF LAMELLAE UNDER FOURTH TOE.

Males ($N = 19$) : The number varies from 12–15. The mean is 13.89 ± 0.16 . 57.89 % of males have 14 lamellae under the fourth toe. The C. V. is 6.30 %.

Females ($N = 33$) : The number varies from 12–15. The mean is 14.09 ± 0.15 . 48.48 % of females have 14 lamellae under the fourth toe. The C. V. is 5.98 %.

The mean number of lamellae under the fourth toe does not differ significantly in two sexes.

5. NUMBER OF SCALES ROUND MIDDLE OF BODY

Males ($N = 20$) : The number varies from 26–28. The mean is 26.50 ± 0.20 . 75.00 % of males have 26 scales round the middle of body. The C. V. is 3.35 %.

Females ($N = 33$) : The number varies from 24–26. The mean is 24.70 ± 0.17 . 63.64 % of females have 24 scales round the middle of body. The C. V. is 3.85 %.

The value of t (6.85) for sex difference exceeds the value of $t_{0.001}$ (3.492) at 0.1 % level of probability,

hence it is concluded that the mean number of scales round middle of body differ significantly in two sexes (Male 26.50 ± 0.20 ; Female 24.70 ± 0.17).

6. NUMBER OF SCALES DOWN THE BACK.

Males ($N = 11$) : The number varies from 63–92. The mean is 69.45 ± 2.52 . 18.18 % of males have 63.

while another 18.18 % have 66 scales down the back. The C. V. is 12.02 %.

Females ($N = 18$) : The number varies from 66—71. The mean is 68.33 ± 0.41 . 33.33 % of females have 68 scales down the back. The C. V. is 2.56 %.

Here the variance ratio differs significantly, hence t' was computed. Since the value of t' (0.44) for sex difference does not exceed the value for $t'_{0.05}$ (2.226), hence the difference is non-significant.

(10) *Cabrita leschenaulti* (Milne-Edwards)

(Table 10, Text-fig. 2F)

1. NUMBER OF SCALES ROUND MIDDLE OF BODY.

Males ($N = 15$) : The number varies from 44—50. The mean is 47.02 ± 0.47 . 40.00 % of males have 48 scales round middle of body. The C. V. is 4.02 %.

Females ($N = 9$) : The number varies from 40—48. The mean is 44.22 ± 0.76 . 33.33 % of females have 44 scales round middle of body. The C. V. is 5.15 %.

The value of t (3.46) for sex difference exceeds the value of $t_{0.01}$ (2.819) at 1 % level of probability, hence it is concluded that the mean number of scales round middle of body differ significantly in two sexes (Male 47.02 ± 0.47 ; Female 44.22 ± 0.76). The data for both sexes have been represented graphically in Text-fig. 2F.

2. NUMBER OF LONGITUDINAL ROWS OF PLATES ON BELLY

Males ($N = 15$) : The number of longitudinal rows of plates on belly in all males is 6.

Females ($N = 9$) : The number of longitudinal rows of plates on belly in all females is 6:

The mean number of longitudinal rows of plates does not differ significantly in two sexes.

3. NUMBER OF TRANSVERSE ROWS OF PLATES ON VENTRUM.

Males ($N = 15$) : The number varies from 23—26. The mean is 24.27 ± 0.26 . 46.67 % of males have 25 transverse rows of plates on ventrum. The C. V. is 4.26 %.

Females ($N = 9$) : The number varies from 23—25. The mean is 23.56 ± 0.24 . 55.55 % of females have 23 transverse rows of plates on ventrum. The C. V. is 3.08 %.

The mean number of transverse rows of plates on ventrum does not differ significantly in two sexes.

TABLE 10.— *Cabrila leschenaulti* (Milne—Edwards). Biometrical constants of certain body parts.

S. No.	Character	No. of samples		Range		Mean \pm S.E.		C.V.		't' value for sex difference
		M	F	M	F	M	F	M	F	
1.	No. of scales round middle of body	15	9	44—50	40—48	47.02 \pm 0.47	44.22 \pm 0.76	4.02	5.15	4.46**
2.	No. of longitudinal rows of plates on belly.	15	9	6—6	6—6	6.00 \pm 0.00	6.00 \pm 0.00	—	—	0.00 N.S.
3.	No. of transverse rows of plates on ventrum.	15	9	23—26	23—25	24.27 \pm 0.26	23.56 \pm 0.24	4.26	3.08	1.81 N.S.
4(a)	No. of femoral pores (left)	15	9	12—15	12—16	14.13 \pm 0.25	14.00 \pm 0.44	7.01	9.45	0.28 N.S.
4(b)	No. of femoral pores (right)	15	9	12—15	12—15	13.80 \pm 0.27	13.67 \pm 0.37	7.84	8.18	0.28 N.S.

N.S. = Not Significant ** = Significant at 1% level of probability.

C.V. = Coefficient of variation; F. = Female; M. = Male; S.E. = Standard error.

4. (a) NUMBER OF FEMORAL PORES (left).

Males (N = 15) : The number varies from 12—15. The mean is 14.13 ± 0.25 . 46.67 % of males have 15 left femoral pores. The C. V. is 7.01 %.

Females (N = 9) : The number varies from 12—16. The mean is 14.00 ± 0.44 . 33.33 % of females have 13 left femoral pores. The C. V. is 9.45 %.

The mean number of left femoral pores does not differ significantly in two sexes.

4. (b) NUMBER OF FEMORAL PORES (right).

Males (N = 15) : The number varies from 12—15. The mean is 13.80 ± 0.27 . 33.33 % of males have 15 right femoral pores. The C. V. is 7.84 %.

Females (N = 9) : The number varies from 12—15. The mean is 13.67 ± 0.36 . 33.33 % of females have 15 right femoral pores. The C. V. is 8.18 %.

The mean number of right femoral pores does not differ significantly in two sexes.

(11) *Cabrita jerdoni* Beddome

(Table 11, Text-fig. 2G)

1. NUMBER OF SCALES ROUND MIDDLE OF BODY.

Males (N = 18) : The number varies from 25—31. The mean is 28.67 ± 0.35 . 33.33 % of males have 28 scales round middle of body. The C. V. is 5.21 %.

Females (N = 5) : The number varies from 23—28. The mean is 26.60 ± 0.98 . 60.00 % of females have 28 scales round middle of body. The C. V. is 8.24 %.

The value of t (2.48) for sex difference exceeds the value for $t_{0.05}$ (2.08) at the 5 % level of probability, hence it is concluded that the mean number of scales round middle of body differ significantly in two sexes (Male 28.67 ± 0.35 ; Female 26.60 ± 0.98). The data for both sexes have been represented graphically in Text-fig. 2G.

2. NUMBER OF LONGITUDINAL ROWS OF PLATES ON BELLY.

Males (N = 18) : The number varies from 6—8. The mean is 6.11 ± 0.11 . 94.44 % of males have 6 longitudinal rows of plates on belly. The C. V. is 7.71 %.

Females (N = 5) : The number of longitudinal rows of plates on belly in all the females is 6.

TABLE 11.— *Cabrita jerdoqi* Beddome. Biometrical constants of certain body parts.

S. No.	Character	No. of samples		Range		Mean \pm S.E.		C.V.		't' value for sex difference
		M	F	M	F	M	F	M	F	
1.	No. of scales round middle of body	18	5	25—31	23—28	28.67 \pm 0.35	26.60 \pm 0.98	5.21	8.24	2.48*
2.	No. of longitudinal rows of plates on belly	18	5	6—8	6—6	6.11 \pm 0.11	6.00 \pm 0.00	7.71	—	(0.99) N.S.
3.	No. of transverse rows of plates on ventrum	18	5	19—23	19—23	21.56 \pm 0.35	21.40 \pm 0.81	6.79	8.49	0.21 N.S.
4(a)	No. of femoral pores (left)	18	5	10—17	12—14	12.11 \pm 0.46	12.80 \pm 0.37	16.24	6.53	0.75 N.S.
4(b)	No. of femoral pores (right)	18	5	10—17	12—14	12.22 \pm 0.42	12.60 \pm 0.40	14.73	7.09	0.45 N.S.

The figure in parenthesis is not student t — see text. N.S. = Not Significant. * = Significant at 5% level of probability. C.V. = Coefficient of variation; F. = Female; M. = Male; S.E. = Standard error.

Here the variance ratio differs significantly, hence t' was computed. Since the value of t' (0.99) for sex difference does not exceed the value for t' 0.05 (2.11), hence the difference is non-significant.

3. NUMBER OF TRANSVERSE ROWS OF PLATES ON VENTRUM.

Males (N = 18) : The number varies from 19-23. The mean is 21.56 ± 0.35 . 33.33 % of males have 23 transverse rows of plates on ventrum. The C. V. is 6.79 %.

Females (N = 5) : The number varies from 19-23. The mean is 21.40 ± 0.81 . 40.00 % of females have 23 transverse rows of plates on ventrum. The C. V. is 8.49 %.

The mean number of transverse rows of plates on ventrum does not differ significantly in two sexes.

4. (a) NUMBER OF FEMORAL PORES (left).

Males (N = 18) : The number varies from 10-17. The mean is 12.11 ± 0.46 . 22.22 % of males have 10, 11 and 12 left femoral pores. The C. V. is 16.24%.

Females (N = 5) : The number varies from 12-14. The mean is 12.80 ± 0.37 . 40.00 % of females have 12, while another 40.00% of females have 13 left femoral pores. The C. V. is 6.53 %.

The mean number of left femoral pores does not differ significantly in two sexes.

4. (b) NUMBER OF FEMORAL PORES (right).

Males (N = 18) : The number varies from 10-17. The mean is 12.22 ± 0.42 . 38.89% of males have 11 right femoral pores. The C. V. is 14.73%.

Females (N = 5) : The number varies from 12-14. The mean is 12.60 ± 0.40 . 60.00 % of females have 12 right femoral pores. The C. V. is 7.09 %.

The mean number of right femoral pores does not differ significantly in two sexes.

(12) *Ophisops jerdoni* Blyth

(Table 12, Text-fig. 2H)

1. NUMBER OF SCALES ROUND MIDDLE OF BODY.

Males (N = 30) : The number varies from 29-35. The mean is 30.77 ± 0.26 . 63.33 % of males have 30 scales round middle of body. The C. V. is 4.57 %.

Females (N = 21) : The number varies from 26-33. The mean is 28.19 ± 0.30 . 76.19 % of females have 28 scales round middle of body. The C. V. is 4.84 %.

TABLE 12.— *Ophisops jerdoni* Blyth. Biometrical constants of certain body parts.

S. No.	Character	No. of samples		Range		Mean \pm S.E.		C.V.		't' value for sex difference
		M	F	M	F	M	F	M	F	
1.	No. of scales round middle of body	30	21	29—35	26—33	30.77 \pm 0.26	28.19 \pm 0.30	4.57	4.84	6.53 ***
2.	No. of longitudinal rows of plates on belly.	30	21	6—6	6—6	6.00 \pm 0.00	6.00 \pm 0.00	—	—	0.00 N.S.
3.	No. of transverse rows of plates on ventrum	30	21	23—28	23—30	25.33 \pm 0.35	24.76 \pm 0.49	7.57	9.11	0.97 N.S.
4(a)	No. of femoral pores (left)	30	21	7—11	6—12	8.47 \pm 0.21	8.90 \pm 0.31	13.78	16.25	1.17 N.S.
4(b)	No. of femoral pores (right)	30	21	7—11	6—12	8.40 \pm 0.22	8.81 \pm 0.30	14.52	15.49	1.13 N.S.

N.S. = Not Significant. *** = Significant at 0.1% level of probability.

C.V. = Coefficient of variation; F. = Female; M. = Male; S.E. = Standard error.

The value of t (6.53) for sex difference exceeds the value for t 0.001 (3.501) at 0.1% level of probability, hence it is concluded that the mean number of scales round middle of body differ significantly in two sexes (Male 30.77 ± 0.26 ; Female 28.19 ± 0.30). The data for both sexes have been represented graphically in Text-fig. 2H.

2. NUMBER OF LONGITUDINAL ROWS OF PLATES ON BELLY.

Males (N = 30) : The number varies from 6-6. All the males have 6 longitudinal rows of plates on belly.

Females (N = 21) : All the females have 6 longitudinal rows of plates on belly.

The mean number of longitudinal rows of plates does not differ significantly in two sexes.

3. NUMBER OF TRANSVERSE ROWS OF PLATES ON VENTRUM.

Males (N = 30) : The number varies from 23-28. The mean is 25.33 ± 0.35 . 36.67 % of males have 26 transverse rows of plates on ventrum. The C. V. is 7.57 %.

Females (N = 21) : The number varies from 23-30. The mean is 24.76 ± 0.49 . 52.38 % of females have 23 transverse rows of plates on ventrum. The C. V. is 9.11 %.

The mean number of transverse rows of plates on ventrum does not differ significantly in two sexes.

4. (a) NUMBER OF FEMORAL PORES (left).

Males (N = 30) : The number varies from 7-11. The mean is 8.47 ± 0.21 . 40.00 % males have 8 left femoral pores. The C. V. is 13.78 %.

Females (N = 21) : The number varies from 6-12. The mean is 8.90 ± 0.31 . 33.33% of females have 10 left femoral pores. The C. V. is 16.25 %.

The mean number of left femoral pores does not differ significantly in two sexes.

4. (b) NUMBER OF FEMORAL PORES (right)

Males (N = 30) : The number varies from 7-11. The mean is 8.40 ± 0.22 . 30.00% of males have 8, while another 30.00% possess 9 right femoral pores. The C. V. is 14.52 %.

Females (N = 21) : The number varies from 6-12. The mean is 8.81 ± 0.30 . 38.10% of females have 9 right femoral pores. The C. V. is 15.49 %.

The mean number of right femoral pores does not differ significantly in two sexes.

(13) *Elaphe helena* (Daudin)

(Table 13, Text-figs. 3A & B)

1. (a) NUMBER OF UPPER LABIALS (left)

Males (N = 11) : The number varies from 9—11. The mean is 9.36 ± 0.20 . 72.73% of males have 9 left upper labials. The C. V. is 7.20%.

Females (N = 10) : The number varies from 9—11. The mean is 9.50 ± 0.22 . 60.00% of females have 9 left upper labials. The C. V. is 7.44%.

The mean number of left upper labials does not differ significantly in two sexes.

1. (b) NUMBER OF UPPER LABIALS (right)

Males (N = 11) : The number varies from 9—10. The mean is 9.82 ± 0.12 . 81.82% of males have 10 right upper labials. The C. V. is 4.12%.

Females (N = 10) : The number varies from 9—10. The mean is 9.50 ± 0.17 . 50.00% of females have 9, while another 50.00% possesses 10 right upper labials. The C. V. is 5.55%.

The mean number of left upper labials does not differ significantly in two sexes.

2. (a) NUMBER OF LOWER LABIALS (left)

Male (N = 11) : The number varies from 9—11. The mean is 9.91 ± 0.16 . 72.73% of males have 10 left lower labials. The C. V. is 5.44%.

Females (N = 10) : The number varies from 8—12. The mean is 9.80 ± 0.33 . 60.00% of females have 10 left lower labials. The C. V. is 10.53%.

The mean number of left lower labials does not differ significantly in two sexes.

2. (b) NUMBER OF LOWER LABIALS (right)

Males (N = 11) : All the males have 10 right lower labials.

Females (N = 10) : The number varies from 9—10. The mean is 9.70 ± 0.15 . 70.00% of females have 10 right lower labials. The C. V. is 4.98%.

Here the variance ratio differs significantly hence t' was computed. Since the value of t' (1.97) for sex difference does not exceed the value for $t'_{0.05}$ (2.262), hence the difference is non-significant.

TABLE 13.— *Elaphe helena* (Daudin). Biometrical constants of certain body parts.

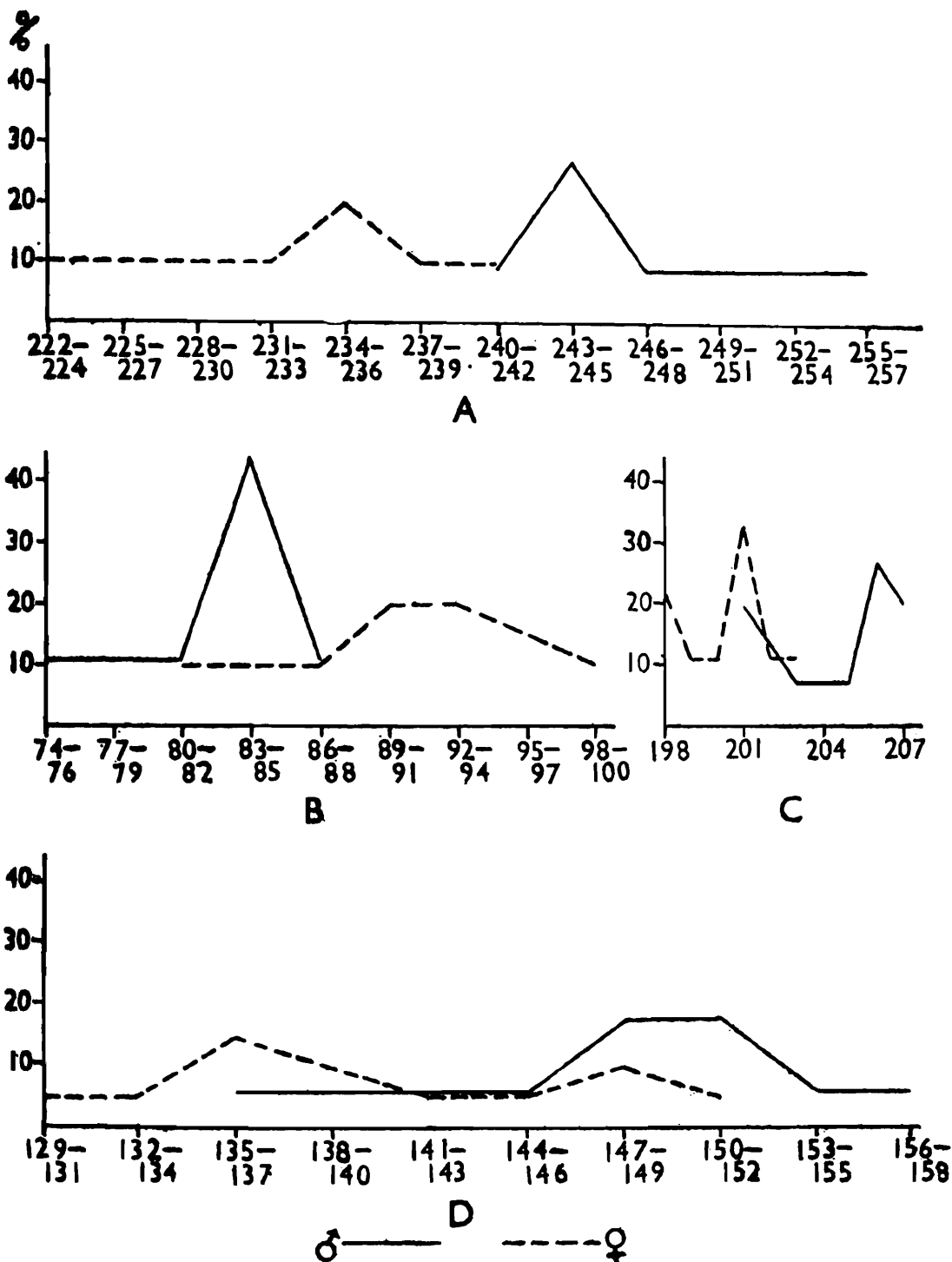
S. No.	Character	No. of samples		Range		Mean \pm S.E.		C.V.		't' value for sex difference
		M	F	M	F	M	F	M	F	
1(a)	No. of upper labials (left)	11	10	9—11	9—11	9.36 \pm 0.20	9.50 \pm 0.22	7.20	7.44	0.46 N.S.
1(b)	No. of upper labials (right)	11	10	9—10	9—10	9.82 \pm 0.12	9.50 \pm 0.17	4.12	5.55	1.57 N.S.
2(a)	No. of lower labials (left)	11	10	9—11	8—12	9.91 \pm 0.16	9.80 \pm 0.33	5.44	10.53	0.31 N.S.
2(b)	No. of lower labials (right)	11	10	10—10	9—10	10.00 \pm 0.00	9.70 \pm 0.15	—	4.98	(1.97) N.S.
3.	No. of temporal scales	11	10	2+2—2+3	2+2—2+3	2+3.10 \pm 0.15	2+2.20 \pm 0.13	9.90	10.05	4.41 ***
4.	No. of ventral shields	11	10	242—257	222—241	246.64 \pm 1.50	233.30 \pm 1.80	2.02	2.43	5.73 ***
5.	No. of sub-caudal shields	9	10	74—86	82—100	81.67 \pm 1.25	90.30 \pm 1.56	4.58	5.45	4.25 ***
6.	No. of scales round middle of body	11	10	25—27	25—27	25.73 \pm 0.30	26.40 \pm 0.30	3.92	3.66	1.52 N.S.

The figure in parenthesis is not student *t*—see text. N.S. = Not significant. *** = Significant at 0.1% level of probability.

C.V. = Coefficient of variation; F. = Female; M. = Male, S.E. = Standard error.

3. NUMBER OF TEMPORAL SCALES.

Males (N = 11) : The number varies from 2 + 2 - 2 + 3. The mean is $2 + 3.10 \pm 0.15$. 63.64% of males have 2 + 3 temporal scales. The C. V is 9.90%



Text-Fig. 3.— Graphs to show variation in number of scales in some reptiles from Peninsular India. Vertical axis (Y — axis) represents the percentage of specimen in a particular category; horizontal axis, the number of scales.

(A). *Elaphe helena* (Daudin) (n = 0.11, 0.10) : Number of ventral shields. (B). *Elaphe helena* (Daudin) (n = 0.11, 0.10) : Number of sub-aural shields. (C). *Ptyas mucosus* (Linnaeus) (n = 0.15, 0.9) : Number of ventral shields. (D). *Xenochrophis piscator* (Schneider) (n = 0.17, 0.20) : Number of ventral shields.

Females (N = 10) : The number varies from 2 + 2 – 2 + 3. The mean is $2 + 2.20 \pm 0.13$. 80.00% of females have 2 + 2 temporal scales. The C. V. is 10.05%.

The value of t (4.41) for sex difference exceeds the value for $t_{0.001}$ (3.883) at 0.1% level of probability, hence it is concluded that the mean number of temporal scales differ significantly in two sexes (Males $2 + 3.10 \pm 0.15$; Females $2 + 2.20 \pm 0.13$).

4. NUMBER OF VENTRAL SHIELDS.

Males (N = 11) : The number varies from 242–257. The mean is 246.64 ± 1.50 . 27.27% of males have 244 ventral shields. The C. V. is 2.02%.

Females (N = 10) : The number varies from 222–241. The mean is 233.30 ± 1.80 . 20.00% of females have 235 ventral shields. The C. V. is 2.43%.

The value of t (5.73) for sex difference exceeds the value for $t_{0.001}$ (3.883) at 0.1% level of probability, hence it is concluded that the mean number of ventral shields differ significantly in two sexes (Males 246.64 ± 1.50 ; Females 233.30 ± 1.80). The data for both sexes have been represented graphically in Text-fig. 3A.

5. NUMBER OF SUB-CAUDAL SHIELDS.

Males (N = 9) : The number varies from 74–86. The mean is 81.67 ± 1.25 . 44.44% of males have 83 sub-caudal shields. The C. V. is 4.58%.

Females (N = 10) : The number varies from 82–100. The mean is 90.30 ± 1.56 . 20.00% of females have 89 while another 20.00% have 94 sub-caudal shields. The C. V. is 5.45%.

The value of t (4.25) for sex difference exceeds the value for $t_{0.001}$ (3.965) at 0.1% level of probability, hence it is concluded that the mean number of sub-caudal shields differ significantly in two sexes (Males 81.67 ± 1.25 ; Females 90.30 ± 1.56). The data for both sexes have been represented graphically in Text-fig. 3B.

6. NUMBER OF SCALES ROUND THE MIDDLE OF BODY.

Males (N = 11) : The number varies from 25–27. The mean is 25.73 ± 0.30 . 63.64% of males have 25 scales round the middle of body. The C. V. is 3.92%.

Females (N = 10) : The number varies from 25–27. The mean is 26.40 ± 0.30 . 70.00% of females have 27 scales round the middle of body. The C. V. is 3.66%.

The mean number of scales round the middle of body does not differ significantly in tow sexes.

(14) *Ptyas mucosus* (Linnaeus)

(Table 14, Text-fig. 3C)

1. (a) NUMBER OF UPPER LABIALS (left).

Males (N = 15): The number varies from 8–9. The mean is 8.33 ± 0.13 . 66.67 % of males have 8 left upper labials. The C. V is 5.86 %.

Females (N = 9): The number of upper labials (left) is 8 in all the females.

Here the variance ratio differs significantly hence t' was computed. Since the value of t' (2.62) for sex difference exceeds the value for $t'_{0.05}$ (2.145), hence it is concluded that the mean number of left upper labials differ significantly in two sexes (Male 8.33 ± 0.13 ; Female 8.00).

1 (b) NUMBER OF UPPER LABIALS (right).

Males (N = 15): The number varies from 8–9. The mean is 8.20 ± 0.11 . 80.00 % of males have 8 right upper labials. The C. V is 5.05 %.

Females (N = 9): The number varies from 8–9. The mean is 8.11 ± 0.11 . 88.89 % of females have 8 right upper labials. The C. V. is 4.13 %.

The mean number of right upper labials does not differ significantly in two sexes.

2. (a) NUMBER OF LOWER LABIALS (left).

Males (N = 15): The number varies form 8–10. The mean is 8.93 ± 0.21 . 40.00 % of males have 9 left lower labials. The C. V is 8.95 %.

Females (N = 9): The number varies from 8–9. The mean is 8.67 ± 0.17 . 66.67% of females have 9 left lower labials. The C. V is 5.77 %.

The mean number of left lower labials does not differ significantly in two sexes.

2. (b) NUMBER OF LOWER LABIALS (right).

Males (N = 15): The number varics from 8–9. The mean is 8.60 ± 0.13 . 60.00 % of males have 9 right lower labials. The C. V is 5.89 %.

Females (N = 9): The number varies from 8–9. The mean is 8.67 ± 0.17 . 67.67 % of females have 9 right lower labials. The C. V is 5.77 %.

TABLE 14.— *Ptyas mucosus* (Linnaeus). Biometrical constants of certain body parts

S. No.	Character	No. of samples		Range		Mean \pm S.E.		C.V.		't' value for sex difference (2.62)*
		M	F	M	F	M	F	M	F	
1(a)	No. of uppr labials (left)	15	9	8—9	8—8	8.33 \pm 0.13	8.00 \pm 0.00	5.86	—	
1(b)	No. of upper labials (right)	15	9	8—9	8—9	8.20 \pm 0.11	8.11 \pm 0.11	5.05	4.13	0.55 N.S.
2(a)	No. of lower labials (left)	15	9	8—10	8—9	8.93 \pm 0.21	8.67 \pm 0.17	8.95	5.77	0.91 N.S.
2(b)	No. of lower labials (right)	15	9	8—9	8—9	8.60 \pm 0.13	8.67 \pm 0.17	5.89	5.77	0.33 N.S.
3.	No. of temporal scales.	15	9	2+2—2+2	2+2—2+2	2+2.00 \pm 0.00	2+2.00 \pm 0.00	—	—	0.00 N.S.
4.	No. of ventral shields.	15	9	201—207	198—203	204.27 \pm 0.61	200.33 \pm 0.58	1.16	0.86	4.32 ***
5.	No. of subcaudal shields	15	8	115—135	116—135	125.47 \pm 1.57	127.37 \pm 2.42	4.86	5.37	0.68 N.S.
6.	No. of scales round middle of body.	15	9	14—17	14—17	16.73 \pm 0.21	16.56 \pm 0.34	4.78	6.12	0.43 N.S.

The figure in parenthesis is not student t — see text. N.S. = Not significant. * = Significant at 5% level of probability. *** = Significant at 0.1% level of probability.

C.V. = Coefficient of variation; F. = Female; M. = Male; S.E. = Standard error

The mean number of right lower labials does not differ significantly in two sexes.

3. NUMBER OF TEMPORAL SCALES.

Males (N = 15) : The number varies from 2 + 2 - 2 + 2. The mean is $2 + 2.00 \pm 0.00$. All males have 2 + 2 temporal scales.

Females (N = 9) : The number varies from 2 + 2 - 2 + 2. The mean is $2 + 2.00 \pm 0.00$. All the females have 2 + 2 temporal scales.

The mean number of temporal scales does not differ significantly in two sexes.

4. NUMBER OF VENTRAL SHIELDS.

Males (N = 15) : The number varies from 201—207. The mean is 204.27 ± 0.61 . 26.67 % of males have 206 ventral shields. The C. V. is 1.16 %.

Females (N = 9) : The number varies from 198—203. The mean is 200.33 ± 0.58 . 33.33 % of females have 201 ventral shields. The C. V. is 0.86 %.

The value of t (4.32) for sex difference exceeds the value for $t_{0.001}$ (3.792) at 0.1 % level of probability,

hence it is concluded that the mean number of ventral shields differ significantly in two sexes (Male 204.27 ± 0.61 ; Female 200.33 ± 0.58). The data for both sexes have been represented graphically in Text-fig. 3C.

5. NUMBER OF SUB-CAUDAL SHIELDS

Males (N = 15) : The number varies from 115—135. The mean is 125.47 ± 1.57 . 13.33 % of males have 132 sub-caudal shields. The C. V. is 4.86 %.

Females (N = 8) : The number varies from 116—135. The mean is 127.37 ± 2.42 . 25.00 % of females have 124 sub-caudal shields. The C. V. is 5.37 %.

The mean number of sub-caudal shields does not differ significantly in two sexes.

6. NUMBER OF SCALES ROUND THE MIDDLE OF BODY.

Males (N = 15) : The number varies from 14—17. The mean is 16.73 ± 0.21 . 86.67 % of males have 17 scales round the middle of body. The C. V. is 4.78 %.

Females (N = 9) : The number varies from 14—17. The mean is 16.56 ± 0.34 . 77.78 % of females have 17 scales round the the middle of body. The C. V. is 6.12 %.

The mean number of scales round the middle of body does not differ significantly in two sexes.

(15) *Xenochrophis piscator* (Schneider)

(Table 15, Text-figs. 3D & 4A)

1 (a) NUMBER OF UPPER LABIALS (left).

Males (N = 17) : The number varies from 9–10. The mean is 9.12 ± 0.08 . 88.24% of males have 9 left upper labials. The C. V is 3.64%.

Females (N = 20) : The number varies from 9–10. The mean is 9.15 ± 0.08 . 85.00% of females have 9 left upper labials. The C. V is 4.00%.

The mean number of left upper labials does not differ significantly in two sexes.

1. (b) NUMBER OF UPPER LABIALS (right).

Males (N = 17) : The number varies from 9–10. The mean is 9.06 ± 0.06 . 94.12% of males have 9 right upper labials. The C. V is 2.67%.

Females (N = 20) : The number varies from 9–9. All the females have 9 right upper labials.

Here the variance ratio differs significantly, hence t' was computed. Since the value of t' (1.01) for sex difference does not exceed the value for $t'_{0.05}$ (2.120), hence the difference is non-significant.

2. (a) NUMBER OF LOWER LABIALS (left).

Males (N = 17) : The number varies from 9–10. The mean is 9.18 ± 0.10 . 82.35% of males have 9 left labials. The C. V is 4.28%.

Females (N = 20) : The number varies from 9–10. The mean is 9.05 ± 0.05 . 95.00% of females have 9 left lower labials. The C. V is 2.48%.

Here the variance ratio differs significantly, hence t' was computed. Since the value of t' (1.20) for sex difference does not exceed the value for $t'_{0.05}$ (2.114), hence the difference is non-significant.

2. (b) NUMBER OF LOWER LABIALS (right).

Males (N = 17) : All males have 9 right lower labials.

Females (N = 20) : All females have 9 right lower labials.

The mean number of right lower labials does not differ significantly in the two sexes.

3. NUMBER OF TEMPORAL SCALES.

Males (N = 17) : The number varies from 2 + 2 – 2 + 3. The mean is $2 + 2.06 \pm 0.06$. 94.12% of males have 2 + 2 temporal scales. The C. V. is 5.96%.

TABLE 15.— *Xenochrophis piscator* (Schneider). Biometrical constants of certain body parts.

S. No.	Character	No. of samples		Range		Mean \pm S.E.		C.V.		't' value for sex difference
		M	F	M	F	M	F	M	F	
1(a)	No. of upper labials (left)	17	20	9—10	9—10	9.12 \pm 0.08	9.15 \pm 0.08	3.64	4.00	0.26 N.S.
(1)b	No. of upper labials (right)	17	20	9—10	9—9	9.06 \pm 0.06	9.00 \pm 0.00	2.67	—	(1.01) N.S.
2(a)	No. of lower labials (left)	17	20	9—10	9—10	9.18 \pm 0.10	9.05 \pm 0.05	4.28	2.48	(1.20) N.S.
2(b)	No. of lower labials (right)	17	20	9—9	9—9	9.00 \pm 0.00	9.00 \pm 0.00	—	—	0.00 N.S.
3.	No. of temporal scales.	17	20	2+2—2+3	2+2—2+3	2+2.06 \pm 0.06	2+2.30 \pm 0.11	5.96	10.93	(2.00) N.S.
4.	No. of ventral shields.	17	20	135—158	129—152	147.59 \pm 1.54	140.75 \pm 1.21	4.30	3.85	3.54 **
5.	No. of subcaudal shields.	14	17	68—87	74—95	76.14 \pm 1.27	84.65 \pm 1.35	6.26	6.55	4.52 ***

The figure in parenthesis is not student t — see text. N.S. = Not significant. ** = Significant at 1% level of probability. *** = Significant at 0.1% level or probability.

C.V. = Coefficient of variation; F. = Female; M. = Male; S.E. = Standard error.

Females ($N = 20$) : The number varies from 2 + 2 – 2 + 3. The mean is $2 + 2.30 \pm 0.11$. 70.00% of females have 2 + 2 temporal scales. The C. V. is 10.93%.

Here the variance ratio differs significantly, hence t' was computed. Since the value of t' (2.00) for sex difference does not exceed the value for $t'_{0.05}$ (2.099),

hence the difference is iron-significant.

4. NUMBER OF VENTRAL SHIELDS.

Males ($N = 17$) : The number varies from 135–158. The mean is 147.59 ± 1.54 . 17.65 % of males have 148 while another 17.65 % have 150 ventral shields. The C. V. is 4.30 %.

Females ($N = 20$) : The number varies from 129–152. The mean is 140.75 ± 1.21 . 15.00 % of females have 137 ventral shields. The C. V. is 3.85 %.

The value of t (3.54) for sex difference exceeds the value of $t_{0.01}$ (2.724) at 1 % level of probability, hence

it is concluded that the mean number of ventral shields differ significantly in two sexes (Male 147.59 ± 1.54 ; Female 140.75 ± 1.21). The data for both sexes have been represented graphically in Text-fig. 3D.

5. NUMBER OF SUB-CAUDAL SHIELDS

Males ($N = 14$) : The number varies from 68–87. The mean is 76.14 ± 1.27 . 21.43 % of males have 77 sub-caudal shields. The C. V. is 6.26 %.

Females ($N = 17$) : The number varies from 74–95. The mean is 84.65 ± 1.35 . 17.65 % of females have 82 sub-caudal shields. The C. V. is 6.55 %.

The value of t (4.52) for sex difference exceeds the value for $t_{0.001}$ (3.659) at 0.1 % level of probability,

hence it is concluded that the mean number of sub-caudal shields differ significantly in two sexes (Males 76.14 ± 1.27 ; Females 84.65 ± 1.35). The data for both sexes have been represented graphically in Text-fig. 4A.

(16) *Echis carinatus* (Schneider)

(Table 16, Text-figs. 4B, C & D)

1. NUMBER OF SCALES ACROSS THE FOREHEAD.

Males ($N = 20$) : The number varies from 8–11. The mean is 8.95 ± 0.20 . 40.00 % of males have 9 scales across the forehead. The C. V. is 9.91 %.

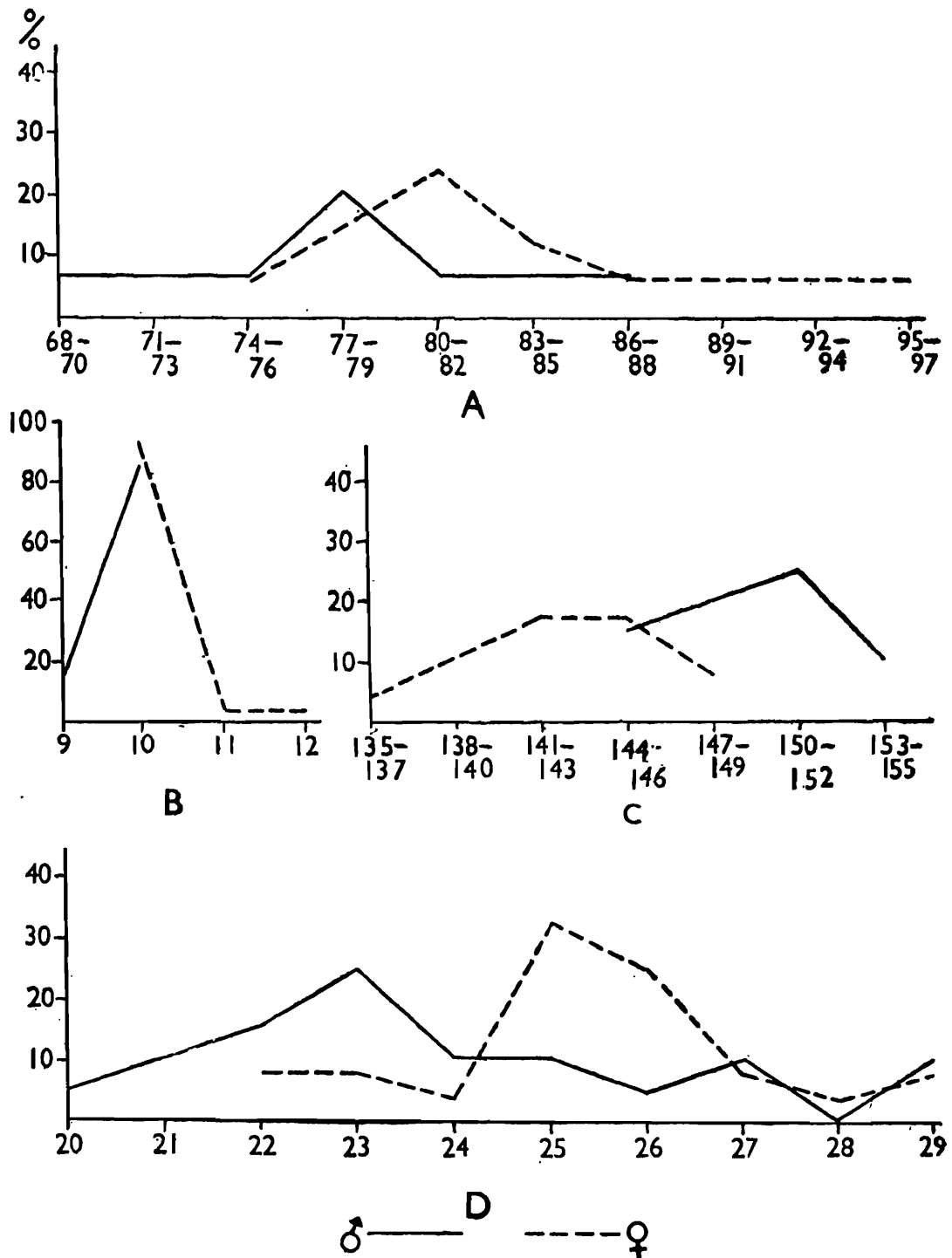
TABLE 16.— *Echis carinatus* (Schneider). Biometrical constants of certain body parts.

S. No.	Character	No. of samples		Range		Mean \pm S.E.		C.V.		't' value for sex difference
		M	F	M	F	M	F	M	F	
1.	No. of scales across the fore head	20	24	8—11	8—11	8.95 \pm 0.20	8.83 \pm 0.16	9.91	8.62	0.48 N.S.
2.	No. of scales round the eye	20	24	12—15	12—16	13.40 \pm 0.23	13.58 \pm 0.22	7.80	8.10	0.55 N.S.
3(a)	No. of upper labials (left)	20	24	9—10	9—11	9.90 \pm 0.07	10.00 \pm 0.06	3.11	2.95	1.09 N.S.
3(b)	No. of upper labials (right)	20	24	9—10	10—10	9.95 \pm 0.05	10.00 \pm 0.00	2.24	—	(1.00) N.S.
4(a)	No. of lower labials (left)	20	24	9—10	10—12	9.85 \pm 0.08	10.12 \pm 0.09	3.72	4.43	2.16*
4(b)	No. of lower labials (right)	20	24	9—10	9—10	9.90 \pm 0.07	9.96 \pm 0.04	3.11	2.05	0.77 N.S.
5.	No. of ventral shields	20	24	145—154	135—148	149.10 \pm 0.65	142.33 \pm 0.64	1.94	2.21	7.36 ***
6.	No. of subcaudal shields	20	24	20—29	22—29	23.95 \pm 0.95	25.42 \pm 0.38	10.70	7.23	2.21*
7.	No. of scales round middle of body	20	24	24—30	25—30	28.00 \pm 0.40	28.75 \pm 0.23	6.35	3.87	(1.64) N.S.
8.	No. of scales round anal region	20	24	16—21	16—22	19.30 \pm 0.28	19.58 \pm 0.25	6.53	6.19	0.75 N.S.
9.	No. of scales round neck	20	24	21—26	21—26	24.10 \pm 0.28	24.25 \pm 0.32	5.19	6.46	0.34 N.S.

The figure in parenthesis is not a student t—see text. N.S. = Not significant. * = Significant at 5% level of probability. *** = Significant at 0.1% level of probability. C.V. = Coefficient of variation; M. = Male; F. = Female; S.E. = Standard error.

Females (N = 24) : The number varies from 8—11. The mean is 8.83 ± 0.16 . 54.17 % of females have 9 scales across the forehead. The C. V. is 8.62 %.

The mean number of scales across the forehead does not differ significantly in two sexes.



Text-Fig. 4.— Graphs to show variations in number of scales in some reptiles from Peninsular India. Vertical axis (Y — axis) represents the percentage of specimen in a particular category; horizontal axis, the number of scales.

(A). *Xenochrophis piscator* (Schneider) (n = 0.17, 0.20) : Number of subcaudal shields. (B). *Echis carinatus* (Schneider) (n = 0.20, 0.24): Number of lower labials (left). (C). *Echis carinatus* (Schneider) (n = 0.20, 0.24): Number of ventral shields. (D). *Echis carinatus* (Schneider) (n = 0.20, 0.24) Number of sub-caudal shields.

2. NUMBER OF SCALES ROUND THE EYE.

Males ($N = 20$) : The number varies from 12-15. The mean is 13.40 ± 0.23 . 40.00 % of males have 13 scales round the eye. The C. V. is 7.80 %.

Females ($N = 24$) : The number varies from 12-16. The mean is 13.58 ± 0.22 . 41.67 % of females have 14 scales round the eye. The C. V. is 8.10 %.

The mean number of scales round the eye does not differ significantly in two sexes.

3. (a) NUMBER OF UPPER LABIALS (left).

Males ($N = 20$) : The number varies from 9-10. The mean is 9.90 ± 0.07 . 90.00 % of males have 10 left upper labials. The C. V. is 3.11 %.

Females ($N = 24$) : The number varies from 9-11. The mean is 10.00 ± 0.06 . 91.66 % of females have 10 left upper labials. The C. V. is 2.95 %.

The mean number of left upper labials does not differ significantly in two sexes.

3. (b) NUMBER OF UPPER LABIALS (right).

Males ($N = 20$) : The number varies from 9-10. The mean is 9.95 ± 0.05 . 95.00 % of males have 10 right upper labials. The C. V. is 2.24 %.

Females ($N = 24$) : The number of upper labials (right) is 10 in all the females.

Here the variance ratio differs significantly, hence t' was computed. Since the value of t' (1.00) for sex difference does not exceed the value for $t'_{0.05}$ (2.09), hence the difference is non-significant.

4. (a) NUMBER OF LOWER LABIALS (left).

Males ($N = 20$) : The number varies from 9-10. The mean is 9.85 ± 0.08 . 85.00 % of males have 10 left lower labials. The C. V. is 3.72 %.

Females ($N = 24$) : The number varies from 10-12. The mean is 10.12 ± 0.09 . 91.67 % of females have 10 left lower labials. The C. V. is 4.43 %.

The value of t (2.16) for sex difference exceeds the value for $t_{0.05}$ (2.019) at the 5 % level of probability, hence it is concluded that the mean number of left lower labials differ significantly in two sexes (Male 9.85 ± 0.08 ; Female 10.12 ± 0.09). The data for both sexes have been represented graphically in Text-fig. 4B.

4. (b) NUMBER OF LOWER LABIALS (right).

Males (N = 20) : The number varies from 9–10. The mean is 9.90 ± 0.07 . 90.00 % of males have 10 right lower labials. The C. V. is 3.11%.

Females (N = 24) : The number varies from 9–10. The mean is 9.96 ± 0.04 . 95.83% of females have 10 right lower labials. The C. V. is 2.05%.

The mean number of right lower labials does not differ significantly in two sexes.

5. NUMBER OF VENTRAL SHIELDS.

Males (N = 20) : The number varies from 145–154. The mean is 149.10 ± 0.65 . 25.00% of males have 150 ventral shields. The C. V. is 1.94%.

Females (N=24) : The number varies from 135–148. The mean is 142.33 ± 0.64 . 16.67 % of females have 143, while another 16.67% possess 145 ventral shields. The C. V. is 2.21%.

The value of t (7.36) for sex difference exceeds the value for $t_{0.001}$ (3.539) at 0.1 % level of probability, hence it is concluded that the mean number of ventral shields differ significantly in two sexes (Male 149.10 ± 0.65 ; Female 142.33 ± 0.64). The data for both sexes have been represented graphically in Text-fig. 4C.

6. NUMBER OF SUB-CAUDAL SHIELDS.

Males (N = 20) : The number varies from 20–29. The mean is 23.95 ± 0.57 . 25.00 % of males have 23 sub-caudal shields. The C. V. is 10.70 %.

Females (N = 24) : The number varies from 22–29. The mean is 25.42 ± 0.38 . 33.33 % of females have 25 sub-caudal shields. The C. V. is 7.23%

The value of t (2.21) for sex difference exceeds the value for $t_{0.05}$ (2.019) at the 5 % level of probability, hence it is concluded that the mean number of sub-caudal shields differ significantly in two sexes (Male 23.95 ± 0.51 ; Female 25.42 ± 0.38). The data for both sexes have been represented graphically in Text-fig. 4D.

7. NUMBER OF SCALES ROUND THE MIDDLE OF BODY.

Males (N = 20) : The number varies from 24–30. The mean is 28.00 ± 0.40 . 25.00 % of males have 29, while another 25.00 % possess 28 scales round the middle of body. The C. V. is 6.35 %.

Females (N = 24) : The number varies from 25–30.

The mean is 28.75 ± 0.23 . 62.50 % of females have 29 scales round the middle of body. The C. V. is 3.87 %.

Here the variance ratio differs significantly, hence t' was computed. Since the value of t' (1.64) for sex difference does not exceed the value of $t'_{0.05}$ (2.08), hence the difference is non-significant.

8. NUMBER OF SCALES ROUND THE ANAL REGION.

Males (N = 20) : The number varies from 16–21. The mean is 19.30 ± 0.28 . 40.00 % of males have 19 scales round the anal region. The C. V. is 6.53 %.

Females (N = 24) : The number varies from 16–22. The mean is 19.58 ± 0.25 . 50.00 % of females have 19 scales round the anal region. The C. V. is 6.19 %.

The mean number of scales round the anal region does not differ significantly in the two sexes.

9. NUMBER OF SCALES ROUND THE NECK.

Males (N = 20) : The number varies from 21–26. The mean is 24.10 ± 0.28 . 35.00 % of males have 24 scales round the neck. The C. V. is 5.19 %.

Females (N = 24) : The number varies from 21–28. The mean is 24.25 ± 0.32 . 33.33 % of females have 23 scales round the neck. The C. V. is 6.46 %.

The mean number of scales round the neck does not differ significantly in the two sexes.

ACKNOWLEDGEMENTS

I am thankful to Dr. A. P. Kapur, Director, Zoological Survey of India for providing necessary facilities in connection with this work. I am highly indebted to my Professor Dr. P. N. Mathur for his valuable and expert guidance in the finalisation of this work. I am very thankful to Shri J. S. Rao, Computer (Statistics), Central Arid Zone Research Institute, Jodhpur for going through the statistical calculations.

SUMMARY

Certain conventional characters of the following 16 species of reptiles from different Indian localities have been analysed statistically for showing the variability and difference between means in the two sexes (Tables 1–16), on the basis of tests of significance. The differences in all cases were deemed to be real where they were found to be significant at 5 per cent and lower levels of probability. The means have been expressed with its standard error.

Order Squamata (Suborder Sauria : *Hemidactylus brooki* Gray, *Hemidactylus reticulatus* Beddome, *Hemidactylus leschenaulti* Dumeril and Bibron, *Calotes rouxi* Dumeril and Bibron, *Psammophilus blanfordianus* (Stoliczka), *Mabuya macularia* (Blyth), *Mabuya carinata* (Schneider), *Riopa punctata* (Gmelin), *Cabrita leschenaulti* (Milne-Edwards), *Cabrita jerdoni* Beddome, *Ophisops jerdoni* Blyth. (Suborder Serpentes) : *Elaphe helena* (Daudin), *Ptyas mucosus* (Linnaeus), *Xenochrophis piscator* (Schneider), *Echis carinatus* (Schneider).

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NOTES ON THE REPTILIA COLLECTION FROM THE GREAT NICOBAR ISLAND DURING THE GREAT NICOBAR EXPEDITION IN 1966

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(With 3 Text-figures)

INTRODUCTION

The Reptile collection studied in this paper was collected from the Great Nicobar Island by a party from Zoological Survey of India, one of the constituent units of the Great Nicobar Expedition, 1966 and five snakes and lizards collection from Mr. Humayun Abdulali, an eminent Naturalist of Bombay Natural History Society who also participated in the Expedition.

The Great Nicobar Island is situated between 6° 45' N and 7° 36' N latitude and 93° 37' E and 93° 36' E and it is the furthest or southernmost of the Andaman and Nicobar group of islands. It is by far the largest of the eleven islands of the Nicobar group, having an area of nearly 865 sq. km. out of a total area of 1651 Sq. km. for all the islands. This island is about 55 km. long between Murry Point in the north and Pygmalion Point in the south and about 30 km. wide on the north but narrows down to only about 3 km. at the southern tip which is 144 km distant from the island of Sumatra in Indonesia. This island is very rugged consisting of numerous ridges many of which appear to radiate from a knot in the north-eastern part culminating in a peak, the Mt. Thuillier (700 m). It contains the only large perennial rivers with sweet waters and evergreen lush vegetation on both the banks which provides an ideal habitat for the reptiles.

For the convenience of faunistic survey, the island was surveyed in six parts *viz.* Campbell Bay, Bananga, Galathea Bay, Megapod Island, Casuarina Bay and Kundul Island areas and we have reptile collection from Campbell, Galathea and Casuarina areas.

Practically nothing about the reptile fauna of this island is known. The reason may be due to lack of facilities available to the earlier workers for surveying the island. But on the other hand reptiles of Andaman and

islands of Nicobars (Nancawry and Camorta) are better known as these could be surveyed making Port Blair, the administrative headquarter as a centre. So we find work of eminent herpetologists like Blyth (1846), Stoliczka (1873), Annandale (1905) and Smith (1941) on the reptile fauna of Andaman and some islands of Nicobar group excepting Great Nicobar Island.

The reptile fauna of the island will be found equally rich and varied if it is compared with (Tables. 1 & 2) Andaman or other Nicobar Islands. While narrating his experiences on Nicobar Islands Sewell (1923) commented "... but this is almost compensated for by the superabundance of reptiles. Though the actual numbers of species may be small in comparison with the continental fauna the primaeval forest is everywhere swarming with small lizards, most of them belong to the genus *Calotes*". Sewell's opinion about the abundance of reptile fauna in Nicobar Islands is also applicable in case of Great Nicobar due to the presence of nineteen species numbering five snakes, eleven lizards and three chelonians in the present collection. The number of species collected are quite large for a small party in a short period.

All the species that are enlisted in this paper are new record from the Great Nicobar. Some of the lizards *Calotes cristatellus*, *Dasia olivacea*, *Varanus salvator* and *Dibamus novae-guineae* and among snakes *Python reticulatus* and *Ahaetulla humayuni* recorded from this island also occur in other Nicobar islands and *Calotes danieli* appears to be indigenous. It seems *Crocodilus porosus* occur in the creeks of this island. One lower jaw of this species was collected during the survey.

The following are the abbreviations used in this paper : Ex : example, Exs : examples, Stn : Stations, Loc : Locality, Sl. No. : serial number, Coll. No. : collection number, Reg. No. : register number, B. N. H. S. : Bombay natural History Society.

ACKNOWLEDGEMENT

The authors are thankful to the Director Zoological Survey of India for his kind permission to work out the collection and to Mr. Humayun Abdulali for allowing us to examine his collection.

SYSTEMATIC ACCOUNT

Order TESTUDINES

Family CHELONIIDAE

1. *Eretmochelys imbricata* (Linn.)

1766. *Testudo imbricata* Linn., *Syst. Nat.* ed. 12 : 350.

Material.—1 ex. (Head only), Campbell bay, Stn. 1, 2. III. 1966.

Remarks.—This species was recorded earlier by Blyth (1846) from Nicobar Coast.

2. *Chelonia mydas* (Linn.)

1758. *Testudo mydas* Linn., *Syst. Nat.* ed. 10 : 197.

Material.—1 ex., Galathea bay area, Sl. No. 713, 22. III. 1966.

Remarks.—Commonly known as Green Turtle. Its distribution is tropical and subtropical seas. Smith (1931) found it common in the vicinity of the Andaman Islands. The present record extends its distribution further south near the coast of Great Nicobar.

Family EMYDIDAE

3. *Cuora amboinensis* (Daudin)

1802. *Testudo amboinensis* Daudin, *Hist. Nat. Rept.* II : 309

Material.—1 ex., Alexandra river, Sl. No. 18, 13. IV. 1966.

Remarks.—One young specimen was collected from the bank of the river.

White band bordering the top of head is interrupted in two or three places and 2nd and 3rd bands meeting behind the jaw separates again. Plastral spots are not confluent. Every marginal plate has black spot below. Plastral bridge is black. Margin of the shell is narrowly bordered white.

Distribution.—In the collection of Zoological Survey of India there are records of occurrence of this species from Burma, Malaysia, Assam and Great Nicobar, (Reg. No. 14719, collector *C. G. Rogers*).

Range.—It occurs in both the sub region, Indochinese (Tenasserim, Thailand, Cambodia, Indochina) and Malaysia (Malay Peninsula and Archipelago, Philippine).

Suborder SAURIA

Family GEKKONIDAE

4. *Cnemaspis kandiana* (Kelaart)

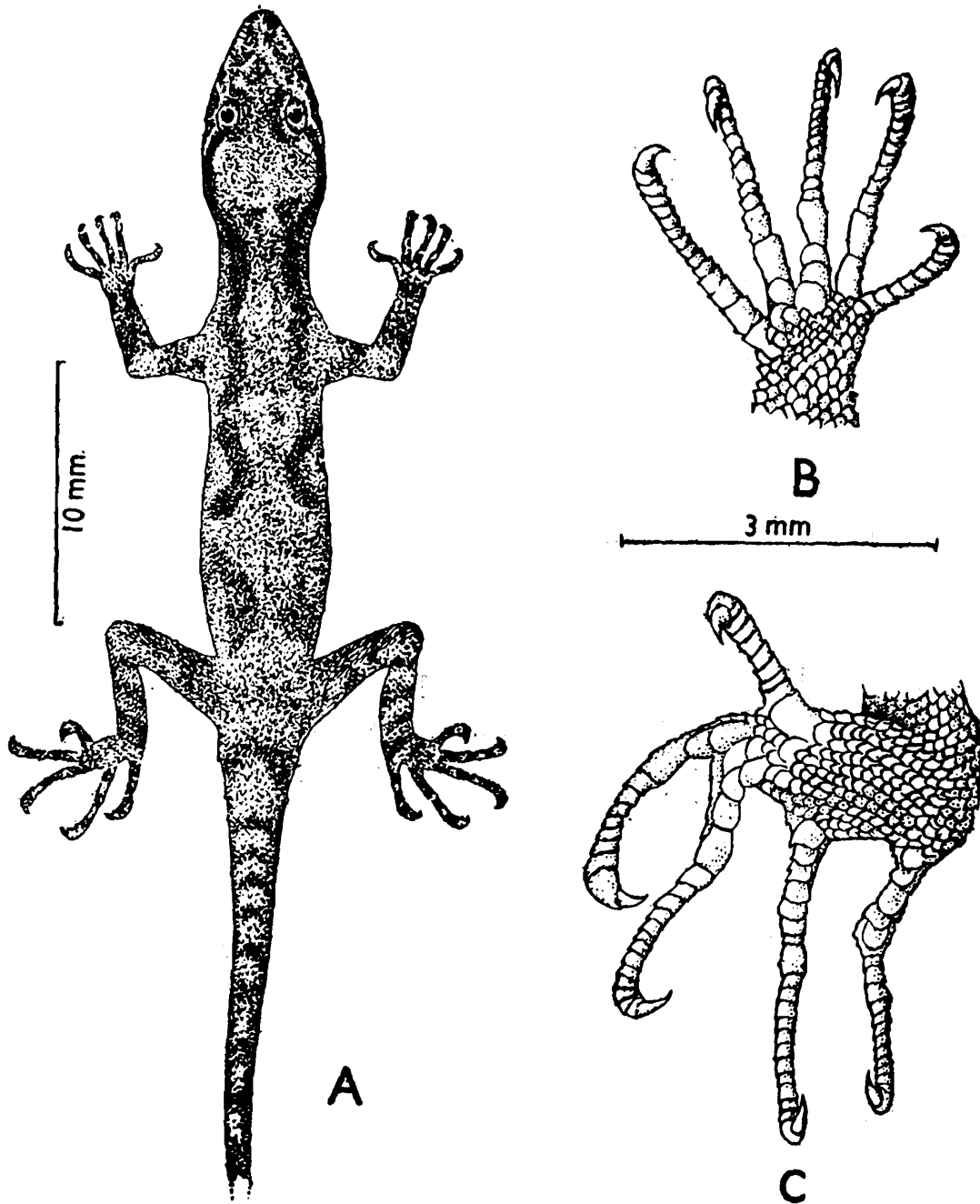
(Text fig. 1, A-C)

1852. *Gymnodactylus kandiana* Kelaart, *Prod. Fauna Zeyl.* : 186.

Material.—1 ex., Campbell bay, Stn. 1, 10. III. 1966.

Remarks.—One female specimen was collected from a tree. The general body colour is brown with 4 or 5 dark W-shaped markings on the body.

Measurement & Count.—8 upper and as many lower labials; length: Snout to vent—21 mm., tail broken.



Text-Fig. 1.— *Cnemaspis kandiana* (Kelaart). A. Dorsal view. B. under surface of hand. C. under surface of leg.

Distribution.—Regarding the distribution of this species Smith (1935) suggested that it might have been introduced in Andaman Is. and the Malay Archipelago by man's agency which is most unlikely in the present case because Great Nicobar was till now almost unconnected with civilised world.

Its range of distribution is Sri Lanka, South India as far north as lat. 12°, Andaman Islands and the Malay Archipelago.

5. *Hemiphyllodactylus typus typus* Bleeker

1860. *Hemiphyllodactylus typus* Bleeker, *Nat. Tijdschr. Ned. Ind.* 20 : 327.

Material.—1 ex., Campbell bay, Stn. No. 1, Coll. No. 2, 28, II. 1966.

Remarks.—One female specimen was collected from the camparea at night.

In the present specimen the postmentals are distinguishable being larger than the other scales. These are placed lining the infralabials. Colouration is almost the same as described in the literature excepting dorsally at the base of the tail there is a black spot posteriorly white instead of a large white spot edged with black.

Measurement Count.—10 upper and lower labials each, 4th toe with 4 lamellae. Length—snout to vent 35 mm. and tail 33 mm.

Distribution and Range.—Sri Lanka, S. Burma, S. E. Thailand, Singapore, East Indian Archipelago and islands of Oceania.

6. *Platyurus platyurus* (Schneider)

1792. *Stellio platyurus* Schneider, *Amphib. Physiol.* II : 30.

Material.—1 ex., Campbell Bay area, Stn. 1, 1. V. 1966.

Remarks.—One male specimen from the mouth of a tree snake *Dendrelaphis humayuni* Tiwari & Biswas, while it was devouring it.

The cutaneous fold is prominent only in the front and hind portion of the leg. The body colour is more or less uniformly grayish brown.

Measurement & count.—Upper labials 9, lower 8 and 9; lamellae under 1st toe 9 and 4th toes 10 & 11; femoral pores continuous, 17 on each side.

Distribution.—This is an example of a species belonging to the Indochinese subregion extending to the Malayan subregion.

Range.—Sri Lanka, N. India upto Nepal in the West, Indo-china, Hongkong, Formosa and the E. Indian Archipelago.

7. *Gekko gekko* (Linnaeus)

1900. *Lacerta gekko* Linnaeus, *Syst. Nat.* ed. 10, p. 205.

Material.—2 exs.; Campbell Bay, Great Nicobar; Coll. No. B. N. H. S. Reg. Nos. 947 and 948, Date of Coll.? Collector, H. Abdulali.

Remarks.—Two specimens, one with tail and another without tail were received from B. N. H. S. for examination and these have been

referred to the present species. The occurrence of this species in Great Nicobar further proves the wide distribution of it in the Indochinese Subregion.

Measurement and count.—Length from snout to vent 123 mm., Tail 110 mm., 124 mm. tail missing.

Range.—North-eastern India (Bihar, Bengal, Tripura, Andaman island): Indochina, Southern China, Malay Peninsula, Burma and East Indian Archipelago.

Family AGAMIDAE

8. *Calotes cristatellus* (Kuhl)

1820. *Agama cristatella* Kuhl, *Beitr. Zool. Vergl. Anat.* 1, : 108.

Material.—1 ex., Campbell Bay, Stn. 1, Coll. No. 413, 14. III. 1966; 1 ex., Campbell Bay, Stn. 5, Coll. No. 355, 11. III. 1966; 1 ex., NW of Campbell Bay, Stn. 1, 5. III. 1966.

Remarks.—Two adults and one young specimens are in the collection. These specimens were collected from trees. The body colouration of larger specimen is mainly green with bluish tinge and scattered yellow spots are on the posterior part of the body and on the anterior part of the tail. Another specimen is bluish with chocolate colour on the head and patches on the body. The young specimen is grayish or blackish with white specks on the hind part of the dorsum which continue as bands on the tail.

Measurement & Count.—Specimen coll. No. 413—length: from snout to vent 75 mm., tail 225 mm.; scales round the body 63. Specimen coll. no. 355.—length: snout to vent 80 mm., tail 257 mm.; scales round the body 58. Young specimen—scales round the body, 63. length: body and tail 37 mm. and 107 mm. respectively.

Distribution.—This is an example of Malayan species extending its range in the Indo-Chinese Subregion. There is a record of this species from Nicobar Island (Steindachner, 1867).

Range.—Tenasserim; S. W. and Peninsular Siam; the Nicobar Is.; Malay Peninsula and the East Indian Archipelago except New Guinea.

9. *Calotes danieli* Tiwari & Biswas

1973. *Calotes danieli* Tiwari and Biswas, *J. zool. Soc. India*, Calcutta, 25 (1 & 2): pp. 57--63.

Material.—1 ex., Holotype Reg. No. 22455, Campbell Bay, Stn. 1, 2. III. 1966.

Remarks.—This species belongs to the *Calotes cristatellus* (Kuhl) group of species having long head, slender limbs, long tail and sides

of the body scales being pointed backward and downwards but differs from them in the length of the hind limbs, in the proportions of the fingers to toes and in colouration.

A species of slender and strongly compressed body, ventral scales more than 5 times larger than dorsal and strongly keeled, 71 scales round middle of body; nuchal crest composed of 12 compressed and erect scales, dorsal crest prominent reaches beyond base of tail. Limbs long and slender. In preserved specimen hind portion of body reddish chocolate and front portion including head blackish chocolate; a black patch surrounding eye and tympanum and one vertical white patch between eye and tympanum, another white spot behind eye.

Measurement and Count.—(in mm.) Head length 25, head breadth 12, diameter of orbit 6, orbit to end of snout 9, diameter of tympanum 3, length of hind limb 71, length of body (snout to vent) 79, tail 271, snout to axilla 34, axilla to groin 43, scale count in the middle of the body not 48 as mentioned in the type description but the count is 71.

Family SCINCIDAE

10. *Mabuya multifasciata multifasciata* (Kuhl)

1820. *Scincus multifasciata* Kuhl, *Beitr. Zool. Vergl. Anat.* 126.

Material.—1 ex., Nepa Point, Stn. 8, Coll. No. 582, 24. III. 1966; 1 ex., Casuarina Bay, Stn. 10, Coll. No. 833, 3. IV. 1966; 1 ex., on the way to Pulokunyi Vill., 18. IV. 1966; 2 exs., 5 km. E. of Casuarina Bay, Stn. 1, Sl. No. 239, 6. III. 1966; 1 ex., 5 km. E of Campbell Bay, Stn. 1, Sl. No. 239, 6. III. 1966; 1 ex., Mangrove area Creek, Stn. 4, Coll. No. 332, 10. III. 1966.

Remarks.—7 specimens in total were collected from this island. These are one of the common lizard of this place. Most of the specimens are uniformly coloured brown above and whitish below excepting in the larger specimens where a faint lateral line is visible.

In larger specimens carina on the scale are very strong. Usually scales round the body of specimens from the mainland are between 30 to 34 but it is 30 to 37 in the present collection and the count of the lamellae of the 4th toe is 19 to 20 instead of 17 to 23.

Measurement and Count.—Scales round the body 30 to 37, number of keels on the scales—3 to 5, number of lamellae under the 1st toe 8 to 9 and under 4th toe 19 to 20, length—snout to vent 85 to 130 mm. and tail 105 to 210 mm.

Distribution.—This is an example of Indo-Chinese species extending its distribution in the Malaysia subregion.

Range.—N. W. Assam, Yunnan, Indo-China, Malay Peninsula, E. Indies, New Guinea and Nicobar island.

11. *Dasia olivacea* Gray

1838. *Dasia olivacea* Gray, *Ann. Mag. nat. Hist.* III : 331.

Material.—1 ex., Casuarina Bay, Stn. 10, 12.IV.1966.

Remarks.—Only one specimen was collected from the ground near the camp area. The specimen corresponds to the colour description of young as given in the literature.

Measurement and Count.—Scales round the body 30, number of keels on the scale 3, upper labials 7, lower labials 6, lamellae under 4th toe 17, Length—Snout to vent 40 mm., tail 45 mm.

Distribution Range.—Tenasserim, Southern Thailand and Indochina, Malay Peninsula, Indoneisa; the Andamans and Nicobar Islands.

12. *Lygosoma quadrivittatum* Peters

1867. *Lygosoma quadrivittatum* Peters, *Mon. Berl. Ac.* : 19.

Material.—1 ex., Campbell Bay, 10.III. 1966.

Remarks.—One young specimen is in the collection which was collected from the ground. The specimen agrees mostly with description of the species excepting some of the characters mentioned below.

17 lamellae under the 4th toe instead of 15 or 16, plam and sole with black tubercles, preanals large with irregular carinae on them, posterior abdominal scale also carry some kind of carinae, a part of the covering scale of the tympanum transparent, lateral band starts from the nostril instead of from the eye, scales round the body 23.

Some of the differences mentioned above are prominent enough to suggest it to be a new species but these characters should be verified from some more specimens.

Distribution—Range: Borneo, Philippines, Calesbes, Malay Peninsula and Sumatra (Bukit Besar, Patani States).

Family DIBAMIDAE

13. *Dibamus novae-guineae* Dum. & Bibr.

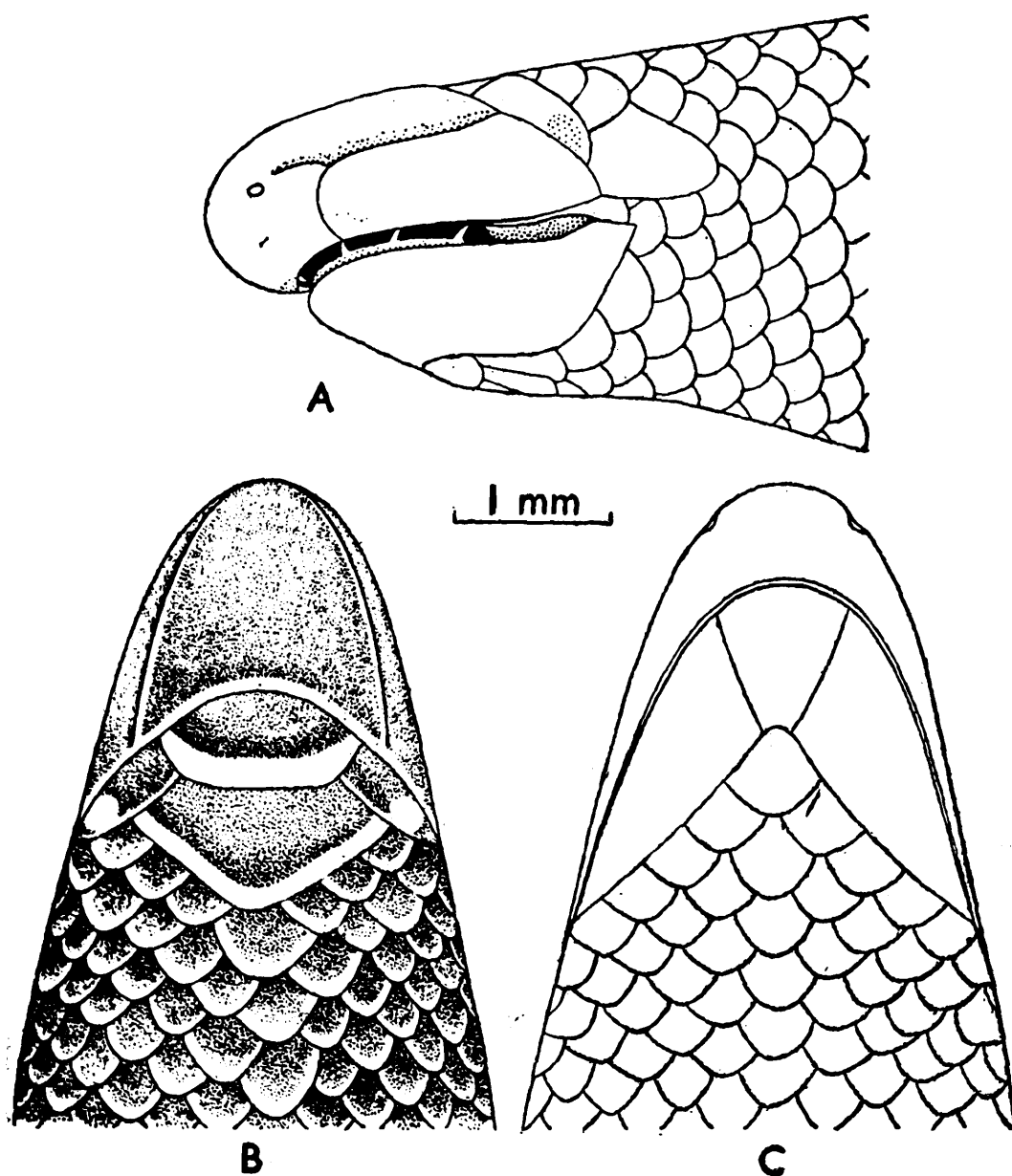
(Text-figs. 2 and 3)

1839. *Dibamus novae-guineae* Dum. and Bibr., *Erp. Gen.* 5 : 834.

1867. *Rhinophidion nicobaricum* Steindachner, *Reise Novara, Rept.* : 53.

Materials.—1 ex., Campbell Bay area, Stn. 1. Coll. No. 124, 3. III. 1966; 1 ex., N. W. of Campbell Bay, Stn. 1, 5.IV. 1966; 1 ex., Casuarina Bay, Stn. 10, Coll. No. 912, 5. IV. 1966.

Remarks.—The material consists of specimens, one male and two females which superficially appears like Typhlops. These burrowing blind lizards were collected from the ground under the debris of the jungle.



Text-Fig. 2.— *Dibamus novae-guineae* Dum & Bibr. A. Lateral view of head region. B. Dorsal view of same. C. ventral view of same.

Body smooth, slender, wormlike, and equal in diameter throughout; colour in spirit uniform brown or chocolate; scale smooth, equal in size, magnified scales and head shields bordered white, 25 round the body; ventrals 206 to 220; subcaudals 35 to 38.

Measurements (in mm.) and scale count:

	♂	♀	♀
Snout to vent	97	113	112
Vent to tip of tail	10	12	12
Breadth of head (from junction of jaw)	2'6	2'3	2'9

Breadth of the body	3'5	3'3	3'0
Number of the ventrals	206	220	217
Number of subcaudals	36	38	35
Scales round the body	25	25	25

Distribution.—*Range:* Nicobars, New Guinea and Patani, Malay Peninsula.

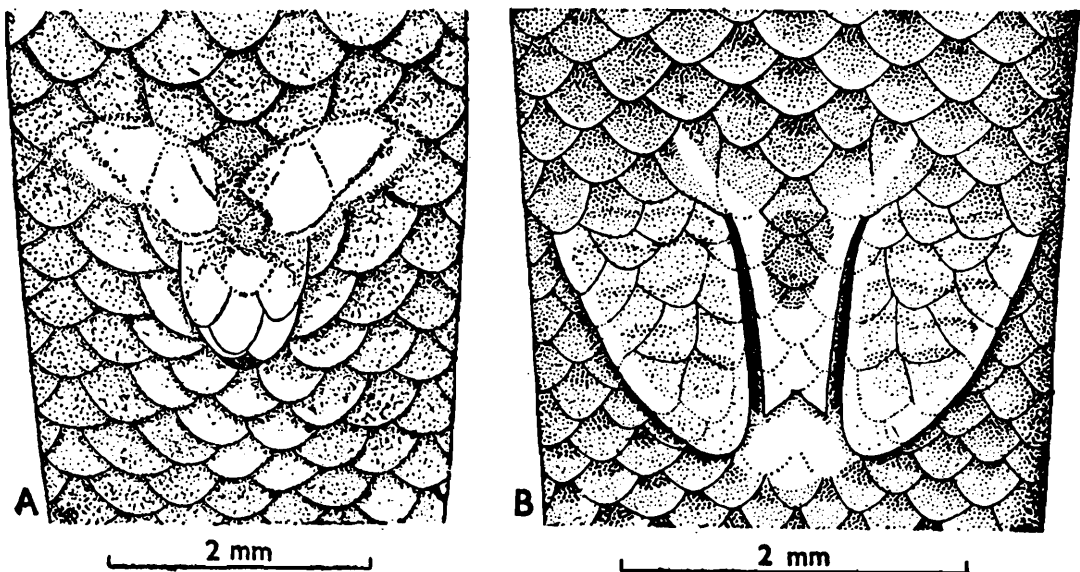
Faimly VARANIDAE

14. *Varanus salvator* (Laurenti)

1768. *Stellio salvator* Laurenti, *Syn. Rept.* (based on Seba's *Illustr.* II, pl. 88, fig. 2).

Materials.—1 ex., entrance of Galathea river, 10 kms up the river, Stn. 8, Sl. No. 709, 27. III. 1966; 1 ex., Stn. 8., Coll. No. 538, 24. III. 1966.

Remarks.—One specimen from the river bank at the entrance of Galathea river and another juvenile specimen by opening a fully developed egg collected from the Megapod mound are in the collection. The body colour of the adult specimen is blackish above with scattered small yellow spots and concentration of smaller spots in group of 4 to 6 arranged in seven transverse series. Ventral surface of the body is yellow. Though black lines come between two rows of ventral scales from the sides of the belly, it is not v-shaped. The body of the juvenile specimen is grayish with some white spots on the head and on the dorsal side of the body and these are 6 to 7 rings of white spots; the central ones are larger and laterals are gradually smaller. There are alternating white and gray bars on the tail. The gray bars are more than twice the white.



Text-Fig. 3.— *Dibamus novae-guineae* Dum & Bibr. A. Anal region of female
B. Anal region of male.

Deraniyagala (1944) described 4 subspecies within this species relying on the colour variations. The pattern of the two specimens described above comes near either *Varanus salvator philippinensis* or *v. s. andamanensis* in the absence of ocelli. The colour variation within this species may be due to long isolation.

Measurement and Count.—Length of the adult specimen—snout to vent 360 mm., tail, 600 mm.; length of the juvenile specimen snout to vent 85 mm., tail 120 mm.

Distribution.—This species is mainly distributed in the Indochinese sub regions though it is also available in N. Australia, E. Indian Archipelago and Sri Lanka.

Suborder *SERPENTES*

Family *BOIDAE*

15. *Python reticulatus* (Schneider)

1801. *Boa reticulata* Schneider, *Hist. Amph.* II : 264.

Material.—1 ex., 15 km. S. E. of Campbell Bay towards Galathea Bay, Stn. 2, Sl. No. 287, 8. III. 1966.

Remarks.—The specimen was collected from the ground in the jungle. The black line in middle of head starts from middle of the temporal region instead of from the end of the snout in the other Malayan specimens. Two zigzag black lines start from behind temporal region and continue dorsolaterally, these unite dorsally in the front part of the body to form rhombus but remain free in the hinder part of the body and again join dorsally in the posterior region of the tail.

Variation in the dorsal and ventral scale count and colour pattern of the specimen from the description of the species points out the necessity of investigating further on some more specimens collected from this island.

Measurement and Count.—Upper labials 12/13, anterior 4 deeply pitted, one side 6th and another side 7th touching eye; lower labials 20, 2 anterior and 6 posterior pitted; preoculars 2, postoculars 3; dorsal scale in 66 rows, ventral 290; tail ends bluntly indicating it was mutilated.

Distribution.—Present record of the species fill up a gap in the range—Indo--China as far north as Tong-King, Burma and Siam as far north as lat. 18°, Malay Peninsula and Archipelago and the Nicobar Islands.

Family *COLUBRIDAE*

Subfamily *COLUBRINAE*

16. *Dendrelaphis humayuni* Tiwari & Biswas

1973. *Dendrelaphis humayuni*, *J. zool. Soc. India*, Calcutta 25 (1 & 2) : 57-63.

Material.—Holotype: 1 ex., Campbell Bay, Great Nicobar Island, 1. V 1966; Paratypes: 1 ex., Galathea Bay area, 28.III. 1966; 1 ex., Campbell Bay area, 1. V 1966; 2 exs., Great Nicobar, B. N. H. S. Reg. No. 2339 & 2340, Humayun Abdulali.

Remarks.—There are three specimens in this collection. One was collected from a tree and the other two from the ground below trees. Colouration of the Holotype and one Paratype specimen is similar but it is different in the Paratype no. 22388. In the former the body colour is uniformly deep bluish or blackish and the ventral part is white with bluish tinge and in the latter specimen and 5 other Paratype specimens collected from other Nicobar Islands it is bronze with alternately arranged yellowish white short bars on the anterolateral part of the body. The apparent colour variation is due to the temporal stripe being scarcely distinguishable from the general body colouration in the above mentioned Holotype and Paratype specimens.

Over and above these three specimens from the Great Nicobar island there are 5 more specimens from the Nicobar islands in the Z.S.I. collection by the earlier collectors (Reg. No. 13516-17, W. Theohald; 7711 & 8886, F.A. de Roepstaff and 17568, F. Wall) which were identified by Wall (1921) as *Dendrelaphis cyanochloris* (Wall). These five specimens have been also placed under the present species. The measurements, scale count etc. of these specimens have been mentioned in detail in the literature cited above. Colour scheme of these specimens agrees with that of Paratype No. 22388. Therefore the difference of colour pattern found in case of the Holotype and other Paratype may be due to the preservative used in case of these two specimens.

In the ventral count (171 & 177) and the head shield characters the two snakes received from the Bombay Natural History Society come near this species and so have been placed under the present species but unfortunately end portions of the tails of these two specimens are missing. The colour pattern conforms to the Holotype where body colour is deep bluish. In one specimen breaking up of parital stripe into spots at the side of body is faintly visible.

The genus name *Ahae tulla* link has been replaced by *Dendrelaphis* Boulenger in view of the opinion No. 524, Opin. int. Comm. zool. Nom. 19(12): 277-276, 1958.

Distribution.—The range of distribution of this species is now Nicobar group of islands and Great Nicobar. Two specimens from Sumatra (Bangnar) and Benang Star in Palani placed by Smith (1930) in *D. formosa* (Boie) and later transferred by him (1943) to *D. cyanochloris* (Wall) may perhaps have also to be included in this species. Two speci-

mens in the British Museum from Penag and Malaceca are to be also included in this species.

17. *Dendrelaphis ahaetulla andamanensis* (Anderson)

1871. *Dendrophis picta* var *andamanensis* Anderson, *Proc. zool. Soc.*, London : 184.

Materials.—3 exs., Great Nicobar; B.N.H.S. Reg. Nos. S. 1009, 1010 and 1012, Coll. Humayun Abdulali.

Remarks.—Three snakes out of the collection received from the Bombay Natural History Society have been assigned to the present subspecies due to the colour pattern which is markedly different from that of the typical subspecies. In other characters these specimens agree well with the characters of the species.

The sub-species *andamanensis* differs markedly from *Dendrelaphis ahaetulla striata* (Cohn) which occurs in Sumatra and Nias in having more ventrals and the colour pattern though it appears to some extent from the sides like dark oblique bars from the back, but all the dorsals and the outer margins of the ventrals are heavily edged with black.

Often the mainland species *D. tristis* (Daudin) may likely be confused with *D. ahaetulla*, and its subspecies due to their similarity in the scale count, head shield character, and apparent colour approximation but the *tristis* group of species are separated from the *ahaetulla* group by its shorter posterior maxillary teeth than the other.

Measurement and Count.—

Reg. No.	1010	1009	1012
Ventrals	188	191	186
Subcaudals	133	122	112
Up. labials/touching eye	9/5th & 6th	9/5th & 6th	9/5th & 6th
Length: Snout to Vent in mm.	695	740	795
Length: Tail in mm.	327	345	350

Distribution.—This sub-species was so far known from Andamans only but the present record extends its distribution further south in the Great Nicobar Island.

18. *Boiga dendrophilus* (Boie)

1827. *Dipsas dendrophilus* Boie, *Isis* : 549.

Material.— 1 ex., Campbell Bay area, Stn. 5; Coll. No. 354, 11. III. 1966; 1 ex., Campbell Bay, near the camp, Stn. 1, Coll. No. 1260, 25. IV. 1966; 1 ex., Campbell Bay area, stn. 1, Coll. No. 1., 28.ii.1966.

Remarks.—Three specimens have been collected from the ground at night. The usual yellow cross bars present on the body of specimens from the mainland are wanting in these specimens. The normal colour of the species is black with white or yellow cross bars but in the present specimens the body is more or less uniformly brown with scattered patches of black marks on the tail. The body scales are edged blackish.

Measurement and Count.—Temporal 2+2, upper labials 8, lower labials 11, ventrals 232 and 235, Subcaudal 104 and 106, snout to vent 1175 and 855 mm. and tail 330 and 240 mm.

Distribution.—Thailand, Malay Peninsula and Archipelago.

19. *Natrix trianguligera* (Boie)

1827. *Tropidonotus trianguligerus* Bois, *Isis* : 535.

Material.—1 ex., near Galathea river, Stn. 8, Coll. No. 537, 23. III. 1966.

Remarks.—The place of collection is the jungle near the river. The body is uniformly coloured dark or blackish excepting upper and lower labials which are yellowish with black edges. Ventral side of the specimen is yellowish white and the edges of the ventrals are powdered gray. Excepting the lower labial colouration, the typical colour pattern of the body is absent in this specimen. The reason of this variation may be due to gradual disappearance of colour pattern with the age. The ventral scale count of the specimen agrees with the range (134 to 150) mentioned by Boulenger (1912) but not of Smith's (1943), (134 to 145).

Measurement and Count.—One preocular, 3 postocular, ventrals 149, subcaudals 90; snout to vent 690 mm. and tail 303 mm.

Distribution.—Southern Burma upto Mergui, Malay Peninsula and Archipelago.

NOTES ON ZOOGEOGRAPHY.

After studying the distribution of reptiles in the southern part of the Indo-Malayan subregion it can be presumed that *Hemidactylus frenatus* Schlegel and *Gehyra mutilata* (Weigmann) may also occur in this island as they also occur in the East Indian Archipelago but in case of *Mabuya rugifera* (Stoliczka) the chance is more because its distribution is not only Malaysia but also in other Nicobar islands. In the same way we can expect some species of poisonous snakes in this island but total absence of Elapidae and Viperidae particularly *Trimeresurus* in the present collection is much interesting when on the one hand six species of *Trimeresurus* occur in Malaysia and four species in the Nicobar islands.

Smith's (1931) opinion "The Andaman contain an impoverished Burmese fauna; that of the Nicobar Island approximate to the Sumatran

type" will be further proved if we study the list of reptile species so far recorded in Andaman and Nicobar islands, (for snake Smith, 1943 and for lizard Table No. 1) and compare with the present record from the Great Nicobar Island (Table No. 2). The reptile fauna of the island clearly shows the affinity with the Malayan fauna as it is in case of Sumatra and that of Andaman with the Burmese which belongs to the Indochinese Subregion. Gradual mixing of Malaysian influence took place in the other Nicobar island through the Great Nicobar. The Andaman and Nicobar Islands are projection above sea level of long and narrow submarine ranges continuous with Arakan Yomas in the north and island festoon of the south-west Sumatra. In the geologically past this part was connected with the mainland by land but due to the land movement submergence of all except the highest peaks took place and the continent of Asia was separated from the East Indian Archipelago. Therefore in the present collection in some examples of species some variations of characters and colouration noticed might have been produced by long isolation.

TABLE 1. List of Lizards species from Andaman and Nicobar Islands.

No.	Species	Andaman Is.	Nicobar Is.	Indigenous	Distribution outside Andaman Nicobar Is.
1.	<i>Gymnodactylus rubidus</i> (Blyth)	+	—	Yes	—
2.	<i>Cnemaspis kandiana</i> (Kelaart)	+	+	No	Sri Lanka, S. India, W. Sumatra
3.	<i>Gekko gecko</i> (Linnaeus)	+	—	No	Indochina, extending to Malaysia
4.	<i>Gekko smithi</i> Gray	+	—	No	Malaysia
5.	<i>Lepidodactylus lugubris</i> (Dum. & Bibr.)	+(?)	+(?)	No	Sri Lanka, S.W. Pacific Island, rarer in Malaysia
6.	<i>Ptychozoon kuhli</i> Stejneger	—	+	No	Malaysia
7.	<i>Phelsuma andamanense</i> Blyth	+	+	Yes	—
8.	<i>Goniocephalus subcristatus</i> (Blyth)	+	+	Yes	—
9.	<i>Calotes versicolor</i> (Daudin)	+	—	No	Indochina, Sri Lanka, Afghanistan, part of Malaysia
10.	<i>C. calotes</i> (Linnaeus)	—	+	No	Sri Lanka, S. India
11.	<i>C. mystaceus</i> (Dum. & Bibr.)	+	+	No	Indochina

12.	<i>C. Jubatus</i> (Dum. & Bibr.)	—	+	No	Java
13.	<i>C. Cristatellus</i> (Kuhl)	—	+	No	Malaysia, extending Indochina
14.	<i>C. andamanensis</i> Boulenger	+	—	Yes	—
15.	<i>Mabuya andamanensis</i> Smith	+	+	Yes	—
16.	<i>M. Tyleri</i> (Theobald)	+	—	Yes	—
17.	<i>M. rugifera</i> (Stoliczka)	—	+	No	Malaysia
18.	<i>M. multifasciata multifasciata</i> (Kuhl)	—	+	No	Indochina, Malaysia
19.	<i>Lygosoma maculatum</i> (Blyth)	+	+	No	Indochina
20.	<i>Leiopisma macrotympalum</i> (Stoliczka)	+	—	Yes	—
21.	<i>Riopa bowringi</i> (Günther)	+	—	No	Indochina
22.	<i>Dibamus novae-guineae</i> Dum. & Bibr.	—	+	No	Malaysia, New Guinea
23.	<i>Varanus salvator</i> (Laurenti)	+	+	No	Indochina, Sri Lanka, India, E.Ind. Archi., N. Australia

TABLE 2. List of species recorded from the Great Nicobar and their distribution.

No.	Species	Andaman Is.	Nicobar Is.	Sumatra and Adj. Is.	Indogenous	Distribution outside Andaman and Nicobar and G. Nicobar
Order-Testudines						
Suborder-Thecophora						
Family-Cheloniidae						
1.	<i>Eretmocleys imbricata</i> (Linn.)					Marine
2.	<i>Chelonia mydas</i> (Linn.) Fam. Emydidae					Marine
3.	<i>Cuora amboinensis</i> (Daudin) Sub-order—Sauria Fam.-Gekkonidae	—	—	+	No	Indochina and Malaysia
4.	<i>Cnemaspis kandiana</i> (Kelaart)	+	—	+	No	Sri Lanka, S. Ind., W. Sumatra
5.	<i>Hemiphyllodactylus typus typus</i> Bleeker	—	—	+	No	Sri Lanka, S. Burma, Malaysia

6. <i>Platyurus platyurus</i> (Schneider)	—	—	— +	No	N. India, Indochina, E. Ind., Archi.
7. <i>Gekko gekko</i> (Linnaeus)	+	+	No	No	Widely in Indo-Chinese sub-region.
Fam.-Agamidae					
8. <i>Calotes cristatellus</i> (Kuhl)	—	+	+	No	Malaysia, extending in Indo-China
9. <i>Calotes danieli</i> Tiwari & Biswas	—	—	—	Yes	
Fam.-Scincidae					
10. <i>Mabuya multifasciata</i> <i>multifasciata</i> (Kuhl)	—	+	+	No	Indo-china, extending into Malaysia
11. <i>Dasia olivacea</i> Gray	+	+	+	No	Malaysia, extending into Indo-china
12. <i>Lygosoma quadrivittatum</i> Peters				+	
Fam.—Varanidae					
13. <i>Dibamus novae-guineae</i> Dum & Bibr.	—	+	+	No	Malaysia, New-Ginea.
14. <i>Varanus salvator</i> (Laurenti)	+	+	+	No	Ceylon, India, Indo- China, & E. Ind., Archi., N. Australia.
Fam.—Dibamidae					
Sub-order-Serpentes					
Fam. -Boidae					
15. <i>Python reticulatus</i> (Schneider)	—	+	+	No	Malaysia, extending to Indo-China.
16. <i>Ahaetulla andamanensis</i> (Anderson)	+	+	—	Yes	
Fam.—Colubridae					
17. <i>Dendrelaphis humayuni</i> Tiwari & Biswas	—	+	+	No	Probably Malaysia
18. <i>Boiga dendrophilus</i> (Boie)	—	—	+	No	Malaysia
19. <i>Natrix trianguligera</i> (Boie)	—	—	+	No	Malaysia, extending into Indo-china.

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NEMATODES FROM TEA PLANTATIONS OF DEHRA DUN, INDIA

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(With 1 Table and 8 Text-figures)

Nematodes cause damage to the tea plantations particularly to plants at the nursery stage. The information available on nematode parasites of tea is not extensive and is naturally restricted to the countries where tea is being grown. Sivapalan (1972) has given an excellent review of the nematode pests of tea.

While working on the nematodes of plantations one of us (S.K.) went around the different tea estates of Dist. Dehra Dun (U.P.) to collect soil samples and study the nematodes, both parasitic and free living, found in the rhizosphere of tea plants. It may be mentioned here that the tea plantations of Dehra Dun are gradually disappearing; in fact some are lying neglected and a few others have been cleared in favour of other crops.

We thank the staff of the Northern Regional Station, Zoological Survey of India, Dehra Dun for assistance in the collection of soil samples.

SYSTEMATIC ACCOUNT

Order TYLENCHIDA

Family TYLENCHIDAE

1. *Tylenchus* (*Filenchus*) *filiformis* Bütschli,

Tylenchus filiformis Bütschli, 1873, *Nova Acta Acad. Caesor. Leop. Carol.* 36(5): 37; Thorne, 1961, *Principles of Nematology*: 97.

Material.—1 ♀, 2 ♂♂; Indian Institute of Petroleum and Mohkampur; 28. vi. 1972 and 26. i. 1973.

Measurements.—1 ♀ : Length=0.45 mm, a=26, b=5.5, c=3.2, V=58; stylet = 11 µm.

2 ♂♂ : Length=0.57 mm, a=37-41, b=5.7-6.3, c=3.0-3.2, stylet=11-13 µm. spicula=14-15 µm, gubernaculum=6-7 µm.

Remarks.—Although the males are rare (Thorne, 1961, states that males are unknown), Das (1960) has described a male from the roots of *Sorghum vulgare* and recently Khera and Chaturvedi (1975) have recorded males.

The species has been found associated with tea for the first time. Another species, *Tylenchus agricola* de Man has been recorded from tea gardens in India whereas *Tylenchus* sp. has been associated with tea in E. Africa.

Family HOPLOLAIMIDAE

2. *Helicotylenchus digonicus* Perry

Helicotylenchus digonicus Perry, 1959, *Bull. Wis. agric. Exp. Stn.* 207: 8; Sher, 1966, *Nematologica* 12: 15.

Helicotylenchus broadbalkiensis Yuen, 1964, *Nematologica*, 10: 374.

Material.—48 ♀♀; Indian Institute of Petroleum, Vikasnagar, Mohkampur, Herbertpur, East Hope Town and Harbanswala; 28. vi. 1972 and 26. i. 1973.

Measurements.—7 ♀♀; Length=0.51-0.63 mm, a=20-24, b=4.6-5.9, b'=3.6-4.4, c=40-52, c'=0.8-0.9, V=66-68, stylet=25-28 µm, O=27. Phasmids 21-25 µm from tail tip, 7-8 annules anterior to anus.

Remarks.—Our specimens differ from the earlier descriptions of the species in the forward position of the phasmids and the position of vulva. Sher (1966) described phasmids at anus level or 1-5 annules anterior to anus and vulva at 58-65. The species is being recorded for the first time from India.

H. digonicus had not so far been associated with tea although *H. dihystra* (Cobb) had been recorded from tea in Sri Lanka and Japan, *H. erythrinae* (Zimmermann) from Japan and Taiwan and *Helicotylenchus* sp. from southern India, Bangladesh, Sri Lanka and E. Africa.

3. *Pratylenchus penetrans* (Cobb)

Tylenchus penetrans; Cobb, 1917, *J. agric. Res.* 11: 32.

Tylenchus pratensis; Steiner, 1927, *J. agric. Res.* 35: 961.

Tylenchus (Chitinotylenchus) penetrans; Rahm, 1928, *Brasil. Arch. Inst. Biol. S. Paulo* 1: 239-251.

Pratylenchus penetrans; Chitwood and Oteifa, 1952, *A. Rev. Microbiol.* 6: 151-184.

Material.—21 ♀♀, 4 ♂♂; East Hope Town, Arcadia, Mohkampur; 26. i. 1973.

Measurements.—5 ♀♀: Length=0.53-0.59 mm, a=29.0-32.8, b=4.6-7.3, c=18-19, V=80-82, stylet=13-18 µm.

3 ♂♂: Length=0.41-0.42 mm, a=32-33, b=3.2-3.8, c=18-19, stylet=13-14 µm, spicula = 13-14 µm, gubernaculum = 4-6 µm.

Remarks.—*P. brachyurus* (Godfrey) has been recorded from tea in north-eastern India, *P. loosi* Loof from Sri Lanka and Japan and *Pratylenchus* sp. from both north-eastern and southern India, Indonesia and Taiwan. *P. penetrans* has been found associated with tea for the first time.

After going through the literature we feel that *P. indicus* Das may be a synonym of *P. pratensis* (de Man). It would be worthwhile examining the type material of *P. indicus*.

Family CRICONEMATIDAE

4. *Hemicriconemoides mangiferae* Siddiqi

Hemicriconemoides mangiferae Siddiqi, 1961, *Proc. helminth. Soc. Wash.* 28: 28; Das Gupta, Raski & Van Gundy, 1969, *J. Nematol.* 1: 134.

Hemicriconemoides birchfieldi Edward, Misra & Singh, 1965, *Nematologica* 11: 161.

Material.—8 ♀♀; East Hope Town and Mohkampur; 26.i.1973.

Measurements.—5 ♀♀: Length=0.47-0.56 mm, a=18-28, b=3.7-5.0, c=14-21, V=91-93, stylet=70-80 μ m, VL/Vb=1.2-1.6, R=132-142, RV=12-13, R an=9-12.

Remarks.—The value of 'a' in the de Manian formula in our specimens is higher; so far it was recorded up to 24 by Dasgupta *et al.* (1969).

The species is recorded from the rhizosphere of tea plant for the first time. So far *H. kanayensis* Nakasono and Ichinohe has been found associated with tea and that, too, from Japan and Taiwan. The genus *Hemicriconemoides* Chitwood & Birchfield is being recorded from tea for the first time from India.

5. *Paratylenchus tenuicaudatus* Wu

Paratylenchus tenuicaudatus Wu, 1961, *Can. J. Zool.* 39: 163; Geraert, 1965, *Nematologica* 11: 312.

Material.—2 ♀♀; Mohkampur; 26.i.1973.

Measurements.—2 ♀♀: Length=0.34-0.39 mm, a=21-24, b=4.2, c=13.6-14.0, V=80-82, stylet=25-31 μ m.

Remarks.—Considering the stylet length and the value of 'V', Geraert (1965) divided the species of *Paratylenchus* Micoletzky into ten groups. Our specimens fall within Group 2 and tally with the description of *P. tenuicaudatus* Wu.

The species is being recorded for the first time from India as well as from the rhizosphere of tea. So far *P. curvittatus* v. d. Linde has been associated with tea in north-eastern India, Sri Lanka and Japan and *Paratylenchus* sp. in southern India and E. Africa.

Family NEOTYLENCHIDAE

6. *Neotylenchus latus* Thorne

Neotylenchus latus Thorne, 1935, *J. Agric. Res. U.S. Dept. Agric.* 51 (6): 513.

Material.—1 ♂; Herbertpur; 26.i.1973.

Measurements.—1 ♂: Length=0.59 mm, a=30, b=4.4, c=21, stylet=13 μm , spicula=21 μm , gubernaculum=7 μm .

Remarks.—The genus *Neotylenchus* Steiner has been found in association with tea plant for the first time. The species is being recorded for the first time from India.

7. *Boleodorus longistylus* sp. n.

(Text-fig. 1)

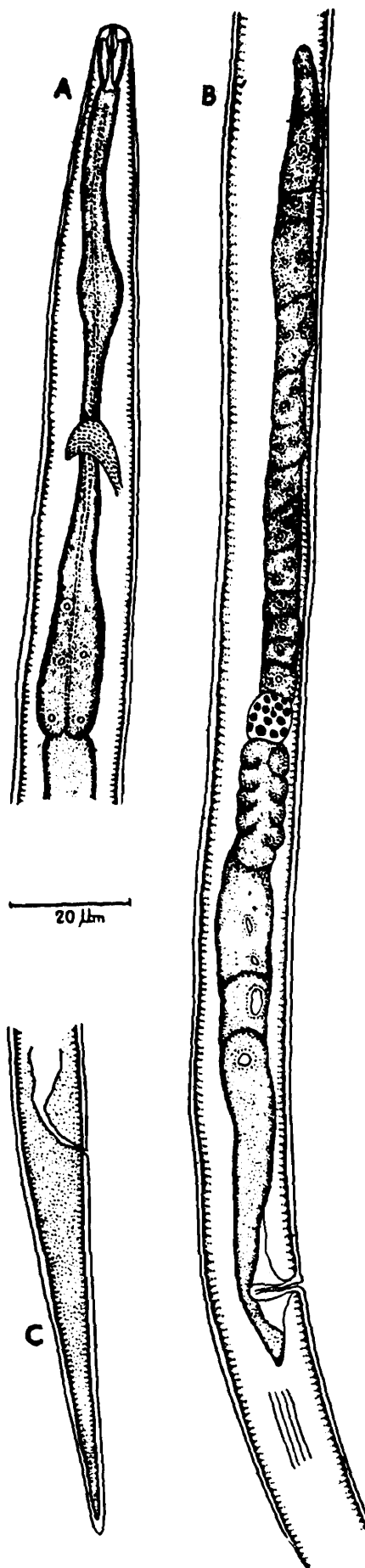
Material.—2 ♀♀; Indian Institute of Petroleum and Mohkampur; 28. vi. 1972 and 26.i.1973.

Measurements.—Holotype: ♀: Length=0.65 mm, a=36, b=5.3, c=8.5, V=73, stylet=11 μm .

Paratype: 1 ♀: Length=0.54 mm, a=35, b=5.3, c=8.7, V=71, stylet=13 μm .

Description.—Body slender and straight with posterior end curved ventrally. Tail 62–76 μm long, conical, elongate with blunt (round) terminus, curved ventrally. Cuticle thin with fine transverse striae. Lateral field occupying $\frac{1}{4}$ the body diameter; with four incisures, inner incisures being feeble. Head not offset, narrower than body, low and flattened anteriorly without median involution. Amphids not observed. Lips amalgamated, lip region without striae. Labial framework with very poor sclerotization which could have been easily overlooked. Style slender, provided with basal flanges, anterior conical part about half of total length. Oesophagus 101–109 μm long with a corpus 39 μm long having a small fusiform valveless bulb 8–10 μm in diameter, total length of posterior oesophagus 62–70 μm comprising a long slender isthmus 31–35 μm long and a terminal bulb 31–35 μm long. The latter does not overlap the intestine. There appears to be a very small valve but it is not very distinct. Orifice of dorsal oesophageal gland lies 1.5 μm from stylet base. Intestine narrow and thin walled. Rectum about as long as the anal body width. Nerve ring surrounds isthmus at 71–72 μm and excretory pore at 77–78 μm from anterior end. Phasmids, deirids and hemizonids not observed.

Ovary anterior outstretched; oöcytes in single row towards proximal end, in two rows in the middle. Spermatheca with sperm. Post-vulvar



Text-fig. 1.—*Boleodorus longistylus* sp. n. (♀).

A—Anterior end, B—Middle part of body showing vulva, female gonad and incisures, C—Tail.

uterine sac $\frac{1}{2}$ body width long. Vagina long and transverse, prominent. Vulva flush with body surface.

Male not found.

Diagnosis and Relationship.—According to Geraert (1971) there are three well-established species in the genus *Boleodorus* Thorne, viz. *B. thylactus* Thorne, *B. clavicaudatus* Thorne and *B. volutus* Lima and Siddiqi.

The new species differs from *B. clavicaudatus* by the absence of median involution on the head, non-clavate tail and more posteriorly placed vulva ($V=80$ in *B. clavicaudatus*) and from *B. thylactus* by the absence of median involution on the head, straight body and tail and position of vulva ($V=52-70$ in *B. thylactus*). The specimens resemble *B. volutus* in the body being without median involution, but differ in the body being straight, position of vulva ($V=66-72$ in *B. volutus*) and in having longer tail.

Holotype : ♀ : U.P., Dehra Dun, Indian Institute of Petroleum, 28. vi. 1972; *S. Khera* Coll. Deposited at the Zoological Survey of India, Calcutta.

Paratype : 1 ♀ : U.P., Dehra Dun, Mohkampur; 26.i.1973; other data as for holotype.

Remarks.—The genus *Boleodorus* Thorne is being recorded from the rhizosphere of tea for the first time from India.

8. *Boleodorus atypicus* sp. n.

(Text-fig. 2)

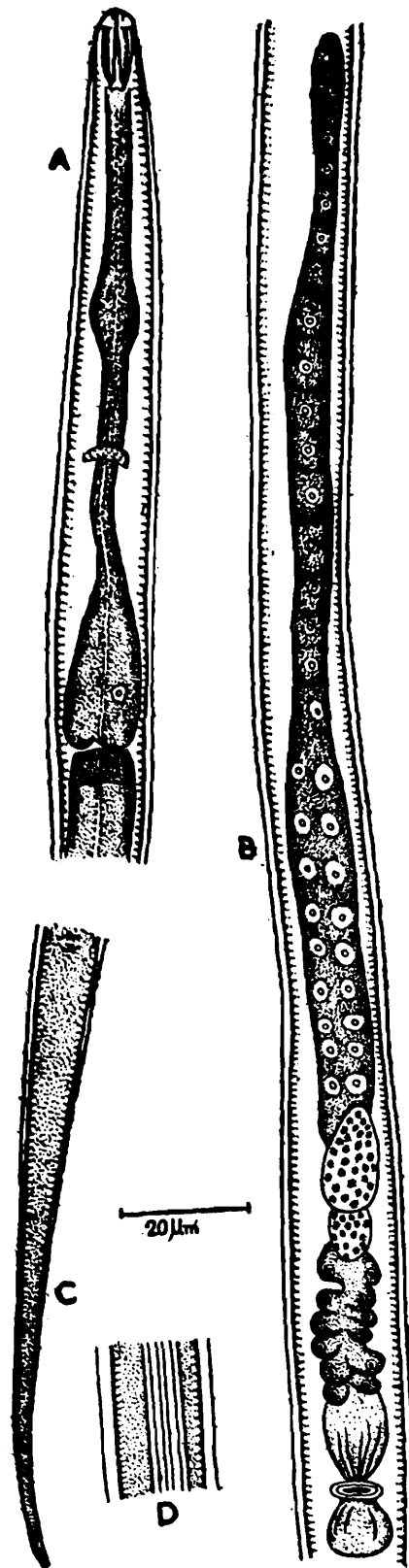
Material.—2 ♀ ♀; Mohkampur; 26.i.1973.

Measurements.—*Holotype*: ♀ : Length=0.67 mm, $a=39$, $b=5.8$, $c=7.2$, $V=68$, stylet=13 μm .

Paratype: 1 ♀ : Length=0.58 mm, $a=31$, $b=4.8$, $c=8.9$, $V=69$, Stylet=11 μm .

Description.—Body straight, cuticle thin with fine striations. Lips rounded, low, unstriated, not offset; stylet with basal part about $\frac{1}{3}$ total length, bearing flanges. Cephalic framework poorly sclerotized. Lateral field occupying $\frac{1}{3}$ the body width, starts in the oesophageal region; incisures 6, arranged in three bands of 2 each. Procorpus 28-29 μm long; median bulb 14 μm , valveless, fusiform; isthmus 21 μm long joining a terminal bulb 44-45 μm posterior end of terminal bulb not overlapping intestine; a rectangular or disc-like oesophago-intestinal valve present, but not very distinct; intestine obscured by granular bodies, Nerve ring 91 μm from anterior end.

Vulva postequatorial, vulvar lips slightly raised, vagina about 3/4 the vulvar body width; ovary anterior, outstretched, oöcytes in single row then in double row; spermatheca oval partially filled with sperm, crustaformeria consisting of 2 rows each with 4 cells, post-uterine sac



Text-fig .2.—*Boleodorus atypicus* sp. n. (♀).

A—Anterior end, B—Middle part of body showing vulva and female gonad C—Tail, D—Incisures.

slightly more than $\frac{1}{2}$ the body width. Tail conoid tapering to a pointed end, with an arcuate tendency. Phasmids not seen.

Male not found.

Diagnosis and Relationship.—The new species differs from all the three species of the genus recognised by Geraert (1971) in the number of incisures besides other characters. In possessing six incisures it resembles *B. typicus* Hussain and Khan (Geraert, *loc. cit.*, considers *B. typicus* closely allied to *B. thylactus*). The new species, however, differs from *B. typicus* by having a more anteriorly placed median bulb (procorpus including median bulb shorter than the isthmus and posterior bulb combined) and incisures being arranged in three bands.

Holotype : ♀; U.P., Dehra Dun, Mohkampur; 26.i. 1973; *S. Khera* Coll. Deposited at the Zoological Survey of India, Calcutta.

Paratype : 1 ♀; other data as for holotype.

Family APHELENCHIDAE

9. *Aphelenchus avenae* Bastian

(Text-fig. 3)

Aphelenchus avenae Bastian, 1865, *Trans. Linn. Soc. Lond.* 25: 122; Goodey, 1963, *Soil and freshwater nematodes*: 134; Goodey and Hooper, 1965, *Nematologica* 11: 55.

Material.—21 ♀♀ ; Indian Institute of Petroleum, Vikasnagar Arcadia, Herbertpur, East Hope Town and Mohkampur; 28.vi.1972 and 26.i.1973.

Measurements.—4 ♀♀ : Length=0.67-0.76 mm, a=29-30, b=7.0-7.9, c=28-30, V=72-77, stylet=8-10 µm.

Remarks.—The specimens fully agree with the previous descriptions of the species. However, some of them show interesting variation in the shape of the median bulb from ovoid to violin-shaped to double bulb, valve in the latter case being situated in the posterior bulb.

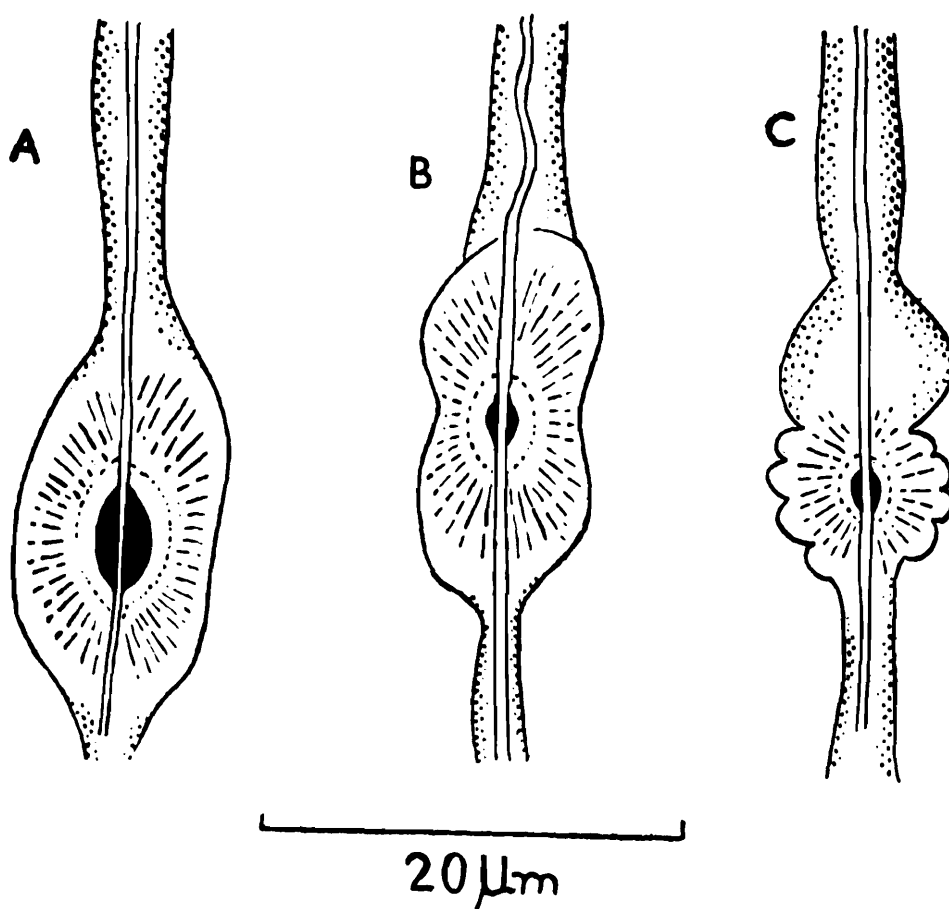
A cosmopolitan species. So far *A. agricola* de Man, (which is considered to be a synonym of *A. avenae* by Goodey, 1963) has been found in association with tea in north-eastern India.

Family APHELENCHOIDIDAE

10. *Aphelenchoides saprophilus* Franklin

Aphelenchoides saprophilus Franklin, 1957, *Nematologica* 2: 309.

Material.—9 ♀♀, 1 ♂ (damaged), 1 juv; Vikasnagar, Arcadia, East Hope Town and Mohkampur; 26.i.1973.



Text-fig. 3.—*Aphelenchus avenae* Bastian.

A—Normal median bulb, B—Violin-shaped median bulb, C—
“Double” median bulb.

Measurements.—5 ♀♀ : Length=0.63-0.65 mm, a=34-46, b=8.0-9.6
b'=4.4-4.6, c=13-16, V=69-71, stylet=11-12 μ m.

Remarks.—The species was first recorded from India by Khera and Chaturvedi (1975) from the rhizosphere of banana and spinach. Now it is being recorded for the first time from the rhizosphere of tea plant. An allied species, *A. composticola* Franklin, has been found associated with tea in north-eastern India and E. Africa.

Order RHABDITIDA

Family RHABDITIDAE

11. *Rhabditis (Uniovaria) cranganorensis* Khera

Rhabditis (Uniovaria) cranganorensis Khera, 1968, *J. zool. Soc. India* 20: 38.

Material.—35 ♀♀ ; Indian Institute of Petroleum, Arcadia, Herbertpur, East Hope Town, Harbanswala and Mohkampur; 28.vi.1972 and 26.i.1973.

Measurements.—6 ♀♀ : Length=0.44-0.53 mm, a=16-18, b=3.0-4.2, c=8.0-12.5, V=72-80.

Remarks.—The specimens come close to the original description given by Khera (1968). These, however, differ from the original description in value of 'a' in the de Manian formula ($a=28-31$ in the original description). Further a greater variation has been observed in the value of 'b', 'c' and 'V' ($b=3.5-3.7$, $c=9-10$, $V=73-76$ in the original description).

Family PANAGROLAIMIDAE

12. *Trilabiatulus lignicolus* (Körner)

Tricephalobus lignicolus Körner, 1954, *Zool. Jber. Neapel* 82 (3-4) : 245-353.
Tricephalobus franzi Rühm, 1956, *Parasit. SchrReihe* 6: 312 (*New Synonymy*).
Trilabiatulus franzi; Goodey, 1963, *Soil and freshwater nematodes*: 265..

Material.—1 ♂; Arcadia, 26.i.1973.

Measurements.— 1 ♂ : Length=0.59 mm, $a=35$, $b=4.3$, $c=9.5$, spicula=21 μm , gubernaculum=8 μm .

Spicula arcuate, cephalated and alate; gubernaculum bifid. Tail conical, tapering; one pair preanal and seven pairs postanal papillae.

Remarks.—The specimen before us resembles *T. lignicolus* but for the knobbed tip of the spicula as given in the diagram by Goodey (1963) where the spicula protrude from the cloacal aperture. We, however, feel that spicula being alate, their tip could assume a knobbed appearance when thus protruded.

The structure and size of the stoma and the shape and size of the spicula and even other structures are similar in *T. franzi* (Rühm) and *T. lignicolus*. The de Manian values of *T. franzi* fall within the range given for *T. lignicolus* by Goodey (1963). Therefore, it is proposed that *T. franzi* (Rühm) be considered a synonym of *T. lignicolus* (Körner). The genus *Trilabiatulus* Goodey is being recorded for the first time from India.

Family CEPHALOBIDAE

13. *Acrobeloides buetschlii* (de Man)

Cephalobus buetschlii de Man, 1884, Die frei neiderlandischen Fauna. Eine Systematischefaunistische Monographie, Leiden: 92; de Man, 1921, *Capita zool.* 1: 21.

Cephalobus presegnis; Bütschli, 1873, *Nova Acta Acad. Caesar. Leop. Carol.* 36 (5) : 80; var. *buetschlii*, Micoletzky, 1922, *Arch. Naturgesch.* 87:185.

Acrobeles (Acrobeloides) buetschlii; Thorne, 1925, *Trans. Amer. micros. Soc.*, 44: 181.

Acrobeloides buetschlii; Steiner & Buhner, 1933, *Z. ParasitKde.* 5: 419; Goodey, 1963, *Soil and freshwater nematodes*: 276.

Material.—6 ♀♀, 2 juv; Indian Institute of Petroleum, East Hope Town and Herbertpur; 28.vi.1972 and 26.i.1973.

Measurements.—4 ♀♀ : Length=0.39-0.46 mm, a=13.8-17.0, b=3.5-3.8, c = 17-18, V=63-66.

Remarks.—Except for minor variations, the specimens fit in well with the description of the species as given by Goodey (1963). The species has been associated with tea plant (Steiner & Buhrer, 1933).

14. *Chiloplacus* sp.

Material.—1 juv; Mohkampur, 26.i.1973.

Measurements.—1 juv. : Length=0.41 mm, a=8.7, b=3.8, c=22.

Order ARAEOLAIMIDA

Family PLECTIDAE

15. *Plectus prox. thornei* Rühm

Plectus thornei Rühm, 1956, *Parasit. SchrReihe* 6: 412; Maggenti, 1961. *Proc. helminth. Soc. Wash.* 28: 146.

Material.—1 ♀; Herbertpur, 26. i. 1973.

Measurements.—1 ♀ : Length=0.44, a=24, b=3.5, c=9.4, V=50.

Description.—Body arcuate; cuticle transversely striated; lateral field marked with four incisures, inner pair feeble and with wider gap. Many glands open in the lateral field. Oesophagus cylindrical with a valvular terminal bulb, anterior to the terminal bulb, there is a swollen structure, difficult to explain or to identify.

Remarks.—Maggenti (1961) recorded only one species *P. thornei* Rühm with four longitudinal alae (=incisures) in each wing area (=lateral field). Our specimen comes close to *P. thornei* in this respect but differs from it by being longer and by the absence of body spines and knots on incisures and is being provisionally identified as *P. thornei*.

Family CAMACOLAIMIDAE

16. *Paraphanolaimus micoletzkyi* sp. n.

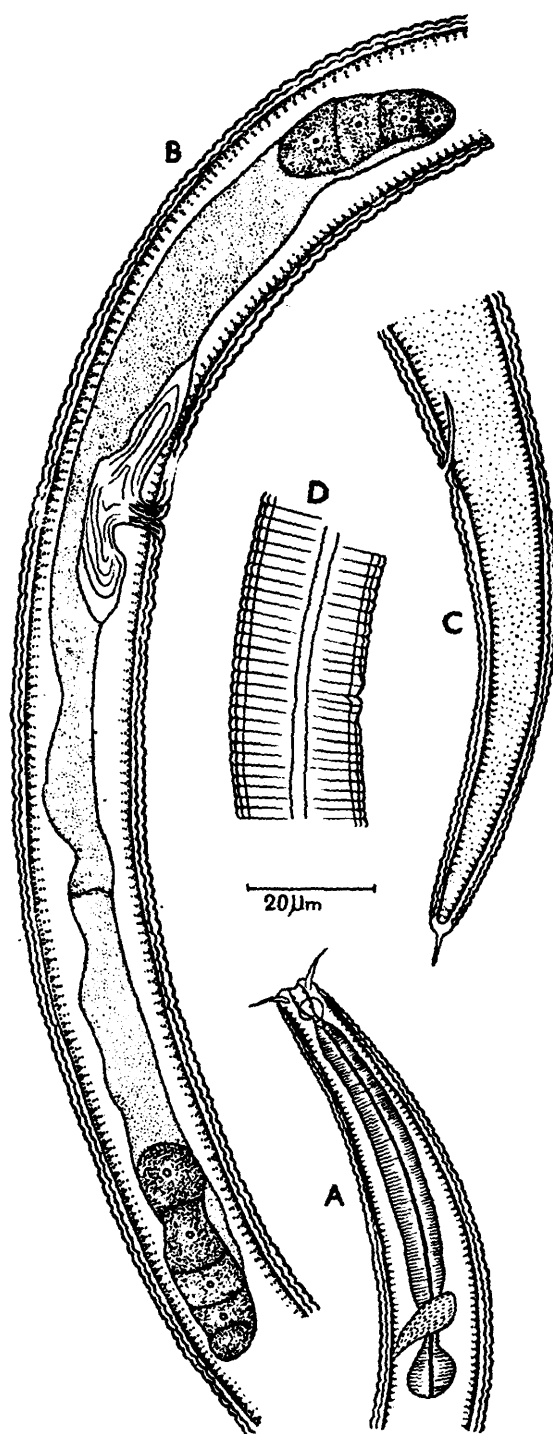
(Text-fig. 4)

Material.—1 ♀; Herbertpur; 27.vi.1972.

Measurements.—Holotype : ♀: Length=0.52 mm, a=25, b=7.7, c=5.7, V=51.

Description.—Body recurved ventrally on thermal death. Tail conical, gradually narrowing behind anus, with a narrow and pointed tip, ending in a terminal spike. Cuticle transversely striated, striations coarse, 1.6 μm apart in the vulvar region. Lateral field narrow, 1.5 μm wide: 2 incisures, crenate, beginning in the oesophageal region and continuing

far behind anus. Under the lateral field occur a series of gland cells, each connected to the exterior by a pore through the cuticle, 2 in the oesophageal region, 13 over the intestine, 1 opposite anus and 1 on the tail. Head not offset, rounded, lips and papillae obscure, 4 cephalic



Text-fig. 4.—*Paraphanolaimus micoletzkyi* sp. n. (♀).

A—Anterior end, B—Middle part of the body showing female gonads, C—Tail, D—Incisures.

setae, each 6 μm long. Amphids large, far forward on head, open spiral but almost ring-like. Stoma slightly less than one head width deep, tapering towards base and provided with 3 short local thickenings of

wall. Oesophagus cylindrical followed by a somewhat pear-shaped bulbi 91 μm long. Oesophago-intestinal cell 10 μm long. Excretory gland cell at 63 μm from anterior end. Excretory pore not discernible. Vulva flush with body surface. Ovaries two, opposed and reflexed.

Male not known.

Diagnosis and Relationship.—The genus *Paraphanolaimus* Micoletzky is monotypic, being represented by *P. behningi* Micoletzky. This species was reported by Micoletzky (1923, 1925) from R. Volga and in certain Danish lakes.

The new species described differs from the type species in being about half the size in length ($L=0.95-1.07$ mm. in *M. behningi*), in having a conical tail (clavate tail in *M. behningi*) and slightly in the de Manian formula and the number and disposition of gland cells.

Holotype : ♀ : U.P., Dehra Dun, Herbertpur Tea Estate; 27.vi.1972; S. Khera Coll. Deposited at the Zoological Survey of India, Calcutta.

Remarks.—The genus is being recorded for the first time from India. It has so far been recorded from temperate regions. It is now being recorded from the sub-mountainous region of the Himalaya. The species is about half the size of the type species which probably is in consonance with the phenomenon that specimens/species found in warmer climates tend to be smaller.

Order MONHYSTERIDA

Family MONHYSTERIDAE

17. *Prismatolaimus andrassyi* sp. n.

(Text-fig. 5)

Material.—4 ♀♀ : Herbertpur, Mohkampur; 26.i.1973.

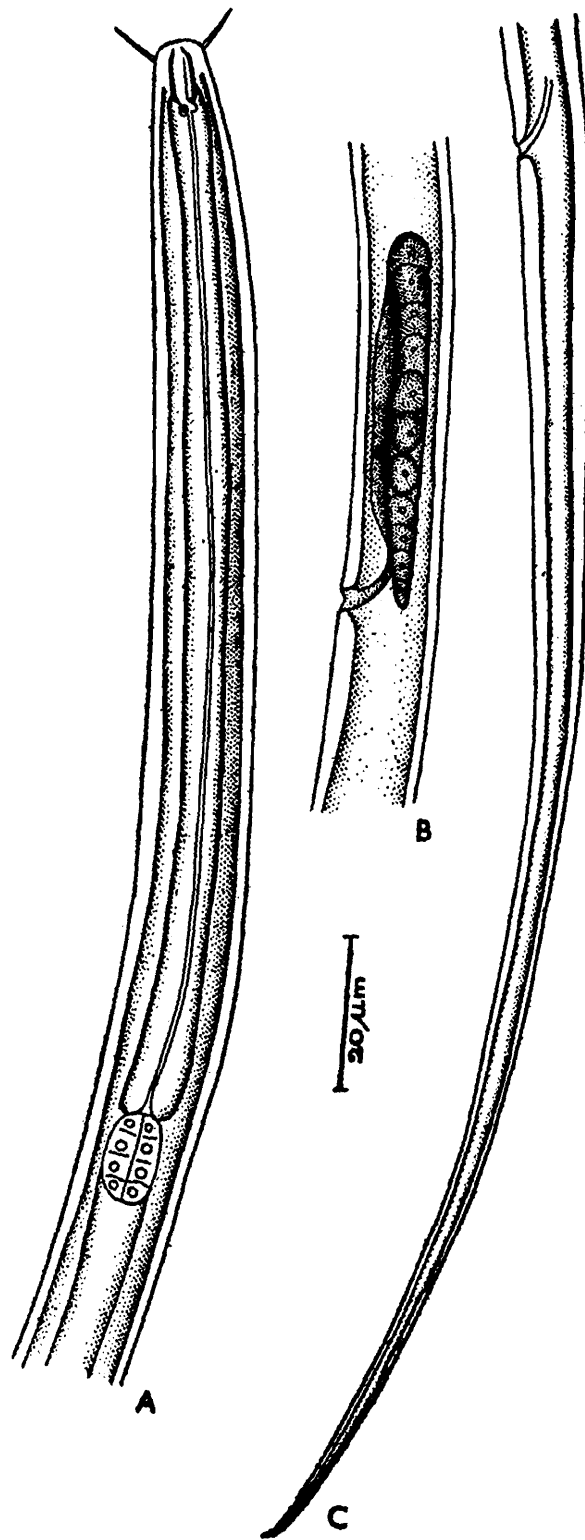
Measurements.—Holotype : ♀ : Length=0.64 mm, $a=38$, $b=4$, $c=3.5$, $V=58$.

Paratypes : 3 ♀♀ : Length=0.63-0.66 mm, $a=34-36$, $b=4.0-4.4$; $c=3.3-3.6$, $V=55-57$.

Description.—Body slender, curved ventrally after fixation, posterior end tapering more than the anterior end. Fine transverse striations. Head not offset, low and rounded anteriorly. Cephalic setae 10, in two circlets of 6 and 4, subterminal. Amphids obscure at 17 μm from anterior end. Stoma 8-10 μm long and 4 μm wide; walls cuticularized, posterior part narrow, provided with denticulate basal cushion and dorsal tooth. Oesophagus 143-158 μm long, cylindrical with slight expansion towards the posterior end. Oesophago-intestinal valve oval, 7 μm long with two rows of 4 cells. Intestinal lumen filled with granular bodies. Nerve ring at 70 μm from anterior end. Vulva flush with body

surface; vagina directed anteriorly; ovary 56-70 μm long, anterior reflexed, ovarian flexure reaching up to vulva. Oöcytes arranged in single row. Tail 182-189 μm long, narrow and filiform with spinneret. Anal body diameter 12-15 μm .

Male not found.



Text-fig. 5—*Pristomatolaimus andrassyi* sp. n. (♀),
 A—Anterior end, B—Middle part of the body showing female gonads,
 C—Tail.

Diagnosis and Relationship.—In possessing monoprodelfic reflexed gonad and a spinneret, *P. andrassyi* sp. n. resembles *P. hsuei* Wu and Hoeppli, *P. intermedius* (Bütschli), *P. parvus* Milne and *P. indicus* Ali, Suryawanshi and Chisty, but differs from these in the presence of a basal cushion in stoma. In the latter character it resembles *P. verrucosus* Hirschmann which differs from the new species in having paired, opposed gonads and in the value of 'V' (V=40-42 in *P. verrucosus*).

Holotype : ♀; U.P., Dehra Dun, Herbertpur Tea Estate; 26.i.1973; S. Khera Coll. Deposited at the Zoological Survey of India, Calcutta.

Paratypes : 3 ♀♀; U.P., Dehra Dun, Mohkampur; 26.i.1973; other data as for the holotype.

Order CHROMADORIDA

Family CYATHOLAIMIDAE

18. *Achromadora ruricola* (de Man)

Cyatholaimus ruricola de Man, 1880, *Tijdschr. ned. dierk. Vereen.* 5 (1-2): 18.

Achromadora ruricola; Micoletzky, 1925, *K. danske. Vidensk. Selsk. Skr. Naturv. Og Math. Afd.* 8 R. 10.(2): 133.

Material.—2 ♀♀; Mohkampur; 26.i.1973.

Measurement.—2 ♀♀: Length=0.41-0.72 mm, a=23-24, b=5.5-6.2, c=6.5-8.5, V=47-49.

Remarks.—The specimens tally with the description of the species given by Goodey (1963). However, they show slight variation in the value of 'b' and 'c' (b=5.4-5.9, c=5.9-7.4 in Goodey's account).

19. *Odontolaimus aquaticus* Schneider

Odontolaimus aquaticus W. Schneider, 1937, *Arch. Hydrobiol. Suppl.* 15(1): 86.

Material.—1 ♀; Herbertpur; 26.i.1973.

Measurements.—1 ♀: Length=0.72 mm, a=36, b=6.3, c=2.8, V=38

Remarks.—The specimen differs slightly from the original description in the de Manian formula (L=0.762 mm, a=39.2, b=7, c=2.2, V=29). The species was recorded by Schneider (1937) from Java. The genus *Odontolaimus* is being recorded for the first time from India.

Order ENOPLIDA

Family ONCHULIDAE

20. *Onchulus longicauda* (Daday)

Monhystera longicauda Daday, 1899, *Math. Term. tud. Akad. Bpest-* 17: 560; Daday, 1901, *Termeszett. Fuz.* 24, : 3.

Onchulus longicaudatus; Cobb, 1920, *Contr. Sci. Nematol.* 9: 313; Goodey, 1963, *Soil and freshwater nematodes*: 377.

Onchulus longicauda: Andrassy, 1964, *Opusc. zool. Bpest.* 5: 29; Ali, Suryawanshi & Chisty, 1972, *Indian J. Nematol.* 2: 9.

Material.—1 ♀; Vikasnagar; 26.i.1973.

Measurements.—1 ♀: Length=0.92 mm, a=48, b=5.2, c=2.7, V=38.

Remarks.—Andrássy (1964) gave a redescription of *O. longicauda*. The specimen before us fits in with Andrássy's description except for the value of 'V' in the de Manian formula (V=43-46 in Andrássy's account). Ali *et al.* (1972) recorded this species from India (Maharashtra: Dist. Osmanabad, Ahmedpur) for the first time, the value of 'V' in their specimen being 43-45. Our specimen extends the lower limit of this value.

Family TRIPYLIDAE

21. *Tripyla affinis* de Man

Tripyla affinis de Man, 1880, *Tijdschr. ned. dierk. Vereen.* 5(1-2): 12.

Material.—5 juv; Herbertpur, Vikasnagar, East Hope Town and Arcadia; 26.i.1973.

Measurements.—4 juv. : Length=0.60-0.97 mm, a = 25-29, b=3.8-5.0, c=7 7.

Remarks.—Two specimens show genital primordium ? vulva position) at 66%, 68%. In general characters the specimens resemble *T. affinis*

Family IRONIDAE

22. *Ironus ignavus* Bastian

Ironus ignavus Bastian, 1865, *Trans. Linn. Soc. Lond.* 25: 104. var. *typicus* Brakenhoff, 1914, *Abh. naturw. Ver. Bremen* 22(2): 278.

Material.—12 juv., 6 ♀♀; Vikasnagar, Herbertpur and Mohkampur; 26.i.1973.

Measurements.—6 juv. : Length=1.06-1.16 mm, a=48-54, b=5.2-5.5, c=3.1-3.3.

3 ♀♀: Length=1.40-1.54 mm, a=40-50, b=5.2-5.9, c=4.7-5.3, V=45-49.

23. *Cryptonchus abnormis* (Allgén)

Cylindrolaimus abnormis Allgén, 1933, *Zool. Anz.* 103(11-12): 317.

Cryptonchus abnormis; Schuurmans Stekhoven, 1951, *Mem. Inst. r. Sci. nat. Belg.* 2 (39): 39; Goodey, 1961, *Soil and freshwater nematodes*: 392.

Gymnolaimus axilis; Goodey, 1951, *Soil and freshwater nematodes*: 203; Andrássy, 1956, *Opusc. zool. Bpest.* 1: 9.

Material.—2 ♀♀; Herbertpur and Mohkampur; 27.vi.1972 and 26.i.1973.

Measurements.—2 ♀♀. Length=0.98-1.06 mm, a=44-47, b=4.6-4.7, c=3.3-3.4, V=43-44.

Remarks.—It would be worthwhile examining the types of the genera *Cryptonchus* Cobb and *Gymnolaimus* Cobb and *Isolaimium* Cobb as the three seem to be very closely related.

Order DORYLAIMIDA

Family DORYLAIMIDAE

24. *Aporcelaimellus maitai* Yeates

Aporcelaimellus maitai Yeates, 1967, *N. Z. Jl. Sci.* 10 : 757.

Material.—1 ♀; Indian Institute of Petroleum; 28.vi.1972.

Measurements.—1 ♀: Length=1.1 mm, a = 23, b=3.4, c=36, V=52, stylet=20 μm, stylet aperture=55%.

Remarks.—Tjepkema *et al.* (1971) recognised 20 species of the genus. Our specimen comes close to *A. maitai* except for the stylet length which is 11-13 μm in *A. maitai*.

The species is being recorded for the first time from India.

25. *Amphidorylaimus infecundus* (Cobb)

Dorylaimus infecundus Cobb in Thorne & Swanger, 1936, *Capita. zool.* 6(4): 31.

Amphidorylaimus infecundus; Andrásy, 1960, *Acta zool. hung.* 6 (1-2): 1-28.

Material.—2 ♀♀; Indian Institute of Petroleum; 28.vi.1972.

Measurements.—2 ♀♀; Length=0.90-0.95 mm, a=45, b=4.3, c=3.5-3.7, V=36-37, stylet=10-11 μm.

Remarks.—The specimens fit well in the original description of the species but for the higher value of 'a' (a=33 for female in the original description). The species is being recorded for the first time from India.

26. *Thornenema cavalcantii* (Lordello)

Dorylaimus cavalcantii Lordello, 1955, *Revta. bras. Biol.* 15 (2): 216.

Thornenema cavalcantii; Andrásy, 1959, *Acta. zool. hung.* 5(3-4): 196.

Thornenema cavalcanti; Goodey, 1963, *Soil and freshwater nematodes* : 424.

Material.—1 ♀; Indian Institute of Petroleum; 28.vi.1972.

Measurements.—1 ♀: Length=1.24 mm, a=33, b=4, c=12, V=46, stylet=12.6 μm.

27. *Thornenema mauritianum* (Williams)

Chrysonema mauritiana Williams, 1959, *Occ. Pap. Maurit. Sug. Ind. Res. Inst.* 3: 28.

Thornenema viriosum Williams, 1964, *Nematologica* 10.: 346.

Thornenema filiforme Siddiqi, 1965, *Labdev. J. Sci. Tech.* 3: 129.

Thornenema africanum Andrásy, 1965, *Opusc. zool. Bpest* 2: 139.

Thornenema delhiensis Prasad & Chawla, 1965, *Indian J. Ent.* 27: 140.

Thornenema mauritianum; Baqri and Jairajpuri, 1967, *Nematologica* 13: 358,

Material.—1 ♀; Mohkampur; 26.i.1973.

Measurements.—1 ♀: Length=1.55 mm, a=46, b=4, c=5.5, V=31, stylet=11.2 μm .

Remarks.—The species has been recorded from northern and southern India as well as from the Andamans by Baqri & Jairajpuri (1967).

Family MONONCHIDAE

28. *Mylonchulus index* Cobb

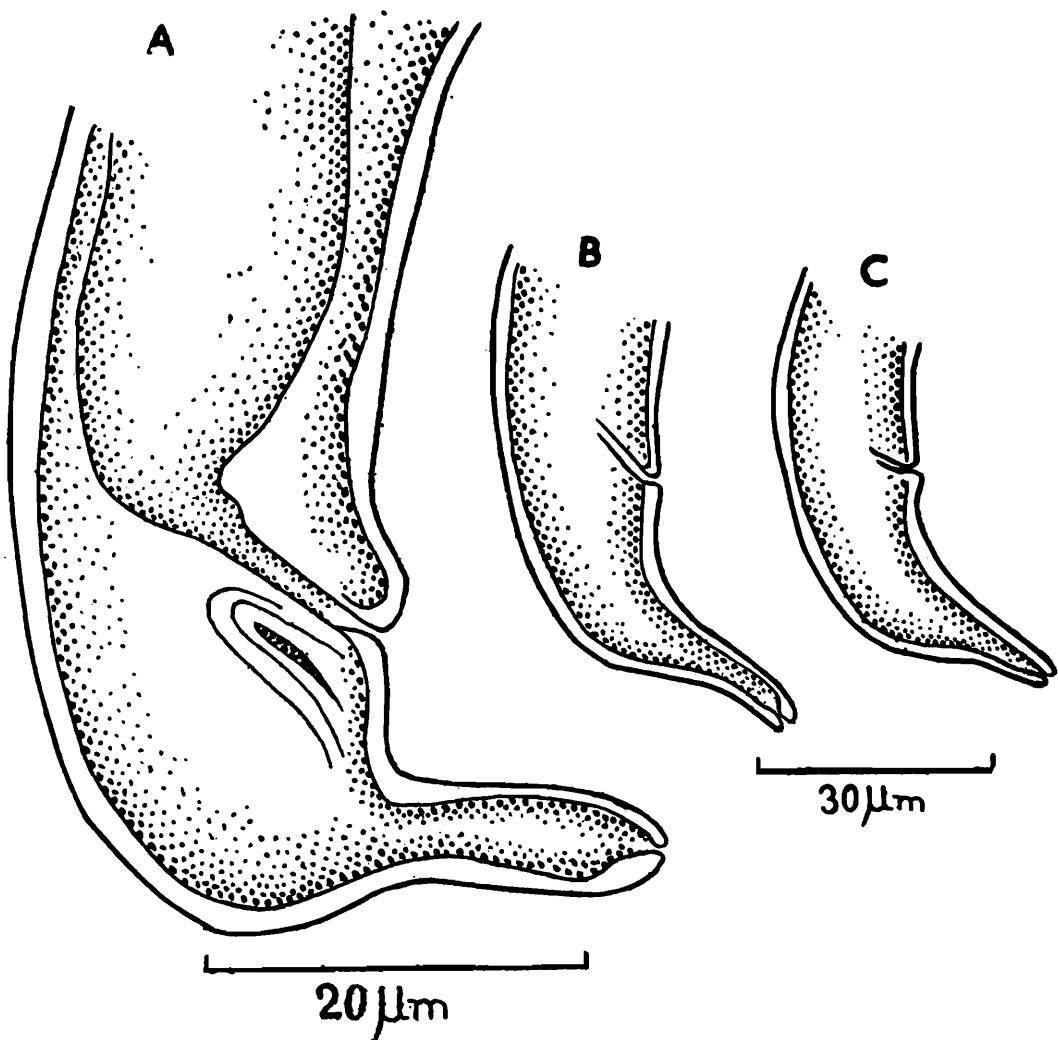
(Text-fig. 6)

Mononchus (Mylonchulus) index Cobb, 1906, *Bull. Div. Path. and Physiol. Hawaiian Sug. Plrs' Ass. Exp. Stn.*, 2nd ed. (5): 180.

Mylonchulus index; Andr assy, 1958, *Annl. hist. nat. Mus. natn. hung. n.s.* 9:

Material.—6 ♀♀; Arcadia, Mohkampur and Herbertpur; 26.i.1973.

Measurements.—4 ♀♀: Length=0.82-0.95 mm, a=34-39, b=2.7-3.0, c=21-27, V=72-77.



Text-fig. 6.—*Mylonchulus index* (Cobb) (♀).
Variations in tail shape,

Remarks.—The tail shows variations in the shape as depicted in the text-figure 6. Jairajpuri (1970) recorded *M. index* from roots of coconut in the Andamans. This is the first record of the species from the Indian mainland.

29. *Mylonchulus incurvus* Cobb

Monochus (Mylonchulus) incurvus Cobb, 1917, *Soil Science* 3(5): 468.

Mylonchulus incurvus; Andr assy, 1958, *Annl. hist. nat. Mus. natn. hung.* 50:

Mylonchulus hawaiiensis Cassidy, 1931, *Hawaii. Plrs' Rec.* 35: 326.

Material.—3 ♀♀ ; Vikasnagar and Herbertpur; 26.i.1973.

Measurements.—2 ♀♀ ; Length=1.05-1.16 mm, a=27-32, b=3.1-3.2, c=31-32, V=60-61.

Remarks.—Mulvey (1961) considers *M. hawaiiensis* as a synonym of *M. incurvus*. Jairajpuri (1970), however, considers it a valid species. We follow Mulvey (*loc. cit.*) in this regard.

30. *Iotonchus* sp.

Material.—30 juv.; Indian Institute of Petroleum, Vikasnagar, Arcadia, Mohkampur, East Hope Town and Harbanswala; 28.vi.1972 and 26.i.1973.

Measurements.—12 juv.; Length=0.86-1.43 mm, a=29-35, b=3.3-5.5, c=6-11.

Remarks.—Jairajpuri (1970) recorded *I. monhystera* (Cobb) from tea from Jorhat, Assam. The life cycle studies of the nematode could be promising since the adults were not obtained in the acme of summer and winter.

Family ALAIMIDAE

31. *Alaimus jaulasali* Siddiqi & Husain

Alaimus jaulasali Siddiqi & Husain, 1967, *Proc. helminth. Soc. Wash.* 34(2): 159.

Material.—1 ♀; Arcadia, 26.i.1973.

Measurements.—1 ♀: Length=1.02 mm, a=60, b=4.3, c=5.6, V=41.

Description.—Body tapering towards both ends, arcuate after death. Tail elongate, tapering to a pointed terminus. Transverse cuticular striations fine. Head rounded, not offset. Amphid aperture inconspicuous. Stoma reduced. Oesophagus narrow and tubular, posterior fifth expanded into a bulb. Excretory pore not visible. Ovary single, posterior, reflexed. Oesophagus-vulvar distance 70 μ m longer than neck.

Remarks.—The specimen shows some variation in the values of 'b' and 'c' and in the de Manian formula (b=4.8-5.3, c=7.0-8.6 in original

description). The species was recorded by Siddiqi and Husain (1967) from sal trees. Now it is being recorded from tea.

32. *Amphidelus dolichurus* (de Man)

Monhystera? dolichura de Man, 1876, *Tijdschr. ned. dierk. Vereen.* 2: 100.

Alaimus dolichurus; de Man, 1880, *Tijdschr. ned. dierk. Vereen.* 5(1-2): 3.

Amphidelus dolichurus; Thorne, 1939, *Capita zool.* 8(5): 175.

Material.—6 ♀♀; Vikasnagar, Arcadia, Harbanswala and East Hope Town; 26.i.1973.

5 ♂♂; Indian Institute of Petroleum, Vikasnagar, Mohkampur and Herbertpur; 28.vi.1972 and 26.i.1973.

Measurements.—4 ♀♀ : Length=0.87-1.01 mm, a=56-57, b=4.0-4.5, c=3.8-8.0, V=35-41.

4 ♂♂ : Length=1.03-1.17 mm, a=65-71, b=3.0-3.9, c=7.0-7.9, spicula=11-13 μ m.

Remarks.—In the specimens before us there is a considerable variation in the value of 'c' in the females; this was also observed by Thorne (1939). He, however, suggested that the two populations with long tail and with short tail might represent two different species. We differ from him as we have found that the variability in the value of 'c' in the long tailed species of nematodes is generally quite considerable.

33. *Amphidelus loofi* sp. n.

(Text-fig. 7)

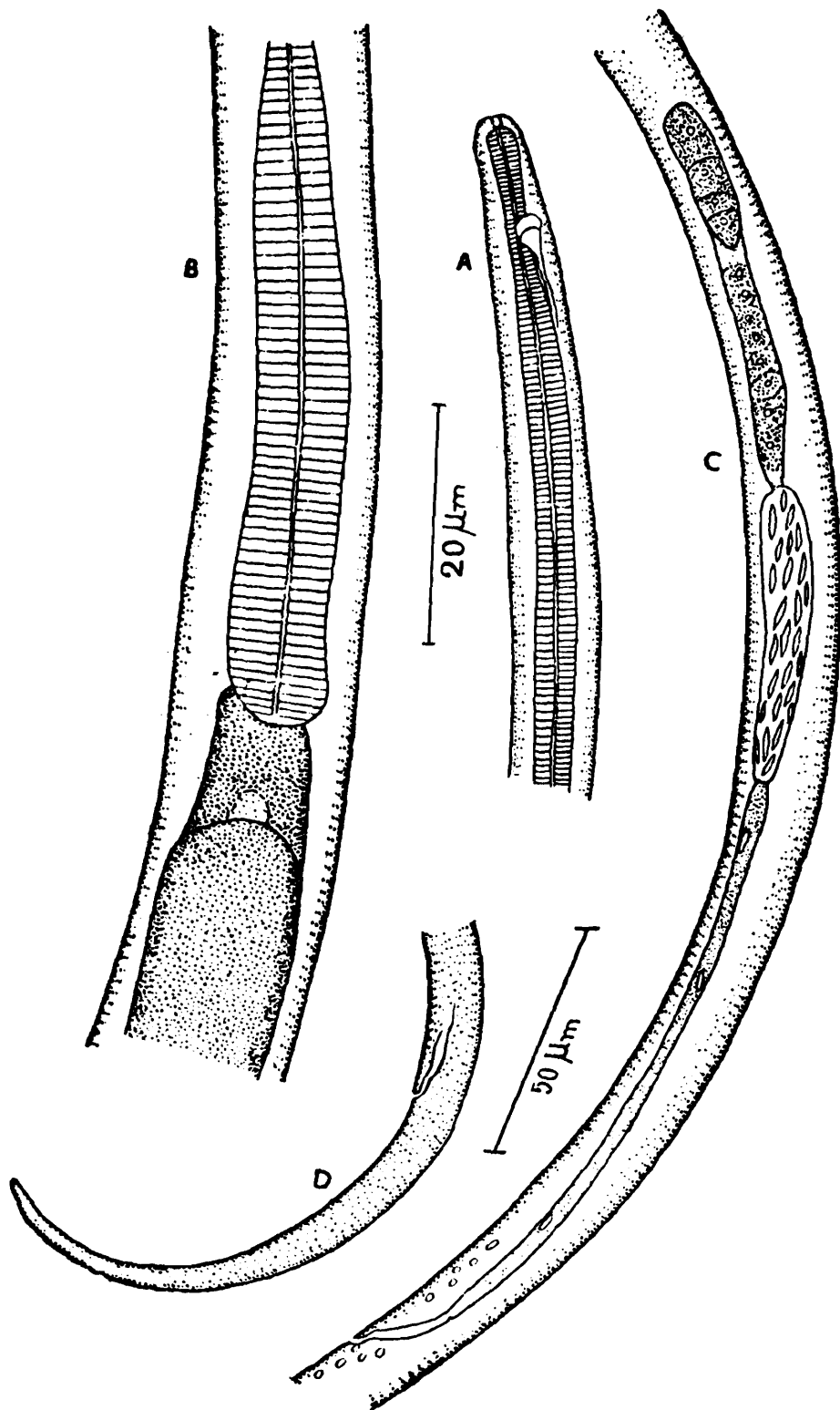
Material.—3 ♀♀; Mohkampur and Arcadia; 26.i.1973.

Measurements.—Holotype : ♀ : Length=1.37 mm, a=75, b=3.9, c=11.6, V=65.

Paratype : 2 ♀♀ : Length=1.03-1.04 mm, a=67-74, b=3.3, c= 8.9, V=65-67.

Description.—Body long, slender, tapering towards either end, more so posteriorly; curved ventrally or a loose spiral. Tail elongate 116-119 μ m long, tapering gradually to filiform. Head not offset, lip region rounded, wide about 1/4 the neck base. Stoma much reduced and inconspicuous. Amphid goblet-shaped, aperture about half as wide as lip region, 8-10 μ m from anterior end. Oesophagus narrow and tubular, expanding in posterior fourth. Oesophago-intestinal valve well developed in the holotype but small and rectangular in two paratypes. Nerve ring at 126-133 μ m from anterior end. Intestine filled with granular bodies on its two ends. Vulva flush with body surface. Ovary single, anterior and

reflexed; oöoytes arranged in single row. A long spermatheca filled with elongate sperm. Vagina oblique. Male not found.



Text-fig. 7.—*Amphidelus loofi* sp. n. (♀).

A—Anterior end, B—Part of the body showing oesophago-intestinal junction, C—Part of body showing female gonad, D—Tail.

Remarks.—Only two species of the genus *Amphidelus* Thorne, viz. *A. dolichurus* (de Man) and *A. pusillus* Thorne are monodelphic. The Z. S. .10

ovary, however, is posterior in both the species. The new species differs from these in having a prodelphic ovary.

Holotype : ♀; U.P., Dehra Dun, Mohkampur; 26.i.1973; S. Khera Coll. Deposited at the Zoological Survey of India, Calcutta.

Paratype : 2 ♀♀ ; Arcadia; other data as for holotype.

Family DIPHTHEROPHORIDAE

34. *Diphtherophora communis* de Man

Diphtherophora communis de Man, 1880, *Tijdschr. ned. dierk. Vereen.* 5(1-2): 63; Micoletzky, 1922, *Arch. Naturgesch.* 87: 422, Thorne, 1939, *Capita zool.* 8(5): 156.

Chaolaimus pellucidus Cobb, 1893, *Agric. Gaz. N. S. W.* 4(10): 44.

Diphtherophora obesus Thorne, 1939, *Capita zool.* 8(5): 157. (*New Synonymy*).

Material.—3 ♀♀ ; Lakhanwala and Vikasnagar; 26.i.1973.

Measurements.—3 ♀♀ : Length=0.42 mm, a=16-17, b=3.3-3.7, c=15-18, V=56-63, stylet=15.5 μ m.

Description.—Amphid aperture ellipsoidal, 4 μ m wide, just below the conical elevations of the cephalic papillae at 4 μ m from anterior end. Excretory pore a prominent feature, 90-97 μ m from anterior end. Tail 22-27 μ m long being about 1½ times the anal body diameter, conoid with a stumpy, slightly digitate, blunt terminus.

Remarks.—The measurements, de Manian formula, etc., of our specimens fall in between those of *D. communis* de Man and *D. obesus* Thorne. The value of tail length/anal body diameter being 1.5 is intermediate to that of the two species. We, therefore, feel that the measurements, de Manian formulae, etc., as given for the two species, actually represent two extremes of the same species, viz. the type species, *D. communis*. It is proposed that *D. obesus* Thorne be considered a synonym of *D. communis* de Man.

Family TRICHODORIDAE

35. *Trichodorus* sp.

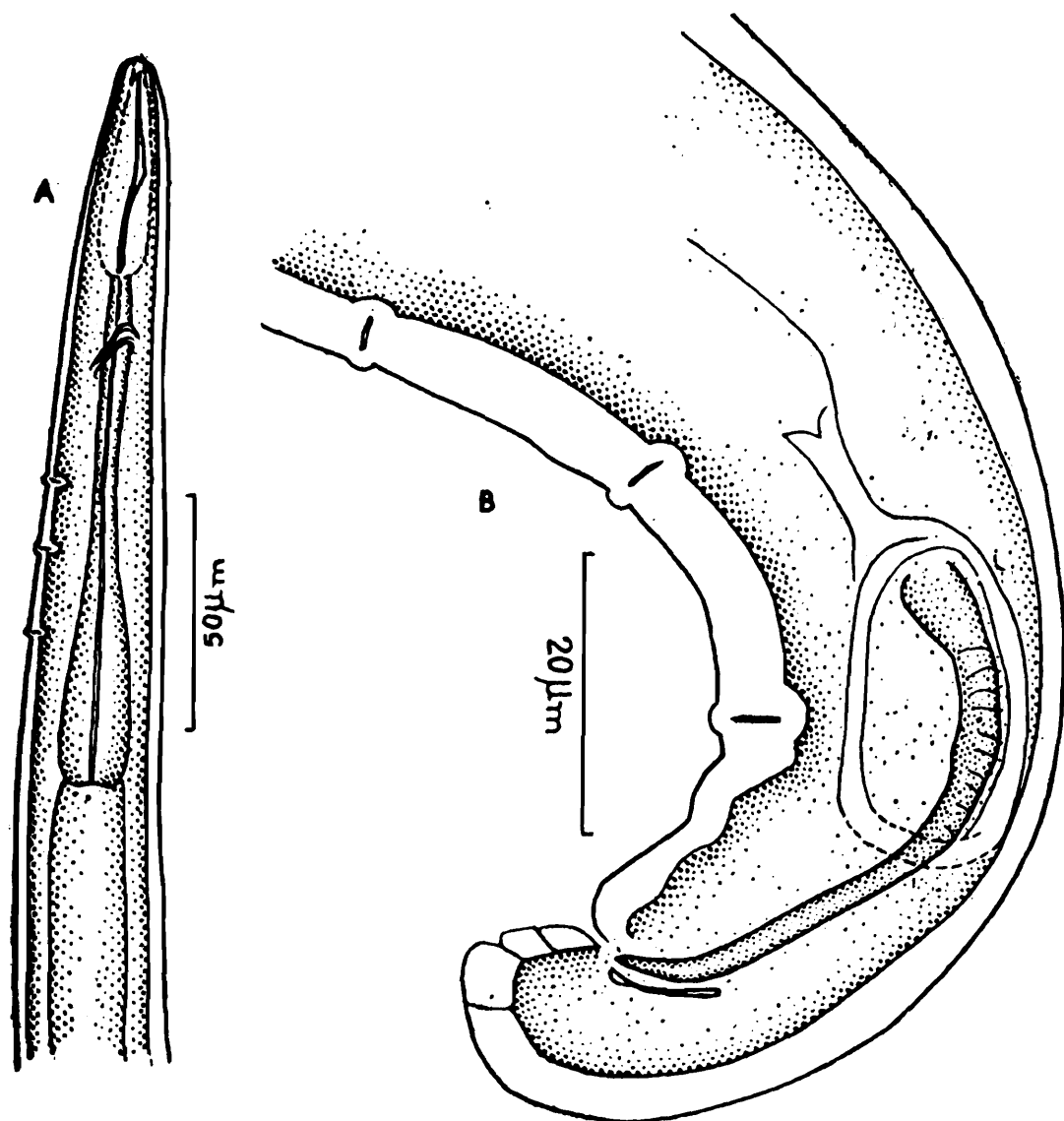
(Text-fig. 8)

Material.—1 ♂; Lakhanwala; 26.i.1973.

Measurements.—1 ♂: Length=0.62 mm, a=17, b=4, c=44, onchiostyle=42 μ m, spicula=47 μ m, gubernaculum=8 μ m.

Description.—Body tapering anteriorly, cuticle much swollen in posterior part, subcuticle finely striated. Lip region about 6 μ m in diameter, continuous. Amphid aperture 7 μ m from anterior end. Onchiostyle tripartite in the middle. Three ventromedian cervical papillae opposite

the posterior part of oesophagus, placed equidistantly at about 15 μm from each other, first one 89 μm away from anterior end. Oesophagus with a terminal bulb with two nuclei. Nerve ring 60 μm from anterior end. Supplements comprising 3 ventromedian papillae, extended to a distance about two spicular lengths from cloaca, the posterior-most opposite the anterior quarter of spicula. Spicules with striated markings. Caudal alae absent.



Text-fig. 8.—*Trichodorus* sp. (de Man) (♂).
A—Anterior end, B—Posterior end.

Remarks.—Recently Siddiqi (1974) has split the genus *Trichodorus* Cobb, in two genera and has given useful keys to the species of these genera. Loof (1975) has made slight modifications to the keys.

The specimen before us seems to take up an intermediate position between *T. pakistanensis* Siddiqi and *T. kurumeensis* Yokoo.

The genus *Trichodorus* is being recorded from the rhizosphere of tea for the first time. The genus is known to be a vector of viruses and as such the association of this nematode with tea has to be taken seriously.

GENERAL REMARKS

Sivapalan (1972) has listed twenty plant parasitic (tylenchid and dorylaimid) nematodes of tea indentified up to specific level. The species and genera so far reported from India and those being added to the list have been shown in the Table 1. The genera *Hemicriconemoides* Chitwood & Birchfield, *Neotylenchus* Steiner and *Trichodorus* Cobb, are being reported from tea for the first time. The association of the last named genus has to be taken seriously since it is a proven vector of viruses. The tylenchid species, *Paratylenchus tenuicaudatus*, *Neotylenchus latus* are recorded for the first time from tea as well as from India.

Most of the species of *Meloidogyne* Goeldi, except *M. brevicauda* Loos, are associated only with nursery plants. Since the nursery plants and for that matter even the roots in the mature tea fields were not examined, nothing can be said about the existence or otherwise of *Meloidogyne* spp. in the tea estates of Dehra Dun, although, it must be added that the plants appeared to be quite healthy.

The study of the geographical distribution of plant parasitic nematodes poses certain problems. These are: (1) the discontinuous distribution of crops and vegetative matter over the globe, (2) the non-host-specificity of most of the ectoparasitic and some endoparasitic nematodes, (3) the movement of plants with soil by human agency even across the seas, and (4) the vast areas in the world which have not yet been surveyed. As such it is difficult and much too premature to take up the study of the geographical distribution of the plant parasitic nematodes. We, however, feel that most of the plant parasitic species reported would be cosmopolitan, each species parasitising on a variety of hosts.

Amongst the free living nematodes, the genera *Rhabditis* Dujardin, *Acrobeloides* (Cobb), *Plectus* Bastian, *Achromadora* Cobb, *Tripyla* Bastian, *Ironus* Bastian, *Cryptonchus* Cobb, *Aporcelaimellus* Heyns, *Thornenema* Andr assy, *Mylonchulus* Cobb, *Iotonchus* Cobb, *Alaimus* de Man, *Amphidelus* Thorne, and *Diphtherophora* de Man, are, despite inadequate global survey studies, fairly well distributed throughout the world. Other genera like *Trilabiatus* J.B. Goodey, *Paraphanolaimus* Micoletzky, *Prismatolaimus* de Man, *Odontolaimus* de Man, *Onchulus* Cobb, and *Amphidorylaimus* Andr assy have distinctly discontinuous distribution which could either be attributed to inadequate surveys in the intervening areas or to the movement of the plant and the attendant soil material by human agency. It is interesting to note that the genus *Tobrilus* Andr assy, species of which are commonly found in the soil samples in India, was not encountered.

Dehra Dun is located in the submountainous region of the N.W. Himalaya and two of the nematode genera, viz. *Trilabiatus* and *Para-*

phanolaimus and four species, viz. *Acrobeloides buetschlii*, *Plectus thornei*, *Amphidorylaimus infecundus* and *Amphidelus dolichurus* are palaeartic in distribution. Species like *Rhabditis (Uniovaria) cranganorensis*, *Odontolaimus aquaticus* and *Alaimus jaulasali* are of Oriental region. *Aporcelaimellus maitai* and *Thornenema cavalcantii* belong to the Australian and Neotropical regions respectively. No nematode strictly Ethiopian or Neartic has been found. All other species are cosmopolitan in their distribution. This analysis is, of course, based on the present day knowledge of the distribution of these free living nematodes; it may change with more survey work and further knowledge.

SUMMARY

Thirty-five species of nematodes have been found in the rhizosphere of tea plants in Dehra Dun. Ten species belong to the order Tylenchida; most of the species have been found in association with tea for the first time. *Trichodorus* sp. a proven virus vector, and *Diphtherophora communis* have also been recorded. The genera *Paraphanolaimus*, *Odontolaimus*, *Trilabiatus* and the species *Helicotylenchus digonicus*, *Paratylenchus tenuicaudatus*, *Neotylenchus latus*, *Aporcelaimellus maitai*, *Amphidorylaimus infecundus*, have been recorded for the first time from India. Five new species, *Boleodorus longistylus*, *B. atypicus*, *Paraphanolaimus micoletzkyi*, *Prismatolaimus andrassyi* and *Amphidelus loofi* have been described. Systematic status of a number of species has been discussed.

TABLE 1: Plant parasitic Nematodes associated with Tea

<i>Nematode species</i> (1)	<i>Countries other than India (After Sivapalan, 1972)</i> (2)	<i>India (After Sivapalan, 1972)</i> (3)	<i>New records in this paper</i> (4)
<i>Tylenchus agricola</i>		+	
<i>T. filiformis</i>			+
<i>Tylenchus</i> sp.	+		
<i>Ditylenchus</i> sp.	+		
<i>Tylenchorhynchus</i> sp.	+	+	
<i>Pratylenchus loosi</i>	+		
<i>P. brachyurus</i>		+	
<i>Pratylenchus penetrans</i>			+
<i>Pratylenchus</i> sp.	+	+	
<i>Radopholus similis</i>	+		
<i>Pratylenchoides</i> sp.	+		

<i>Nematode species</i>	<i>Countries other than India (After Sivapalan, 1972)</i>	<i>India (After Sivapalan, 1972)</i>	<i>New records in this paper</i>
<i>Rotylenchulus</i> sp.	+		
<i>Rotylenchus</i> sp.	+	+	
<i>Helicotylenchus dihystrera</i>	+		
<i>H. erythrinae</i>	+		
<i>H. digonicus</i>			+
<i>Helicotylenchus</i> sp.	+	+	
<i>Scutellonema brachyurum</i>	+	+	
<i>Scutellonema</i> sp.	+		
<i>Hoplolaimus columbus</i>		+	
<i>Hoplolaimus</i> sp.	+		
<i>Neotylenchus latus</i>			+
<i>Boleodorus longistylus</i>			+
<i>B. atypicus</i>			+
<i>Boleodorus</i> sp.	+		
<i>Meloidogyne javanica</i>	+	+	
<i>M. incognita</i>	+	+	
<i>M. arenaria</i>	+		
<i>M. hapla</i>		+	
<i>M. brevicauda</i>	+	+	
<i>Meloidodera floridensis</i>		+	
<i>Hemicriconemoides kanayaensis</i>	+		
<i>H. mangiferae</i>			+
<i>Paratylenchus curvittatus</i>	+	+	
<i>P. tenuicaudatus</i>			+
<i>Paratylenchus</i> sp.	+	+	
<i>Macroposthonis ornata</i> (?)		+	
<i>Trophotylenchulus</i> sp.	+		
<i>Aphelenchus agricola</i>		+	
<i>A. avenae</i>			+
<i>Aphelenchoides composticola</i>	+	+	
<i>A. saprophilus</i>			+
<i>Xiphinema insigne</i>		+	
<i>Xiphinema</i> sp.	+		
<i>Longidorus</i> sp.	+		
<i>Trichodorus</i> sp.			+

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STUDIES ON SPIDER FAUNA OF ANDAMAN AND NICOBAR ISLANDS, INDIAN OCEAN

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(With 27 Text--figures)

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INTRODUCTION

The spider fauna of Andaman and Nicobar Islands has not yet been studied in a comprehensive manner. Thorell (1892) and Pocock (1900) were the pioneer workers in this field and they recorded only sixteen species of spiders from these oceanic islands. There are many oceanic islands around Indian mainland but no effort has so far been made to explore intensively the spider fauna of these islands. All oceanic islands have, presumably, received their spider fauna mainly through ballooning mechanism of spiders from adjacent mainland. The present study was undertaken with the aim of describing the species occurring in these islands and also comparing the distribution of spider fauna of these islands with the adjoining mainlands of India, Burma and Sumatra. It is possible that some species are common with mainland while a few are characteristic of the places of their respective occurrence. The present account is based on spiders collected by the author from Andaman and Nicobar islands during the faunistic survey conducted during February to May 1970 and April to June 1971. The author believes that there are still a number of spider species from these islands which have not yet been collected and described.

Altogether fifty-eight species, contained in forty-one genera, distributed in the families Scytodidae, Psechridae, Filistatidae, Uloboridae, Amaurobiidae, Dictynidae, Pholcidae, Linyphiidae, Theridiidae, Tetragnathidae, Argiopidae, Hersiliidae, Oxyopidae, Pisauridae, Lycosidae, Gnaphosidae, Heteropodidae, Thomisidae, Clubionidae and Salticidae are dealt with in this paper. Of these, twenty-six species are new to science. All type specimens will be deposited in due course in the National Collection, Zoological Survey of India, Calcutta.

GENERAL DESCRIPTION OF ANDAMAN AND NICOBAR ISLANDS

The Andaman and Nicobar Islands comprise of 348 Islands of various sizes. They run in a more or less north-south line between 6° and 14° North latitude and 92° East longitude in the South-East Bay of Bengal. The total land area of the Islands is about 8,293 sq. kms. They are the summits of the submarine range of hills, 1,120 kms. long that connects the Arakan Yomas of Burma with Achin head in Sumatra. These Islands which can be broadly divided into two groups: (1) the Andaman Group, and (2) the Nicobar Group, are separated from each other by the ten-degree channel which is about 150 kms. wide and 400 fathoms deep.

Andaman group consists of 324 Islands, of which only 18 are inhabited. The main part of the group, collectively known as Great Andamans, consists of five closely adjoining Islands viz. North Andamans, Middle

Andamans, South Andamans, Baratang and Rutland. The Great Andaman group covers land area of 6,340 sq. kms. Little Andamans (48 kms. long. and 27 kms. wide) forms the southern extremity and lies about 50 kms. south of Great Andamans from which it is separated by a strait called Duncan Passage.

The Nicobar Group of Islands covering a land area of 1,953 sq. kms. comprises of 24 Islands, of which only 12 are inhabited. The distance between Car Nicobar, the northern-most Island, and Pygmalion Point, the southern-most tip of the Great Nicobar is about 260 kms. The Pygmalion Point is about 150 kms. from Achin Head, the northern tip of Sumatra Islands of Indonesia.

The Andaman and Nicobar Islands generally have low ranges of hills enclosing narrow valleys, which are covered by dense forest descending in many places to the sea shore. The vegetation is Burmese and Malay type. The middle Andaman and Great Nicobar have steep ridges and valleys with perennial streams and rivers. The climate of the Islands is tropical (Max. 23°-31°C) and variation in temperature is very little. Humidity is high, the average being 80%. These islands get both the monsoons; the heavy annual rainfall of about 313 cms. is mostly derived from the South-West monsoon.

The dense tropical forests are completely devoid of big mammals. Only pigs (a source of food for the aborigines) and rats occur in these islands. Spotted and barking deer were introduced from the Indian mainland in the last century. A great variety of birds, a few species of snakes and amphibians constitute the bulk of the endemic vertebrate fauna. The most poisonous creature is the giant centipede which some times is more than a foot long. The Giant African Snail was introduced during the Japanese occupation along with some plants. This snail has further spread to different Islands where it has become a great nuisance to the vegetable and fruit gardens. Biological control methods are being tried at present to control the population of these snails.

Key to the families of Andaman and Nicobar Islands Spiders

- | | |
|--|---------------|
| 1. Eyes eight | .2 |
| Eyes six | .SCYTODIDAE |
| 2. Cribellum and calamistrum present | .3 |
| Cribellum and calamistrum absent | 7 |
| 3. Tarsi furnished with unguis tufts and inferior claw | .PSECHRIDAE |
| Tarsi without unguis tufts and inferior claw | .4 |
| 4. Tracheal spiracles advanced in front of spinnerets | .FILISTATIDAE |
| Tracheal spiracles not advanced in front of spinnerets | .5 |

5. All eyes dark colouredULOBORIDAE
All eyes not dark coloured6
6. All eyes pearly white colouredAMAUROBIIDAE
Eyes white except anterior medians darkDICTYNIDAE
7. Palpal tarsus with claw in female8
Palpal tarsus without claw in femalePHOLCIDAE
8. Eyes heterogenousLINYPHIIDAE
Eyes homogenous9
9. Tarsi bear three claws10
Tarsi bear two claws17
10. Fourth tarsi with a ventral row of serrated bristlesTHERIDIIDAE
Fourth tarsi without a ventral row of serrated bristles11
11. Chelicerae very longTETRAGNATHIDAE
Chelicerae not long12
12. True web-weavers, sedentaryARGIOPIDAE
Not true web-weavers, not sedentary13
13. Chelicera without a lateral condyle and
very long spinneretsHERSILIIDAE
Chelicera with a lateral condyle and spinnerets short14
14. Trochanters not notchedAGELENIDAE*
Trochanters deeply notched15
15. Only fourth trochanters deeply notchedOXYOPIDAE
All trochanters deeply notched16
16. Paired claws with numerous teethPISAURIDAE
Paired claws with few teethLYCOSIDAE
17. Lower margin of chelicerae with distinct teeth18
Lower margin of chelicerae without distinct teeth19
18. Eyes heterogenous, small spiderGNAPHOSIDAE
Eyes homogeneous, big spiderHETEROPODIDAE
19. Crab-like spiderTHOMISIDAE
Not crab-like spider20
20. Eyes in two rows, almost equal in sizeCLUBIONIDAE
Eyes in three rows, very unequal in sizeSALTICIDAE

* Family not dealt with in this paper.

III. SYSTEMATIC ACCOUNT

Family I. SCYTODIDAE

Genus 1. *Scytodes* Latreille1. *Scytodes thoracica* (Latreille)

1802. *Aranea thoracica* Latreille, *Hist. Nat. Incrus. Ins.*, 7: 249.
 1864. *Scytodes thoracica* Blackwall, *History of British Spiders*, : 380.
 1902. *Scytodes thoracica*: Rainbow, *Rec. Aust. Mus. Sydney*, 4: 312.
 1935. *Scytodes thoracica*: Dyal, *Bull. Zool. Punjab Univ.*, 1: 154.
 1963. *Scytodes thoracica*: Tikader, *J. Univ. Poona Sci.*, 24: 31.

Specimens examined—1 ♀, Diglipur, North Andaman, Coll. B. K. Tikader, 23.4.1971. 1 ♀, Chiriatapu, South Andaman, Coll. B. K. Tikader, 29.5.1971. 1 ♀, Tugapur, Mayabandar, North Andaman, Coll. B. K. Tikader, 13.4.1971. 1 ♀, Durgapur, Diglipur, North Andaman, Coll. B. K. Tikader, 30.4.1971.

This species differs from *S. propingua* Stoliczka in being deep brown in colour. Cephalothorax has only a few black longitudinal streaks. Legs with transverse bands. Abdomen is dotted with black or brown colour.

According to Rainbow (1902) this was an European species which made its way to Australia by the agency of commerce. If so, it is quite possible that this species has migrated into India as well as Andaman Islands during the British time.

This spider is not web-spinning, but hides itself in dark corners of old houses and inside packing boxes.

Distribution.—India: Calcutta, Shillong, Punjab, Gujarat, Poona, Andaman Islands; Australia, Europe, America and Africa.

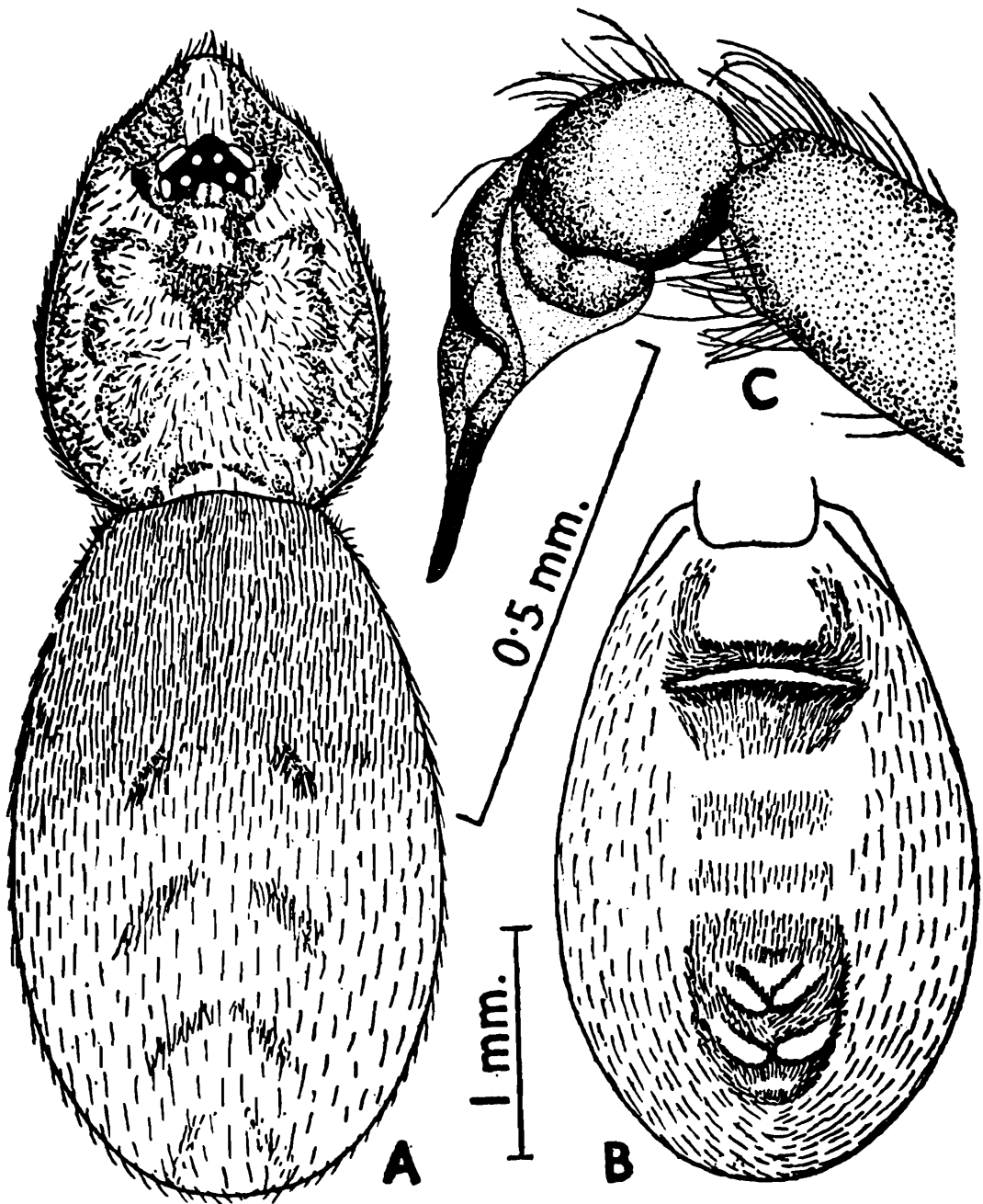
Family II. FILISTATIDAE

Genus 2. *Filistata* Latreille2. *Filistata nicobarensis* sp. nov.

General.—Cephalothorax and legs light brownish-green, abdomen brown or pale. Total length 5.00 mm. Carapace 2.00 mm. long, 1.50 mm. wide; abdomen 3.00 mm. long, 1.80 mm. wide.

Cephalothorax.—Longer than wide, pointed forward, almost flat but ocular area high, clothed with brown hairs. On lateral side of eye group a deep pointed muscular depression on each side. Eyes formed in a small group on the cephalic region, which is wider than long. Only anterior median eyes dark in colour, round and small, the others pearly

white and oval; both rows procurved; anterior lateral eyes larger than the others; the posterior median eyes contiguous with posterior laterals. Sternum oval, slightly pointed behind, thickly clothed with fine hairs. Legs long, specially the 1st pair. Legs formula 1243. Male palp as in text-fig. 1C.



Text-fig. 1 *Filistata nicobarensis* sp. nov.

(A) Dorsal view of female, legs omitted, (B) Ventral view of abdomen, (C) Male palp.

Abdomen.— Nearly egg shaped slightly narrower in front; clothed with fine brown hairs. Ventral side pale in colour; spinners situated near the middle of ventral side of abdomen. Epigyne simple like a transverse fold.

Type-specimen.—*Holotype* one ♀, *paratype* twenty ♀♀, *allotype* one ♂ in spirit.

Type locality.—Horticulture garden, office building, Car-Nicobar, India. Coll. B. K. Tikader, 8.3.1970.

This species resembles *Filistata poonaensis* Tikader but is separated from it as follows: (i) Abdomen nearly egg-shaped but in *F. poonaensis* Tikader abdomen nearly elliptical. (ii) Spinners situated near the middle of ventral side of abdomen but in *F. poonaensis* spinners situated near the end of ventral side of abdomen.

Other localities.—1 ♀ Aerial Bay, Guest House, Diglipur, North Andaman. Coll. B. K. Tikader, 23.4.1971. 2 ♀♀, Mayabandar Government Rest House, North Andamans. Coll. B. K. Tikader, 4.5.1971.

Family III. ULOBORIDAE

Genus 3. *Uloborus* Latreille

3. *Uloborus danolius* Tikader

1969. *Uloborus danolius* Tikader, *Proc. Indian Acad. Sci.*, 70: 129.

Specimens examined.—25 ♀♀, 10 ♂♂, Malacca village, Car-Nicobar India, Coll. B. K. Tikader, 11.3.1970.

Field notes.—This spider was collected from inside of an old and abandoned house. It prefers dark, old and abandoned houses. It spins an extremely fine web and it lies suspended upside down. The webs are placed near each other almost like a colony in a single abandoned house mainly in the dark corner of house.

Distribution.—India: Calcutta, North Bengal, Poona. Car-Nicobar. *Type-locality*—Danoli, District Ratnagiri, Maharashtra.

4. *Uloborus krishnae* Tikader

1970. *Uloborus krishnae* Tikader, *Rec. zool. Surv. India*, 64(1-4): 5.

Specimens examined.—4 ♀♀, 2 ♂♂ Kakana village, Car-Nicobar India, Coll. B. K. Tikader, 9.3.1970. 10 ♀♀, Keating point, Car-Nicobar, Coll. B. K. Tikader, 7.3.1970. 2 ♀♀, 1 ♂, Arong village, Car-Nicobar, Coll. B. K. Tikader, 9.3.1970. 5 ♀♀, 2 ♂♂, Diglipur, North Andaman, Coll. B. K. Tikader, 25.4.1971. 10 ♀♀, 7 ♂♂, Horticulture garden, Kamorta Island, Nicobar, Coll. B. K. Tikader, 25.3.1970.

Field notes.—I have collected this species from inside of an old and temporary abandoned hut. The specimens of Kamorta Island have some colour variation, mainly the abdomens of some females are without black bands and completely white in colour.

Distribution.—India: Gujarat, Sikkim, Andaman and Nicobar Islands,

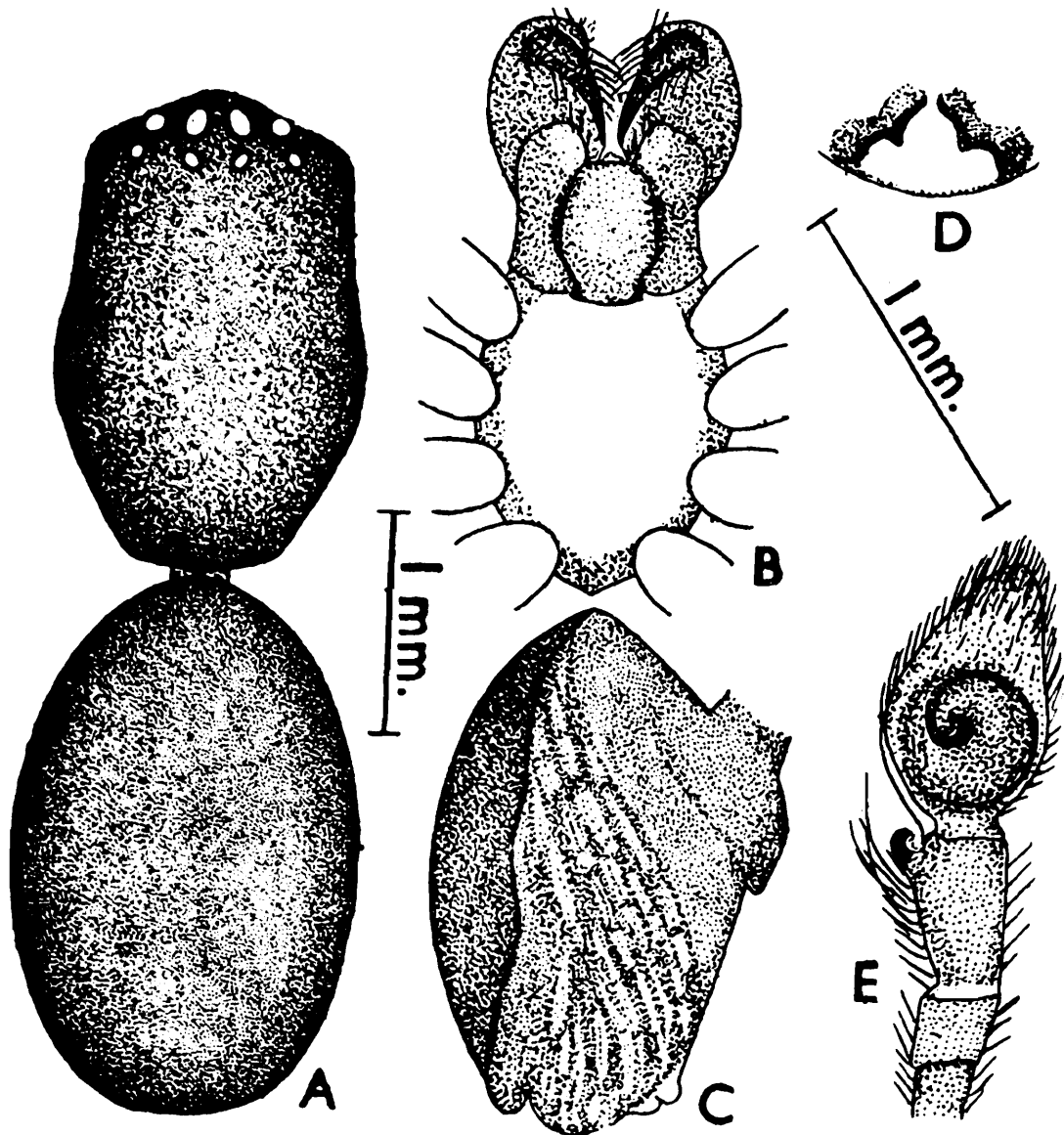
Family IV. AMAUROBIIDAE

Genus 4. Amaurobius Koch

5. *Amaurobius andamanensis* sp. nov.

General.—Cephalothorax, abdomen and legs deep reddish in colour. Total length 3.00 mm. Carapace 1.40 mm. long, 0.90 mm. wide, abdomen 1.60 mm. long, 1.10 mm. wide.

Cephalothorax.—Longer than wide, smooth, practically devoid of hairs or spines. Middle of cephalothorax high and sloping in all the directions. Eyes pearly white in two rows, both the rows procurved; ocular quad narrowing in front, slightly longer than wide. Legs thin and long clothed with fine hairs and spine like hairs. Tibiae and metatarsi of I leg with six and four pairs of ventral spines respectively. Legs for-



Text fig. 2 *Amaurobius andamanensis* sp. nov.

- (A) Dorsal view of female, legs omitted, (B) Maxillae and labium,
(C) Lateral view of abdomen, (D) Epigyne, (E) Male palp.

mula 1423. Chelicerae strong and stout. Sternum heart shaped, pointed behind. Maxilla and labium as in text-fig. 2B. Male palp as in text-fig. 2E.

Abdomen.—Longer than wide, narrowing in front without hairs and very smooth. Upper portion of abdomen provided with a chitinous collar. Ventral side without chitinous collar and clothed with fine hairs. Epigyne as in text-fig. 2D.

Type specimen.—*Holotype* one ♀, *allotype* one ♂ in spirit.

Type-locality.—Aerial Bay, Diglipur, North Andaman, India. Coll. B. K. Tikader, 25.4.1971. *allotype*, from Smith Island, North Andaman, India, Coll. B. K. Tikader, 27.4.1971.

This species somewhat resembles *Amaurobius bennetti* (Blackwall) from America, but it is separated as follows: (i) Upper portion of abdomen provided with chitinous collar but in *A. bennetti* abdomen with two parallel longitudinal light bands; each of these is continued in a zig-zag manner, up to the tip of the abdomen. (ii) Epigyne and male palp structurally different.

Family V. DICTYNIDAE

Genus 5. *Dictyna* Sundevall

6. *Dictyna bedeshai* Tikader

1966. *Dictyna bedeshai* Tikader *Proc. Linn. Soc.*, 177: 50.

Specimens examined.—1 ♀, Long Island, Middle Andaman, India, Coll. B. K. Tikader, 17.5.1971. 1 ♀, Chiriatapu, South Andaman, India, Coll. B. K. Tikader, 29.5.1971.

Distribution.—India : Poona, Maharashtra, Andaman and Nicobar Islands.

7. *Dictyna rebai* Tikader

1966. *Dictyna rebai* Tikader, *Proc. Linn. Soc.*, 177: 45.

Specimens examined—1 ♀, Kamorta Island, Nicobar Islands, India, Coll. B. K. Tikader, 17.3.1970.

Distribution—India: Poona, Maharashtra, Andaman and Nicobar Islands.

Family VI. PHOLCIDAE

Genus 6. *Artema* Walckenaer

8. *Artema atlanta* Walckenaer

1837. *Artema atlanta* Walckenaer, *Ins. Apteres.*, 1: 656.

1900. *Artema atlanta*: Pocock, *Fauna. Brit. India. Arach.*, : 238.

1963. *Artema atlanta*: Tikader, *J. Univ. Poona, Sci. & Tech.*, 24: 38.

Specimens examined— 5 ♀♀, 2 ♂♂, in the waiting hall near Rangat Jetty, Middle Andaman, India, Coll. B. K. Tikader, 22.4.1970. 7 ♀♀, at Mayabandar rest house, North Andaman, India, Coll. B. K. Tikader, 4.5.1971. 1 ♀, in the rest house of Delanipur, Port Blair, South Andaman, Coll. B. K. Tikader, 22.4.1971.

Distribution—India: Travancore, Bombay, Meerut, Poona, Rajasthan, Bengal, Andaman Island; Ceylon, Burma.

Genus 7. Pholcus Walckenaer

9. *Pholcus kapuri* sp. nov.*

General— Cephalothorax, abdomen and legs light greenish. Total length 6.20 mm. Carapace 1.50 mm. long, 1.40 mm. wide; abdomen 4.80 mm. long, 1.20 mm. wide.

Cephalothorax—Nearly as long as wide, slightly narrow in front; ocular area slightly high. Middle of cephalothorax provided with a conspicuous broad longitudinal line extending from ocular area to base of cephalothorax, lateral side of cephalothorax also provided with similar brown patch. Anterior median eyes almost continuous and smaller than the other eyes. Anterior and posterior lateral along with posterior median eyes formed a compact group. In the male this group of eyes formed a little stalk-like projection as in text-fig. 3C. Legs thin and very long provided with inconspicuous light brown transverse bands. Sternum nearly as wide as long, narrowing behind, clothed with fine hairs. Male palp as in text fig. 3E & F.

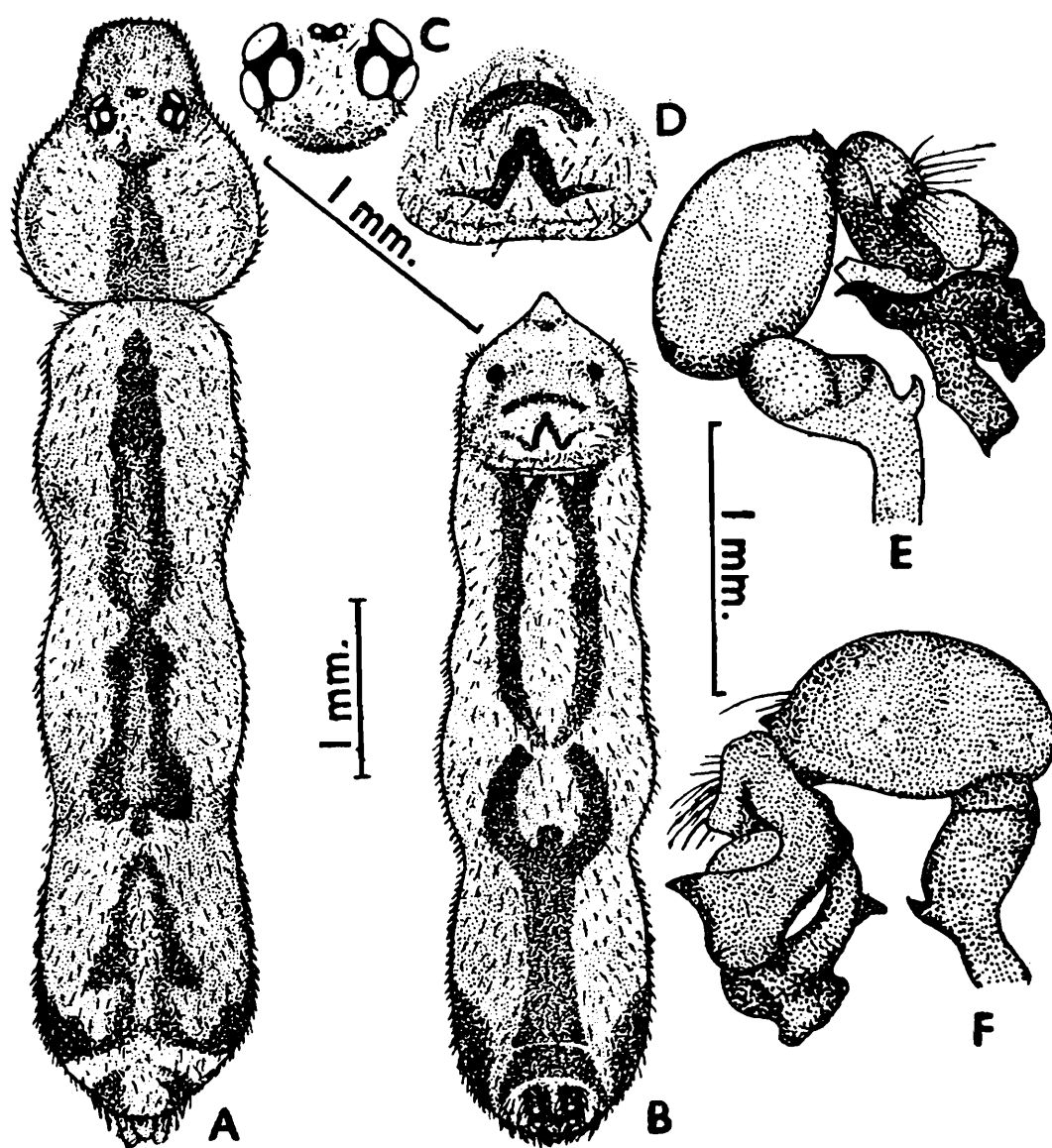
Abdomen— Cylindrical in shape, about ten times as long as wide. Mid-dorsally and mid-ventrally provided with conspicuous longitudinal brownish band as in text-fig. 3A & B. Spinners situated at the end of abdomen. Epigyne very simple as in text fig. 3D.

Type-specimen— *Holotype* one ♀, *paratype* two ♀♀, *allotype* one ♂ in spirit.

Type locality—Neil Island, Reserve forest, Andaman and Nicobar Islands, India, Coll. B. K. Tikader, 11.4.1970. Also collected from Chiria-tapu South Andaman. One female, Coll. B. K. Tikader, 28.5.1971.

This species resembles *Pholcus gracillimus* Thorell but separated as follows: (i) Abdomen mid-dorsally and mid-ventrally provided with a longitudinal brownish-red band but in *P. gracillimus* no such band. (ii) Epigyne and male palp also structurally different.

*It is with much pleasure that I named this species after Dr. A. P. Kapur, an eminent Entomologist and former Director, Zoological Survey of India.



Text fig. 3 *Pholcus kapuri* sp. nov.

- (A) Dorsal view of female, legs omitted, (B) Ventral view of abdomen,
 (C) Eyes of male, (D) Epigyne, (E) Ventral view of male palp,
 (F) Dorsal view of male palp.

Family VII. LINYPHIIDAE

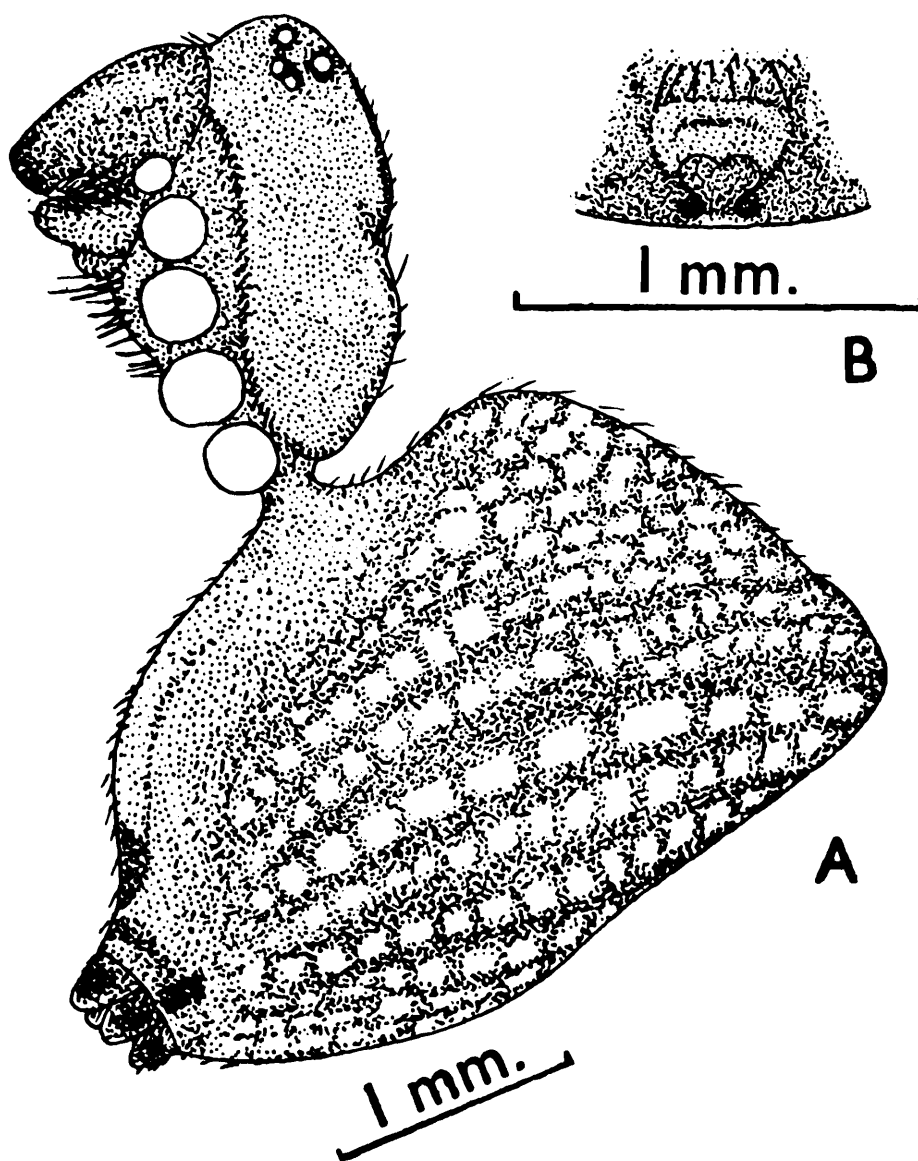
Genus 8. *Linyphia* Latreille

10. *Linyphia nicobarensis* sp. nov.

General—Cephalothorax and legs light greenish, abdomen greenish brown ornamented, with silvery patches. Total length 5.00 mm. Carapace 1.80. mm. long, 1.40 mm. wide, abdomen 3.20 mm. long, 2.00 mm. wide.

Cephalothorax— Longer than wide, nearly flat, cephalic region slightly convex, lower half broadest and narrowing in front. Middle of cephalothorax provided with two conspicuous dark brown lines extending from

base of posterior middle eyes to near the base of cephalothorax; lateral margin also provided with dark brown line. Eyes pearly white, anterior row recurved, posterior row straight, lateral eyes small and contiguous, base of each eye encircled by conspicuous black patch. Sternum heart-shaped, longer than wide and pointed behind. Legs long and clothed with fine hairs and spines. I pair of leg very long and stout. Legs formula 1243.



Text-fig. 4 *Linyphia nicobarensis* sp. nov.

(A) Lateral view of female, legs omitted, (B) Epigyne.

Abdomen—Globular, slightly longer than wide, clothed with very fine hairs, slightly overlapping the posterior region of cephalothorax in front. Anterodorsal side provided with two humps as in text-fig. 4A. All the sides of abdomen beautifully decorated with silvery patches as in text-fig. 4A. Epigyne as in text-fig. 4B.

Holotype—One ♀ in spirit.

Type-locality—Kamorta Island, Nicobar, India, Coll. B. K. Tikader, 22.3.1970.

This species resembles *Linyphia urbasae* Tikader but it is distinguished from it as follows: (i) Cephalothorax provided with two brown conspicuous longitudinal lines but in *L. urbasae* cephalothorax uniform brown. (ii) Abdomen with a dorsal hump and decorated with conspicuous silvery patches but in *L. urbasae* abdomen chalk-white and dorsal side conspicuously marked with a longitudinal and two transverse black bars. (iii) Epigyne is also structurally different.

Family VIII. THERIDIIDAE

Genus 9. *Theridion* Walckenaer

11. *Theridion indica* sp. nov.

General—Cephalothorax and legs light green, abdomen brownish white with black and white patches. Total length 4.20 mm. Carapace 1.20 mm. long, 0.90 mm. wide; abdomen 3.00 mm. long, 2.80 mm. wide.

Cephalothorax—Slightly longer than wide, convex, moderately narrowing in front, clothed with fine pubescence. Eyes pearly white, lateral eyes contiguous, ocular quad longer than wide, anterior row strongly recurved and posterior row straight. Sternum heart-shaped, pointed behind and provided with a mid-longitudinal dark line. Legs stout and strong, clothed with hairs. Tarsi of IV pair of legs with distinct comb-like setae.

Abdomen—Globular in shape, slightly longer than wide, clothed with fine hairs. Dorsal and lateral sides beautifully coloured with regular admixture of chalk-white and brownish green patches as in text-fig. 5A, A1. Ventral side uniform light brown or pale brown in colour without white patches. Epigyne as in text-fig. 5B.

Holotype—one ♀, *paratype* three ♀♀ in spirit.

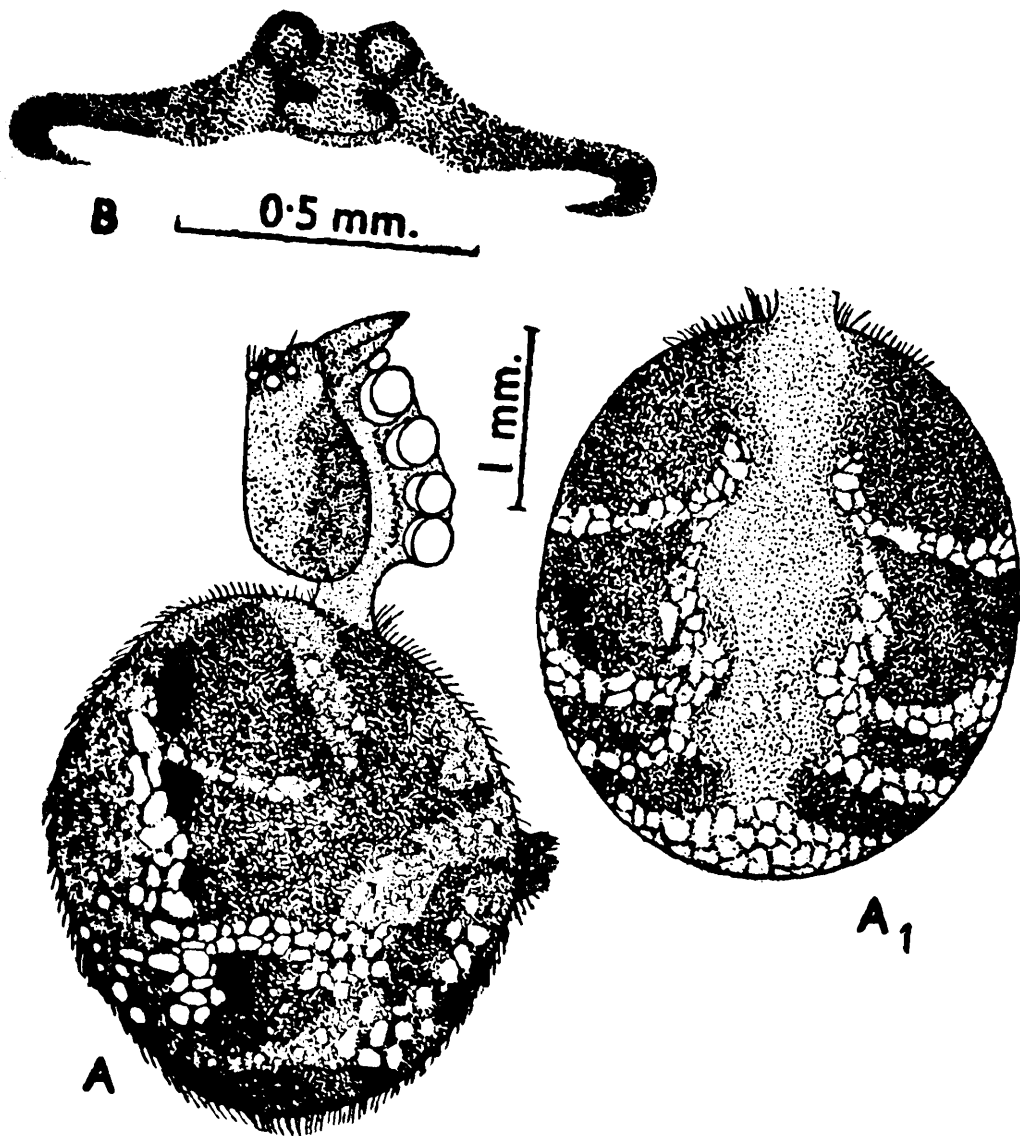
Type-locality—Neil Island, South Andaman, India, Coll. B. K. Tikader, 13.4.1970.

This species resembles *Theridion manjithar* Tikader from Sikkim but it is separated as follows: (i) Abdomen beautifully coloured with regular admixture of chalk-white and brownish green patches but in *T. manjithar* abdomen beautifully coloured with irregular white and black spots. (ii) Epigyne is also structurally different.

Genus 10. *Argyroides* Simon

12. *Argyroides carnicobarensis* sp. nov.

General—Cephalothorax and legs light to deep brown, abdomen light silvery in colour. Total length 3.00 mm. Carapace 1.20 mm. long, 1.00 mm. wide; abdomen 2.00 mm. long, 1.50 mm. wide.



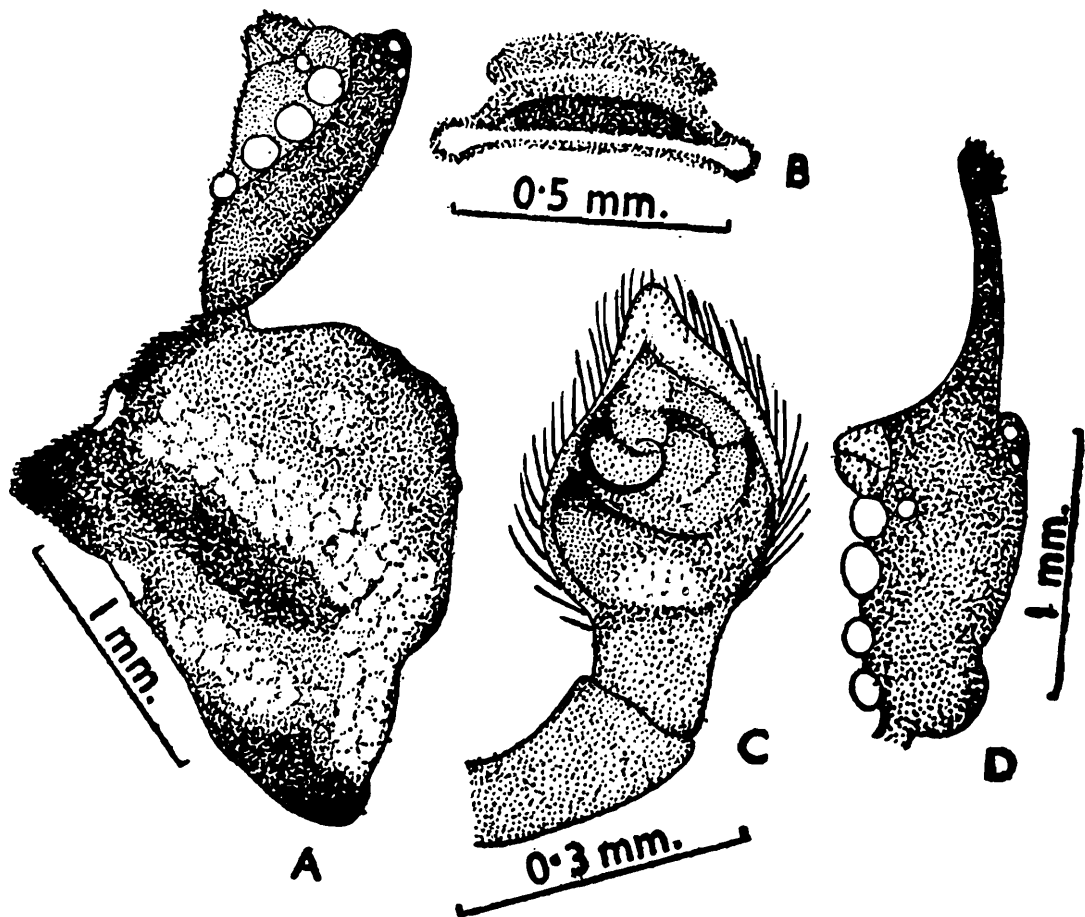
Text-fig. 5 *Theridion indica* sp. nov.

- (A) Lateral view of female, legs omitted, (A 1) Dorsal view of abdomen of female, (B) Epigyne.

Cephalothorax—Longer than wide, cephalic region slightly high, anterior and posterior ends narrow. Eyes pearly white, lateral eyes small and contiguous, anterior medians slightly larger than posterior medians; ocular quadrangle wider than long. Anterior row recurved and posterior row procurved. Sternum heart-shaped, pointed behind. Legs long and slender, clothed with fine hairs.

Abdomen— Nearly as long as wide or slightly longer than wide, abdomen extends posteriorly beyond the spinners. Dorsal side of abdomen decorated with conspicuous silvery patches. Ventral side uniform dark brown in colour, provided with three conspicuous silvery dots, one in front of spinners and another two behind the spinners. Epigyne as in text-fig. 6B. Males more slender than females and with less silvery decoration on the abdomen. Head of male bears one conspicuous long

horn as in text-fig. 6D. Legs of male longer and slender than female. Male palp as in text-fig. 6C.



Text-fig. 6 *Argyrodes carnicobarensis* sp. nov.

(A) Lateral view of female, legs omitted, (B) Epigyne, (C) Male palp, (D) Head of male.

Holotype— one ♀, *paratype* four ♀♀, *allotype* three ♂♂ in spirit.

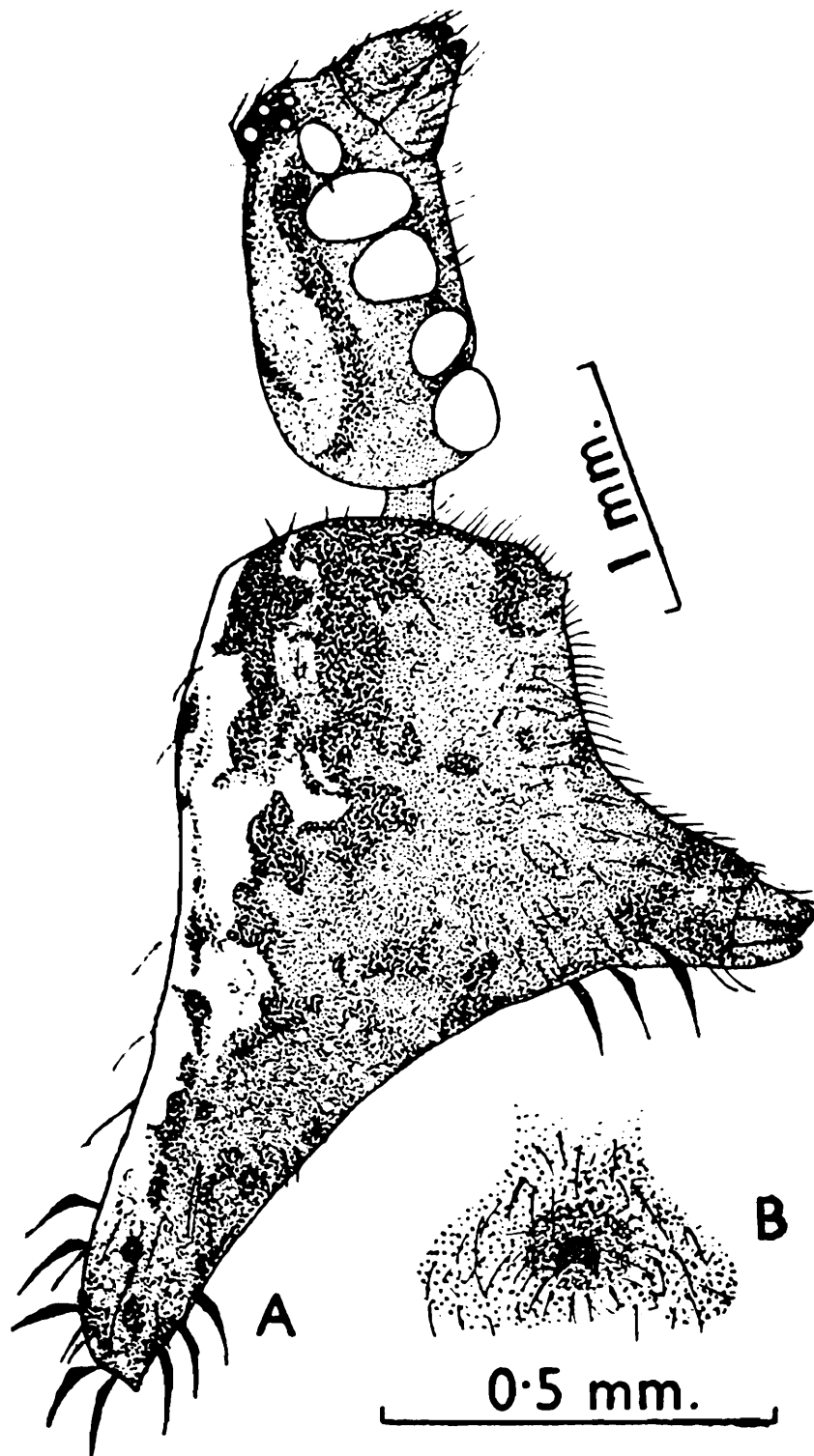
Type-locality— Kakana village, Car-Nicobar, India, Coll. B. K. Tikader, 4.3.1970.

I have collected this species from the web of pisaurid spider. This species resembles *Argyrodes gazedes* Tikader from Sikkim but it is distinguished from it as follows: (i) Carapace of male bears a conspicuous long horn but in *A. gazedes* male bears two horns. (ii) Posterior end of abdomen without black spot but in *A. gazedes* abdomen with a conspicuous black spot. (iii) Female epigyne and male palp also structurally different.

13. *Argyrodes andamanensis* sp. nov.

General— Cephalothorax and legs light greenish yellow, abdomen chalk-white. Total length 5.00 mm., Carapace 1.50 mm. long, 0.80 mm. wide; abdomen 3.50 mm. long, 1.50 mm. wide.

Cephalothorax— Longer than wide, narrowing in front clothed with fine hairs and with long hairs, ocular area conspicuously elevated. Middle of cephalothorax slightly depressed, centre provided with conspicuous triangular deep brown markings and similar deep-brown markings near the border as in text-fig. 7A. Eyes of anterior row slightly recurved and posterior row procurved; lateral eyes contiguous. Ocular quad as long as wide. Sternum heart-shaped, pointed behind. Legs very long,



Text-fig. 7 *Argyrodes andamanensis* sp. nov.

(A) Lateral view of female, legs omitted, (B) Epigyne.

clothed with hairs and special type of black setae and black dots. I and IV legs robust and end of tibiae provided with conspicuous black setae.

Abdomen— Long, remarkably slender and moderately prolonged from beyond the spinners as in text-fig. 7A. Abdomen provided with deep brown and silvery white patches. Posterior pointed portion of abdomen provided with tuft of conspicuous black setae. Epigyne as in text-fig. 7B.

Holotype— one ♀ in spirit.

Type locality— Forest adjoining rest house, Chiriatapu, South Andaman, India, Coll. B. K. Tikader, 28.5.1971.

This species resembles *A. ambalikae* Tikader from Sikkim but it is separated as follows: (i) Cephalothorax provided with conspicuous triangular deep brown marking but in *A. ambalikae* no such markings on cephalothorax. (ii) Abdomen on the posterior end provided with conspicuous black setae but in *A. ambalikae* no such setae on the posterior end of abdomen. (iii) Epigyne also structurally different.

14. *Argyrodes chiriatapuensis* sp. nov.

General.— Cephalothorax and abdomen deep brown, legs reddish. Total length 3.70 mm. Carapace 1.20 mm. long, 0.85 mm. wide; abdomen 2.50 mm. long, 1.80 mm. wide.

Cephalothorax.— Longer than wide, narrowing in front, cephalic region slightly high, posterior end of cephalothorax provided with longitudinal white patch. Eyes pearly white except anterior median, posterior row nearly straight, anterior row strongly recurved, lateral eyes contiguous. Sternum heart-shaped, pointed behind. Legs long and slender, clothed with fine hairs.

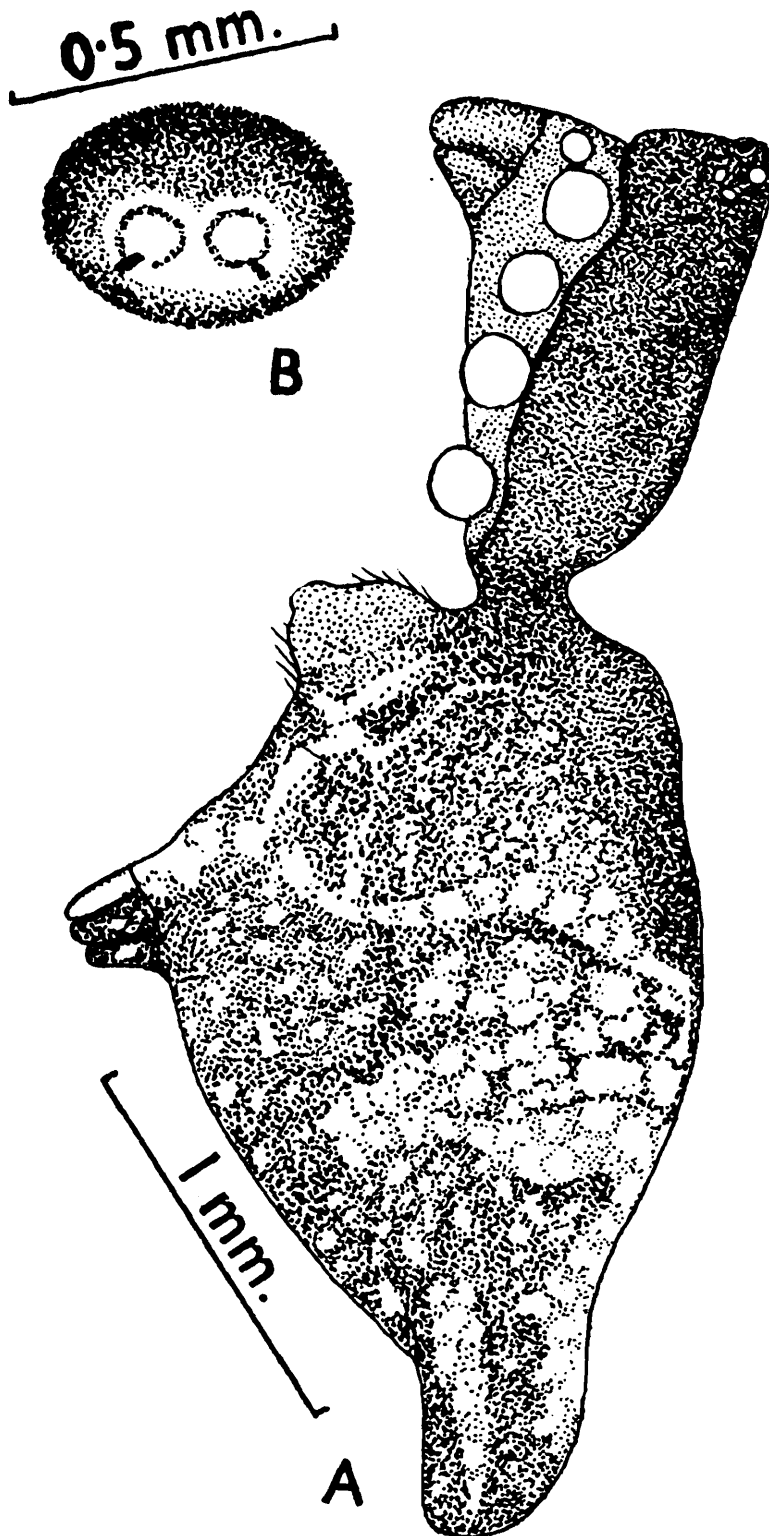
Abdomen.— Wider than long, clothed with fine hairs; overlapping the posterior region of cephalothorax in front, broadest in the region of spinnerets, abdomen extended behind spinners, posterior end elevated and provided with a conspicuous black patch. Abdomen decorated with silver white and deep brown patches as in text-fig. 8A. Epigyne as in text-fig. 8B.

Holotype.— one ♀ in spirit.

Type-locality.— Chiriatapu, South Andaman, India, Coll. B. K. Tikader, 29.5.1971.

This species resembles *Argyrodes gazedes* Tikader from Sikkim but it is distinguished from it as follows: (i) Posterior end of cephalothorax provided with longitudinal white patch but in *A. gazedes* no such patch on cephalothorax. (ii) Posterior end of abdomen provided with a con-

spicuous black patch but in *A. gazedes* posterior end of abdomen provided with white patch. (iii) Epigyne structurally different.



Text-fig. 8 *Argyrodes chiriatapuensis* sp. nov.

(A) Lateral view of female, legs omitted, (B) Epigyne.

Genus 11. *Achaeearanea* Strand

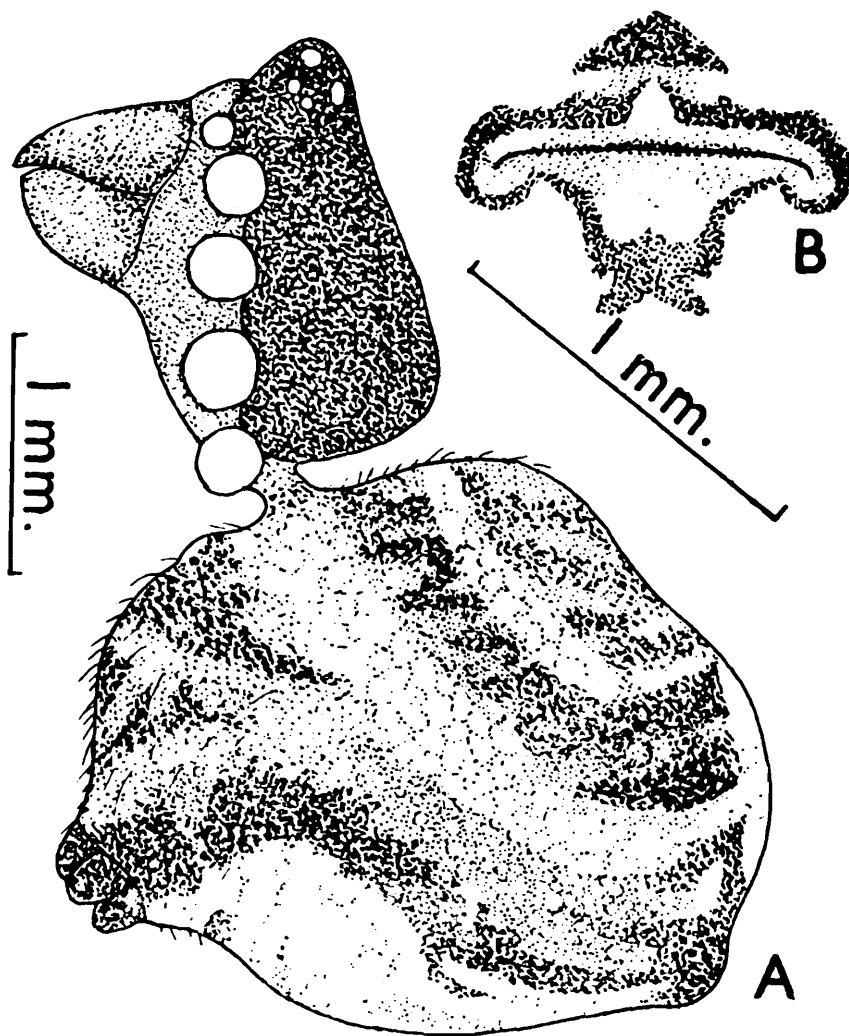
15. *Achaeearanea diglipuriensis* sp. nov.

General.— Cephalothorax light to deep brown, legs brownish green,

abdomen brown. Total length 4.10 mm. Carapace 1.60 mm. long, 1.00 mm. wide; abdomen 2.50 mm. long, 2.00 mm. wide.

Cephalothorax.— Longer than wide, convex, narrowing in front; clothed with fine hairs. Eyes pearly white except anterior medians, lateral eyes small and contiguous, ocular quad longer than wide. Clypeus round and slightly grooved under eyes. Sternum heart-shaped, longer than wide, pointed behind, clothed with fine hairs and posterior extremity of sternum provided with dark brown patch. Legs robust, clothed with thick hairs. Tarsi of IV pair of leg with distinct comb-like setae.

Abdomen.— Globular, nearly as long as wide, clothed with fine hairs slightly overlapping the posterior region of cephalothorax in front. Spinners behind the middle of abdomen with an elevated knob having posteriorly a blackish-white mark. Abdomen provided with a regular pattern of chalk-white and deep brown patches as in text-fig. 9A. Epigyne as in text-fig. 9B.



Text-fig. 9 *Achaearanea diglipuriensis* sp. nov.

- (A) Lateral view of female, legs omitted, (B) Epigyne.

Holotype.— one ♀, **paratypes** six ♀♀, **allotypes** three ♂♂ in spirit.

Type-locality.— Aerial Bay, Diglipur, North Andaman, India, Coll. B. K. Tikader, 25.4.1971.

This species resembles *Achaearanea durgae* Tikader from Sikkim but it can be distinguished from it as follows: (i) Abdomen with an elevated knob having posteriorly blackish-white mark but in *A. durgae* Tikader abdomen greenish-brown and moderately elevated posteriorly with a knob having yellowish-white mark. (ii) Epigyne and male palp also structurally different.

Family IX. TETRAGNATHIDAE

Genus 12. *Tetragnatha* Latreille

16. *Tetragnatha mandibulata* Walckenaer

1837. *Tetragnatha mandibulata* Walckenaer, *Ins. Apt.*, 2: 211.

1900. *Tetragnatha mandibulata*: Pocock, *Fauna Brit. India, Arach.*, : 215.

1921. *Tetragnatha mandibulata*: Gravely, *Rec. Indian Mus. Calcutta*, 22: 429.

1962. *Tetragnatha mandibulata*: Tikader, *J. Univ. Poona, Sci. Tech*, 24: 49.

Specimens examined.—1 ♀, 1 ♂, Neil Island, Andaman, India, Coll. B. K. Tikader, 11.4.1970. 1 ♀, 1 ♂, Port Blair, South Andaman, India, Coll. B. K. Tikader, 18.4.1971.

Distribution.— India: Cochin, Bangalore, Mysore, Madras, Orissa, West Bengal, Bihar, Nepal, Sikkim, Assam, Andaman Islands; Burma,

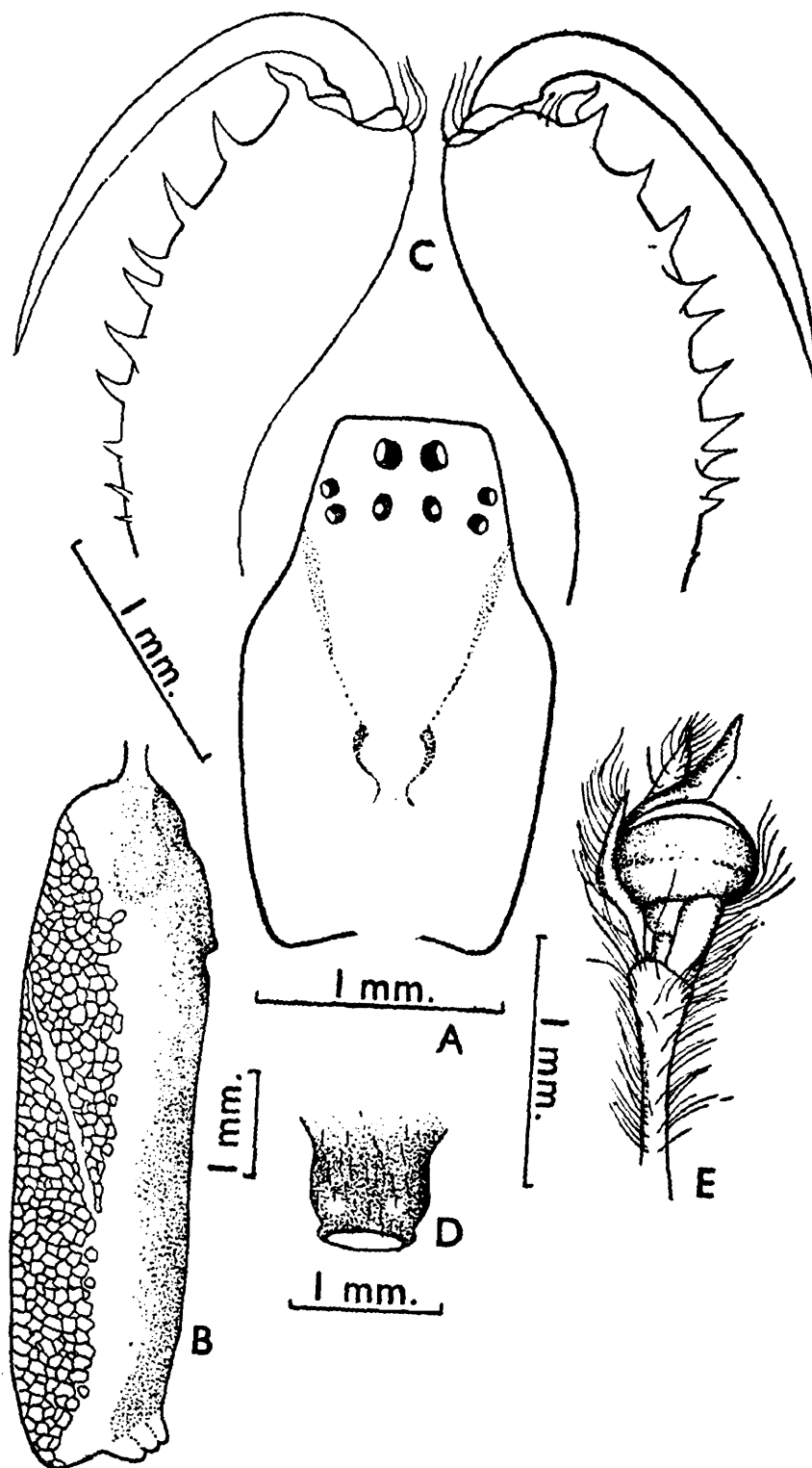
17. *Tetragnatha andamanensis* sp. nov.

General.— Cephalothorax and legs light brownish green, abdomen light brown. Total length 4.80 mm. Carapace 2.00 mm. long, 1.20 mm. wide; abdomen 2.80 mm. long, 0.80 mm. wide.

Cephalothorax— Longer than wide, narrowing in cephalic region; flat, cephalic region slightly high, centre of the cephalothorax depressed. Eyes in two rows, both rows recurved but anterior row more recurved than the posterior row. Anterior median eyes larger than the others, lateral eyes nearly contiguous. Ocular quad longer than wide and slightly narrower in front than behind. Chelicerae nearly as long as carapace and strongly divaricate. Outer row of chelicerae provided with ten teeth, first is larger, others gradually diminishing in size as in text-fig. 10C. Inner margin also provided with ten teeth but first tooth is slightly curved than the others. Fang slender and unarmed. Legs very long, clothed with hairs and spines. Male palp as in text-fig. 10E.

Abdomen— Long, nearly parallel sided, clothed with fine hairs. Supinnerets nearly to the posterior end of the abdome. Abdomen de-

corated with minute silvery white dots as in text-fig. 10B. Ventral side uniform pale colour without silvery dots. Epigyne as in text-fig. 10D.



Text-fig. 10 *Tetragnatha andamanensis* sp. nov.

- (A) Cephalothorax of female,
 (B) Abdomen of female, (C) Chelicerae of female, (D) Epigyne,
 (E) Male palp.

Holotype— one ♀, *paratype* one ♀, *allotype* one ♂ in spirit.

Type-locality— Chiriatapu, South Andaman, India, Coll. B. K. Tikader, 28.4.1971. **Allotype**: Delanipur, Port Blair, Andaman Island, India, Coll. B. K. Tikader, 22.5.1971.

This species somewhat resembles *Tetragnatha sutherlandi* Gravely but it is separated as follows: (i) Dorsal and ventral row of chelicerae provided with ten teeth but in *T. sutherlandi*, chelicerae with five teeth. (ii) Abdomen long, parallel sided but in *T. sutherlandi* abdomen long and narrowing behind. (iii) Epigyne and pedipalp also structurally different.

Family X. ARGIOPIDAE

Genus 13. *Argiope* Savigny

18. *Argiope aemula* (Walck.)

1837. *Epeira aemula* Walck., *Ins. Apt.*, 2: 118.

1881. *Argiope aemula*: Thorell, *Ann. Mus. Genova*, 17: 63.

Specimens examined— 1 ♀, Neil Islands, Andaman, Coll. B. K. Tikader, 11.4.1970. 1 ♀, Car-Nicobar, Coll. B. K. Tikader, 8.3.1970. 1 ♀, Durgapur village, Diglipur, North Andaman, Coll. B. K. Tikader, 30.4.1971.

Distribution— India: Trivandrum, Nilgiri Hills, Maharashtra, Gujarat, Andaman and Nicobar Islands; Ceylon, Burma, Rangoon and Austro-Malaysia.

Genus 14. *Nephila* Leach

19. *Nephila maculata* (Fab.)

1793. *Araneae maculata* Fabricius, *Ent. Syst.*, 2: 425.

1900. *Nephila maculata*: Pocock, *Fauna Brit. India Arach.*, : 217.

1923. *Nephila maculata*: Gravely, *J. Bombay nat. Hist. Soc.*, 28: 1047.

1962. *Nephila maculata*: Tikader, *J. Linn. Soc. London*. 44(300).

Specimens examined— 1 ♀, Durgapur near Diglipur Jetty, North Andaman, Coll. B. K. Tikader, 23.4.1971. 1 ♀, Kamorta Island, Nicobar, Coll. B. K. Tikader, 21.3.1970.

Distribution— India: Tinnevely, Trivandrum, Ootacamund, Kanara, Dehra Dun, Darjeeling, Madhya Pradesh, Sikkim, Assam, Maharashtra, Mysore, West Bengal, Andaman and Nicobar Islands; Burma, Ceylon, China and Australia.

Genus 15. *Gasteracantha* Sundevall

20. *Gasteracantha brevispina* (Dol.)

1857. *Plactana brevispina* Doleschall, *Nat. Tij. Nederland, India*, 13: 423.

1900. *Gasteracantha brevispina*: Pocock, *Fauna Brit. India Arach.*, 235.

1970. *Gasteracantha brevispina*: Tikader, *Rec. zool. Surv. India*, 64(1-4): 38.

Specimens examined— 2 ♀♀, Horticulture garden, Car-Nicobar, Coll. B. K. Tikader, 11.3.1970. 2 ♀, 1 ♂, Arong Village, Car-Nicobar, Coll. B. K. Tikader, 9.3.1970. 18 ♀♀, Diglipur, North Andaman, Coll. B. K. Tikader, 28.4.1971. 13 ♀♀, Malacca village, Car-Nicobar, Coll. B. K. Tikader, 5.3.1970. 2 ♀♀, Durgapur, near Diglipur jetty, North Andaman, Coll. B. K. Tikader, 30.4.1971.

Distribution— India: Madras, Dehra Dun, Poona, Bombay, Andaman & Nicobar Islands, Darjeeling, Calcutta, Bihar, Shillong, Orissa; Bangladesh; Burma; Sikkim; Ceylon; Austro-Malaysia; Japan.

21. *Gasteracantha diadesmia* Thorell

1887. *Gasteracantha diadesmia* Thorell, *Ann. Mus. Geneva*, 25: 225.

1900. *Gasteracantha diadesmia*: Pocock, *Fauna Brit. India Arach.*, : 234.

1970. *Gasteracantha diadesmia*: Tikader, *Rec. zool. Surv. India*, 64(1-4): 40.

Specimens examined— 1 ♀, Neil Island, Andaman, Coll. B. K. Tikader, 12.3.1970.

Distribution— India: Kalimpong, West Bengal, Andaman and Nicobar Islands, Sikkim; Burma, Rangoon, Thailand.

Genus 16. *Araneus* Clerck

22. *Araneus dehaanii* (Dol.)

1859. *Epeira dehaanii* Doleschall, *Verh. Nut. Vereen Nederland India*. 5: 83.

1900. *Araneus dehaanii*: Pocock, *Fauna Brit. India Arach.*, : 225.

1970. *Araneus dehaanii*: Tikader, *Rec. zool. Surv. India*, 64 (1-4): 30.

Specimens examined— 1 ♀, Kamorta Island, Nicobar, Coll. B. K. Tikader, 17.3.1970. 1 ♀, Haddoo, Port Blair. Coll. B. K. Tikader, 18.4.1971.

Distribution— India: Kanara; Cochin, Mysore, Darjeeling, Kalimpong in West Bengal, Assam; Sikkim, Ceylon, Malay Peninsula and Austro-Malaysia.

23. *Araneus mitifica* (Thorell)

1878. *Epeira mitifica* Thorell, *Ann. Mus. Genova*, 13 : 187.

1896. *Epeira mitifica*: Workman, *Malaysian Spider*, : 39.

1963. *Araneus mitifica*: Tikader, *J. Univ. Poona*, 24: 43.

Specimens examined— 1 ♀, Kamorta Island, Nicobar Islands, Coll. B. K. Tikader, 17.3.1970.

Distribution— India: West Bengal, Mysore, Assam, Maharashtra, Andaman and Nicobar Islands; Burma.

24. *Araneus noegeata* (Thorell)

1895. *Epeira noegeata* Thorell, *Spider of Burma*, : 178.

1896. *Epeira noegeata*: Workman, *Malayasian Spiders, Belfast*, : 43.

Specimen examined— 1 ♀, Long Island, Middle Andaman, India, Coll. B. K. Tikader, 17.5.1971.

Distribution— India: Andaman Islands; Burma, Sumatra.

Genus 17. *Cyclosa* Menga25. *Cyclosa centrodes* (Thorell)

1887. *Epeira centrodes*, Thorell, *Ann. Mus. Genova*, 5 : 209.

1896. *Epeira centrodes*: Workman, *Spiders, Malaysian Spiders, Belfast*, : 35.

Specimens examined— 1 ♀, Long Island, Middle Andaman. Coll. B. K. Tikader, 17.5.1971.

This species was first described by Thorell (1887) and subsequently described by Workman (1896). But their description is very inadequate. I am giving full description for future help to recognise this species easily.

General— Cephalothorax and legs yellowish-red, abdomen whitish brown. Total length 6.00 mm. Carapace 2.00 mm. long, 1.50 mm. wide; abdomen 5.00 mm. long, 3.00 mm. wide.

Cephalothorax— Slightly longer than wide, cephalic region and cervical groove prominent. Eyes two rows, posterior row slightly procurved and anterior row slightly recurved and lateral eyes contiguous. Ocular quad slightly longer than wide. Posterior half of the cephalothorax overlapped by the abdomen. Legs long, clothed with hairs and spine-like hair. Legs formula 1243.

Abdomen— Longer than wide, posterior end pointed like a tail. Anterior side of abdomen provided with three pairs of sigilla. Dorsal side more deep brown than the ventral side and provided with transverse muscular ridges. Spinnerets situated near epigyne.

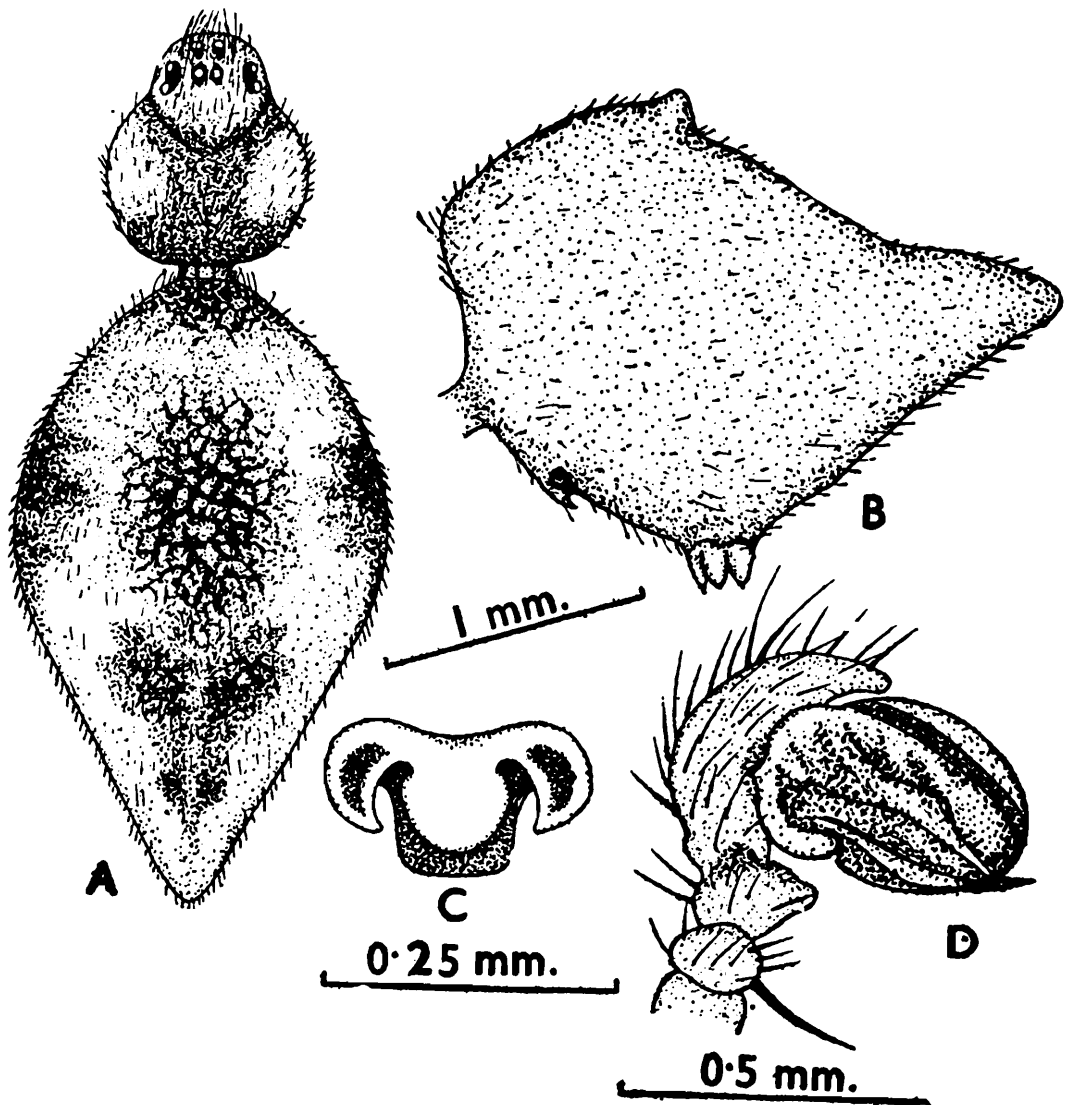
Distribution— India: Andaman and Nicobar Islands; Burma, Sumatra.

26. *Cyclosa neilensis* sp. nov.

General— Cephalothorax and legs light brown, abdomen chalk white. Total length 3.20 mm. Carapace 0.80 mm. long, 0.60 mm. wide; abdomen 2.20 mm. long, 1.50 mm. wide.

Cephalothorax— Longer than wide, cephalic region slightly high, cervical groove very prominent. Thoracic region provided with conspicuous brown patch. Eyes two rows, posterior row straight and anterior

row strongly recurved and lateral eyes contiguous. Ocular quad wide in front. Legs thin and clothed with fine hairs and provided with deep brown transverse bands. Legs formula 1243. Sternum heart-shaped pointed behind. Male palp as in text-fig. 11D.



Text-fig. 11 *Cyclosa neilensis* sp. nov.

(A) Dorsal view of female, legs omitted, (B) Lateral view of abdomen, (C) Epigyne, (D) Male palp.

Abdomen— Longer than wide, pointed behind, clothed with fine hairs. Two small muscular prominences on the antero-dorsal side of the abdomen. Ventral side almost similar colour like dorsal. Spinnerets situated on the middle of abdomen. Epigyne as in text-fig. 11 C

Holotype—one ♀, *paratypes* eleven ♀♀ in spirit.

Type-locality— Neil Island, Andaman, India, Coll. B. K. Tikader, 12.3.1970.

This species resembles *Cyclosa centrodes* (Thorell) but is separated as follows: (i) Posterior row of eyes straight but in *C. centrodes* posterior

row of eyes procurved. (ii) Abdomen pointed behind but in *C. centrodes* abdomen pointed behind like a tail. (iii) Epigyne and male palp also structurally different.

Genus 18. *Cyrtophora* Simon

27. *Cyrtophora cicatrosa* (Stoliczka)

1869. *Eperia (Nephila) cicatrosa* Stoliczka, *J. Asia. Soc. Bengal*, 38:242.
 1900. *Araneus cicatrosa*: Pocock, *Fauna Brit. India, Arach.*, : 226.
 1921. *Cyrtophora cicatrosa*: Gravely, *Rec. Indian Mus.*, Calcutta, 22:413.
 1962. *Cyrtophora cicatrosa*: Tikader, *J. Linn. Soc. London*, 44(300): 563.

Specimens examined.— 1 ♀, Haddoo, Port Blair, South Andaman, Coll. B. K. Tikader, 30.4.1970. 1 ♀, Kamorta Island, Nicobar Islands, Coll. B. K. Tikader, 21.3.1970.

Distribution.— India: Chingalput, Allahabad, West-Bengal, Calcutta, Mysore, Maharashtra, Punjab, Andaman and Nicobar Islands; Burma.

28. *Cyrtophora moluccensis* (Dol.)

1857. *Epeira moluccensis* Doleschall, *Nat. Tijdschr. Nederland, India*, 13: 418.
 1900. *Araneus moluccensis*: Pocock, *Fauna Brit. India, Arach.*, : 226.
 1962. *Cyrtophora moluccensis*: Tikader, *J. Linn. Soc. London*, 44(300): 562.

Specimens examined.— 1 ♀, Malacca village, Car-Nicobar, Coll. B. K. Tikader, 4.3.1970.

Distribution.—India: Trivandrum, Nilgiri Hills, Sikkim, Darjeeling, Kalimpong, Madhya Pradesh; Ceylon, Burma, Austro-Malaysia.

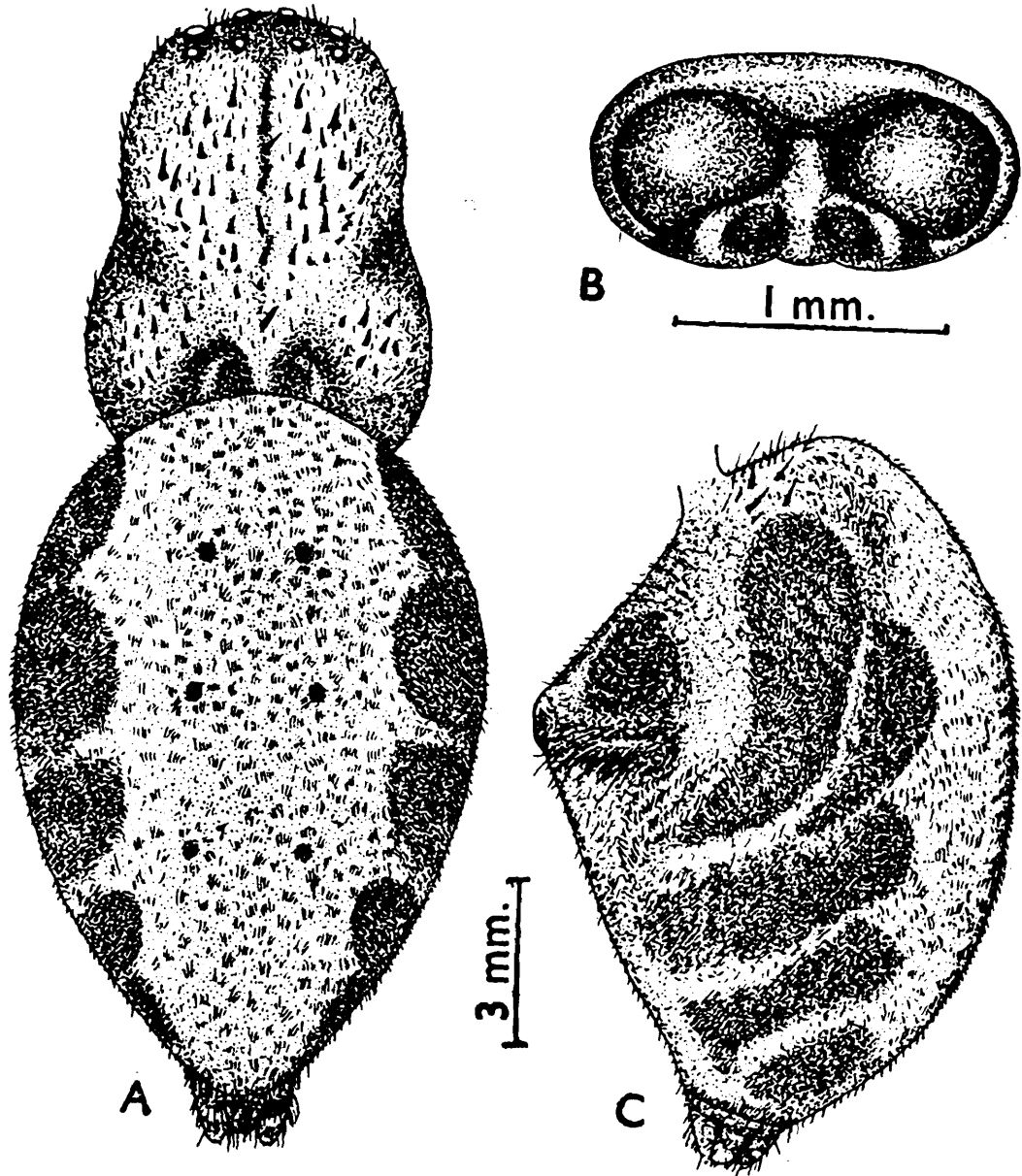
Genus 19. *Metepeira* Cambridge

29. *Metepeira andamanensis* sp. nov.

General.— Cephalothorax light to deep brown, abdomen and legs pale colour. Total length 20.00 mm. Carapace 8.00 mm. long, 6.10 mm. wide; abdomen 13.00 mm. long, 9.00 mm. wide.

Cephalothorax.—Longer than wide, cephalic region slightly high and broad, clothed with prominent black, short and stout spines. Eyes two rows, posterior row almost straight and anterior row slightly recurved. Lateral eyes not contiguous but situated on the common elevated portion of cephalothorax. Ocular quad slightly longer than wide and narrowing in front. Chelicerae strong, outer and inner margin provided with three teeth but middle tooth of outer row larger than others. Sternum heart-shaped, whitish yellow, provided with black hairs. Legs long and strong, clothed with hairs and few spines, legs formula 1243. All legs provided with conspicuous transverse deep brown or black bands.

Abdomen.—Longer than wide; clothed with fine hairs and anterior portion high and overlapping the cephalothorax; posterior portion narrow. Dorsal side of abdomen provided with three pairs of small sigilla and decorated with fine brown pattern as in text-fig. 12A, C. Ventral side more dark-brown than dorsal, provided with conspicuous whitish yellow spots. Epigyne as in text-fig. 12B.



Text-fig. 12 *Metepeira andamanensis* sp. nov.

(A) Dorsal view of female, legs omitted, (B) Lateral view of female, (C) Epigyne.

The web of this species is different from the other species of Argiopidae. It has incomplete orb and an irregular net and upper portion provided with labyrinth and the end of labyrinth attached with the base which may be a branch of tree or old house's roof etc. The spider generally waits in the labyrinth in day time. This genus is being reported here for the first time from Indian sub-continent.

Holotype.— one ♀, **paratypes** four ♀♀ in spirit.

Type-locality.— Aerial Bay, P.W.D. workshop compound, Diglipur, North Andaman, India. Coll. B. K. Tikader, 28.4.1971.

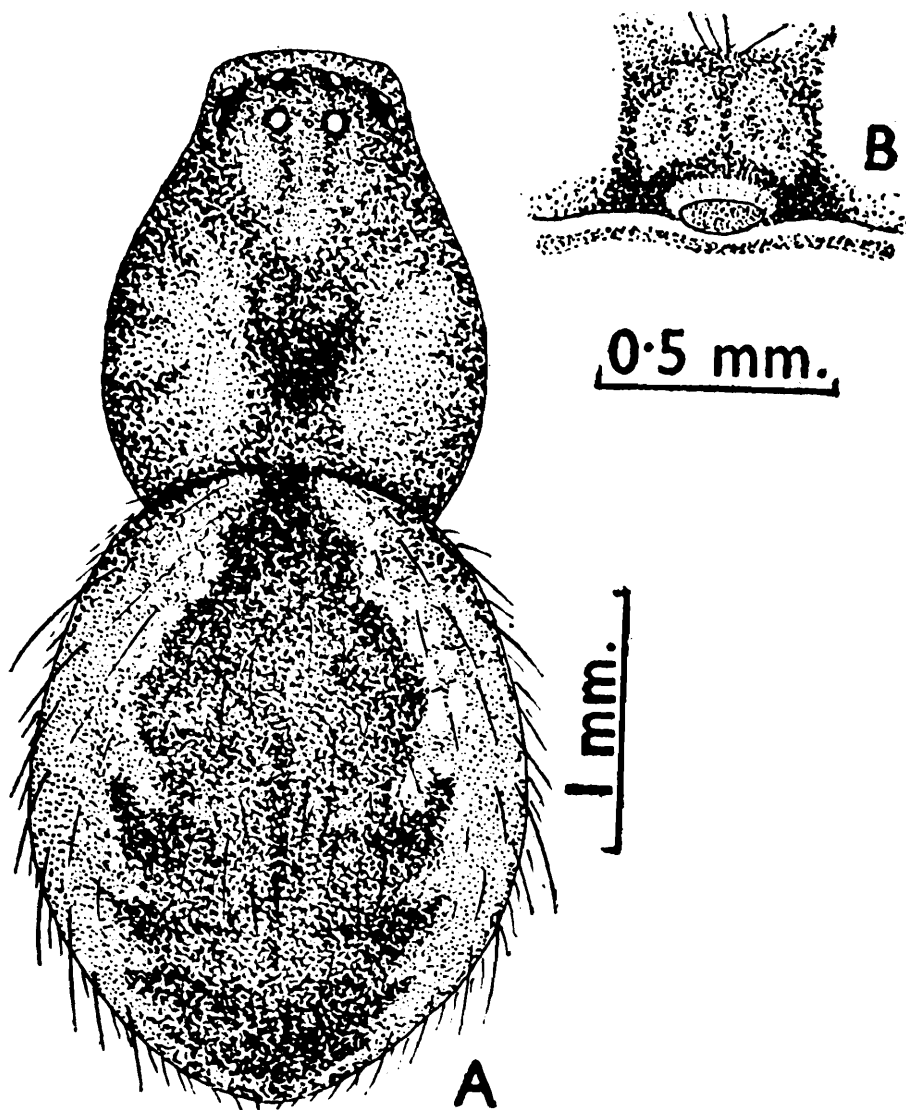
This species resembles *Metepeira labyrinthea* (Hentz) but is distinguished from it as follows: (i) The colour pattern of abdomen different. (ii) Epigyne also structurally different.

Genus 20. *Singa* Koch

30. *Singa haddoensis* sp. nov.

General.— Cephalothorax and legs light to deep brown, abdomen chalk-white. Total length 4.20 mm. Carapace 2.00 mm. long, 1.60 mm. wide; abdomen 2.80 mm. long, 2.00 mm. wide.

Cephalothorax.— Longer than wide, narrowing in front. Mid-dorsally provided with a longitudinal deep-brown broad patch. Eyes two rows,



Text-fig. 13 *Singa haddoensis* sp. nov.

(A) Dorsal view of female, legs omitted, (B) Epigyne.

posterior row straight and anterior row strongly recurved, lateral eyes contiguous. Posterior median eyes larger and posterior median eyes closer to each other than to the posterior lateral eyes. Sternum heart-shaped, pointed behind. Legs clothed with hairs and without spine. Legs formula 1423.

Abdomen.— Longer than wide and almost elliptical in shape. Mid-dorsally provided with a longitudinal conspicuous brown broad patch extending from base to end of the abdomen. Ventral side light pale colour and provided with a deep brown longitudinal band. Epigyne as in text-fig. 13B.

Holotype.— one ♀, *paratypes* two ♀♀ in spirit.

Type-locality.— Haddoo, Port Blair, South Andaman, India. Coll. B. K. Tikader, 18.4.1971.

This species resembles *Singa chota* Tikader from Sikkim but it is distinguished from it as follows: (i) Cephalothorax mid-dorsally provided with a conspicuous longitudinal brown band, but in *S. chota* cephalic region with reddish brown patches. (ii) Abdomen mid-dorsally provided with a longitudinal conspicuous brown broad patch but in *S. chota* abdomen shiny-white and mid-dorsally with a longitudinal brown cracked line. (iii) Epigyne structurally different.

Family XI. HERSILIIDAE

Genus 21. *Hersilia* Audouin

31. *Hersilia savignyi* Lucas

1836. *Hersilia savignyi* Lucas, *Mag. zool.*, 8: 10.

1869. *Hersilia calcuttensis*: Stoliczka, *J. Asia Soc. Bengal*, 38: 216.

1900. *Hersilia savignyi*: Pocock, *Fauna British India Arach.*,: 241.

1950. *Hersilia savignyi*: Sinha, *Rec. Indian Mus. Calcutta*, 48: 122.

1963. *Hersilia savignyi*: Tikader, *J. Uni. Poona*, 24:48.

Specimen examined.— 3 ♀♀, Tugapur, Mayabandar, N. Andaman, India. Coll. B. K. Tikader, 13.4.1971.

Distribution.— India: Nilgiri Hills, Travancore, Poona, Allahabad, Calcutta, Assam, Andaman Islands; Ceylon, Burma.

Family XII. OXYOPIDAE

Genus 22. *Oxyopes* Latreille

32. *Oxyopes sitae* Tikader

1970. *Oxyopes sitae* Tikader, *Rec. zool. Surv. India*, 64(1-4): 75.

Specimens examined.— 4 ♀♀, 1 ♂, Durgapur, Diglipur, North Andaman. Coll. B. K. Tikader, 23.4.1971. 7 ♀♀, 3 ♂♂, Chiriatapu, South Andaman, Mayabandar, North Andaman. Coll. B. K. Tikader, 10.5.1971. 6 ♀♀, 3 ♂♂, Tugapur, Mayabandar, North Andaman. Coll. B. K. Tikader, 13.4.1971. 1 ♀, 1 ♂, Tugapur, Mayabandar, North Andaman. Coll. B. K. Tikader, 13.5.1971.

Distribution.— India: Sikkim, Andaman Islands.

Family XIII. PISAURIDAE

Genus 23. *Pisaura* Simon

33. *Pisaura gitae* Tikader

1970. *Pisaura gitae* Tikader, *Rec. zool. Surv. India*, 64(1-4): 59.

Specimens examined.— 1 ♀, Aerial Bay, Diglipur, North Andaman Island, India, Coll. B. K. Tikader, 28.4.1971. 2 ♀♀, Neil Island, India. Coll. B. K. Tikader, 8.4.1970.

Distribution.— India: Sikkim, West Bengal, Andaman, Neil Islands.

Genus 24. *Tinus* Cambridge

34. *Tinus sikkimus* Tikader

1970. *Tinus sikkimus* Tikader, *Rec. zool. Surv. India*, 64(1-4): 61.

Specimen examined.— 10 ♀♀, Tugapur, Mayabandar, North Andaman Island, India. Coll. B. K. Tikader, 13.5.1971.

Distribution.— India: Sikkim, West Bengal, Andaman Island.

Family XIV LYCOSIDAE

Genus 25. *Lycosa* Latreille

35. *Lycosa sumatrana* Thorell

1890. *Lycosa sumatrana* Thorell, *Ann. Mus. Stor. Nat.*, 10(2): 136.

1924. *Lycosa sumatrana*: Gravely, *Rec. Indian. Mus. Caclutta*, 26: 604.

1963. *Lycosa sumatrana*: Tikader, *J. Univ. Poona*, 24: 51.

Specimens examined.— 1 ♀, 1 ♂, Chiriatapu village, South Andaman, India. Coll. B. K. Tikader, 30.5.1971. 1 ♀, 1 ♂, Tugapur, Mayabandar, North Andaman. Coll. B. K. Tikader, 13.5.1971.

Distribution.— India: Bengal, Mysore (Karnataka), Kerala, Madras (Tamil Nadu), Bihar, Himachal Pradesh, U. P., Assam, Andaman, Nicobar; Burma, Sumatra.

36. *Lycosa birmanica* (Simon)

1884. *Pardosa birmanica* Simon, *Ann. Mus. Stor. Nat.*, 20: 333.
 1895. *Lycosa birmanica*: Thorell, *Spiders of Burma*,: 242.
 1924. *Lycosa birmanica*: Gravelly, *Rec. Indian Mus. Calcutta*,: 607.
 1935. *Lycosa birmanica*: Dyal, *Bull. Zool. Punjab Univ.*, 1:136.
 1963. *Lycosa birmanica*: Tikader, *J. Univ. Poona*, 24:51.

Specimens examined.— 7 ♀♀, 1 ♂, Chiriatapu village, South Andaman, India. Coll. B. K. Tikader, 30.5.1971. 13 ♀♀, 3 ♂♂, Tugapur, Mayabandar, North Andaman, India. Coll. B. K. Tikader, 10.5.1971. 10 ♀♀, 5 ♂♂, Chiriatapu village, South Andaman. Coll. B. K. Tikader, 30.5.1971. 16 ♀♀, 2 ♂♂, Mayabandar, North Andaman, Coll. B. K. Tikader, 5.5.1971. 30 ♀♀, 7 ♂♂, Tugapur, Mayabandar, Delanipur, Port Blair, Andaman. Coll. B. K. Tikader, 22.5.1971. 1 ♀, Aerial bay, Diglipur, North Andaman. Coll. B. K. Tikader, 23.4.1971. 2 ♀♀, 1 ♂, Smith Island, North Andaman. Coll. B. K. Tikader, 27.4.1971. 1 ♀, Neil Island, South Andaman. Coll. B. K. Tikader, 10.4.1971.

Distribution.— India: Karnataka, Tamil Nadu, Orissa, Maharashtra, Assam, West Bengal, Andaman, Nicobar; Burma.

Family XV GNAPHOSIDAE

Genus 26. *Drassodes* Westring37. *Drassodes andamanensis* sp. nov.

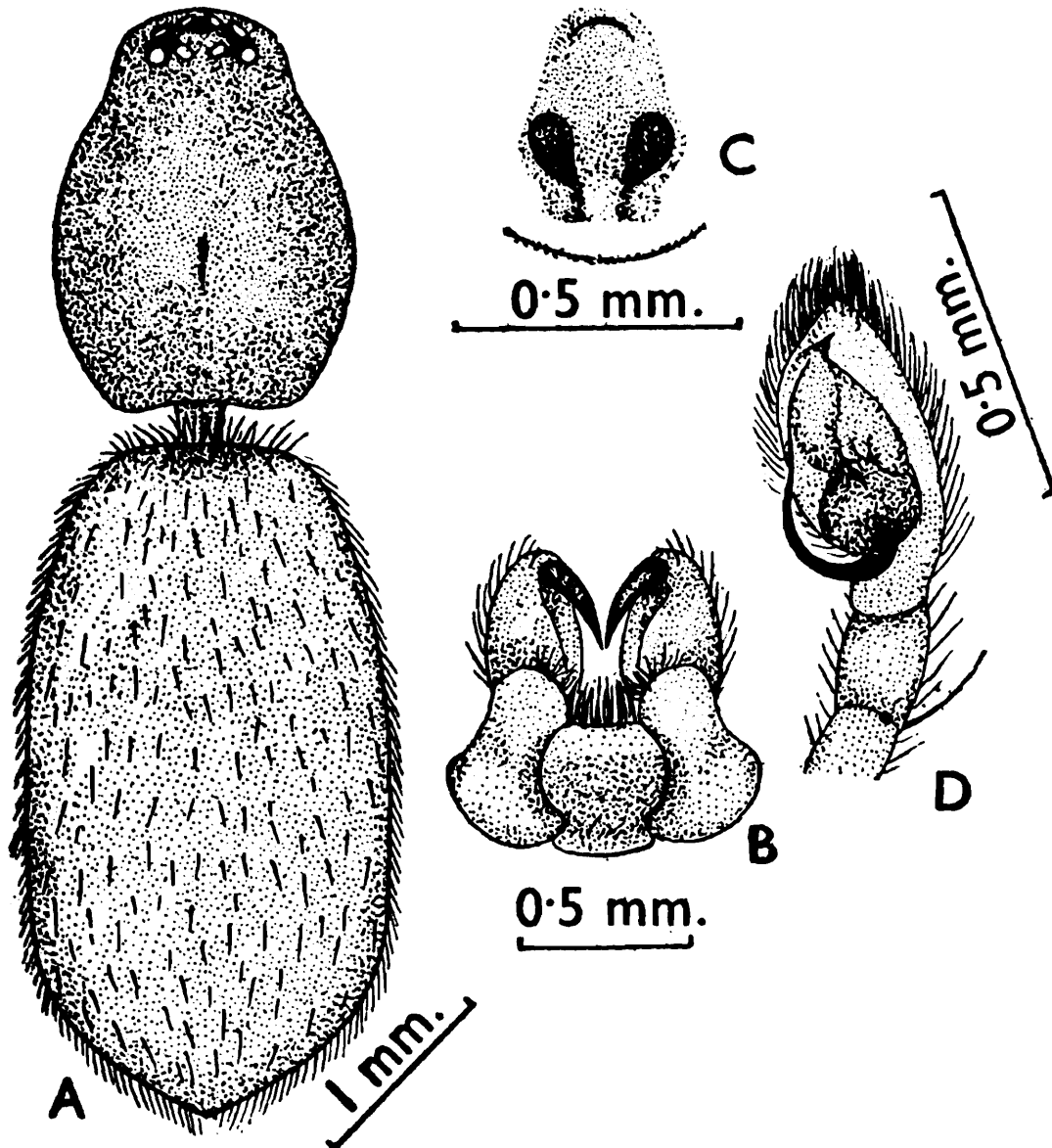
General.— Cephalothorax and legs light reddish brown, abdomen light greenish. Total length 5.50 mm. Carapace 2.00 mm. long, 1.60 mm. wide; abdomen 3.50 mm. long, 1.90 mm. wide.

Cephalothorax.— Longer than wide, broader in front, clothed with fine hairs, convex with a small fovea at the centre of cephalothorax. Eyes in two rows, anterior median dark and rest pearly white in colour and irregular in shape, both rows procurved (as seen from front) anterior medians smaller than the others, posterior row larger than anterior row. Clypeus narrow. Ocular quad slightly longer than wide. Sternum heart-shaped, pointed behind, clothed with hairs. Maxillae and labium as in text-fig. 14B. Chelicerae strong, nearly vertical, two small teeth on inner margin and two slightly larger teeth on outer margin. Legs long, stout, clothed with hairs and few spines. Leg formula 4123. Male palp as in text-fig. 14D.

Abdomen.— Nearly oval, wider behind, clothed with fine brown pubescence, slightly overlapping the posterior region of cephalothorax in front. Ventral surface uniform pale colour. Epigyne as in text fig. 14C.

Holotype.— one ♀, *allotype* one ♂ in spirit.

Type-locality.—Smith Island, near forest Department Camp, Andaman, India. Coll. B. K. Tikader, 27.4.1971. **allotype:** Durgapur, 3 km. away from Aerial Bay Jetty Diglipur, N. Andaman, India, Coll. B. K. Tikader, 23.4.1971.



Text-fig. 14 *Drassodes andamanensis* sp. nov.

(A) Dorsal view of female, legs omitted, (B) Maxillae and labium, (C) Epigyne, (D) Male palp.

This species closely resembles *Drassodes malodes* Tikader but it can be distinguished as follows : (i) Cephalothorax and legs light reddish brown but in *D. malodes* cephalothorax and legs light brown. (ii) Maxillae and labium structurally different. (iii) Epigyne structurally different.

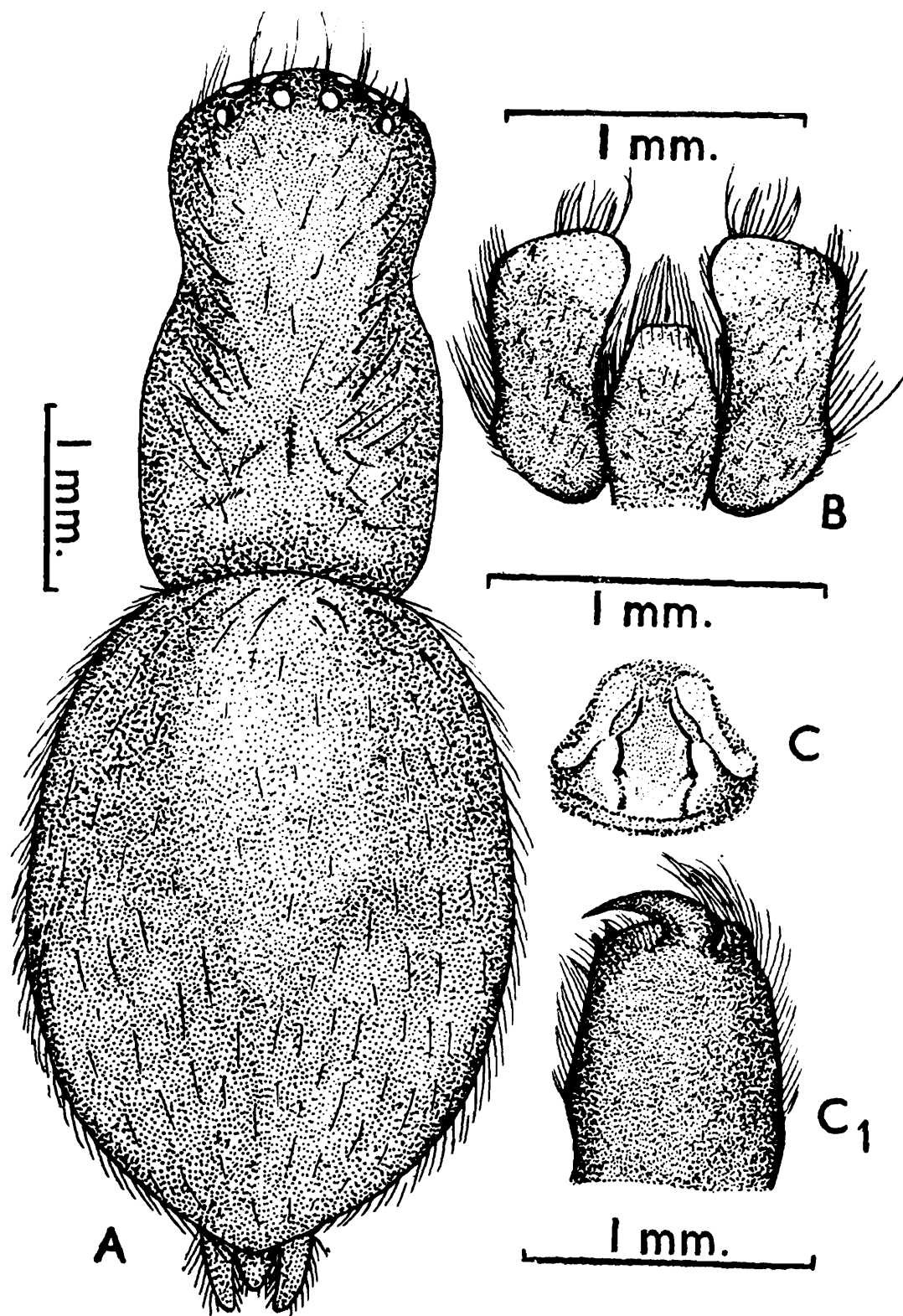
Genus 27. *Phaeocedus* Simon

38. *Phaeocedus nicobarensis* sp. nov.

General.—Cephalothorax and chelicerae reddish brown, legs pale-greenish, abdomen light brown. Total length 6.30 mm. Carapace

2.80 mm. long, 1.60 mm. wide; abdomen 3.60 mm. long, 2.50 mm. wide.

Cephalothorax.— Longer than wide, clothed with hairs, cephalic region high and convex, slightly broader in front, centre with a minute fovea, posterior lateral sides of cephalothorax with two inconspicuous



Text-fig. 15 *Phaeocedus nicobarensis* sp. nov.

(A) Dorsal view of female, legs omitted, (B) Maxillae and labium, (C) Epigyne, (C₁) Chelicera.

brown lines as in text-fig. 15A. Eyes pearly white, anterior row straight, anterior eyes larger than the anterior medians, posterior row also straight but slightly longer than the anterior row; middle eyes slightly larger than the laterals. Ocular quad longer than wide narrowing in front. Chelicerae vertical noticeably long and narrow, convex at base, bearing no teeth, but with an angular projection apically inside. Sternum oval, clothed with hairs, pointed behind. Maxillae and labium as in text-fig. 15B. Legs long, stout, clothed with hairs and a few spines. Metatarsi I and II with three pairs of ventral spines.

Abdomen.—Oval, clothed with fine hairs, ventral side more lighter than dorsal. Epigyne as in text-fig. 15C.

Holotype.—one ♀, *allotype* one immature ♂ in spirit.

Type-locality.—Keating point, Car-Nicobar, India. Coll. B. K. Tikader 6.3.1970.

This species resembles *Phaeoedus mosambaensis* Tikader but it can be distinguished as follows: (i) Posterior lateral sides of cephalothorax with two inconspicuous brown lines but in *P. mosambaensis* cephalothorax uniform. (ii) Abdomen oval without any dorsal marking but in *P. mosambaensis* posterior dorsal side with deep brown cheverons. (iii) Epigyne structurally different.

Family XVI. HETEROPODIDAE

Genus 28. *Heteropoda* Latreille

39. *Heteropoda venatoria* Linn.

1766. *Heteropoda venatoria* Linn., *Syst. Nat. ed.*, 12:1035.

1887. *Heteropoda venatoria*: Simon, *J. Asia Soc. Bengal*, 56:102.

1900. *Heteropoda venatoria*: Pocock, *Fauna Brit. India, Arach.*, : 260.

Specimens examined.—1 ♀, 1 ♂, Narcondam Island, Andaman, India. Coll. Humayun Abdulali, 26.3.1972.

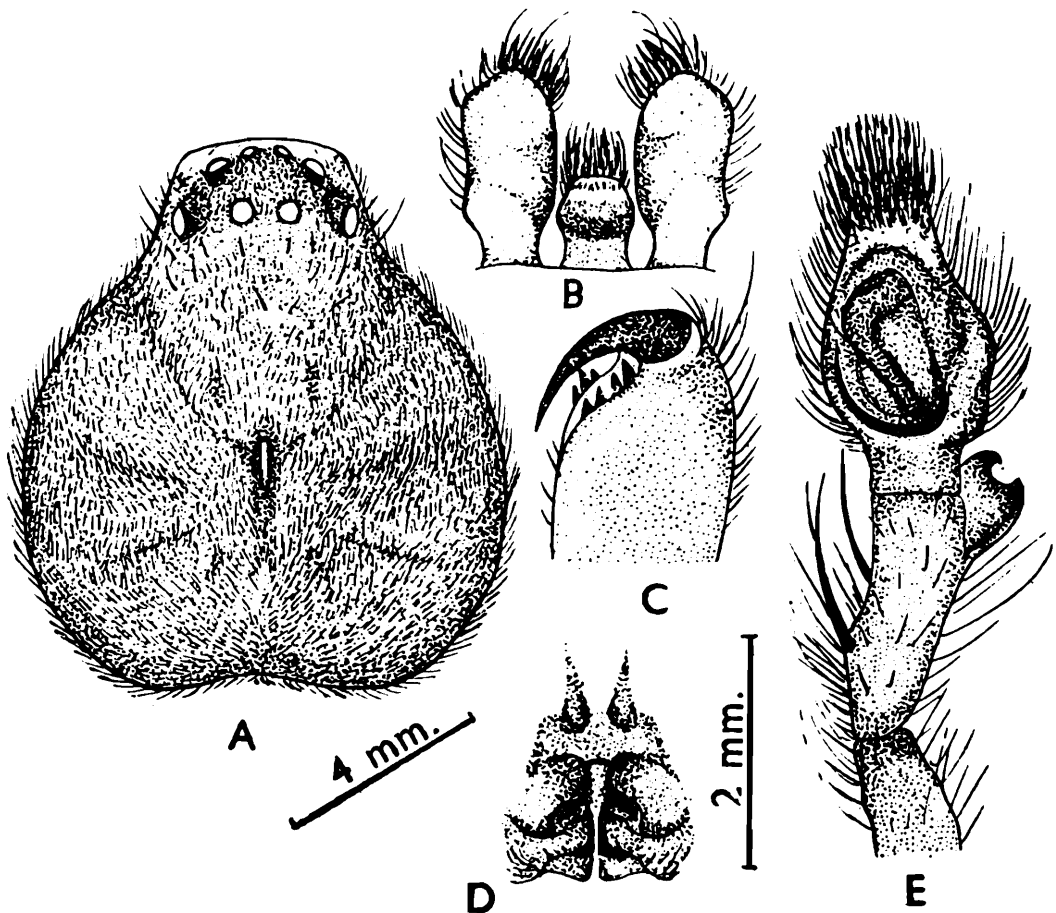
Distribution.—India; Ceylon, Burma and all tropical Countries of the world.

40. *Heteropoda andamanensis* sp. nov.

General—Cephalothorax and legs reddish brown, abdomen pale brown. Total length 27.00 mm. Carapace 11.00 mm. long, 10.00 mm. wide; abdomen 16.00 mm. long, 10.00 mm. wide.

Cephalothorax—Slightly longer than wide, clothed with fine hairs, cephalic region slightly high, middle of cephalothorax provided with a fovea. Eyes pearly white, posterior row slightly recurved, lateral eyes

larger than the medians, anterior row short and slightly procurved (as seen from front), lateral eyes larger than the medians. Ocular quad longer than wide and narrow in front. Chelicerae moderate, inner margin provided with four teeth and outer margin with three teeth as in text-fig. 16C. Sternum nearly heart-shaped, clothed with hairs and pointed posteriorly. Maxillae and labium as in text-fig. 16B. Legs very long and stout, clothed with hairs and spines. Tibiae and metatarsi of I and II provided with three pairs of ventral spines Male palp as in text-fig. 16E.



Text-fig. 16 *Heteropoda andamanensis* sp. nov.

(A) Cephalothorax of female, (B) Maxillae and labium, (C) Chelicera of female, (D) Epigyne, (E) Male palp.

Abdomen.— Longer than wide, clothed with fine hairs, tapering at both ends. Ventral side more pale than the dorsal, clothed with pale hairs. Epigyne as in text-fig. 16D.

Holotype— one ♀, *paratypes* two ♀♀, *allotype* one ♂ in spirit.

Type-locality— Long Island, Middle Andaman, India. Coll. B. K. Tikader, 17.5.1971. *Allotype*, Havlock Island, Coll. B. K. Tikader, 18.4.1970.

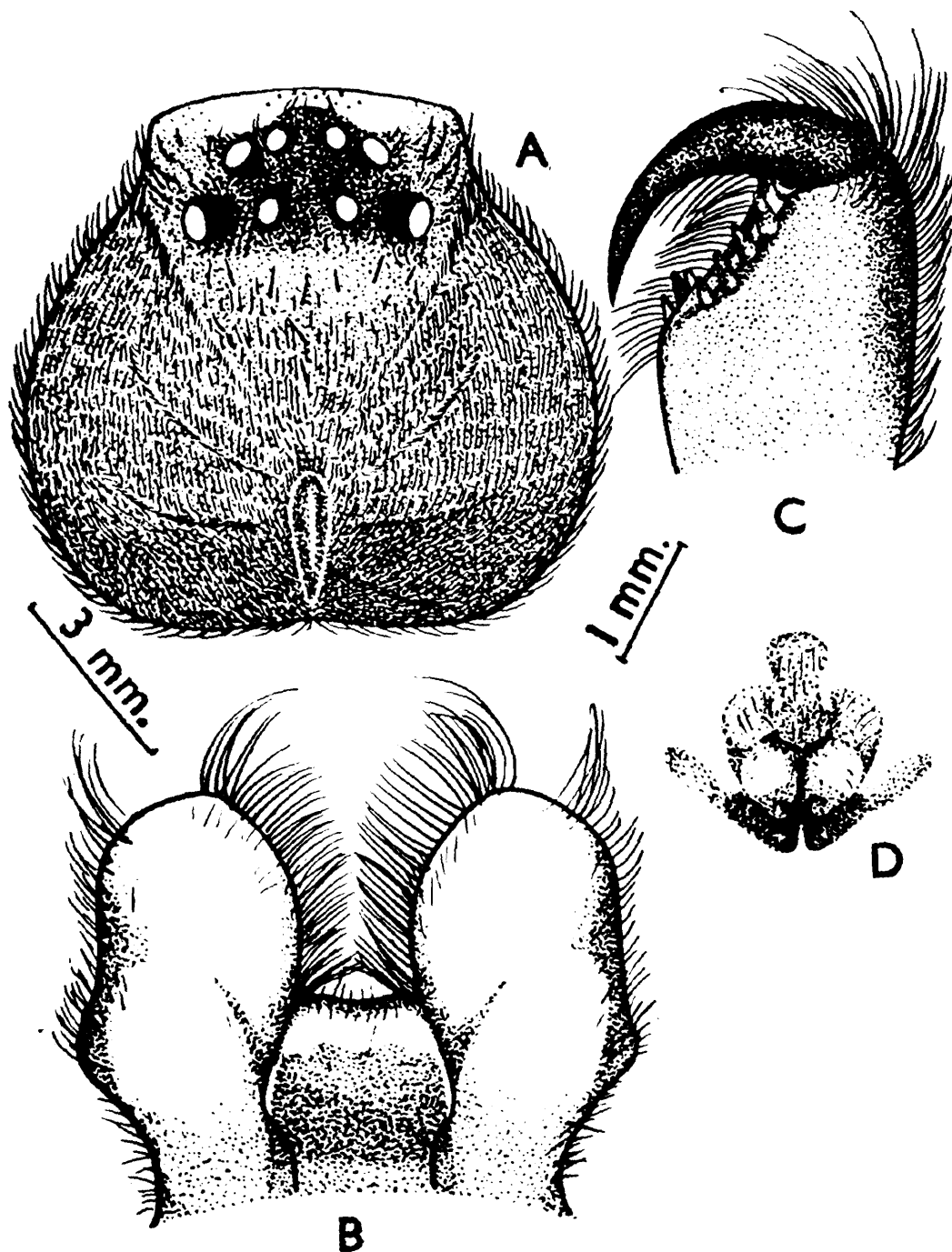
This species resembles *Heteropoda robusta* Fage from Siju Cave, Assam, but differs as follows: (i) Maximum length upto 30 mm. but in

H. robusta maximum length more than 32 mm. (ii) Epigyne and male, palp also structurally different.

41. *Heteropoda nicobarensis* sp. nov.

General— Cephalothorax and abdomen brown, legs brownish green. Total length 18.40 mm. Carapace 8.40 mm. long, 9.00 mm. wide; abdomen 10.00 mm. long, 6.00 mm. wide.

Cephalothorax— Wider than long, flat, clothed with thick brown hairs, centre provided with a fovea. Cephalic region slightly high. Eyes pearly



Text-fig. 17 *Heteropoda nicobarensis* sp. nov.

(A) Cephalothorax of female, (B) Maxillae and labium, (C) Chelicera, (D) Epigyne.

white, posterior row nearly straight or very slightly recurved, lateral eyes larger than the medians, median eyes more closer to each other than to adjacent laterals. Anterior row short, slightly procurved (as seen from in front), median eyes more closer to adjacent laterals than to each other. Chelicerae moderate, inner margin provided with four teeth, first three teeth are very large, while the fourth is very small; outer margin provided with three teeth close together, middle tooth larger while the other two are small as in text-fig. 17C. Maxillae and labium as in text-fig. 17B. Sternum oval clothed with fine hairs, pointed behind. Legs long and strong, clothed with thick hairs and few spines. Tibiae and metatarsi I and II provided with three and two pairs of ventral spines respectively.

Abdomen— Longer than wide, clothed with thick hairs, slightly narrow behind, ventral surface pale than dorsal surface, clothed with grey hairs. Epigyne as in text-fig. 17D.

Holotype— one ♀ in spirit.

Type-locality— Guest House, Kamorta Island, Nicobar, India. Coll. B. K. Tikader, 20.3.1970.

This species resembles the foregoing species, *H. andamanensis* sp. nov. but can be distinguished from it as follows: (i) Maximum length up to 19 mm. but in *H. andamanensis* maximum length upto 27 mm. (ii) Cephalothorax of *H. nicobarensis* more flat than *H. andamanensis*. (iii) Epigyne structurally different.

Family XVII. THOMISIDAE

Genus 29. *Thomisus* Walckenaer

42. *Thomisus cherapunjeus* Tikader

1966. *Thomisus cherapunjeus* Tikader, *Proc. Indian Acad. Sci.*, 64(1) : 53.

Specimens examined— 2 ♀♀, Chiriatapu, South Andaman, India. Coll. B. K. Tikader, 29.5.1971. 1 ♀, Haddoo, Port Blair, Andaman, India. Coll. B. K. Tikader, 30.4.1970.

Distribution— India: Cherapunji, Shillong, Assam, Calcutta, West Bengal, Andaman.

Genus 30. *Camaricus* Thorell

43. *Camaricus formosus* Thorell

1887. *Camaricus formosus* Thorell, *Ann. Mus. Civ. Gen.*, : 261.

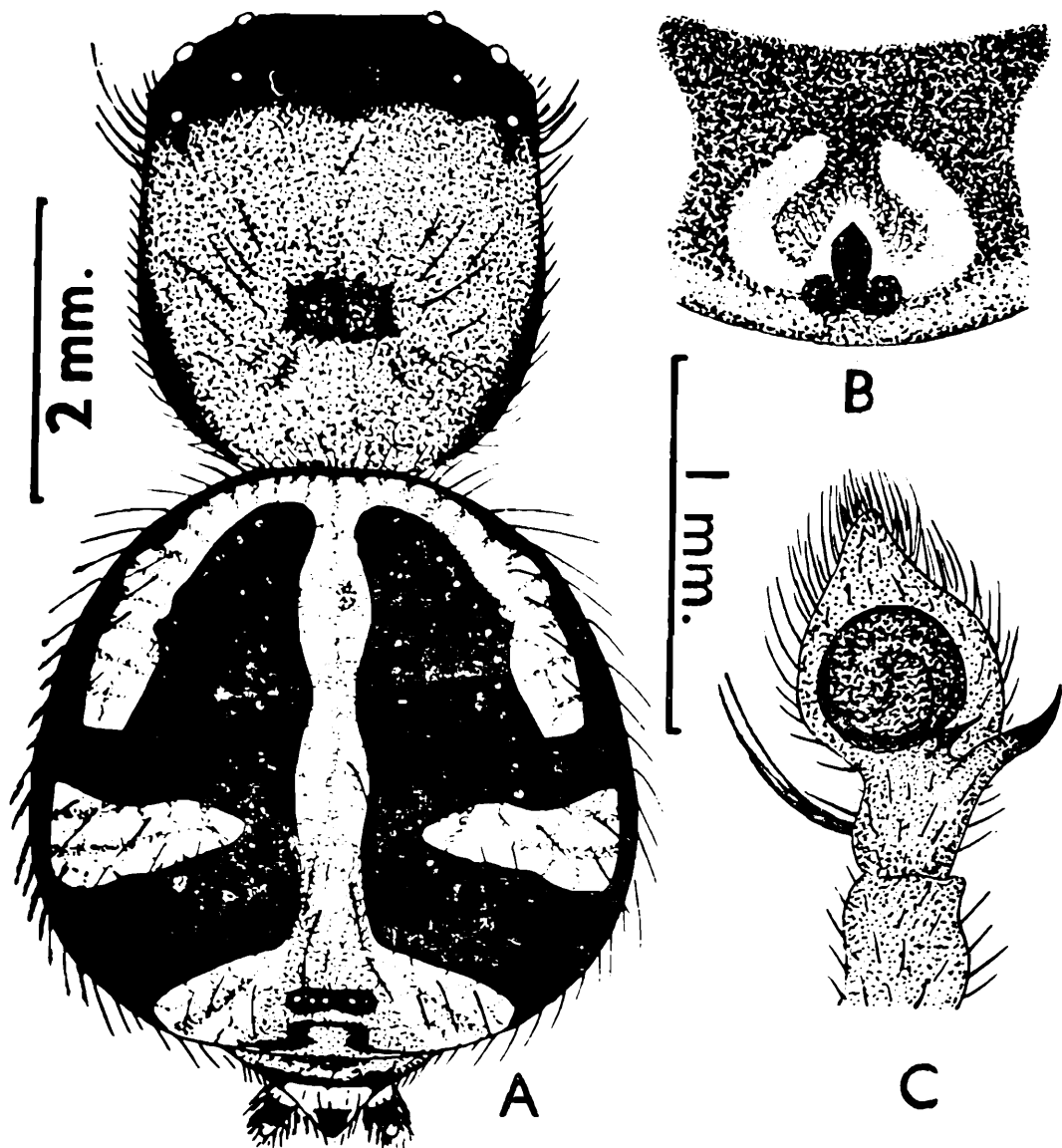
1890. *Camaricus fornicatus* Thorell, *Arach. Nies. de. Sumatra*, : 60.

1896. *Camaricus formosus*: Workman, *Malaysian Spider*, 1:-4.

Specimens examined— 1 ♀, Chiriatapu village, South Andaman, India, Coll. B. K. Tikader, 29.5.1971. 3 ♂♂, Tugapur, Mayabandar, North Andaman, India. Coll. B. K. Tikader, 13.4.1971. 3 ♀♀, Havlock Island, Middle Andaman, Coll. B. K. Tikader, 17.4.1970. 1 ♂, Rangat Jetty, Middle Andaman, Coll. B. K. Tikader, 23.4.1970.

This species was first reported by Thorell (1887) and subsequently described by Workman (1896). But their description is very inadequate, moreover, Workman has mentioned that he has examined only the male. I am describing and illustrating the male and female to recognise this species easily, by future workers.

General— Cephalothorax red, legs light greenish, abdomen dark brown. Total length 7.40 mm. Carapace 3.00 mm. long, 2.50 mm. wide; abdomen 4.20 mm. long, 4.00 mm. wide.



Text-fig. 18 *Camaricus formosus* Thorell

(A) Dorsal view of female, legs omitted, (B) Epigyne, (C) Male palp.

Cephalothorax— High, clothed with black hairs, wider in front, anterior portion and the lateral sides of cephalothorax provided with con-

spicuous deep brown or black patches. Centre of cephalothorax provided with deep brown patch but in male specimen there is no such patch. Eyes two rows, both rows recurved, posterior row slightly longer than anterior row. Middle eyes situated adjacent to lateral eyes. Ocular quad longer than wide. Legs robust, clothed with hairs and spines and ornamented with black patches, but in male I and II pair complete dark brown in colour. Tibiae and metatarsi provided with three pairs of ventral spines. Chelicerae moderate, dark brown colour. Sternum heart-shaped, pointed behind, clothed with fine hairs. Male palp as in text-fig. 18C.

Abdomen— Longer than wide, widest behind the middle, clothed with black hairs, conspicuously decorated longitudinally and laterally by chalk-white bands as in text-fig. 18A. Ventral side light brown, mid-ventral side provided with longitudinal broad brown patch extending from epigastric fold to near the base of spinnerets. Epigyne as in text-fig. 18B.

Distribution— India: Andaman Islands, West Bengal; Burma, Sumatra.

Genus 31. *Misumenoides* Cambridge

44. *Misumenoides kripalaniae* Tikader

1963. *Misumenoides kripalaniae* Tikader, *Proc. Indian Acad. Sci.*, **58**(5): 257.

Specimen examined— 1♀, Tugapur, Mayabandar, North Andaman, India. Coll. B. K. Tikader, 13.4.1971.

Distribution— India: Kotigehara, Dist. Chikmagalur, Karnatak, Poona, Maharashtra, Andaman.

Genus 32. *Ebo* Keyserling

45. *Ebo bharatae* Tikader

1965. *Ebo bharatae* Tikader, *Proc. Indian Acad. Sci.*, **61**(5): 278.

Specimens examined.— 2♀♀, Rest House Campus, Long Island, Middle Andaman, India. Coll. B. K. Tikader, 17.5.1971. 1♀, Sipighat, Port Blair, Andaman, India. Coll. B. K. Tikader, 4.6.1971.

Distribution— India: Poona, Maharashtra, Andaman Island.

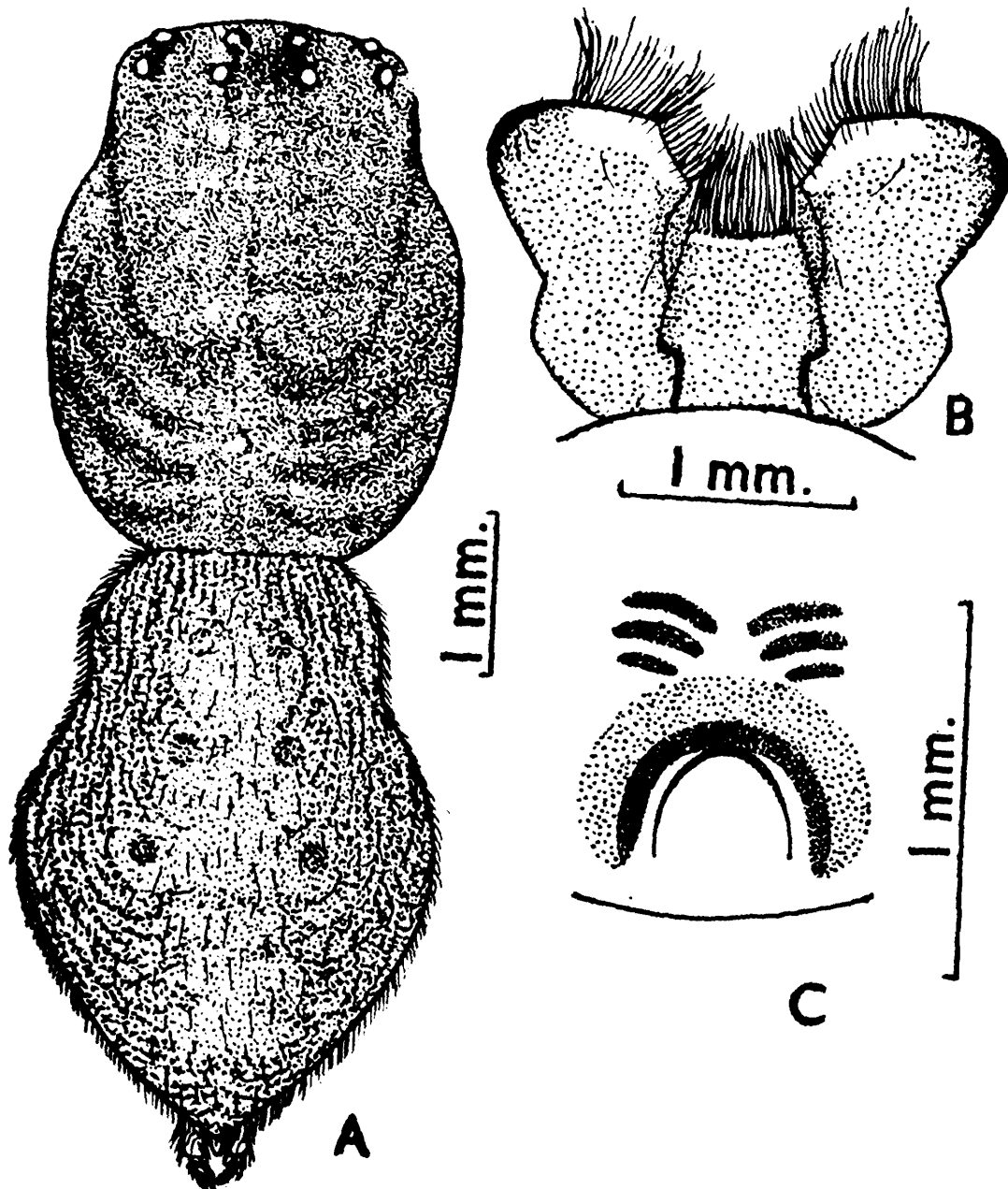
Family XVIII. CLUBIONIDAE

Genus 33. *Clubiona* Latreille

46. *Clubiona andamanensis* sp. nov.

General— Cephalothorax, legs brownish green, abdomen light brown. Total length 8.50 mm. Carapace 4.00 mm. long, 3.00 mm. wide, abdomen 4.20 mm. long, 3.20 mm. wide.

Cephalothorax— Longer than wide, broader in front and cephalic region slightly high, clothed with fine hairs. Eyes pearly white, two rows, posterior row slightly longer than the anterior row, nearly straight or slightly procurved, anterior row recurved, anterior two eyes nearer to each other than the adjacent laterals; and the posterior laterals conti-



Text-fig. 19 *Clubiona andamanensis* sp. nov.

- (A) Dorsal view of female, legs omitted, (B) Maxillae and labium,
(C) Epigyne.

guous. Ocular quad longer than wide and geniculate and deep brown colour. Maxillae and labium as in text-fig. 19B. Sternum nearly oval, pointed behind, clothed with hairs. Legs long and strong, I and II leg longer than III and IV

Abdomen— Longer than wide, narrowing behind, clothed with fine hairs, ventral side more pale than the dorsal side. Epigyne as in text-fig. 19 C

Holotype— one ♀ in spirit.

Type-locality— Long Island, Middle Andaman, India. Coll. B. K. Tikader, 17.5 1971.

This species resembles *Clubiona pashabhii* Patel and Patel, but differs as follows: (i) Cephalothorax brownish green but in *C. pashabhii* cephalothorax yellow brown. (ii) Abdomen uniform without any marking but in *C. pashabhii* abdomen dorsally ornamented with brown patches. (iii) Epigyne structurally different.

47. *Clubiona nicobarensis* sp. nov.

General—Cephalothorax, chelicerae reddish brown, legs greenish brown, abdomen whitish. Total length 7.40 mm. Carapace 3.00 mm. long, 2.00 mm. wide; abdomen 4.20 mm. long, 2.50 mm. wide.

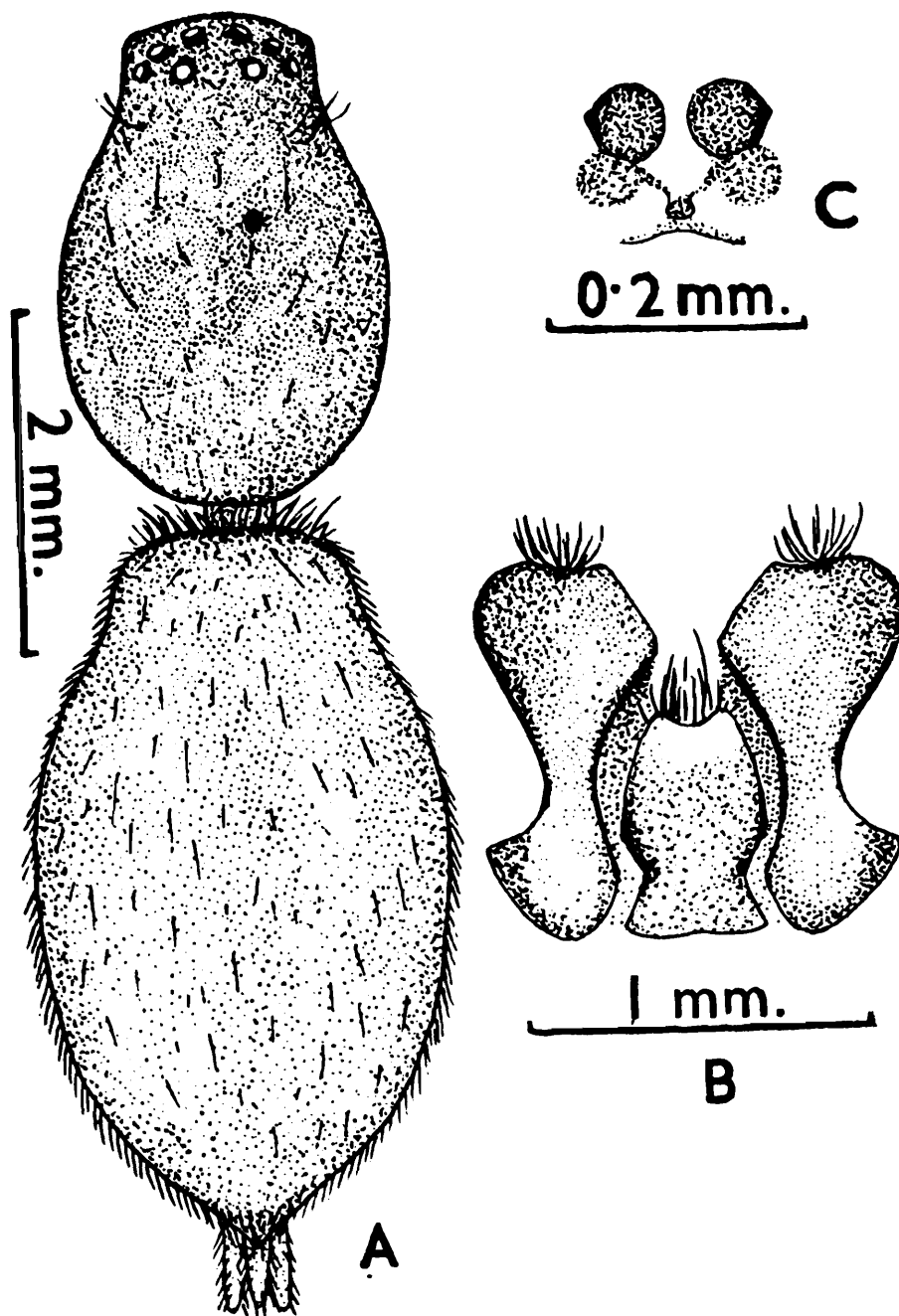
Cephalothorax— Longer than wide, clothed with fine hairs and few spine-like hairs, centre of cephalothorax provided with fine fovea moderately high and slightly narrowing in cephalic region. Eyes pearly white except anterior median, anterior row recurved, posterior row nearly straight, lateral eyes close together. Ocular quad slightly longer than wide, narrowing in front. Chelicerae prominent, inner row of chelicerae with two small teeth and outer row with a big tooth along with six-seven teeth. Maxillae and labium as in text-fig. 20B. Sternum oval, clothed with fine hairs, pointed behind. Legs long and strong, clothed with hairs and spines. Legs formula 2413. Tibiae and metatarsi of I and II provided with two pairs of ventral spines.

Abdomen— Longer than wide, tapering in both ends but posterior side is more tapering than anterior, clothed with fine hairs. Ventral side more white than dorsal side. Epigyne as in text-fig. 20C.

Holotype— one ♀, *paratype* one ♀ in spirit.

Type-locality— Kamorta Island, Nicobar, India. Coll. B. K. Tikader, 21.3.1970. *Paratype*, Port Blair, South Andaman, India. Coll. B. K. Tikader, 18.4.1971.

This species resembles the previous species *Clubiona andamanensis* sp. nov. but it is separated as follows: (i) Cephalothorax reddish brown but in *C. andamanensis* cephalothorax brownish green. (ii) Epigyne structurally different.



Text-fig. 20 *Clubiona nicobarensis* sp. nov.

- (A) Dorsal view of female, legs omitted, (B) Maxillae and labium,
(C) Epigyne.

Family XIX. SALTICIDAE

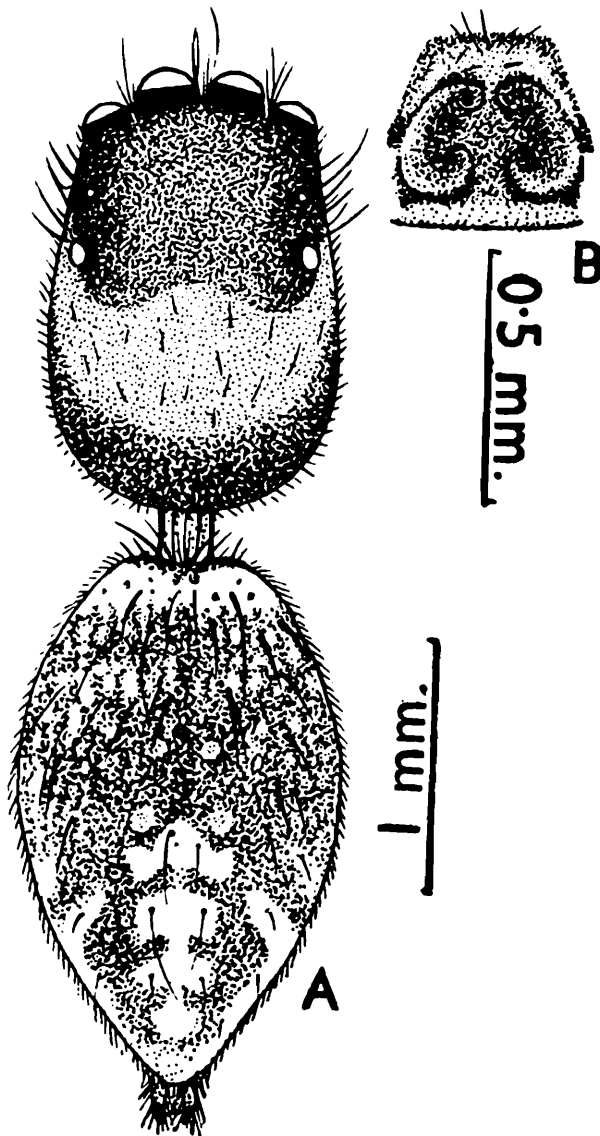
Genus 34. *Salticus* Latreille

48. *Salticus andamanius* sp. nov.

General— Cephalothorax and abdomen light brown to deep brown, legs brownish green. Total length 4.00 mm. Carapace 1.80 mm. long, 1.20 mm. wide; abdomen 2.00 mm. long, 1.40 mm. wide.

Cephalothorax— Longer than wide, cephalic region nearly flat in the first half and then slopes abruptly behind, clothed with fine black hairs and a few coarse hairs. Middle of cephalothorax provided with a small fovea. Cephalic region flat with conspicuous deep brown colour, later-

ally and posteriorly encircled by a semi-crescent shaped light patch as in text-fig. 21B, and rest of the portion of cephalothorax is deep brown. Eyes pearly white, anterior row slightly recurved and anterior median eyes larger than laterals by more than four times. Middle row of eyes very small and situated nearly equidistant from anterior and posterior rows. The ocular trapezium about one third broader than long. Chelicerae with one small tooth on inner margin and two very small teeth on outer margin. Sternum oval, clothed with fine hairs. Legs strong and stout, I and II more stout than III and IV legs. Tibiae and metatarsi of I and II provided with three and two ventral spines respectively.



Text-fig. 21 *Salticus andamanicus* sp. nov.

(A) Dorsal view of female, legs omitted, (B) Epigyne.

Abdomen— Longer than wide and narrow behind, clothed with fine hairs. Mid-dorsum provided with white patch as in text-fig. 21A. Ventral side with pale colour and provided with a broad longitudinal deep brown line extending from epigastric fold to nearly base of spinners. Epigyne as in text-fig. 21B.

Holotype— one ♀, *paratypes* two ♀♀ in spirit.

Type-locality— Rest house Campus, Long Island, Middle Andaman, India. Coll. B. K. Tikader, 17.4.1971., and *paratype* from Chiriatapu, South Andaman, India. Coll. B. K. Tikader, 29.4.1971.

This species resembles *Salticus ranjitus* Tikader but it is distinguished from it as follows: (i) Abdomen posterior with white markings but in *S. ranjitus* abdomen black with minute dots. (ii) Epigyne structurally different.

Genus 35. *Marpissa* Koch

49. *Marpissa andamanensis* sp. nov.

General— Cephalothorax and legs deep brownish grey and abdomen brown. Total length 12.00 mm. Carapace 5.00 mm. long, 3.80 mm. wide; abdomen 6.90 mm. long, 4.40 mm. wide.

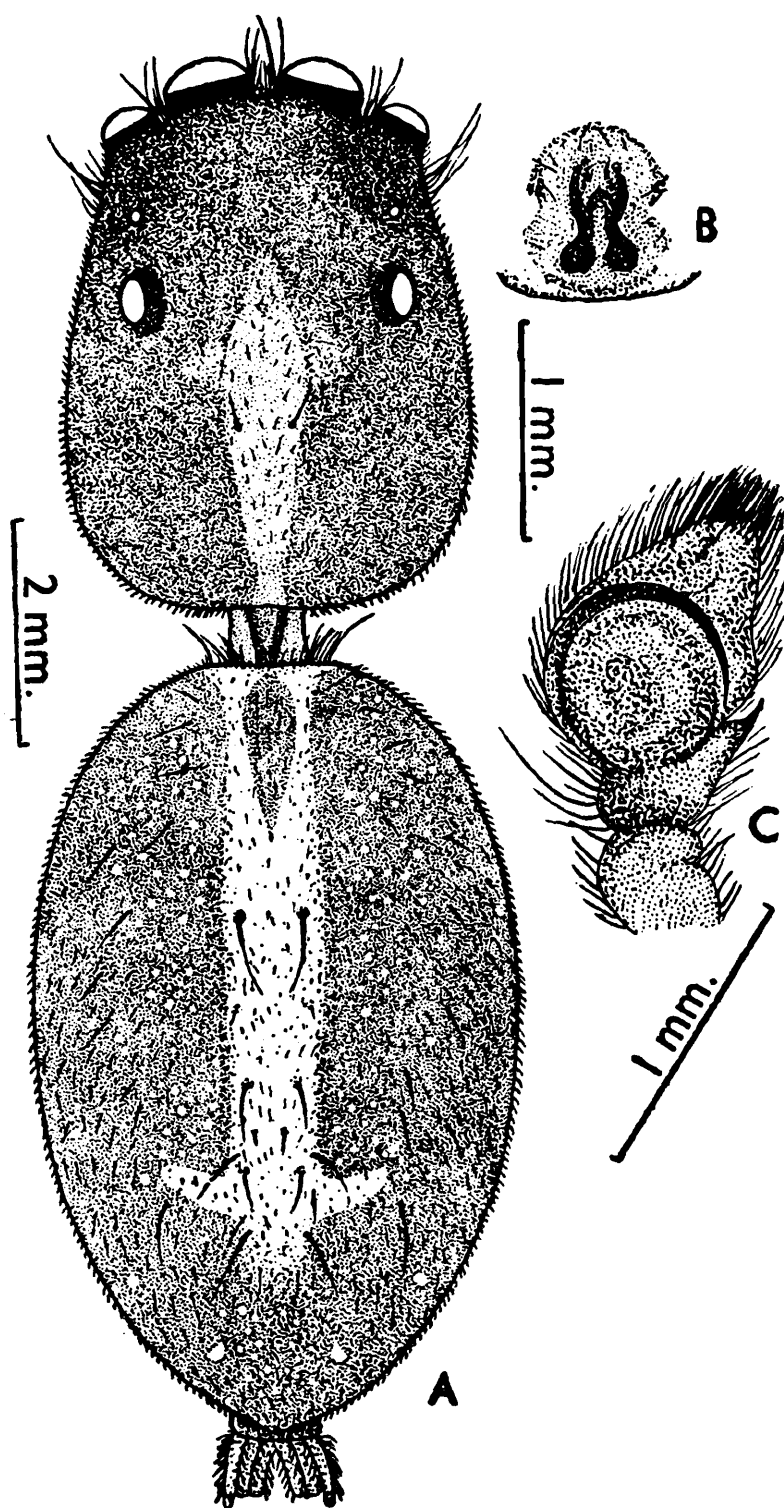
Cephalothorax: Longer than wide, high in front, posterior and lateral sides sloping. Cephalic region flat, clothed with fine hairs and few spines or spine-like hairs, just behind the ocular platform on the middle of cephalothorax provided with longitudinal conspicuous white bands, inside of the bands provided with small black fovea. Eyes moderate, anterior row of eyes pearly white. Anterior lateral eyes slightly larger than the posterior lateral eyes; second pair of eyes are very small and situated on the middle of anterior and posterior eyes. The ocular trapezium is slightly broader than long. Chelicerae with a moderate tooth on inner margin and two similar teeth on outer margin. Maxillae provided with fine scopulae. Sternum nearly oval, narrowing in both ends. Legs I and II more robust than III and IV, clothed with long grey hairs and few spines, legs formula 4132. Tibiae and metatarsi I and II provided with three and two pairs of ventral spines respectively.

Abdomen— Longer than wide and pointed behind and clothed with two types of hairs. Base provided with fine short hairs and some long grey hairs all over the abdomen. Mid-dorsally provided with a longitudinal white patch as in text-fig. 22A. Ventral side with uniform deep brown colour and clothed with small hairs. Epigyne as in text-fig. 22. B. Male much smaller than female. Legs deep brown and robust. Abdomen black provided with longitudinal central and lateral bands. Legs formula 1423. Male palp as in text-fig. 22C.

Holotype— one ♀, *allotype* one ♂ in spirit.

Type-locality— Chiriatapu village, South Andaman, India. Coll. B. K. Tikader, 30.5.1971.

This species resembles *Marpissa bengalensis* Tikader but it is distinguished from it as follows: (i) Colour pattern of abdomen and cephalothorax different. (ii) Epigyne and male palp also structurally different.



Text-fig. 22 *Marpissa andamanensis* sp. nov.

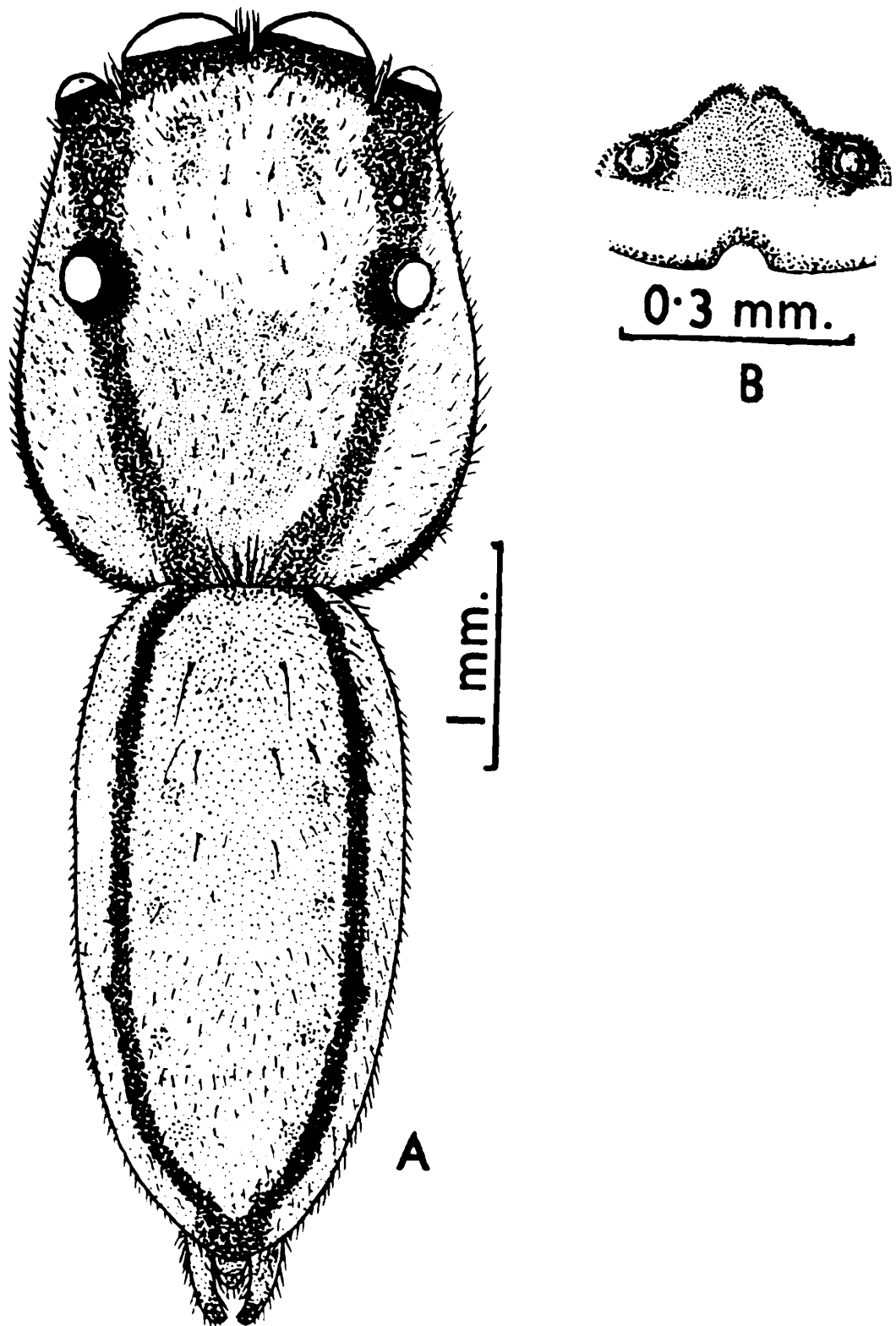
(A) Dorsal view of female, legs omitted, (B) Epigyne, (C) Male palp.

50. *Marpissa kalapani* sp. nov.

General— Cephalothorax, abdomen and legs are light yellowish in colour. Total length 5.80 mm. Carapace 2.80 mm. long, 2.00 mm. wide; abdomen 3.20 mm. long, 1.50 mm. wide.

Cephalothorax— Longer than wide, cephalic region flat and slightly higher than the rest of the portion. Just behind the cephalic high portion

on the middle of cephalothorax there is a small fovea; posterior portion of cephalothorax slightly sloping behind. Cephalothorax clothed with hairs. Two conspicuous longitudinal deep brown lines extending from base of anterior lateral eyes to the base of cephalothorax as in text-fig. 23A. Eyes of anterior row recurved and anterior median eyes nearly four times larger than the lateral eyes. Middle row of eyes small and



Text-fig. 23 *Marpissa kalapani* sp. nov.

(A) Dorsal view of female, legs omitted (B) Epigyne.

situated nearly equidistant from anterior and posterior rows. Base of eyes encircled by black patch. Posterior eyes and anterior lateral eyes nearly same size. Chelicerae with one small tooth on inner margin and two nearly similar size teeth on outer margin. Sternum nearly oval, narrowed in front, clothed with fine hairs. Leg; moderately strong, clothed with hairs and spines and leg formula of female 4132. Tibiae and metatarsi of I provided with three and two pairs of ventral spines respectively.

Abdomen— Longer than wide, narrowing behind, clothed with fine hairs and few coarse hairs. Dorsum provided with two longitudinal conspicuous deep brown bands extending from base to the end of abdomen as in text-fig. 23A. Ventral side uniform pale colour. Epigyne as in text-fig. 23B.

Holotype— one ♀ in spirit.

Type-locality— Horticulture Cum Zoological garden, Haddoo, Port Blair, South Andaman, India. Coll. B. K. Tikader, 19.4.1971.

This species resembles *Marpissa tigrina* Tikader but it is distinguished from it as follows: (i) Dorsal side of abdomen provided with two longitudinal conspicuous deep brown bands extending from base to end but in *M. tigrina* abdomen provided with conspicuous red-brown chevron-like pattern. (ii) Epigyne structurally different.

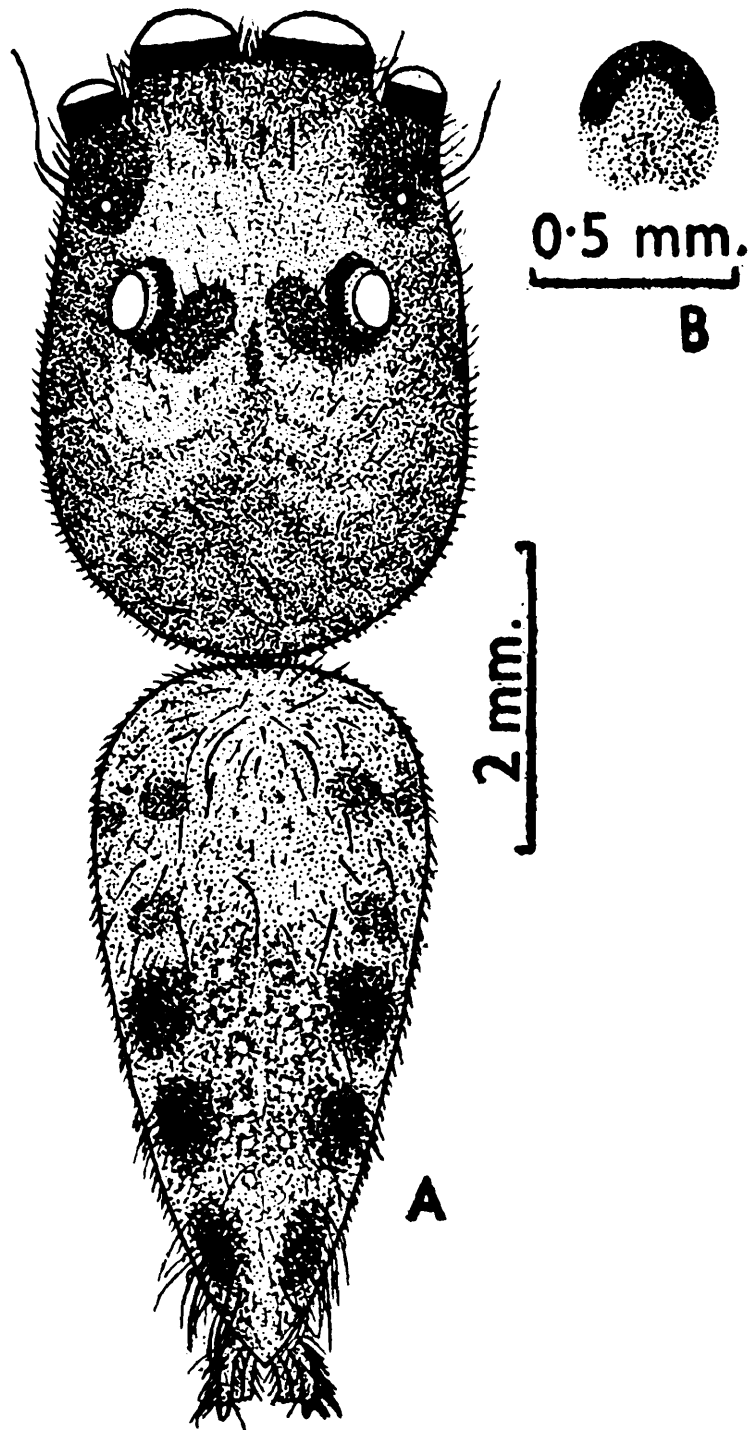
Genus 36. *Phidippus* Koch

51. *Phidippus yashodharae* sp. nov.

General— Cephalothorax and legs light grey, abdomen yellowish lemon colour. Total length 9.00 mm. Carapace 4.00 mm. long, 3.00 mm. wide; abdomen 5.00 mm. long, 2.20 mm. wide.

Cephalothorax— Longer than wide, high in front, posterior and lateral sides very sloping. Cephalic region flat, clothed with fine pubescence and few spine-like hairs. Outer sides of lateral eyes provided with two long black hairs. Eyes comparatively small according to the size of the spider. Anterior row recurved and anterior middle eyes pearly white and others black. Base of the eyes encircled with a conspicuous black patch. Anterior lateral eyes and posterior eyes nearly same size; second pair of eyes very small and situated near the anterior lateral eyes than the posterior eyes. Middle of cephalothorax provided with a small fovea. Chelicerae with one small tooth on inner margin and two small teeth on the outer margin. Sternum nearly oval, narrowing in front. Maxillae provided with thick scopulae at the upper end. Legs short and robust, clothed with hairs and spines. Tibiae and metatarsi I and II provided with three and two pairs of ventral spines respectively.

Abdomen— Longer than wide and pointed behind, clothed with fine hairs. Dorsally in front provided with two faint transverse yellowish bands and posteriorly three pairs of deep brown conspicuous dots as in text-fig. 24A. Ventral side uniform pale colour. Epigyne as in text-fig. 24B.



Text-fig. 24 *Phidippus yashodharae* sp. nov.

(A) Dorsal view of female, legs omitted, (B) Epigyne.

Holotype— one ♀, **paratypes** three ♀♀ in spirit.

Type-locality— Haddoo, Port Blair, South Andaman, India. Coll. B. K. Tikader, 18.4.1971.

This species resembles *Phidippus pateli*, Tikader, but it is distinguished from it as follows: (i) Dorsally on the posterior end of abdomen with a

conspicuous three pairs of brown dots arranged longitudinally but in *P. pateli* dorsally on the abdomen with a conspicuous V-shaped longitudinal deep brown patch. (ii) Outer sides of lateral eyes provided with two long hairs but in *P. pateli* outer sides of lateral eyes provided with tuft of conspicuous long black hairs. (iii) Epigyne structurally different.

Genus 37. **Rhene** Thorell

52. **Rhene indicus** Tikader

1973. *Rhene indicus* Tikader, *Proc. Ind. Acad. Sci.*, 78(2): 68-72.

Specimen examined— 2♀♀, Tugapur, Mayabandar, North Andaman, India. Coll. B. K. Tikader, 13.5.1971.

Distribution— India: Punjab Agriculture University Compound, Ludhiana (*Type-locality*), West Bengal, Andaman Islands.

Genus 38. **Myrmarachne** Mac Leay

53. **Myrmarachne orientales** Tikader

1973. *Myrmarachne orientales* Tikader, *Proc. Indian Acad. Sci.*, 78 (2): 60-62.

Specimen examined— 1♀, Kamorta Island, Nicobar, India. Coll. B. K. Tikader, 21.3.1970.

Distribution— India: Calcutta, West Bengal, Nicobar Islands.

54. **Myrmarachne plataleoides** (Camb.)

1869. *Salticus plataleoides* Cambridge, *Ann. Mag. nat. Hist.*, 3(4): 68.

1897. *Myrmarachne plataleoides*: Simon, *Hist. Nat. Araig.*, 2: 499.

1915. *Myrmarachne plataleoides*: Narayan, *Rec. Indian Mus.*, 11(5): 396.

1973. *Myrmarachne plataleoides*: Tikader, *Proc. Indian Acad. Sci.*, 78(2): 60.

Specimen examined— 2 ♀♀, Haddoo, Port Blair, South Andaman, India. Coll. B. K. Tikader, 18-4-1971.

Distribution— India: Bihar, West Bengal, Calcutta, Tamil Nadu, Maharashtra, Andaman.

55. **Myrmarachne bengalensis** Tikader

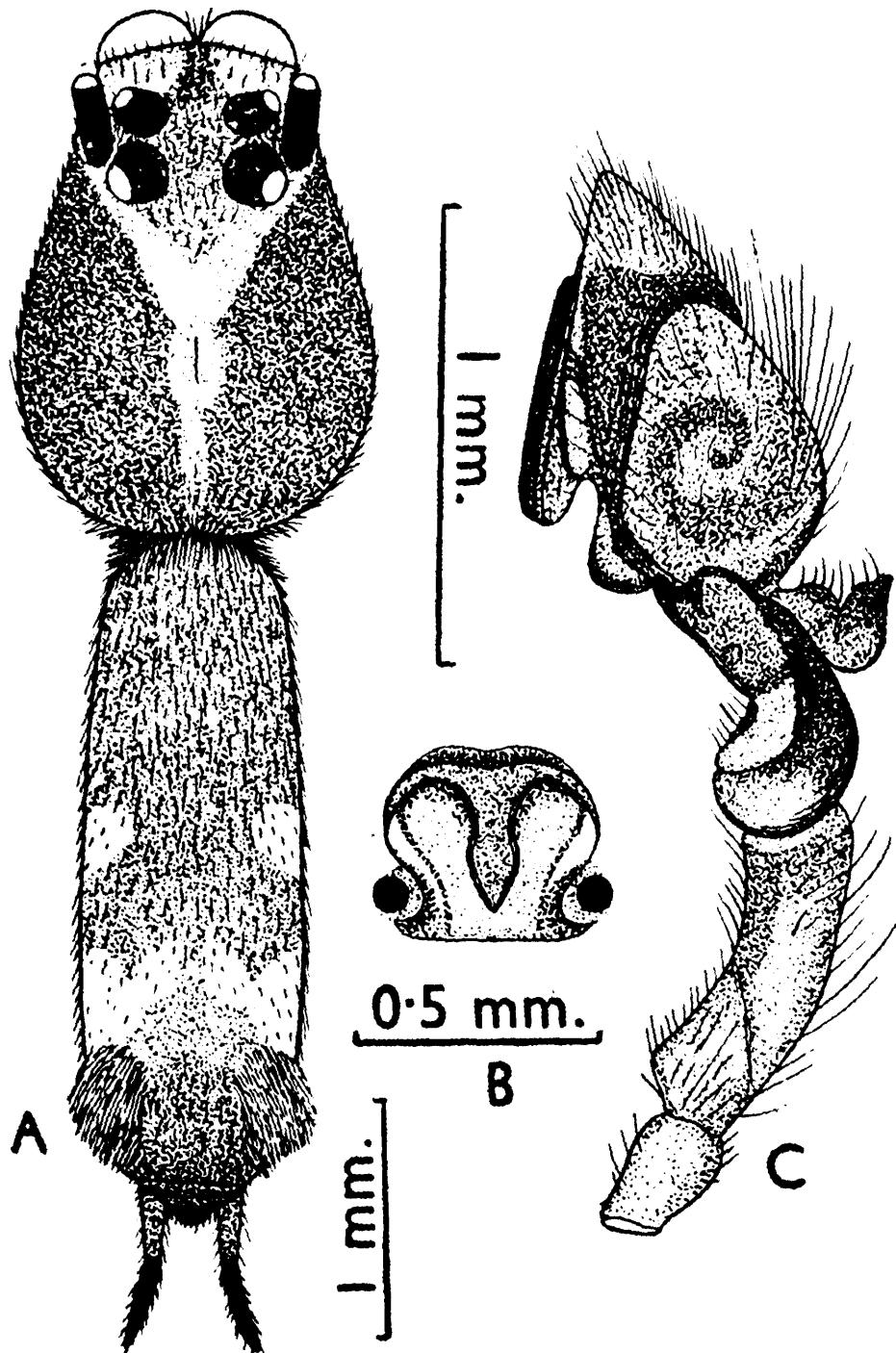
1973. *Myrmarachne bengalensis* Tikader, *Proc. Indian Acad. Sci.*, 78(2): 65.

Specimen examined— 1 ♀, Rest house compound, Long Island, Middle Andaman, India. Coll. B. K. Tikader, 17.5.1971.

Distribution— India: Dhakuria, Calcutta, W Bengal, (*Type-locality*): Andaman Islands.

Genus 39. *Lyssomanes* Hentz56. *Lyssomanes andamanensis* sp. nov.

General—Cephalothorax and abdomen deep brown, legs light green. Total length 5.00 mm. Carapace 2.10 mm. long, 1.50 mm. wide; abdomen 2.80 mm. long, 1.00 mm. wide.



Text-fig. 25 *Lyssomanes andamanensis* sp. nov.

(A) Dorsal view of female, legs omitted, (B) Epigyne, (C) Male palp.

Cephalothorax—Cephalothorax longer than wide, clothed with fine pubescence; cephalic region high, thoracic region sloping behind. Cepha-

lothorax provided with a conspicuous white light patch from anterior eyes to base of cephalothorax. Eyes four rows, anterior eyes white and bases of rest of the eyes encircled by conspicuous black patch. Anterior eyes close together and anterior median eyes more than six times larger than anterior lateral eyes, anterior lateral eyes with prominent stalk. Posterior middle row of eyes not very small and situated behind the stalk of the anterior lateral eyes; posterior row of eyes medium size. Ocular quad slightly wider than long. Sternum heart-shaped pointed behind and clothed with fine hairs. Chelicerae not strong. Legs long and slender clothed with hairs and spine-like hairs. Tibiae, metatarsi of all legs provided with conspicuous longitudinal deep brown line. In female there is no such marking on the leg. Tarsi provided with well developed claw tufts. Male palp as in text-fig. 25C.

Abdomen— Long, clothed with thick hairs, posterior end provided with deep brown transverse hairs and sides provided with a tuft of hairs as in text-fig. 25A. Spinners conspicuously long with two segments. Abdomen of female uniform pale colour. Epigyne as in text-fig. 25B.

Holotype— one ♂, *paratypes* three ♂♂, *allotype* one ♀ in spirit.

Type-locality— Tugapur, Mayabandar, North Andaman, India. Coll. B. K. Tikader, 13.5.1971.

This species resembles *Lyssomanes sikkimensis* Tikader but it is separated as follows: (i) Cephalothorax provided with conspicuous longitudinal marking but in *L. sikkimensis* cephalothorax uniform brownish green. (ii) Abdomen provided with transverse bands on the posterior end but in *L. sikkimensis* abdomen provided with 'V' shaped black markings. (iii) Spinners conspicuously long but in *L. sikkimensis* spinners not long. (iv) Epigyne structurally different.

Genus 40. *Euophrys* Koch

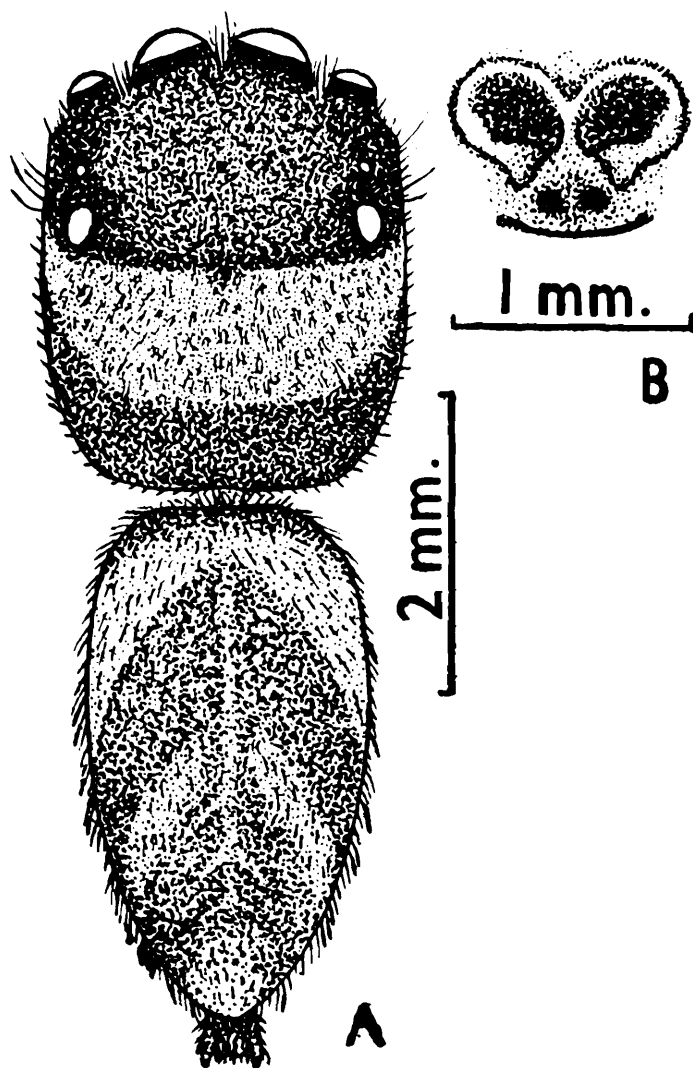
57. *Euophrys chiriatapuensis* sp. nov.

General— Cephalothorax deep brown, legs and abdomen greenish brown. Total length 7.00 mm. Carapace 3.00 mm. long, 2.20 mm. wide; abdomen 3.50 mm. long, 2.00 mm. wide.

Cephalothorax— Cephalothorax longer than wide, not very high, clothed with black hairs and white short spatulate hairs, anterior portion slightly wider than posterior region, centre of cephalothorax provided with conspicuous fovea. Behind the posterior eyes a conspicuous crescent shaped white hairy patch, covered the whole cephalothorax as in text-fig. 26A. Eyes pearly white, anterior median eyes nearly touching each other in a slightly recurved row, the lateral eyes nearly half of the middle eyes. Middle row of eyes between the anterior lateral eyes

and posterior eyes. Sternum oval, clothed with fine hairs. Labium slightly longer than wide, end of maxillae provided with conspicuous scopulae. Chelicerae not very strong, inner margin provided with two teeth and outer margin also with two small teeth. Legs clothed with hairs and spines; first pair of legs robust and longer than others. Tibiae and metatarsi I and II provided with three and two pairs of ventral spines respectively.

Abdomen— Longer than wide, narrowing behind, clothed with fine hairs, anterior portion and middle portion of abdomen decorated with golden patches as in text-fig. 26A. Ventral side pale white coloured



Text-fig. 26 *Euophrys chiriatapuensis* sp. nov.

(A) Dorsal view of female, legs omitted, (B) Epigyne.

provided with longitudinal dark brown patch extending from epigastric fold to near the base of spinners. Epigyne as in text-fig. 26B.

Holotype— One ♀ in spirit.

Type-locality— Chiriatapu village, South Andaman, India. Col. B. K. Tikader, 29.4.1971,

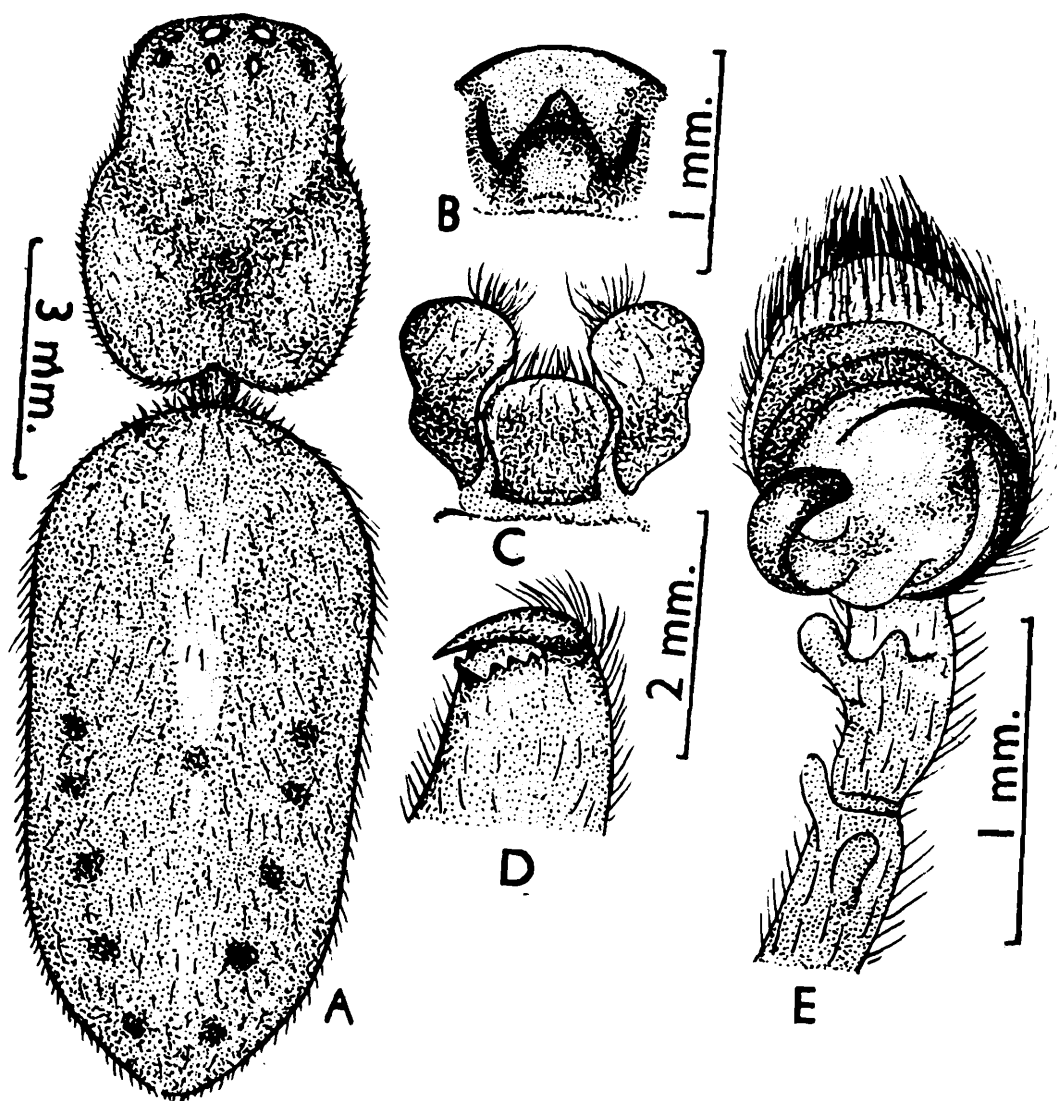
This species nearly resembles *Euophrys monadnock* Simon but differs as follows: (i) Abdomen provided with golden patches but in *E. monadnock* no such patches on the abdomen. (ii) Cephalothorax provided with crescent shaped silvery patch but no such patch in *E. monadnock*. (iii) Epigyne structurally different.

Family XX. PSECHRIDAE

Genus 41. *Psechrus* Thorell

58. *Psechrus nicobarensis* sp. nov.

General— Cephalothorax, legs, abdomen greenish brown. Total length 13.50 mm. Carapace 4.50 mm. long, 3.30 mm. wide; abdomen, 8.60 mm. long, 4.00 mm. wide.



Text-fig. 27 *Psechrus nicobarensis* sp. nov.

(A) Dorsal view of female, legs omitted, (B) Epigyne, (C) Maxillae and labium, (D) Chelicera, (E) Male palp.

Cephalothorax— Long, clothed with thick hairs, cephalic region prominently high and slightly wide in front. Eyes two rows encircled by

black base, anterior row slightly short or recurved and middle eyes larger than the others, posterior row slightly longer and almost straight. Ocular quad longer than wide. Clypeus moderate. Chelicerae strong, inner margin provided with four teeth and outer margin with three teeth. Sternum heart-shaped, clothed with fine hair. Legs long, clothed with hairs, I and II legs very much longer than the III and IV. Male palp as in text-fig. 27E.

Abdomen— Longer than wide, almost parallel sided, clothed with fine hairs, posterior end of dorsal side provided with two longitudinal brown dots line as in text-fig. 27A. Ventral side uniform light brown with fine hairs, prominent cribellum near the base of spinnerets. Epigyne as in text-fig. 27B.

Holotype— one ♀, **paratypes** nine ♀♀, **allotypes** two ♂♂.

Type-locality— Kakana village, Car-Nicobar Island, India. Coll. **B. K. Tikader**, 9.3.1970.

This species resembles *Psecrus torvus* Cambridge but separated as follows: (i) Cephalothorax uniform greenish brown but in *P. torvus* cephalothorax with broad pale band on each side. (ii) Posterior end of dorsal side of abdomen provided with two longitudinal brown dots but in *P. torvus* abdomen laterally with a black patch. (iii) Epigyne and male palp structurally different.

ACKNOWLEDGEMENTS

I take this opportunity to express my sincere thanks to Dr. A. P. Kapur, former Director, Zoological Survey of India for sending me to Andaman and Nicobar Islands, twice, for faunistic survey, for placing the valuable spider collection at my disposal and also for invaluable aid and encouragement in the present study. I am also thankful to Dr. N.V. Subba Rao, Zoologist, Zoological Survey of India, who accompanied me to the above mentioned surveys and Dr. M. Babu Rao, Zoologist, Zoological Survey of India, Western Regional Station, for kindly going through the manuscript. The illustrations used in this paper are prepared by Shri S. K. Chanda, Artist of this Station, to whom my thanks are also due.

SUMMARY

Fifty-eight species of spiders from Andaman and Nicobar Islands are described in this paper. Of these, 32 are known and 26 are new to science. The new species belong to 22 genera distributed in the families Filistidae, Amaurobiidae, Pholcidae, Linyphiidae, Theridiidae, Tetragnathidae, Argiopidae, Gnaphosidae, Heteropodidae, Clubionidae, Salticidae and Psecridae.

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FAUNA OF RAJASTHAN PROTOZOA (No. 3)

By

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(With 1 Table and 3 Text-figs.)

INTRODUCTION

General

This is the third of the series of papers on the free-living protozoan fauna of Rajasthan, and is based on the collections made by the author during the period August-September 1964 from the Districts of Ajmer, Jaisalmer, Sirohi and Udaipur. Field cultures were prepared to obtain examples of the various species, except in the case of the testacean rhizopods, e.g., *Diffugia* spp. The material was subjected to appropriate *intra vitam* staining and were also observed under phase contrast microscope. In some cases, owing to the scarcity of the material these procedures could be followed only for one or two individuals. For the study of the ciliates, silver-line observations were taken as far as possible.

The numbers of examples mentioned under "Material" relates to the permanent preparations made, whereas several individuals were observed and studied in the field, and the final conclusions and identifications arrived at were based on both sets of observations.

A total of 19 species [(these are in addition to 63 species already described in the Parts 1 and 2 of this series) Mahajan 1969, 1971] belonging to 14 genera, 11 families of 7 orders and 3 classes (Mastigophora, Sarcodina and Ciliata) of protozoa are included in this paper. Of these, two taxa (one species and one subspecies both belonging to the class Ciliata) are new to science.

Abbreviations used

Distt.: District; Ex.: Example, Exs.: Examples; Hom.: Homonym; Syn.: Synonym; Z. S. I.: Zoological Survey of India.

List of Collecting Stations

The collecting stations, with their locations, etc. are listed in Table 1.

TABLE 1. List of collecting stations for Rajasthan Protozoa listed in this paper.

Collecting Stations.	Latitude (N) (Approx.)	Longitude (E) (Approx.)
(I) <i>Dist. Ajmer.</i>		
<i>Camp.—Ajmer.</i>		
1. Anna Sagar (near Ajmer)	26° 26'	74° 36'
2. Fai Sagar (near Ajmer)	27° 27'	74° 36'
3. Fushkar Lake	26° 30'	74° 34'
(II) <i>Dist.—Jaisalmer.</i>		
<i>Camp.—Jaisalmer.</i>		
4. Barabagh (12 km. from Jaisalmer)	26° 15'	70° 00'
5. Gariswar (Tank)	26° 55'	70° 57'
6. Gulab Sagar	26° 55'	70° 57'
(III) <i>Dist.—Jodhpur.</i>		
<i>Camp.—Phalodi.</i>		
7. Ramsar (Tank near Phalodi)	27° 08'	72° 22'
(IV) <i>Dist.—Sirohi.</i>		
<i>Camp.—Mount Abu.</i>		
8. Achalgarh Fort Area		
9. Banda (near Mount Abu)	24° 36'	72° 45'
10. Nakhi Lake (Mount Abu)	24° 36'	72° 45'
11. Nalā (near Mount Abu)	24° 36'	72° 45'
(V) <i>Dist.—Udaipur.</i>		
<i>Camp.—Udaipur.</i>		
12. Fateh Sagar (near Udaipur)	24° 37'	73° 38'
13. Pichola Lake (near Udaipur)	24° 34'	73° 38'
14. Sarup Sagar (near Udaipur)	24° 35'	73° 35'

SYSTEMATIC ACCOUNT

1. *Euglena sociabilis* Dangeard

1901. *Euglena sociabilis* Dangeard, *Recherches sur les Eugleniens*. La Bot. 18 : 97.

1965. *Euglena sociabilis*: Pringsheim, *Nova Acta Leop.* 18 (125) : 147.

Material. —2 exs., Barabagh (Jaisalmer), 14. viii. 1964.

Remarks. —Animals cylindrical in shape with delicate pellicle; flagellum slightly longer than body. Size 65-112 μ by 15-30 μ . In spite of the

long flagellum, these animals are not good swimmers; they are usually seen gliding.

Distribution. —Rajasthan (first record): As above. Other records from India are from Uttar Pradesh, Jammu and Kashmir and Bombay (Maharashtra).

2. *Euglena geniculata* Dujardin

1841. *Euglena geniculata* Dujardin, *Histoire Naturelle der Zoophytes Infusaire*, Paris : 22.

1965. *Euglena sociabilis*, Pringsheim, *Nova Acta Leop.*, 18 (125) : 72.

Material. —1 ex., Nala, Mount Abu (Distt. Sirohi) 31. viii. 1964.

Remarks. —Body elongate, sub-cylindrical, more or less even throughout, flexible but slightly contractile; with an obliquely directed tail-like prolongation; cuticular surface smooth, colour green; red pigment spot very conspicuous. Length 1-200 μ .

Distribution. —Rajasthan (first record): As above.

3. *Peranema trichophorum* (Ehrenberg)

(Text-fig. 1 a, b)

1938. *Trachelius trichophorum* Ehrenberg, *Die Infusionsthierchen als Volkommene Organismen*. Leipzig : 322, pl. 33, fig. 11.

1945. *Peranema trichophorum* D. R. Pitelka, *J. Morph.*, 78 : 179.

Material. —3 exs., Barabagh (Jaisalmer), 14. viii. 1964.

Remarks. —The posterior end blunter than the front and looks as if truncated. Colourless, but granular cytoplasm sometimes gives a yellowish-gray tinge. Animalcule secretes a characteristic slimy substance. With two flagella, each arising from its own basal granule (the blepharoplast) in right side-wall of reservoir, one extending spirally backwards, adhering to the pelical and can be observed under phase-contrast microscope; the other one free and about as long as body.

Distribution. —Rajasthan (first record): As above. Other record from India: Guddapah (South India).

4. *Amoeba proteus* (Pallas)

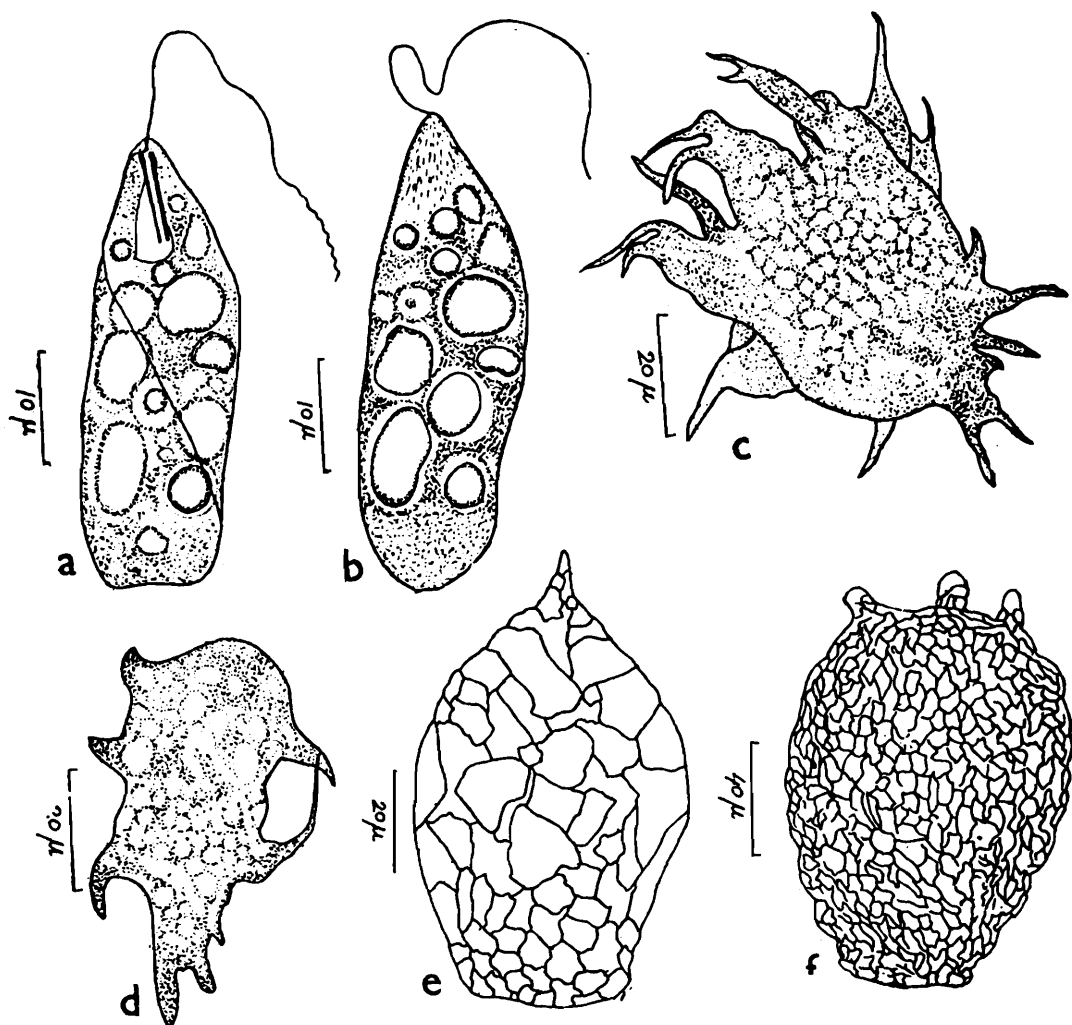
(Text-fig. 1 c, d)

1766. *Volvox proteus* Pallas, *Elenchus zoophytorum*, Hague - Comitum : 417.

1875. *Amoeba proteus* Leidy, *Proc. Acad. Nat. Sci. Philadelphia*, Philadelphia : 99.

Material. —2 exs., lake at Barabagh, 12 km. from Jaisalmer, 14. viii. 1964.

Remarks.—Body transparent; constantly changing shape by amoeboid movements, due to the mechanism of contraction-hydraulic



Text-fig. 1 a. & b. *Paranema trichophorum* (Ehb.) c. & d. *Amoeba proteus* (Pallas) e. *Diffugia acuminata* Ehb. f. *D. lobostoma* var. *tuborsa* Lievare and Thomas

system operating in protoplasm. Through this system the Amoeba makes more or less stiffly gelled tubes of the body (often called pseudopodia) which help in movement.

Ectoplasm hyaline, firm and very often with superficial longitudinal folds on body. Nucleus single, discoidal. Contractile vacuole single.

Bhatia and Mullick (1930) report it from Srinagar (Kashmir) as *Amoeba nitida* Penard (1902, p. 61) and relate it to *Amoeba proteus* Leidy (1878). Carter (1856) reports it as *Amoeba princeps* Carter from Bombay (Maharashtra). Later on, Leidy (1879) diagnosed Carter's species as *proteus*. The controversy of the name is discussed by Leidy (1878, p. 99) and Schaefer (1916 b). Bovee 1965, has discussed clearly the importance of movements in the taxonomy of Sarcodina, particularly that of *Amoeba*.

Distribution. —Rajasthan (first record): As above. Other records from India: Srinagar (Kashmir); Bombay (Maharashtra).

5. *Diffugia acuminata* Ehrenberg

(Text-fig. 1 e)

1838. *Diffugia acuminata* Ehrenberg, *Infusionthieschen* : 131, pl. IX, fig. 3.

Material. —1 ex., Fateh Sagar lake at Udaipur, 13. ix. 1964.

Remarks. —This species of *Diffugia* occurs in a considerable size range. The example recorded here appears to be largest recorded so far. Test with a pointed tubular extension at the anterior end of the dome. The quartz crystals of the test are big and some of them project out of the margin of the test.

Distribution. —Rajasthan (first record): As above. Other records from India is from Bombay (Maharashtra) Carter, 1856 : 229.

6. *Diffugia lobostoma* var. *tuberosa* Gauthier and Thomas

(Text-fig. 1 f)

1958. *Diffugia lobostoma* var. *tuberosa* Gauthier and Thomas, *Arch. Protistink.* Jena, 103 : 268, pl. 9, fig. 1.

Material. —4 exs., Nakhi lake, Mount Abu, 2. ix. 1964.

Remarks. —Body ovoid to subspherical, with 3-4 regular lobes in the pseudostome, which is terminal. Test composed of sand grains. Endoplasm colourless. Size, Pseudostome—18-32 μ , height 80-105 μ ; Dia. 70-95 μ .

Distribution. —Rajasthan (first record): As above. First record from India.

7. *Lacrymaria lagenula* Claparede and Lachmann

(Text-fig. 2 g)

1858. *Lacrymaria lagenula* Claparede and Lachmann, *Etudes sur les infusoires et les rhi opodes*, Geneve, 5 : 1.

Material. —2 exs., Ramsar Phalodi, 22. ix. 1964.

Remarks. —Body elevate-shaped (while living changes to flask shape very often) and attenuated anteriorly; striated obliquely, (Striations can be observed only when alive and that too under phase-contrast). Finely and continuously ciliated; a single circlett of longer cilia around the oral region. Contractile vacuole single, terminal and posterior. Macronucleus short, sausage like; endoplasm granulated; body 60 μ long.

Distribution. —Rajasthan (first record): As above. First record from India.

8. *Trachelophyllum vastitum* Stokes

(Text-fig. 2h)

1884. *Trachelophyllum vastitum* Stokes, *Amer. Monthly Micr. J.*, 5 : 155, pl. iv, fig. 10.

Material. —3 exs., Barabagh, 12 km. from Jaisalmer, 14. viii. 1964.

Remarks. —Body flattened, flexible, ribbon-like, very extensible and elastic. Length about 4-5 times of breadth. Neck somewhat fusiform, and about one and half of the body in length. Apical constriction truncated. Cytopharynx narrow, round in cross-section. Ciliary rows widely apart. Two macronuclei. Length 180-200 μ .

My specimens are of average size and are obtained from the surface of submerged and water-soaked objects.

Distribution. —Rajasthan (first record): As above. First record from India.

9. *Loxodes striatus* (Engelmann)

(Text-fig. 2i)

1862. *Drepanostoma striatum* Engelmann, *Z. Wiss. zool.*, 2 : 382, pl. 21, fig. 7.

1917. *Loxodes striatus* (Engelmann): Penard, *Rev. suisse zool.*, Geneve, 25 : 471, figs. 5-12.

Material. —2 exs., Nullah at Mount Abu, 4. ix. 1964.

Remarks. —Body flattened and leaf-like, with a beak-like anterior end; ciliation uniform, cilia fine and small; cytostome cleft along the curved anterior part and followed by a tube-like pharyngeal tube; with two vesicular macronuclei; the two micronuclei situated at the posterior pole of the anterior, and the anterior pole of the posterior macronucleus; size 125-143 μ .

This species resembles *Loxodes vorax* Stokes in size but differs in having a pointed posterior end and in the disposition of micronuclei. Commonly observed with plenty of ingested algal fragments and diatoms. No Muller's corpuscles and tactile bristles observed. Specimens are small, nearly half of those recorded length by Kahl (length 200 μ).

Distribution. —Rajasthan (first record): As above. Other records from India: Calcutta (W. B.); Srinagar (Kashmir).

10. *Colpoda steinii* Maupas

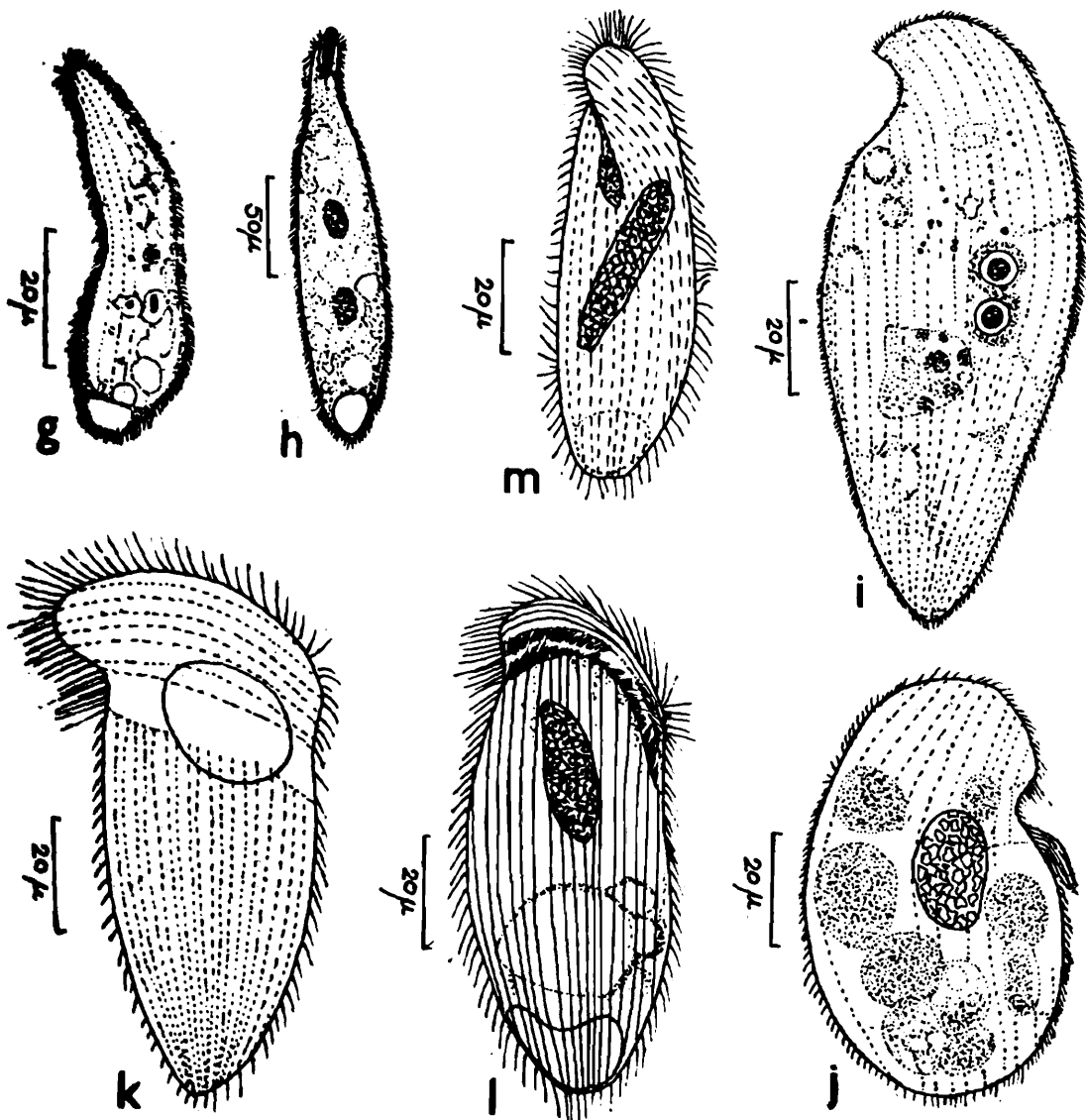
(Text-fig. 2j)

1833. *Colpoda steinii* Maupas, *Arch. zool. exp. gen.*, 1(2) : 436, pl. xix, figs. 7-14.

Material. —7 exs., Nakhi lake, Mount Abu, 4. ix. 1964.

Remarks. —Body cylindrically oval, anteriorly more narrow. Frontal dentation 6-7. Colour deep grey; cytostome at the bottom of

the depression followed by a short tubular cytopharynx. Large food vacuoles often present. Contractile vacuole single, and in the posterior region of the body. Macronucleus central and oval. Length: 25-60 μ , width : 9-15 μ .



Text-fig. 2 g. *Lacrymaria legenula* Clap. Lachman h. *Trachelophylum clavatum* Stokes i. *Loxodes atriatus* (Engelmann) j. *Colpoda steinii* Maupas k. *Metopus ovalis caudoconica* n. subsp. l. *Metopus barbatus* Kahl m. *Metopus fuscus* Kahl

My specimens are of average size.

Distribution. —Rajasthan (first record): As above. Other records from India are from soil of Pusa (Bihar); Sinnamara (Assam); Poona (Maharashtra); Kanara and Coimbatore (Kerala); Karnataka; Delhi; Dehradun (U.P.); and pond water at Srinagar (Kashmir).

11. *Metopus ovalis* Kahl *caudoconica* n. subsp.

(Text-fig. 2k)

Material. —2 exs., Nakhi lake, Mount Abu, 2. ix. 1964; 1 ex., Fatehsagar, Udaipur, 13. ix. 1964.

Remarks. —Body oval; posterior end distinctly conical with sharp angle; macronucleus single, oval and placed anteriorly. Size about 100 by 40 μ .

Comparison. —The new variety differs from the typical one as follows:— (i) Shape ovoid (instead of round) and posterior end produced into a cone. (ii) Size somewhat large and macronucleus also large, oval and placed anteriorly (instead of reniform and centrally placed).

Type specimens. —Holotype: One ex., on slide; S.I. Reg. No. Pt. 601.

Type Locality. —Nakhi lake, Mount Abu.

Paratypes. —Two ex. on slide; S.I. Reg. No. Pt. 602 (2. ix. 1964), 603 (13. ix. 1964).

Distribution. —Rajasthan: As above.

12. *Metopus barbatus* Kahl

(Text-fig. 2l)

1927. *Metopus barbatus* Kahl, *Arch. Protistenk.* 57 : 146, fig. 13.

Material. —1 ex., Barabagh —12 km. from Jaisalmer, 18. ix. 1964

Remarks. —Body oval; posterior end conical with round apex: Macronucleus single; long and oval; placed near the anterior end. Size about 100 μ .

My specimens are of large size, almost double to Kahl's forms.

Distribution. —Rajasthan (first record from India): As above.

13. *Metopus fuscus* Kahl

(Text-fig. 2m)

1927. *Metopus fuscus* Kahl, *Arch. fur protistenk.* 57 : 147, fig. 14.

Material. —3 exs., Fateh Sagar (Udaipur); 20. ix. 1964.

Remarks. —Body elongated; posterior end oval; Macronucleus, sharply outlined and is well seen even in the living specimen, it is single, oval and placed in the first half of the body. Size 180-300 μ long and 40 μ thick, largest so far recorded.

Distribution. —Rajasthan (first record): As above.

14. *Caenomorpha medusula* Perty

(Text-fig. 3n)

1852. *Caenomorpha medusula*, Perty, *zur Kenntinis Kleinster Lebensformen*, Bern : 147.

1932. *Caenomorpha medusula*, Kahl, *Urtiere oder Protozoa, in Dalh's Tierwelt Deutsch.*, Jena, Pt. 25 : 430, fig. 71(30).

Material. —2 exs., Fateh Sagar lake (Udaipur); 20. ix. 1964.

Remarks.—Small, bell-shaped animalcul with a long caudal projection at posterior region. Peristome situated at base of bell-shaped part, with long and dense cilia on the posterior margin of the bell-shaped body; the long cilia in the anterior region in a bunch; contractile vacuole single and dumbbell shaped; a micronucleus lying just below the connecting strand of the ends of micronucleus ends; the animal moving by rotating on its long axes; size $60 \times 30 \mu$.

The specimens are very similar to the Kahl's *C. medusula* var *lata* in shape and disposition of nuclei, but are smaller than Kahl's forms (1932).

Distribution.—Rajasthan (first record) : As above. Other records from India: Calcutta (Mahajan & Nair 1971).

15. *Blepharisma undulans* Stein

(Text-fig. 3 o)

1859. *Blepharisma undulans* Stein, *F. Der Organismus der Infusionsthier.*
II. *Wilhelm Engelmann*, Leipzig: 186.

Material.—6 exs., from the Nullah, Mount Abu, 4. ix. 1964.

Remarks.—Body oblong and almost colourless, about 90-140 μ long; macronucleus in two parts and the two nod-shape ends connected by a comparatively thin strand. Undulating membrane long and very prominent. Cytopharynx directed backward.

These specimens observed from the bottom ooze, and are of average size.

Distribution.—Rajasthan (first record from India) : As above.

16. *Blepharisma tropicum* Bhandari

(Text-fig. 3 p)

1962. *Blepharisma tropicum* Bhandari, *J. Protozool.* 9 (4) : 437, fig. 3.

Material.—6 exs., from Nullah at Mount Abu, 4. ix. 1964.

Remarks.—Body oblong, pink in colour. Undulating membrane not prominent; the macronucleus with two terminal nods as that of *B. undulans*, but connected by a very prominent thick strand much more conspicuous than that of *B. undulans*.

Distribution.—Rajasthan (first record from India): As above.

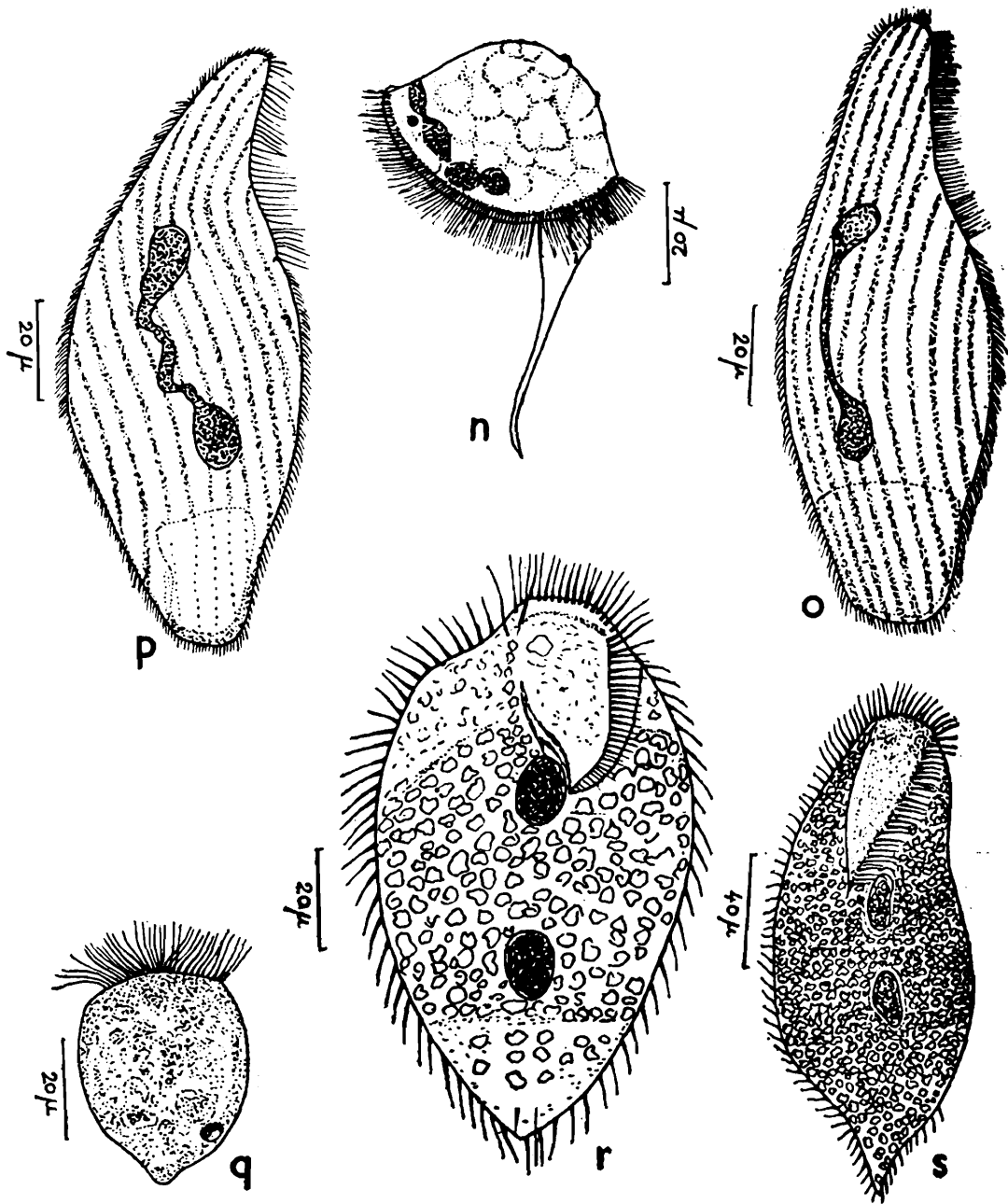
17. *Strobilidium gyrans* (Stokes)

(Text-fig. 3 q)

1887. *Strobilidium gyrans*, Stokes, *J. Royal Micros. Soc.* February, 7 : 35-40.

1932. *Strobilidium gyrans*: Kahl, *Urtiere order Protozoa Tierwelt Dtsch.*, Pt. 25, Teil (3) : 510, fig. 82(7).

Material. —2 exs., Nullah, Mount Abu, 4. ix. 1964; 1 ex., Nakhi lake, Mount Abu, 2. ix. 1964.



Text-fig. 3 n. *Caenomorpha medusula* Perty o. *Blepharisma undulans* Stein p. *Blepharisma tropicum* Bhandary q. *Strobilidium gyrans* (Stokes) r. *Oxytricha acuminata* n. np. s. *Uroleptus piscis* (Müller)

Remarks.—Body like a top and less than twice as long as broad. Macronucleus horse-shoe shaped. Micronucleus lies among the open ends of the macronucleus. The anterior end with a crown of cilia whereas the posterior one ending into a knob-like projection. Nucleus can be studied in detail in living specimens only under phase-contrast microscope.

These specimens are commonly observed on the bottom. My specimens are of large size.

Distribution.—Rajasthan (first record from India): As above.

18. *Oxytricha acuminata* n. sp.

(Text-fig 3 r)

Material. —8 exs., Fateh Sagar (Udaipur) 13. ix. 1964.*Remarks.* —Body broadly oval and posteriorly drawn as inverted cone. Frontal cirri 9, ventral 5, anal 5, marginal running interrupted upto posterior end; macronucleus in 2 oval parts; contractile vacuole situated in one side of peristome, size $100\ \mu - 115\ \mu$ by $50-60\ \mu$.*Comparison.* —The new species differs from allied ones, as below: 1. From *Oxytricha ovalis* Kahl: Body being proportionately more broad; posterior end not rounded but drawn into a cone. 2. From *Oxytricha oblongatus* Mahajan: Body almost oval and sides not parallel (vs. not so).*Type specimens.*—*Holotype*: 1 ex. on a slide, Z. S. I. Reg. No. Pt. 694.*Type Locality.* —As above.*Paratypes.* —7 exs., on 7 slides, Z. S. I. Reg. No. Pt. 695-701.*Distribution.* —Rajasthan: As above.19. *Uroleptus piscis* (Müller)

(Text-fig. 3 s)

1773. *Trichoda piscis* Müller, *Verminum terrest. et fluviatils animal. infusoria. etc. historia* Havniae et Lipsiae, : 73.1838. *Uroleptus piscis* Ehrenberg, *Die Infussionsthierchen als vollkommene Organismen*. Leipzig : 358, pl. xI, fig. 1.*Material.* —3 exs., Fai Sagar lake (Udaipur), 17. ix. 1964.*Remarks.* —Body exceedingly elastic and variable in shape, fusiform but elongated, about 6 to 8 times longer than broad, anterior end rounded, with a long ribbon-shaped tail, ending bluntly and turning slightly towards right. Peristome extending from one-fourth to one-third of the body. Macronucleus consisting of two ovoid masses occupying the middle part of the body.Living forms quite large i.e. about 800 to $1000\ \mu$ long and 80 to $120\ \mu$ broad, always fully ladden with injected food material. The animal is very sensitive and contracts considerably at the slightest disturbance.*Distribution.* —Rajasthan (first record): As above. Other records from India are from soil of Indore (M.P.); Coimbatore (Tamil Nadu) and Freshwater of Srinagar (Kashmir).

SUMMARY

This paper (third in series of papers on protozoa of Rajasthan) deals with freshwater protozoa, collected by the author during August-

September, 1964, in Rajasthan in the districts of Jaisalmer, Sirohi, Udaipur and Ajmer.

19 species belong to 14 genera, 11 families, 5 orders and 3 classes (Mastigophora, Sarcodina, Ciliata) are included; of these the following two taxa (1 species and 1 subspecies) both belonging to the class ciliata are new to science.

(A) Sub-cl. Holotricha, Ord. Heterotrichida: (Family Metopidae).

1. *Metopus ovalis caudoconica* n. subsp.

(B) Sub-cl. Spirotricha, Ord. Hypotrichida: (Family Oxytrichidae).

2. *oxytricha acuninata* n. sp.

All the 19 species are recorded for the first time from Rajasthan, whereas the 14 of them are first record from India.

ACKNOWLEDGEMENTS

My thanks are due to the following for assistance rendered: To the Staff of the Protozoology Section at Calcutta for assistance in the field as well as in the laboratory.

To the Rajasthan State authorities, particularly the Collectors of Ajmer, Jaisalmer, Sirohi and Udaipur. To Shri Madan Lal Sharma, Superintendent, Circuit House, Mount Abu, Shri Bhim Sen, Principal, M. B. College, Udaipur, for their valuable assistance at Mount Abu and Udaipur respectively, and finally, to the Director, Zoological Survey of India, for his kind suggestions and guidance.

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ON A SMALL COLLECTION OF DIPTERA FROM CHOTA NAGPUR, BIHAR

By

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INTRODUCTION

This report deals with the material of Diptera collected from Chota Nagpur, Bihar, by Dr. A. P. Kapur during 1954-1955 and Dr. Raj Tilak during 1966-1969 of Zoological Survey of India, Calcutta. Majority of the species are recorded for the first time from this area. These are preliminary surveys and a number of intensive faunistic surveys are required to know in detail the Diptera fauna of Chota Nagpur.

The families dealt with are Tipulidae, Chironomidae, Bombyliidae, Pipunculidae, Syrphidae, Tephritidae, Sepsidae, Sciomyzidae, Chloropidae, Calliphoridae, Sarcophagidae, Muscidae and Hippoboscidae.

SYSTEMATIC ACCOUNT

Family TIPULIDAE

1. *Conosia irrorata* (Wiedemann)

1828. *Limnobia irrorata* Wiedemann, *Auss. Zweifl.*, 1 : 574.

1912. *Conosia irrorata* (Wiedemann): Brunetti, *Fauna Brit. India*, Diptera, Nematocera: 497-499, text-fig. 43.

Material. —1 ex., Sanka River Bank, Ranchi Dist., 14. ix. 1966, and 1 ex., Lohardaga, Ranchi Dist., 17. xii. 1967; coll. R. Tilak.

Remarks. —The specimen bearing Reg. No. 4483/H6 without spots on sides of the median line of thorax. In the other, apical tarsus of anterior leg brown dorsally.

Recorded from whole of Orient; also from Japan and Australia.

Family CHIRONOMIDAE

2. *Calyptopogon albitarsis* Kieffer

1910. *Calyptopogon albitarsis* Kieffer, *Mem. Indian Mus.*, 2 : 209-210, pl. 8, figs. 2, 6.

Material. —8 exs., at light, Simdega, Ranchi Dist., 15. ix. 1966; coll. R. Tilak.

Remarks.—Reported from Calcutta, W. Bengal; also from East Indies.

3. *Palpomyia disticta* Kieffer

1911. *Palpomyia disticta* Kieffer, *Rec. Indian Mus.*, 6 : 115-116, pl. 6, fig. 1.

Material.—2 exs., at light, Simdega, Ranchi Dist., 15 ix. 1966; coll. R. Tilak.

Remarks.—Recorded from Calcutta, W. Bengal; Madhpur and Bhogaon, Bihar; Allahabad, Uttar Pradesh.

Family BOMBYLIIDAE

4. *Anthrax albofulva* Walker

1852. *Anthrax albofulva* Walker, *Ins. Saund. Dipt.*, pt. 3 : 182.

1920. *Anthrax albofulva* Walker: Brunetti, *Fauna Brit. India*, Diptera, 1: 251-252.

Material.—1 ex., Basia, Ranchi Dist., 25. xii. 1967; coll. R. Tilak.

Remarks.—National Zoological Collection, Calcutta, contains specimens from Guindy and Waltair, S. India; Hathikund, Gharwal District, Uttar Pradesh.

Family PIPUNCULIDAE

5. *Pipunculus limpidipennis* Brunetti

1912. *Pipunculus limpidipennis* Brunetti, *Rec. Indian Mus.*, 7 : 491.

1923. *Pipunculus limpidipennis* Brunetti: Brunetti, *Fauna Brit. India*, Diptera, 3 : 20-21.

Material.—2 exs., Kuru, Ranchi Dist., 12. xii. 1969; coll. R. Tilak.

Remarks.—Recorded from Calcutta, W. Bengal; Puri, Orissa; Igatpur, Western Ghats; Pusa, Bihar; also from Nepal.

Family SYRPHIDAE

6. *Paragus rufiventris* Brunetti

1913. *Paragus rufiventris* Brunetti: *Rec. Indian Mus.*, 8 : 157-158.

1923. *Paragus rufiventris* Brunetti: Brunetti, *Fauna Brit. India*, Diptera, 3 : 34-35.

Material.—1 ex., Tholkabad, Chaibasa Dist., 2. ii. 1955; coll. A. P. Kapur.

Remarks.—Widely distributed in India.

7. *Melanostoma univittatum* (Wiedemann)

1824. *Syrphus univittatum* Wiedemann, *Analec. Entom.*, p. 36.

1923. *Melanostoma univittatum* (Wiedemann): Brunetti, *Fauna Brit. India*, Diptera, 3 : 50-51.

Material.—1 ex., Manoharpur, Chaibasa Dist., 29. xii. 1967; coll. R. Tilak.

Remarks.—Recorded from Darjeeling, W. Bengal; Chapra and Pusa, Bihar, Sadiya, Dibrugarh and Shillong, A sam; NEFA; Coorg, Nedumangad and Coromandel, S. India; also from Sri Lanka; Lower Burma; Sumatra; Queensland.

8. *Syrphus balteatus* (De Geer)

1776. *Musca balteata* De Geer, *Mem. Insectes*, 6 : 116.

1923. *Syrphus balteatus* (De Geer): Brunetti, *Fauna Brit. India*, Diptera, 3 : 82-84, pl. 1, figs. 19-20.

Material.—1 ex., Mandar, Ranchi Dist., 6. xii. 1967, and 2 exs., Mandar, Ranchi Dist., 7. xii. 1967; coll. *R. Tilak*.

Remarks.—Very common throughout the East in hills and plains; also known to occur in Europe; Maderia; Canaries; N. Africa; Asia to Japan.

9. *Syrphus confrater* Wiedemann

1830. *Syrphus confrater* Wiedemann, *Auss. Zweifl.*, 2 : 120.

1923. *Syrphus confrater* Wiedemann: Brunetti, *Fauna Brit. India*, Diptera, 3 : 92-94, pl. 2, fig. 17.

Material.—2 exs., Lohardaga, Ranchi Dist., 19. xii. 1969; coll. *R. Tilak*.

Remarks.—Previously reported from Pusa, Chapra and Patna, Bihar; Simla, Himachal Pradesh; Khasi Hills, Assam; also recorded from Sumatra and China.

10. *Ischiodon scutellaris* (Fabricius)

1805. *Scaeva scutellaris* Fabricius, *Syst. Antl.*, p. 252.

1923. *Ischiodon scutellaris* (Fabricius): Brunetti, *Fauna Brit. India*, Diptera, 3 : 97-99, text-fig. 17.

Material.—2 exs., Mandar, Ranchi Dist., 7. xii. 1967, 3 exs., Mandar, Ranchi Dist., 8. xii. 1967, and 1 ex., Kuru, Ranchi Dist., 12. xii. 1969; coll. *R. Tilak*.

Remarks.—Common in India especially in W Bengal and Assam; widely distributed in the East; common in North Africa.

11. *Sphaerophoria indiana* Bigot

1884. *Sphaerophoria indiana* Bigot, *Ann. Soc. Ent. France*, (6) 4 : 99.

1923. *Sphaerophoria indiana* Bigot: Brunetti, *Fauna Brit. India*, Diptera, 3 : 102-103, pl. 3, figs. 1-6.

1967. *Sphaerophoria indiana* Bigot: Joseph, *Oriental Insects*, 1 (3 & 4) : 248, figs. 6, 8-13.

Material.—1 ex., Mandar, Ranchi Dist., 6. xii. 1967, and 1 ex., Lohardaga, Ranchi Dist., 19. xii. 1969; coll. *R. Tilak*.

Remarks.—Distributed throughout India, common in the Western Himalaya but less so in eastern ranges.

12. *Eristalis arvorum* (Fabricius)

1787. *Syrphus arvorum* Fabricius, *Mant. Ins.* 2 : 335.

1923. *Eristalis arvorum* (Fabricius): Brunetti, *Fauna Brit. India*, Diptera, 3 : 181-183, pl. 4, figs. 6, 7.

Material. —2 exs., Basia, Ranchi Dist., 25. xii. 1967; coll. *R. Tilak*.

Remarks. —Common all over India, occurring in almost all parts of the Orient.

13. *Megaspis errans* (Fabricius)

1787. *Syrphus errans* Fabricius, *Mant. Ins.*, 2 : 337.

1923. *Megaspis errans* (Fabricius): Brunetti, *Fauna Brit. India*, Diptera, 3 : 199-200.

Material. —1 ex., Basia, Ranchi Dist., 25. xii. 1967, 7 exs., Basia, Ranchi Dist., 26. xii. 1967, and 5 exs., Basia, Ranchi Dist., 27. xii. 1967; coll. *R. Tilak*.

Remarks. —In one example (Reg. No. 4574/H6), thoracic dorsum completely black with brown pubescence except for some whitish hairs on either side of the suture.

Very Common throughout the East.

14. *Megaspis argyrocephalus* (Macquart)

1842. *Eristalis argyrocephalus* Macquart, *Dipt. Exot.*, 2 : 45, pl. 10, fig. 5.

1923. *Megaspis argyrocephalus* (Macquart): Brunetti, *Fauna Brit. India*, Diptera, 3 : 201-203, pl. 4, fig. 20.

Material. —2 exs., Mandar, Ranchi Dist., 8. xii. 1967, 2 exs., Basia, Ranchi Dist., 26. xii. 1967, and 1 ex., Basia, Ranchi Dist., 27. xii. 1967; coll. *R. Tilak*.

Remarks. —A widely distributed species of the Orient.

Family TEPHRITIDAE

15. *Dacus (Zeugodacus) tau* (Walker)

1849. *Dasyneura tau* Walker, *List. Dipt. Brit. Mus.*, 4 : 1674.

1970. *Dacus (Zeugodacus) tau* (Walker): Kapoor, *Oriental Insects*, 4 (2) : 219-220.

Material. —15 exs., Timra, Chaibasa Dist., 12. ii. 1955; coll. *A. P. Kapur*.

Remarks. —Widely distributed in India; also reported from Nepal, Sri Lanka, Burma, Malaya, Formosa, Philippines and Java.

16. *Platensina acrostacta* (Wiedemann)

1824. *Trypeta acrostacta* Wiedemann, *Anal. Entom.*, 54 : 119.

1970. *Platensina acrostacta* (Wiedemann): Kapoor, *Oriental Insects*, 4 (2) : 244.

Material.—1 ex., Kuru, Ranchi Dist., 12. xii. 1969; coll. *R. Tilak*.

Remarks.—Reported from Khasi Hills, Assam; Puri, Orissa; Calcutta, W. Bengal; also from Sylhet, Bangladesh; Burma.

17. *Stylia sororcula* (Wiedemann)

1830. *Trypeta sororcula* Wiedemann, *Auss. Zweifl.*, 2 : 509.

1970. *Stylia sororcula* (Wiedemann): Kapoor, *Oriental Insects*, 4(2) : 243.

Material.—24 exs., Ghaghra, Ranchi Dist., 23. xij. 1967, and 1 ex., Kuru, Ranchi Dist., 12. xii. 1967; coll. *R. Tilak*.

Remarks.—Earlier recorded from Puri, Orissa; Parasnath, Bihar; Calcutta, W. Bengal; Simla, Himachal Pradesh.

18. *Tephritis spilopectera* Bezzi

1913. *Tephritis spilopectera* Bezzi, *Mem. Indian Mus.*, 3 : 165-166, pl. 10, fig. 68.

1970. *Tephritis spilopectera* Bezzi: Kapoor, *Oriental Insects*, 4(2) : 240.

Material.—1 ex., Netarhat, Ranchi Dist., 22. i. 1954; coll. *A. P. Kapur*. 2 exs., Ghaghra, Ranchi Dist., 23. xii. 1967; coll. *R. Tilak*.

Remarks.—The specimen bearing Reg. No. 4540/H6, without blackish stripes on the thorax.

Originally described from Calcutta, W. Bengal; National Zoological Collection, Calcutta, has specimens from several parts of India.

Family SEPSIDAE

19. *Sepsis himalayensis* Brunetti

1909. *Sepsis himalayensis* Brunetti, *Rec. Indian Mus.*, 3 : 345-347, pl. 13, figs. 1-2.

Material.—2 exs., Mandar, Ranchi Dist., 7 xii. 1967; coll. *R. Tilak*.

Remarks.—So far reported only from Darjeeling.

20. *Sepsis rufa* Macquart

1850. *Sepsis rufa* Macquart, *Dipt. Exot. Suppl.*, 4 : 269.

1909. *Sepsis rufa* Macquart: Brunetti, *Rec. Indian Mus.*, 3 : 359.

Material.—1 ex., Ghaghra, Ranchi Dist., 23. xii. 1967.

Remarks.—Recorded from Calcutta and Darjeeling, W. Bengal; Simla, Himachal Pradesh; Shillong, Assam; Puri, Orissa; also from Rangoon.

Family SCIOMYZIDAE

21. *Sepedon aenescens* Wiedemann

1830. *Sepedon aenescens* Wiedemann, *Auss. Zweifl.*, 2 : 579.

1907. *Sepedon aenescens* Wiedemann: Brunetti, *Rec. Indian Mus.* 1 : 213.

Material.—1 ex., Netarhat, Ranchi Dist., 22. i. 1954, and 1 ex., Netarhat, Ranchi Dist., 22-26. i. 1954; coll. *A. P. Kapur*.

Remarks.—It is earlier recorded from Bangalore, S. India.

22. *Sepedon plumbellus* Wiedemann

1830. *Sepedon plumbellus* Wiedemann, *Auss. Zweifl.*, 2 : 577.

1907. *Sepedon plumbellus* Wiedemann: Brunetti, *Rec. Indian Mus.*, 1 : 212-213.

Material.—1 ex., Mandar, Ranchi Dist., 6. xii. 1967, and 1 ex., Mandar, Ranchi Dist., 7. xii. 1967; coll. *R. Tilak*.

Remarks.—Known to occur in Calcutta, W. Bengal; Dharampur, Simla Hills.

23. *Sepedon ferruginosus* Wiedemann

1830. *Sepedon ferruginosus* Wiedemann, *Auss. Zweifl.*, 2 : 577.

1907. *Sepedon ferruginosus* Wiedemann: Brunetti, *Rec. Indian Mus.*, 1 : 215-216.

Material.—1 ex., Basia, Ranchi Dist., 26. xii. 1967, and 1 ex., Basia, Ranchi Dist., 27. xii. 1967; coll. *R. Tilak*.

Remarks.—Common in Calcutta, W. Bengal; Orissa; also reported from Rangoon, Burma.

Family CHLOROPIDAE

24. *Pachylophus rufescens* (de Meijere)

1904. *Myrmomorpha rufescens* de Meijere *Bijdr Dierkunde*, 17 : 113.

1913. *Pachylophus rufescens* (de Meijere): Brunetti, *Rec. Indian Mus.*, 8 : 188-189.

Material.—1 ex., Mandar, Ranchi Dist., 29. i. 1954, and 4 exs., Kunti, Ranchi Dist., 17. ii. 1954; coll. *A. P. Kapur*. 1 ex., Kuru, Ranchi Dist., 12. xii. 1969, and 1 ex., Lohardaga, Ranchi Dist., 17. xii. 1969; coll. *R. Tilak*.

Remarks.—Earlier reported from Dibrugarh, Assam; Monghyr, Rajmahal and Manbhum, Bihar; also from Nepal.

Family CALLIPHORIDAE

25. *Chrysomyia megacephala* (Fabricius)

1784. *Musca megacephala* Fabricius, *Syst. Ent.*, 4 : 317.

1940. *Chrysomyia megacephala* (Fabricius): Senior-White, Aubertin and Smart, *Fauna Brit. India*, Diptera, 6 : 138-140, figs. 64, 65a.

Material.—1 ex., Mandar, Ranchi Dist., 6. xii. 1967, 1 ex., Mandar, Ranchi Dist., 7. xii. 1967, and 4 exs., Mandar, Ranchi Dist., 8. xii. 1967; coll. *R. Tilak*.

Remarks.—Apical half of arista black in specimens bearing Reg. Nos. 4572/H6 and 4573/H6.

Of common occurrence in Oriental and Australian Regions.

26. *Chrysomyia rufifacies* (Macquart)

1842. *Lucilia rufifacies* Guer in Macquart, *Mem. Soc. Roy. Sci. Arts Lille, Année*, p. 303.

1940. *Chrysomyia rufifacies* (Macquart): Senior-White, Aubertin and Smart, *Fauna Brit. India, Diptera*, 6 : 141-143, fig. 67.

Material.—1 ex., Kuru, Ranchi Dist., 15. xii. 1967; coll. *R. Tilak*.

Remarks.—Hairs on lower squama mainly black. Thoracic stripe absent. Very common all over the Orient and Australian Regions.

27. *Chrysomyia nigripes* Aubertin

1932. *Chrysomyia (Microcalliphora) nigripes* Aubertin, *Ann. Mag. nat. Hist.*, (10) 9 : 26.

1940. *Chrysomyia nigripes* Aubertin: Senior-White, Aubertin and Smart, *Fauna Brit. India, Diptera*, 6 : 147-148, fig. 72.

Material.—3 exs., Old Anqua, Chaibasa Dist., 13. ii. 1955; coll. *A. P. Kapur*.

Remarks.—Originally described from Sri Lanka. It is recorded for the first time from India; also new to ZSI.

28. *Stomorphina discolor* (Fabricius)

1794. *Musca discolor* Fabricius, *Ent. Syst.*, 4 : 320.

1940. *Stomorphina discolor* (Fabricius): Senior-White, Aubertin and Smart, *Fauna Brit. India, Diptera*, 6 : 192-194, text-fig. 89.

Material.—2 exs., Mandar, Ranchi Dist., 7. xii. 1967, and 5 exs., Basia, Ranchi Dist., 26. xii. 1967; coll. *R. Tilak*.

Remarks.—The specimen bearing Reg. No. 4570/H6, de with the wing apex broadly and deeply infuscated; the front tarsi all black excepting the brownish yellow basal segment.

Distributed generally in India; recorded also from Sri Lanka; Malaya; Java; Borneo; Philippine Islands; Hong Kong; Buru Island; N. Australia; New Caledonia; Fiji.

Family SARCOPHAGIDAE

29. *Sarcophaga albiceps* Meigen

1826. *Sarcophaga albiceps* Meigen, *Syst. Besch.*, 5 : 22.

1940. *Sarcophaga albiceps* Meigen: Senior-White, Aubertin and Smart, *Fauna Brit. India, Diptera*, 6 : 242-243, fig. 120.

Material.—2 exs., Old Anqua, Chaibasa Dist., 13. ii. 1955, and 1 ex., Old Anqua, Chaibasa Dist., 16. ii. 1955; coll. *A. P. Kapur*. 1 ex., Mandar, Ranchi Dist., 8. xii. 1967; coll. *R. Tilak*.

Remarks.—Widely distributed in the Orient including India; also recorded from Europe; Palestine; Australia.

30. *Sarcophaga hirtipes* Wiedemann var. *orchidea* Böttcher1913. *Sarcophaga orchidea* Böttcher, *Ann. Mus. Nat. Hung.*, 11 : 375.1940. *Sarcophaga hirtipes* Wiedemann var. *orchidea* Böttcher, Senior-White, Aubertin and Smart, *Fauna Brit. India*, Diptera, 6 : 244-245, fig. 121.*Material*. —1 ex., Basia, Ranchi Dist., 26. xii. 1967; coll. *R. Tilak*.*Remarks*. —Occur generally throughout India; also occur in Burma; Sri Lanka; Philippines; Formosa; N. China; Australia.31. *Sarcophaga orientaloides* Senior-White1924. *Sarcophaga orientaloides* Senior-White, *Rec. Indian Mus.*, 26 : 244, pl. 15, fig. 31.1940. *Sarcophaga orientaloides* Senior-White: Senior-White, Aubertin and Smart, *Fauna Brit. India*, Diptera, 6 : 251-253, fig. 129.*Material*. —2 exs., Mandar, Ranchi Dist; 8. xii., 1967; coll. *R. Tilak*.*Remarks*. —Widely distributed in India; also reported from Sri Lanka; Burma; Siam; Malaya.32. *Sarcophaga ruficornis* (Fabricius)1794. *Musca ruficornis* Fabricius, *Ent. Syst.*, 4 : 314-316.1940. *Sarcophaga ruficornis* (Fabricius) : Senior-White, Aubertin and Smart, *Fauna Brit. India*, Diptera, 6 : 269-270, fig. 145.*Material*. —1 ex., Lohardaga, Ranchi Dist., 17. xii. 1969; coll. *R. Tilak*.*Remarks*. —Widely distributed in India; also reported from Sri Lanka; Malacca; Philippines; Formosa; N. E. Africa; the Chagos Archipelago; Socotra Island.

Family MUSCIDAE

33. *Musca (Musca) domestica vicina* Macquart1851. *Musca vicina* Macquart, *Mem. Soc. Sci. Agric. Arts Lille*, p. 226.1965. *Musca (Musca) domestica vicina* Macquart: Emden, *Fauna India*, Diptera, 7 (1) : 55.*Material*. —1 ex., Mandar, Ranchi Dist., 6. xii. 1967; coll. *R. Tilak*.*Remarks*. —World wide in Tropics and Subtropics. Very common in whole of Orient.34. *Musca (Byomyia) ventrosa* Wiedemann1830. *Musca ventrosa* Wiedemann, *Auss. Zweifl.*, 2 : 656.1965. *Musca (Byomyia) ventrosa* Wiedemann: Emden, *Fauna India*, Diptera, 7 (1) : 60-61.*Material*. —1 ex., Basia, Ranchi Dist., 25. xii. 1967; coll. *R. Tilak*.*Remarks*. —Of common occurrence in the Ethiopian and Oriental Regions.

35. *Musca (Byomyia) sorbens* Wiedemann

1830. *Musca sorbens* Wiedemann, *Auss. Zweifl.*, 2 : 418.

1965. *Musca (Byomyia) sorbens* Wiedemann: Emden, *Fauna India*, Diptera, 7 (1) : 61-63, fig. 14.

Material. —1 ex., Topadi, Chaibasa Dist., 8. ii. 1955; coll. *A.P. Kapur*. 1 ex., Mandar, Ranchi Dist., 6. xii. 1967, and 1 ex., Basia, Ranchi Dist., 27. xii. 1967; coll. *R. Tilak*.

Remarks. —Distributed throughout the Ethiopian, Australian and Oriental Regions.

36. *Musca (Byomyia) lucens* (Villeneuve)

1922. *Pristirynchomyia lucens* Villeneuve, *Ann. Sci. nat. (Zool.)*, 5 (10) : 336.

1965. *Musca (Byomyia) lucens* (Villeneuve): Emden, *Fauna India*, Diptera, 7 (1) : 63-64, pl. 1, fig. 1.

Material. —1 ex., Netarhat, Ranchi Dist., 22. i. 1954; coll. *A. P. Kapur*.

Remarks. —Abdominal sternites are dark brown to blackish, instead of the usual fuscous black.

Reported for the first time from India; also new to ZSI. So far known only from Sri Lanka and N. E. Burma.

37. *Musca (Byomyia) pattoni* Austen

1910. *Musca pattoni* Austen, *Ann. Mag. nat. Hist.*, (8) 5 : 114.

1965. *Musca (Byomyia) pattoni* Austen: Emden, *Fauna India*, Diptera, 7 (1) : 64-65, text-fig. 15.

Material. —1 ex., Mandar, Ranchi Dist., 6. xii. 1967, 1 ex., Basia; Ranchi Dist., 25. xii. 1967, and 3 exs., Basia, Ranchi Dist., 26. xii. 1967, coll. *R. Tilak*.

Remarks. —Recorded from S. India to N. W. Uttar Pradesh; Assam; also from Sri Lanka.

38. *Musca (Philaematomyia) crassirostris* Stein

1903. *Musca crassirostris* Stein, *Mitt. Zool. Mus. Berlin*, 2 : 99.

1965. *Musca (Philaematomyia) crassirostris* Stein: Emden, *Fauna India*, Diptera, 7 (1) : 71-72, fig. 11b.

Material. —1 ex., Mandar, Ranchi Dist., 6. xii. 1967 and 7 exs., Kuru, Ranchi Dist., 15. xii. 1967; coll. *R. Tilak*.

Remarks. —Distributed in whole of the Oriental Region; also in Mediterranean; Socotra Sudan; Belgian Congo; S. Rhodesia; Transvaal.

39. *Musca (Viviparomusca) bezzii* Patton and Cragg

1913. *Musca bezzii* Patton and Cragg, *Ind. J. med. Res.* 1 : 19, pl. 4.

1965. *Musca (Viviparomusca) bezzii* Patton and Cragg: Emden, *Fauna India*, 7 (1) : 83-84, figs. 10e, 11a, 12, 19.

Material.—1 ex., Tholkabadd, Chaibasa Dist., 9. ii. 1955; coll. A. P. Kapur.

Remarks.—Occurring commonly in India at altitudes of 450 m. and above.

40. *Orthellia coerulea* (Wiedemann)

1819. *Musca coerulea* Wiedemann, *Zool. Mag.*, 3 : 23.

1965. *Orthellia coerulea* (Wiedemann): Emden, *Fauna India*, Diptera, 7 (1) : 124-125, pl. 1, fig. 4.

Material.—3 exs., Old Anqua, Chaibasa Dist., 13. ii. 1955; coll. A. P. Kapur. 1 ex., Basia, Ranchi Dist.; 26. xii. 1969; coll. R. Tilak.

Remarks.—Reported from India; Sri Lanka; Sikkim; Nepal; Burma; Malaya; Siam; China; Formosa; Japan; Indonesia to Australia; Solomon Islands.

41. *Orthellia lauta* (Wiedemann)

1830. *Musca lauta* Wiedemann, *Auss. Zweifl.*, 2 : 410.

1965. *Orthellia lauta* (Wiedemann): Emden, *Fauna India*, Diptera 7 (1) : 128-130.

Material.—1 ex., Basia, Ranchi Dist., 26. xii. 1967; coll. R. Tilak.

Remarks.—Widely distributed in India; also recorded from Sri Lanka; Nepal; Burma; Malaya; Siam; Laos; Sumatra; Borneo; Java; Lombok; Australia.

42. *Stomoxys calcitrans* (Linnaeus)

1758. *Conops calcitrans* Linnaeus, *Syst. Nat.* ed. 10 : 604.

1965. *Stomoxys calcitrans* (Linnaeus): Emden, *Fauna India*, Diptera, 7 (1) : 160-161, figs. 35-37.

Material.—1 ex., Mandar, Ranchi Dist., 7. xii. 1967; coll. R. Tilak.

Remarks.—Of world-wide occurrence, including throughout the Orient.

43. *Gymnodia tonitrui* (Wiedemann)

1824. *Anthomyia tonitrui* Wiedemann, *Anal. Ent.* p. 52.

1965. *Gymnodia tonitrui* (Wiedemann): Emden, *Fauna India*, Diptera, 7 (1) : 631-633.

Material.—1 ex., Basia, Ranchi Dist., 26. xii. 1967; coll. R. Tilak.

Remarks.—Distributed in N. and C. India; Assam; also in W. Pakistan; Singapore; Formosa. The species is not so far recorded from S. India.

Family HIPPOBOSCIDAE

44. *Hippobosca longipennis* Fabricius

1805. *Hippobosca longipennis* Fabricius, *Syst. Antliat*, p. 338.

1962. *Hippobosca longipennis* Fabricius: Maa, *Pacific Insects*, 4 (3) : 610-611, figs. 14, 16, 18, 19, 21, 23.

Material.—6 exs., Mandar, Ranchi Dist., 7. xii. 1967; coll. R, Tilak.

Remarks.—Aedeagus comparatively large. A common pest of domestic dog.

Widely distributed throughout India; common in Manchuria and China proper.

SUMMARY

This paper records 44 species of Diptera from Chota Nagpur belonging to 13 families; 2 of which, *Chrysomyia nigripes* Aubertin (Calliphoridae) and *Musca (Byomyia) lucens* (Villeneuve) (Muscidae), are reported for the first time from India. Of the remaining 42 species, 38 are reported for the first time from this area, the rest 4 known species are *Sarcophaga hirtipes* Wiedemann var. *orchidea* Bottcher, *S. orientalis* Senior-White and *S. ruficornis* (Fabricius) belonging to Sarcophagidae and *Stomoxys calcitrans* (Linnaeus) belonging to Muscidae.

ACKNOWLEDGEMENTS

We are grateful to Dr. A. P. Kapur, Director and Mr. K. S. Pradhan, Superintending Zoologist, Zoological Survey of India, Calcutta, for placing the material at our disposal.

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SENIOR-WHITE, R. AUBERTIN, D. and SMART, J. 1940, *The Fauna of British India* including the remainder of the Oriental Region, Diptera, Calliphoridae, Taylor and Francis, London, 6, pp. ix + 288.

OCCURRENCE OF *HYMENICOIDES CARTER*
KEMP FROM THE RIVER GANGA AT VARANASI
TOGETHER WITH NOTES ON OTHER MATERIAL
OF THE SPECIES IN THE ZOOLOGICAL SURVEY
OF INDIA

By

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The genus *Hymenicoides carteri* was erected by Kemp in 1917 to accommodate his new monotypic species *Hymenicoides carteri*, twenty two specimens of which were collected from the banks of the river Hughli at Sibpur near Calcutta. According to Kemp "they were obtained in a timber bored by *Teredo (Xylotria) dunlopi* lying between tide marks. The water at the time they were found, was almost or quite fresh at all states of the tide, but it was doubtless brackish later in the year". Besides, Kemp had access to two more specimens collected near Khulna in the Gangetic delta.

Some time back, three specimens of this interesting species were collected by Shri D. V. Pahwa of the Central Inland Fisheries Research Sub-Station, Allahabad from the bed of the river Ganga at Nagwan Ghat, Varanasi (U.P.), and one of them which was in good condition was received from the Research Officer, Central Inland Fisheries Sub-Station, Allahabad for determination. After careful examination and comparison with the type, it was found that the specimen belonged to *H. carteri* Kemp. Interesting ecological observations made by Shri. Pahwa in this connection are given separately as an appendix to this paper.

In addition to the material mentioned above, the unidentified material of the Survey includes a bottle containing several specimens of this species from the Pulta Water Works, Barrackpore. Details of this material together with measurements of the largest and smallest crab available for study are given below:

Reg. No.	Locality and date of collection	No. of exs.
C. 3892/1	Amongst sponges and pupal cases of Trichopteran insects taken from the 51' pipe leading from the outlet channel	20

Reg. No.	Locality and date of collection	No. of exs.
	of final settling tank — 2.3.1937.	
C. 3896/1	In cistern of intake pipe, old filter bed 6— 19.5.1936.	3
C. 3894/1	On leaves and stems of <i>Vallisneria</i> sp. from the western edge of the last settling tank — 18.5.1936.	2
C. 3895/1	Under stones near the cistern — 20.11.1936.	1
C. 3893/1	On sand in new filter bed 10 — 14.12.1936	1

Measurements in mm.

Largest specimen:

Carapace:	Greatest length	—	9.5
	Greatest breadth	—	8.3

Smallest specimen:

Carapace:	Greatest length	—	3.6
	Greatest breadth	—	3.3

The tiny crabs of the family Hymenosomatidae appear to adapt themselves to different ecological environments. Majority of them are exclusively brackish or estuarine and only a few are known to occur in purely salt water. Most of them appear to inhabit places where the percentage of salinity is comparatively low. The most remarkable feature of this group, however, is that a few species also occur in freshwater, some surviving even in lakes at higher altitudes.

The new records of *Hymenicoides carteri* Kemp from Varanasi and Pulta Water Works situated at a distance of about 678 and 25 kilometres respectively from Calcutta adds to our knowledge on the distribution of the species and also progressive adaptation of the species from brackish to freshwater. In addition, it is remarkable that these crabs, besides inhabiting underneath stones and timber bored by molluscs, also occur in bottom biota, amongst sponges and pupal cases of trichopteran insect larvae and on the leaves and stems of an aquatic plant viz. *Vallisneria* sp.

The author is grateful to Dr. K. K. Tiwari, Deputy Director, Zoological Survey of India for kindly going through the manuscript and offering helpful criticism in the preparation of this note.

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XV. *Rec. Indian Mus.*, 13(5) : 243-279.

APPENDIX

ECOLOGICAL NOTES

By

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Three specimens of this interesting crab were collected by me from the bed of the river Ganga at Nagwan Ghat, Varanasi on 8th January, 1960 around 4 p.m. These were obtained along with other benthic organisms such as Ephemeropterous larvae, Polychaetes and Gastropod molluscs. The bottom biota was obtained by means of an Ekman dredge generally used in sampling the soft surface layers of both lotic and lentic waters. Five samples of each of one sq. foot area were obtained in all from a depth of about 15 feet (4.6 metres) and at a distance of about 20-25 yds. (18-22 metres) from the west bank of the river. In general this bank at this season was shallow in depth with the pale olive coloured water flowing sluggishly.

The specimens along with bottom silt, vegetative debris and other aforesaid animals were alive at the time of the collection and were of scarlet colour. The temperature of the water both at surface and at bottom was 19°C. and the air temperature 16°C. These were actively nibbling the polychaete worms and insect larvae.

ON A COLLECTION OF FISH FROM NORTH BENGAL

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INTRODUCTION

North Bengal comprises those districts of West Bengal which lie north to the Ganga. The term does not denote any natural division and is purely an administrative connotation. Five districts constitute North Bengal. These are: Malda, W. Dinajpur, Darjeeling, Jalpaiguri and Cooch-Behar. Faunistically however, this area is very rich, especially the piscine populations inhabiting this area are numerous in variety and taxonomically interesting. This may be because of the rich Himalayan foot-hills with the numerous streams and major rivers rushing to the plains through these districts. The chief rivers are the Mahananda, and Teesta with many tributaries such as Sevoke, Atrai, Jaldhaka, Karala, Karotoyar etc.

The most comprehensive account of the fish fauna of North Bengal was published by Shaw and Shebbeare in 1938 which continue to remain as a constant source of reference and use by ichthyologists and fishery workers. Shaw and Shebbeare (1938) listed 131 species in their treatise. Hora and Gupta (1941) reporting on a small collection from Kalimpong Duars and Siliguri Terai added 2 species to this list. Subsequent to this there seems to be no report of any fish collection from North Bengal.

With a view mainly to collect specimens of two elusive bagrid species, *Pimelodus rama* Hamilton and *Pimelodus chandramara* Hamilton the authors undertook a survey of the North Bengal rivers in February, 1970. Not only it has been possible to collect material of the aforesaid curious bagrids, but also adequate representative collection of other fishes have also been made. This report lists 96 species, of which 17 have not been reported by previous workers. It must however be stated,

that common species such as the major carps, large sized catfishes such as *A. aor* (Hamilton), *A. seenghala* (Sykes) etc., though noticed, were not deliberately collected.

In the systematic account given here, under synonymy the first reference together with the type locality is given. Wherever necessary, the most recent important reference to the concerned species has also been added. Notes on variations noticed on some species have been given. The arrangement of the taxa upto family level is as per Greenwood, Rosen, Myers & Weitzman (1966).

We are thankful to Dr. A. P. Kapur, Ex-Director, Zoological Survey of India for kindly allowing us to undertake this survey. We are also obliged to Shri S. N. Ghose, Deputy Director, West Bengal State Fisheries Department for arranging facilities in the field.

Class : PISCES
Cohort : TAENIOPAEDIA
Superorder : CLUPEOMORPHA
Order : CLUPEIFORMES
Suborder : CLUPEOIDEI
Family I CLUPEIDAE

1. *Goniolosa manmina* (Hamilton)

1822. *Clupanodon manmina* Hamilton, *Fish. Ganges*, pp. 247, 249 (type locality, most of the freshwater branches of the Ganges).

Material. —3 exs., Stn. 5, confluence of R. Tengan with Mahananda at Aihoo village, 16 km S. E. of Malda, North Bengal, 1. ii. 1970.

Distribution. —Indian: Ganga, Jamuna, Brahmaputra and Mahanadi rivers, their affluents and main streams; Pakistan: Sind, Karachi, Makran. Bangladesh; Known to enter estuaries and tanks.

2. *Gudusia chapra* (Hamilton)

1822. *Clupanodon chapra* Hamilton, *Fish. Ganges*, pp. 248, 383 (type locality, upper parts of Ganges).

Material. —3 exs., Stn. 18, Atrai river, Balurghat, 12. ii. 1970; 3 exs., Stn. 20, Jalpaiguri fish market, purchased, 14. ii. 1970.

Distribution. —India: throughout as far south as Krishna river, but absent from Kerala and Tamil Nadu; Pakistan: Sind; Bangladesh; Malaysia: Penang.

Remarks. —Of the six examples, the first lot from River Atrai at Balurghat, measuring 67 to 83 mm. in standard length, has a dark shoulder spot, whereas the second lot from Jalpaiguri do not have any

such marking. Further, the dorsal profile upto the lateral line is dark shaded in the first lot, unlike the second. Day (1878) also observed that the shoulder spot may be absent.

Family II ENGRAULIDAE

3. *Setipinna phasa* (Ham.)

1822. *Clupea phasa* Hamilton, *Fish. Ganges*, pp. 240, 382 (type locality, brackish rivers of Bengal).

Material.—9 exs., Stn. 5, confluence of River Tengan with Mahananda river at Aihoo village, 16 km S.E. of Malda, 1. ii. 1970.

Distribution.—India: Orissa, Bengal, Assam; Pakistan; Bangladesh; Burma.

Remarks.—The prolongation of the outermost pectoral fin ray is variable in this species. In four examples 109 to 115 mm. in standard length, the outermost pectoral ray reaches the commencement of the anal fin. But in an example 77 mm. in standard length, the outermost ray is vestigial. In a few, all the pectoral fin rays are completely stained black.

Cohart : ARCHAEOPHYLACES

Superorder : OSTEOGLOSSOMORPHA

Suborder : NOTOPTEROIDEI

Family III NOTOPTERIDAE

4. *Notopterus (Notopterus) notopterus* Pallas

1769. *Gymnotus notopterus* Pallas, *Spicil. Zool.*, 7, p. 40, pl. 6, fig. 2 (type locality, Indian Ocean).

Material.—1 ex., Stn. 4, Kenpukur fish 'hat', catch from Purnabhasa river, 31. i. 1970; 1 ex., Stn. 6, Aihoo Village 'hat', 1. ii. 1970.

Distribution.—India: throughout. Pakistan; Burma, Thailand; Malaya and Malay Archipelago.

Cohart : EUTELEOSTEI

Superorder : OSTARIOPHYSI

Order : CYPRINIFORMES

Suborder : CYPRINOIDEI

Family IV CYPRINIDAE

5. *Chela (Chela) cachius* Hamilton

1822. *Cyprinus cachius* Hamilton, *Fish. Ganges*, pp. 258, 384. (type locality, River Ganga, about the commencement of the delta).

1958. *Chela (Chela) cachius*, Silas, *J. Bombay nat. Hist. Soc.*, 55 (1) : 66 (synonymy, description, specific limits).

Material.—39 exs., Stn. 20, Jalpaiguri fish market, purchased, 14. ii. 1970; 10 exs., Stn. 26, below Road bridge of River Dharla at Changrabandha, 40 km S.E. of Jaipauri, 16. ii. 1970.

Distribution.—India: Orissa, W. Bengal, Assam, Madhya Pradesh, Tamil Nadu, Mysore; Pakistan; Bangladesh; Burma.

Remarks.—Silas (1958) in a valuable revision of this genus restricted the genus *Chela sensu stricto* as comprising only two species in India: viz. *C. cachius* Hamilton and *C. laubuca*. He also indicated that *C. atpar* represents adult specimens of *C. cachius* which renders the former a synonym of the latter, as *cachius* has priority over *atpar*.

This species was not reported by Shaw & Shebbeare (1938).

6. *Oxygaster bacaila* (Hamilton)

1822. *Cyprinus bacaila* Hamilton, *Fish Ganges*, pp. 265, 384, pl. 8, fig. 76 (type locality, freshwater rivers of all Gangetic provinces).

1958. *Oxygaster bacaila*, Silas, *J. Bombay nat. Hist. Soc.*, 55 (1) : 61 (key to genus).

Material.—4 exs., Stn. 5, confluence of River Tengan with River Mahananda at Aihoo village, 10 km S.E. of Malda, 1. ii. 1970; 1 ex., Stn. 10, River Kalindri at village Ratua, 38 Km N. W. to Malda, 4. ii. 1970; 5 exs., Stn. 11, River Mahananda at Malda Town, 5. ii. 1970; 20 exs., Stn. 14, River Jamuna at Hilli village, 24 Km N.E. of Balurghat, 8. ii. 1970; 2 exs., Stn. 15, River Purnabhasa at Gangarampur near road bridge, 42 km NW to Balurghat, 9. ii. 1970; 1 ex., Stn. 16, River Atrai at Pugleegunj, 10 km North of Balurghat, 10. ii. 1970; 5 exs., Stn. 18, River Atrai at Balurghat, 12. ii. 1970; 11 exs. Stn. 20, Jalpaiguri fish market, purchased, 14. ii. 1970; 7 exs., Stn. 24, River Teesta, Western bank at Teesta bridge, 12 km N.E. of Jalpaiguri, on Assam Trunk Road, 15. ii. 1970.

Distribution.—India: North of Krishna river system; Pakistan, W. Punjab; Bangladesh.

Remarks.—Silas (1958) differentiated *Oxygaster* and *Chela* on basis of the extension of the predorsal scales to the interorbital space and the symphysial knob in the lower jaw fitting into a corresponding emargination of the upper jaw in the former. In a random examination of 36 examples measuring 20 to 130 mm. in standard length, excepting in one example of 130 mm. length, in all the remaining, the predorsal scales do not extend upto the interorbital space, although in all of them the symphysial knob clearly fits into the upper jaw. It cannot be definitely stated that this condition is common in all, or this variation is due to the comparatively juvenile nature of the specimens examined. As Silas (1958) stated, this genus is badly in need of a revision.

7. *Oxygaster gora* (Hamilton)

1822. *Cyprinus gora* Hamilton, *Fish. Ganges*, pp. 263, 384 (type locality, Ganges and its tributaries).

Material.—9 exs., Stn. 20, Jalpaiguri fish market, purchased 14. ii. 1970.

Distribution.—India: north of Mahanadi river system; Pakistan, W. Punjab; Bangladesh.

Remarks.—Shaw and Shebbeare (1938) did not record this species in their work.

8. *Barilius bendelisis bendelisis* (Hamilton)

1807. *Cyprinus bendelisis* Hamilton, *Journey Mysore*, 3, 345, pl. 32 (type locality, rivers of Mysore).

Material.—1 ex., Stn. 22, River Karotayar at Chawalhatti village 32 km S.W. of Jalpaiguri, 15. ii. 1970; 2 exs., Stn. 23, River Panga at Pangasahitpura, 25 km. south of Jalpaiguri; 19 exs., Stn. 24, River Teesta, Western bank at Teesta Bridge, 12 Km N.E. of Jalpaiguri, 15. ii. 1970; 5 exs., Stn. 32, River Balasan at Digana near Panighata, 32 km N.W. of Siliguri, 21. ii. 1970.

Distribution.—India: throughout; Pakistan: W. Punjab. Bangladesh; Sri Lanka.

Remarks.—The number of bands and black dots at base of each scale varies with the size of the specimens. In a 12 mm long juvenile, 8 or 9 bands are present with the black dots well marked. But in specimens 37 to 53 mm in standard length, the bands are 6 to 8 and along with the spots at base of each scale they tend to become faint.

Shaw and Shebbeare (1938) did not record this species in their treatise.

9. *Barilius bendelisis chedra* (Hamilton)

1822. *Cyprinus chedra* Hamilton, *Fish. Ganges*, p. 273, 274 (type locality, Patgong).

1937. *Barilius bendelisis* Var. *chedra*, Shaw & Shebbeare, *J. Roy. Asiat. Soc. Beng.*, 3, p. 23.

Material.—1 ex., Stn. 32, River Balasan at Digana near Panighata, 32 Km N.W. of Siliguri, 21. ii. 1970.

Distribution.—India: Ganga, Jamuna and Brahmaputra river systems.

Remarks.—The single example of this remarkable subspecies, 91 mm long, is characteristic with 14 bands, but the black dots at the base of the scales are so numerous, bright, that the bands are obliterated

unlike the nominate species. The pectoral fins are large, with the axillary process well developed. Many pores are also present on the snout above the mouth.

10. *Barilius barna* (Hamilton)

1822. *Cyprinus bendelisis* Hamilton, *Fish. Ganges*, pp. 270, 385 (type locality, Rivers of Mysore).

Material.—22 exs., Stn. 28, River Dharla at Mainaguri, 16 Km N.E. of Jalpaiguri near Road bridge, 11. ii. 1970; 2 exs., Stn. 30, Khoribari fish hat, 45 Km S. W. of Siliguri, 20. ii. 1970.

Distribution.—India: Orissa, Madhya Pradesh, U.P., Bihar, W. Bengal, Assam; Pakistan; Bangladesh.

Remarks.—The number of bands vary from 6 or 7 to 9 or 10. The frequency distribution is as below:

6 or 7	8	9 or 10	13
15 ex.	15 ex.	2 ex.	2 ex.
25-36 mm.	26-54 mm.	38 and 47 mm.	30 mm.

Standard length. Standard length. Standard length. Standard length.

Three examples 13 to 25 mm in standard length have no bands at all. In a specimen there are seven bands on one side and eight on the opposite side. As stated by Motwani, Jayaram & Sehgal (1962) nuptial tubercles are present in one specimen 93 mm long.

11. *Barilius barila* Hamilton

1822. *Barilius barila* Hamilton, *Fish. Ganges*, pp. 267, 384 (type locality, rivers of Northern Bengal).

Material.—5 exs., Stn. 11, River Mahananda, at Malda Town, 5. ii. 1970; 8 exs., Stn. 20, Jalpaiguri fish market, purchased, 14. ii. 1970; 6 exs., Stn. 24, River Teesta Western Bank at Teesta Bridge, 12 Km N.E. of Jalpaiguri, 15. ii. 1970.

Distribution.—India: throughout except Kerala, Tamil Nadu. Pakistan. Bangladesh.

12. *Danio (Danio) aequipinnatus* (McClelland)

1839. *Perilampus aequipinnatus* McClelland, *Asiatic Researches*, 12, p. 3, pl. 60, fig. 11 (type locality, Assam).

Material.—2 exs., Stn. 26, River Dharla at Changrabandha, 40 km S.E. of Jalpaiguri below Road bridge, 16. ii. 1970.

Distribution.—India: Peninsular India, W. Bengal, Assam, Manipur, Eastern Himalaya. Pakistan; Bangladesh; Burma, Thailand; Sri Lanka.

13. *Danio (Danio) devario* (Hamilton)

1822. *Cyprinus devario* Hamilton, *Fish. Ganges*, pp. 341, 393, pl. 6, fig. 94 (type locality, Rivers and ponds of Bengal).

Material.—1 ex., Stn., 14, River Jamuna at Hilli village, 24 Km N.E. to Balurghat, 8. ii. 1970; 8 exs., Stn. 20, Jalpaiguri fish market, purchased, 14. ii. 1970; 22 exs., Stn. 22, River Karotayar at Chawal hatti, 32 Km S.W. of Jalpaiguri, 15. ii. 1970; 8 exs., Stn. 24, River Teesta, Western Bank at Teesta Bridge, 12 Km N.E. of Jalpaiguri, 15. ii. 1970; 2 exs., Stn. 26, River Dharla at Changrabhandha, 40 Km S. E. of Jalpaiguri, 16. ii. 1970; 2 exs., Stn. 27, River Jaldhaka at Charuchurabhandar, 28 Km. N.E. of Jalpaiguri, below road bridge, 16. ii. 1970; 24 exs., Stn. 28, R. Dharla at Mainaguri, 16 Km N.E. of Jalpaiguri, 16. ii. 1970; 3 exs., Stn. 30, Jalpaiguri fish market, purchased, 18. ii. 1970.

Distribution.—India: whole of North India upto Orissa. Pakistan: W. Punjab, Sind. Bangladesh.

Remarks.—Some variations in the colour pattern are noticed. The examples from Stn. 28, 38 to 56 mm. in standard length do not have the reticulated steel-blue lines in anterior part of body as described by Day (1878). All have a dark streak along mid-line of body, posterior to anal fin.

14. *Danio (Brachydanio) rerio* (Hamilton)

1822. *Cyprinus rerio* Hamilton, *Fish. Ganges*, pp. 323, 390 (type locality, Kosi river).

Material.—20 exs., Stn. 27, River Jaldhaka at Charuchurabhandar, 28 Km N.E. of Jalpaiguri, below road bridge, 16. ii. 1970.

Distribution.—India: throughout.

15. *Esomus danrica* (Hamilton)

1822. *Cyprinus danrica* Hamilton, *Fish. Ganges*, pp. 325, 327, pl. 16, fig. 88 (type locality, ponds and ditches of Bengal).

Material.—1 ex., Stn. 27, River Jaldhaka at Charuchurabhandar, 28 Km. of Jalpaiguri, below road bridge, 16. ii. 1970.

Distribution.—India: throughout. Pakistan: Sind, W. Punjab; Burma; Thailand; Malaya; Sri Lanka; Bangladesh.

16. *Rasbora daniconius* (Hamilton)

1822. *Cyprinus daniconius* Hamilton, *Fish. Ganges*, pp. 327, 329. (type locality, rivers of Southern Bengal).

Material. —1 ex., Stn. 5, confluence of River Tengan with Mahananda at Aihoo village, 25 Km S.E. of Malda, 1. ii. 1970; 2 exs., Stn. 10, River Kalindri at village Ratua 38 Km N.W. of Malda, 4. ii. 1970; 4 exs., Stn. 11, R. Mahananda, Malda Town, 5. ii. 1970; 1 ex., Stn. 14, River Jamuna at Hilli village, 38 Km N.E. of Balurghat, 8. ii. 1970; 6 exs., Stn. 16, River Atrai at Pugleegunj, 10 Km North of Balurghat, 10. ii. 1970; 4 exs., Stn. 18, River Atrai at Balurghat, 12. ii. 1970; 9 exs., Stn. 20, Jalpaiguri fish market, purchased, 14. ii. 1970; 5 exs., Stn. 28, 2 exs., Stn. 26, River Dharla at Changrabhandha, 40 Km S.E. of Jalpaiguri, 16. ii. 1970; 5 exs., Stn. 28, River Dharla at Mainaguri, 16 Km N.E. of Jalpaiguri near road bridge, 16. ii. 1970; 2 exs., Stn. 29, Bagdogra fish market, purchased, 19. ii. 1970.

Distribution. —India: throughout. Pakistan: Sind, W. Punjab. Sri Lanka; Malaya; Bangladesh.

Remarks. —A most common widely distributed species, but perhaps divisible on colour patterns. In the material examined by us, four different categories of colour patterns are seen.

- (a) Black stripe only towards posterior end beginning from above insertion of anal fin or slightly ahead. The lots representing this pattern are: 1 ex., Stn. 5, 53 mm standard length; 6 exs., Stn. 20, 38 to 58 mm. long; 1 ex., Stn. 10, 48 mm. long. One of these, 57 mm long is abnormally lean with compression of the body near vent.
- (b) A broad bright stripe, body brownish, superiorly spotted with some dots as in *Barilius*. The lots showing this pattern are 4 exs., Stn. 11, 64. 5 to 72 mm long; 1 ex., Stn. 14, 46 mm long.
- (c) A completely black band along mid line of body. Body brownish, scales not coloured: 2 exs., from Stn. 26, 36 and 50 mm long exhibit this pattern.
- (d) A black band along mid line of body, but body olive or brownish-black with scales also black tipped. Six examples from Stn. 16, 44 to 52 mm long, have this pattern.

17. *Amblypharyngodon mola* (Hamilton)

1822. *Cyprinus mola* Hamilton, *Fish. Ganges*, pp. 334, 392, pl. 38, fig. 92 (type locality, Ponds and freshwater rivers in every part of the Gangetic provinces).

Material. —1 ex., Stn. 2, River Tengan at Bulbulchandi, 31. i. 1970; 3 exs., Stn. 30, Khoribari fish market, purchased, 20. ii. 1970.

Distribution. —India: throughout except Kerala. Pakistan: Sind, W. Punjab. Bangladesh; Burma; Thailand.

18. *Aspidoparia morar* (Hamilton)

1822. *Cyprinus morar* Hamilton, *Fish. Ganges*, pp. 264, 381, pl. 31, fig. 75 (type locality, Rivers Yamuna and Teesta: two large, but distinct branches of Ganges)

Material. —2 exs., Stn. 2, River Tengan, at Bulbulchandi, 31. i. 1970; Many exs., Stn. 8, River Kalindri at Kotwalee village, 9 Km N.W. of Malda, 2. ii. 1970; 5 exs., Stn. 14, River Jamuna at Hilli village 8. ii. 1970; 4 exs., Stn. 18, River Atrai at Balurghat, 12. ii. 1970; 10 exs. Stn. 20, Jalpaiguri fish market, purchased, 14. ii. 1970; 5 exs., Stn. 24 River Teesta, Western bank at Teesta bridge, 12 Km. N.E. of Jalpaiguri, 15. ii. 1970.

Distribution. —India: throughout except West Coast, and south of Krishna river system; Bangladesh; Burma; Thailand.

19. *Chagunius chagunio* (Hamilton)

1822. *Cyprinus chagunio* Hamilton, *Fish. Ganges*, pp. 295, 387 (type locality, Yamuna and in the northern rivers of Bihar and Bengal).

Material. —3 exs., Stn. 24. River Teesta, Western Bank at Teesta Bridge, 12 Km. N.E. of Jalpaiguri, 15. ii. 1970.

Distribution. —India: North India above Orissa; Pakistan; Burma; Thailand; Bangladesh.

20. *Tor putitora* (Hamilton)

1822. *Cyprinus putitora* Hamilton, *Fish. Ganges*, pp. 303, 388 (type locality, eastern part of Bengal).

Material. —4 exs., Stn. 24, River Teesta, Western Bank at Teesta Bridge, 12 Km. N.E. of Jalpaiguri, 15. ii. 1970; 2 exs., Stn. 32, River Balasan at Digana, near Panighata, 32 Km N. W. of Siliguri, 21.ii.1970.

Distribution. —India: Himalayan rivers especially along the foot hills, Nepal, U.P., E. Punjab, W. Bengal, Assam. Bangladesh.

21. *Puntius ambassis* (Day)

1868. *Barbus ambassis* Day, *Proc. zool Soc. Lond.*, p. 583 (type locality Kurnool).

Material. —1 ex., Stn. 20, Jalpaiguri fish market, purchased, 14. ii. 1970.

Distribution. —India: along the eastern side, from Tamil Nadu through Orissa, Bengal and Assam upto Sadiya; Bangladesh.

22. *Puntius chola* (Hamilton)

1822. *Cyprinus chola* Hamilton, *Fish. Ganges*, pp. 312, 389 (type locality, Ponds and other stagnant waters in Northern parts of Bengal).

Material. —2 exs., Stn. 26, River Dharla at Changrabhandha, 40 Km S.E. of Jalpaiguri below Road Bridge, 16. ii. 1970.

Distribution —India: throughout; Pakistan; Bangladesh.

Remarks. —Shaw and Shebbeare (1938) did not record this species.

23. *Puntius conchoni* (Hamilton)

1822. *Cyprinus conchoni* Hamilton, *Fish. Ganges*, pp. 317, 389 (type locality; Ponds of north-east Bengal and in the river Kosi).

Material. —4 exs., Stn. 11, River Mahananda at Malda, 5. ii. 1970; 6 exs., Stn. 20, Jalpaiguri fish market, purchased, 14. ii. 1970; 1 ex., Stn. 24, River Teesta on Western bank, at Teesta Bridge, 12 Km. North, of Jalpaiguri, 15. ii. 1970; 5 exs., Stn. 28, River Dharla at Mainaguri 16 Km. N.E. of Jalpaiguri near road bridge, 16. ii. 1970.

Distribution. —India: throughout; Pakistan; Bangladesh.

Remarks. —In most of the examples studied the dorsal spine is serrated along the inner edge with 12 to 20 downward facing serrations. Day (1878) observed that the specimens from the plains are more coarsely serrated than those from the hills.

24. *Puntius cosuatis* (Hamilton)

1822. *Cyprinus cosuatis* Hamilton, *Fish. Ganges*, pp. 338, 392 (type locality, Nathpur).

Material. —45 exs., Stn. 28, River Dharla at Mainaguri, 16 Km. N.E. of Jalpaiguri near road bridge, 16. ii. 1970.

Distribution. —India: South India, W. Bengal, Assam; Bangladesh.

Remarks. —Shaw and Shebbeare (1938) did not record this species. The number of scales between lateral line and base of dorsal fin is 2 in 4 examples and 3 in 8 examples. The number of predorsal scales is 7 in 8 examples and 8 in 4 examples.

25. *Puntius phutunio* (Hamilton)

1822. *Cyprinus phutunio* Hamilton, *Fish. Ganges.*, pp. 319, 390 (type locality, Pirgunj).

Material. —2 exs., Stn. 18, River Atri at Balurghat, 12. ii. 1970; 9 exs., Stn. 20, Jalpaiguri fish market; purchased 14. ii. 1970.

Distribution. —India: along eastern parts from Orissa, through W. Bengal to Assam; Burma; Pakistan; Bangladesh.

Remarks. —In nine examples from Jalpaiguri fish market, the dorsal band is not split as spots but is in the form of a clear continuous band; but the band on the pectoral fins are absent. These may be due to the juvenile nature of the specimens.

26. *Puntius sarana* (Hamilton)

1822. *Cyprinus sarana* Hamilton, *Fish. Ganges.*, pp. 307, 388 (type locality, ponds and rivers of India).

Material. —1 ex., Stn. 4, River Purnabhava at Kenpukur village, 16 Km. S.E. of Malda, 31. i. 1970.

Distribution. —India: throughout; Pakistan; Burma. Thailand; Sri Lanka; China.

27. *Puntius sophore* (Hamilton)

1822. *Cyprinus sophore* Hamilton, *Fish. Ganges.*, pp. 310, 389 (type locality, ponds of Bengal).

Material. —2 exs., Stn. 10, River Kalindri at village Ratua, 38 Km. N.W. of Malda, 4. ii. 1970; 1 ex., Stn. 24, River Teesta, Western bank at Teesta Bridge, 12 Km. N.E. of Jalpaiguri, 15. ii. 1970; 10 exs., Stn. 26, River Dharla at Changrabhanda, 40 Km. S. E. of Jalpaiguri, 16. ii. 1970; 4 exs., Stn. 27, River Jaldhaka at Charuchurabhandar, 28 Km. N.E. of Jalpaiguri below Road bridge, 16.ii.1970.

Distribution. —India: throughout, below 600 metres; Pakistan: throughout; Bangladesh; Burma; China.

Remarks. —Shaw and Shebbeare (1938) did not record this species.

28. *Puntius stigma* (Valenciennes)*

1841. *Leuciscus stigma* Valenciennes, *Hist. Nat. Poiss.*, 17, p. 93, pl. 489 (type locality),

Material. —21 exs., Stn. 14, River Jamuna at Hilli village, 24 Km. N.E. of Balurghat, 8. ii. 1970; 3 exs., Stn. 18, River Atrai at Balurghat. 12. ii. 1970; 1 ex., Stn. 20, Jalpaiguri fish market, purchased, 14. ii. 1970; 1 ex., Stn. 24, River Teesta, Western bank at Teesta Bridge, 12 Km. N.E. of Jalpaiguri, 15. ii. 1970.

Distribution. —India: throughout; Pakistan; Bangladesh; Burma.

29. *Puntius ticto* (Hamilton)

1822. *Cyprinus ticto* Hamilton, *Fish. Ganges*, pp. 314, 389, pl. 8, fig. 87 (type locality, Southeast part of Bengal).

Material. —3 exs., Stn. 20, Jalpaiguri fish market, 14. ii. 1970; 1 ex., Stn. 25, rain water pools, eastern bank of River Teesta Bridge 12 Km. N.E. of Jalpaiguri, 15. ii. 1970; 2 exs., Stn. 26, River Dharla at

* MENON, A. G. K. 1974 *Spl. Publi. No. 1 Inland Fisheries Soc. India, Barrackpore*, p. 40 considers this species as Synonym of *P. sophorek*.

Changrabhandha, 40 Km. S.E. of Jalpaiguri, 16. ii. 1970; 48 exs., Stn. 28, River Dharla at Mainaguri, 16 Km N.E. of Jalpaiguri, near road bridge, 16. ii. 1970.

Distribution.—Throughout India; Pakistan; Bangladesh; Burma; Thailand; Sri Lanka.

Remarks.—The specimens from Stn. 28, River Dharla at Mainaguri, exhibit some variation in respect of the colour spot on the shoulder. Some have a clear black dot, round in shape, but in some the spot is smudged, and elongated. In these examples, the pectoral fin rays and the dorsal fin rays are also prolonged. These are probably due to sexual-dimorphism.

30. *Puntius titius* (Hamilton)

1822. *Cyprinus titius* Hamilton, *Fish. Ganges*, p. 315 (type locality, ponds near Calcutta.)

Material.—7 exs., Stn. 2, Bulbulchandi fish market, Malda dist; purchased, 31. i. 1970; 2 exs., Stn. 7, Malda fish market, purchased, 2. ii. 1970; 1 ex., Stn. 22, River Karotoyar at Chawal Hatti village, 32 Km. S.W. of Jalpaiguri, 15. ii. 1970.

Distribution.—India: Deccan, Orissa, Bengal, Assam; Bangladesh.

31. *Cirrihinus reba* (Hamilton)

1822. *Cyprinus reba* Hamilton, *Fish. Ganges*, pp. 280, 386 (type locality, rivers and ponds of Bengal and Bihar).

Material.—4 exs., Stn. 5, confluence of River Tengan with River Mahananda at Aihoo village, 16 Km S.E. of Malda, 1. ii. 1970; 4 exs., Stn. 11, River Mahananda at Malda, 5. ii. 1970; 2 exs., Stn. 14, River Jamuna at Hilli village, 24 Km. N.E. of Balurghat, 8. ii. 1970; 5 exs., Stn. 16, River Atrai at Pugleegunj, 10 Km north of Balurghat, 10. ii. 1970.

Distribution.—Throughout India; Pakistan; Bangladesh.

32. *Garra annandalei* Hora

1921. *Garra annandalei* Hora, *Rec. Indian Mus.*, 22, p. 657 (type locality, Assam).

Material.—13 exs., Stn. 32, River Balasan at Digana near Panighata, 32 Km. N. W. of Siliguri.

Distribution.—India: Darjeeling; W. Bengal; Assam along base of hills.

33. *Garra gotyla* (Gray)

1832-33. *Cyprinus gotyla* Gray, *Ill. Ind. zool. Hardwicki*, 2, pl. 88, figs. 3, 31 (type locality, Northern India).

Material.—1 ex., Stn. 20, Jalpaiguri fish market, purchased, 14. ii. 1970; 6 exs., Stn. 24, River Teesta Western bank, Teesta bridge, 12 Km. N.E. of Jalpaiguri, 15. ii. 1970; 1 ex., Stn. 29, Bagdogra fish market, purchased, 19. ii. 1970; 76 exs., Stn. 32, River Balasan at Digana, near Panighata, 32 Km N. W. of Siliguri, 21. ii. 1970.

Distribution.—India, along the Himalayan foot hills; Pakistan: W. Punjab. Bangladesh.

Remarks.—Menon (1964) gave the features of the “lamta” complex to which this species belongs. The horny tubercles on the snout are arranged in a bilaterally symmetrical pattern. In the adult, four tubercles are present on either side of the nostrils, six on each side above angle of mouth, 9 or 10 on top of snout tip or the proboscis. In the juveniles also the same pattern exists, but the number of tubercles is less.

Besides the tubercles, a transverse groove across the top of the snout is also present. The base of branched fin rays does not have any dark spots. All are uniformly cement grey in colour with the ventral surface dull yellowish.

A few specimens were kept alive in rock pool in River Balasan at Digana. They were observed to scrap the bottom with their lips, with the body at an inclined angle, and very rarely they remained horizontal. However, when they were placed in a pool with a sandy bottom and sides, they buried themselves in the sand at the bottom.

This species is most closely related to *G. mullya* (Sykes) with which it is often confused also. It may be reiterated here that *G. mullya* is now restricted to Peninsular India, and is separated by the relative position of the vent in relation to the place of insertion of pelvic and anal fins.

34. *Labeo bata* (Hamilton)

1822. *Cyprinus bata* Hamilton, *Fish. Ganges*, pp. 283, 386 (type locality, rivers and ponds of Bengal).

Material.—2 exs., Stn. 17, River Atrai, Kumaigunj, 11. ii. 1970.

Distribution.—India: north of the Krishna river system; Bangladesh.

35. *Labeo boga* (Hamilton)

1822. *Cyprinus boga* Hamilton, *Fish. Ganges*, pp. 286, 386, pl. 28, fig. 80 (type locality, Brahmaputra).

Material.—1 ex., Stn. 4., River Purnabhava, at Kenpukur village, 16. Km S.E. of Malda, 31. i. 1970; 5 exs., Stn. 14, River Jamuna at

Hilli village, 24 Km N.E. of Balurghat, 8. ii. 1970; 2 exs., Stn. 17, River Atrai, Kumargunj, 11. ii. 1970; 5 exs., Stn. 18, River Atrai at Balurghat, 12. ii. 1970.

Distribution. —Throughout India; Pakistan; Bangladesh; Burma.

36. *Labeo calbasu* (Hamilton)

1822. *Cyprinus calbasu* Hamilton, *Fish. Ganges*, pp. 297, 387, p. 2, fig. 83 (type locality, Rivers and ponds of Bengal and Western provinces).

Material. —1 ex., Stn. 2, Bulbulchandi on bank of R. Tengan, 20 Km S.E. of Malda, purchased, 31. i. 1970; 1 ex., Stn. 4, River Purnabhava, at Kenpukur village, 31. i. 1970; 2 exs., Stn. 6, Aihoo Village, purchased, 1. ii. 1970; 2 exs., Stn. 14, River Jamuna at Hilli Village, 24 Km N.E. of Balurghat, 8. ii. 1970.

Distribution. —Throughout India; Pakistan; Bangladesh; Burma; Thailand.

37. *Labeo gonius* (Hamilton)

1822. *Cyprinus gonius* Hamilton, *Fish. Ganges*, pp. 292, 387 (type locality, freshwater rivers and ponds of Bengal).

Material. —1 ex., Stn., 14, River Jamuna at Hilli village, 24 Km N.E. of Balurghat, 8. ii. 1970.

Distribution. —India: E. Punjab, Uttar Pradesh, Bihar, Bengal, Assam. Burma; Bangladesh.

38. *Osteobrama cotio cotio* (Hamilton)

1822. *Cyprinus cotio* Hamilton, *Fish. Ganges*, pp. 339 pl. 39, fig. 93 (type locality, ponds and ditches of Bengal).

Material. —7 exs., Stn. 5, confluence of Tengan with R. Mahananda at Aihoo village, 16 Km S. E. of Malda, 1. ii. 1970. 14 exs., Stn. 9; River Mahananda at Adampur village, 10 Km. S.E. of Malda; 3 exs., Stn. 11, River Mahananda at Malda, 5. ii. 1970; 2 exs., Stn. 14, River Jamuna at Hilli village, 24 Km N.E. of Balurghat, 42 exs., Stn. 18, River Atrai at Balurghat, 12. ii. 1970; 2 exs., Stn. 24, River Teesta, Western Bank at Teesta Bridge, 12 Km N. E. of Jalpaiguri, 15. ii. 1970.

Distribution. —India, North of Krishna river system; Pakistan: W. Punjab. Bangladesh; Burma; China.

Remarks. —All anal fin rays are streaked with black dots. A random count of ana fin rays (both branched and simple) showed as below:

Stn. 5	7 exs.	39 to 55 mm SL	30-32 rays
Stn. 9	14 exs.	30 to 56 mm SL	29-32
Stn. 18	10 exs. (out of 42)	23 to 36 mm SL	29-30
Stn. 24	2 exs.	44 & 55 mm SL	28, 30

Silas (1952) differentiated the peninsular form as a separate variety. The specimens under report however belong to the nominate form.

39. *Semiplotus semiplotus* McClelland

1839. *Cyprinus semiplotus* McClelland, *Asiat. Res.* 19. p. 274, fig. 20 (type locality Brahmaputra in Upper Assam).

Material. —1 ex., Stn. 24, River Teesta, Western bank at Teesta bridge, 12 Km N. E. of Jalpaiguri, 15. ii. 1970; 2 exs., Stn. 32, River Balasan at Digana near Panighata, 32 Km N. W. of Siliguri, 21. ii. 1970.

Distribution. —India: along Terai Duars, N. Bengal, Assam; Burma.

40. *Crossocheilus latius latius* (Hamilton)

1822. *Cyprinus latitus* Hamilton, *Fish. Ganges*, pp. 345, 393 (type locality, the Teesta).

Material. —1 ex., Stn. 2, River Tengan at Bulbulchandi, 20 Km S. E. of Malda, 31. i. 1970; 6 exs., Stn. 10, River Kalindri at village Ratua, 38 Km N. W. of Malda, 4. ii. 1970; 1 ex., Stn. 13, Balurghat fish market, purchased, 8. ii. 1970; 1 ex., Stn. 16, River Atrai at Puglee gunj, 10 Km. North of Balurghat, 10. ii. 1970; 18 exs., Stn. 18, River Atrai at Balurghat, 12. ii. 1970; 8 exs., Stn. 20, Jalpaiguri fish market purchased, 14. ii. 1970; 14 exs., Stn. 32, River Balasan at Digana near Panighata, 32 Km N. W. of Siliguri 21. ii. 1970.

Distribution. —India: hill streams from plains level to 600 m. of U.P., Bihar, W. Bengal, Deccan; Pakistan; Bangladesh.

Remarks. —Mukerji (1934) ably discussed the variations met with in this species, in different geographical areas of its habitat. The Assamese and Burmese forms are reported to have only 8 scales in a transverse series ($4\frac{1}{2}/3\frac{1}{2}$) and 15 or 16 round the caudal peduncle; the head length is stated to contain 4.3 to 4.8 times in the standard length. The material examined by me agree well with these findings of Mukerji.

All examples have a black streak along mid-line of body, Specimens collected in River Balasan at Digana, however lack the black band. It may be mentioned that Balasan is a hill stream with a rocky bottom.

Family V. PSILORHYNCHIDAE

41. *Psilorhynchus balitora* (Hamilton)

1822. *Cyprinus balitora* Hamilton, *Fish. Ganges*, pp. 348, 394 (type locality, rivers in north-east of Bengal).

Material. —2 exs., Stn. 24, River Teesta Western bank at Teesta bridge, Jalpaiguri, 17. ii. 1970; 5 exs., Stn. 29, Bagdogra fish market, purchased, 19. ii. 1970.

Distribution.—India: along the foot hill mountains of E. Himalaya in W. Bengal, Assam; Bangladesh.

42. *Psilorhynchus sucatio* (Ham.)

1822. *Cyprinus sucatio* Hamilton, *Fish. Ganges*, pp. 347, 393 (type locality, rivers of Northern Bengal).

1933. *Psilorhynchus sucatio*, Mukerji, *J. Bombay nat. Hist. Soc.*, 36 pp. 823-828.

Material.—1 ex., Stn., 18, River, Atrai at Balurghat, 12. ii. 1970; 3 exs., Stn. 20, Jalpaiguri fish market, 14. ii. 1970; 5 exs., Stn. 20, Jalpaiguri fish market, 14. ii. 1970; 5 exs., Stn. 24, River Teesta, Western bank at Teesta Bridge, 12 Km N.E. of Jalpaiguri, 15. ii. 1970; 2 exs., Stn. 28, River Dharla at Mainaguri, 16 Km N.E. of Jalpaiguri, 16. ii. 1970; 5 exs., Stn. 29, Bagdogra fish market, purchased, 19. ii. 1970; 8 exs., Stn. 30, Khoribari fish market, 44 Km S.W. of Siliguri, 20. ii. 1970.

Distribution.—India: hill streams of North Bengal.

Remarks.—This is a more common species than *P. balitora*. The colour spots on the body as stated by Hora and quoted by Shaw and Shebbeare (1938) are very diagnostic. Hora (1921) described them as "broad, clouded vertical bands on the body and a number of stripes on the caudal fin"

Family VI COBITIDAE

43. *Lepidocephalichthys guntea* (Hamilton)

1822. *Cobitis guntea* Hamilton, *Fish. Ganges*, pp. 353, 394. (type locality, ponds and fresh water rivers of Bengal.)

Material.—1 ex., Stn. 5, confluence of Tengan river with Mahananda at Aihoo village, 1. ii. 1970; 1 ex., Stn. 6, Aihoo village fish market, purchased 1. ii. 1970; 1 ex., Stn. 11, River Mahananda at Malda, 5. ii. 1970; 1 ex., Stn. 16, River Atrai at Pugleegunj, 10 Km north of Balurghat, 10. ii. 1970; 1 ex., Stn. 26, River Dharla at Changrabhandha, 40 Km S. E. of Jalpaiguri, 16. ii. 1970; 8 exs., Stn. 29, Bagdogra fish market, purchased, 19. ii. 1970; 1 ex., Stn. 32, River Balasan, at Digana near Panighata, 21. ii. 1970.

Distribution.—India: throughout North India; Pakistan and Bangladesh.

44. *Lepidocephalichthys guntea balgara* (Hamilton)

1822. *Cobitis balgara* Hamilton, *Fish. Ganges*, pp. 356, 394 (type locality, Nathpur).

Material.—3 exs., Stn. 18, River Atrai at Balurghat, 12. ii. 1970.

Distribution.—India: W. Bengal, Burma, North Bengal; Bangladesh.

Remarks.—The colour spots over the body is very characteristic in this species. Three examples from Stn. 18, River Atrai at Balurghat are referable to the variety *balgara* of Day (1878, p. 609). These have the body colour pale brown, without any heavy spots. Faint black lines along centre of body are present. In two specimens the pelvic fins are inserted slightly in advance of the dorsal fin.

45. *Botia dario* (Hamilton)

1822. *Cobitis dario* Hamilton, *Fish. Ganges*, pp. 354, 394, pl 29, fig. 95 (type locality, northern rivers of Bengal).

Material.—11 exs., Stn. 5, confluence of River Tengan with River Mahananda at Aihoo village, 16 Km S.E. of Malda, 1. ii. 1970; 5 exs., Stn. 13, Balurghat fish market, purchased, 8. ii. 1970; 23 exs., Stn. 18, River Atrai at Balurghat, 12. ii. 1970; 4 exs., Stn. 20, Jalpaiguri fish market, purchased, 14. ii. 1970; 1 ex., Stn. 29, Bagdogra fish market, purchased, 19. ii. 1970;

Distribution.—India: U.P., Bihar, W. Bengal, Assam. Bangladesh.

Remarks.—The number of bands on the body and on the caudal fin is variable. Most of the specimens examined have 7 bands on body and 2 on the caudal. In a lot of 26 examples examined only one had 3 bands over the caudal and four had six bands over the body.

46. *Somileptes gongota* (Hamilton)

1822. *Cobitis gongota* Hamilton, *Fish. Ganges*, pp. 351, 394 (type locality, Northern Bengal towards mountains; Patgong in original notes).

Material.—4 exs., Stn. 20, Jalpaiguri fish market purchased, 14. ii. 1970; 2 exs., Stn. 24, River Teesta, Western bank at Teesta Bridge, 12 Km N.E. of Jalpaiguri, 15. ii. 1970; 2 ex., Stn. 26, River Dharla at Changra-bhandha, 40 Km S.E. of Jalpaiguri, 16. ii. 1970; 2 exs., Stn. 28, River Dharla at Mainaguri, 16 Km. N.E. of Jalpaiguri, near road bridge. 16. ii. 1970.

Distribution.—India: Bihar, W. Bengal, Assam; Bangladesh.

Remarks.—In general 6 or 7 oblique blotches with light edges descend from the back in this species. Two examples 69 and 78 mm in standard length from River Dharla at Minaguri have only five blotches, lighter in colour and placed irregularly, but the body is heavily pigmented.

47. *Noemacheilus botia* (Hamilton)

1822. *Cobitis botia* Hamilton, *Fish. Ganges*, pp. 350, 358, 394, 395 (type locality, Rivers of north eastern parts of Bengal).

Material. —2 exs., Stn. 9, River Mahananda at Adampur village, 10 Km S.E., of Malda, 3. ii. 1970; 1 ex., Stn. 10, River Kalindri at village Ratua, 38 Km N. W. of Malda, 4. ii. 1970; 8 exs., Stn. 20, Jalpaiguri fish market, purchased 14. ii. 1970; 3 exs., Stn. 27, River Jaldhaka at Charchurabhandar, 28 Km N.E. of Jalpaiguri, 16. ii. 1970; 7 exs., Stn. 30, Khoribari fish market, 44 Km. S. W. of Siliguri, 20. ii. 1970; 2 exs., Stn. 32, River Balasan at Digana, near Panighata, 32 Km N.W. of Siliguri, 21. ii. 1970.

Distribution.—India; Pakistan; Bangladesh; Sri Lanka.

Remarks. —The caudal fin has 4 or 5 bands in some of the examples studied from River Mahananda and Kalindri. The dorsal fin has 12 rays in most specimens.

48. *Noemacheilus botia aureus* Day

1878. *Nemachilus botia aureus* Day, *Fish. India*, p. 614, pl. 156, fig. 4 (type locality, Assam).

Material. —1 ex., Stn. 5, confluence of River Tengan with Mahananda at Aihoo village, 16 Km S.E. of Malda, 1. ii. 1970.

Distribution —India: Deccan, Orissa, N. Bengal.

49. *Noemacheilus beavani* Günther

1868. *Nemachilus beavani* Günther, *Cat Fish. Brit. Mus.*, 7, p. 350 (type locality, Kosi river).

Material. —3 exs., Stn. 29, Bagdogra fish market, purchased, 19. ii. 1970; 3 exs., Stn. 32, River Balasan at Digana near Panighata, 32 Km N. W. of Siliguri, 21. ii. 1970.

Distribution. —India: Khasi, Garo hills, Eastern Himalaya and along foot hills of N.E.F.A.

Remarks. —There are 8 to 10 bands on body. No fleshy appendage is seen on the pectoral or pelvic axil as reported by Hora (1935). The dark band at the base of the caudal fin is distinct.

50. *Noemacheilus corica* (Hamilton)

1822. *Cobitis corica* Hamilton, *Fish. Ganges*, pp. 359, 395 (type locality, Kosi river).

1964. *Noemacheilus corica*, Jayaram & Majumdar, *J. Bombay nat. Hist. Soc.*, 61(2), p. 277.

Material. —8 exs., Stn. 8, Kalindri river at Kotwalce village, 9 Km N.W. to Malda, 2. ii. 1970; 1 ex., Stn. 24, Teesta river near Jalpaiguri, at Teesta bridge, 12 Km N.E. of Jalpaiguri, 16. ii. 1970.

Distribution.—India: Punjab, North-East Bengal, Assam, N.E.F.A.

Remarks.—The coloration is characteristic in this species. In the single example from River Teesta, 10 blotches are present over the body, the caudal fin is slightly forked, and the third and fourth pectoral fin ray produced reaching the pelvic fin. The examples from Kalindri river are juveniles 26 to 30 mm long, and have 9 to 12 spots along the dorsal profile, but the pectoral fin rays are not produced.

51. *Noemacheilus zonatus* (McClelland)

1839. *Schistura zonata* McClelland, *Asiatic researches*, 19, pp. 308, 441, pl. 53, fig. 1 (type locality, Upper Assam).

1962. *Noemacheilus zonatus*, Motwani, Jayaram & Sehgal, *Tropical Ecology*, 3, p. 27.

Material.—2 exs., Stn. 9, River Mahananda at Adampur village, 10 Km S.E. to Malda, 3. ii. 1970; 1 ex., Stn. 18, River Atrai, at Balurghat, 12. ii. 1970.

Distribution.—India : Jamuna, Ganga, Brahmaputra river system and extending upto Orissa in the south.

Remarks.—The number of bands vary from 14 to 17. The lateral line commencing from two roots is rather faint in the two examples from Mahananda river. In all other respects, the material agree with Day's (1878) description. Motwani, Jayaram and Sehgal (1962) discussed its differentiating characters from *N. sikmaiensis* Hora with which it is closely related.

Family VII BAGRIDAE

52. *Batasio batasio* (Hamilton)

1822. *Pimelodus batasio* Hamilton, *Fish. Ganges*, pp. 179, 377 (type locality, Teesta river, Jalpaiguri).

Material.—54 exs., Stn. 20, Jalpaiguri fish market, purchased, 14. ii. 1970; 40 exs., Stn. 24, River Teesta, Western bank at Teesta Bridge, 12 Km N.E. of Jalpaiguri, 15 ii. 1970.

Distribution.—India : N. Bengal, Teesta river system.

53. *Batasio tengana* (Hamilton)

1822. *Pimelodus tengana* Hamilton, *Fish. Ganges*. pp. 176, 377, pl. 39, fig. 58 (type locality, Brahmaputra river, Goalpara in original notes).

Material.—80 exs., Stn. 32, Balasan river at Digana near Panighata, 21. ii. 1970.

Distribution.—India: hill streams along foot hills of Eastern Himalaya in North Bengal, Assam; Bangladesh; Burma; Malaysia.

54. *Chandramara chandramara* (Hamilton)

1822. *Pimelodus chandramara* Hamilton, *Fish. Ganges*, pp. 162, 375 (type locality, River Atrai).
 1973. *Chandramara chandramara*, Jayaram, *Int. Revue ges. Hydrobiol.*, 5 (5) (1971) p. 816 (systematic position, description).

Material.—12 exs., Stn 31, Bidhan Roy fish market, Siliguri, purchased, 21. ii. 1970; 2 exs., Stn. 24, Jalpaiguri fish market, purchased, 17. ii. 1970.

Distribution.—India: Rivers Atrai, Mahananda, Teesta, and their tributaries in North Bengal; Bangladesh.

Remarks.—The systematic position of this elusive bagrid fish has been dealt with by Jayaram (1972, 1973).

55. *Mystus bleekeri* (Day)

1877. *Macrones bleekeri* Day, *Fish. India*, p. 451, pl. 101, fig. 1 (type locality, Sind, Jamuna, Upper waters of Ganges, Burma).

Material.—41 exs., Stn. 2, Bulbulchandi fishmarket, purchased, reported catch from R. Tengan, 31. i. 1970; 11 exs., Stn. 15, River Purnabhava at Gangarampur, 42 Km N. W. of Balurghat, 9. ii. 1970; 21 exs., Stn. 16, River Atrai at Puleegunj, 10 Km North of Balurghat, 10. ii. 1970; 33 exs., Stn. 20, Jalpaiguri fish market, purchased, 14. ii. 1970.

Distribution.—India: North of Orissa; throughout Pakistan; Bangladesh; Burma; Malaysia.

56. *Mystus cavasius* (Hamilton)

1822. *Pimelodus cavasius* Hamilton, *Fish. Ganges*, pp. 203, 379, pl. 11, fig. 6 (type locality, larger rivers of Gangetic provinces).

Material.—4 exs., Stn. 2, Bulbulchandi fish market, purchased, reported catch from River Tengan; 134 exs., Stn. 6, Aihoo village fish market, catch from River Tengan, 1. ii. 1970; 2 exs., Stn. 9, Rivers Mahananda at Adampur village, 10 Km. S. E. of Malda, 3. ii. 1970; 10 exs., Stn. 14, River Jamuna at Hilli Village, 24 Km N.E. of Balurghat, 8. ii. 1970; 22 exs., Stn. 15, River Purnabhava at Gangarampur, 42 Km N. W. of Balurghat, 9. ii. 1970; 4 exs., Stn. 16, River Atrai at Puleegunj, 16 Km North of Balurghat, 10. ii. 1970; 50 exs., Stn. 20, Jalpaiguri fish market, 14. ii. 1970; 4 exs., Stn. 24, River Teesta, western bank of Teesta bridge, 12 Km N. E. of Jalpaiguri, 16. ii. 1970.

Distribution.—Throughout India; Pakistan; Bangladesh; Burma; Thailand; Malaysia.

57. *Mystus menoda* (Hamilton)

1822. *Pimelodus menoda* Hamilton, *Fish. Ganges*, p. 203, pl. 1, fig. 72 (type locality, Northern Bengal, Bolahat in original notes).

Material.—1 ex., Stn. 2, Bulbulchandi, purchased from fishermen bringing catch from River Tengan, 31. i. 1970; 3 exs., Stn. 6, Aihoo village fish market, purchased, 1. ii. 1970. 1 ex., Stn. 14, River Jamuna at Village Hilli, 24 Km N. E. of Balurghat, 8. ii. 1970.

Distribution.—India: Orissa, Bengal, Assam.

58. *Mystus tengara* (Hamilton)

1822. *Pimelodus carcio* Hamilton, *Fish. Ganges*, p. 377, pl. 23, fig. 60 (type locality, northern parts of Bengal).

Material.—1 ex., Stn. 5, confluence of River Tengan with River Mahananda, 16 Km S.E. of Malda, 1. ii. 1970; 2 exs., Stn. 24, River Teesta, western bank at Teesta bridge, 12 Km N.E. of Jalpaiguri, 15. ii. 1970; 1 ex., Stn. 29, Bagdogra fish market, purchased, 19. ii. 1970; 28 exs., Stn. 30, Khoribari fish market, purchased, 44 Km S.W. of Siliguri, 20. ii. 1970.

Distribution.—India: north of Orissa, Bangladesh.

59. *Mystus vittatus* (Bloch)

1797. *Silurus vittatus* Bloch, *Ichthyol. Hist. Nat.*, 11, p. 40, pl. 361, fig. 12 (type locality, Tranquebar, S. India).

Material.—32 exs., Stn. 31, Bidhan Roy Market, Siliguri, purchased, 21. ii. 1970.

Distribution.—Throughout India; Sri Lanka; Pakistan; Bangladesh; Burma; Thailand.

Family VIII SILURIDAE

60. *Ompok bimaculatus* (Bloch)

1797. *Silurus bimaculatus* Bloch, *Syst. Icth.*, 11, p. 17, pl. 369 (type locality, Malabar).

Material.—1 ex., Stn. 2, Bulbulchandi fish market, purchased from fishermen, catch from R. Tengan, 31. i. 1970; 1 ex., Stn. 3, Aihoo village, River Tengan, 31. i. 1970; 1 ex., Stn. 4, River Purnabhava at Kenpukur, 16 Km S. E. of Malda, 31. i. 1970; 2 exs., Stn. 8, Aihoo village 'hat', purchased 1. ii. 1970; 13 exs., Stn. 20, Jalpaiguri fish market, purchased, 14. ii. 1970; 1 ex., Stn. 24, River Teesta, western bank at Teesta bridge, 12 Km N.E. of Jalpaiguri, 15. ii. 1970; 2 exs., Stn. 30, Khoribari fish 'hat', purchased, 20. ii. 1970.

Distribution.—Throughout India; Pakistan; Sri Lanka; Burma; Thailand; Malaysia; China.

61. *Ompok pabda* (Hamilton)

1822. *Silurus pabda* Hamilton, *Fish. Ganges*, pp. 150, 374, pl. 23, fig. 47 (type locality, Bengal).

Material.—5 exs., Stn. 20, Jalpaiguri fish market, purchased, 14. ii. 1970.

Distribution.—India: North of Orissa; Bangladesh.

Remarks.—Parameswaran *et al.* (1967) demonstrated that *O. pabo* and *O. pabda* are two distinct species, each having a separate life-history, though the former is of rare occurrence.

Family IX SCHEILBEIDAE

62. *Ailia coila* (Hamilton)

1822. *Malapterus coila* Hamilton, *Fish. Ganges*, pp. 158, 375 (type locality, fresh water rivers of Bengal).

Material.—10 exs., Stn. 5, confluence of River Tengan with River Mahananda, at Aihoo Village, 16 Km S.E. of Malda, 1. ii. 1970; 21 exs., Stn. 8, River Kalindri at village Kotwalee, 2 Km N.W. of Malda 2. ii. 1970; 1 ex., Stn. 15, River Purnabhava at Gangarampur village, 42 Km N. W. of Balurghat, 9. ii. 1970; 1 ex., Stn. 16, River Atrai at Pugleegunj, 10 Km North of Balurghat, 10. ii. 1970; 1 ex., Stn. 20, Jalpaiguri fish market, purchased, 14. ii. 1970.

Distribution.—Throughout India except Kerala; Throughout Pakistan and Bangladesh.

Remarks.—Jayaram (1963) discussed the affinities of this species with *A. punctata* (Day).

63. *Eutropichthys vacha* (Hamilton)

1822. *Pimelodus vacha* Hamilton *Fish. Ganges*, pp. 196, 378, pl. 19, fig. 6 (type locality, larger freshwater rivers of the Gangetic provinces).

Material.—1 ex., Stn. 2, Bulbulchandi, purchased from fishermen on the bank of River Tengan, 31. i. 1970; 4 exs., Stn. 10, River Kalindri at Village Ratua, 38 Km of N.W. of Malda, 1. ii. 1970.

Distribution.—India: North of Orissa; Bangladesh; Burma.

64. *Eutropiichthys murius* (Hamilton)

1822. *Pimelodus murius* Hamilton, *Fish. Ganges*, pp. 195, 378 (type locality, Mahananda river).

Material.—2 exs., Stn. 5, Confluence of River Tengan with River Mahananda at village Aihoo, 16 Km S.E. of Malda, 1. ii. 1970.

Distribution.—India: North of Orissa; Bangladesh.

65. *Clupisoma garua* (Hamilton)

1822. *Silurus garua* Hamilton, *Fish. Ganges*, pp. 156, 375, pl. 21, fig. 50 (type locality, freshwater rivers of the Gangetic provinces).

Material.—12 exs., Stn. 5, Confluence of River Tengan with River Mahananda at Aihoo village, 16 Km S. E. of Malda, 1. ii. 1970; 1 ex., Stn. 13, Balurghat fish market, purchased, 10. ii. 1970; 7 exs., Stn. 15, River Purnabhava at Gangarampur, 42 Km N.W. of Balurghat, 9. ii. 1970; 3 exs., Stn. 20, Jalpaiguri fish market, purchased, 14. ii. 1970.

Distribution.—India: north of Orissa; Bangladesh; Burma.

66. *Clupisoma montana* Hora

1937. *Clupisoma montana* Hora, *J. Bombay nat. Hist. Soc.*, 39(4), p. 673 (type locality, Teesta river, below Darjeeling).

Material.—7 exs., Stn. 8, River Kalindri at village Kotwalee, 9 Km N.W. of Malda, 2. ii. 1970.

Distribution.—India: Teesta river system, North Bengal.

Remarks.—Shaw and Shebbeare (1938) did not record this species.

Family X AMBLYCIPITIDAE

67. *Amblyceps mangois* (Hamilton)

1822. *Pimelodus mangois* Hamilton, *Fish. Ganges*, pp. 199, 379 (type locality, Northern Bengal).

Material.—2 exs., Stn. 29, Bagdogra fish market, purchased, 19. ii. 1970; 1 ex., Stn. 30, Khoribari fish 'hat', purchased, 20. ii. 1970; 2 exs., Stn. 32, River Balasan at Digana, near Panighata, 32 Km N.W. of Siliguri, 21. ii. 1970.

Distribution.—India: along streams at the foot hills of Himalaya from Punjab to Manipur; Burma; Thailand.

Family XI SISORIDAE

68. *Bagarius bagarius* Hamilton

1822. *Pimelodus bagarius* Hamilton, *Fish. Ganges*, pp. 186, 318, pl. 7, fig. 62 (type locality, the Ganges).

Material.—4 exs., Stn. 13, Balurghat fish market, purchased, 12. ii. 1970.

Distribution.—India: north of Krishna river system; Pakistan: throughout; Bangladesh; Burma; Malaya; Malay; Archipelago; Thailand; Laos; Vietnam.

69. *Gagata cenia* (Hamilton)

1022. *Pimelodus cenia* Hamilton, *Fish. Ganges*, pp. 174, 376, pl. 31, fig. 57 (type locality, Northern Bengal).

Material.—6 exs., Stn. 5, confluence of River Tengan with River Mahananda at village Aihoo 16 Km S.W. of Malda 1. ii. 1970; 7 exs., Stn. 9, River Mahananda at village, Adampur, 10 Km S.E. of Malda, 3. ii. 1970; 3 exs., Stn. 10, River Kalindri at village Ratua, 38 Km N.W. of Malda, 4. ii. 1970; 22 exs., Stn. 13, Balurghat fish market, purchased catch from river Atrai, 8. ii. 1970; 12 exs., Stn. 18, River Atrai, Balurghat, 12. ii. 1970.

Distribution.—India: north of Orissa; Bangladesh; Burma.

70. *Laguvia ribeiroi* Hora

1921. *Laguvia ribeiroi* Hora, *Rec. Indian, Mus.*, 22, pp. 741, pl. 29 fig. 3 (type locality, River Kholia, a tributary of Teesta at Jalpaiguri).

Material.—1 ex., Stn. 28, R. Dharla at Mainaguri, 16 Km. N.E. of Jalpaiguri, 16. ii. 1970.

Distribution.—India : N. Bengal.

Remarks.—Jayaram (1973) discussed the generic status of this species and resurrected the genus from the synonymy of *Glyptothorax* Blyth. The specimen was obtained by means of trap net from the Dharla river from a sluggish stretch of the stream.

71. *Nangra nangra* (Hamilton)

1822. *Pimelodus nangra* Hamilton, *Fish. Ganges*, pp. 193, 378, pl. 11, fig. 63 (type locality, Kosi river, Nathpur in original notes).

Material.—2 exs., Stn. 13, Balurghat fish market, purchased, catch from R. Atrai, 8. ii. 1970.

Distribution.—India: Jamuna, Ganga, Indus.

Remarks.—The two examples have a black streak along the lateral line and also a caudal spot.

72. *Nangra viridiscens* (Hamilton)

1822. *Pimelodus viridiscens* Hamilton, *Fish. Ganges*, pp. 173, 376, pl. 11, fig. 56. (type locality, Northern Bengal).

Material.—1 ex., Stn. 9, River Mahananda at Adampur village 10 Km S.E. of Malda, 3. ii. 1970; 17 exs., Stn. 13, Balurghat fish market, purchased, catch from River Atrai, 8. ii. 1970; 25 exs., Stn. 16, River, Atrai at Puleegunj, 10 Km North of Balurghat, 10. ii. 1970, 9 exs., Stn. 18, River Atrai at Balurghat, 12. ii. 1970.

Distribution.—India: North Bengal, Jamuna at Delhi; Bangladesh.

Remarks.—Shaw and Shebbeare (1938) did not record this species. Jayaram (1973a) resurrected this genus from the synonymy of *Gagata* Bleeker and defined its generic limits.

73. *Erethistoides montana* Hora

1950. *Erethistoides montana* Hora, *Rec. Indian Mus.*, 47, p. 191, pl. 1, figs. 10-12 (type locality, Tangla, Darrang dist., Assam).

Material.—2 exs., Stn. 26, R. Dharla at Changrabhandha, 40 Km. S. E. of Jalpaiguri, 16. ii. 1970.

Distribution.—India: North Bengal, Assam.

Remarks.—*Erethistoides montana* Hora was collected along with *Laguvia ribeiroi* from a sluggish part of the River Dharla. Both share the same ecological niche and are peculiar.

74. *Hara hara* (Hamilton)

1822. *Pimelodus hara* Hamilton, *Fish. Ganges*, p. 190 (type locality, River Kosi).

Material.—2 exs., Stn. 24, River Teesta, Western bank, at Teesta Bridge, 12 Km N.E. of Jalpaiguri, 15. ii. 1970.

Distribution.—India: Bihar, N. Bengal, Assam; Bangladesh; Burma.

Remarks.—This species closely resembles *Laguvia ribeiroi*. Jayaram (1973 b) discussed the relationship between the two genera and pointed out the differentiating characters.

75. *Glyptothorax telchitta* (Hamilton)

1822. *Pimelodus telchitta* Hamilton, *Fish. Ganges*, pp. 185, 378 (type locality, Bengal and Bihar; Jungipur, Nathpur in original notes).

Material.—3 exs., Stn. 7, Malda fish market, purchased, 2. ii. 1970; 1 ex., Stn. 13, Balurghat fish market, purchased, 10. ii. 1970; 2 exs., Stn. 30, Khoribari fish 'hat', 44 Km. S.W. of Siliguri, purchased, 20. ii. 1970; 9 exs., Stn. 32, River Balasan at Digana near Panighata, 32 Km N.W. of Siliguri, 21. ii. 1970.

Distribution.—India: U. P., Bihar, N. Bengal; Bangladesh; Nepal.

76. *Sisor rhabdophorus* Hamilton

1822. *Sisor rhabdophorus* Hamilton, *Fish. Ganges*, pp. 208, 379 (type locality, Northern rivers of Bengal and Bihar).

Material.—1 ex. Stn. 11, River Mahananda, Malda, 5. ii. 1970.

Distribution.—India: generally North India; Throughout Pakistan; Bangladesh.

Family XII HETEROPNEUSTIDAE

77. *Heteropneustes fossilis* (Bloch)

1797. *Silurus fossilis* Bloch, *Auslandische Fische*, 11, pl. 370, text-fig. 2 (type locality, Tranquebar).

Material.—2 exs., Stn. 3, R. Tengan at Aihoo village, 31. i. 1970.

Distribution.—India: Throughout; Pakistan; Bangladesh; Sri Lanka; Nepal; Burma; Thailand.

Family XIII SCIAENIDAE

78. *Jahnius coitor* (Hamilton)

1822. *Bola coitor* Hamilton, *Fish. Ganges*, pp. 75, 308, pl. 27, fig. 24. (type locality, Ganges, river).

Material.—2 exs., Stn. 9, River Mahananda at Adampur village, 3. ii. 1970.

Distribution.—Throughout the larger rivers of India descending to the sea at certain seasons. Bangladesh; Burma.

Family XIV AMBASSIDAE

79. *Chanda baculis* Hamilton

1822. *Chanda baculis* Hamilton, *Fish. Ganges*, pp. 112, 371 (type locality, Ganges).

Material.—3 exs., Stn. 28, R. Dharla at Mainaguri, 16 Km N. E. of Jalpaiguri, 16. ii. 1970.

Distribution.—India: North of Orissa. Throughout Pakistan; Bangladesh; Burma; Thailand.

Remarks.—The color is olive and no occipital spot is present.

80. *Chanda nama* Hamilton

1822. *Chanda nama* Hamilton, *Fish. Ganges*, pp. 109, 371, pl. 39, fig. 37 (type locality, ponds throughout Bengal).

Material.—2 exs., Stn. 2, Bulbulchandi fishmarket, purchased, catch from River Tengan, 31. i. 1970; 1 ex., Stn. 6, Aihoo village 'hat'

purchased, 1. ii. 1970; 7 exs., Stn. 18, River Atrai at Balurghat, 12. ii. 1970; 10 exs., Stn. 20, Jalpaiguri fish market, purchased 14. ii. 1970; 2 exs., Stn. 24, River Teesta, Western bank near Teesta Bridge, 12 Km N. E. of Jalpaiguri, 15. ii. 1970; 1 ex., Stn. 28, River Dharla at Mainaguri, 16 Km N.E. of Jalpaiguri, 16. ii. 1970.

Distribution.—Throughout India; Pakistan; Bangladesh; Burma.

Remarks.—The lateral line in all the specimens studied is indistinct. The black spot behind the opercle is also present. Some specimens have a blotch on the dorsal fin. However, the seven examples from Stn. 18, 25-39 mm long, have no opercular spot.

81. *Chanda ranga* Hamilton

1822. *Chanda ranga* Hamilton, *Fish. Ganges*, pp. 13, 371, pl. 16, fig. 38 (type locality, freshwater rivers of Gangetic provinces).

Material.—15 exs., Stn. 9, River Mahananda at Adampur village, 10 Km. S. E. of Malda, 3. ii. 1970; 1 ex., Stn. 10, River Kalindri at village Ratua, 38 Km N. W. of Malda, 4. ii. 1970; 1 ex. Stn. 13, Balurghat at fish market, catch from River Atrai, 8. ii. 1970; 4 exs., Stn. 14, River Jamuna at Hilli village, 24 Km N.E. of Balurghat, 8. ii. 1970; 32 exs., Stn. 18, River Atrai at Balurghat, 12. ii. 1970; 2 exs., Stn. 24, River Teesta, Western bank at Teesta Bridge, 12 Km N.E. of Jalpaiguri, 15. ii. 1970; 2 exs., Stn. 26, River Dharla at Changra-bhandha, 40 Km S.E. of Jalpaiguri, below road bridge, 16. ii. 1970; 2 exs., Stn. 28, River Dharla at Mainaguri, 16 Km N.E. of Jalpaiguri, near road bridge, 16. ii. 1970.

Distribution.—Throughout India; Pakistan; Bangladesh; Burma; Thailand; Malaya.

Remarks.—The 32 specimens from Stn. 18, River Atrai, Balurghat form a good series, 17 to 30 mm in standard length. The dark spot on the dorsal fin is present. The spot on either side of the occipital crest-become coalesced in the smaller specimens. Similarly in the juveniles the upper caudal lobe is longer.

Family XV NANDIDAE

82. *Nandus nandus* (Hamilton)

1822. *Coius nandus* Hamilton, *Fish. Ganges*, p. 96, pl. 30, fig. 32 (type locality, ponds of Gangetic provinces).

Material.—2 exs., Stn. 14, River Jamuna at Hilli village, 24 Km N.E. of Balurghat, 8. ii. 1970; 2 exs., Stn. 26, River Dharla at Changra-bhandha, 40 Km S.E. of Jalpaiguri, 16. ii. 1970; 1 ex., Stn. 30, Khoribari fish 'hat,' purchased, 20. ii. 1970; 2 exs., Stn. 32, River Balasan at Digana near Panighatta, 32 Km N.W. of Siliguri, 21. ii. 1970.

Distribution.—Throughout India; Pakistan; Bangladesh; Burma; Thailand; Malaya.

83. *Badis badis* (Hamilton)

1822. *Labrus badis* Hamilton, *Fish. Ganges*, pp. 70, 368, pl. 25, fig. 23 (type locality Gangetic provinces).

Material.—2 exs., Stn. 29, Bagdogra fish market, purchased, 19. ii. 1970; 1 ex., Stn. 30, Khoribari fish 'hat', 44 km S. W. of Siliguri, purchased, 20. ii. 1970.

Distribution.—Throughout India, Pakistan, Bangladesh; Burma.

Family XVI GOBIIDAE

84. *Glossogobius giuris giuris* (Hamilton)

1822. *Gobius giuris* Hamilton, *Fish. Ganges*, pp. 51, 368, pl. 33, fig. 15 (type locality, ponds and freshwater rivers of the Gangetic provinces).

Material.—7 exs., Stn. 2, Bulbulchandi on bank of River Tengan, 20 km S.E. of Malda, purchased, 31. ii. 1970; 1 ex., Stn 5, confluence of River Tengan with Rivers Mahananda at Aihoo village, 16 km S.E. of Malda, 1. ii. 1970; 10 exs., Stn. 9, River Mahananda at Adampur village, 10 km S.E. of Malda, 3. ii. 1970; 5 exs., Stn. 10, River Kalindri, at village Ratua, 38 km N. W. of Malda, 4. ii. 1970; 4 exs., Stn. 11, River Mahananda at Malda, 5. ii. 1970; 1 ex., Stn. 16, River Atrai at Pugleegunj, 10 km North of Balurghat, 10. ii. 1970; 4 exs., Stn. 20, Jalpaiguri fish market, purchased, 14. ii. 1970; 3 exs., Stn. 24, River Teesta, Western Bank, at Teesta Bridge, 12 km N.E. of Jalpaiguri, 15. ii. 1970.

Distribution.—Throughout India, Pakistan, Bangladesh; Burma; Ceylon; East and South coasts of Africa, Mauritius, Malaya; Malay Archipelago; Thailand; China; Japan; Philippines; Melanesia; Polynesia; Australia.

Remarks.—This is a highly variable species. Specimens less than 40 mm in standard length have practically no interorbital space, and the space is measurable only in larger specimens. Most examples have a plain anal fin. The largest example 97 mm long has 3 or 4 dark blotches on the body.

Family XVII. MASTOCSEMBELIDAE

85. *Mastocembelus armatus armatus* (Lacépède)

1800. *Macrogathus armatus* Lacépède, *Hist. nat. poiss.*, 2, pp. 283, 284 (type locality, not given).

Material.—1 ex., Stn. 2, Bulbulchandi fish market, purchased from fishermen on bank of R. Tengan, 31. ii. 1970; 1 ex., Stn. 20, Jalpaiguri fish market, purchased, 14. ii. 1970; 1 ex., Stn. 24, Teesta river western bank at Teesta bridge, 12 km N. E. of Jalpaiguri, 16. ii. 1970.

Distribution.—Throughout India; Pakistan; Bangladesh; Sri Lanka; Burma; Thailand; Malaya; Hainan.

86. *Mastocembelus pancalus* (Hamilton)

1822. *Macrogathus pancalus* Hamilton, *Fish. Ganges*, pp. 30, 364, (type locality tanks of the Gangetic provinces).

Material.—4 exs., Stn. 2, Bulbulchandi fish market, purchased from fishermen on bank of R. Tengan, 31. ii. 1970; 1 ex., Stn. 11, River Mahananda at Malda, 5. ii. 1970; 1 ex., St. 30, Khoribari fish 'hat', purchased 20. ii. 1970.

Distribution.—Throughout India, Pakistan, Bangladesh.

87. *Macrogathus aculeatum* (Bloch)

1787. *Ophidium aculeatum* Bloch, *Naturg Ausländisch Fische.*, 5, p. 60., pl. 159, fig.2 (type locality, East Indies).

Material.—4 exs., Stn. 2, Bulbulchandi fish market, purchased from fishermen on bank of River Tengan, 31. i. 1970; 1 ex., Stn. 14, River Jamuna at Hilli Village, 24 km N.E. to Balurghat, 8. ii. 1970; 1 ex., Stn. 20, Jalpaiguri fish market, purchased, 14. ii. 1970.

Distribution.—Throughout India; Pakistan; Bangladesh; Burma; Thailand; Malaya; Malay Archipelago; Viet-Nam; China.

Family XVIII TETRAODONTIDAE

88. *Tetraodon cutcutia* Hamilton

1822. *Tetraodon cutcutia* Hamilton, *Fish. Ganges*, pp: 8, 362, pl. xviii, fig. 3 (type locality, Nathpur).

Material.—3 exs., Stn. 6, Aihoo village 'hat' purchased, 1. ii. 1970; 4 exs., Stn. 9, River Mahananda at Adampur village, 10 km S.E. of Malda; 1 ex., Stn. 20, Jalpaiguri fish market, purchased, 14. ii. 1970.

Distribution.—India: freshwaters of Orissa, Bengal, Assam; Bangladesh.

Family XIX OSPHRONEMIDAE

89. *Colisa chuna* (Hamilton)

1822. *Trichopodus chuna* Hamilton, *Fish. Ganges*, pp. 121, 372 (type locality, Goalpara).

Material.—1 ex., Stn. 2, Bulbulchandi, purchased from fishermen on bank of R. Tengan, 31. i. 1970.

Distribution.—India: Bengal, Assam; Bangladesh.

90. *Colisa fasciatus* (Bloch & Schneider)

1801. *Trichogaster fasciatus* Bloch & Schneider, *Syst. Ichth.*, p. 164, pl. 36 (type locality, Bengal).

Material.—1 ex., Stn. 14, River Jamuna at Hilli village, 24 km N. E. of Balurghat, 8. ii. 1970; 3 exs., Stn. 30, Khoribari fish 'hat', 44 Km S.W. of Siliguri, 20. ii. 1970.

Distribution.—Throughout India; Bangladesh; Burma.

91. *Colisa latius* (Hamilton)

1811. *Trichopodus latius* Hamilton, *Fish. Ganges*, pp. 120, 372 (type locality, Goalpara).

Material.—5 exs., Stn. 30, Khoribari fish 'hat', 44 km S.W. of Siliguri, 20. ii. 1970.

Distribution.—India: North India, along Ganga, Jamuna, Indus river systems. Pakistan: Sind.

92. *Ctenops nobilis* McClelland

1839. *Ctenops nobilis* McClelland, *Calcutta J. nat. Hist.*, 5, p. 281, pl. 21, fig. 1 (type locality, rivers at the Sikkim passes on the northern frontier of Bengal).

Materials.—1 ex., Stn. 11, River Mahananda at Malda, 5. ii. 1970; 11 exs., Stn. 13, Balurghat fish market, purchased, 8. ii. 1970; 7 exs., Stn. 18, River Atrai at Balurghat, 12. ii. 1970.

Distribution.—India: N.E. Bengal, Assam; Bangladesh.

Remarks.—The example from Stn. 20, Jalpaiguri fish market is brown with many black dots; no silvery line is present. The pectoral fin is elongated.

Family XX BELONIDAE

93. *Xenentodon cancila* (Hamilton)

1822. *Esox cancila* Hamilton, *Fish. Ganges*, pp. 213, 380, pl. 27, fig. 70 (type locality, ponds and smaller rivers of the Gangetic provinces).

Material.—7 exs., Stn. 5, confluence of River Tengan with River Mahananda at Aihoo village, 16 km S E of Malda, 1. ii. 1970; 2 exs., Stn. 10, River Kalindri at village Ratua, 38 km N.W. of Malda, 4.ii.1970.

Distribution.—Throughout India, Pakistan; Bangladesh; Sri Lanka Burma; Thailand; Malaya.

Family XXI CYPRINODONTIDAE

94. *Aplocheilus panchax* (Hamilton)

1822. *Escos panchax* Hamilton, *Fish. Ganges*, pp. 211, 380, pl. 3, fig. 69 (type locality, ditches and ponds of Bengal).

Material. —2 exs., Stn. 17, River Atrai at Gopalgunj, 25 km North of Balurghat, 11. ii. 1970.

Distribution. —India: North of Orissa. Pakistan; Bangladesh
Burma: Sri Lanka; Malaya; Malay Archipelago; Thailand.

Family XXII OPHIOCEPHALIDAE

95. *Channa punctatus* (Bloch)

1793. *Ophicephalus punctatus* Bloch, *Naturg. Ausland. fisch.*, 7, p. 139, pl. 358 (type locality, Malabar Coast).

Material. —5 exs., Stn. 2, Bulbulchandi fish 'hat', purchased from fishermen on the bank of R. Tengan, 31. i. 1970; 1 ex., Stn. 3, Aihoo village on bank of R. Tengan, purchased 31. i. 1970; 1 ex., Stn. 9, River Mahananda at Adampur village, 10 km S.E. of Malda, 3. ii. 1970; 2 exs., River Jaldhaka at Charchurabhandar, 28 km N.E. of Jalpaiguri, 16. ii. 1970.

Distribution. —Throughout India; Pakistan; Bangladesh; Sri Lanka; Burma; Malaya; China; Tahiti; Polynesia.

Family XXIII MUGILIDAE

96. *Mugil corsula* Hamilton

1822. *Mugil corsula* Hamilton, *Fish. Ganges*, pp. 221, 381, pl. 9, fig. 97 (type locality, rivers of the Gangetic provinces and in the southern parts of Bengal).

Material. —37 exs., Stn. 14, River Jamuna at village Hilli, 24 km N. E. of Balurghat, 8. ii. 1970; 1 ex., Stn. 15, River Purnabhava at Gangarampur village near road bridge, 9. ii. 1970; 3 exs., Stn. 16, River Atrai at Pugleegunj, 10 km North of Balurghat, 10. ii. 1970; 7 exs. Stn. 18, River Atrai at Balurghat, 12. ii. 1970; 1 ex., Stn. 20, Jalpaiguri fish market, purchased, 14. ii. 1970.

Distribution. —India: Rivers and estuaries of Bengal. Bangladesh: Burma.

Remarks. —Shaw and Shebbeare (1938) did not record this species.

SUMMARY

A taxonomic account of 96 species of fishes collected during a survey of North Bengal districts in February 1970 is presented in this paper. Of these 17 are new records, the most noteworthy being the rediscovery

of *Pimelodus chandramara* Hamilton, the elusive Bagrid which has been collected and reported for the first time subsequent to its original description by Hamilton 150 years ago. Notes on variations, and ecological observations are given wherever necessary.

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STUDIES ON THE LARVAL TREMATODES OF
WEST BENGAL PART II
ON A NEW ECHINOSTOME CERCARIA

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and

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(With 1 Text-figure)

An intensive investigation of larval trematodes carried out in West Bengal resulted in a discovery of a new Furcocercous cercaria the description of which was included in Part I of this series. Present paper deals with the description of a new echinostome cercaria.

Out of 15 *Gyraulus convexiusculus* collected from Manohar Das tank, Dharmatalla, Calcutta, two snails were found to discharge small echinostome cercariae. They are whitish in appearance and move like one part to another in the container. They move in the water directing clouds from the anterior-part upwards and the powerful muscular tail downwards. On the flat surface of the slide they can crawl rapidly with oral and ventral suckers. Under laboratory condition majority of the the help of cercariae died within 8 to 10 hours time after they emerged from the infected snails.

Cercaria dharmatallans n. sp.

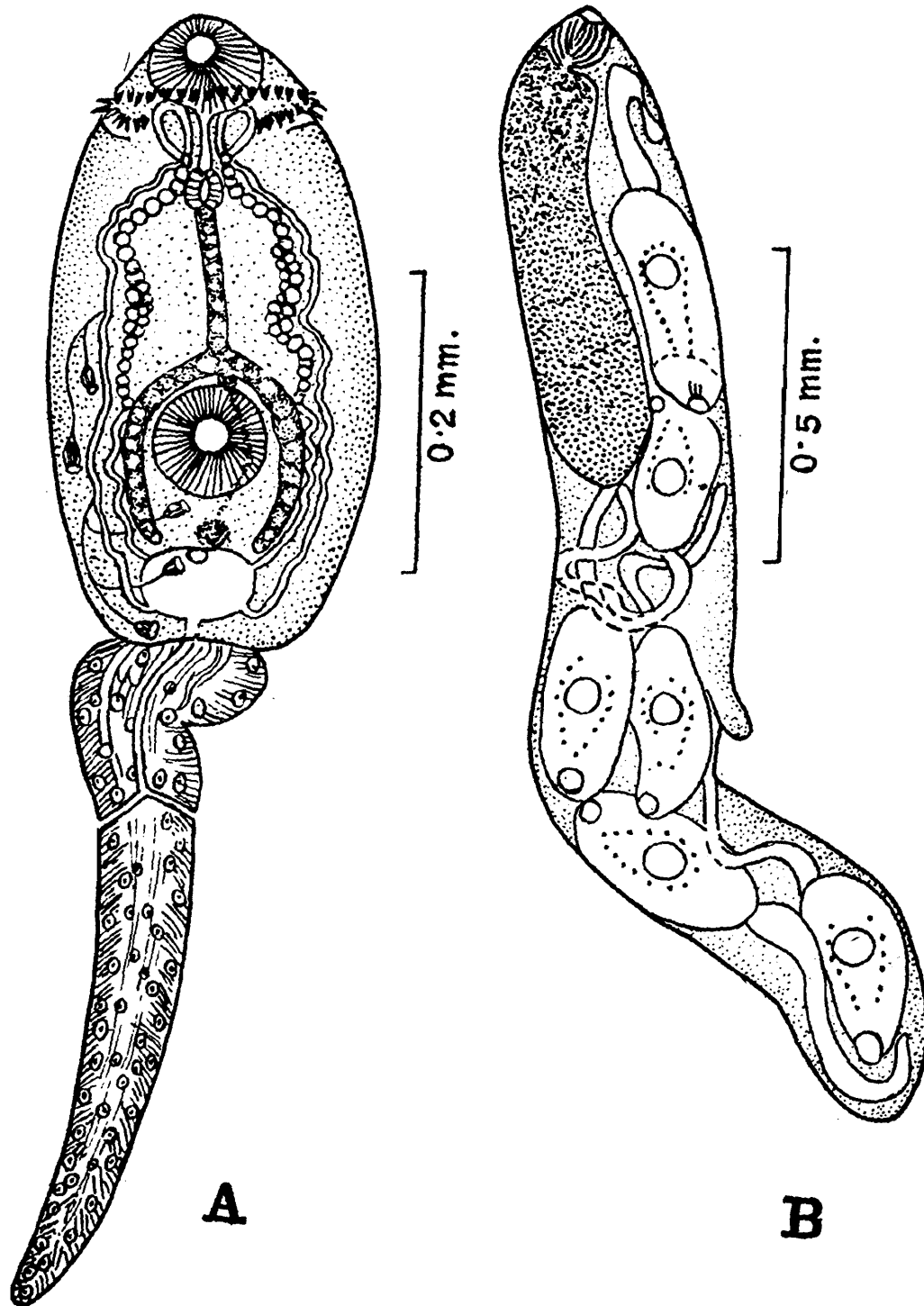
(Text-fig. 1 A & B).

Flat body of the cercaria measures 0.270-0.432* in length and 0.117-0.198 in breadth. Tail measures 0.360-0.459 in length and 0.045-0.063 in breadth. Oral sucker measures 0.062-0.077 in length and 0.058-0.079 in breadth. The well developed pharynx measures 0.029-0.036 in length and 0.022-0.037 in breadth.

Body is provided anteriorly with a collar which carries 32 collar spines. The body and tail are smooth and without any spines. Mouth is located terminally and the prepharynx is narrow and long. Long and narrow oesophagus bifurcates just above ventral sucker into two almost

* All measurements are in mm.

straight caeca. Caeca extends far behind ventral sucker and terminate at anterior or middle level of excretory bladder. Oesophagus and caeca are provided with uninucleate cells. The rounded muscular ventral sucker situated in mid-region and at post-equatorial part of body. Cystogenous cells are compactly arranged in the body. Powerful muscular tail is slightly longer than body and gradually tapers towards posterior end.



Text-fig. 1.— A. *Cercaria dharmatalansis* n. sp. B. Redia of *Cercaria dharmatalansis* n. sp.

Transversely elongated, thin walled excretory bladder is oval in shape and situated a little in front of posterior end of body. From its antero-lateral parts two narrow ducts arise and runs forward in a zig-zag course. These ducts run on either side of ventral sucker and widen out in front of it and again they narrow down near the pharynx. Descending excretory canals form loops near prepharynx. Portions of ascending canals, between ventral sucker and pharynx contain refractile excretory granules of various sizes. Descending canal of each side gives out two flame cells at mid region of oesophagus and three flame cells at posterior part of body. Excretory bladder gives out a median duct into the tail and this duct soon after entering the tail divides into two lateral ducts which open on two lateral sides of tail.

Redia is an elongated body, measures 1.446—1.962 in length and 0.065—0.072 in breadth. It is provided with a pair of locomotor appendages but without a collar. Well developed pharynx is located anteriorly and measures 0.063 — 0.081 in length and 0.054 — 0.072 in breadth. Gut broad, elongated sac and content is yellowish in colour. It measures 0.052—0.450 in length and 0.063 — 0.171 in breadth. The birth pore is located anteriorly and at posterior level of pharynx. Each redia contains 6 to 10 cercariae and germ balls.

Host : *Gyraulus convexiusculus*

Locality : Manohar Das Tank, Dharmatalla, Calcutta.

Discussion: Present cercaria comes close to *Cercariae indicae* XII. Swell, 1922, *Cercariae nairi* Peter, 1955 and *Cercariae echinostome* sp. Odening, 1970 but it differs from *C. indicae* XII in number of collar spines, number of flame cells and arrangement of spines and flame cells. It differs from *C. nairi* in number of collar spines and their arrangement and absence of caudal processes. It differs from *C. echinostome* sp. in number of collar spines and their arrangement, number of flame cells and absence of fin fold in the tail.

ACKNOWLEDGEMENT

Thanks are due to the Director, Zoological Survey of India, Calcutta for providing laboratory facilities.

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STUDIES ON THE GENUS *Ganeo* KLEIN, 1905 (TREMATODA · LECITHODENDRIIDAE)

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(With 2 Text-figures)

Klein (1905) proposed the genus *Ganeo* with *G. glottoides* as the type species obtained from a frog, *Rana hexadactyla* from Tamil Nadu, India. He tentatively placed this genus under subfamily Pleurogenetinae Looss (1899). Odhner (1911) discussed its systematic position and assigned this genus to the subfamily Pleurogenetinae of the family Lecithodendriidae. Since the description of *G. glottoides* by Klein, *G. glottoides* var. *africana* Skrjabin (1922), *G. tigrinum* Mehra & Negi (1928), *G. glottoides* var. *madrasensis* Mehra & Negi (1928), *G. gastricus* Srivastava (1933), *G. attenuatum* Srivastava (1933), *G. korkei* Bhalerao (1936), *G. kumaonensis* Pande (1937), *G. lingnanensis* Li (1938), *G. srinagarensis* Kaw (1950), *G. gobindiu* Dayal & Gupta (1953), *G. panjabensis* Gupta, N. K. (1954), *G. bufonis* Fotedar (1959) and *G. gazipurensis* Pandey & Chakrabarti (1968) have been added to the genus *Ganeo*. Some workers have also extended the distribution of certain species.

MATERIAL AND METHOD

This paper is based on the study of 15 specimens of *G. kumaonensis* and 21 specimens of *G. tigrinum* collected by the author from Jaisalmer and Jodhpur districts of Rajasthan. In addition 4 examples of *Ganeo kumaonensis* and 14 of *G. tigrinum* present in the earlier collection of the Zoological Survey of India and 17 specimens of *G. tigrinum* in the collection of Dr. G. S. Thapar, acquired by the Survey, were also examined.

Genus *Ganeo* Klein, 1905

1905. *Ganeo* Klein, *Zool. Jahrb. Syst.*, 22 : 57-79, pl. 41, fig. 505.

In differentiating the species of the genus *Ganeo* various authors have used different characters. Some workers have considered certain characters as variations rather than of any specific value. A short resume of earlier workers follows.

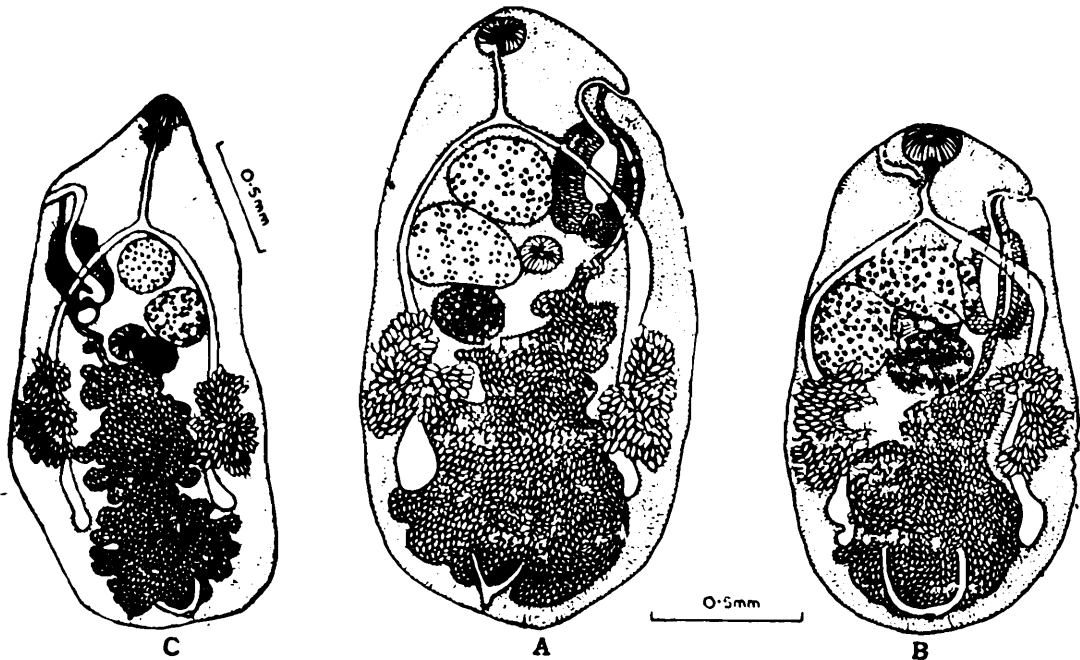
Skrjabin (1922) does not consider the extension of intestinal caeca of any specific value. Mehra and Negi (1928) do not consider the difference in the position of gonads of any importance because of the variations in the arrangement of gonads in *G. glottoides* var. *madrassensis* and *G. glottoides* var. *africana*. According to Mehra and Negi (1928) the shape of seminal vesicle is variable depending on the contents and condition at the time of preservation. According to Fotedar (1959) twisting of seminal vesicle brings about different shapes even among the members of the same species. Fotedar has recorded presence of metaterm in *G. tigrinum* although no mention of this structure was made by Mehra and Negi (1928), further he also agrees with Mehra and Negi in not assigning any value to slight variations in the position gonads.

A careful study of the shape of excretory vesicle in various species of *Ganeo* has revealed valuable information. Earlier workers have described it as 'U', 'V' and 'Y' shaped but a close scrutiny of this structure shows a remarkable resemblance. It is found in all cases to be 'Y' shaped, having either a very short (sometimes almost negligible) or slightly to fairly long median stem. In species having a broad posterior end, showing maximum contraction, the excretory vesicle is reported as 'U' shaped, e.g. *G. gastricus* and *G. linganensis*. In specimens with moderate stage of extension the excretory vesicle is variously described 'U', 'V' and 'Y' shaped with or without a median stem—'U' shaped in *G. tigrinum*, *G. panjabensis*, *G. kumaonensis* and *G. srinagarensis*; 'V' shaped in *G. korkei* and *G. gobindia* and 'Y' shaped in *G. attenuatum*.

Some species of the genus *Ganeo* have been distinguished on the basis of position and distribution of vitellaria in relation to gonads, ventral sucker and termini of intestinal caeca. Views of Mehra and Negi (1928) and Fotedar (1959) have been stated above for not giving importance to slight variations in the position of gonads. Similarly these species should not be differentiated on the basis of distribution of vitellaria in relation to gonads and the ventral sucker. It is observed that distribution of vitelline follicles in relation to body length provides a fairly stable character.

Text-fig. 1 A-C shows some of the variations occurring in *G. tigrinum* obtained from *Rana cyanophlyctis* from Jaisalmer and Jodhpur districts of Rajasthan in India. In two specimens (Text-fig. 1A and B) the testes are apposed to each other and in the third specimen (Text-fig. 1C) they are separately situated. The ovary is occupying a position clearly behind the ventral sucker and the posterior testis in one specimen (Text-fig. 1A), where as it is partly in level with the posterior testis and the ventral sucker in other two specimens. The excretory vesicle is showing all the three types of 'U', 'V' and 'Y' shaped structures.

Here relative size of oral and ventral suckers, position of gonads in relation to the ventral sucker, laterality of testes and extension of vitelline foellcles in relation to body length have been utilized as stable characters for differentiating species of the genus *Ganeo*.



Text-fig. 1. A-C. Mature specimens of *Ganeo tigrinum* showing variations of different characters.

1. *Ganeo tigrinum* Mehra & Negi, 1928

1928. *Ganeo tigrinum* Mehra & Negi, *Allahabad Univ. Stud.*, 4 : 66-80.

1926. *Ganeo glottoides*, Bhalerao, *Parasitology*, 18 : 154-159.

New synonyms

1933. *Ganeo attenuatum* Srivastava, *Bull. Acad. Sci. U. P.*, 3 : 103-108.

1938. *Ganeo linganensis* Li, *Lingnan Sci. J.*, 17 : 221-223.

1953. *Ganeo gobindia* Dayal & Gupta, *Thapar Comm. Vol.* : 63-68.

1954. *Ganeo panjabensis* Gupta, N. K., *Res. Bull. Punjab Univ.*, No. 55 : 125-129.

1959. *Ganeo bufonis* Fotedar, *J. Helminth.*, 33 : 151-160.

Srivastava (1933) differentiated *G. attenuatum* from *G. tigrinum* on the basis of attenuated shape of body, position, shape and size of suckers, shape of receptaculum seminis, shape of vesicula seminalis length of vitellaria, presence of metraterm and configuration of uterine coils. The omission of metraterm in the description by Mehra and Negi (1928) should not be treated as a positive statement about its absence in *G. tigrinum*. Further, *Ganeo bufonis*, *G. panjabensis* and *G. lingnanensis* which will be discussed below and are treated synonyms of *G. tigrinum*, give an indication about presence of metraterm. A few specimens in Dr. G. S. Thapar's collection, obtained from the gut of *Rana cyanophlyctis* at Lucknow and identified by this author as *G. tigrinum*, show presence of metraterm. The receptaculum seminis is flask shaped both in *G. tigrinum* and *G. attenuatum*. As mentioned above, Mehra

and Negi (1928) consider shape of vesicula seminalis as a variable character. The vitellaria occupy 1/5th instead of 1/4th of body length as reported by Mehra & Negi in case of *G. tigrinum*. The extended condition of the specimen described by Srivastava appears to have resulted in the characteristic shape and configuration of uterine coils. The ventral sucker is larger than the oral sucker, although not in the ratio of exactly 3:2 as in the case of *G. tigrinum*. In view of the similarities between the two species it will be better to treat *G. attenuatum* as synonym of *G. tigrinum*.

Li (1938) differentiated *G. lingnanensis* from *G. tigrinum* on the basis of presence of metraterm, shape of pars prostatica and position of anterior testis. The presence of metraterm in *G. tigrinum* has been mentioned while dealing with *G. attenuatum*. The remaining characters are not sufficient to distinguish *G. lingnanensis* from *G. tigrinum*. Fotedar (1959) has also inferred similarly.

Dayal and Gupta (1953) distinguished *Ganeo gobindia* on the basis of differences in the structure of the excretory vesicle which is stated to be 'V' shaped in *G. gobindia* and 'U' shaped (actually 'Y' shaped) in *G. tigrinum*. The occurrence of *G. gobindia* in *Wallago attu* (Bloch), a piscine host appears to be accidental since the hitherto known other species are from amphibian host with the exception of another case when Simha (1958) has reported occurrence of *G. tigrinum* from the intestine of *Chamaeleon zeylanicus*. The difference in the shape of excretory vesicle could be explained by the observations made above. Of the ten specimens studied by Dayal and Gupta, only one is mature but its stunted growth is apparent from the extremely small number of ova in the uterus. The stunted growth due to accidental nature of infection is a common phenomenon. One specimen (Z.S.I. registration number W 4165/1) collected from a toad, closely resembles *G. gobindia* but differs from it in the shape of testes and vesicula seminalis. Therefore on the basis of other resemblances between the two species, *G. gobindia* should be treated as a synonym of *G. tigrinum*.

Ganeo panjabensis Gupta, (N. K.) 1954 has 'U' shaped excretory vesicle with a median stem, vitelline follicles extending to caecal termini and occupying the third quarter of body length, covering less than 1/4th of the body length and intestinal caeca extending behind the vitellaria. The 'U' shaped excretory vesicle with a median stem—basically 'Y' shaped, has been described by Mehra and Negi in case of *G. tigrinum*. Singh (1954) has recorded the variation of caeca not extending behind vitellaria in case of *G. kumaonensis*. The vitelline follicles in *G. panjabensis* show a range of distribution resembling that of *G. tigrinum*. *Ganeo panjabensis* so closely resembles *G. tigrinum* in having oral sucker smaller than the ventral, absence of pseudocirrus sac, position of genital

opening, arrangement of gonads and their position in relation to the ventral sucker and vitelline follicles commencing behind the ovary, that it will be desirable to treat *G. panjabensis* as a synonym of *G. tigrinum*.

Ganeo bufonis Fotedar (1959) is based on a single specimen. It is distinguished from other species on the basis of both the vitellaria being situated on left side of body. Fotedar (1959) has cited a number of examples to justify creation of this species. Ciurea (1933) has reported atrophy of both the testes and vitellarium of the left side in case of *Metagonimus yokogawai*. A similar case with vitellaria on one side has been reported by Kaw (1950) in case of *Ganeo* sp. Dawes (1946) has stressed that such abnormalities should not be treated as of any systematic value. Since *G. bufonis* resembles *G. tigrinum* in other characters, it is considered as a synonym of the latter species.

2. *Ganeo korkei* Bhalerao, 1936

1936. *Ganeo korkei* Bhalerao, *J. Helminth.*, 14 : 208-211.

Bhalerao (1936) has described vitelline follicles arranged in five groups on the left side and seven groups on the right side. Mehra and Negi (1928) have stated in case of *G. tigrinum* that the vitellaria are not arranged in groups. No other species of this genus has vitelline follicles arranged in groups. It is felt that Bhalerao (1936) has possibly made an erroneous statement about grouped arrangement of vitelline follicles. Also the position of ventral sucker has not been shown by Bhalerao (1936) in the figure for *G. korkei*.

3. *Ganeo kumaonensis* Pande, 1937

1937. *Ganeo kumaonensis* Pande, *Proc. Indian Acad. Sci.*, B, 6 : 109-120.

1950. *Ganeo* sp. Kaw, *Indian J. Helminth.*, 2 : 91, 92.

New synonyms

1959. *Ganeo tigrinum*, Fotedar, *J. Helminth.*, 33 : 151-160.

1968. *Ganeo gazipurensis* Pandey and Chakrabarti, *Sci. & Cult.*, 34 : 218, 219.

The distribution of vitelline follicles in *G. kumaonensis*, being about 1/3rd in relation to body length, is most extensive. In *Ganeo korkei* they occupy slightly less than 1/3rd of body length. The excretory vesicle has a median stem in both the species but it is described as 'U' shaped in *G. kumaonensis* and 'V' shaped in *G. korkei*. These two species resemble each other so closely in the extension of intestinal caeca, arrangement of testes, position of ovary, the basic 'Y' shaped excretory vesicle and ventral sucker being larger than the oral sucker that slight difference in the distribution of vitelline follicles may not be sufficient to distinguish *G. kumaonensis* and *G. korkei*. A study of the life history of these parasites may further elucidate this point. However, the two species are tentatively treated here distinct from each other.

Singh (1954) has reported occurrence of *G. kumaonensis* from Lucknow (U.P.). These forms show certain interesting variations of caeca not extending behind vitelline follicles, size of testes and ovary, absence of spines from the metraterm. However, Singh's form resembles *G. korkei* in the distribution of vitellaria compared to body length.

Fotedar (1959) has reported the occurrence of *G. tigrinum* from *Bufo viridis* in Kashmir. This form resembles *G. kumaonensis* of Singh (1954). Fotedar's material show the extension of vitelline follicles to approximately 1/3 rd of body length whereas it is 1/5th in *G. tigrinum*. These specimens support the similarity between *G. korkei* and *G. kumaonensis* as mentioned above. It is helpful to consider this point in view of the occurrence of *G. kumaonensis* in Kashmir reported by Kaw (1950), who has observed variations in the shape of body, size of testes, ovary, vitellaria and excretory vesicle.

Ganeo gazipurensis Pandey and Chakrabarti (1968) has been distinguished by its authors from *G. bufonis* which has been shown above as a synonym of *G. tigrinum*. Similarly *G. gazipurensis* is to be treated as a synonym of *G. kumaonensis* due to their similarity in the extension of vitelline follicles, location and arrangement of gonads and length of intestinal caeca. Kaw (1950) had similarly treated *Ganeo* sp. in considering the location of vitellaria on one side only as an aberration.

In view of the synonymies of *G. tigrinum* indicated above, the emended diagnosis of this species is given below.

Emended diagnosis of *Ganeo tigrinum* Mehra & Negi : Body, 0.9—3.7 mm. in length and 0.53—1.63 mm. in width, is highly contractile. Cuticle spinose. Suckers nearly spherical or slightly transversely elongated. Oral sucker smaller than the ventral sucker. Prepharynx very small. Intestinal caeca extending 3/4th to 4/5th of body length in mature specimens and about 5/6th in immature specimens. They may or may not extend behind the vitelline follicles. Sometimes caecum of one side may be slightly longer than the other. Gonads very closely situated; their position greatly variable in relation to one another. Testes obliquely situated and ovary is post-testicular. Vesicula seminalis variously coiled. Uterus intercaecal and post acetabular, metraterm present. Vitellaria occupying middle portion of body, covering 1/5th to 1/4th body length. Excretory vesicle 'Y' shaped, capable of changing with contraction or extension of body.

Key to the species of the genus *Ganeo*

- | | |
|--|--------------------|
| 1. Pseudocirrus sac present | 2 |
| Pseudocirrus sac absent | 4 |
| 2. Ventral sucker smaller than oral sucker | 3 |
| Ventral sucker equal to oral sucker | <i>G. africana</i> |

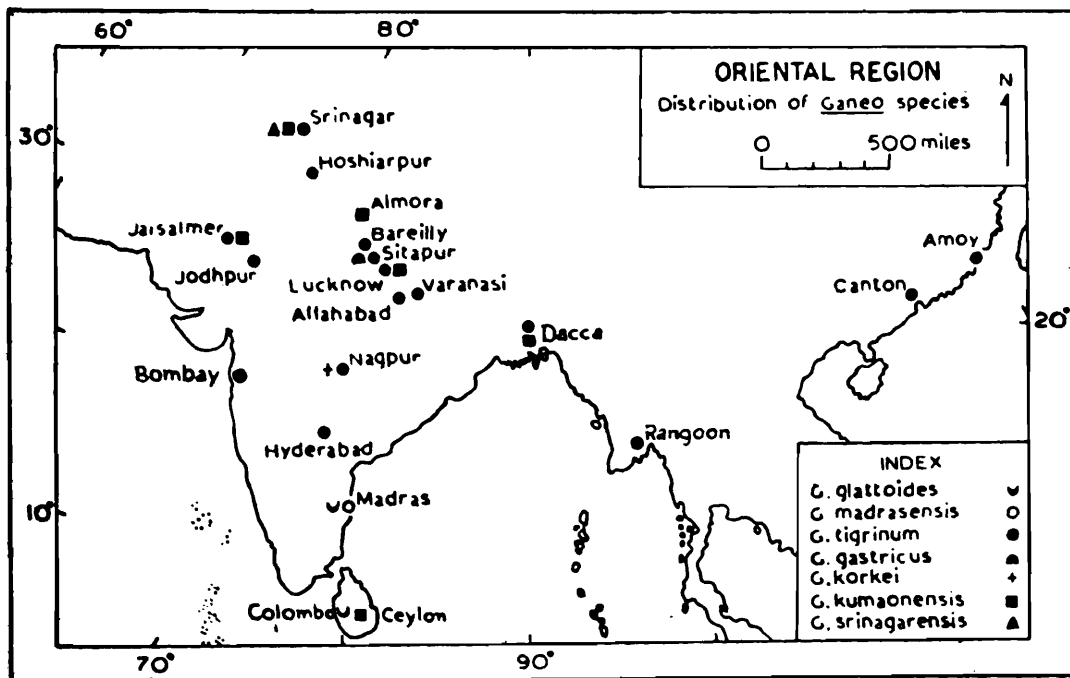
Key to the species of the genus *Ganeo* (cont.)

- | | |
|--|-------------------------|
| 3. Gonads entirely behind the ventral sucker,
and arranged in a triangular fashion. | <i>G. madrasensis</i> |
| Gonads arranged in linear fashion,
extending from pre to post acetabular
region | <i>G. glottoides</i> |
| 4. Testes one on each side | 5 |
| Testes obliquely situated | 6 |
| 5. Testes almost preacetabular, ovary behind the right testis | <i>G. gastricus</i> |
| Testes almost postacetabular, ovary between the testes | <i>G. srinagarensis</i> |
| 6. Vitellaria covering 1/5th to 1/4th of body length | <i>G. tigrinum</i> |
| Vitellaria covering nearly 1/3rd of body length | 7 |
| 7. Vitellaria occupying 1/3rd of body length | <i>G. kumaonensis</i> |
| Vitellaria occupying less than 1/3rd of body length | <i>G. korkei</i> |

Host and Geographical distribution of the genus *Ganeo*.

Almost all the species are parasites of frogs (*Rana*: Ranidae). In a few cases they have been reported from toads (*Bufo* : Bufonidae). *Ganeo tigrinum* has been recorded once from a piscine host, *Wallago attu* and on another occasion from a reptilian host, *Chamaeleon zeylanicus*.

Geographically the genus *Ganeo* is known practically from the Oriental Region (Text-fig. 2) with the exception of *G. africana* and *G. glottoides* occurring in Africa (Ehtiopian Region). The report of *G.*



Text-fig. 2. Map showing geographical distribution of *Ganeo* spp. in Oriental Region.

glottoides from Athieme (Dahomey) on the south western coast of Africa is interesting as this species is known from Tamil Nadu (southern India) and Sri Lanka. *Ganeo tigrinum* is the most widely distributed species occurring from eastern to the western limits of the Oriental Region.

SUMMARY

Ganeo glottoides of Bhalerao (1926), *G. attenuatum* Srivastava (1933), *G. lingnanensis* Li (1938), *G. gobindia* Dayal & Gupta. (1953), *G. panjabensis* Gupta (1954) and *G. bufonis* Fotedar (1959) have been considered synonyms of *G. tigrinum* Mehra & Negi, 1928.

Emended diagnosis of *G. tigrinum* has been furnished.

Certain discrepancies in the description of *G. korkei* Bhalerao, 1926 have been pointed out.

Probability of synonymy between *G. korkei* and *G. kumaonensis* has been hinted.

Ganeo tigrinum of Fotedar (1959) and *G. gazipurensis* Pandey & Chakrabarti (1968) have been assigned to *G. kumaonensis*.

Host and Geographical distribution of the genus *Ganeo* have been studied.

ACKNOWLEDGEMENT

The author is thankful to the Director, Zoological Survey of India, Calcutta for the facilities and suggestions during this work.

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STUDIES ON THE AMPHIBIAN TREMATODES FROM TAMIL NADU AND KERALA

By

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INTRODUCTION

Mukherjee and Ghosh (1970; 1972) reported on the Amphibian trematodes collected from West Bengal, Uttar Pradesh and Maharashtra. Very little work has been done on the Amphibian trematodes of Kerala and Tamil Nadu. Hence the present communication on the Amphibian trematodes from Tamil Nadu and Kerala. The collections were made in the course of the faunistic survey to Tenmalai, Punalur, Andoorpacha, Kulathupuzha of Kerala State and Madras, Courtalam, Schencottah of Tamil Nadu recently undertaken by this department. The detailed descriptions of the species are not given as most of them have been already dealt with. This paper includes relevant references, material examined, distributional range and the variations observed. The parasites were washed in saline, fixed in F.A.A. under cover glass pressure, stained in alum caramine and mounted in Canada balsom.

SYSTEMATIC ACCOUNT

Family 1. LECITHODENDRIDAE Odhner, 1910

Subfamily 1. PLEUROGENETINAE Looss, 1899

1. *Pleurogenoides gastropus* (Luhe, 1910)

1901. *Pleurogenes gastropus* Luhe, *Zentbl. Bak. Parasitkde. Abt.*, 30 (4): 166.

Material. —8 exs. (i) 2 exs. from the intestine of *Rana tigrina*, Madras 10.10.73. (ii) 2 exs., from the intestine of *Rana cyanophlyctis* Courtalam, 12.11.73. (iii) 1 ex. from the intestine of *Rana tigrina*, Punalur, 15.11.73. (iv) 1 ex. from the intestine of *Rana tigrina* Poonamalle, 11.10.73. (v) 1 ex. from the intestine of *Rana cyanophlyctis*, Thiruvannamayar, 12.10.73. (vi) 1 ex. from the intestine of *Rana cyanophlyctis*, Kunrathur, 9.10.73.

Distribution.—Uttar Pradesh, Maharashtra and West Bengal (Mukherjee and Ghosh 1972), Andhra Pradesh (Simha 1958), Madras, Poonamalle, Thiruvannamayur, Kunrathur and Kourtalam in Tamil-Nadu, Punalur (Kerala).

Remarks.—This species is reported from different parts of North India. This is the first report of the species from Tamil Nadu and Kerala. Mukherjee and Ghosh (1972) reported it from *Rana tigrina* and *Rana cyanophlyctis* in Uttar Pradesh, Maharashtra and West Bengal. Simha (1958) recorded the same from a reptilian *Chamaeleon zeylanicus* from Hyderabad (A.P.)

Subfamily 2. GANEONIAE Yamaguti, 1958

2. *Ganeo tigrinum* Mehra and Negi, 1928.

1928. *Ganeo tigrinum* Mehra and Negi, *Allahabad Univ. Stud.*, 4 : 63.

Material.—10 exs. (i) 5 exs. from the intestine of *Rana tigrina*, Madras; 21.11.73. (ii) 3 exs. from the intestine of *Rana cyanophlyctis* Courtalam, 4.12.73. (iii) 2 exs. from the intestine of *Rana cyanophlyctis*, Kunrathur, 15.12.73.

Distribution.—Madras. Kunrathur. Courtalam and Courtalam in Tamil Nadu. Uttar Pradesh, Maharashtra and West Bengal (Mukherjee and Ghosh 1972). Hyderabad (A.P.) (Simha 1958). So far it has not been recorded from Madras.

Family 2. PARAMPHISTOMATIDAE Fishoeder, 1901

Subfamily 3. DIPLODISCINAE Cohn, 1904

3. *Diplodiscus amphichrus* Tubangui, 1973

Material.—10 exs., (i) 6 exs. from the rectum of *Rana tigrina*, Kunrathur 15.10.73. (ii) 2 exs. from the rectum of *Rana tigrina* Kunrathur, 12.11.73. (iii) 2 exs. from the rectum of *Rana tigrina*, Courtalam 13.11.73. (iv) 2 exs. from the rectum of *Rana tigrina*, Madras. 12.10.73.

Distribution.—Uttar Pradesh, Maharashtra and West Bengal (Mukherjee and Ghosh 1972). Madras, Kunrathur and Courtalam in Tamil Nadu. Punalur (Kerala)

Family 3. PLAGIORCHIDAE Ward, 1917

4. *Tremiorchis ranarum* Mehra and Negi, 1925

1925. *Tremiorchis ranarum* Mehra and Negi, *Parasit*, 18 (2) : 168.

Material.—12 exs. (i) 2 exs. from the Intestine of *Rana cyanophlyctis* Punalur, 10.11.73. (ii) 5 exs, from *Rana tigrina*, intestine, Courtalam, 15.11.73. (iii) 3 exs. from the intestine of *Rana cyanophlyctis* Kunrathur

& Madras. 10.9.73 (iv) 2 exs. from the intestine of *Rana cyanophlyctis*, Kulathupuzha 9.11.73.

Distribution.—Uttar Pradesh, Maharashtra and West Bengal (Mukherjee and Ghosh 1970; 1972). Punalur and Kulathupuzha in Kerala, Madras, Kunrathur, Courtalam in Tamil Nadu.

Remarks.—This species is distributed widely and its incidence was recorded in almost all the frogs.

Family 4. LECITHODENDRIIDAE Odhner, 1910

Subfamily 5. PROSTOCINAE Yamaguti, 1958

5. *Mehraorchis ranarum* Srivastava, 1934

1934. *Mehraorchis ranarum* Srivastava, *Bull. Acad. Sci. U.P. Allahabad*, 3 (4) : 239.

Material.—5 exs. (i) 2 exs. from the intestine of *Rana tigrina*, Punalur 10.11.73. (ii) 3 exs. from the gall Bladder of *Rana tigrina*, Tenmala 14.11.73. (iii) 1 ex. from the intestine of *Rana tigrina*, Madras 12.11.73.

Distribution.—Uttar Pradesh, Maharashtra and West Bengal (Mukherjee and Ghosh 1970; 1972). Punalur, Tenmala and Andoor Pacha in Kerala. Madras in Tamil Nadu.

Remarks.—In all these specimens ovary was post acetabular vitellaria diffusely distributed in anterior part. Apart from the other two members *Ganeo* and *Pleurogenoides* of this family Lecithodendriidae this specimen shows the extracaecal bile duct.

Family 5. HEMIURIDAE Lühe, 1901

Subfamily 6. HALIPEGINAE Ejsmout, 1931

6. *Halipegus mehransis* Srivastava, 1933.

1933. *Halipegus mehransis* Srivastava, *Bull. Acad. Sci. U. P. Allahabad* 3 (1) : 42.

Material.—4 exs. from the stomach of *Rana cyanophlyctis*, Madras, 10. 10. 1973. (ii) 2 exs. from the intestine of *Rana tigrina*, Punalur 1. 12. 73.

Distribution.—Uttar Pradesh, Maharashtra and West Bengal (Mukherjee and Ghosh, 1970; 1972). Madras (Tamil Nadu). Punalur (Kerala).

Family 6. PLAGIORCHIIDAE Ward, 1917

Subfamily 7. HAEMATOLECHINAE Yamaguti, 1958.

7. *Haematolechus almorai* Pande, 1973

1937. *Pneumonaeces almoraj* Pande, *Proc. Indian Acad. Sci.*, 6 : 114.

Material.—4 exs. from the lungs of *Rana cyanophlyctis*. Madras. 12.12.73. (ii) 2 exs. from the lungs of *Rana cyanophlyctis*, Kovelong 14.12.73. (iii) 1 ex. from the lungs of *Rana cyanophlyctis*, Punalur 10.11.1973.

Distribution.—Sitapur, Barielly (U.P.) Ramtek (Maharashtra) West Bengal (Mukherjee and Ghosh 1970, 1972). Punalur (Kerala) Madras, Kovelong (Tamil Nadu).

Family 7. BRACHIOCOELIDAE Jhonston 1912

Subfamily 8. MESOCOELINAE Dollfus 1929

8. *Mesocoelium sociale* Lühe, 1901

1901. *Distoma Sociale* Luhe, 1901, *Zentrbl. Bakt. Parasitkde Abt. 1* : 30 (4) : 171.

Material.—5 exs. (i) 3 exs. from the intestine of *Bufo melanostictus*. Courtalam, 8.11.73. (ii) 2 exs. from the intestine and stomach of *Bufo melanostictus*, Andoorpacha, 10.11.73.

Distribution.—Uttar Pradesh, West Bengal, Maharashtra, (Ghosh, & Mukherjee) Courtalam (Tamil Nadu). Andoorpacha (Kerala).

SUMMARY

The present paper deals with the various trematode parasites found in the Amphibians of Tamil Nadu and Kerala states with their distributional range.

ACKNOWLEDGEMENTS

My thanks are due to Dr. S. Khera, Deputy Director-in-Charge, Zoological Survey of India, Calcutta and Dr. A. G. K. Menon, Deputy Director, Officer-in-Charge, Southern Regional Station, Zoological Survey of India, Madras for encouragement and facilities. My thanks also due to Dr. K. C. Jayaramakrishnan, Superintending Zoologist for his keen interest in this work.

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THE ACRIDOIDEA (INSECTA : ORTHOPTERA) OF GOA

By

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(With 3 Text-figures)

INTRODUCTION

This report is based on two collections made by Shri K. S. Pradhan in 1966 and Shri T. D. Soota in 1970, comprising about 172 exs. from Union Territory of Goa. The list includes 21 species distributed over 17 genera and 2 families. For list of collecting localities and map of Goa reference may be made to Tilak, (1969)*.

We are grateful to Dr. S. Khera, Joint Director-in-Charge, Zoological Survey of India, Calcutta for his encouragement and to the collectors of this interesting material.

Key to the genera represented in the collection examined from Goa

1. Head acutely conical, with incurved frons, fastigial furrow present. External apical spine of hind tibia absent, lower basal lobe of hind femur usually longer than upper .2
- Head variable in shape, fastigial furrow absent, fully winged or with reduced wings or rarely apterus. Tympanum usually present. External apical spine of hind tibia present or absent, lower basal lobe of hind femur usually shorter than upper one .3
2. Pronotum above with posterior angles of lateral lobes spread sidewise, (Text-fig. 1a) strongly tuberculate, protruding from under pronotum even when vestigial. Male supra anal plate angular (Text-fig. 1b), cercus short obtusely conical (Text-fig. 1c), epiphallus with acutely curved large lophi (Text-fig. --1d) *Chrotogonus* Serville
- Pronotum elongate, subcylindrical, slightly widening backwards, crossed by three sulci, elytra and wings fully developed. Last abdominal sternite of normal

* TILAK, R. 1969. A study of the freshwater and Estuarine fishes of Goa. 2. Notes on the Fishes found within the territory of Goa.—*Rec. zool. Surv. India*.—67 (1-4) : 87—120.

- shape, Male supra anal plate elongate trigonal, cercus short subconical straight with subacute apex, epiphallus with middle portion anchor shaped (Text-fig. 1f) *.Atractomorpha* Saussure
3. Prosternal spine present .4
 — Prosternal spine absent .11
4. Radial area of elytron with series of regular parallel stridulatory veinlets .. 5
 — Radial area of elytron without stridulatory veinlets .6
5. Antennae long extending to posterior margin of pronotum or beyond. Pronotum without lateral carinae (Text. fig-1g) *.Gesonula* Uvarov
 — Antennae short, do not extend to posterior margin of pronotum. Pronotum with distinct lateral carinae (Text-fig. 1h) *.Spathosternum* Karsch
6. Lower external lobe of hind knee with spine like apex ..*Oxya* Serville
 — Lower external lobe of hind knee with apex rounded, angular or subacute but not spine like 7
7. Mesosternal lobes rounded or obtuse angular or acute angular but not rectangular 8
 — Mesosternal lobes rectangular .10
8. Dorsum of pronotum flat or weakly tectiform with median and lateral carinae linear. Male cercus with strongly compressed, lobiform or subacute downcurved apex .9
 — Dorsum of pronotum of variable shape, lateral carinae, if present not linear. Male cercus variable. Prosternal spine cylindrical, bluntly rounded, mesosternal lobes contiguous .. *.Catantops* Schaum
9. Hind femur moderately long, slightly produced beyond end of abdomen, not inflated in basal and not strongly narrowing in apical half. Hind tibia with narrow spines. Pronotum with distinct carinae, dorsum mostly with dark longitudinal spot (Text-Fig. 2f) ...*Eyprepocnemis* Fieber
 — Hind femur long, produced far beyond end of abdomen, inflated in basal and narrowing in apical half, hind tibia with dense spines. Male cercus narrow with acute apex (Text-fig. 2g) *.Tylotropidius* Stål
10. Tegmina with oblique venation in apical part, transverse veins situated obliquely to principal veins (Text-fig. 3d). Male cercus elongate, conical with acuminate apex, male subgenital plate acuminate, apex pointed *.Pachyacris* Uvarov
 — Tegmina with straight venation in apical part transverse veins forming almost right angle with principal veins (Text-fig. 3e). Male cercus short not reaching beyond the supra anal plate, narrow at base, conical with obtuse apex, male subgenital plate long, curved upwards conical, apex pointed. ...*Patanga* Uvarov

11. **Body sturdy, frons vertical, integument mostly rugose. Tegmina with intercalary vein, at least in the male well developed, serrate, forming the file of stridulatory mechanism** .12
 — **Body slender, compressed laterally, frons oblique. Tegmina without stridulatory mechanism. Tarsi with a large wide empodium between the claws** *Acrida* Linnaeus
12. **Median carina of pronotum distinct and cut by one transverse groove** .13
 — **Median carina of pronotum cut by two grooves** .16
13. **Pronotum short** .14
 — **Pronotum long** .15
14. **Pronotum above with light X-shaped pattern** *Oedaleus* Fieber
 — **Pronotum above without X-shaped pattern** *Pternoscirta* Saussure
15. **Pronotum with strong crest and posterior margin elongate and strongly acute angular** ... *Gastrimargus* Saussure
 — **Pronotum with distinct median carina and with numerous longitudinal ridges** *Morphacris* Walker
16. **Pronotum distinctly angular with well-marked crest which when view in profile is strongly bilobed in front (Text-fig. 31)** *Trilophidia* Stål
 — **Pronotum very short with widely rounded posterior margin (Text-fig. 3i)** *Acrotylus* Fieber

TAXONOMIC ACCOUNT

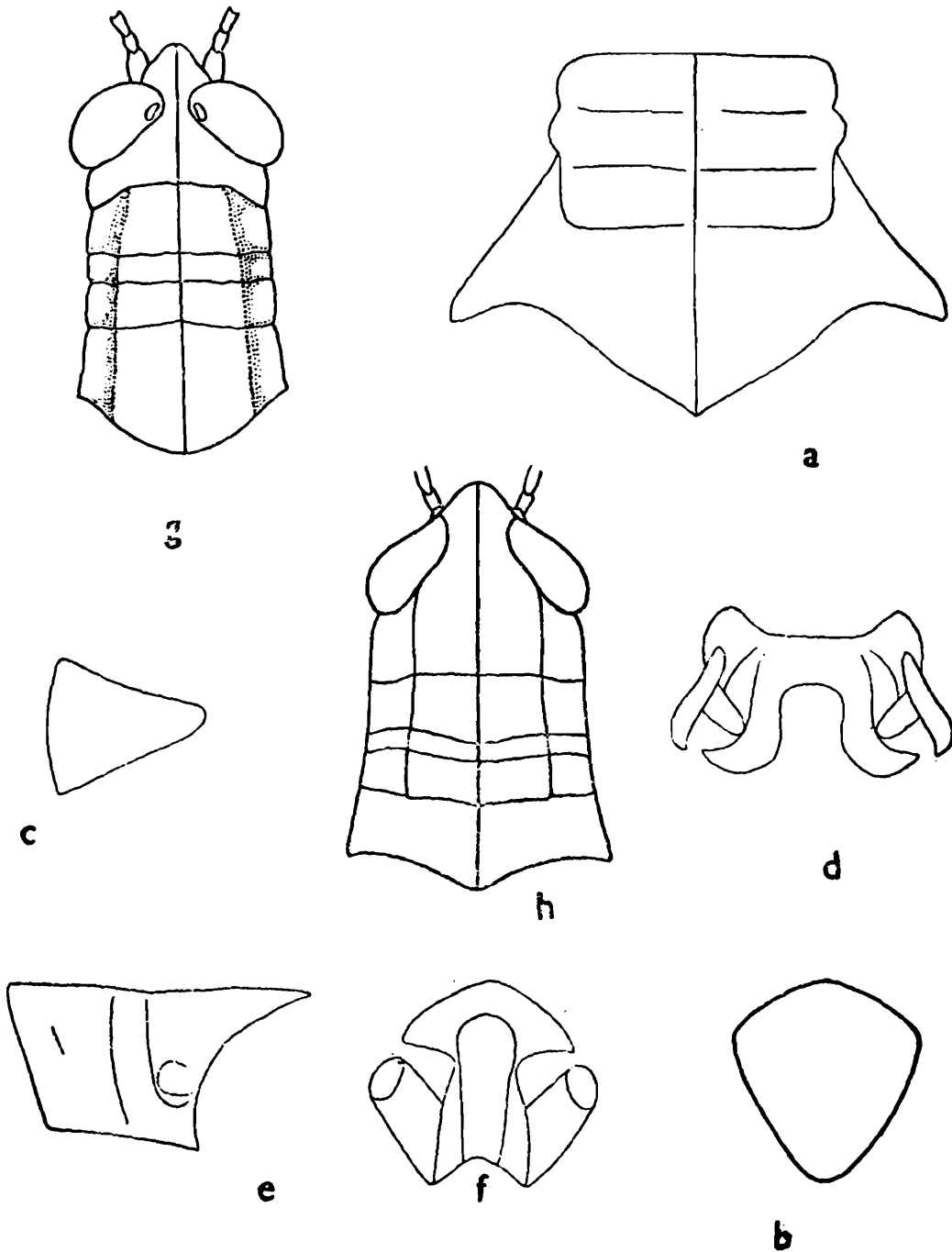
Family PYRGOMORPHIDAE

1. *Chrotogonus* (*Chrotogonus*) *oxypterus* (Blanchard)

1798. *Gryllus scaber* Fabricius, *Suppl. Ent. syst.* : 196, no. 62-3 (nec. Gmelin, 1788).
 1836. *Ommexecha oxypterus* Blanchard, *Ann. Soc. ent. Fr.*, 5 : 622
 1959. *Chrotogonus* (*Chrotogonus*) *oxypterus*: Kevan, *Publ. cult. Comp. Diam.* Angola, no. 43 : 48.

Material.—25 exs.: Goa, Margao (Fatorda), 21.iii.1966 (1♂ and 1♀), 23.iii.1966 (1♀), 31.iii.1966 (IN and 2♂♂); Old Goa, 27.iii.1966 (3♀♀); Collem, 3.iv.1966 (4♂♂ and 7♀♀); Sanguem, 5.iv.1966 (1♀); Canacona, 6.iv.1966 (1♀); Margao, 7.iv.1966 (1♂); Veluz, Valpoi Nagargaon, 13.iv.1966 (1♂); Colva Road 14.iv.1966 (1♂); Nuvem, Majorda, 20.iv.1966 (1♀).

Remarks.—This species is widely distributed in southern and central India to Bombay on west, north east to West Bengal and Bangladesh and has been known to feed upon the plants of paddy, wheat and coffee. It can easily be distinguished by its characteristic large and broad head and infumated to dark fuscous hind wings.

2. *Atractomorpha crenulata* (Fabricius)1793. *Truxalis crenulata* Fabricius, *Ent. Syst.* 2 : 28.1971. *Atractomorpha crenulata* : Kevan and Tandon, *Ent. mon. Mag.*, 107 : 216,*Material.*—16 exs.: Goa, Margao, 23.iii.1966 (2♀♀), 25.iii.1966 (2♀♀), 2.iv.1966 (1♀); Vasco, 9.iv.1966 (2♀♀); Colva Road, 14.iv.1966

Text-fig. 1 a-d. *Chrotogonus* (*Chrotogonus*) *oxypterus* (Blanchard); a, pronotum, dorsal view; b, Male supra-anal plate, dorsal view; c, Male cercus, lateral view; d, Male epiphallus; e-f. *Atractomorpha crenulata* (Fabricius); e, Pronotum, (lateral view); f, Male epiphallus. g. *Gesonula punctifrons* (Stal); Head and Pronotum, dorsal view; h. *Spathosternum prasiniferum prasiniferum* (Walker); Head and Pronotum, dorsal view.

(2♀); Nuvum, Majorda, 20.iv.1966 (1♀); Collem, 3.iv.1966 (1♀); Valpoi, 21.xii.1970 (2♂♂), Partagl village, 25.xii.1970 (1♀).

Remarks.—Distributed widely in India and in the neighbouring Indo-Malayan subregion. The size and colour of this species is extremely variable, specimens from Goa are similar in shape and colour when compared to the examples from peninsular India. It can easily be separated by generally slender body form, fastigium of vertex rather short, longer tegmina and in having a well developed membranous area near the posterior margin (Text-fig. 1e). It feeds upon variety of hosts.

Family ACRIDIDAE

Subfamily HEMIACRIDINAE

3. *Gesonula punctifrons* (Stål)

1861. *Acridium (Oxya) punctifrons* Stål, *Eugenies Resa, Orth.*, : 336.

1955. *Gesonula punctifrons* : Willemse, *Publ. natuurhist Gen. Limburg*, 8 : 161.

Material.—3 exs.: Goa, Valpoi, 21.xii. 1970 (3♂♂).

Remarks.—Recorded earlier from Calcutta (West Bengal), Ledo (Assam), Coimbatore, Madurai and Nedungadun (Tamilnadu). This species occurs in mixed habitat of grass and low vegetation and feeds on paddy and allied crops. It can easily be identified by the characteristic wide vertex in both sexes (Text-fig. 1g), mesonotum with a rather narrow space between the lobes and dorsal valve of female ovipositor with small blunted teeth along the dorso-outer margin.

4. *Spathosternum prasiniferum prasiniferum* (Walker)

1871. *Heteracris prasinifera* Walker, *Cat. Derm. Salt. Brit. Mus.*, 5 : 65.

1952. *Spathosternum prasiniferum prasiniferum* : Mishchenko, *Fauna S.S.S.R.*, 4, no. 2 : 127.

Material.—19 exs.: Goa, Canacona, 6. iv. 1966 (1♂); Concalim, 6. iv. 1966 (1♂), Margao, 7. iv. 1966 (1♂), 10. iv. 1966 (1♂); Bicholim, 10. iv. 1966 (2♂♂); Colva Road, 14. iv. 1966 (1♂); Nandre, 16. iv. 1966 (1♀); Marmagoa Harbour, 18. iv. 1966 (1♂); Ponda, 1.xii. 1970 (1♂ and 1♂); Marmagoa harbour, 5.xii. 1970 (1♂ and 2♀♀); Naturlin village (5♂♂)

Remarks.—This species occurs throughout India and Indo-Malayan subregion. It has also been reported from south eastern China. It lives in the grassy habitats and can easily be separated from *Spathosternum prasiniferum sinense* Uvarov, in having well developed tegmina reaching distal end of hind femora or slightly beyond it, wing well developed.

Subfamily OXYINAE

5. *Oxya fuscovittatus* (Marschall)

1836. *Gryllus fuscovittatus* Marschall, *Annln. wien. Mus. Naturg.*, 1 : 211.
 1971. *Oxya fuscovittatas* Hollis, *Bull. Br. Mus. nat. Hist. (Ent.)*, 26 (7) : 289.

Material.—2 exs.: Goa, Tarvala, Margao. 11. iv. 1966 (1♂), Concalim, Margao, 6. iv. 1966 (1♂).

Remarks.—Recorded earlier from southern, north west and north east India. This species is a well known pest of rice in various countries. It can easily be distinguished by laterally compressed, weakly bifurcate male cercus (Text-fig. 2 a) and ventral surface of subgenital plate in female almost completely flat or weakly concave.

6. *Oxya hyla hyla* Serville

1831. *Oxya hyla* Serville, *Ann. Sci. Natur.*, 12 : 287.
 1971. *Oxya hyla hyla* : Hollis, *Bull. Br. Mus. nat. Hist. (Ent.)*, 26(7) : 282.

Material.—1 ex.: Goa, Margao, 11. iv. 1966 (1♀).

Remarks.—This species is widely distributed in different parts of Indian subcontinent and Africa. It is variable in its general appearance and can easily be identified in having ventral surface of subgenital plate in female with two longitudinal ridges extending forwards from posterior margin, these ridges often toothed (Text-fig. 2 b).

7. *Oxya japonica japonica* (Thunberg)

1824. *Gryllus japonicus* Thunberg, *Mem. Acad. Sci. St. Petrsb.*, 9 : 429.
 1971. *Oxya japonica japonica* : Hollis, *Bull. Br. Mus. nat. Hist. (Ent.)*, 26 (7) : 302.

Material.—3 exs.: Goa, Concalim, Margao, 6.iv.1966 (1♀); Vasco (Margao), 15.iv.1966 (2♀♀).

Remarks.—This subspecies is widely distributed in India and Indo-Malayan region. It has also been reported from Andaman Islands. *O. japonica japonica* is variable in size, relative length of tegmina and in the form of male cercus. It can easily be distinguished in female by the lateral longitudinal ridges on ventral surface of subgenital plate without spines except at apices (Text-fig. 2c).

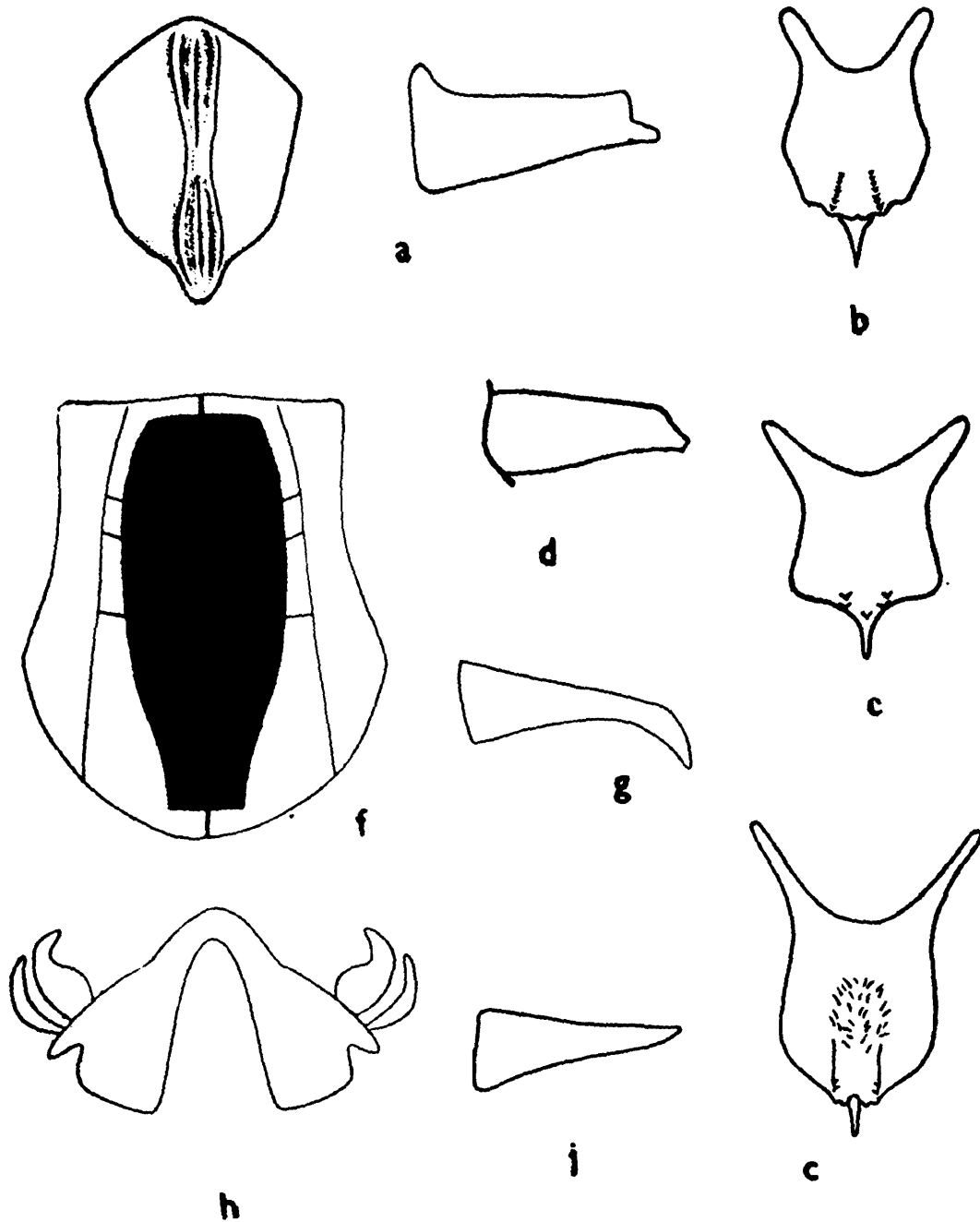
8. *Oxya nitidula* (Walker)

1870. *Acridium nitidulum* Walker, *Cat. Derm. Salt. Brit. Mus. London*, IV : 631.
 1971. *Oxya nitidula* : Hollis, *Bull. Br. Mus. nat. Hist. (Ent.)*, 26(7) : 315.

Material.—3 exs.: Goa: Margao (Fatorda), 23.iii. 1966 (1♀); Concalim (Margao), 6.iv. 1966 (1♀), Margao, 15.iv. 1966 (1♂).

Remarks.—Recorded earlier from South India and Ceylon. *O. nitidula* is very similar to *O. japonica* but can easily be separated from

the latter by the truncate apex of the male cercus (Text.-fig. 2d) and in having a subapical tooth on each side of a median apical spine on the ventral surface of subgenital plate in female (Text.-fig. 2e).



Text-fig. 2-a. *Oxya fuscovittata* (Marschall); Male cercus, lateral view; b. *Oxya hyla hyla* Serville; Female subgenital plate, ventral view; c. *Oxya japonica japonica*; Female subgenital plate, ventral view; d-e. *Oxya nitidula* (Walker); d, Male cercus, lateral view; e, Female subgenital plate, ventral view; f-h. *Eyprepocnemis alacris alacris* (Serville); f, Pronotum dorsal view; g, Male cercus, lateral view; h, Male epiphallus; i-j. *Tylotropidius varicornis*; i, Male supraanal plate, dorsal view; j, Male cercus, lateral view.

Subfamily EYPREPOCNIMIDINAE

9. *Eyprepocnemis alacris alacris* (Serville)

1893. *Acridium alacre* Serville, *Hist. Nat. Ins. Orth.*, : 682.

1958. *Eyprepocnemis alacris alacris* : Dirsh, *Proc. R. ent. Soc. Lond.*, (13) 27 (3-4) : 40.

Material.—1 ex.: Veluz, Valpoi Nagargaon, 13.iv. 1966 (1♂).

Remarks.—This is a typical species of the genus with a wide distribution in Northern, Southern and Eastern India. It has also been reported from Pakistan, Afghanistan, Bangladesh and Ceylon. It can easily be separated from other members of genus in having bluish grey hind tibia, with two whitish rings at the base and reddish apex and tarsus; male cercus gradually narrowing towards apex incurved and downcurved, with acute apex (Text-fig. 2 g) and the shape of male epiphallus (Text-fig. 2h).

10. *Tylotropidius varicornis* (Walker)

1870. *Heteracris varicornis* Walker, *Cat. Derm. Salt. Brit. Mus. (nat. Hist.)*, IV : 667.

1921. *Tylotropidius varicornis* : Uvarov, *Trans. R. ent. Soc. Lond.*, : 136.

Material.—20 exs.: Goa, Anja Diu, 13.xii. 1970 (1♂); Khawat village 14.xii. 1970. (3♂♂ and 2♀♀); Partagl village, 15.xii. 1970 (1♂); Sishorh village, 13.xii. 1970 (6♂♂). Banmag village, 20.xii. 1970 (6♂♂ and 2♀♀)

Remarks.—This species has been recorded mainly from South India, Burma and Ceylon. This species can easily be distinguished by bituberculate prosternal spine, elytra with semi-transparent membrane having a row of triangular whitish spots upon the radial nervure, male supra anal plate elongate triangular (Text-fig. 2 i) sulcated and male cercus slightly compressed in apical part, acuminate (Text-fig. 2j).

Subfamily CATANTOPINAE

11. *Catantops henryi* I. Bolivar

1918. *Catantops henryi* I. Bolivar, *Rev. Acad. Madrid*, 16 : 404.

1956. *Catantops henryi* : Dirsh, *Publ. Cult. Comp. Diam. Angola*, no. 28 : 90.

Material.—5 exs : Old Goa, 27.iii. 1966 (1♂); Aralem, 28.iii. 1966 (1♂); Canacona, 6.iv. 1966 (1♀); Suctalem, 16.iv. 1966 (1♀); Mahalvasa 16.xii. 1970 (1♂).

Remarks.—This species occurs all along the western coast of India and has also been recorded from upper Burma. *Catantops henryi* can easily be distinguished by two broad incomplete black fasciae on external side of hind femur (Text-fig. 3 a) and moderately robust male cercus (Text-fig. 3 b), broadened in the base, almost straight, with bifurcate apex, the internal-upper lobe short, with rounded apex.

12. *Catantops pinguis innotabilis* (Walker)

1870. *Acridium innotabile* Walker, *Cat. Derm. Salt. B. M.*, IV : 629.
 1956. *Catantops pinguis innotabilis* Dirsh, *Publ. Cult. Comp. Diam. Angola* no. 28 : 105.

Material.—5 exs.: Goa Marmogoa harbour, 22.iii. 1966 (1♀), Old Goa, 27.iii. 1966 (1♀); Caisua Fort, 29.iii. 1966 (1♀); Marmogoa, 18. iv. 1966 (1♂); Marmogoa harbour 2.xii. 1970 (1♂ and 1♀).

Remarks.—This species is widely distributed in Indian subcontinent. It is very variable in size, colour pattern and in the shape of male cercus. Male cercus normally with widened, slightly hammer shaped apex (Text-fig. 3c).

Subfamily CYRTACANTHACRIDINAE

13. *Pachyacris vinosa* (Walker)

1870. *Acridium vinosum* Walker, *Cat. Derm. Salt. B. M.*, 3 : 588.
 1923. *Pachyacris vinosa* : Uvarov, *Ann. Mag. nat. Hist.* 9(XI) : 478.

Material.—2 exs.: Goa, Margao (Fatorda), 23.iii. 1966. (1♂ and 1♀).

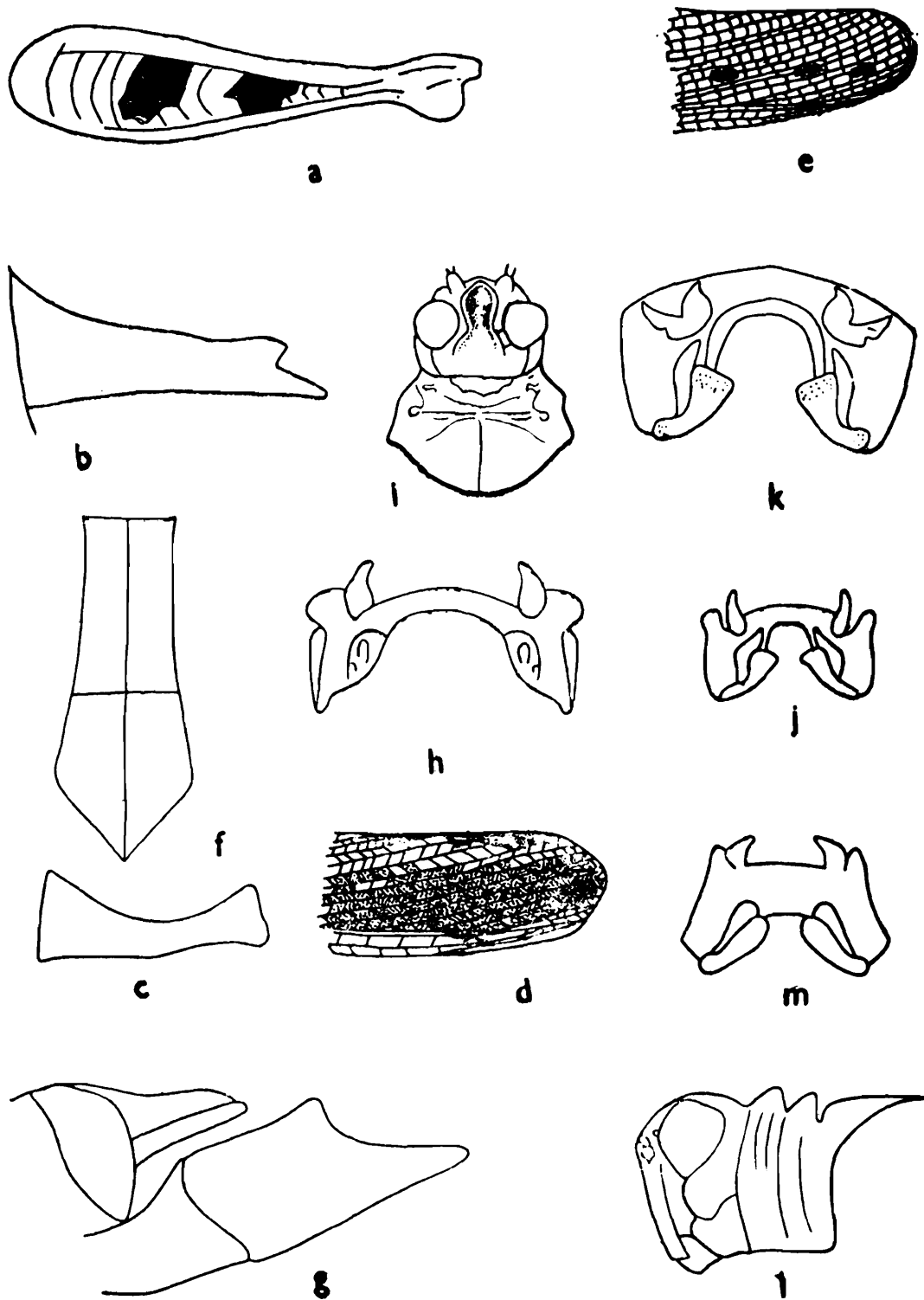
Remarks.—This species is fairly well distributed in India. Recorded earlier from Kumaon hills (U.P.), Chakardharpur (Orissa), Chota nagpur (Bihar), Mohanpur, pukur (West Bengal), Aijal, Lushai Hills, (Assam). *P. vinosa* has also been known from Burma, western and south eastern china. It can easily be indentified in having tegmina with oblique venation in apical part, transverse vein situated obliquely to principal veins (Text-fig. 3d), mesosternum in the female with a trapezoidal space between the lobes and male cercus elongate conical with acuminate apex.

14. *Patanga succincta* (Johansson)

1763. *Gryllus Locusta succinctus* Johansson, *Amoen. Acad. VII Centur. Ins. rarior.*, : 398.
 1923. *Patanga succincta* Uvarov : *Ann. Mag. nat. Hist.* 9(XII) : 364, 365.

Material.—2 exs.: Goa, Mangeshi, 27.iii. 1966 (1♂ and 1♀).

Remarks.—*Patanga succincta* is popularly known as Bombay Locust and is widely distributed throughout plains of Indian subcontinent and all over south and south eastern Asia and Malayan Archipelago. This species can easily be distinguished in having tegmina with a straight venation in apical part, transverse veins forming almost right angle with principal veins (Text-fig. 3e), wing base rosy violet or colourless, apically colourless, male subgenital plate long, curved upwards, conical, apex pointed.



Text-fig. 3 a-b. *Catantops henryi* I. Bolivar; a, Hind-femur, external side; b, Male cercus, lateral view; c. *Catantops pinguis innotabilis* (Walker); Male cercus, lateral view; d. *Pachyacris vinosa* (Walker); Elytra, apical part; e. *patanga succincta* (Johansson); Elytra, apical part; f.-h. *Acrida exaltata*; f, Pronotum, dorsal view; g. Male subgenital plate in profile; h, Male, epiphallus; i-j. *Acrotylus humbertianus* Saussure; i, Head and Pronotum, dorsal view, j, Male epiphallus; k. *Gastrimargus africanus orientalis* Sjostedt; Male, epiphallus; l-m. *Trilophidia annulata*; l, Pronotum in profile; m Male, epiphallus.

Subfamily ACRIDINAE

15. *Acrida exaltata* (Walker)

1859. *Truxalis exaltata* Walker, *Ann. Nat. Hist.*, 4 : 222.

1954. *Acrida exaltata* : Dirsh, *Bull. Soc. Fouad. Ent.*, 38 : 149.

Material.—7 exs. : Goa, Mercas, 24.iii. 1966 (2♂♂); Collem, 3.iv. 1966 (2♂♂ and 1♀); Veluz Valpoi, 13.iv. 1966 (1♂); Satpali village, 26.xi. 1970 (1♀).

Remarks.—This species is widely distributed throughout plains and hilly regions of Indian subcontinent. It has also been reported from south east Tibet, Afghanistan, south east Iran and middle east countries. *Acrida exaltata* varies in size and general colouration from uniformly green to ochraceous and brownish. It can easily be recognised by comparatively slender pronotum (Text-fig. 3f) pronotal disc, relatively narrow, head less robust, male subgenital plate in profile short (Text-fig. 3g) and the shape of male epiphallus (Text-fig. 3 h).

Subfamily OEDIPODINAE

16. *Acrotylus humbertianus* Saussure

1884. *Acrotylus humbertianus* Saussure, *Mém. Soc. Genève*, xxviii (9) : 189.

Material.—4 exs. : Goa, Mangeshi (Panjim), 27.iii. 1966 (1♂); Margao, 2. iv. 1966 (1♂); Veluz Valpoi, 13. iv. 1966 (1♀); Kodal Valpoi, 13.iv. 1966 (1♀).

Remarks.—This species is fairly well distributed all over Indian subcontinent and Ceylon. It can easily be identified by the following characters, Tegmina long, extending beyond the middle of hind tibiae, wing base yellow with a wide incomplete dark band and the shape of male epiphallus (Text-fig. 3j).

17. *Gastrimargus africanus orientalis* Sjöstedt

1888. *Oedaleus* (*Gastrimargus*) *marmoratus* var. *africanus* Saussure, *Mem. Soc. Geneve*, 30 (1) : 39.

1951. *Gastrimargus africanus orientalis* Bei-Bienko and Mischenko, *Fauna, S.S.S.R.*, No. 40 : 581.

Material.—5 exs. : Goa, Caisua Fort uphill, 29.iii.1966 (1♂); Nandre, 16.iv. 1966 (2♂♂); Khawat village, 14.xii.1970 (2♂♂).

Remarks.—This species occurs from peninsular India to the north of Himalayas, Ceylon and southern Tibet. It can easily be distinguished in having pronotum without a distinct constriction, its median carina cut by the transverse sulcus, hind femora ventrally blue black and the shape of male epiphallus (Text-fig. 3k).

18. *Morphacris citrina* Kirby

1910. *Morphacris citrina* Kirby, *Syn. Cat. Orth.*, 3 : 219.

Material.—15 exs.: Goa, Margao, 22.iii.1966 (1N); Margao (Fatorda), 23.iii.1966 (2♂♂ and 2♀♀); 24.iii.1966 (2♂♂ and 1N); Arvalem, 29.iii.1966 (2♀♀); Collem, 3.iv.1966 (3♀♀); Colva Road, 14.iv.1966 (1♂); Nandre, 16.iv.1966 (1♂); Concalim, Margao, 6.iv.1966 (1♂).

Remarks.—This species is fairly well distributed in India and Ceylon and can easily be distinguished in having numerous longitudinal ridges on the pronotum. Wing light yellow at the base, bordered by dark black fasciae.

19. *Oedaleus abruptus* (Thunberg)

1815. *Gryllus abruptus* Thunberg, *Mèm. Acad. Petersb.*, 5 : 233.

1951. *Oedaleus abruptus* Bei-Bienko and Mishchenko, *Fauna S.S.S.R.*, No. 4:0 579.

Material.—2 exs: Goa, Calangute Beach, 29.iii.1966 (1♂ and 1♀).

Remarks.—This is a typical species of the genus with a wide distribution in Indian subcontinent from Himalayas to Kanya Kumari and has also been known from southern and central China. It can easily be distinguished by the light bands of the X-shaped markings of the pronotum situated on slightly raised ridges.

20. *Pternoscirta cinctifemur* (Walker)

1859. *Acidium cinctifemur* Walker, *Ann. Mag. nat. Hist.*, 4 (3) : 223.

1914. *Pternoscirta cinctifemur* Kirby, *Faun. Brit. India, Orth. Acrid.*, : 134.

Material.—2 exs.: Goa, Mercedes, 24.iii.1966 (1♂); Canacona uphill. 6. iv. 1966 (1♂).

Remarks.—Recorded earlier from southern India and Ceylon. It can easily be distinguished in having wings red at base, external side of hind femora buff or bluish grey, internal side black and banded with black above.

21. *Trilophidia annulata* (Thunberg)

1815. *Gryllus annulatus* Thunberg, *Mem. Acad. Sci. Sb. Petersb.*, 5 : 234.

1965. *Trilophidia annulata* Hollis, *Trans. R. ent. Soc. Lond.*, 117 (8) : 251.

Material.—29 exs.: Goa, Margao (Fatorda), 21.iii.1966 (1♂), 23.iii.1966 (1♂ and 1♀); Mercedes, 24.iii.1966 (1♂); Margao, 25.iii.1966 (1♂ and 1♀); Mangeshi, Panjim, 27.iii.1966 (1♂ and 2♀♀); Old Goa 27.iii.1966 (1♂); Arvalem, 28.iii.1966 (1♂); Caisua Fort, uphill, 29.iii.1966 (3♀♀); Barim bridge, 1.iv.1966 (1♂), 1.iv.1966 (2♀♀); Margao, 2.iv.1966 (1♂ and 1♀); Colem, 3.iv.1966 (1♀); Sanguem, 5.iv.1966 (1♀); Margao,

7.iv.1966 (1♂); Bicholim, 10.iv.1966 (1♂ and 1♀); Margao, 11.iv.1966 (1♀); Veluz Valpoi, 13.iv.1966 (1♀), 21.xii.1970 (2♀♀); Sanguem, 11.xii.1970 (1♂).

Remarks.—*Trilophidia annulata* is widely distributed in India. Its range of distribution extends from Pakistan to North Borneo and extends into Palaearctic region in Mongolia, China, Korea and Japan. This species is very variable in size and general colouration. It can easily be distinguished by the shape of the lophi of male epiphallus (Text-fig. 31).

SUMMARY

A comprehensive report of the Acridoidea fauna of Goa is given here for the first time, and is based on the collections made by parties of the Zoological Survey of India. In all 21 species belonging to 2 families and 17 genera are reported as follows:—

Family 1. PYRGOMORPHIDAE : *Chrotogonus*, *Atractomorpha*.

Family 2. ACRIDIDAE : *Gesonula*, *Spathosternum*, *Oxya*, *Eyprepocnemis*, *Tylotropidius*, *Catantops*, *Pachyacris*, *Patanga*, *Acrida*, *Acrotylus*, *Gastrimargus*, *Morphacris*, *Oedaleus*, *Pternoscirta*, *Trilophidia*.

A key to the identification of genera examined has also been provided.

FAUNA OF RAJASTHAN, INDIA—NEUROPTERA

By

S. K. GHOSH

Zoological Survey of India, Calcutta

INTRODUCTION

(a) General

The collection dealt with here includes specimens of Neuroptera from various localities of Rajasthan (from the districts of Bikaner, Jaipur, Jaisalmer, Jodhpur, Nagaur and Chittorgarh) and is brought by different survey parties of the Zoological Survey of India during the years 1958-61, 64-65.

This paper is important from the standpoint of Geographical distribution. This is the first attempt to study of Neuroptera hitherto unrecorded from Rajasthan. So, in this respect, all the species are new records from the area. Moreover, *Halter halterata* (Forsk.) is recorded for the first time from India.

(b) Acknowledgements

Author is grateful to Dr. A. P. Kapur, Ex-Director, Zoological Survey of India, Calcutta, for providing the necessary facilities throughout the work and to Sri K. S. Pradhan, Superintending Zoologist, Zoological Survey of India, Calcutta for his valuable suggestions and help.

List of Species Arranged Phylogenetically

Order Neuroptera

Family 1. Mantispidae

1. *Mantispa indica* Westw.

Family 2. Chrysopidae

2. *Chrysopa* sp.

Family 3. Nemopteridae

3. *Halter halterata* (Forsk.)
4. *Croce filipennis* Westw.

Family 4. Myrmeleonidae

5. *Acanthaclisis edax* (Walker)

6. *Centroclisis eustalacta* (Gerst.)
7. *Creoleon perfidus* (Walker)
8. *Myrmecaelurus acerbus* (Walker)
9. *Myrmecaelurus* sp.
10. *Palpares patiens* (Walker)
11. *Palpares nobilis* Navas
12. *Palpares pardus* (Rambur)
13. *Neuroleon guernii* Navas

SYSTEMATIC ACCOUNT

Family MANTISPIDAE

1. *Mantispa indica* Westw.

1848. *Mantispa indica* Westw., *Trans. R. ent. Soc. Lond.*, (N. S.), 1 : 268, fig. 5
 1853. *Mantispa indica* Walker, *Cat. Brit. Mus. Neur.* : 226.
 1909. *Mantispa indica* Needham, *Rec. Indian Mus.*, 3 : 195.
 1933. *Mantispa indica* Banks, *Indian For. Rec.*, 18 (6) : 2.

Material.—Jodhpur District : 1 ex., Jodhpur.

Distribution.—Rajasthan : Jodhpur Dist., U. P. : Kangra Valley; Mysore : Fraserpet; Assam : Sibsagar.

Family CHRYSOPIDAE

2. *Chrysopa* sp.

Material.—Nagaur District : 1 ex. : Nawa.

Family NEMOPTERIDAE

3. *Halter halterata* (Forsk.)

- Panorpa halterata* Forsk., *Descript Anim.*, 97, pl. 25, fig. 2.
 —*Nemoptera pallida* Oliv., *Enc. Meth.*, 8 : 179, 5, pl. 98, fig. 1.
 — „ „ Lam., *Hist. Nat. Anim. Invert.*, 4 : 419, 5.
 — „ „ Ram., *Hist. Nat. Ins. Neur.* : 335, 5, pl. 8, fig. 4.
 —*Nemopteryx africana* Leach, *Zool. Miscell.* 2 : 74, pl. 85.

1836. *Nemoptera halterata* Klug., *Abh. Kon. Akad. Wiss. Berlin* : 94, 8.
 1853. *Nemoptera halterata* Forsk., Walker, 1853. *Cat. Brit. Mus. Neur.* : 473.
 1909. *Halter halterata* Forsk., Needham, J. G., *Rec. Indian Mus., Cal.*, 3 : 201.

Material.—Jaipur District : Coll. T. G. Vazirani; 4 exs., Phulera. Nagaur District: Coll. T. G. Vazirani : 4 exs., Gudha: Coll. B. Biswas: 2 exs. Sambhar Lake. Coll. T. G. Vazirani: 1 ex. Jhapog.

Distribution.—Rajasthan : Jaipur and Nagaur Dist. Beluchistan.

Remarks.—The species is recorded for the first time from India.

4. *Croce filipennis* (Westwood)

1848. *Nemoptera filipennis* Westwood, *Cab. orient. Ent.*, pl. 34.
 1853. *Nemoptera filipennis* Walker, *Cat. Brit. Mus. Neur.* : 476.
 1909. *Croce filipennis* Needham, *Rec. Indian Mus.*, 3, 196.
 1911. *Croce filipennis* Imms, *Trans. Linn. Soc.*, 11 : 151-160.

Material.—Jodhpur District : Coll. J. S. Bhatti : 4 exs. : Jodhpur.

Distribution.—Rajasthan : Jodhpur Dist., West Bengal : Calcutta, lower Bengal, North Bengal, Bombay : Surat, Jagatpuri.

Family MYRMELEONIDAE

5. *Acanthacilisis edax* (Walker)

1853. *Myrmeleon edax* Walker, *Cat. Brit. Mus. Neur.* : 317.
 1909. *Myrmeleon edax* Needham, *Rec. Indian Mus.*, 3 : 200.
 1921. *Acanthacilisis edax* Dover, *Rec. Indian Mus.*, 22 : 397-398.

Material.—Bikaner District : Coll. M. Chandra : 2 exs. Kolayat.

Distribution.—Rajasthan : Bikaner Dist., Tamil Nadu : Ramnad, Madura Dist.

6. *Centroclisis eustalacta* (Gerst.)

1863. *Acanthacilisis eustalacta* Gerstaecker, *Stett. ent. Ztg.*, 24 : 178.
 1866. *Centroclisis eustalacta* Hagen, *Stett. ent. Ztg.*, 27 : 378.
 1909. *Acanthacilisis eustalacta* Needham, *Rec. Indian Mus.*, Cal., 3 : 200.

Material.—Jodhpur District : Coll. A. K. Datta : 1 ex. : Paota, Jodhpur. Bikaner Dist : Coll. M. Chandra : 2 exs. : Kalayat.

Distribution.—Rajasthan, Jodhpur Dist. U.P. : Lucknow.

7. *Creoleon perfidus* (Walker)

1853. *Myrmeleon perfidus* Walker, *Cat. Brit. Mus. Neur.* pts. I-IV : 350.
 1853. *Myrmeleon sedulus* (Walker), *Cat. Brit. Mus. Neur.*, pts. I-IV : 355.
 1853. *Myrmeleon adversus* Walker, *Cat. Brit. Mus. Neur.*, pts. I-IV : 358.
 1868. *Creagris perfidus* MacLachlan, *J. Linn. Soc. Zool.*, 9 : 277-278.
 1909. *Creagris sedulus* Needham, *Rec. Indian Mus.*, 3 : 201

Material.—Nagaur District : Coll. T. G. Vazirani : 1 ex. : Gudha, Jodhpur District : 1 ex. : Jodhpur.

Distribution.—Rajasthan : Nagaur & Jodhpur Dist. Bombay (Bulsar); North India.

Remarks.—*Creagris* Hagen 1860 (Neurop.) is a homonym of *Creagris* Neitner, 1857 (Coleop.) Hence Tillyard changed the genus *Creagris* of Neuroptera to *Creoleon* (vide *Proc. Linn. Soc. N. S. Wales*, 43, p. 436). So according to the present author *Creagris perfidus* should be named as *Creoleon perfidus*.

8. *Myrmecaelurus acerbus* (Walker)

1853. *Myrmeleon acerbus* Walker, *Cat. Brit. Mus. Neur.*, pts. I-IV : 366.
 1868. *Myrmecaelurus acerbus* MacLachlan, *J. Linn. Soc. Zool.*, 9 : 278.
 1909. *Myrmecaelurus acerbus* Needham, *Rec. Indian Mus.*, Cal., 3 : 201.

Material.—Nagaur District : T. G. Vazirani : 4 exs. : Gudha.
 Nagaur District : (i) T. G. Vazirani : 1 ex. Sambhar Lake. (ii) A. K. Mukherjee : Several exs. : Sambhar Lake.

Nagaur District : T. G. Vazirani : 1 ex. : Lihorana.

Bikaner District : Coll. M. Chandra : 3 exs. : Kolayat, Jaisalmer District : Coll. B. Biswas : 1 ex. : Nokh, Nagaur District : Coll. B. Biswas : 1 ex. : Sambhar Lake.

Distribution.—Rajasthan : Nagaur, Bikaner & Jaisalmer Dist., Punjab : Chevist; U. P. : Mussoorie; Bihar : Pusa & Palamau; Baluchistan.

9. *Myrmecaelurus* sp.

Material.—1. Bikaner District : (i) Coll. M. Chandra : 5 exs. : Kolayat, (ii) Coll. M. Chandra : 3 exs. : Pugal. (iii) Coll. M. Chandra : 1 ex. Lankaransah. 2. Jaisalmer District : Coll. B. Biswas : 4 exs. : Nokh. 3. Nagaur District : Coll. T. G. Vazirani : (i) 3 exs. : Nawa. (ii) 2 exs. : Lihorana. (iii) 4 exs. : Gudha. (iv) 1 ex. : Phulera. (v) 1 ex. : Japog.

10. *Palpares patiens* (Walker)

1853. *Myrmeleon patiens* Walker, *Cat. Brit. Mus. Neur.*, pts. I-IV : 305.
 1868. *Palpares patiens* MacLachlan, *J. Linn. Soc. Zool.*, 9 : 275.

Material.—Nagaur District : (i) Coll. T. G. Vazirani : 2 exs. : Sambhar Lake. (ii) Coll. T. G. Vazirani : 2 exs. Gudha; Jaipur District : (i) Coll. T. G. Vazirani : 1 ex. Korsina; Bikaner District : Coll. M. Chandra : 5 exs. : Pugal.

Distribution.—Rajasthan : Nagaur, Jodhpur & Jaipur Dist.; Orissa : Barkuda Id. Chilka Lake, Ganjam Dist.; Bihar : Dalkhola, Purneah Dist.

11. *Palpares nobilis* Navas

1931. *Palpares nobilis* Navas, *Rev. Acad. Cienc. Zaragoza*, 14, : 77.

Material.—Bikaner District : Coll. M. Chandra : (i) 4 exs. : Kolayat. (ii) 1 ex. : Pugal.

Jaisalmer District : (i) Coll. B. Biswas : 4 exs. : Nokh. (ii) Coll. M. Chandra : 3 exs. : Nokh.

Distribution.—Rajasthan : Bikaner & Jaisalmer Districts. Quetta,

12. *Palpares pardus* (Rambur)

1842. *Myrmeleon pardus* Rambur, *Hist. nat. Ins. Neur.* : 375.
1853. *Myrmeleon pardus* Walker, *Cat. Brit. Mus. Neur.* : 308.
1868. *Palpares pardus* MacLachlan, *J. Linn. Soc. Zool.*, 9 : 275.
1909. *Palpares pardus* Needham, *Rec. Indian Mus.*, 3 : 200.

Material.—Chittorgarh District : Coll. S. Biswas 1 ex. : Chittorgarh.

Distribution.—Rajasthan : Chittorgarh Dist. U. P. (Dehra Dun, base of W. Himalaya); Orissa (Khurda); S. India (Bangalore); Bombay (Surat); Bengal (Pusa & Rampurhat); North Bengal.

13. *Neuroleon guernii* Navas

1974. *Neuroleon guerneii* Navas, *Rev. Russe. Ent.*, Petrograd, 14, : 319.

Material.—Bikaner District : (i) Coll. M. Chandra : 1 ex. : Pugal; (ii) Coll. M. Chandra : 1 ex. : Kolayat.

Distribution.—Rajasthan : Bikaner Dist., Bombay : Bandra.

SUMMARY

A systematic account of the Neuroptera fauna of Rajasthan is given for the first time. The present paper includes eleven species all of which are new record from the area and one of them viz., *Halter halterata* (Forsk.) is recorded for the first time from India.

THE CORAL REEFS OF ANDAMAN AND NICOBAR ISLANDS

By

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(with 5 Plates & 1 Table)

INTRODUCTION

Hydrographic surveys of the seas around Andamans and Nicobars were made from 1889 to 1907 and again in 1926 and 1956 by the Marine Survey of India. Oceanographic work in the seas around these islands was largely that of I.N.S. *Investigator* (1887-1901) limiting mainly to deeper waters beyond reef limits. The text of these surveys was compiled in the Bay of Bengal Pilot. Though these surveys provide a useful guide for contours, depth and for general oceanographic and meteorological conditions, these add very little to the knowledge of reef characteristics and growth. Sewell (1938) and Scheer (1971) briefly mentioned the occurrence of shore reefs.

The results presented in this paper are obtained from a visit by the author together with the members of the survey party from September to November 1972. South Andaman and Cinque Islands in the Andamans, a few islands in the Richie's archipelago, Car Nicobar, Camorta and Nancowry in the Nicobars were examined with particular reference to reef structure, shore profiles, fauna and flora inhabiting reefs at these places.

PHYSIOGRAPHY

Andaman and Nicobar Islands are two groups of Islands formed in a sub-linear series in the Bay of Bengal. The sea on the west of the chain is referred as the Bay of Bengal and on the east as the Andaman sea. The Andaman ridge is broadly divided into North Andaman, Middle Andaman, South Andaman and Baratang Islands. The ridge was considered to have undergone folding, faulting and uplift. Towards the east coast of the South Andaman ridge are a group of islands called the Richie's archipelago. Further east of this group is a recent volcanic island, the Barren and to the north of this island lies another extinct volcanic island, the Narcondum.

The Andaman group of Islands are separated from the Nicobar group by a 296 km wide channel. The Nicobars are set obliquely towards the south-east. The northernmost is the Car Nicobar and the Southernmost, the Great Nicobar. The larger islands in the central group are Katchal, Camorta, Teressa, Bompoka and Tillachong while Battimalv and Choura are smaller islands located north of the Central group.

GEOMORPHOLOGY

The geomorphology of islands, reefs and other associated structures can be studied in two ways. *viz.* by visual observation and boring data. The following geomorphic structures are visible in these areas.

Reef platforms : A feature common to these islands, as elsewhere, is the development of benching condition formed by the peneplanation of shores by waves. These benches or platforms are usually absent on steep shores but are more often found on sloping landscapes. The shore rocks of sandstone, conglomerates and plutonic rocks are less porous and less soluble. The platforms formed around these rocks show more features of abrasion. The shore rocks consisting of limestone (Pl. IV a) and calcareous clays are more soluble and therefore show more features of solution. The structural and biological differences of the platforms in the two groups of islands are enumerated below.

Platforms of Andaman Islands (Pl. IIa): Usually platforms of about 500 m in width from shore occur. Shore rocks appear as relicts on these platforms, some in a pinnacle form and others in a vertically bedded state. Wide erosion channels, some 20 m in width intersect the platforms at various places. Surge channels of the type found in the Nicobars are absent. The platform edges are flat on the channel side and sloping on the windward side. Reef edges contain mostly the species of *Porites*, *Favia*, *Pocillopora* and *Acropora*. On the leeward shores, the boulders though usually small, are rounded. The alcyonarians, *Sarcophyton*, *Lobophytum* and *Sclerophytum* and the gorgonids *Isis hippuris*, *Melitheia phillippinensis* and *Chalcogorgia* sp. occur in shallow shoals and at reef edges. The slow rise of tide on leeward shores provides a good habitat for the growth of the fragile species of *Acropora* and the sea cups, *Phyllospongia calciformis*. Andaman platforms favour thick growth of corals at reef edges and patchy growths at various places on the platforms.

Platforms of Nicobar Islands : (Pl. VI a; IV b) Platforms up to 1000-m in width from shore occur. These appear to be formed mainly by the dissolution of shore rocks. The platforms develop prominent landward and seaward inclinations. Surge channels of 1 m in depth and width at reef edges are found on the windward side. The reef edges are buttressed and trenched. The slippery nature of reef edges is mainly

due to the presence of algae. *Porites*, *Favia*, *Acropora*, *Pocillopora*, *Heliopora*, *Tubipora* and *Montipora* are the most common among the boulder forming coral genera. Alcyonarians and gorgonaceans also occur.

Most shores of Andaman and Nicobar Islands contain the associated reef structures such as pinnacles which are mainly the submerged rocks of the island shores. At some places there are rubble terraces of 1.4 m thick which are formed usually by strong monsoonal winds or cyclones. Some of them may also be formed by wave action during high tide.

BORING DATA

Boring data on these islands are very few and are limited to bays where there is least coral growth as required for harbour development. One boring made on the 30 m width of the flat indicated a 6 m thickness of coral bed followed by 10 m thick hard clay bed (Shri Raju, Personal communication). Bore holes in a 4" size inner casing are known for four places (2 in Andamans and 2 in Nicobars) in the off reef areas to a depth of 15 m below the sea bed. The base rock is covered by a 10 m thick coarse sand which is again covered by a 3 m thick clay bed, containing loose coral boulders. The topmost layer near the surface is a 3.5 m cover of silt with occasional clay lumps. In the off-reef areas of Little Andamans at a depth of 15 m, the top layer of 7 m consisted of fine sand, followed by 5 m of loose clay and 3 m of hard clay. This hard clay was described as a very stiff grey silty clay which is said to have formed the base of the coral bed.

No data of borings on the reef platforms of Nicobars are available, but examination of growing reef fronts show not less than 10 m where huge columns of growing corals are visible as arms extending out into the sea, dipping down to the bottom from the reef rim. Boulders of *Montipora*, *Acropora*, *Porites* and *Favia* are seen rising from these extended areas upwards towards the sea level. This situation can be visualised in bright sunlight and calm weather all along the windward reef front at Car Nicobar.

Geomorphologically the following profiles of platforms may be distinguished especially in the Nicobar Islands.

1. High level conglomerate flats with prograding shores.
2. Unconsolidated conglomerate flats
3. Consolidated flat conglomerate
4. Unconsolidated irregularly shaped flats
5. Exposures of old beach rock, base rock, recent or sub recent upraised reefs under severe erosion and beach retreat.

Sedimentologically, the following environments of deposition may also be distinguished as in the other tropical reefs.

1. Reef front or reef wall
2. Brecciated zone
3. Reef-flat shoals or back reef shoals
4. Beach sediments or beach deposits.

Biologically, the following zones may be distinguished.

1. Supra-littoral
2. Littoral
3. Eulittoral (Sub-tidal)

REEFS

In the geometric classification of reefs as fringing, barrier and atoll, Andamans and Nicobars belong mostly to the fringing type. A barrier was reported earlier on the west of Andaman ridge (*vide* Sewell, 1938) but atoll reefs are absent. The following categories of reefs may be distinguished further in the Andaman and Nicobar Islands.

I. Recent or sub-recent Reefs : *Emergent reefs* : These are widely reported on many islands by earlier authors. At Car Nicobars, this reef is extensive on the north-east. Coral and *Tridacna* beds are found 2 m above the present sea level, and exposed *insitu* on the island rim at Keating point and all along the beach face. *Tridacna maxima* and a number of other bivalves occur in quarry pits of 3 m deep, some *Tridacna* reaching 1 m in length. Such reefs indicate negative eustatic movements.

II. Modern Reefs :

(a) *Windward reefs* : (Pl. IV b). Reefs growing in the direction of prevailing winds are called windward reefs. Andamans and Nicobars lie in the monsoonal belt. So these reefs grow chiefly in the direction of monsoon winds. Swell brought by other sources generally have a considerably less wave force, but may carry food supply to the reef. A reef growing windward is bevelled or sloped. The character of slope varies from place to place depending upon the oceanographic conditions. Such reefs are found on most islands on the windward side.

(b) *Channel reefs* : (Pl. II a; VI b) : Channels present in these islands are usually protected from winds due to the presence of islands on either side. These are therefore referred as leeward reefs. Because of less wind action, less wave action follows and flat growth of reef is developed. The reef edges are usually steep, not sloping as in windward reefs. *e. g.*, Channels of South Andamans and Kamorta-Nancowry complex.

(c) *Bay reefs* : These reefs are subjected to similar wind and wave action as the channel reefs but sediment deposition plays a large part

in the growth and death of these reefs. The bay is filling in nature both by upward coral growth and by sediment deposition and ultimately bringing the bay reef to the level of the channel reef. *Porites* and *Favia* are the chief reef builders. Alcyonarian growths are present but not abundant. Fragile *Acropora* occur in deeper bays. eg. Bays of Nancowry.

(d) *Knoll reefs* (coral knolls) : These are found in the midst of channels or to one side adjoining the main reef. These are circular topographic highs arising from about 20 m depth in these islands (Reddaih *et al*, 1974). Some of them are also found in the off-reef areas. The knoll is flat-topped with two hollows and two rims. It is a hard and compact hillock. *Porites* and *Favia* are the chief reef builders. Alcyonarian growths of *Sarcophyton*, *Lobophytum* and *Sclerophytum* are found on top of the knoll. *Acropora* grows on the periphery e. g., channels of the Richie's archipelago.

(e) *Patch reefs* : These are also circular growths developed on the inner side of the main reef usually half to one fathom in low spring tides. Though they resemble knoll reefs, these are not compact. Almost all corals found in the vicinity but mostly the fragile forms grow indiscriminately and lie loose on top of the patch. Most of them collapse or break while walking over them. Alcyonarian growths are abundant. The patch may grow a foot higher than the adjoining main reef. The patch reefs are apparently the formative stages of knoll reefs. These are found in the back reef shoals of Nicobar Islands. e. g., Camorta.

BIOLOGICAL CONSTITUENTS

Coelenterates : Most coelenterate groups occur. Of these, Scleractinia form the most important constituent among the reef builders in these shores. The Octocorallia and Milliporina are well represented. Hydroids occur mostly in deeper waters. Zoantharia and Scyphozoa are less prominent. Of about 75 species of Scleractinian corals studied (*vide* table 1) about 15% are boulder forming, hard and wave resistant. Some species of *Acropora* (Pl. V a) and *Porites* (Pl. II b) are encrusting in nature. Most of these corals grow in the direction of prevailing winds.

Other reef builders : Molluscs are also important reef builders on these shores. Most boulders of *Favia* and *Porites* in the Nicobars and in the Richie's archipelago contain 10 to 20 specimens of *Tridacna crocea* or sometimes *T squamosa*. This genus is an important molluscan reef builder at the reef-flat level. Other species mostly *Turbo*, *Trochus*, *Lambis*, *Conus* and *Cypraea* occur at reef edges and flats. Sea cucumbers form an important constituent of leeward reefs, some species occurring in unusually large numbers and sizes. Foraminifera also occur in emerged sediments and beach deposits.

Algae. The marine algae (Chlorophyceae, Rhodophyceae and Phaeophyceae, also contribute in the formation of coral reefs. Though coralline algae occur, the part played by them is not so marked as in atoll reefs. *Lithothamnion* sp. and *Lithophyllum amplexatum* are conspicuous on the windward side at reef edges, forming important constituents of the buttress zone. On the leeward shores, their presence is insignificant. Less wave action, lack of suitable base for their settlement and growth are some factors accounting for their absence but these are recorded at considerable depths by Sewell (1938). *Turbinaria* sp. occurs profusely on windward reef fronts but its part in reef ecology is not known. *Halimeda opuntia* is a very conspicuous semi-calcareous alga found on almost all reef-flats. *Ulva* and *Avernavillia* sp. grow in front of mangrove flats and act as sediment binders. *Sargassum*, *Laminaria*, *Codium*, *Gelidium* etc. and a number of other algal species occur on leeward side of islands where there are deep shoals. In the shallow shoals near the shores, *Amphiroa* occurs abundantly.

ZONATION OF CORALS

Detailed zonation patterns for the corals are difficult to obtain as the corals have the tendency to grow irregularly in any conceivable place where there is some water in motion. Though transect studies have been attempted, these have not shown a clear pattern of zonation. Certain broad generalisations can be made. On the leeward shores, corals grow more freely as these are met with less interference from waves. Boulders of *Favia* and *Porites* are found growing for about 200 m up to almost near the reef rim. Their tops are flattish as their upward growth is checked by sub-aerial exposure (Pl. III b). These are rounded boulders when young but assume a flat top due to weathering and solvent action of rain water during sub-aerial exposure. These features can be seen in growths developed in front of the mangroves.

From about 20 m from the reef edge, there appears a succession of coral species running parallel to the reef edge, each species covering about 50 m in width (Pl. VI a). Thus it may be inferred that on windward shores, the reef edge zonation appears parallel but the zonation on the remaining parts of the reef flat is difficult to arrive at as these are metamorphosed after death and decay. Sometimes these may be present in shoals. It may be assumed that *Porites* and *Favia* are the chief flat builders growing perpendicularly to the shore for about half the width of the reef flat but after, a succession of various coral species, one after the other run parallel to the reef edge. In very wide shoal areas, *Acropora* grows in thickets and it is the shallowness and calm water that determine the extent of the fragile species of *Acropora*. Certain hardy species of *Acropora* such as *A. humilis* are encrusting on windward reef fronts

and are capable of resisting the most forceful wave effect. More information is needed before conclusive evidence is presented on zonation of corals in these shores.

MANGROVES

A unique feature of Andamans and Nicobars is the presence of mangroves in open shores also, while these are quite common in every channel and bay in sheltered places. These are absent, however, on certain islands like Car Nicobar which may be due to the severity of wave action that prevents settlement and growth. When erosion had cut back a number of open shores and channels, shoals may have developed close to shore by deposition seaward. These shoals today are filled with coral growths. Whether mangroves have settled first or the corals is difficult to conclude. More likely that the mangroves did so earlier supported by the appearance of mangrove seedlings in the spits formed in front of such recent shoals. *e. g.*, Tapong, Nancowry. Almost in every mangrove flat in open shores, bays and channels, corals are seen growing in front and behind mangroves so long as a few feet of water is present. Mangroves provide a sheltered environment for the corals from severe wave action and from abrupt deposition of land drawn sediment. The massive forms of *Porites* and *Favia* usually grow here to as much as 5.5 m and 2 m in diameter respectively. Where wave action is severe and deposition by flood is more, these defoliate and vanish.

TABLE 1. RELATIVE ABUNDANCE OF SCLERACTINIAN CORALS COLLECTED OR OBSERVED DURING THE SURVEY.

CORAL SPECIES (1)	ANDAMAN ISLES (2)	NICOBAR ISLES (3)
Family ACROPORIDAE		
<i>Acropora nasuta</i> (Dana)	abundant	not found
<i>A. grandis</i> (Brook)	„	abundant
<i>A. humilis</i> (Dana)	„	„
<i>A. palifera</i> (Brook)	„	„
<i>A. rectina</i> Nomenzo	„	„
<i>A. pacifica</i> (Brook)	„	„
<i>A. digitifera</i> (Dana)	„	„
<i>A. canalis</i> (Quelch)	„	„
<i>A. clavigera</i> (Brook)	„	„
<i>A. calamaria</i> (Brook)	„	„
<i>A. hyacinthus</i> (Dana)	„	„
<i>A. polymorpha</i> (Brook)	„	abundant
<i>A. corymbosa</i> (Lamark)	„	„
<i>A. echinata</i> (Dana)	not found	„

(1)	(2)	(3)
<i>A. robusta</i> (Dana)	„	„
<i>A. clathrata</i> (Brook)	„	„
<i>A. squarrosa</i> (Ehrenberg)	abundant	abundant
<i>A. cancellata</i> (Brook)	not found	common
<i>A. botryoides</i> (Brook)	„	„
<i>A. formosa</i> (Dana)	common	common
<i>A. variabilis</i> (Klunzinger)	rare	„
<i>A. palmerae</i> Wells	common	„
<i>A. monticulosa</i> (Brüggemann)	rare	„
<i>A. diversa</i> (Brook)	abundant	abundant
<i>A. intermedia</i> (Brook)	„	„
<i>A. armata</i> (Brook)	„	„
<i>A. pulchra</i> (Brook)	common	common
<i>A. brueggemanni</i> (Brook)	„	„
<i>A. surculosa</i> (Dana)	abundant	„
<i>A. conigera</i> (Dana)	„	„
<i>A. irregularis</i> (Brook)	rare	unknown
<i>Montipora fruticosa</i> Bernard	not found	abundant
<i>M. hispida</i> (Dana)	„	common
<i>M. composita</i> Crossland	„	abundant
<i>M. foliosa</i> (Pallas)	„	„
<i>Montipora florida</i> Nomenzo	„	„
Family : POCILLOPORIDAE		
<i>Pocillopora elegans</i> Dana	abundant	abundant
<i>P. danicornis</i> (L.)	„	„
<i>Stylophora mordax</i> (Dana)	„	„
Family : AGARICIDAE		
<i>Pachyseris gemmae</i> Nomenzo	not found	common
<i>Pavona (Polyastra) Ootusta</i> (Quelsh)	„	„
<i>Leptoseris papyracea</i> (Dana)	„	„
Family : MUSSIDAE		
<i>Lobophyllia hemprichii</i> (Ehrenberg)	„	abundant
<i>Mussa angulosa</i> (Pallas)	common	not found
<i>Euphyllia glabrescens</i> Chamisso & Eysenhardt	unknown	common
<i>Euphyllia</i> sp.	„	„
<i>Symphyllia recta</i> (Dana)	abundant	not found
Family : MERULINIDAE		
<i>Merulina ampliata</i> (Ellis & Sol.)	not found	abundant
<i>M. laxa</i> Dana	abundant	„
Family : FAVIIDAE		

(1)	(2)	(3)
<i>Favia abdita</i> (Ellis & Solander)	"	not found
<i>F. halicora</i> (Ehrenberg)	"	"
<i>F. speciosa</i> (Dana)	"	"
<i>F. pallida</i> (Dana)	not found	abundant
<i>Diploastrea heliopora</i> (Lamark)	"	"
<i>Platygyra daedalea</i> (Ellis & Solander)	abundant	not found
<i>P. sinensis</i> (Milne Edwards & Haime)	"	"
<i>Goniastrea pectinata</i> (Ehrenberg)	"	"
<i>G. planulata</i> (Milne Edwards & Haime)	not found	common
<i>G. benhami</i> Vaughan	"	"
<i>G. retiformis</i> Lamark	"	"
<i>Goniastrea</i> sp.	"	"
<i>Coelaseris magiri</i> Vaughan	"	not found
Family : OCCULINIDAE		
<i>Galaxea fascicularis</i> (L.)	abundant	abundant
Family : THAMNASTERIDAE		
<i>Psammocora contigua</i>	not found	common
<i>Psammocora</i> sp.	"	"
Family : PORITIDAE		
<i>Alveopora</i> sp.	common	common
<i>Porites porites</i> (Pallas)	"	"
<i>P. tenuis</i> (Verill)	"	"
<i>Porites nigrescens</i> Dana	"	"
<i>Gonopora Columna</i> (Dana)	common	not found
<i>G. tenuidens</i> (Quelch)	"	"
<i>G. stokesi</i> Milne Edwards & Haime	"	"
<i>G. peteolata</i> Bernard	"	"
Family : PECTINIDAE		
<i>Echiniphyllia aspersa</i> (Ellis & Solander)	not found	"
Family : FUNGIIDAE		
<i>Fungia echinate</i> (Pallas)	common	abundant
<i>F. fungites</i> (L.)	"	"
<i>F. horrida</i> (Dana)	not found	"
<i>Herpolitha limax</i> (Esper)	"	"

SUMMARY

Coral reefs present in the representative groups of Andaman and Nicobar Islands namely, South Andaman, Cinque, Car Nicobar, Camorta, Nancowry and in the Richie's archipelago have been described. The geomorphology of island shores, reef platforms and their associated fauna and flora with special reference to reef building corals are elucidated. Some aspects of zonation of corals and the occurrence of mangroves are discussed.

ACKNOWLEDGEMENTS

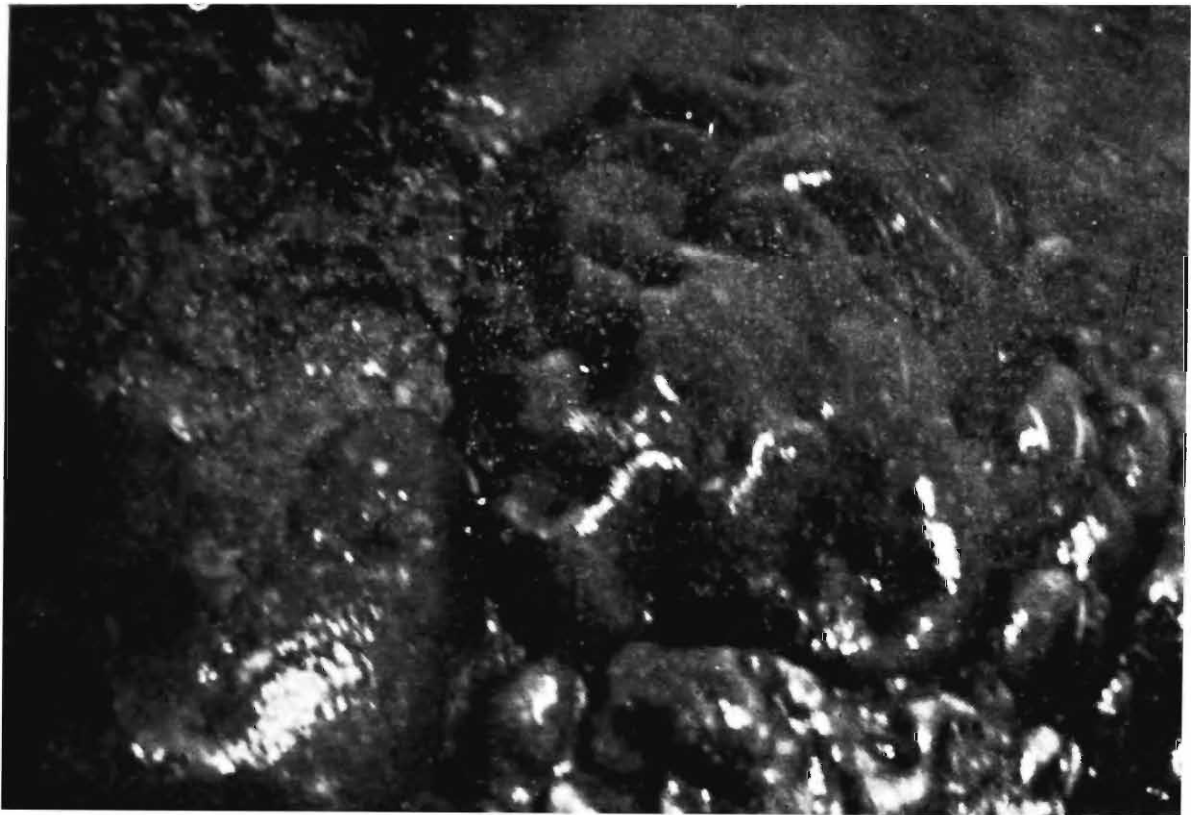
The author is grateful to Dr. A. P. Kapur, former Director Zoological Survey of India for encouragement during the work, to Dr. S. Khera and Dr. K. K. Tiwari, deputy Directors for assistance. Thanks are also due to the administration of Andaman and Nicobar Islands especially to the staff of P (Marine), forest and fisheries departments on various islands for the facilities provided and to the members of the survey party, namely, Shri N. V. Subbarao, Dr. P. T. Cherian, Shri K. R. Halder and Shri T. Roy for assistance in field work.

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- SCHEER, G. 1971. *Regional variations in Indian Ocean Coral Reefs* edited by D. R. Stoddart and C. M. Yonge. *Symp. Zool. Soc. Lond.*, 429. pp.
- REDDIAH, K., SUBBARAO, N. V., P. T. CHERIAN, K. R. HALDER and T ROY. 1974. Two Indian Ocean Coral Knolls. *Indian, J. mar. Sci.* 3: 67-71.



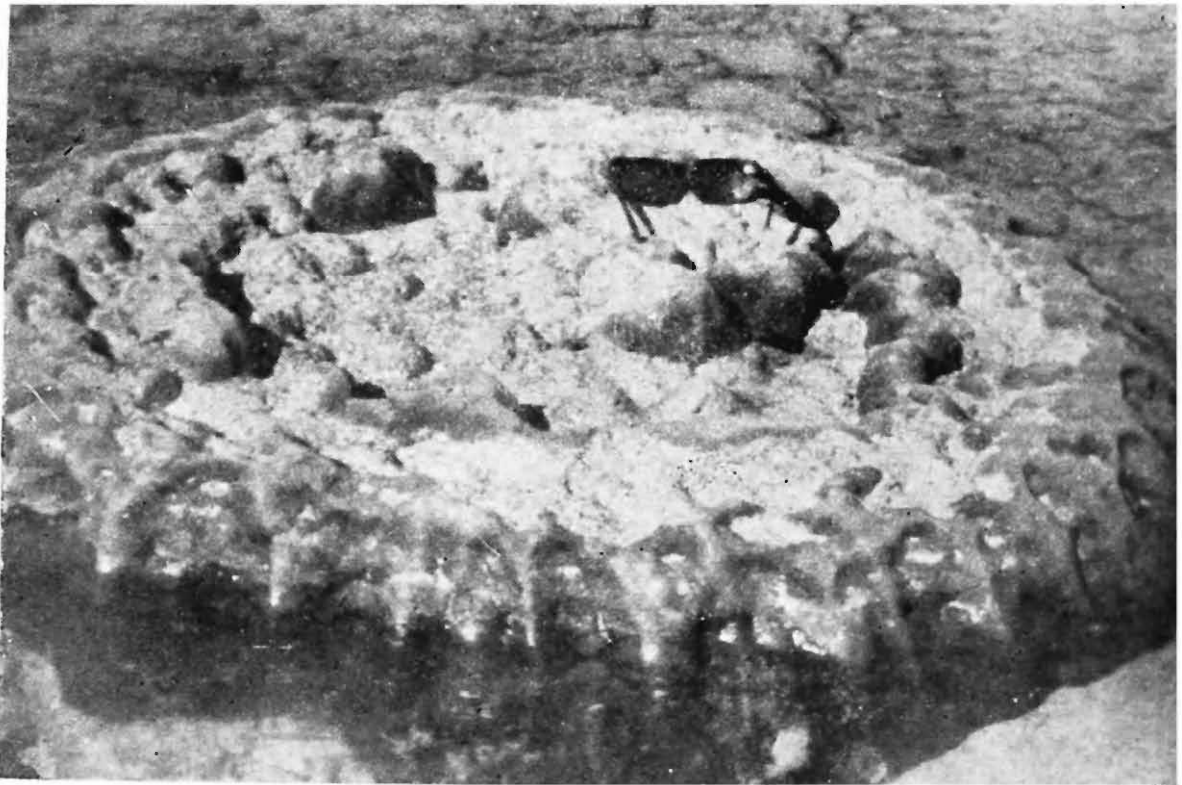
a, Leeward shores at Chrietapu, South Andaman Island (Photo by N. V. S.)



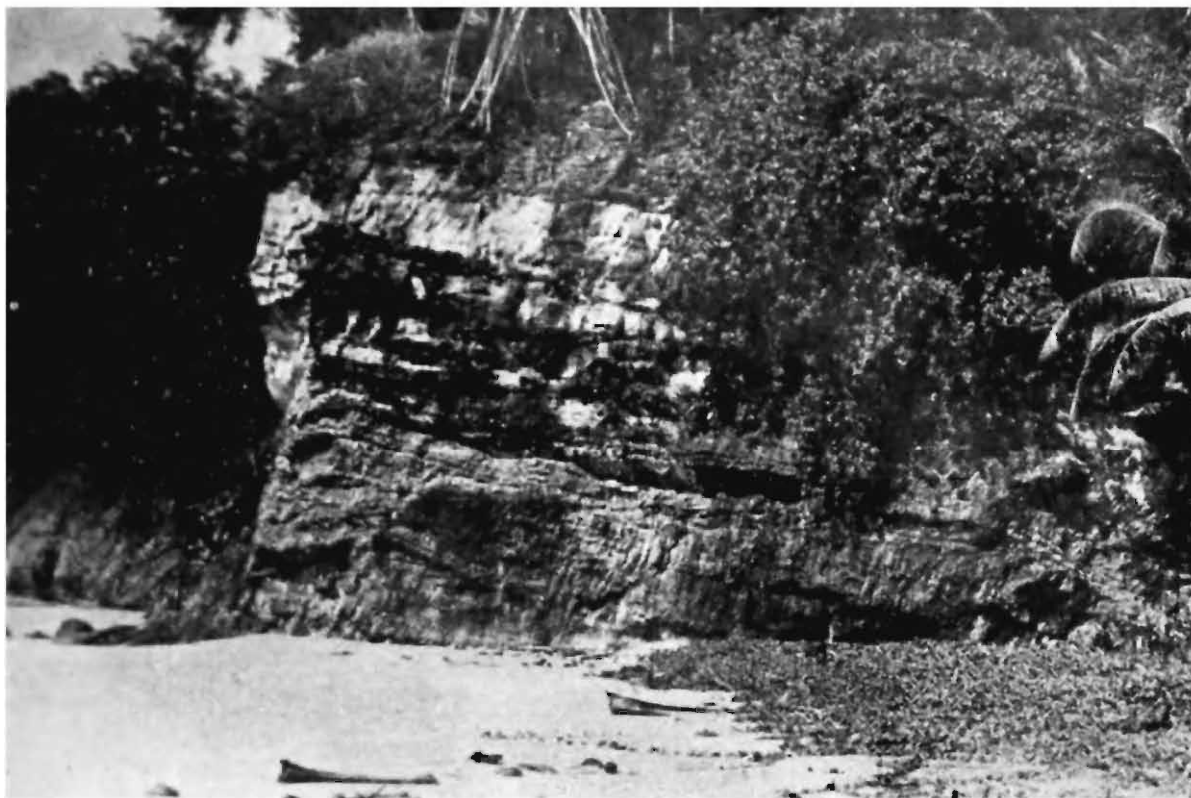
b, encrusting *Porites* sp. on the windward reef fronts at Car Nicobar



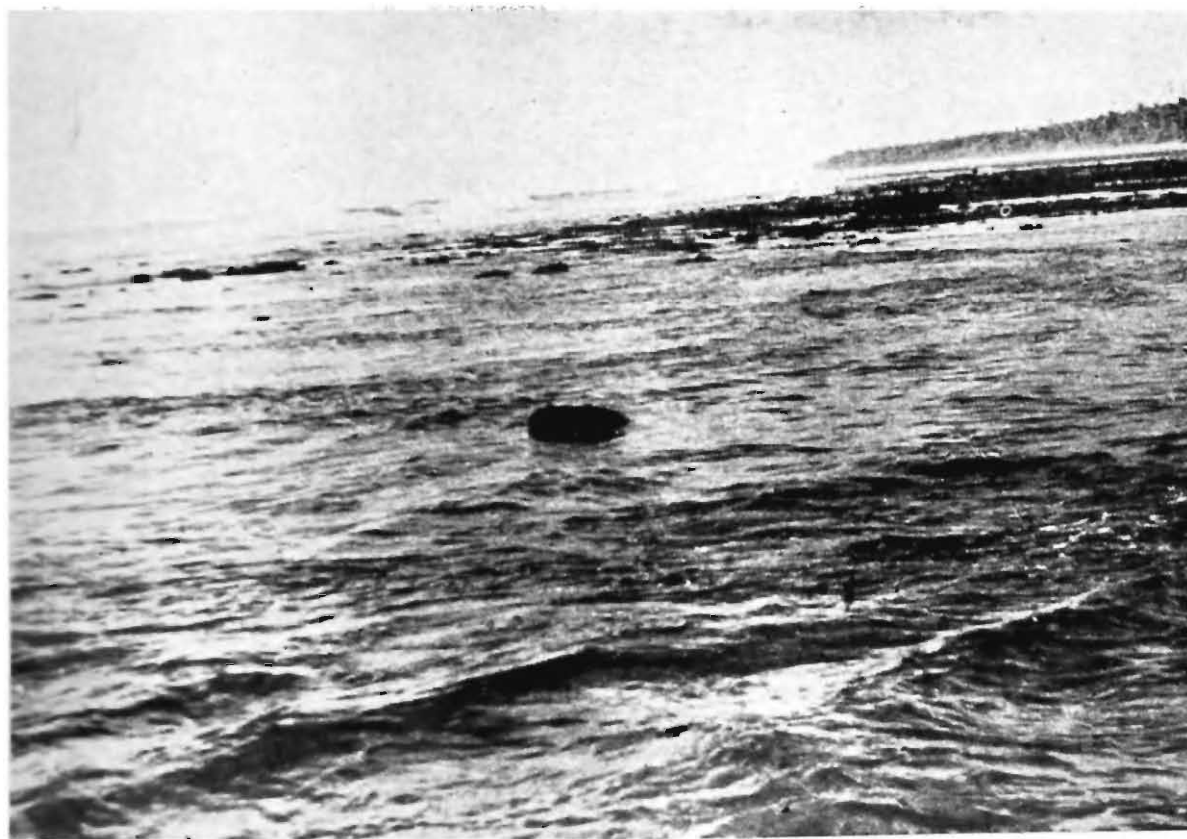
a, Solution effected shore rocks at Passa, Car Nicobar



b. *Porties* sp. found in the back reef shoals at Passa, Car Nicobar.



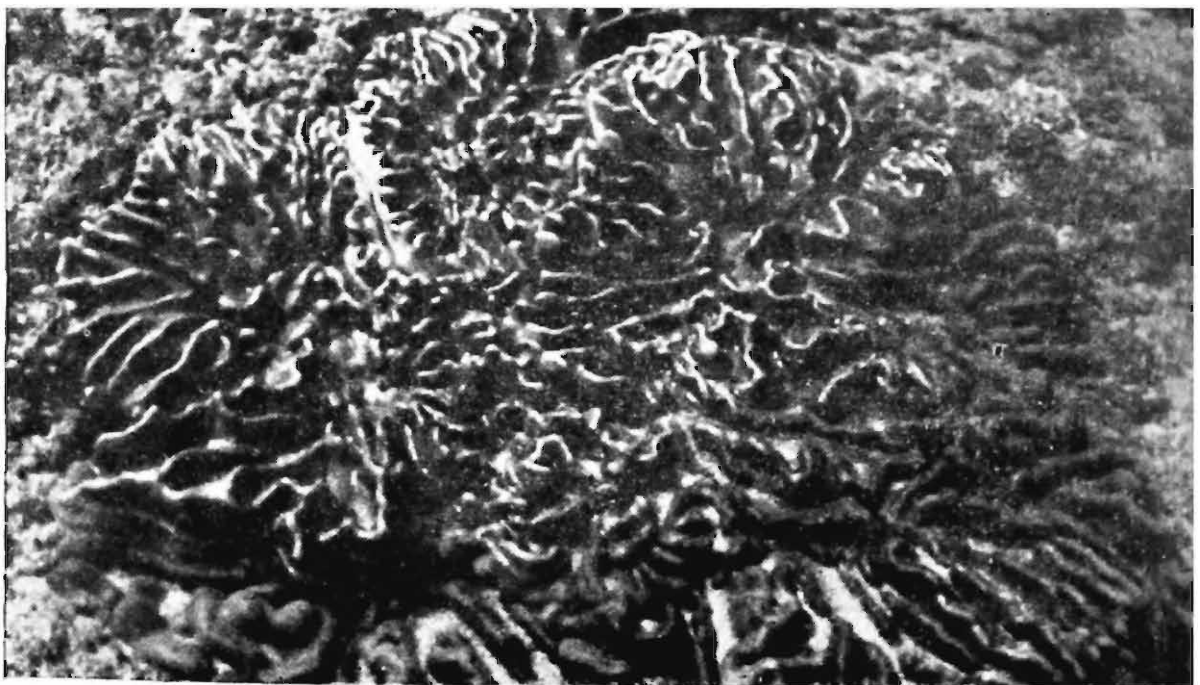
a, Lime stone outcrops at Passa, Car Nicobar.



b, Windward reef platform of Malacco, Car Nicobar exposing parts of the flat. White patch is the surf beaten reef front.



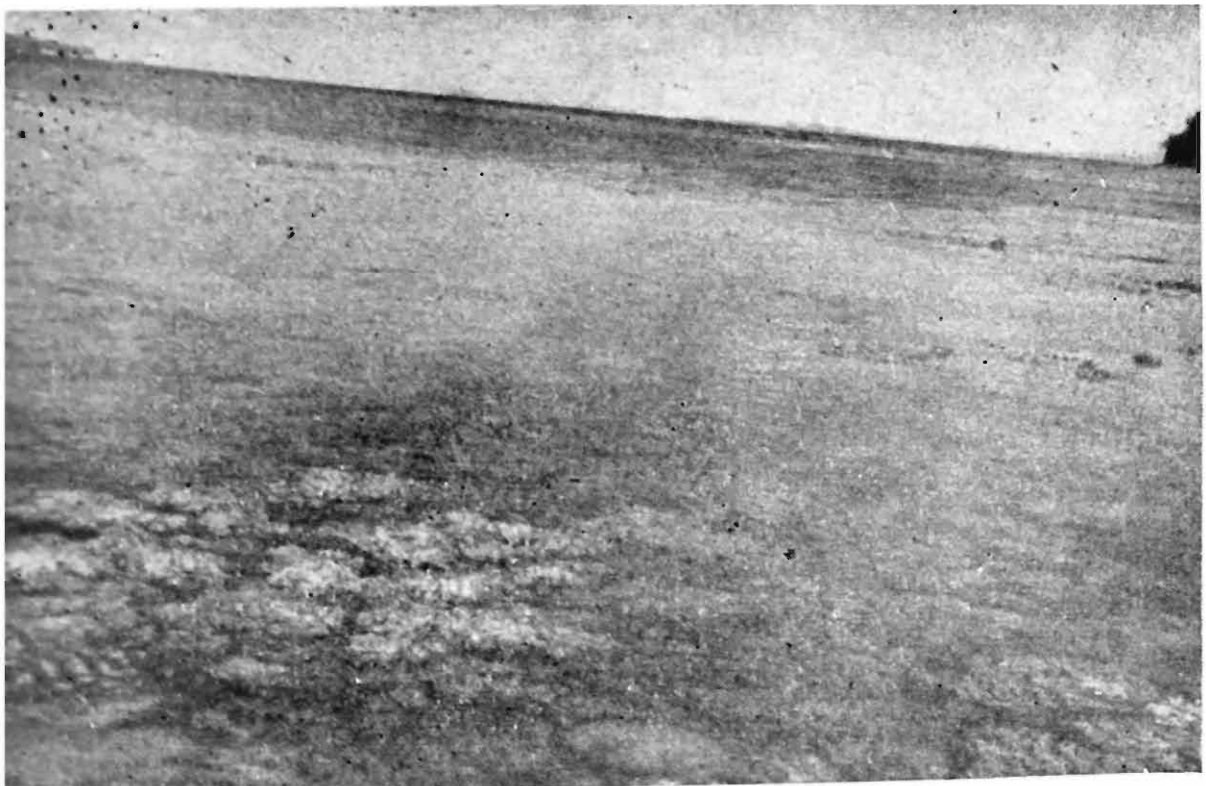
a, Encrusting *Acropora* on windward reef front at Car Nicobar.



b, Alcyonarian growths on leeward shores.



a. Zonation of a single species of *Acropora* with round boulder on the windward reef front at Car Nicobar.



b. Channel reef-flats of Nicobar Islands. Corals are covered with a thin sheet of water in low spring tides, at the trijunction of Kamorta, Nancayory and Trinkat.

**TWO PLANT PARASITIC NEMATODES OF THE
GENUS SEINURA FUCHS, 1931 (NEMATODA :
APHELENCHOIDIDAE) FROM LUCKNOW**

By

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(With 4 Text-figures)

INTRODUCTION

Two species of the genus *Seinura* Fuchs were obtained from the two different hosts *Carica papaya* and *Solanum melongena*, which on detailed study, were found to be new to Science. The roots of both these plants were also infected heavily with the genera *Aphelenchus* Bastian and *Aphelenchoides* Fischer.

***Seinura tandoni* sp. n.**

(Text-fig. 1)

Measurements of Females (N=20) : L=0.74mm. (0.62—0.86 mm.)

a=24 (20.6—27); b=9.5 (8.2—10.6);

c=9.8 (8.8—11); V%=74% (71%—80%);

Stylet=17 μ (16 μ —18 μ); Hemizonid-O. 1mm. (0.08-0.12 mm.)

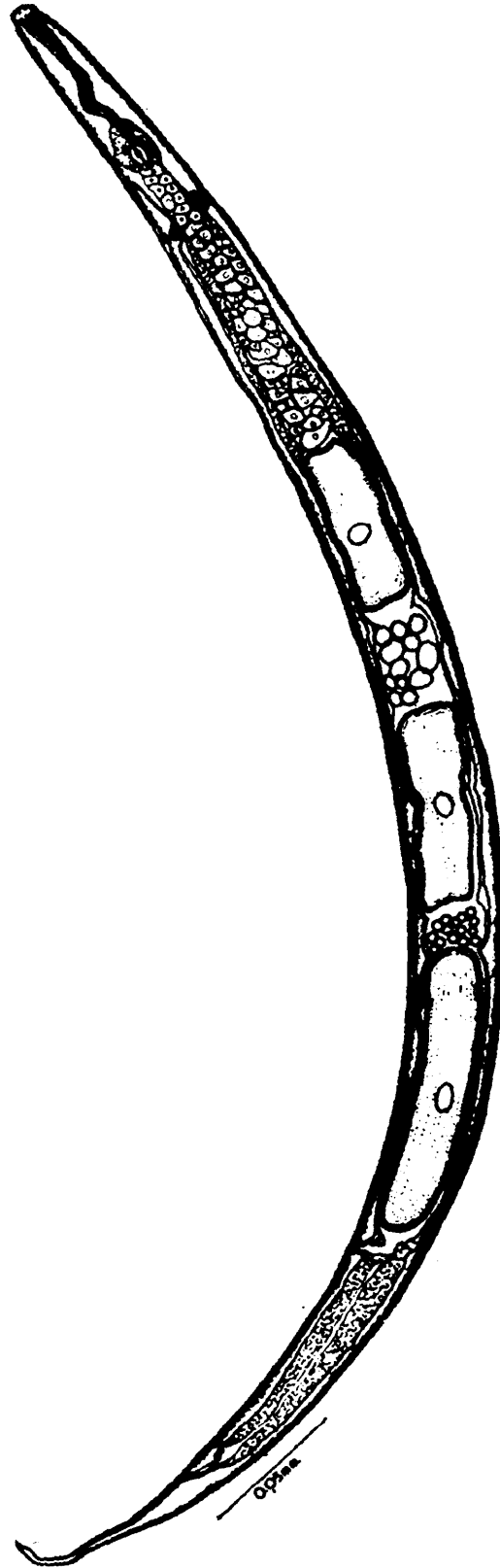
Female (Holotype) : L=0.64 mm.; a=20.06; b=8.9;

c=10.2; V%=73; Stylet=17 μ ; Hemizonid=0.09 mm.

(from the anterior end); Excretory pore=0.068mm.

Body cylindrical, arcuate and very finely striated. Lip region distinctly set off from the body by a constriction. Annules in the lip region not visible. Stylet strongly built and knobless. Oesophageal bulb generally oval with a constriction along its length and measures 18 μ —20 μ in length and 12-15 μ in width; shape of the oesophageal bulb variable. Crescentic valve located posteriorly. Storage chamber present at both the ends of the oesophageal bulb. Oesophageal glands 85 μ —160 μ long. Excretory pore present anterior to the nerve ring at the level of the posterior end of the median oesophageal bulb. Hemizonid at the level of the nerve ring in almost all the specimens. Its distance from the excretory pore ranges 25 μ to 34 μ . Tail 0.076mm. (0.063-0.98mm.) or six to seven body widths in length, tapering towards its tip but not forming a filiform process, tail tip may be curved dorsally or ventrally.

Ovary single, anterior reaches up to the level of the oesophageal bulb separated from the uterus by a constriction. Oöcytes in one, two or more rows. One or two eggs present in uterus measuring 0.091—0.129 mm. \times 0.018—0.02mm. Post-vulvar uterine sac absent. Vulva transverse without prominent lips, placed at about two third of the body length from the anterior end.



Text-fig. 1. *Seinura tandoni* sp. n., Female showing general anatomy.

Holotype: ♀ (Slide St/1); Uttar Pradesh; Lucknow (Govt. Agriculture Farm, Aliganj); decaying roots of papaya (*Carica papaya*); 16.1.1971; S. P. Singh Coll.; in R. S. Tandon Coll. at Zoology Department, Lucknow University, Lucknow.

Paratypes: 19 ♀ ♀ (St/2—St/19) India; Uttar Pradesh; Lucknow (Govt. Agriculture Farm, Aliganj); decaying roots of papaya (*Carica papaya*) 16.1.1971; S. P. Singh Coll.; in Dr. R. S. Tandon Coll. at Zoology Department, Lucknow University, Lucknow.

Relationship and differential diagnosis.—According to the key given by Hechler and Taylor, 1965 for the genus *Seinura* the new species resembles *Seinura winchesi* (Goodey, T, 1927) J. B. Goodey, 1960 in possessing knobless stylet and in the absence of post-vulvar uterine sac, but differs in the values of a, b and c of the deManiam formula, length of the stylet, variable shape of the median oesophageal bulb, posterior position of the crescentic valve and extension of ovary.

Seinura tandoni n. sp. comes nearer to *Seinura oxura* (Paesler, 1957) J. B. Goodey, 1960 in its stylet, offset lip region, posteriorly placed crescentic valve, arrangement of oogonia, presence of hemizonid posterior to the excretory pore, in having a shorter stylet, in the absence of lateral line incisures, in the size of eggs and shape and length of tail.

It also resembles *Seinura oostenbrinki* Hussain & Khan, 1967 in having a knobless spear, distinctly set off head, b and c values presence of hemizonid and absence of lateral line incisures but it differs from *Seinura oostenbrinki* in size of the body, shape of the spear, absence of the spear guide, shape of the median oesophageal bulb and its valve, position of hemizonid and excretory pore, length of the tail, absence of post-vulvar uterine sac and arrangement of oöcytes.

The species is named after Dr. R. S. Tandon, Department of Zoology, University of Lucknow, Lucknow, India.

Seinura kherai sp. n.

(Text-figs. 2—4)

Measurements of Females (N—12): L=0.768mm. (0.62—0.97mm.

a=28 (22—36); b=9 (8—11); c=16 (11—20);

V%=76%; (71=82%); Stylet=15 μ . (12 μ —18 μ)

Female (Holotype) : L=0.97mm.; a=34; b=11; c=18

V%—71% Stylet=18 μ ; Excretory pore=0.094 mm.

Body moderately slender, bow shaped tapering at both the extremities **Head** set off from the body with six prominent lips. Cuticle finely striated with eight to ten striations in 0.01mm., stylet stout knobless 18 μ long with oblique orifice at anterior end. Lateral fields with three incisures.

Hemizonid absent. Excretory pore a little behind the median oesophageal bulb. Tail conoid and shorter than vulva anus distance, measuring 0.047 mm. (0.03—0.058 mm.). Shape and the length of the tail variable.

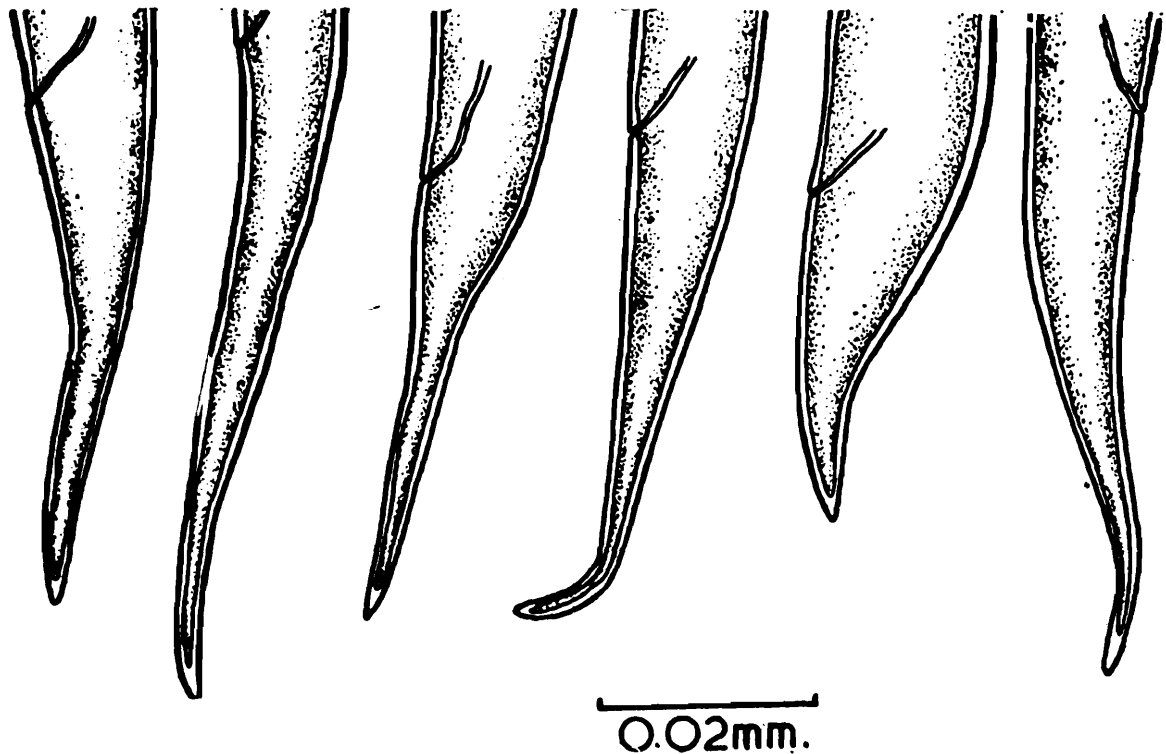


Text-fig. 2. *Seinura kherai* sp. n., Female showing general morphology.

Procorpus narrow, median oesophageal bulb large pear shaped measuring $23 \times 17 \mu$ [21μ (17μ — 25μ) \times 13μ (10μ — 17μ)]. Crescetine valve located posteriorly. Nearly whole of the anterior and a little

posterior portion of the bulb alveolated and seems to function as reservoir for the glandular products. Oesophageal glands 130—140 μ long and overlaps intestine dorsally. Narrow oesophageal duct suddenly widens soon after it comes out of the median oesophageal bulb and again it narrows. No oesophago-intestinal valve was observed. Intestine tessellated, its lumen is wide just posterior to the median oesophageal bulb, narrowing rapidly behind the nerve ring widening again just anterior to the short rectum.

Ovary single, outstretched and its anterior extension a little anterior to the end of the oesophageal gland. Oocytes arranged in a single or double file. Presence of sperm, in the uteri of some specimens, shows that the region of the spermatheca is formed but not clearly demarcated. Vulva transverse, vagina perpendicular to the body axis or directed anteriorly. Post-vulvar uterine sac absent.

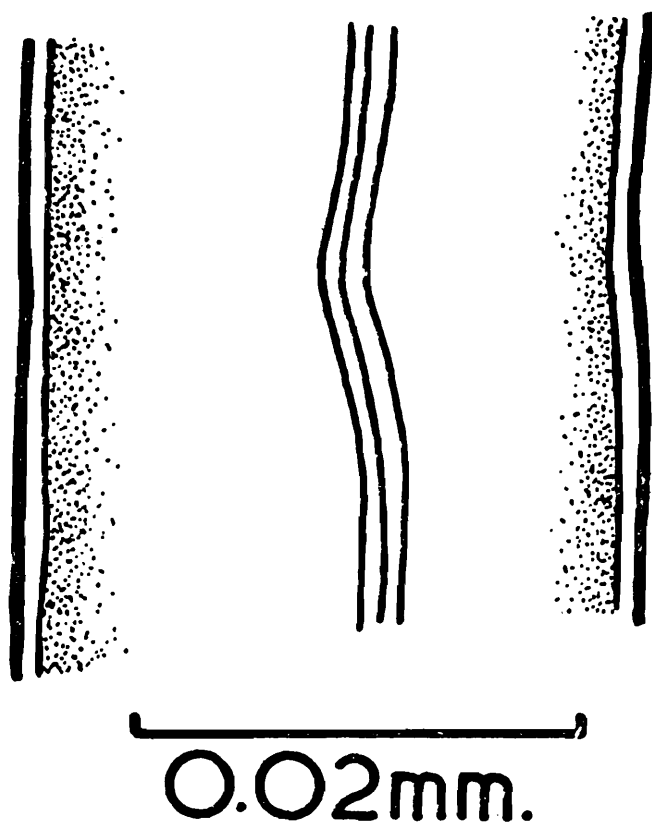


Text-fig. 3. *Seinura kherai* sp. n., Posterior portions of females showing variations in shape of the tails.

Holotype: ♀ (Slide Sk/I); India; Uttar Pradesh; Lucknow; (Kitchen Garden of Dr. R. S. Tandon, Lucknow University) roots of brinjal (*Solanum melongena*); 4.ii.1971; S. P. Singh Coll.; in Dr. R. S. Tandon Coll. at Zoology Department, Lucknow University, Lucknow.

Paratypes: 12 ♀♀ (Slides Sk/2—Sk/12); India; Uttar Pradesh; Lucknow (Kitchen Garden of Dr. R. S. Tandon, Lucknow University); roots of brinjal (*Solanum melongena*); 4.ii.1971; S. P. Singh Coll.; in Dr. R. S. Tandon Coll. at Zoology Department Lucknow University, Lucknow.

Relationship and differential diagnosis.—The new species resembles *Seinura oxura* (Paesler, 1957) J. B. Goodey, 1960 in the absence of post-vulvar uterine sac, three incisures in the lateral fields, anterior extension of the ovary and arrangement of oocytes in ovary at the anterior end. It however differs from *S. oxura* in its larger size, different dimensions of the body, length and shape of the tail and stylet, absence of hemizonid, larger size of the eggs and absence of males.



Text-fig. 4. *Seinura kherai* sp. n., Lateral line incisures.

It comes nearer to *Seinura pinni* Messey, 1966 in having a knobless spear, in the shape of the oesophageal bulb, in the presence of glandular part anteriorly and posteriorly in the median oesophageal bulb; in having an outstretched ovary with its anterior portion overlapping the distal end of glands but differs in the dimensions of the body, size of the stylet, in having only three incisures in the lateral fields, absence of post-vulvar uterine sac and shape of the tail.

Seinura kherai n. sp. also comes close to *S. oostenbrinki* Hussain & Khan, 1967 in its shape of the body, values of b and V in deManian formula distinctly offset head, knobless spear and glandular intestine but it differs in the shape and size of the stylet, values of a and c, shape of the oesophageal bulb and its valve, position of the excretory pore and absence of post-vulvar uterine sac.

The species is named after Dr. S. Khera, Deputy Director, Zoological Survey of India, Calcutta.

SUMMARY

Two new plant nematodes, *Seinura tandoni* from the roots of *Carica papaya* and *Seinura kherai* from the roots of *Solanum melongena* are described. Descriptions of both species are based on females only.

ACKNOWLEDGEMENT

The author is thankful to Dr. R. S. Tandon, Department of Zoology, Lucknow University for valuable guidance and criticism during the research period.

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DIPTERA FROM ARUNACHAL PRADESH* AND ASSAM FOOT HILLS, PART V, TIRAP DIVISION

By

A. N. T. JOSEPH AND P. PARUI

Zoological Survey of India, Calcutta-12

INTRODUCTION

This is the last in this series of papers, the preceding one was published in this journal in 1976. It deals with the Diptera of Tirap Division collected by Dr. G. S. Arora during October-November 1971. As in the preceding paper, the geographical distribution is given only in cases where they have not been recorded in any of the earlier papers of the series.

The Families dealt with are Tipulidae, Sciaridae, Asilidae, Stratiomyidae, Tabanidae, Dolichopodidae, Syrphidae, Sepsidae, Muscidae, Celyphidae, Calliphoridae and Sarcophagidae.

SYSTEMATIC ACCOUNT

Family TIPULIDAE

1. *Holorusia fulvolateralis* (Brunetti)

1911. *Tipula fulvolateralis* Brunetti, *Rec. Indian Mus.*, 6 : 249-250.
1912. *Ctenacrosceles sikkimensis* Enderlein, *Zol. Jb. Syst.*, 32 : 4-5.
1973. *Holorusia fulvolateralis* (Brunetti) : Alexander and Alexander, *A Catalog of Diptera of the Oriental Region*, 1 : 27.

Material.—1♂, Changlong, 540 m., 2.xi.1971.

Remarks.—It is widely distributed in the Eastern Himalaya, also recorded from Kumaon.

2. *Nephrotoma consimilis* (Brunetti)

1911. *Pachyrhina consimilis* Brunetti, *Rec. Indian Mus.*, 6 : 268.
1973. *Nephrotoma consimilis* (Brunetti); Alexander and Alexander, *A Catalog of Diptera of the Oriental Region*, 1 : 33.

Material.—1♂, 1♀, Khonsa, 800 m., 4.xi.1971.

* Formerly N. E. F. A.

3. *Nephrotoma serricornis* (Brunetti)

1912. *Pachyrhina serricornis* Brunetti, *Fauna Brit. India*, Diptera, Nematocera : 341.
 1973. *Nephrotoma serricornis* (Brunetti): Alexander and Alexander, *A Catalog of Diptera of the Oriental Region*, 1 : 37.

Material.—1♂, Khetti Village, Khonsa, 900 m., 7.xi.1971.

4. *Tipula (Acutipula) subvernalis* Alexander

1918. *Tipula fasciculata* Brunetti, *Rec. Indian Mus.*, 15 : 269.
 1927. *Tipula subvernalis* Alexander, *Rec. Indian Mus.*, 29 : 168.
 (Preoccupied, renamed).
 1973. *Tipula (Acutipula) subvernalis* Alexander : Alexander and Alexander, *A Catalog of Diptera of the Oriental Region*, 1 : 43.

Material.—1♂, Changlong, 540 m., 31.x.1971.

Remarks.—Recorded from Darjeeling, also from Tibet.

5. *Tipula (Emdotipula) stylostena* Alexander

1961. *Tipula (Lunatipula) stylostena* Alexander, *Phillippine J. Sci.*, 90 : 439.
 1973. *Tipula (Emdotipula) stylostena* Alexander : Alexander and Alexander, *A Catalog of Diptera of the Oriental Region*, 1 : 45.

Material.—1♂, Jairampur, 225 m., 27.x.1971.

Remarks.—Recorded from Kumaon, India, also from Khoghhozi Pakistan.

6. *Conosia irrorata* (Wiedemann)

1828. *Limnobia irrorata* Wiedemann, *Ausser. zweifl.*, 1 : 574.
 1912. *Conosia irrorata* (Wiedemann) : Brunetti, *Fauna Brit. India*, Diptera, Nematocera : 497.
 1973. *Conosia irrorata* (Wiedemann) : Alexander and Alexander, *A Catalog of Diptera of the Oriental Region*, 1 : 175.

Material.—3♀♀, Deomali, 200 m., 9.xi.1971.

Family SCIARIDAE

7. *Phorodonta exacta* (Brunetti)

1912. *Sciara exacta* Brunetti, *Fauna Brit. India*, Diptera, Nematocera : 132-133.
 1973. *Phorodonta exacta* (Brunetti) : Steffan, *A Catalog of Diptera of the Oriental Region*, 1 : 466.

Material.—(i) 3♀♀ Jairampur, 225 m., 26.x.1971; (iv) 4♀♀ Changlong, 540 m., 30.x.1971; (iii) 60♀♀, Changlong, 540 m., 31.x.1971; (vi) 2♀♀ Changlong, 540 m., 1.xi.1971; (v) 15♀♀, Khonsa, 825 m., 6.xi.1971; (vi) 2♀♀ Khonsa, 800 m., 7.xi.1971 and (vii) 3♀♀ Deomali, 200 m., 10.xi.1971.

Remarks.—Recorded from Darjeeling, West Bengal, Kumaon, Uttar Pradesh, Ukhrul, Manipur; also from Shanghai, China; Ohiya, Ceylon.

Family STRATIOMYIDAE

8. *Sargus mactans* Walker

1860. *Sargus mactans* Walker, *Proc. Linn. Soc.*, London, 4 : 97.

1920. *Sargus mactans* Walker : Brunetti, *Fauna Brit. India*, Diptera, Brachycera : 83-84.

Material.—1♂, Khetti Village, Khonsa, 900 m., 7.xi.1971.

Remarks.—It is recorded from several localities in the Himalaya; also from Nepal, Ceylon and Malaya Archipelago.

Family TABANIDAE

9. *Chrysops designata* Ricardo

1911. *Chrysops designata* Ricardo, *Rec. Indian Mus.*, 4 : 383.

Material.—1♀, Jairampur, 225 m., 27.x.1971.

Family ASILIDAE

10. *Philodicus femoralis* Ricardo

1921. *Philodicus femoralis* Ricardo, *Ann. Mag. Nat. Hist.*, (9) 8 : 190.

1960. *Philodicus femoralis* Ricardo : Ratan Lal, *Catalogue of Indian Insects*, Part 29. Asilidae, Diptera : 35.

Material.—1♀, Changlong, 500 m., 31.x.1971.

11. *Clephroneura sundaica* (Jaennicke)

1867. *Asilus sundaicus* Jaennicke, *Abh. Senckenb. Naturf. Ges.*, 6 : 363.

1938. *Clephroneura sundaica* (Jaennicke) : Oldroyd, *Ann. Mag. Nat. Hist.*, (11) 1 : 454-455.

Material.—(i) 1♀, Changlong, 500 m., 1.xi.1971 and (ii) 1♀, 31.xi.1971.

Remarks.—This is the first record of the species from India, it is also new to Z.S.I. It was earlier reported from Burma, Malaya and Siam.

Family DOLICHOPODIDAE

12. *Dolichopus angustinervis* Becker

1922. *Dolichopus angustinervis* Becker, *Capita Zoological* 1 (4) : 9-10.

Material.—(i) 10♂♂, 5♀♀, Khonsa, 850 m., 4.xi.1971; (ii) 1♀, Khetti Village, Khonsa, 900 m., 7.xi.1971 and (iii) 1♀, Deomali Forest, 250 m., 9.xi.1971.

Remarks.—It is new to Z.S.I. collection.

Family SYRPHIDAE

13. *Paragus serratus* (Fabricius)

1805. *Mulio serratus* Fabricius, *Syst. Antliat.*, :186.

1923. *Paragus serratus* (Fabricius) : Brunetti, *Fauna Brit. India*, Diptera, 3 : 31.

Material.—1♂, Jairampur, 225 m. 27.x.1971.

14. *Paragus rufiventris* Brunetti

1913. *Paragus rufiventris* Brunetti, *Rec. Indian Mus.*, 8 : 157.

1923. *Paragus rufiventris* Brunetti : Brunetti, *Fauna Brit. India*, Diptera, 3 : 34.

Material.—1♂, Jairampur, 225 m., 27.x.1971.

15. *Melanostoma orientale* (Wiedemann)

1824. *Syrphus orientale* Wiedemann, *Analec. Enl.*, : 36.

1923. *Melanostoma orientale* (Wiedemann) : Brunetti, *Fauna Brit. India*, Diptera, 3 : 48.

Material.—(i) 2♀♀, Jairampur, 225 m., 27.x.1971 and (ii) 1♀, Khonsa, 850 m., 4.xi.1971.

16. *Asarcina ericetorum* (Fabricius)

1781. *Syrphus ericetorum* Fabricius, *Spec. Ins.*, 2 : 425.

1923. *Asarcina ericetorum* (Fabricius) : Brunetti, *Fauna Brit. India*, Diptera, 3 : 63.

Material.—(i) 1♀, Pangsau Pass, 1265 m., 28.x.1971; (ii) 1♂, Deomali Forest, 250m., 9.xi.1971.

17. *Sphaerophoria indiana* Bigot

1884. *Sphaerophoria indiana* Bigot, *Ann. Soc. Ent.*, France, (6) 4 : 99:

1923. *Sphaerophoria indiana* Bigot : Brunetti, *Fauna Brit. India*. Diptera, 3 : 102-103, pl. III, figs. 1-6.

Material.—1♂, Changlong, 500 m., 1.xi.1971.

Remarks.—It is widely distributed all over India.

Family SEPSIDAE

18. *Sepsis himalayensis* Brunetti

1909 *Sepsis himalayensis* Brunetti, *Rec. Indian Mus.*, 3 : 345-347.

Material.—1♂, Khonsa, 900 m., 7.xi.1971.

Remarks.—Originally described from Darjeeling. The National Zoological collection contains specimens from Simla, Bangalore and Austria.

19. *Sepsis viduata* Thomson

1868. *Sepsis viduata* Thomson, *Engene Resa* : 587.
 1909. *Sepsis viduata* Thomson : Brunetti, *Rec. Indian Mus.*, 3 : 366.

Material.—(i) 1♂, Changlong, 500 m., 1.xi.1971 and (ii) 1♂, Deomali, 200 m., 10.xi.1971.

Family CELYPHIDAE

20. *Celyphus (Celyphus) obtectus* Dalman

1818. *Celyphus obtectus* Dalman, *K. Ventensk Akad. Handl.*, 39 : 73.
 1972. *Celyphus (Celyphus) obtectus* Dalman : Tenorio, *Trans. R. Ent. Soc. London*, 123 (4) : fig. 19.

Material.—1♂, Changlong, 500., 1.xi.1971.

Remarks.—It is widely reported from the Oriental Region but in India it is so far recorded only from Assam.

Family MUSCIDAE

21. *Musca (Byomyia) pattoni* Austen

1910. *Musca pattoni* Austen, *Ann. Mag. Nat. Hist.*, (8) 5 : 114.
 1965. *Musca (Byomyia) pattoni* Austen : Emden, *Fauna India, Diptera*, 7 (1) : 64

Material.—1♀, Nampong, 450 m., 28.x.1971.

22. *Musca (Philaematomyia) crassirostris* Stein

1903. *Musca crassirostris* Stein, *Mitt. Zool. Mus.*, Berlin, 2 : 199.
 1965. *Musca (Philaematomyia) crassirostris* Stein : Emden, *Fauna India, Diptera* 7 (1) : 71.

Material.—(i) 1♂, 4♀♀, Jairampur 225 m. 27.x.1971; (ii) 1♂ Pangsau Pass, 225m., 28.x.1971 and (iii) 2♀♀, Deomali, 200 m., 10.xi.1971.

23. *Musca (Viviparomusca) bezzii* Patton and Cragg

1913. *Musca bezzii* Patton and Cragg, *Ind. J. Med. Res.*, 1 : 19.
 1965. *Musca (Viviparomusca) bezzii* Patton and Cragg : Emden, *Fauna India, Diptera*, 7 (1) : 83.

Material.—1♂, Jairampur, 225 m., 27.x.1971.

24. *Musca (Ptilolepis) inferior* Stein

1909. *Musca inferior* Stein, *Tijdschr. Ent.*, 52 : 213.
 1965. *Musca (Ptilolepis) inferior* Stein : Emden, *Fauna India, Diptera*, 7 (1) : 89-90.

Material.—1♂, Jairampur, 225 m., 27.x.1971.

25. *Orthellia coerulea* (Wiedemann)

1819. *Musca coerulea* Wiedemann, *Zool. Mag.*, 3 : 23.
 1965. *Orthellia coerulea* (Wiedemann) : Emden, *Fauna India, Diptera*, 7 (1) : 124.

Material.—1♂, 1♀, Khetti Village, Khonsa, 900m., 7.xi.1971.

26. *Stomoxys calcitrans* (Linnaeus)

1958. *Conops calcitrans* Linnaeus, *Syst. Nat.*, 10 : 604.

1965. *Stomoxys calcitrans* (Linnaeus) : Emden, *Fauna India*, Diptera, 7(1) : 160.

Material.—1♂, 3♀♀, Khetti Village, Khonsa, 900 m., 7.xi.1971.

Family CALLIPHORIDAE

27. *Chrysomya megacephala* (Fabricius)

1784. *Musca megacephala* Fabricius, *Syst. Ent.*, 4 : 317.

1967. *Chrysomya megacephala* (Fabricius) : Kurahashi, *Science Reports of Kanazawa University*, 12 (2) : 270-271.

Material.—1♀, Jairampur, 225 m., 15.x.1971.

Family SARCOPHAGIDAE

28. *Parasarcophaga orchidea* (Bottcher)

1913. *Sarcophaga orchidea* Bottcher, *Ann. Mus. Nat. Hung.*, 11 : 375, fig. 1.

1940. *Sarcophaga hirtipes* Widemann var. *orchidea* Bottcher : Senior white, Aubertin and Smart, *Fauna Brit. India*, Diptera, 6 : 244-245.

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Material.—1♂, Deomali forest, 250 m., 11.xi.1971.

Remarks.—Widely distributed almost all parts of the world.

SUMMARY

This paper records twenty-eight species of Diptera belonging to twelve families. Of these *Clephydroneura sundaica* (Jaenicke) (Asilidae) is new to India.

ACKNOWLEDGEMENTS

We express our gratitude to Dr. S. Khera, Deputy Director-in-Charge and Mr. K. S. Pradhan, Superintending Zoologist, Zoological Survey of India, Calcutta, for their encouragement.

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VARIATIONS IN THE KNOWN VARIATION-STABLE
(*PHASE GREGARIA*) POPULATION OF THE
DESERT LOCUST *SCHISTOCERCA*
GREGARIA FORSKAL

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(with 6 tables and 1 plate)

The species *Schistocerca gregaria* undergo periodic population explosion. During the swarming or plague years its distribution covers three continents affecting 66 countries of the old world and spreading over 16.5 million square miles. This plague period alternates with non-swarming years or recession period which is restricted to 9.5 million square miles (Roonwal, 1954).

Polymorphic aspect of this species is now well known (Uvarov 1923, 1928). The two Uvarovian phase individuals differ from each other in size, proportion of body-parts and colour. The two extreme forms react differently in physiology and behaviour. "The phase polymorphism involves a whole complex of responses of an individual to the population density. Some responses to density are immediate while others are cumulative in the course of several generations (Uvarov 1966)."

The morphological variation in phase polymorphism have been worked out by several workers. In general phase *solitaria* is considered far more variable than phase *gregaria*. The most sensitive character which indicates significant differences in two phases is width of head at genal level (C). However, 20 different body parts and their indices signify phase difference.

"Solitaria" individuals as variation unstable

That there is a flowering of variations in *solitaria* phase individuals is ably demonstrated by Roonwal (1954). He discovered the occurrence of three types of eye-stripe polymorphs in solitarious populations the 6-, 7- and 8-stripes, the number of moults also varying according to order thus, 5, 5-6 and 6-7 respectively. Similarly the number of antennal segments varies from 26-27, 28-29 and 30. The proportion of sexes

also differs among 6-, 7- and 8-striped individuals. Males ($\text{♂} : \text{♀}$ 60:40) predominating among 6-striped individuals, but females predominating over males in 7- ($\text{♂} : \text{♀}$ 35 : 65) and 8- ($\text{♂} : \text{♀}$ 29: 71) striped individuals. The other notable morphological differences in two extreme phases are the degree of sexual dimorphism, in the number of hind tibial spines and in the development of eye-stripes (Roonwal, 1954).

These maximum variation lead Roonwal (1954) to propound a new evolutionary effect, "Roonwal effect" or "A New Effect" according to which variation intensity in the Desert Locust is greatest in minimum population (*solitaria* or non-swarming years) and least in maximum populations (*gregaria* or swarming years). The "effect" further elucidate that (i) this effect is inversely proportional to population size and (ii) land area of distribution.

"Gregaria" individuals as variation stable

The *gregaria* phased individuals in the Desert Locust are variation-stable and only a single type of eye-stripe polymorph (6-eye-striped) occur. The almost uniformity in this phase is much worked out by various authors. The behaviour, physiology and morphometry of the individuals along with their indices and sex-ratios ($\text{♂} : \text{♀}$ 50 : 50) are almost constant and there appears least over lapping in this respect.

Roonwal (1962) on the causes of polymorphism stated thus, "Phase polymorphism should be essentially regarded as a continuum between two extreme points-the *gregaria* and *solitaria*, the most important single factor governing the change from one point to another on this continuum is population density. On the other hand non-phase polymorphs are sharply separated and do not form a continuum."

Variations in the heitherto variation-stable (phase *gregaria*) populations.

Roonwal (1958, p. 84) on the evolutionary effects of population flux stated thus: "the existence of interspecific variability is the basis of speciation by which term we mean the process by means of which specific differences arise. Variation first arises in individuals and then spread to the group and speciation thus depends upon the behaviour of variability in natural populations. This behaviour is influenced by various factors called "pressures".

The desert locust, phase *gregaria* individuals in the natural field populations are known for their constancy in the morphometric characters, behaviour and physiology. However, in the recent laboratory work at IARI, New Delhi, we have observed the appearance of variability in the individuals of crowded population as follows:

I—EMERGENCE OF GREEN AND BLACK HOPPERS FROM THE SAME EGG-POD.

Uvarov (1966, p. 333) have stated that heavier hatchlings from crowded parents, as a rule, are of darker and even almost black coloured. Where as under Delhi laboratory condition we have invariably come across 2-3 green coloured hatchlings emerging from each egg-pod from crowded stock from 2nd generation onwards. These hatchlings are usually weak and slower in action in the beginning and after few days readily respond to the colour of environment if isolated. The findings are similar to those of Chauvin (1941) and Hunter Jones (1958). In the later generations (F_4 and F_5), the number of such green hatchlings are much more. It is further noticed that from 3rd to 4th generation onward, the number of eggs per pod laid by females are considerably reduced even when the environment, density and food material remains the same. As a rule gregarious colour pattern is not subject to change in response to the colour of environment, where as *solitaria* hoppers readily adjust their coloration to it.

These green hatchlings take longer time of development (*solitaria* characteristics) for reaching adult stage than their counterparts from the same egg-pod. Thus it appears that some of the *gregaria* individuals, from crowded stock having *gregaria* antecedent, behave abnormally thereby creating a weakening tendency in the crowded stock. The morphometrics of such fledglings and adults may or may not become as those of solitarious populations but their behavioural aspect remains *gregarious*. In the natural field population of gregarious individuals similar activity might be happening and light green hoppers must be emerging (although not recorded so far) and such adults born out of green hoppers may move along with their *gregaria* counter parts, even along with immigrating swarms and may even develop 7- or 8-stripes (Bhanotar and Mahto, 1974 and Mahto & Bhanotar *in press*), a *solitaria* characteristic, as happened in the *Dehradun* swarm of 1954, the study of which, on the basis of the occurrence of a 7-striped individual, made Roonwal (1955) to predict the weakening and decline of 1949-55 locust cycle in India. The colouration, body measurements and ratios indicated *solitaria* characteristics of the individual although 1954 was the peak year of that swarming cycle when the maximum number (174) of swarms invaded India.

This may also be the answer and reason to Bhatia and Singh's (1959) discovery of three 7-striped adults among phase *gregaria* individual during 1958. In one instance it was obtained from laboratory bred crowded stock (without their mentioning as to after how many generations) and in other two instances from natural field populations with low density. Two of the individuals (on the basis of E/F ratios) were attributed to phase *gregaria* and one to phase *transiens*. Incidentally next year (1959) heralded the 10th (recorded) locust cycle in India.

TABLE 1: Morphometric measurements (in mm.) and related ratios of the 7-striped individuals obtained from crowded stock (IARI—population) along with statistical constants.

BODY CHARACTERS							
S. No.	O	C	P	H	M	E	W ₁
<i>Females</i>							
1.	6.60	7.25	9.60	8.05	5.35	52.70	7.20
2.	6.80	7.30	9.90	8.25	5.85	51.95	6.85
3.	6.90	7.45	10.45	8.30	5.35	56.15	7.25
4.	6.65	7.40	10.45	8.45	5.90	53.30	7.35
5.	6.60	7.05	9.60	8.30	6.05	54.90	6.80
6.	6.85	7.40	8.80	8.05	6.05	53.60	7.40
7.	6.60	7.10	9.40	8.15	5.90	52.25	6.40
8.	6.90	7.45	10.45	8.60	6.30	58.05	7.00
9.	6.90	7.60	9.60	8.65	6.25	54.10	7.50
Total	60.80	66.00	88.25	74.80	53.00	487.00	63.75
Mean	— 6.75 ± 0.04	— 7.33 ± 0.18	— 9.80 ± 0.18	8.31 ± 0.07	5.88 ± 0.11	54.11 ± 0.65	7.08 ± 0.11
S. D.	± 0.14	± 0.55	± 0.56	± 0.21	± 0.34	± 1.97	± 0.35
C. V.	2.07	7.62	5.76	2.63	5.79	3.64	4.96
<i>Males</i>							
1.	6.05	6.60	8.85	7.20	5.05	46.60	5.60
2.	6.00	6.35	8.45	7.35	4.90	45.65	6.20
Total	12.05	12.95	17.30	14.55	9.95	92.25	11.80
Mean	6.02 ± 0.02	6.47 ± 0.12	8.65 ± 2.07	7.27 ± 0.07	4.97 ± 0.07	46.12 ± 0.47	5.90 ± 0.30
S. D.	± 0.03	± 0.17	± 2.92	± 0.10	± 0.10	± 0.67	± 0.42
C. V.	5.98	2.73	2.07	1.46	2.13	1.45	7.19

Abbreviations: O, width of head at ocular level; C, width of head at genal level; P, length of pronotum at Keel; H, height of pronotum; M, width of pronotum at constriction; E, length of elytron; F, length of hind femur, W_1 ; width of elytron at M. Cu. vein.

RATIOS					
F	E/F	P/C	C/O	F/C	H/C
<i>Females</i>					
24.90	2.11	1.32	1.09	3.43	1.11
—	—	1.32	1.09	—	1.11
24.90	2.25	1.40	1.07	3.34	1.11
26.00	2.05	1.35	1.11	3.51	1.14
24.60	2.23	1.36	1.06	3.48	1.17
24.75	2.16	1.18	1.08	3.34	1.08
24.15	2.16	1.32	1.16	3.40	1.15
25.35	2.25	1.40	1.07	3.40	1.15
20.15	2.06	1.26	1.10	3.44	1.13
194.80	17.27	11.91	9.83	27.34	10.15
24.35	2.15	1.32	1.09	3.41	1.12
± 0.62	± 0.02	± 0.028	± 0.01	± 0.02	± 0.009
± 1.78	± 0.08	± 0.06	± 0.03	± 0.06	± 0.02
7.25	3.73	5.23	2.74	1.77	2.39
<i>Males</i>					
21.60	2.15	1.34	1.09	3.27	1.09
21.85	2.08	1.33	1.05	3.34	1.15
43.45	4.23	2.67	2.14	6.61	2.24
21.72	2.11	1.33	1.07	3.30	1.12
± 0.12	± 0.035	± 0.007	± 0.02	± 0.03	± 0.03
± 0.17	± 0.05	± 0.01	± 0.02	± 0.05	± 0.04
0.81	2.36	0.74	2.64	1.51	3.78

In another instance Roonwal and Misra (1952) obtained a 7-striped (male) in a small sample of 15 individuals from *Ajmer Swarm of June 1950*. The morphometrics of this 7-striped individual indicated *solitaria* features. Regarding this sample-population, Roonwal and Misra (1952, p. 113) stated that "the *Ajmer swarm* has some leanings towards the initial *Kakko concentration* of the previous year. This trend is further evident from the presence of one 7-striped individual even in a small sample of 15 individuals." Later Roonwal and Bhanotar (1966) while studying the biological association between the various pairs of characters and degree of gregarisation in three swarming populations concluded with respect to *Ajmer swarm* that it was evidently in the early stages of built up of the cycle and had not reached the "extreme gregaria phase"

The morphometric measurements along with related indices of such 7-striped individuals obtained from crowded stock as well as from green hoppers are given below (Table-I). Although the individuals have attained 7-stripes in behaviour and colouration they remained gregarious.

II—OCCURRENCE OF A 4-STRIPED BRACHYPTEROUS FEMALE INDIVIDUAL (Tables 1-4)

This morph was obtained in the laboratory from the 4th generation of *gregaria* hoppers from a fairly crowded condition (306 hoppers) in a small sized cage (15" × 15" × 24") during June-July '72 (temperature ranging between 30°C to 35°C). The first individual from his lot fledged after 24 days and the last after 30 days. All other adults of the stock had 6-stripes.

General features of the 4-striped individual

Body : subnormal, slender and shorter; *Colour*: dirty yellow; *Wings*: both fore and hind wings stumpy and crumpled; *Behaviour*: sedentary non-jumping type, crawling movement, not responding to the call of mature males; *Feeding*: less than normal; faecal pellets small, dark and less in number. Efforts for mating this individual were futile and the individual survived for 97 days. Incidentally this is the first ever report of an abnormal brachypterous 4-striped form in laboratory breeding.

Morphological characters:—Eyes small, lightly pigmented: 4-eye-stripes and 5 interstripes; antennal segments 14 and 15; abdominal segments -8; tibial spines:inner (13); outer (12).

Morphometric measurements (in mm.)

- (1) Length of tibia-11.8
- (2) Width of head at ocular level (O)-4.15
- (3) Width of head at genal level (C)-4.30

- (4) Length of pronotum at keel (P)-5.40
- (5) Height of pronotum (H)-5.00
- (6) Width of pronotum at constriction (M)-5.20
- (7) Length of elytron (E, left-side)-2.0
- (8) Length of elytron (E, Right side)-4.35
- (9) Length of femur (F)-12.85
- (10) Body length-28.35

The related indices are: P/C (1.23); M/C(1.20); H/C (1.16); E/F left side' (0.165) and "right side" (0.360); E/C 'left side' (0.465) and "right side" (1.011) and F/C (2.80).

Ecological conditions:—The above 4-striped brachypterous morph was obtained in the laboratory culture kept under crowded condition which was subjected to sharp day and night fluctuation of temperature. The relative humidity percentage was fairly high. The antecedent or parentage of this specimen were of typical *gregaria* (dark-pink-coloured individuals) and were reared throughout earlier in crowded condition, all bearing 6-stripes with E/F ratios above 2.15 in all adults. The lots, were fed on cabbage leaves throughout.

Other types of variations in gregaria stock

Several of the individuals obtained after 3rd generation had considerable variations as follows:

(A) 5-striped male individual (Table-2)

A single individual was obtained with the following features and characteristics: (1) Antennal segments—25 (2) Abdominal segments as in all acridids ♂ 11, terg. 9 strn. (3) Tibial spines = inner 12, outer 10 (4) Tibial length = 15.60 mm.

TABLE 2.— Morphometric measurements (in mm) and ratios of 5-striped individual.

Body parts	Value	Ratios and their value
O—	4.55	P/C—1. 19
C—	4.90	M/C—0. 78
P—	5.85	
H—	5.40	H/C—1.102
M—	3.85	K/L—1. 75
K—	0.70	E/F—1. 72
L—	0.40	
E(R)—	28.00	R/T—1 52
F—	16.20	E/C—5. 71
R—	1.30	F/C—3. 30
T—	0.85	

Abbreviations:— K, max. width of metasternal interspace; L, mini. width of metasternal interspace; R, max. width of mesasternal interspace; T, mini. width of mesasternal interspace; For other abbreviations see Table I.

TABLE 3.—Morphometric measurements (in mm) and related ratios of variable individuals in 6-stripe category ('IARI-population) along with statistical constants.

Abbreviations : as in table 1 and 2.

S. N.	BODY CHARACTERS								
	O	C	P	H	M	K	L	E	F
<i>Females</i>									
a.	5.75	6.50	8.20	6.95	5.35	1.20	0.75	R 28.5	19.20
b.	6.55	7.35	9.65	8.05	6.10	1.80	1.15	L 41.75	—
								R 52.70	
d.	6.35	7.15	8.95	7.85	5.75	1.05	0.90	L 6.60	23.15
								R 51.0	
e.	5.25	5.75	7.05	6.40	4.70	0.80	0.55	17.35	16.70
k.	6.15	6.90	8.35	7.45	5.85	1.00	0.60	R 23.35	L 22.10
l.	5.90	6.25	8.10	6.90	5.40	1.05	0.45	—	—
Total	35.95	39.90	50.30	43.60	33.15	6.90	4.40	L 65.70	59.00
Mean	5.99	6.65	8.38	7.26	5.52	1.15	0.733	21.90	19.80
	± 0.19	± 0.24	± 0.35	± 0.25	± 0.20	± 0.10	± 0.10	± 10.41	± 1.80
S. D.	± 0.46	± 0.59	± 0.87	± 0.62	± 0.492	± 0.25	± 0.25	± 18.01	± 3.20
C. V.	7.7	8.8	10.3	8.5	8.8	21.7	34.2	82.23	16.5
<i>Males</i>									
c.	6.20	6.95	8.55	7.00	5.65	0.90	0.5	—	21.8
f.	5.55	6.05	—	6.55	4.90	0.70	0.40	—	18.9
g.	5.95	6.35	8.35	6.85	5.05	0.60	0.45	L 16.30	R 20.8
								R 41.20	
h.	5.90	6.35	7.90	6.85	5.35	0.75	0.45	R 23.80	—
i.	6.05	6.45	8.55	7.35	5.30	0.75	0.45	L 45.15	20.3
								R 1.40	
j.	5.95	6.45	7.85	7.05	5.05	0.95	0.50	L 13.40	R 20.8
								R 44.15	
Total	35.60	38.60	41.20	41.65	31.30	4.65	2.85	L 74.85	61.0
Mean	5.93	6.43	8.24	6.94	5.21	0.77	0.47	24.95	20.3
	± 0.08	± 0.11	± 0.15	± 0.10	± 0.11	± 0.05	± 0.02	± 1.64	± 0.8
S. D.	± 0.21	± 0.29	± 0.34	± 0.26	± 0.27	± 0.12	± 0.05	± 2.84	± 1.4
C. V.	3.64	4.53	4.12	3.81	5.19	16.64	10.94	11.38	7.3

RATIOS

	T	P/C	M/C	H/C	K/L	E/F	R/T	E/C	F/C
<i>Females</i>									
5	1.10	1.26	0.82	1.06	1.60	1.48	1.59	4.8	2.95
5	1.65	1.31	0.82	1.09	1.56	—	1.30	L 5.66 R 7.17	—
0	1.60	1.25	0.80	1.09	1.16	L 0.28 R 2.20	1.43	L 0.92	2.95
0	1.20	1.22	0.81	1.11	1.45	1.03	1.25	3.01	2.90
0	1.10	1.21	0.84	1.07	1.60	1.05	1.36	3.38	3.20
.5	1.30	1.29	0.86	1.10	2.33	—	1.26	—	—
15	7.95	7.54	4.95	6.52	9.70	L 3.84	8.19	L 17.35	12.00
10	1.32	1.25	0.82	1.08	1.61	0.96	1.36	3.47	3.00
3	± 0.1	± 0.01	± 0.008	± 0.007	± 0.15	± 0.24	± 0.05	± 0.08	± 0.67
13	± 0.24	± 0.03	± 0.02	± 0.01	± 0.38	± 0.49	± 0.12	± 1.75	± 0.13
3	18.4	3.04	2.54	1.65	23.60	51.04	9.45	50.43	45.00
<i>Males</i>									
05	1.30	1.23	0.81	1.01	1.8	—	1.57	—	3.13
55	1.10	—	0.82	1.08	1.75	—	1.40	—	3.12
60	1.35	1.31	0.77	1.07	1.33	R 1.98	1.18	R 6.48	3.27
85	1.05	1.24	0.84	1.07	1.66	—	1.76	3.74	—
80	1.45	1.32	0.82	1.13	1.36	2.22	1.24	7.0	3.14
85	1.35	1.21	0.78	1.09	1.9	L 0.64 R 2.86	1.37	L 2.07 R 6.84	3.22
.70	7.60	6.31	4.84	6.45	9.80	L 2.86	8.52	L 12.81	15.88
.78	1.26	1.26	0.80	1.07	1.63	1.43	1.42	4.27	3.17
.07	± 0.06	± 0.02	± 0.10	± 0.01	± 0.09	± 0.78	± 0.08	± 1.44	± 0.29
.18	± 0.15	± 0.04	± 0.26	± 0.03	± 0.23	± 1.11	± 0.21	± 2.50	± 0.06
.26	12.40	3.88	3.22	3.53	1.40	77.62	14.78	58.71	2.04

* L., Left side and R, Right side.

Status of this morph is still not very clear, but it appears that it has some relation with the critical period of phase transformation. So far it has occurred thus:

(1) Mukerji and Batra (1938) obtained over a dozen individuals from two laboratory mass breeding at Baluchistan and Sind. These belonged to both the sexes including fully winged and brachypterous adults.

(2) Misra (1952) obtained a single male individual from a collection of 192 examples from Kakko village (Rajasthan) in July 1949 from a population density of 18780 per sq. mile. Incidentally 1949 was the initial year of the 1949-55 locust cycle in India.

(3) Roonwal and Bhanotar (1966) obtained two females from Gr. II population of 1955 (period May-August), the last year of 1949-55 cycle in India. These were correlated by them to the most crucial and critical period of phase transformation when the equilibrium of the characters appeared to be most shaken.

(4) Bhanotar *et. al.*, (1972) obtained a single male individual in 1971 from Gadra Road (out of 127 exs. collected). The population density was 18480 per 5 sq. km. It was from the same contiguous area that a loose swarm was formed during July 1972.

According to late Dr. Pradhan (verbal discussion) the occurrence of 5-striped individual in nature indicate a quick development process in the field population accomplished by sudden phase transformation.

(B) Other variations in the 6-striped gregaria individuals (Tables 3 and 4)

Several instances of variabilities and abnormalities were noticed in 6-striped individuals bearing *gregaria* antecedents. The variable characters, their morphometrics and their departure value from normal or typical *gregaria* is given in tables 3 and 4 are as follows:

(a) *6-striped female*:—24 antennal segments; eye smaller both length and width wise; 13(inner) and 12 (outer) tibial spines; abdominal segments. The main variation is seen in the wings and elytron. The wings are very much crumpled and smaller; elytron not crumpled but smaller in size and length (28.5 mm) *ie*, 23.7 mm. reduced in length than the typical *gregaria* value. The values of other important sensitive characters such as C, P and F along with related indices P/C, E/F, and F/C are also lower than typical *gregaria* values. The individual died before attaining maturity. For values of other characters and ratios see Table-3.

(b) *6-striped female*; 25 antennal segments; eyes normal both length and width wise; abdominal segments 9. The main variation is seen in the elytron; wings normal; length of right elytron near normal (52.70 mm) but left elytron much smaller (41.75 mm.) *i.e.*, 16.26 mm. reduced

in length than the typical *gregaria* value. The values of other sensitive characters C and P along with related P/C value are also lower than typical *gregaria* values. The individual died before attaining maturity. For values of other characters and ratios see Table-3.

(c) *6-stripped male*: 27 antennal segments; eyes normal both length and width wise; abdominal segments 8; 13 (inner) and 13 (outer) tibial spines. The main variation is seen in the elytron and wings. Both elytron instead of lying on the lateral side have diagonally crossed over the abdomen from the middle. Wings 2/3rd of the body length. Tibial length 22.60 mm. The values of other sensitive characters C, P and F along with ratios P/C and F/C are also lower than typical *gregaria* values. For values of other characters and ratios see Table-3.

(d) *6-stripped female*: 25 antennal segments; eyes normal; abdominal segments 8; 13 (inner) and 11 (outer) tibial spines; tibial length 21.45 mm. The main variation is again seen in the elytron. Wings normal. The right elytron is near normal (51.0 mm) but the left elytron poorly developed. (6.60 mm) and crumpled. The values of other sensitive characters C, P and F and ratios P/C, E/F and F/C are also lower than typical *gregaria* values. For values of other characters and ratios see Table-3.

(e) *6-stripped female*: 25 antennal segments; eyes subnormal both length and width wise; 13 (inner) and 12 (outer spines); tibial length 16.50 mm; abdominal segments 8. The main variation is seen in the elytron and wings. Both elytron and wings poorly developed (17.35 mm). The values of other sensitive characters (C, P and F along with ratios P/C, E/F and F/C are lower than those in typical *gregaria*. For values of other characters and ratios see Table-3.

(f) *6-stripped male*: 26 antennal segments very much slender, black spots on many segments; eyes subnormal both length and width wise; abdominal segments 8; 13 (inner) and 14 (outer) tibial spines; tibial length 17.15 mm. The main variation is seen in the elytron and wing; no elytron and wings developed on right side, left elytron well developed but curved inward, left wing much slender and rudimentary right femur very much curved inwardly; right tibia curved at more than 90°, the adult could crawl only with hind legs raised and leaning on left side. The values of sensitive characters C and F and ratio F/C lower than those in typical *gregaria*. For values of other characters and ratios see Table-3.

(g) *6-stripped male*: 22 antennal segments eyes smaller than normal but comparatively wider; 14 (inner) and 13 (outer) tibial spines; abdominal segments 8; tibial length 19.55 mm. The main variations is seen in the elytron and wings; left elytron larger than hind-wing but both

poorly developed (16.30 mm.) less than half the length of right elytron, the right elytron (41.20 mm) and wings curved inward apically. The values of sensitive characters C, P, E and F and ratio E/F are lower than those in typical *gregaria* where as for ratios P/C and F/C these are higher. For values of other characters see Table-3.

TABLE 4.—Morphometric values (in mm.) of typical 6-striped males and females of phase *gregaria* and departure value from typical invariable individuals,

Abbreviations:—as in Table 1 and 2 and L and R left and right side of the body part respectively.

Charac- ers and ratios	Variable individuals with departure value from normal						
	sex with eye stripe		sex with eye stripes				
	♂ (6)	♀ 6	(a) 6 ♀	(b) 6 ♀	(c) 6 ♂	(d) 6 ♀	
C	7.55 ± 0.045	7.89 ± 0.074	<1.39	<0.54	<0.60	<0.74	
P	9.87 ± 0.079	10.49 ± 0.133	<2.29	<0.84	<1.32	<1.54	
E	52.85 ± 0.52	58.01 ± 0.81	<29.51 L	<16.26 R	—	L < 51.41 R < 7.01	
F	24.32 ± 0.20	26.44 ± 0.37	<7.24	—	<2.52	< 3.29	
P/C	1.305 ± 0.011	1.32 ± 0.009	<0.064	<0.014	<0.075	<0.074	
E/F	2.17 ± 0.024	2.25 ± 0.017	<0.77	—	—	L < 1.97 R < 0.05	
F/C	3.233 ± 0.32	3.320 ± 0.032	<0.370	—	<0.103	<0.370	
Antennal segments	26	26	24	25	27	25	
(e) 6 ♀	(f) 6 ♂	(g) 6 ♂	(h) 6 ♂	(i) 6 ♂	(j) 6 ♂	(k) 6 ♀	(l) 6 ♀
<2.14	<1.50	<1.20	<1.20	<1.10	<1.10	<0.99	<1.64
< 3.44	—	<1.52	<1.97	<1.32	<2.02	<2.14	<2.39
<40.66	—	L < 36.55	R < 29.05	L < 7.70	L < 39.45	R < 34.66	—
		R < 11.65		R < 51.45	R < 8.70		
<9.74	<5.42	R < 3.52	—	<4.02	R < 3.52	L < 4.34	—
<0.104	—	>0.005	<0.065	>0.015	<0.095	<0.114	<0.034
<1.22	—	R < 0.19	—	>0.05	L < 1.53	<1.20	—
					R < 0.05		
<0.420	<0.113	>0.37	—	<0.093	<0.013	<0.120	—
25	26	22	24	26	26	26	23

(h) *6-striped male*: 24 antennal segments; eyes subnormal, small comparatively wider; abdominal segments 8. The main variation is seen in the elytron and wings, left elytron and wings normal, where as right elytron poorly developed and slender (23.80 mm.), right wing small and stumpy, hind legs broken; The values of sensitive characters C, P, E and ratio P/C lower than those in typical *gregaria*. For values of other characters and ratios see Table-3.

(i) *6-striped male*: 26 antennal segments; eyes normal both length and width wise; abdominal segments 8; 13 (inner) and 13 (outer) tibial spines; tibial length 19.30 mm. The main variation is seen in the elytron and wings, left elytron and wing and right wing normal but right elytron very small (1.40 mm.) and stumpy. The values of sensitive characters C, P, E, F and ratio F/C lower than those in typical *gregaria* where as these are higher in respect to ratios P/C and E/F. For values of other characters and ratios see Table—3.

(j) *6-striped male*: 26 antennal segments; eyes normal both length and width-wise; abdominal segments 8; 13 (inner) and 12 (outer) tibial spines; tibial length 18.75mm. The main variation is seen in the elytron and wings, right elytron and wings and left wing normal but left elytron poorly developed (13.40 mm). The values of sensitive characters C, P, E and F and ratios P/C, E/F and F/C are lower than those in typical *gregaria*. For values of other characters and ratios see Table-3.

(k) *6-striped female*: 26 antennal segments; eyes normal; 12 (inner) and 13 (outer) tibial spines; tibial length 20.45 mm; on the inner side at the apical end of tibia 2 very small spines; the individual could not jump but crawl only. The main variation is seen in the elytron and wings, left elytron and wing and right wing normal but right elytron poorly developed (23.35 mm). The values of sensitive characters C, P, E and F and ratios P/C, E/F and F/C are lower than those in typical *gregaria*. For values of other characters and ratios see Table—3.

(l) *6-striped female*: 23 antennal segments; eyes subnormal, comparatively wider; abdominal segments 8; hindlegs broken; the individual could crawl only. The main variation is seen in the elytron and wings, left and right elytron and right wing fully developed but crumpled, left wing less developed. The value of sensitive characters C, P and ratio P/C are lower than those in typical *gregaria*. For values of other characters and ratios See Table-3.

(C) Variations recorded in *gregaria facies* population in nature.

Bhanotar (1959) recorded asymmetry in the striped eyes of an individual (*coll.* 20.6.55) of 1955-Gr. II population in India, the last year
Z. S...23

of 1949-55 locust cycle. With regard to morphometry and composition of eye stripes and sex ratios, the Gr. II was not significantly different from typical *gregaria*. This particular individual was obtained from a population density ranging 8500 per sq. mile. The morphometric characters indicated the *solitariform* features, however left eye had 7-stripes and the right 8-stripes.

III— BIOLOGICAL AFFINITY OF 7-STRIPED AND 6-STRIPED (ABNORMAL INDIVIDUALS OBTAINED FROM CROWDED STOCK IARI—POPULATION)

(Tables 1, 3, 5 and 6)

For assessing the biological affinity of 7-striped and 6-striped (abnormal) individuals obtained from crowded stock (IARI-population) and for assigning them to phases, these were statistically tested ('t' test) with other known populations, available in literature as follows:

1. Typical phase *gregaria* (6-*greg.*) population (Roonwal, 1949; Roonwal and Nag, 1951).
2. Typical phase 6 and 7-*solitaria* population (Roonwal, 1949; Roonwal and Nag, 1951).
3. Ajmer swarm of 1950 (*Ajm. Sw.* (6) (Roonwal and Misra, 1952).
4. 1955-Gr. III (6-7-solitarious cum transitory) population (Roonwal and Bhanotar, 1966).

In the 7-striped category of IARI-population males, sample being too small ($n=2$), were not tested statistically. Inter-population comparison of various morphometric characters and ratios in respect of females are discussed as under:—

(A) 7-striped individuals (Tables 1 and 5)

(a) Body characters:

(i) *Width of head at genal level (C) : Females* : The value in IARI-population is significantly lower than that in 6-*greg.* and *Ajm. sw.* (6) at 5% level. However, it is not significantly different from that in 1955-Gr. III (6-7-) population. Comparison with 6-and 7-striped individuals of *solitaria* was not possible due to lack of data.

(ii) *Length of pronotum (P) : Females*: The value in IARI-population is significantly lower than that in 6-*greg.* (at 1% level) and *Ajm. sw.* (6) at 5% level. It is also significantly lower than that in 1955-Gr. III (6) at 5% level and Gr. III (7) at 1% level. Comparison with 6-and 7 striped *solitaria* population was not possible due to lack of data.

(iii) *Height of pronotum (H) : Females*: The value in IARI-pop. is significantly lower than that in 6-*greg.* at 1% level of probability.

Because of lack of data in 6-7-*sol.* and *Ajm. sw.* (6) populations, comparison was not possible.

TABLE 5.—Inter—population comparison between IARI—population (7-striped) and typical phase *gregaria*, *solitaria* (Roonwal, 1949; Roonwal and Nag, 1951). Ajmer swarm of 1950 (Roonwal and Misra, 1952) and 1955-Gr. III (Roonwal & Bhanotar 1966).

Abbreviations: As in table 1 and 3 and *Ph. sol.* (7), 7-striped individuals of phase *solitaria*; *Ph. greg* (6) or 6-*greg.*, 6-striped individuals of phase *gregaria*; *Ajm. sw.* (6), 6-striped individuals of Ajmer swarm of 1950; *, significant at 5% level; **, significant at 1% level, and N. S., Not significant.

Morphometric characters and ratios	Ph. <i>sol.</i> (7)	Ph. <i>greg</i> (6)	Ajm. <i>sw.</i> (6)	1955-Gr.III	
	♀ (7)	♀ (6)	♀ (6)	♀ (6)	♀ (7)
C	—	*	*	N. S.	N. S.
P	—	* *	* *	*	* *
H	—	* *	—	* *	* *
M	—	* *	—	* *	* *
E	* *	* *	—	* *	* *
F	* *	*	* *	* *	* *
E/F	* *	*	N. S.	N. S.	*
P/C	—	N. S.	N. S.	* *	* *
F/C	—	* *	N. S.	* *	* *
H/C	—	N. S.	—	* *	* *

(iv) *Width of pronotum at constriction (M) : Females:* The value in IARI-pop. is significantly lower than that in 6-*greg.* at 1% level. Comparison was not possible with 6-7-*sol.* and *Ajm. sw.* (6) due to lack of data.

(v) *Length of elytron (E) : Females:* The value in IARI-pop. is significantly lower than that in 6-*greg.* and 7-*sol.* at 1% level. No comparative data is available in case of *Ajm. sw.* (6).

(vi) *Length of hind-femur (F): Females:* The value in IARI-pop. is significantly lower than those in 6-*greg.* (at 5% level), 7-*sol.* and *Ajm. sw.* (6) at 1 % level.

(vii) *Restricted width of elytron (W1): Females:* The value in IARI-pop. is significantly lower than those in 1955-Gr. I(6), Gr. II (6) and Gr. III (7) at 1% level. No comparative data is available for other populations.

(b) Ratios :

(i) *Ratio E/F: Females*: The value in IARI-pop. is significantly lower than those in 6-greg. (at 5% level) and 7-sol. (at 1% level), where as it is not significantly different than that in *Ajm. sw.* (6).

(ii) *Ratio P/C : Females*: The value in IARI-pop. is not significantly different from those in 6-greg. and *Ajm. sw.* (6), but is significantly lower than that in 1955-Gr. III (7) at 1% level. No comparative data is available for 7-sol.

(iii) *Ratio F/C: Females*: The value in IARI-pop. is significantly higher than those in 6-greg. and 1955-Gr. III (7) at 1% level, but is not significantly different from that in *Ajm. sw.* (6). No comparative data is available for 7-sol.

(iv) *Ratio H/C : Females*: The value in IARI-pop. is not significantly different from that in 16-greg., but is significantly lower than that in 1955-Gr. III (7). No comparative data is available for other populations.

(B) 6-striped (abnormal) individuals

(Table—3 & 6)

(a) Body characters :

(i) *Width of head at genal level (C) : Males*: The value in IARI-pop, is significantly lower than those in 6-greg. and *Ajm. sw.* (6) at 1% level, but is not significantly different from that in 1955-Gr. III (6). *Females*: The value in IARI-pop. is significantly lower than those in 6-greg., *Ajm. sw.* (6) and 1955—Gr. III (6) at 5% level.

(ii) *Length of pronotum (P): Males and Females*: The value in IARI-pop. is significantly lower than those in 6-greg. and 1955-Gr. III (6) at 1% level.

(iii) *Height of pronotum (H) : Males and Females*: The value in IARI-pop. is significantly lower than those in 6-greg. and 1955-Gr. III (6) at 1% level.

(iv) *Width of pronotum at constriction (M): Males and Females* : The value in IARI-pop. is significantly lower from those in 6-greg. (at 5% level) and 1955-Gr. III (6) at 1% level.

(v) *Length of elytron (E): Males*: The value in IARI-pop. is significantly lower from those in 6-greg. and 1955-Gr. III (6) at 1% level. *Females*: The value in IARI-pop. is not significantly different from those in 6-greg. and 1955-Gr. III (6).

(vi) *Length of hind femur (F): Males*: The value in IARI-pop. is significantly lower than that in 6-greg. (at 1% level) and 1955-Gr. III (6) at 5% level. *Females*: The value in IARI-pop. is significantly

lower than that in 1955-Gr. III (6) at 5% level, whereas it is not significantly different from that in 6-greg.

TABLE 6.—Inter-population Comparison between IARI—population (6-striped abnormal) and typical phase *gregaria*, *solitaria* (Roonwal, 1949; Roonwal and Nag, 1951), Ajmer swarm of 1950 Roonwal and Misra 1952) and 1955-Gr. III (Roonwal and Bhanotar, 1966).

Abbreviations:—As in table 1,3 and 5.

Morphometric characters and ratios	Ph.sol. (7)		Ph. greg. (6)		Ajm. sw. (6)		1955-Gr. III	
	♂	♀	♂	♀	♂	♀	♂ (6)	♀ (6)
C	—	—	**	*	**	*	N.S.	*
P	—	—	**	**	—	—	**	**
H	—	—	**	**	—	—	**	**
M	—	—	*	*	—	—	*	**
E	**	N. S.	**	N. S.	—	—	**	N. S.
F	**	*	**	N. S.	N. S.	*	*	*
P/C	—	—	N. S.	*	*	*	**	**
H/C	—	—	*	**	—	—	**	**
E/F	N. S.	*	N. S.	*	N. S.	*	N. S.	*
F/C	—	—	N. S.	N. S.	N. S.	N. S.	N. S.	N. S.

(b) Ratios:

(i) Ratio E/F : Males: The value in IARI-pop. is not significantly different from those in 6-greg. and 1955-Gr. III (6) at 5% level. Females: The value in IARI-pop. is significantly lower than those in 6 greg. and 1955-Gr. III (6) at 5% level.

(ii) Ratio P/C: Males: The value in IARI pop. is significantly lower than that in 1955 Gr. III (6) at 1% level, whereas it is not significantly different from that in 6 greg. Females: The value in IARI-pop. is significantly lower than those in 1955 Gr. III (6) at 1% level and 6 greg. (at 1% level).

(iii) Ratio F/C: Males and Females: The value in IARI-pop. is not significantly different from those in 1955-Gr. III (6) and 6-greg.

(iv) Ratio H/C: Males and Females: The value in IARI-pop. is significantly lower than those in 1955-Gr. III (6) and 6-greg. at 1% level, except at 5% level with 6-greg. males.

DISCUSSION

(1) Regarding the affinity to 7-striped individuals of IARI-population.

Of the important morphometric characters E, F, C, P, H and M for females, except for character 'C' which indicated the *solitaria* features

of the individuals, all other character show significant difference with both phase gregarious and solitarious cum transitory populations.

When compared with typical 7-striped *solitaria*, for which the data for three characters E, F and E/F is available, the IARI-pop. again revealed its significance difference from it at all levels of probability.

Of the other three ratios P/C, H/C and F/C, the former two (P/C and H/C) are in complete agreement with gregarious population *i.e.* they do not differ from each other in their values, where as between 7-striped females of 1955-Gr. III (7) the IARI-population indicates significant difference.

From the analysis we may conclude that 7-striped individuals obtained from crowded stock in laboratory as well as in nature creates imbalance in the stable gregarious population leading to weakening of the degree and intensity of gregarisation in swarming population eventually leading to disbursal and heralding the appearance of transitory individuals in nature thereby initiating the reversal shift towards phase transformation as happened in Dehra Dun swarm of 1954 (Roonwal, 1955).

This may also be one of the reasons that after every swarming season, 7-striped individuals are more frequently met in the wild field population after 3rd or 4th year of the swarming cycle.

It may be recalled here that basically 7-striped individuals make their appearance in nature during acute *solitaria* condition and these should be treated as such and related to phase *solitaria* and their appearance in gregarious populations, because of some other factors, merely creates disturbed equilibrium in the stable and constant characters normally associated with swarming phase.

(2) Regarding the affinity of 6-striped (abnormal) individuals of IARI population.

Of the characters E, F, C, P, H and M, the values in IARI population do not indicate any difference as far as character 'C' and ratio E/F is concerned when compared with 1955-Gr. III solitarious population whereas all other characters show significant difference.

In respect of females except for character E and ratio F/C, all other characters and ratios behave in the same way as in males. IARI-population when compared with typical *gregaria* values indicates significantly lower values in all characters in males except for ratios P/C, E/F and F/C and in females E, F and F/C.

Thus IARI-population of abnormal 6-striped individuals obtained from *gregaria* stock show less affinity to either phases and their appearance

rance after some generations in swarming population may create instability in the constancy of swarming population.

The egg laying capacity of these females (abnormal) also dwindled considerably (36 eggs per pod).

CONCLUSIONS

The variations in the hitherto stable and consistent phase related to *gregaria* population has been observed in morphometric characters especially in the elytron, hindwings, antennal segments, tibial region and in the eye-stripes in Desert Locust. These variations are noticeable equally among males and females. The 7-striped forms so far related to phase *solitaria* also makes their appearance in gregarious population bred under crowded condition under normal laboratory condition after few generations. These 7-striped morphs behave in a typical gregarious way. So far few observations of such type have been recorded in nature. It is suggested that dynamics of swarming population in nature should be studied in detail as the occurrence of such variations may reveal the intensity and degree of gregarisation and probable hint towards start and decline of phase transformation.

ACKNOWLEDGEMENT

We are grateful to Dr. N. C. Pant, Head, Division of Entomology, IARI, New Delhi, for providing us necessary facilities.

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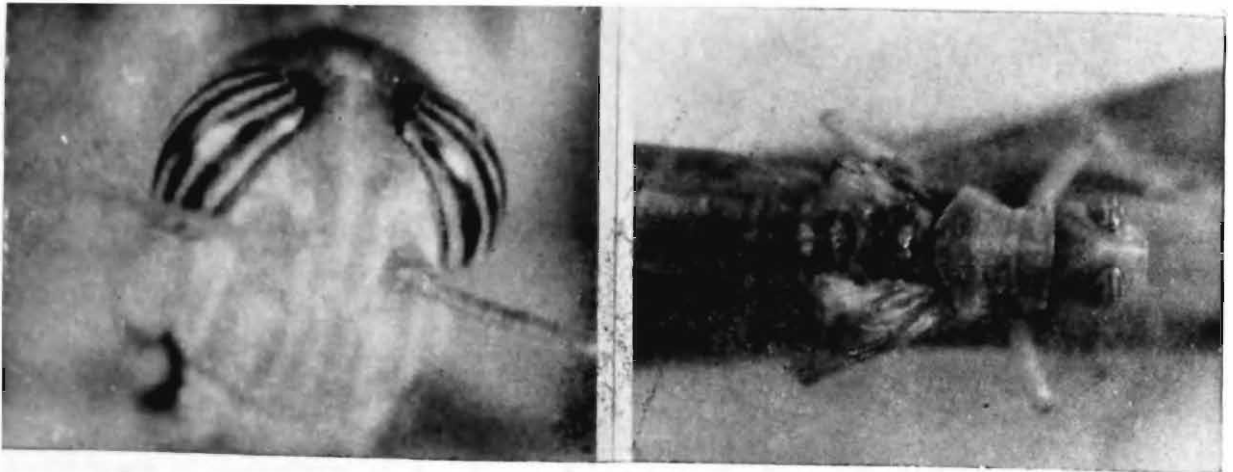
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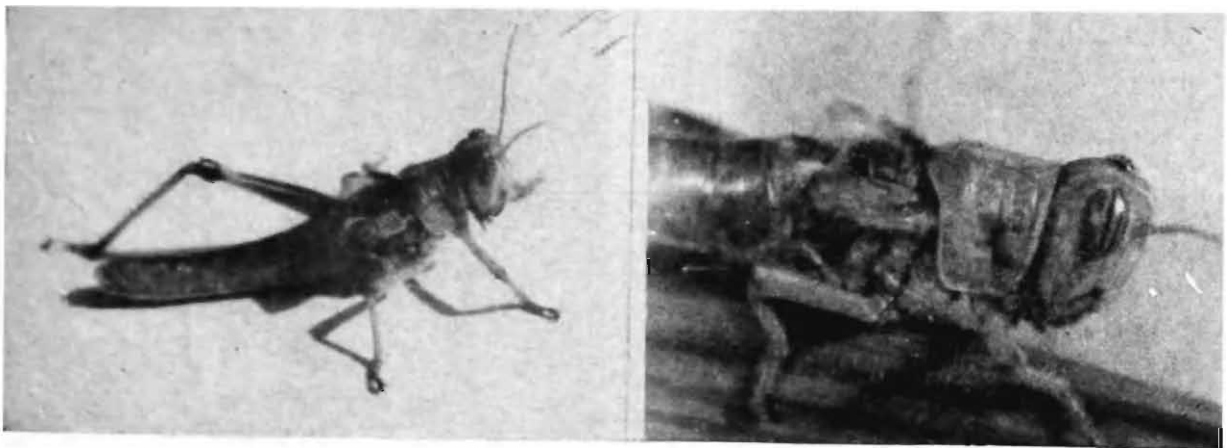
A

B



C

D



The Desert Locust, *Schistocerca gregaria* Forskal. A--front view of the head showing 4 eyestrips in brachypterous female; B--Dorsal view showing 4 eyestrips and crumpled wings and elytron; C--Full view of the 4 eyestriped brachypterous female; D--Lateral view of the same.

ON THE NEW RECORD OF THE GENUS
TARTAROGRYLLUS TARBINSKII AND THE
DESCRIPTION OF VELARIFICTORUS
ANDAMANENSIS (B. H.) FROM INDIA

By

H. K. BHOWMIK

Zoological Survey of India, Calcutta.

(With 1 Text-figure)

INTRODUCTION

While working on an unnamed collection of gryllids from Mysore (South India), the author came across two species of the genus *Tartarogryllus* Tarbinskii 1940 which are new to Indian fauna and are recorded herewithunder for the first time. The paper further comprises of the fuller description of the species *Valarifictorus andamanensis* (Bh.), recorded from South Andaman Island (Bay of Bengal).

All material studied in this paper are deposited in the National Collections of the Zoological Survey of India.

All measurements are given in mm.

SYSTEMATIC ACCOUNT

Order ORTHOPTERA

Family GRYLLIDAE

Subfamily GRYLLINAE

Genus *Tartarogryllus* Tarbinskii 1940

1. *Tartarogryllus bucharicus* (Bey-Bienko)

(Text-fig. 1A)

1933. *Gryllus bucharicus* Bey-Bienko, *Bol. Soc. Esp. Hist. Nat.*, 33:323-325; Bey-Bienko, *Acad. Sci. URSS.*, 259.

1936. *Gryllulus bucharicus* Chopard, *Spol. Zeyl.*, 20: 25.

1961. *Tartarogryllus bucharicus* Chopard, *Eos*, 37: 272.

Measurements.—Length of body ♂♂ 11—13, ♀♀ 8—10.5; length of pronotum ♂♂ 1.8—1.95, ♀♀ 2—2.25; maximum width of pronotum

♂♂ 2.75—3, ♀♀ 3—3.25; posterior femora ♂♂ 5.95—6, ♀♀ 6—6.25; posterior tibiae ♂♂ 3.25—3.6. ♀♀ 3.25—3.7; ovipositor 4.5-6.

Material examined.—4 ♂♂, 1 ♀, Mysore city (University Campus); 3 ♂♂, 1 ♀ Hissar (Haryana).

Remarks.—The occurrence of the species in India is reported for the first time. Its distribution over widely separated parts in India such as Mysore and Haryana indicates its probable abundance all over India.

The male genitalia when viewed dorsally does not agree with the figure given by Chopard (1967). So the same is refigured here.

2. *Tartarogryllus depressiceps* (Ebner)

1935. *Gryllus depressiceps* Ebner, *Anz. Akad. Wiss. Wien*, 15: 51.

1961. *Tartarogryllus depressiceps* Chopard, *Eos*, 37: 272.

Measurements.—♂: Length of body 9; elytra 6; wing 11; posterior femora 5.25; posterior tibiae 3.5.

Material examined.—1 ♂, Mysore city (University campus). S. Vasantha, dt. 1964.

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

Genus *Velarifictorus* Randell, 1964

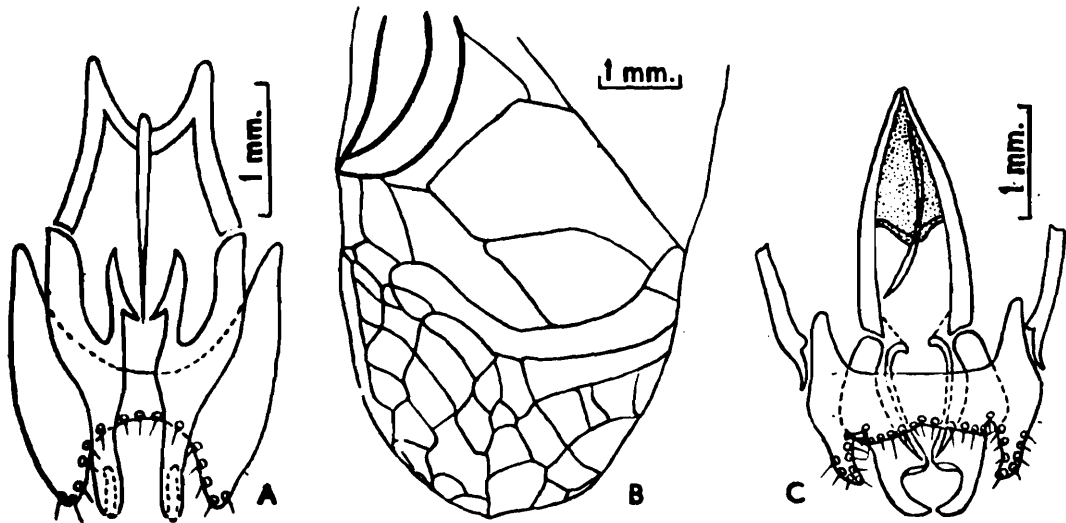
3. *Velarifictorus andamanensis* (Bhowmik)

(Text-figs. 1 B & C)

1967. *Scapsipedus andamanensis* Bhowmik, *Proc. Indian. Sci. Cong. Assoc. Benaras*, Part B: Abst. 492.

Description.—Male: Size medium, brown varied with yellow, pubescent. Head in front as wide as pronotum, rounded, with six clear but uneven yellow lines on the occiput and vertex, and a transverse yellow band connecting the lateral ocelli; anterior ocellus, mandibles and maxillary palpi yellow, rest of the head including face shiny brown; front slightly sloping; frontal rostrum almost twice as wide as the first antennal segment. Face distinctly concave and long with the mandibles less prominent and not excavated; clypeo frontal suture straight; clypeus partially divided, labrum convex with rounded apex; third and fourth segments of maxillary palpi subequal, fifth longest, slightly widened apicad. Pronotum brown with yellow spaces, transverse, slightly widened in front, anterior margin somewhat concave, posterior margin straight, both margins ciliated; disc convex and with a median longitudinal suture; lateral lobes with superior part black and inferior part yellow, inferior margin feebly ascending posteriorly. Abdominal dorsum brown, ventrum yellow. Male genitalia as in figure. Legs testa-

aceous with a few scattered brown spots. Anterior tibia with a long, oval tympanum only at the external face; posterior femora stout and with brown striations; posterior tibia with five spines on each margin, metatarsi longer than other two segments taken together and with denticles on



Text-fig. 1A. *Tartarogryllus bucharicus*, male genitalia, ventral view; $\times 30$.

B & C. *Velarifictorus andamanensis*, B. male elytron, apical portion; $\times 10$.

C. male genitalia, ventral view. $\times 25$.

each margin. Elytra extending up to the apex of abdomen, brown; mirror rectangular and divided by a curved vein in the middle, connected with the first chord by a small veinlet; three curved chords; diagonal a little sinuated and bifurcated at base; two oblique veins; apical field prominent and rounded, at apex with irregular areolae; lateral lobes transparent except a little portion near the mediastinal vein which is dark brown, the inner three of the five veins widely separated; each mediastinal vein with three branches.

Female: Differs from male in the following: the clypeo frontal suture moderately arquate, the colouration of facial shield not uniform, the shield bordering the clypeo frontal suture is shiny brown and with two other small brown lateral ocular bands; face and mandibles almost like a typical gryllus; pronotum a little convex at posterior margin; elytra about 1.5 mm shorter than abdomen, rounded at apex, dorsal neuration complex, only first three veins somewhat clear, other veins are distinguishable only apicad; ovipositor long and straight with both apical valves almost of equal size and acute.

Measurements.—Length of body ♂ 13.5, ♀♀ 13.5—14.25; length of pronotum ♂ 3, ♀♀ 2.75—3; width of pronotum ♂ 4.75, ♀♀ 4.5—4.85; elytra ♂ 8.5, ♀♀ 7.75—8.35; posterior femora ♂ 10, ♀♀ 10.25—10.6; posterior tibia ♂ 7, ♀♀ 8—8.25; ovipositor 10.75—11.25.

Distribution.—South Andaman Island.

Material examined.—1 ♂ (Holotype), 2 ♀♀ (paratypes) from Mannar, ghat, Wright Myo, B. S. Lamba, March, 1964; 1 ♀ (paratype), Cowriaght (South Andaman Island), coll. and dt. same as for the holotype.

Remarks.—In its general appearance, particularly in colouration, the species approaches *Modicogryllus confirmata* (Walker) but its bigger size, long and excavated face, elytral venations and especially its male genitalia justify the erection of a new species. Dr. Randell who confirmed the species as new suggested its inclusion in the genus *Velarifictorus* Rand. because of the nature of genitalia which is very similar to *V. aspersus*, but differs in the structure of ectoparamere and its association with mesal lobes.

ACKNOWLEDGEMENTS

The writer owes his indebtedness to Dr. D. N. Raychawdhuri, Reader, Calcutta University, for guidance during this study and to late Prof. L. Chopard, Paris, for substantial help in many ways.

SUMMARY

The paper enlists the occurrence of the genus *Tartarogryllus* Tarbinskii with the two species, *T. bucharicus* and *T. depressiceps*, for the first time from India. It also provides the full description of the species, *V. andamanesis*, described from S. Andaman Isl.

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TERMITES OF KANHA NATIONAL PARK (MADHYA PRADESH), INDIA

By

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(With 5 plates and 4 text-figures)

INTRODUCTION

(a) General

Kanha National Park is situated at about 22°45' N. latitude and 80°45' E. longitude, in District Mandla of Madhya Pradesh, India. It covers an area of about 245 sq. km. The approximate elevation varies from about 535-880 m. The landscape and the valleys are open.

The average annual rainfall is about 180 cm. The maximum temperature in shade is about 40° C in hot season and the minimum temperature is 5° C in winter.

The Park is full of belts and islands of 'Sal' (*Shorea robusta*) forests and is very rich in insects and wildlife.

The author made an intensive collection of termites in the Park in June, 1964, and the present publication is based on the study of this collection, and some other collections made by Dr. M. L. Roonwal and Dr. K. K. Tiwari of the Zoological Survey of India and Dr. George B. Schaller of Johns Hopkins University (U.S.A.). Sixteen species belonging to two families are reported and field observations in respect of their nesting habits are recorded.

(b) Abbreviations used

The following abbreviations are used: *coll.*, collected by; *ex.*, extracted from; *exs.*, examples; *Im.*, imago; *K.*, king; *Ny.*, nymphs; *Q.*, queen; *S.*, soldier; *W.*, worker; *Z.S.I.*, Zoological Survey of India.

SYSTEMATIC ACCOUNT AND BIOLOGICAL OBSERVATIONS

Family 1 RHINOTERMITIDAE

Subfamily (i) COPTOTERMITINAE

1. *Coptotermes heimi* (Wasmann)

(a) *Material examined*.—A vial with 2 S. and 1 W., coll. K. K. Tiwari, 10.i.1966.

(b) *Measurements*.—(in mm), etc.—*Soldier*: Range (2 exs.): Total body-length, c 3.80—4.00, head-length to lateral base of mandibles 1.27—1.30, maximum width of head 1.01—1.03, length of left mandible 0.73—0.77, maximum diameter of fontanelle 0.13, maximum width of pronotum 0.67—0.70, No. of antennal segments 14.

(c) *Distribution*.—*C. heimi* is widely distributed in India and Pakistan. For detailed distribution *vide* Roonwal and Chhotani, 1962a.

(d) *Biological notes*.—It damages dead and live trees of forestry importance, agricultural crops, converted wood and timber in houses. Roonwal (1959) gives its biology.

Family 2 TERMITIDAE

Subfamily (i) AMITERMITINAE

2. *Speculitermes sinhalensis* Roonwal and Sen-Sarma

(a) *Material examined*.—(i) Two vials with *W.* only, one coll. O. B. Chhotani (026/15.6.64), 15.vi.1964, “under stone and in soil, making narrow galleries”; and the other coll. K. K. Tiwari, 10.i.1966, 600 m alt. (ii) A vial with *W.* and *Ny.*, coll. K. K. Tiwari, 13.i.1966, Bamhni Dadar, c 900 m alt.

(b) *Measurements (in mm), etc.*—*Worker*: Range (5 exs.): Total body length, c 4.40—5.70, head length to tip of labrum 1.70—1.80, head-length of lateral base of mandibles 1.03—1.10, maximum width of head 1.30—1.37, diameter of mid-dorsal spot 0.07—0.08, maximum width of pronotum 0.70—0.77, No. of antennal segments 14.

(c) *Distribution*.—*S. sinhalensis* is known from Sri Lanka and India. It is fairly well distributed in southern India where the author collected it extensively in the year 1962. For detailed distribution in Sri Lanka and southern India, *vide* Roonwal and Chhotani, 1966a.

The present record of the species from Kanha National Park, Madhya Pradesh, shows the northward extent of its distribution.

(d) *Remarks*.—It was believed that the soldier caste in the genera *Speculitermes* and *Anoplotermes* had been lost secondarily, until Roonwal and Chhotani (1960) reported its occurrence in *S. sinhalensis*.

(e) *Biological notes*.—Roonwal and Chhotani (1966a) have given a detailed description of the species, its biology, etc. In Kanha National Park, it was collected from under a stone, making narrow galleries running horizontally a little below the ground-level for some distance.

3. *Euhamitermes kanhaensis* Roonwal and Chhotani

(a) *Material examined*.—The holotype *S.*, morphotype and paramorphotype *W.*, as mentioned in Roonwal & Chhotani (1965).

(b) *Distribution*.—This species is known only from Khana National Park, M. P., India.

(c) *Biological notes*.—*E. kanhaensis* has been collected from under a stone along with the species *Odontotermes obesus* (Ramb.). It makes narrow, longitudinal galleries in the soil.

4. *Eurytermes boveni* Roonwal and Chhotani

(a) *Material examined*.—Holotype *S.*, morphotype and paramorphotype *Im.*, and *W.*, as mentioned in Roonwal and Chhotani (1966b).

(b) *Distribution*.—India: Madhya Pradesh : Kanha National Park (type-locality).

(c) *Biological notes*.—*E. boveni* has been collected from soil making long and narrow galleries, running horizontally about 2-5 cm below the ground-level. The galleries are flattened at places into small, round pockets. The species *Odontotermes assmuthi* Holmgren was also collected from galleries very close to the galleries of the species.

5. *Synhamitermes quadriceps* (Wasmann)

(a) *Material examined*.—Two vials, one (No. 010/16.6.64) with *K.*, *Q.*, *S.* and *W.*, and the other (No. 029/15.6.64) with *Im.*, *S.*, and *W.*, both coll. O. B. Chhotani, June, 1964, nesting in type 'D' mounds of *Odontotermes abesus* (Rambur).

(b) *Measurements (in mm), etc.*—(i) *Imago* : Range (7 exs.) : Total body-length with wings, *c* 9.20—10.40, total body length without wings 4.50—5.00, length of head to tip of labrum 0.97—1.10, length of head to lateral base of mandibles 0.70—0.73, width of head with eyes. 0.83—0.90, max. diameter of eye 0.20—0.21, max. diameter of ocellus 0.09—0.10, min. eye-ocellus distance 0.04—0.05, width of pronotum 0.67—0.70, length of forewing with scale 7.35—8.20, length of hindwing with scale 7.05—8.00, No. of antennal segments 15. (ii) *Soldier*: Range (5 exs.): Total body-length, *c* 3.10—4.30, length of head of lateral base of mandibles 0.90—1.00, max. width of head 0.80—0.83, length of left mandible 0.60, length of right mandible 0.60—0.63, max. width of pronotum 0.50, No. of antennal segments 13.

(c) *Distribution*.—*S. quadriceps* is known from Maharashtra, Madhya Pradesh, Assam and Rajasthan in India, as follows:—*Maharashtra*: Bombay; Khandala; Kusgaon Forest, Lonavala; Vardhangad Forest, Koregaon. *Madhya Pradesh*: Kanha National Park (present record). *Rajasthan*: Chitenpura near Kotah. *Assam*: Gotanagar.

The distribution of this species in Sri Lanka, as given by Roonwal and Chhotani (1962*b*), is actually the distribution for *S. ceylonicus* (Holmgren).

(*d*) *Biological notes*.—In Kanha National Park, the species has been found inhabiting large, dome-shaped, type 'D' mounds of *Odontotermes obesus*. The nests are generally confined to the wall area of the mounds. They are in the form of narrow galleries which get flattened and enlarged into small, round or oval chambers of 2-3 cm diameter. A queen and king were collected from one such chamber.

6. *Microcerotermes beelsoni* Snyder

(Pl. VIII, figs. 1 and 2)

1933. *Microcerotermes beelsoni* Snyder, T. E. *Proc. U. S. nat. Mus.*, **82** (Art. 16) : 12-14. *Im. Type-locality* : Chakata Range, Haldwani, U. P., India.
1933. *Microcerotermes championi* Snyder, T. E. *Proc. U. S. nat. Mus.*, **82** (Art. 16) : 14-15 *Im., S. Type-locality*: Haldwani District, Kumaon, U. P., India, *New synonymy*.
1967. *Microcerotermes beelsoni* Prashad, B., Thapa, R. S. and Sen-Sarma, P. K. *Indian For. Bull. (N. S., Ent., No. 246*: 6, 14-18; and 6, 31-34 (for *championi*).

(*a*) *Material examined*.—10 vials, all coll. O. B. Chhotani; June, 1964, as follows:—Six vials with *Im., S.* and *W.*, 03/14.6.64 and 031/15.6.64 from carton nests in mounds (type 'D') of *Odontotermes obesus*; 02, 03 and 019/15.6.64, from dead stumps of wood lying on ground; and 027/15.6.64, from under a stone. Three vials (013, 016 and 020/15.6.64) with *S.* and *W.*, from pieces of wood lying on jungle floor; and one vial (05/16.6.64) with *Q., S.* and *W.*, from under a stone.

(*b*) *Measurements (in mm), etc.*—(i) *Imago*: Range (14 exs.): Total body-length with wings, *c* 8.50—9.90, total body length without wings, *c* 4.80—5.90, length of head to tip of labrum 1.07—1.17, length of head to lateral base of mandibles 0.80—0.90, width of head with eyes 0.83—0.90, max. diameter of eye 0.18—0.23, max. diameter of ocellus 0.07—0.10, min. eye-ocellus distance 0.05—0.07, width of pronotum 0.65—0.73, length of forewing with scale 7.00—8.00, length of hindwing with scale 6.70—7.70, No. of antennal segments 14 (rarely 13). (ii) *Soldier*: Range (12 exs.): Total body-length, *c* 4.70—5.50, length of head to lateral base of mandibles 1.40—1.67, max. width of head 0.87—1.00, length of left mandible 0.87—0.93, width of pronotum 0.57—0.63, No. of antennal segments 13 (rarely 12).

(*c*) *Distribution*.—*India*: Uttar Pradesh: New Forest, Dehra Dun; Jhajra, Dehra Dun; Chakata Range, Haldwani (type-locality); Hald-

wani (type-locality for *championi*). Delhi: Vijaya Nagar, Delhi. Madhya Pradesh : Kanha National Park (present record).

(*t*) *Remarks*.—Snyder (1933) separated the imago of *M. championi* from that of *M. beesoni*, described by him in the same paper, for having ocelli slightly larger and separated from eyes by a distance of less than the long diameter, slightly smaller eyes and longer pronotum. I have examined the cotypes of both *beesoni* and *championi* and also a long series of imagos collected by me in Kanha National Park. These characters, on which the species have been separated, have been found to be variable. In the figures as given by Snyder (1933), the mesonotum and metanotum are shown to have deep emargination of posterior margin in case of *beesoni* and weaker emargination in *championi*, this character is very variable and was also noted by Snyder in *beesoni*. As such *championi* Snyder is treated here as a synonym of *beesoni* Snyder.

(*e*) *Biological notes*.—In Kanha National Park this species has been observed nesting in dead stumps, under stones, in soil, etc. In soil, it makes narrow galleries which are coated with greyish material and at one place, under a stone, a physogastric queen and soldiers and workers were collected from a small chamber from which the galleries ran to different sides. It was also observed nesting in a what appeared to be a deserted mound (type 'D') of *Odontotermes obesus*, making extensive galleries running from almost the top to the base of the mound. A large number of imagos, soldiers, workers and young ones were found in the wood pieces of a dead plant which was completely covered by the mound soil. The wood was transformed into a carton-like structure (Pl. 1 figs. 1 and 2). No queen was found in the carton structure. Roonwal (1970) describes the nest of this species as large, hard, dark brown structures of semi-digested wood and lignine and of varying shapes. A large nest, according to him weighs about 15 kg.

Subfamily (ii) TERMITINAE

7. *Dicuspiditermes obtusus* (Silvestri)

(*a*) *Material examined*.—Four vials with soldiers and workers, coll. O. B. Chhotani, as follows:—One vial (No. 01/9.6.64), 9.vi.64, nesting in *Odontotermes obesus* mound (type 'D') and three vials (Nos. 023 and 025/15.6.64 and 04/16.6.64), 15-16.vi. 1964. ex. under stones.

(*b*) *Measurements (in mm), etc.*—*Soldier* : Range (5 examples) : Total body length, c 5.80—7.00, length of head with mandibles 3.88—4.40, length of head to lateral base of mandibles 2.00—2.33, width of head 1.25—1.40, median length of labrum 0.30—0.50, width of labrum 0.27—0.33, length of left mandible 1.80—2.10, width of pronotum 0.73—0.90, No. of antennal segments 14.

(c) *Distribution*.—*India*: Orissa: Barkuda Island, Chilka Lake, type-locality. *Madhya Pradesh* : Kanha National Park (present record).

(d) *Biological notes*.—This species has been collected from under stones and soil. In the soil, it makes narrow, longitudinal galleries, which are coated with blackish faecal material. It has also been noted to nest in the walls of *Odontotermes obesus* mound (type 'D').

8. *Pericapritermes tetraphilus* (Silvestri)

(Pl. VIII, fig. 3)

(a) *Material examined*.—A vial with several *S.* and *W.*, *O. B. Chhotani* coll. (02/14.6.64), 14.vi.64, ex. *Odontotermes obesus* mound (type 'D').

(b) *Measurements (in mm), etc.*—*Soldier*: Range (5 examples) : Total body-length, *c* 8.00—9.00, length of head with mandibles 4.60—4.73, length of head to lateral base of mandibles 2.83—3.05, max. width of head 1.60—1.70, length of left mandible 1.63—1.70, max. width of labrum 0.30—0.33, max. length of labrum 0.20—0.23, width of pronotum 1.03—1.13, No. of antennal segments 14.

(c) *Distribution*.—*India*: Kanha National Park, Madhya Pradesh (present record). *Bangladesh*: Rangamati, Chittagong Hill Tracts (type-locality). *Burma*: Maymyo; Yegaw, Pa-an (Karen State).

(d) *Remarks*.—Mathur and Sen-Sarma (1961) described *Capritermes orientalis* from Maymyo, Burma, but Krishna (1965) treated it as a synonym of *Pericapritermes tetraphilus* Silvestri. I have examined the paratypes of *orientalis* Mathur and Sen-Sarma and the present specimens from Kanha National Park agree with them in all respects. As I have had no access to the types of *tetraphilus* Silvestri, I have followed Krishna (1965).

(e) *Biological notes*.—In Kanha National Park this species was found inhabiting the mound (type 'D') of *Odontotermes obesus* (Rambur). It makes small, narrow (2-15 mm wide) galleries which lead into chambers of different sizes (3-4 cm in diameter) and shapes. At one place near the top of the mound, the galleries lead into larger (6-8 cm in diameter) chambers, arranged in tiers one above the other, having flat floors and arched roofs (Pl. VIII, fig. 3). From this set of chambers, galleries of variable sizes lead to about the base of the mound. The galleries and chambers are all coated with greyish faecal matter. A large number of soldiers and workers were collected from these chambers. No royal chamber with queen and the king was, however, found.

Subfamily (iii) MACROTERMITINAE

9. *Odontotermes assmuthi* Holmgren

(a) *Material examined*.—(i) One vial (028/15.6.64) with *Im.*, *S.* and *W.* and two vials (022/15.6.64 and 06/16.6.64) with *S.* and *W.* only,

all coll. *O. B. Chhotani*, June, 1964. (ii) One vial with *S.* and *W.*, Kisli, Kanha National Park, coll. *K. K. Tiwari*, 10.i.1966.

(b) *Measurements (in mm), etc.*—(i) *Imago*: Range (3-5 exs.) : Total body-length with wings, *c* 24.80—26.00, total body-length without wings, *c* 11.80—13.00, length of head to tip of labrum 2.25—2.60, length of head to lateral base of mandibles 1.50—1.80, width of head with eyes 2.20—2.27, max. diameter of eye 0.57—0.60, max. diameter of ocellus 0.19—0.20, min. eye-ocellus distance 0.20—0.25, width of pronotum 1.87—2.03, length of forewing with scale 21.00—22.00, length of hindwing with scale 19.30—20.00, No. of antennal segments 19. (ii) *Soldier*: Range (5 exs.): Total body-length *c* 4.80—5.30, length of head to lateral base of mandibles 1.50—1.70, max. width of head 1.07—1.20, length of left mandibles 0.77—0.80, distance of tooth from the tip in left mandible 0.25—0.28, width of pronotum 0.75—0.86, No. of antennal segments 16.

(c) *Distribution*.—This species is known only from India and is recorded as follows: *India*: Jammu and Kashmir: Gangara and Tanden Forest, Udhampur. Panjab : Gurdaspur; Hoshiarpur; Hamirpur. Uttar Pradesh: Dehra Dun (Malhan and New Forest). Madhya Pradesh : Kanha National Park (present record). Bihar : Burgeri; Pusa. Maharashtra: Bombay (Borivili Jungle, type locality; Salsette Is.). Karnataka : Karwar; Mercara. Tamil Nadu : Shevaroy Hills.

(d) *Biological notes*.—*O. assmuthi* does not construct any mounds; its nests are underground. In Kanha National Park it has been collected, along with *Eurytermes boveni*, from under stones, 2-5 cm below the ground surface, and from a mound of *Odontotermes obesus*. In the later case, it was observed making small, round chambers near the ground surface. From these chambers, imagos, soldiers and workers were collected. The main nest, it is presumed, was below the ground-level as the galleries lead downwards into the soil.

The author has collected this species while swarming and coming out of a hole in the ground at about 4.45 P.M. on 28th June, 1955, at New Forest, Dehra Dun. Swarming has also been reported during July and August.

10. *Odontotermes bhagwatii* Chatterjee and Thakur

(Pl. VIII, figs. 4 and 5; Text-fig. 1; Table 1)

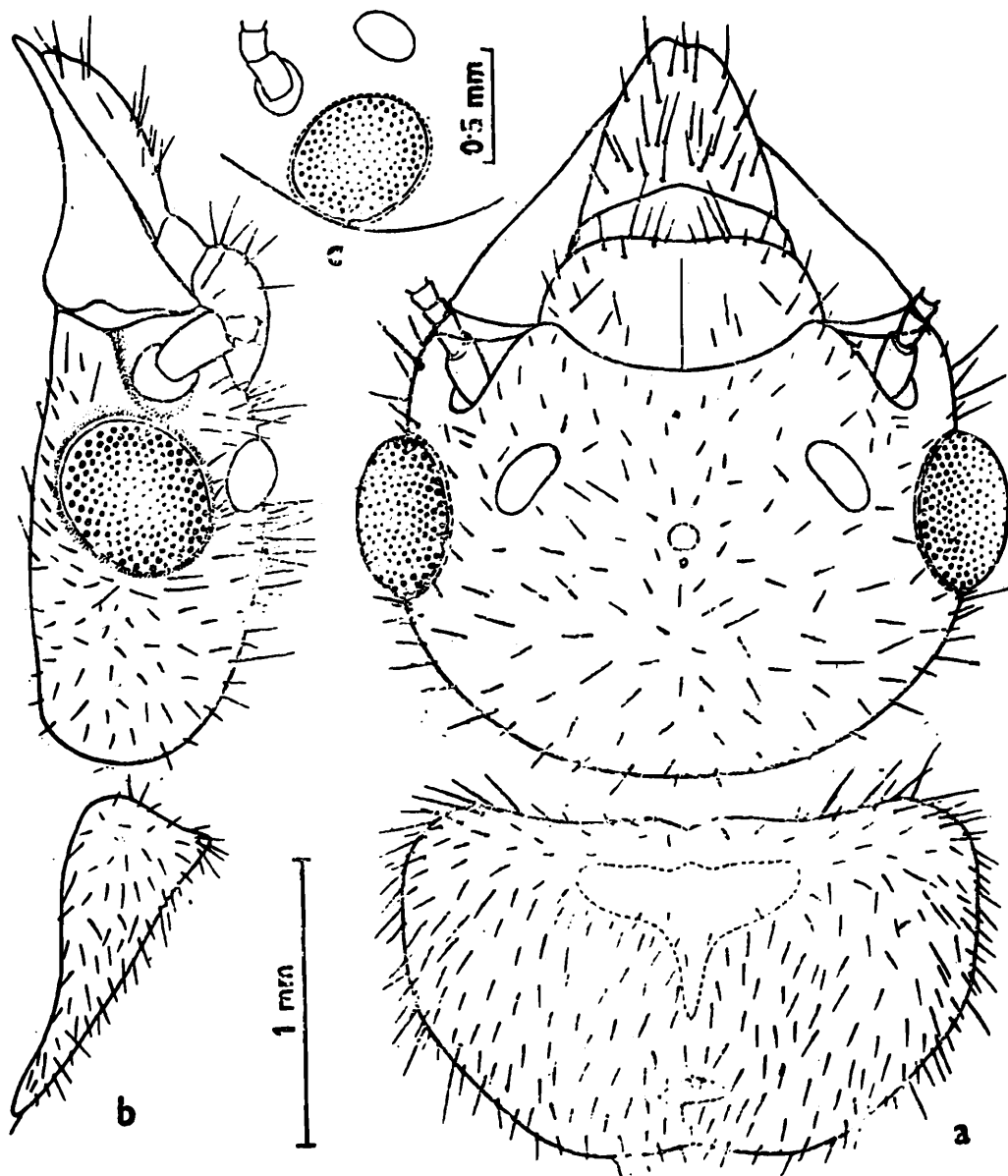
(a) *Material examined*.—Nine vials with *S.* and *W.*, coll. *O. B. Chhotani*, June 1964, thus : 03/13.6.64, from bark of a "Serai" tree; 05, 8, 9, 10, 11, 14 and 15/15.6.64, from twigs of unknown plants lying on ground and 024/15.6.64, from under a stone. Two vials with *S.* and *W.*, coll. *K. K. Tiwari*, Dec. 1965—Jan. 1966, Kanha Rest House (1 vial)

and Kisli Rest House (1 vial). One vial with four *Im.* and one *S.*, coll. George B. Schaller, 27.vi.1964, "coming in swarms from holes in ground."

The hitherto undescribed imago is described here from a collection associated with soldiers.

IMAGO (Text-fig. 1; Table 1).

Head-capsule dark brown; postclypeus, labrum and antennae brownish; pronotum, legs and wing-scales dark brown, paler than head-capsule; wings pale brown, transparent; abdominal tergites brownish, paler than postclypeus; sternites yellowish brown. Head body and legs densely hairy; wings hairy along costal border and in distal one-third.



TEXT-FIG. 1. *Odontotermes bhagwati* Chatterjee and Thakur. Imago. (a) Head, and pronotum, dorsal view. (b) Ditto, side view. (c) Portion of head, showing position of eye, ocellus and antenna.

Head-capsule subcircular; wider than its length to base of mandibles; sutures indistinct; frons weakly depressed. Fontanelle minute, point-like; slightly raised; small area around fontanelle and a little area distal to it, paler. Eyes roundly suboval, only slightly longer than broad; situated obliquely (Text-fig. 1 *b*) little above lateral margin; maximum diameter 0.57—0.60 mm., minimum diameter 0.50—0.53 mm. Ocelli oval, translucent; moderately large 0.30—0.33 mm long and 0.20—0.23 mm wide; from the eyes separated by about short diameter. Antennae with 19 segments; segment 1 long cylindrical; 2 about half of 1, cylindrical; 3-5 short, subequal; 6 to 10 gradually increasing in length; 11 to penultimate subequal, pyriform; last ovate, subequal to preceding-ones. Postclypeus pilose, swollen, little shorter than to half as long as its width; medially divided by dark longitudinal line. Anteclypeus subtrapezoidal, whitish, apilose. Labrum broadly tongue-shaped; little wider than long. Mandibles typically *Odontotermes*-type. Pronotum trapezoidal; narrower than head with eyes; anterior margin weakly incurved, with prominent median notch; posterior margin convex, incurved medially; sides narrowing behind; antero-lateral corners narrower than postero-lateral ones. Mesonotum and metanotum deeply incurved at posterior margin; densely pilose. Legs long; apical tibial spurs 3:2:2. Wings long, pale brownish. Forewing longer than hindwing; scale also longer than that of hindwing and not covering the latter; costa-subcosta fused, thick, running along anterior margin; radius short, fusing with costa-subcosta just outside scale; radial sector as thick as costa-subcosta, running parallel with latter upto distal margin; radial streak separating before middle of wing membrane; median thin, arising from cubitus in wing-membrane and running closer to and parallel with latter, giving off 2-4 branches in distal third; Cubitus weak, giving off 13-15 branches to posterior margin. Hindwing with costa-subcosta, radius and radial-sector as in forewing; median arising from radial sector outside scale and giving off some branches in distal half; cubitus as in forewing, giving off 11-13 branches to posterior margin. Abdomen oblong; densely hairy. Cerci 2-segmented, hairy. styli short, point like.

Comparison: In size it comes close to the imago of *Odontotermes assmuthi* but is generally paler (dark brown vs blackish brown), and has the ocellus larger in size and situated at about its short diameter (vs long diameter) from the eye.

(*b*) *Measurements (in mm), etc.*—(i) *Imago*: Table 1. (ii) *Soldier*: Range (10 exs.) : Total body-length, *c* 4.50—5.50, length of head to ateral base of mandibles 1.50—1.67, maximum width of head 1.13—1.23, length of left mandible 0.83—0.97, distance of tooth from tip in left mandible 0.47—0.52, maximum width of pronotum 0.80—0.87, No. of antennal segments 15-16.

TABLE 1.—Measurements (in mm) etc., of *Odontotermes bhagwatii* Chatterjee and Thakur.

CASTE.—Imago.		
Body-parts		Range (4exs.)
1. Total body-length <i>with</i> wings (excluding antennae), <i>c</i>		24.60—26.00
2. Total body-length <i>without</i> wings, (excluding antennae), <i>ca.</i>	..	10.00—13.20
3. Length of head to lateral base of mandibles		1.67— 1.83
4. Maximum width of head (with eyes)		2.17— 2.37
5. Maximum height of head		0.83— 0.87
6. Maximum length of postclypeus		0.43— 0.50
7. Maximum width of postclypeus	..	0.93— 1.03
8. Maximum length of labrum		0.53— 0.67
9. Maximum width of labrum		0.67— 0.73
10. Maximum diameter of compound eye (with ocular sclerite)		0.57— 0.60
11. Minimum eye—lateral margin distance		0.10— 0.17
12. Maximum diameter of lateral ocellus	..	0.30
13. Minimum diameter of lateral ocellus		0.20— 0.23
14. Minimum eye-ocellus distance		0.20
15. Minimum eye-antennal distance		0.13— 0.17
16. Minimum Ocellus-antennal distance		0.27— 0.30
17. Maximum length of pronotum		1.17— 1.23
18. Maximum width of pronotum		1.83— 2.13
19. Length of forewing with scale		21.60—23.10
20. Length of forewing scale		1.10— 1.17
21. Length of hindwing with scale	.	20.20—22.00
22. Length of hindwing scale		1.00

(c) *Distribution.*—*India*: Punjab : Pathankot (type-locality). Madhya Pradesh : Kanha National Park; Kisli (present record).

(d) *Remarks.*—The soldiers present before me from Madhya Pradesh are somewhat smaller than those available to Chatterjee and Thakur (1967) and have 15-16 segmented antennae (16-segmented *vide* Chatterjee and Thakur, 1967).

(e) *Biological notes.*—The species feeds on dead wood and has been collected from bark of a 'Serai' tree and from twigs and logs of unknown woods lying on the ground in the forest. It has also been found cultivating fungus under a stone. The fungus combs are small, flat, cake-like structures (Pl. VIII, figs. 4 and 5) made from pellets of excreta which are laid in thin, flake-like, upright sheaths. The whole structure is very porous and looks something like a brain coral.

11. *Odontotermes guptai* Roonwal and Bose

1961. *Odontotermes bellahunisensis guptai* Roonwal, M. L. and Bose, G., *J. Bombay nat. Hist. Soc.*, 58 (3) : 588-593, S., W. *Type-locality* : India : Near Gudha village, Nagpur District, Rajasthan.
1967. *Odontotermes lokanandii* Chatterjee, P. N. and Thakur, M. L., *Indian For. Rec. (N. S.) Ent.*, 11(1) : 5, 7, 38-41, pls. 5 and 6. *Type-locality* : India : Residence plot No. 6, near River Tavi, Jammu, Jammu and Kashmir. *New Synonymy*.
1975. *Odontotermes guptai*, Roonwal, M. L., in *Environment Analysis of the Thar Desert* (Ed. R. K. Gupta and I. Prakash) : 409.

(a) *Material examined*.—A vial (No. 08/13.6.64) with S. and W., coll. O. B. Chhotani, 13. vi.1964., ex. "under dung."

(b) *Measurements (in mm), etc.*—*Soldier*: Range (5 exs.) : Total body-length, c 4.20—4.80, length of head to lateral base of mandibles 1.07—1.20, maximum width of head 1.00—1.07, length of left mandible 0.60—0.63, distance of tooth in left mandible from tip 0.19—0.20, maximum width of pronotum 0.77—0.83, No. of antennal segments 16.

(c) *Distribution*.—*India* : Rajasthan: Near Gudha village; Sayadpur salt colony; and Bikaner and vicinity. Jammu and Kashmir: Jammu. *Madhya Pradesh* : Kanha National Park (present record). *Pakistan* : Karachi and vicinity.

(d) *Remarks*.—I have compared the paratype soldier of *O. lokanandii* Chatterjee and Thakur with the holotype of *O. bellahunisensis guptai* Roonwal and Bose and have found them to be identical. *O. bellahunisensis guptai* has priority over *lokanandii*, therefore, the later is treated as a synonym. *O. b. guptai* has recently been raised to the specific level by Roonwal (1975).

12. *Odontotermes horni* (Wasmann)

(a) *Material examined*.—Four vials with S. and W. as follows:—Two vials, coll. O. B. Chhotani, June, 1964, No. 016/15.6.64 ex. "a twig lying on ground" and No. 03/16.6.64 ex. "under a stone"; and two vials coll. K. K. Tiwari, January, 1966, Kisli, Kanha National Park.

(b) *Measurements (in mm), etc.*—*Soldier*: Range (5 exs.): Total body-length c 7.00—7.70, length of head to lateral base of mandibles 2.50—2.60, maximum width of head 1.97—2.05, length of left mandible 1.27—1.33, distance of tooth in left mandible from tip 0.70—0.73, maximum width of pronotum 0.77—0.83, No. of antennal segments 17.

(c) *Distribution*.—It is a widely distributed species in India and Sri Lanka.

(d) *Biological notes*.—This species is not known to construct any mounds; its nests are subterranean. It feeds on dead logs and bark of trees. In Kanha National Park, it has been collected from dead twigs lying on the ground and from under stones.

13. *Odontotermes microdentatus* Roonwal and Sen-Sarma

(Pl. IX, Text-fig. 2)

(a) *Material examined*.—A vial with *S.* and *W.*, coll. *M. L. Roonwal* (R1/21.4.63), ex. mound. Two vials (Nos. 01/13.6.64 and 01/16.6.64) with *Im.*, *S.* and *W.*; two vials (Nos. 01/10.6.64 and 01/12.6.64) with *K.*, *Q.*, *S.* and *W.*; and two vials (Nos. 03/8.6.64 and 03/11.6.64) with *S.* and *W.*, all coll. *O. B. Chhotani*, June, 1964, from mounds. Two vials with *S.* and *W.*, one from a log of wood (No. 09/13.6.64) and other from bark of a 'Sal' tree (No. 05/13.6.64), and a vial (032/15.6.64) with one *Im.*, "at light at 8 P. M." coll. *O. B. Chhotani*, June, 1964. A vial with *S.* and *W.*, Kisli, Kanha National Park, c 600 m. altitude, coll. *K. K. Tiwari*, 9.i.1966, "below a wooden log in the forest around Kisli village"

(b) *Measurements (in mm), etc.*—(i) *Imago* : Range (5 exs.) : Total body-length with wings, c 28.40—30.00, total body-length without wings, c 12.40—14.40, length of head to tip of labrum 2.60—2.80, length of head to lateral base of mandibles 2.00—2.13, width of head with eyes 2.73—2.80, max. diameter of eye. 0.77—0.83, max. diameter of ocellus 0.33—0.37, minimum eye-ocellus distance 0.13—0.17, width of pronotum 2.37—2.50, length of forewing with scale 24.25—26.60, length of hindwing with scale 22.60—25.50, No. of antennal segments 19. (ii) *Soldier* : (Range 10 exs.) : Total body-length, c 4.60—5.30, length of head to lateral base of mandibles 1.37—1.43, maximum width of head 1.10—1.17, length of left mandible 0.87—0.90, distance of tooth from tip in left mandible 0.23—0.27, maximum width of pronotum 0.87—0.93, No. of antennal segments 16—17.

(c) *Distribution*.—*India*: Himachal Pradesh : Bilaspur. Punjab : Palampur. Uttar Pradesh : Dehra Dun; Kalsi. Bihar : Netarhat, Gumla; Porabat; Saranda. Madhya Pradesh : Kanha National Park (present record).

(d) *Biological notes*.—Its mounds (Text-fig. 2; Pl. IX, fig.1), in Kanha National Park are dome-shaped, have a few round swelling and vary from 28-100 cm in height and 4.50—6.30 m in circumference at the base. Inside the mound, there is generally a large, central, multi-tiered fungus comb in a central cavity and a number of smaller combs in vaults or chambers (pl. IX, fig. 2). Sometimes the central comb is not

formed. The royal cell is spindle-shaped, flat-floored and arched-roofed cell (14-15×9-12 cm) situated at ground-level to a depth of about 10 cm below. The fungus combs (pl. IX, figs. 3 and 4) are fairly large, irregular, cake-like structures. They are made up of pellets of excreta laid in horizontal sheaths. The upper side of the combs has fewer pores than on the lower side.



TEXT-FIG. 2. Mound of *Odontotermes microdentatus* Roonwal and Sen-Sarma.

This species has also been observed attacking logs of wood lying on ground and making earthen galleries on and under the bark of "Sal" trees.

14. *Odontotermes obesus* (Rambur)

(Pls. X-XII, Text-figs. 3 & 4; Table 2)

In Kanha National Park, four types of mounds were observed from which extensive collections were made. The mounds are easily separable but it is not possible to differentiate the specimens from these various types of mounds as they are morphologically similar. As such, it is not easy to refer specimens from different mounds to different species but the structure of the mounds is so different that it seems very unlikely that the same species would construct four different kinds of mounds in the same area and locality. It appears to be a case of sibling species and only some other aspects of taxonomy like the protein analysis, cytotaxonomy, etc. can solve this problem. Unfortunately, I do not have any termitophilous insects from these mounds except some Collembola which could throw some light. The Collembola, however, from all the four types of mounds belong to the species *Pseudocypoderus annandalei* Imms. This does not help as this species has also been recorded from *O. redemanni* (Wasm.) (Imms, 1912), *O. wallonesis* (Wasmann) from Madhya Pradesh (Srivastava, unpublished record) and from ground nest of a termite from Lonavala, Maharashtra (Yosii, 1966). It is also collected in association with *O. microdentatus* in Kanha National Park.

Holmgren (1912, pp. 778-781), while studying collections of termites from Bombay and neighbourhood, has referred to three different type of mounds and the collection therefrom to three different biological types of *Odontotermes obesus* (Rambur). Later in a note in the same publication (pp. 781-783), he concluded that these were not distinct forms and that they merged into one another with regards to their morphological characters as well as the structure of their nests.

In Kanha National Park, the mound type 'A' (*vide* below), in general shape and structure, is same as described by Holmgren (1913, Pl. E), referring it to *Odontotermes bangalorensis* (*nec. bengalensis* Holmgren which is not described, though the plates are labelled as *Odontotermes bengalensis*); Annandale (1923), referring to *O. obesus oculatus* Silvestri; Roonwal (1962), referring to *O. obesus*; and Becker (1962), referring it to *O. redemanni* (Wasmann). The mound type 'B' is like the one correlated to form 'a' by Holmgren (1912) and Roonwal and Chhotani (1963). The type 'C' mound cannot be compared with any described earlier and type 'D' is most probably deserted mound of type 'B'

Until some definite conclusions are reached, I refer my observations on the mounds and the material separately in respect of the four types of mounds under the species *O. obesus* (Rambur) as some of these mounds have been referred to this species at one time or the other.

(a) *Material examined*.—All coll. *O. B. Chhotani*, June, 1964, except otherwise mentioned, as follows:—

From type 'A' mound: Coll. *M. L. Roonwal* (R5/21.4.63), *S.* and *W.* 02/9.6.64, *K.*, *Q.*, *S.*, *W.* and *Ny.*; 03/12.6.64; *K.*, *Q.*, *W.*, *Ny.* and eggs; 05/14.6.64, *S.* and *W.*; and 08/16.6.64, *K.*, *Q.*, *S.*, and *W.*

From type 'B' mound: 01/8.6.64, *K.*, *Q.*, *S.*, *W.* and *Ny.*; 02/12.6.64, *K.*, *Q.*, *S.*, *W.* and *Ny.*; and 010/13.6.64, *K.*, *Q.*, *S.* and *W.*

From type 'C' mound: 01/11.6.64, 2 *Q.*, *K.*, *Im.*, *S.* and *W.*; and 02/11.6.64, *K.*, *Q.*, *S.*, *W.* and *Ny.*

From type 'D' mound: 03/10.6.64, *S.*, *W.* and young-ones; 01/14.6.64, *S.*, *W.* and dead *Im.*; and 030/15.6.64, *S.* and *W.*

Apart from the above collection from mounds, the following material was also available for study:—

Two vials with *S.* and *W.*, 04/13.6.64, ex. under cowdung; and 06/14.6.64, ex. under stone, coll. *O. B. Chhotani*, June 1964; one vial with *Im.*, coll. *O. B. Chhotani* (01/15.6.64), "while swarming at about 5.30 A.M. after a rain the evening before"; and one vial with *Im.*, coll. *George B. Schaller*, 21.vi.1964.

(b) *Measurements, etc.*—Table 2.

TABLE 2.—Measurement (in mm), etc. of *Odontotermes odesus* (Rambur)

Body-Parts	Type of mound and range			
	'A' (2-3 exs.)	'B' (4 exs.)	'C' (5 exs.)	'D' (3 exs.)
(a) IMAGO				
1. Total body-length with wings <i>c</i>	Only King & queen available	Only king & queen available	29.60—30.70	25.30—26.00
2. Total body-length without wings <i>c</i>	10.8—13.00 (dealate <i>K.</i>)	11.60—12.20	14.00—15.30	10.60—12.00
3. Length of head to tip of labrum	2.80— 3.00	3.00— 3.05	2.57— 3.07	2.63— 2.70
4. Length of head to lateral base of mandibles	1.83— 2.00	1.90— 2.00	1.83— 2.07	1.73— 1.87
5. Width of head with eyes	2.50— 2.73	2.67— 2.83	2.60— 2.83	2.43— 2.50
6. Maximum diameter of eye	0.77— 0.87	0.80— 0.87	0.73— 0.87	0.73
7. Maximum diameter of ocellus	0.33— 0.38	0.33— 0.40	0.30— 0.43	0.33— 0.37
8. Minimum eye-ocellus distance	0.09— 0.12	0.10— 0.13	0.11— 0.13	0.13
9. Width of pronotum	2.33— 2.43	2.33— 2.47	2.30— 2.43	2.10— 2.23
10. Length of forewing with scale	—	—	26.00—26.90	20.00—22.80
11. Length of hindwing with scale	—	—	24.00—24.70	19.30—22.30
12. No. of antennal segment	Broken	Broken	19	19
(b) SOLDIER				
1. Total body-length <i>c</i>	(8 exs.) 4.95— 6.50	(8 exs.) 4.25— 5.80	(8 exs.) 4.20— 5.00	(6 exs.) 4.90— 5.20
2. Length of head to lateral base of mandibles	1.33— 1.67	1.23— 1.40	1.30— 1.43	1.20— 1.40
3. Maximum width of head	1.13— 1.37	1.07— 1.23	1.17— 1.20	1.00— 1.20
4. Length of left mandible	0.90— 1.00	0.80— 0.87	0.87— 0.90	0.75— 0.90
5. Distance of tooth from tip in left mandible	0.27— 0.35	0.27— 0.31	0.30— 0.33	0.27— 0.30
6. Maximum width of pronotum	0.90— 1.07	0.87— 1.00	0.90— 0.97	0.80— 0.90
7. No. of antennal segments	16—17	16—71	16—71	16—17

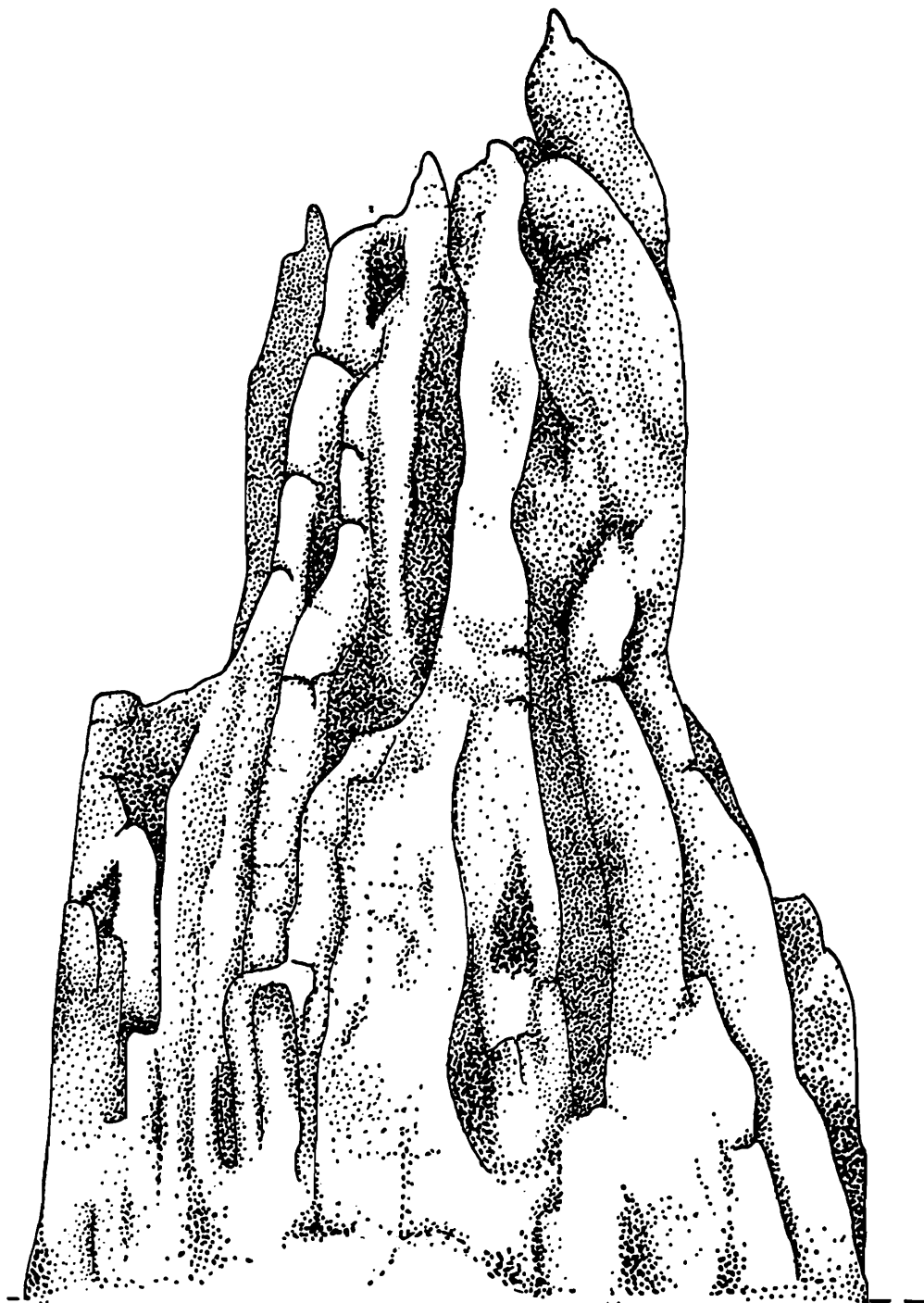
CHHOTANI : On Termites

(c) *Distribution*.—It is a very common termite and is widely distributed in India and Pakistan.

(d) *Biological notes*.—*O. obesus* is a common mound-building termite in India. The four types of mounds, as observed in Kanha National Park, are briefly described below.

Mound Type 'A' (Pl. X, Text-fig. 3).

The tall, unilocular (Pl. X, figs. 1 and 2) mounds with buttresses, varying from about 29 cm to 2.35 m in height and 1.14—7.2 m in circumference at base, are referred to type 'A' The structure of the mound,



TEXT-FIG. 3. Mound of *Odontotermes obesus* (Rambur), type 'A'.

the fungus combs, the royal chamber, etc. have been described in details by Roonwal (1962). The royal chamber (Pl. X, fig. 3), with a spindle-shaped cell inside, is generally an irregular mass of earth, lying approximately at the ground-level or a little below, in the middle or on one side of the mound. In one case however, it was found to have got mixed up in the walls and was located about 40 cm above the ground-level. The fungus combs (Pl. X, figs. 4 and 5) are located in the middle of the mound in a large cavity which extends into the ground to some extent. The combs are very porous and have upright sheaths.

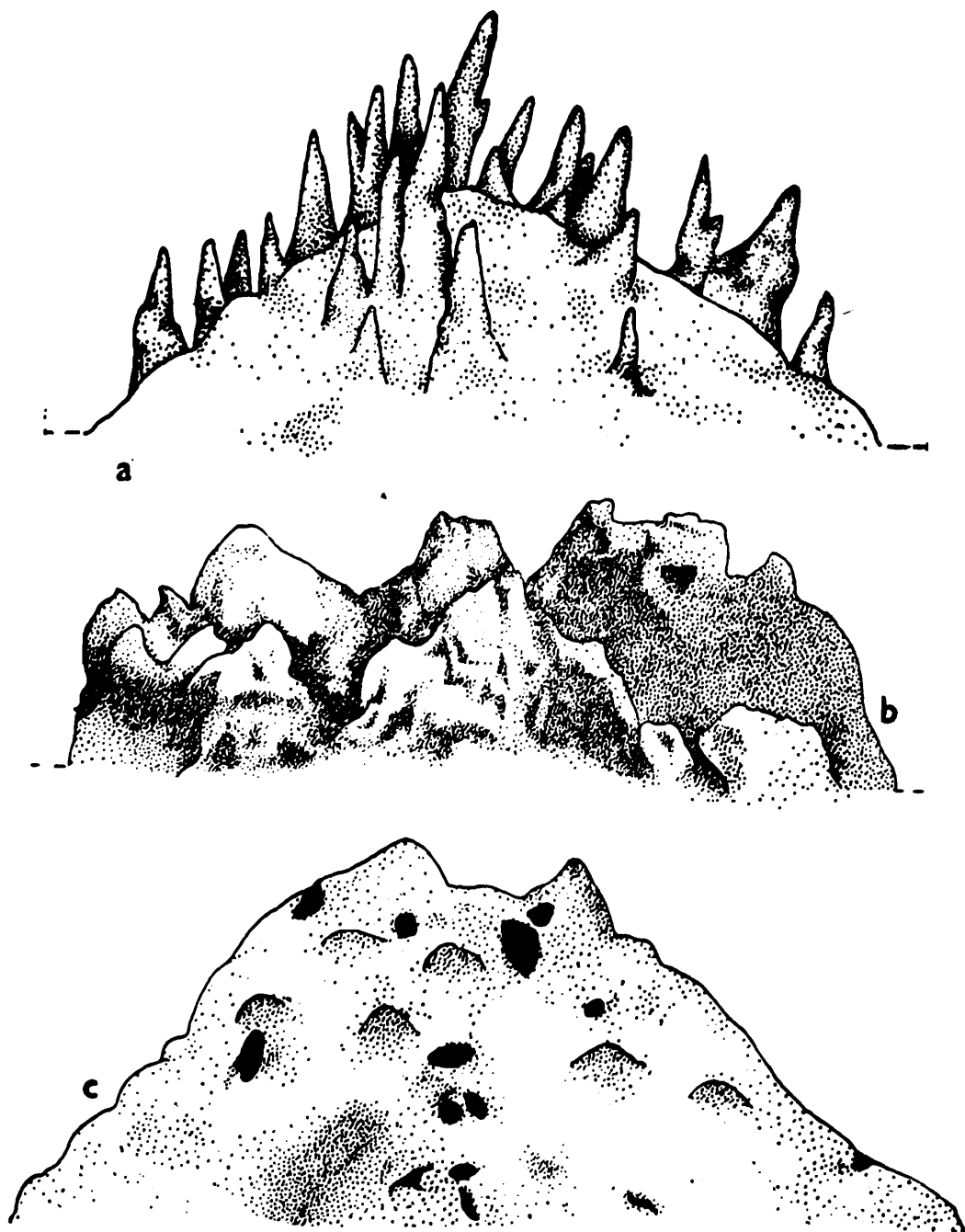
Mound type 'B' (Pl. XI; Text-fig. 4 a).

This type of mounds are dome-shaped and have large number of turrets. The height of the mounds with turrets varies from 60—110 cm and without turrets from 38-64 cm and the circumference at base is 5.80 to 9.10 m. The turrets (Pl. XI, fig. 2) are without any openings outside, have granular, irregularly-leveled outer surface and hollow tunnels leading down below into the nest. Inside, the nest extends to about the depth of its height without turrets and has a large number of vaults or chambers of varying shapes and sizes with the fungus combs. Sometimes a large cavity, divided into several, small, irregular compartments, having fungus combs, is present in the middle of the nest. The royal cell is spindle-shaped, 12-15 cm long and 6-8 cm wide and is located in soil at about the ground level. The fungus combs are flat, cake-like structures having sponge-like perforations (Pl. XI, figs. 4, 5). The sheaths or the layers of the combs are laid up horizontally.

Mound type 'C' (Pl. XII, figs. 1-4; Text-fig. 4 b).

To type 'C' are referred the mounds having a number of lumps of earth over the ground surface. These structures or the lumps are 10-15 cm high, extend in an area of about 5 m circumference, have no openings outside and are hollowed inside. The main nest is below the ground surface, extends to a depth of 50-80 cm below the ground-level and has a number of fungus vaults which are generally round in shape, those just below the lumps of earth are somewhat oval. The fungus combs are thin, flat, round or irregularly-shaped, cake-like structures (Pl. XII, figs. 3 and 4) and are quite similar to those found in type 'B' mounds. The spindle-shaped royal cell is of about 12×8 cm size. In one mound it was found at about the ground-level and in another about 25 cm below the surface of ground. In the later case 2 queens of appreciably different size and one king were found, showing thereby that the smaller queen was a later addition.

The imagos were collected from under the fungus combs at a depth of 15 cm and at the extreme depth of the mound.



TEXT-FIG. 4. Mounds of *Odontotermes obesus* (Rambur). (a) Type 'B'. (b) Type 'C'. (c) Type 'D'.

Mound type 'D' (Pl. XII, figs. 5-7; Text-fig. 4 c)

To this type are referred large, (60—110 cm in height and 5.75-9.30 m in circumference at base), dome-shaped mounds (Pl. XII, fig. 5) having a number of large holes opening outside. These mounds, comparative to size, are very thinly populated, have a very few small and thin fungus combs (Pl. XII, figs. 6 and 7) and several empty fungus vaults. The royal cell too was found empty in two such mounds and not traceable in another. Most probably these mounds were deserted due to certain reasons and looked very much like the type 'B' (described above) as

the general shape of type 'B' mounds without the turrests would be like that of these except that these are larger in size.

15. *Microtermes obesi* Holmgren

(a) *Material examined*.—A vial with *Im.*, *S.* and *W.*, coll. *O. B. Chhotani*, (017/15.6.64). 15.vi.1964 "under a stone" Four vials with *S.* and *W.*, thus: 01c/8.6.64, ex. a mound of *Odontotermes obesus* type 'B'; 02/10.6.64 and 02/13.6.64, ex. mounds of *Odontotermes microdentatus*; and 04/14.6.64 ex. mound of *Odontotermes obesus* type 'D'; and two vials Nos. 04/15.6.64 and 021/15.6.64, ex. twigs of unknown plants, all coll. *O. B. Chhotani*, June 1964. Two vials, coll. *K. K. Tiwari*, one from Kanha National Park Rest House, 31.xii.1965 and the other from Kisli, alt. c 600 m, 10.i.1966.

(b) *Measurements (in mm), etc.*—(i) *Imago*: Range (5 exs.): Total body-length with wings, c 14.20—14.40, total body-length without wings, c 8.00—8.70, length of head to tip of labrum 1.53—1.60, length of head to lateral base of mandibles 0.93—1.03, width of head with eyes 1.27—1.33, max. diameter of eye 0.40—0.43, max. diameter of ocellus 0.11—0.13, min. eye-ocellus distance 0.06—0.07, width of pronotum 1.13—1.27, length of forewing with scale 11.70—12.75, length of hindwing with scale 10.90—11.45, No. of antennal segments 15. (ii) *Soldier*: (Range 10 exs.): Total body-length, c 3.00—3.90, length of head to lateral base of mandibles 0.83—0.87, maximum width of head 0.73—0.80, length of left mandible 0.47—0.50, max. width of pronotum 0.47—0.53, No. of antennal segments 14.

(c) *Distribution*.—It is a very common species and is known from all over the Indian subcontinent. From Sri Lanka it is recorded from Mha Illuppalama.

(d) *Biological notes*.—*M. obesi* is widely distributed. In Kanha National Park, it has been found occurring in soil and in the walls of the mounds of *Odontotermes* spp. The nest is in the form of inter-communicating galleries and small chambers or vaults of 2-4 cm diameter. In these vaults are lodged the fungus combs which are cultivated by the termites. It has also been found eating up twigs of some unknown plants lying on the ground.

16. *Microtermes unicolor* Snyder

(a) *Material examined*.—Several *Im.*, coll. *M. L. Roonwal* (R1/21.4.63), 21.iv.1963, ex. mound of *Odontotermes microdentatus* R. & S. and coll. *George B. Schaller*, 22.vi.1963. Also coll. *O. B. Chhotani*, June, 1964, thus: Three vials with *Im.*, *S.* and *W.*, No. 03/9.6.64, ex. mound type 'A' of *Odontotermes obesus* (Ramb.); 04/10.6.64, ex. dome-shaped mound (type 'D') of *Odontotermes obesus*; and 04/11.6.64, ex. mound

of *Odontotermes microdentatus*; three vials with *S.* and *W.*, Nos. 07 and 08/15.6.64, ex. twigs of woods lying on ground and 04/16.6.64, under stone; and one vials with two *Im.*, (No. 033/15.6.64), "at light."

(b) *Measurements (in mm), etc.*—(i) *Imago*: Range (5 exs.) : Total body-length with wings, *c* 15.00—15.80, total body-length without wings, *c* 8.80—9.30, length of head to tip of labrum 1.53—1.67, length of head to base of mandibles 1.00—1.07, width of head with eyes 1.37—1.40, maximum diameter of eye 0.39—0.40, maximum diameter of ocellus 0.17—0.20, minimum eye-ocellus distance 0.02—0.03, width of pronotum 1.20—1.30, length of forewing with scale 12.20—13.80, length of hindwing with scale 11.60—13.00, No. of antennal segments 15. (ii) *Soldier*: Range (5 exs.): Total body-length, *c* 3.00—3.90, length of head to lateral base of mandibles 0.87—0.90, maximum width of head 0.77—0.80, length of left mandible 0.43—0.47, maximum width of pronotum 0.51—0.53, No. of antennal segments 14.

(c) *Distribution.*—*M. unicolor* is known from Northern India (Punjab, Himachal Pradesh and Jammu and Kashmir), central India (present record) and Pakistan.

(d) *Biological notes.*—This species occurs in soil and in the walls of the mounds of *Odontotermes* spp. The nest is like that of *M. obesi* and it cultivates small fungus combs which are generally round structures and are made up of small granular pellets. It has also been collected eating up small twigs of wood lying on ground.

ACKNOWLEDGEMENTS

The author is grateful to the Joint Director-in-Charge, Zoological Survey of India, for the facilities and encouragement in his work on termites; to Dr. H. Khajuria, Officer-in-Charge, Central Regional Station, Z.S.I., Jabalpur, for extending necessary facilities in his collection work; to Dr. M. L. Roonwal, formerly Director, Z.S.I., for initiating the author to undertake the survey and study of termites of the Kanha National Park; and to Dr. V. D. Srivastava, Zoologist, Z.S.I. for identification of termitophilous Collembola, collected from *Odontotermes* mounds.

SUMMARY

Kanha National Park is situated in Mandla District of Madhya Pradesh and is very rich in insects and wild-life. The present paper deals mainly with the study of termite collections which the author made in June, 1964.

As many as 16 species are recorded, of which one belongs to the family Rhinotermitidae and the others to Termitidae. Two species

viz. *Microcerotermes championi* Snyder and *Odonotermes lokanandii* Chatterjee and Thakur are relegated into synonymy and the unknown imago of *Odontotermes bhagwatii* Chatterjee and Thakur is described here for the first time.

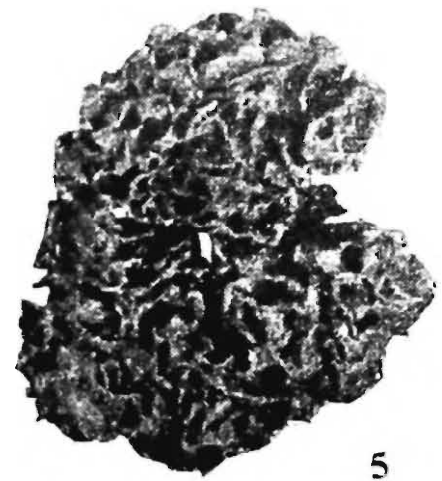
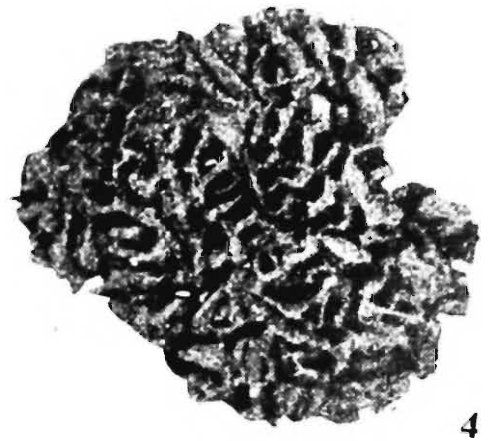
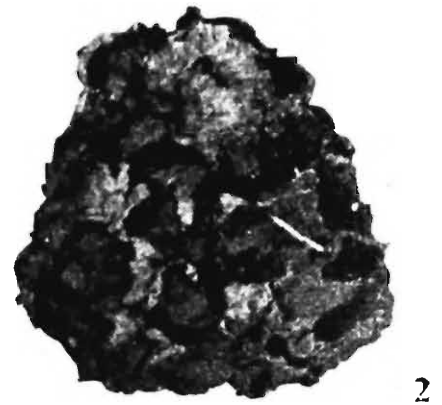
Field observations with regards to the nesting behaviour and the biology of the different species are recorded.

Specimens from the four different types of mounds found in the Park could not be differentiated, the structure of the mounds, the fungus combs, the royal chambers, etc. are so different that it is difficult to believe that the same species makes so many different types of mounds in the same area. It is possible that these mounds belong to more than one sibling species and until some other aspect of taxonomy can solve this intricate problem the specimens are referred to the species *Odontotermes obesus* (Rambur) to which some of these mounds have at one time or the other been referred.

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(1) Nest of *Microcerotermes beesoni* Synder in a stump of wood. (2) Carton structure from the nest of *Microcerotermes beesoni* Synder. (3) Nest of *Pericapritermes tetraphilus* Silvestri in the walls of *Odontotermes cbesus* (Rambur) mound type 'D' showing chambers, in tiers one above the other. (4) Fungus comb of *Odontotermes bhagvatii* Chatterjee and Thakur in dorsal view. (5) Ditto, in ventral view.



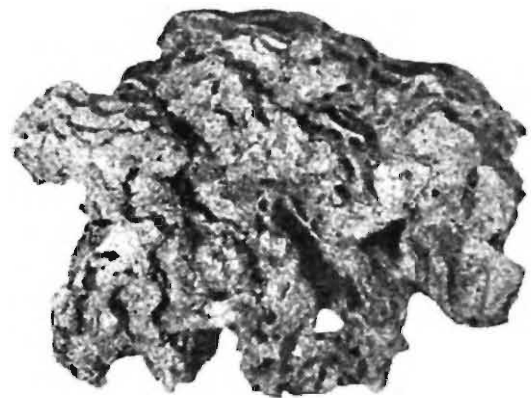
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Odontotermes microdentatus Roonwal and Sen-Sarma. Mound and fungus combs.

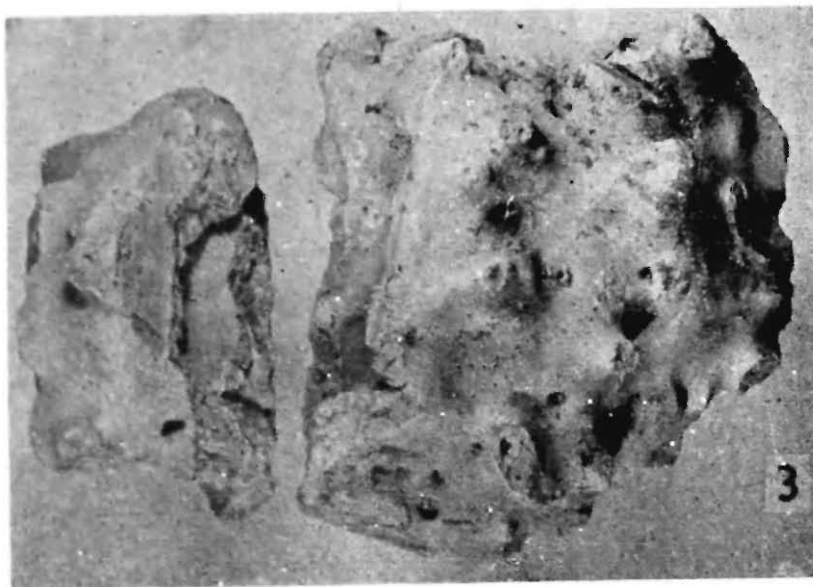
- (1) Whole mound.
- (2) Mound, in vertical section, showing vaults with fungus combs.
- (3) Fungus combs, in dorsal view.
- (4) Ditto, in ventral view.



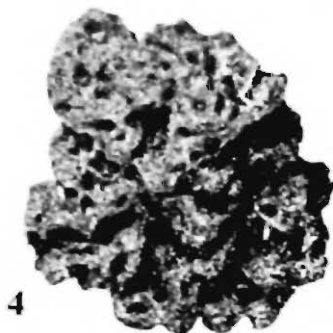
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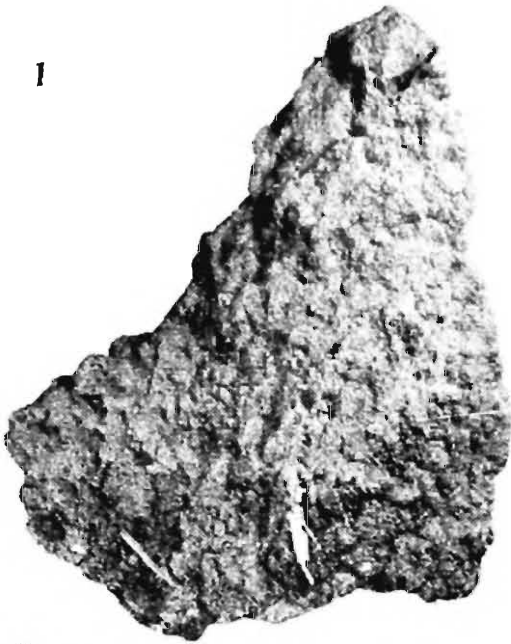


Odantotermes obesus (Rambur). Mound, royal chamber and fungus combs—Type 'A' (1) Mound as a whole. (2) Mound in vertical section, showing fungus combs near the base in middle. (3) Royal chamber cut into two pieces to show the royal cell. (4) Fungus combs, in dorsal view.

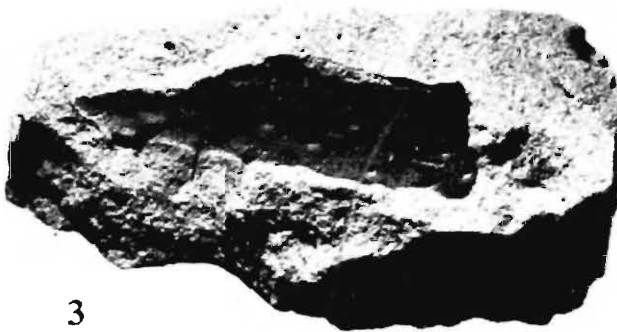


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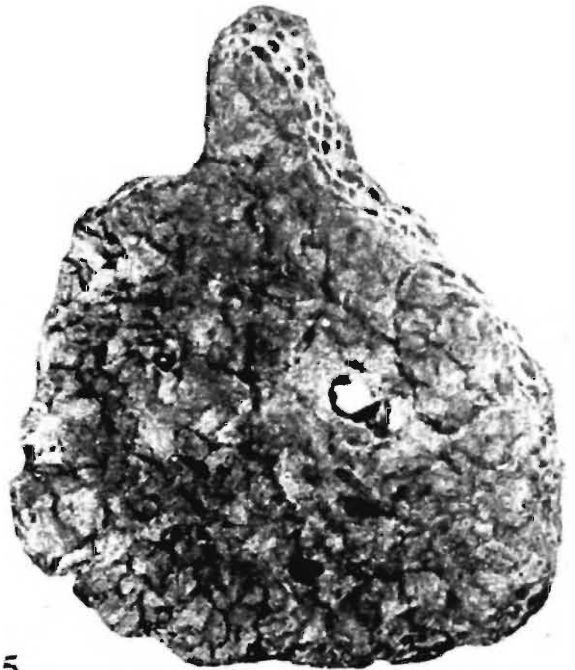
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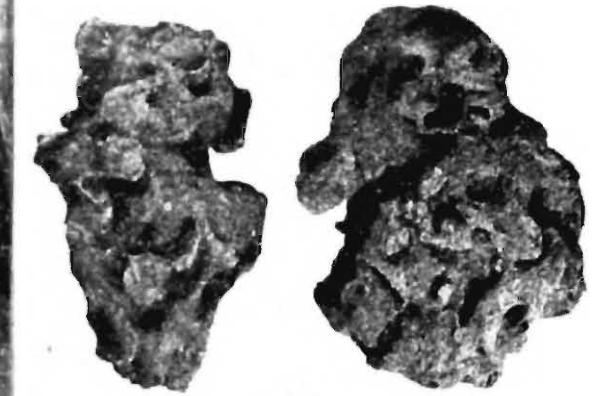
Odontotermes obesus (Rambur). Mound, royal chamber, fungus combs, etc.—
Type 'B' (1) Mound as a whole, partly cut in vertical section to show royal
cell and fungus vaults. (2) A portion of a turret from the above mound. Enlarged,
showing the irregular surface of turrets. (3) Royal cell, in a piece of soil from
the above mound. (4) Fungus comb, in dorsal view. (5) Ditto, in ventral view.



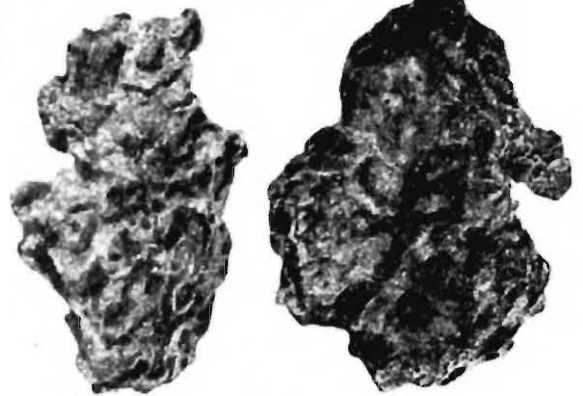
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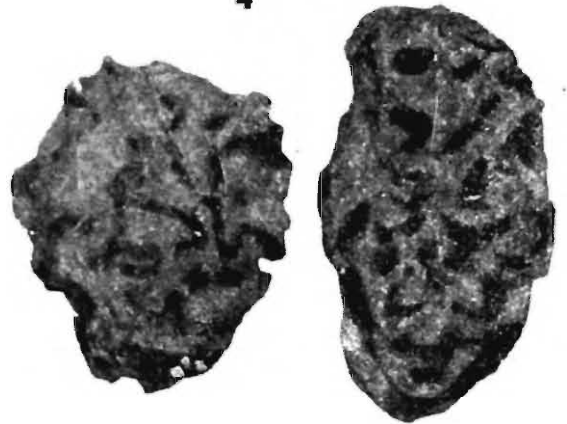
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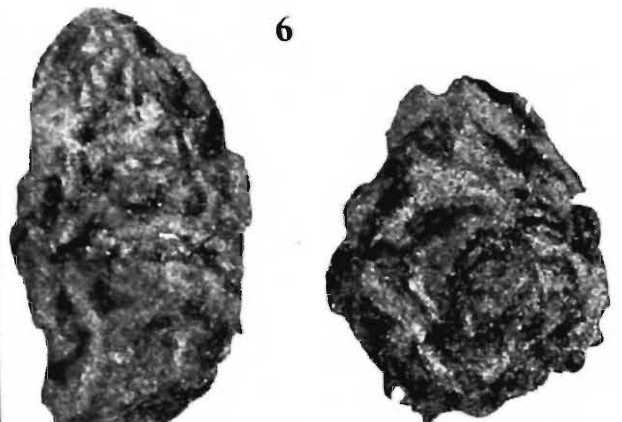
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Odontotermes obesus (Rambur). Mounds and fungus combs. Types 'C' and 'D'
 (1) Mound as a whole—type 'C'. (2) Ditto, in vertical, section, showing royal
 cell with 2 queens and fungus vaults. (3) and (4) Fungus combs from type 'C'
 mound, in dorsal and ventral views respectively. (5) Mound as a whole—type
 'D'. (6) and (7) Fungus combs from type 'D' mound, in dorsal and ventral
 views, respectively.

**ECOLOGY OF DUNG BEETLES (SCARABAEIDAE:
COPRINAE) IN TWO VILLAGES OF
WEST BENGAL**

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(With 3 Tables)

INTRODUCTION

Beetles of the subfamily Coprinae are primarily adapted to eating and burying the solid waste products of mammals, particularly the excrement of man and bovids. Because of the high concentration of bovids and man on or near the grasslands of the northern hemisphere, the population of dung beetles is highest there and the activities of the beetles are of extreme importance (Halffter and Matthews, 1966).

The sudden introduction of new species, such as cattle and sheep, into an area disrupts the flow of energy in the local ecosystem. This is particularly evident in Australia, where the indigenous species of dung beetles are not adapted to the dung of exotic mammals. The result, in part, is that 80% of the nitrogen contained in the fecal matter is lost into the air, rather than returned to the soil to replenish supplies needed for further plant growth. In addition, if fecal matter remains on the soil surface, the nutrients contained in it reenter the soil at a slow rate. Burial of the excrement by dung beetles not only speeds up and increases the efficiency of nutrient recycling, but also increases the porosity and water holding ability of the soil (Bornemissza, 1960; Gillard, 1967). These combined activities of dung beetles result in greatly increased plant growth and yield (Bornemissza and Williams, 1970).

The aim of this study, presented in part here, is to determine the role of dung beetles in a rural area of West Bengal, which is densely populated by man and his domestic animals.

METHODS

The study was done in two villages (Singur and Nasibpur) located 4km NNW of Calcutta in an agricultural area. From January 1971 to February 1972 pit-fall traps were set out twice weekly in each of four different habitats: (1) a tree-shrub habitat with closed canopy and thick undergrowth, (2) a bamboo habitat with closed canopy and a thin layer of leaf litter on the surface of the ground, (3) a banana grove with open canopy and a bare ground surface, and (4) a grazed grass habitat with no canopy cover. Initially six traps were placed in each habitat, each baited with 25 gm of one type of dung: human, monkey (*Presbytis entellus*), dog, goat, cow and buffalo. Starting in mid-August two more traps were added to each trap site: one with elephant dung and one without dung to serve as a control. Position of the bait was rotated randomly among the traps to eliminate position effects. The traps were set between 1400 and 1500 in the afternoon and were picked up the following day between 0830 and 0930. The beetles were removed from the traps, labeled, sorted and identified to species and sex where possible.

RESULTS

The primary peak in abundance of dung beetles in the traps occurred in June, just prior to the heavy monsoon rains of July and August. A secondary peak in abundance occurred in October after the rains had subsided and the watertable dropped below the soil surface. The beetles were most active during the hot wet months and least active during the cold dry months (Table I). Almost half of the beetles were trapped

TABLE I.— Per Cent of total Scarab beetles caught in year occurring in each season and in each habitat*

Seasons	Tree Shrub	Bamboo Grove	Banana Grove	Grassy Plot	Total Per Cent
March—					
May	5.2	19.2	4.1	1.8	30.3
June—					
August	10.0	22.3	9.8	2.7	44.8
September—					
November	4.1	6.5	7.5	2.9	21.0
December—					
February	1.0	0.6	1.5	0.8	3.9
Total					
Per Cent	20.2	48.5	23.0	8.3	100.0

* Based on 35 Scarab species and 10,553 individuals.

in the bamboo groves and most of these were caught during May, June and July. The tree-shrub habitat and the banana grove habitat each had about 20% of the beetles, whereas the grassy plots had only 8%.

During the period of March 1971 to February 1972 over 10,500 beetles were captured. Many of these beetles (44%) were attracted to the traps baited with human feces and 21% were attracted to dog feces. Monkey dung attracted 16%, goat dung 10%, cow dung 6% and buffalo 3%. During the period of August 1971 to January 1972, when the two additional traps were used, over 55% of the beetles were attracted to human dung and less than 1% were caught in the control trap.

Thirty-five species of scab dung beetles were captured and identified (Table II). Of these, 14 were most abundant in the bamboo grove, 10 in the banana grove, and 8 on the grassy plot. No species had its greatest density in the tree-shrub site. The species which were most abundant in the bamboo grove tended to have large populations, whereas those that were most abundant on the grassy plot had small populations or were rare.

More species were attracted to cow dung (29) than to any other dung; however, only 7 of these chose cow dung as their first choice and these species tended to be rare or low in abundance. Human dung attracted 27 species, 14 of which were most abundant of human dung, and all these species tended to have high populations. Monkey and dog dung attracted 24 and 23 species respectively, but none chose monkey dung as their first choice, and only one chose dog dung as its first choice. Eight of the 26 species collected on goat dung chose it as their first choice. Buffalo dung attracted 24 species, but all of these, except one, occurred primarily on the dung of another mammal.

In terms of wet weight 8 of the 35 species accounted for almost 100% of the total beetle biomass and will be discussed below in greater detail. None of the 35 species appeared to be in direct competition and this is exemplified by 8 species shown in Table III. Two of these species were most abundant in the premonsoon months, but one, *Gymnopleurus aethiops*, occurred only in bamboo groves and was attracted to cow dung. The other *Catharsius pithecius*, occurred primarily in banana groves and was attracted to human dung. Five species had their peak abundance during the months of June and July, but only three of these chose the same dung (human) as their first choice: *Onthophagus unifasciatus*, *O. orientalis*, and *Caccobius unicornis*. The first species was most abundant in the banana habitat, whereas the latter two were most abundant in the bamboo habitat. *O. orientalis* is more than twenty times larger (in terms of wet weight) than *C. unicornis* and thus competition

TABLE II.— Per Cent of Scarab dung beetles collected from each dung type and in each habitat between March 1971 and February 1972.

Genus and Species	Dung Types							Habitats				Notes
	Human	Monkey	Dog	Goat	Cow	Buffalo	Total	Tree-Shrub	Bamboo Grove	Banana Grove	Grassy Plot	
<i>Caccobius</i>												
<i>aterrimus</i>	—	—	—	—	—	100	1	—	—	—	100	
<i>diminutivus</i>	—	—	—	—	—	—	1	—	—	—	100	(1)
<i>tortus</i>	4	16	—	36	24	20	25	—	—	4	96	* (2)
<i>unicornis</i>	48	25	22	3	2	1	3022	20	55	22	4	*
<i>vulcanus</i>	48	7	7	14	15	10	59	3	36	61	—	* (2)
<i>Catharsius</i>												
<i>molossus</i>	61	18	8	5	5	2	905	20	57	15	8	*
<i>pithecius</i>	36	27	11	11	11	4	55	—	51	4	46	*
<i>sagax</i>	36	9	—	27	18	9	11	—	46	36	18	
<i>Copris</i>												
<i>sinicus</i>	4	13	6	52	16	9	403	23	46	21	9	*
<i>Drepanocerus</i>												
<i>setosus</i>	—	—	—	—	100	—	1	—	—	—	100	
<i>Gymnopleurus</i>												
<i>aethiops</i>	10	7	7	21	42	13	150	—	100	—	—	*
<i>miliaris</i>	43	14	29	14	—	—	7	—	86	—	14	
<i>Oniticellus</i>												
<i>spinipes</i>	33	33	—	—	33	—	3	33	33	33	—	
<i>Onitis</i>												
<i>philemon</i>	—	—	—	—	100	—	1	—	—	—	100	
<i>Onthophagus</i>												
<i>bonasus</i>	—	—	—	75	25	—	4	25	—	50	25	
<i>gazella</i>	9	22	2	36	25	7	59	—	3	39	58	*

Genus and Species	Human	Monkey	Dog	Goat	Cow	Buffalo	Total	Tree-Shrub	Bamboo Grove	Banana Grove	Grassy Plot	Notes
<i>Caccobius</i>												
<i>rectecornutus</i>	9	—	9	—	46	36	11	9	82	9	—	
<i>bifasciatus</i>	44	6	48	1	1	1	2134	34	23	40	5	*
<i>tragus</i>	48	13	6	16	12	6	69	15	28	19	39	*
<i>vigilans</i>	69	7	10	7	7	—	29	28	69	3	—	*
<i>crassicollis</i>	46	27	4	22	1	—	74	7	31	62	—	*
<i>centricornis</i>	40	29	5	17	4	6	324	16	37	39	9	*
<i>cervus</i>	24	13	24	25	9	5	113	12	21	35	32	*
<i>dama</i>	8	—	—	25	42	25	12	8	42	42	8	
<i>duporti</i>	12	11	4	37	21	17	346	30	54	15	1	*
<i>luridipennis</i>	—	9	1	62	17	10	87	12	78	5	6	*
<i>malabarensis</i>	100	—	—	—	—	—	1	—	100	—	—	
<i>mopsus</i>	—	—	—	42	42	17	12	17	25	50	8	
<i>orientalis</i>	53	24	7	12	2	2	1332	24	54	20	2	*
<i>ramosellus</i>	34	16	16	19	9	6	232	4	3	45	48	*
<i>spinifex</i>	67	22	11	—	—	—	9	22	11	67	—	
<i>triceratops</i>	7	—	—	57	24	13	46	17	20	35	28	*
<i>turbatus</i>	1	3	2	28	50	18	119	3	88	7	2	*
<i>unifasciatus</i>	65	1	33	—	1	1	713	2	29	47	23	*
<i>bengali sp.</i>	27	6	4	12	37	15	186	8	90	2	1	*(3)

* Significant difference in dung preference when tested with Chi Square at P=.001

(1) Collected on elephant dung

(2) Only distribution of males is shown.

(3) New species (Gordon and Oppenheimer, in prep.)

TABLE III .—Comparison of the eight most important dung beetles

Species	Total Number	Average Weight (gm)	Per Cent Total Biomass	Seasonal Abundance (%)				Per Cent at		Habitat first choice
				Mar.— May	June- Aug.	Sept.- Nov.	Dec.- Feb.	Human dung	Dung of choice	
<i>Catharsius molossus</i>	905	2.9200	83	15.3	23.7	55.9	5.2	61.3	—	Bamboo
<i>Copris sinicus</i>	401	0.3895	5	24.1	48.9	22.6	4.5	3.7	Goat 52.0	Bamboo
<i>Onthophagus orientalis</i>	1332	0.0873	4	26.0	58.5	14.3	1.3	52.6	—	Bamboo
<i>Gymnopleurus aethiops</i>	150	0.6250	3	70.3	29.7	0.0	0.0	10.0	Cow 42.0	Bamboo
<i>Onthophagus bifasciatus</i>	2134	0.0269	2	25.9	38.9	27.2	8.0	44.0	Dog 48.0	Bamboo
<i>Catharsius pithecius</i>	55	0.6240	1	52.7	41.8	0.0	5.5	36.0	—	Banana
<i>Onthophagus unifasciatus</i>	713	0.0419	1	30.9	56.3	11.4	1.4	65.9	—	Banana
<i>Caccobius unicornis</i>	3022	0.0038	1	38.2	44.0	15.9	1.8	48.0	—	Bamboo

between these two species would be minimal. The last species, *Catharsius molossus*, was the largest species captured in the pit-fall traps and was the only one with a peak abundance in October. A single individual of this species was capable of burying over 100 gm of human feces in a matter of minutes and could ingest more than one gram in a twelve hour period.

DISCUSSION

The differences in the abundance of dung beetles present in the four habitats probably can be attributed to differences in microclimate and to the availability of suitable dung. The closed canopies of the tree-shrub and bamboo habitats eliminated the high day-time soil surface temperatures that occurred in the banana and grass habitats. The thick understory in the tree-shrub habitat probably prevented deposition of excrement there, whereas bamboo habitats were open underneath and were one of the main defecation areas for the human inhabitants. Cattle and goats were also frequently tethered in the bamboo groves. Eight of the 14 species that were most abundant in the bamboo habitat were attracted primarily by human dung, and these species tended to have the largest populations. On the other hand, the eight species which had their highest abundance in the grass habitat were species with low populations and were attracted primarily to the dung of cows or goats.

Although this study was done in an agricultural area with an abundance of live stock, the size of the human population was four times greater than of cattle which was the most abundant domestic animal in the area (Odend'hal, 1972). Most of the people defecated outside, mostly in the fields and bamboo groves (G. Schad, pers. com.). Cattle dung though abundant was rarely available to dung beetles as it was collected by the villagers to use as fuel after being dried. Thus although more species were attracted to cow dung than to human dung, the greater availability of human dung appears to have selected for larger populations of beetles that fed on it. Most of the species captured in this study were euryphagous in that they were attracted to more than one species, but none-the-less they showed definite preferences. Laboratory studies done with *Catharsius molossus* collected in the field in Uttar Pradesh obtained similar results (Upadhyaya and Tripathi 1973). It has previously been reported that the preferences exhibited by a species in a particular locality may reflect the availability of different types of excrement in the area (Halffter and Matthews, 1966). This suggests three possible strategies: (1) a species may be genetically polymorphic for dung preference, (2) adult beetles tend to feed on the same type of dung that was provided for them by their parents during larval development, or (3) that adult beetles learn which

dung types are most available and thereafter seek them out. All three might be used.

The high attractiveness of monkey and dog dung to the beetles probably is related to the similarity of the feeding habits of these two animals to those of man, as the actual availability of monkey (Oppenheimer, 1973) and dog dung in the area was very low. Dogs are omnivores and dung is similar to that of man (Halffter and Matthews, 1966). The monkeys are primarily leaf and fruit eaters, but are phylogenetically closely related to man. It is possible that many of the dung beetle species that now are primarily attracted to human excrement, were at one time primarily attracted to monkey excrement. In this study the excrement of these three mammals was attractive to some of the same scarab species.

Goats made up 8% of the mammal population and attracted 9.7% of the beetles. Buffalo dung attracted more beetles than might be expected, but most of these beetles were from species that were primarily attracted to cow dung.

The seasonality in the activity of the dung beetle population has some very important implications. The beetles are most active in burying excrement at the time of the year when flies are laying their eggs and maggots are feeding on excrement. The same species of flies that were laying eggs on human feces during this study were captured in the market place feeding and walking on food to be ingested by the villagers. Human viruses were isolated from some of these flies (Graves and Oppenheimer, 1975). Flies are implicated in many ways in the transmission of agents pathogenic to man and his domestic animals (Graham-Smith, 1913; Gregorio *et al.*, 1972). The removal of excrement from the soil surface by dung beetles has been shown to be a very effective means for controlling fly populations (Boremissza, 1970; Lingquist, 1935). The burying activity of these beetles can also directly reduce the number of parasitic larvae infective to domestic animals (Fincher, 1973; Reinecke, 1970). Helminth eggs and protozoan cysts, contained in fecal matter, are reported to be destroyed when ingested by the medium to small dung beetles (Miller, 1961; Miller *et al.*, 1961).

On the other hand, certain species of dung beetles are known to be intermediate hosts for parasites of domestic animals (Balthasar, 1963; Fincher *et al.*, 1969; Halffter and Matthews, 1966). But it would appear that the benefits to be derived from the activities of dung beetles may vastly outweigh any detriment.

The introduction of insecticides into rural areas for control of crop pests may result in decreased soil fertility and crop yield, and increased public health problems due to the elimination or reduction of dung

beetle populations. Hopefully further research on the behaviour and ecology of dung beetles will lead to a greater awareness of the importance of these animals and their value to man.

ACKNOWLEDGEMENTS

This research was carried out in close association with the Zoological Survey of India. I am grateful to Dr. A. P. Kapur, past Director of the Z.S.I., for his encouragement and to Mr. K. S. Pradhan, Superintending Zoologist, Division of Entomology, for his advice and many helpful discussions.

The pit-fall traps followed the design of Drs. D. Gubler and G. Schad.

Identifications of specimens were verified by Dr. V. Balthasar and his help is much appreciated.

Dr. E. G. Matthews kindly made comments on an earlier draft of this paper.

This study was made possible by the continuous efforts of the Field Station Staff: J. Singha Roy, B. Sinha Roy, N. Das, H. Maity, P. Nundi, S. Kundu and S. Dutta. The research was supported by U. S. Public Health Service Research Grant No. R07-A1 10048-12 ICC from the N.I.H. to the Johns Hopkins University Center for Medical Research.

SUMMARY

Thirty-five species of scarab dung beetles were caught in pitfall traps baited with the feces of man, monkey (*Presbytis entellus*), dog, goat, cattle and buffalo between March 1971 and February 1972 in four kinds of habitats in two West Bengal villages, 40 km NN W of Calcutta. The beetles were most abundant in June, occurred most frequently in bamboo groves, and were attracted most (44%) to traps baited with human feces. Cattle dung attracted the most number of species (29), but only 6% of the beetles. None of the species appeared to be in direct competition.

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**SECOND BREEDING SEASON OF *CORVUS
SPLENDENS* IN SOME PARTS OF INDIA :
AN EXPLANATION FOR**

By

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(With 3 Tables)

INTRODUCTION

The Indian House Crow needs no introduction. It is by far the commonest bird in India. So close has its association been with man that it has found its way in the Indian Folklore and even Hindu Mythology. Its intelligence and cunning are proverbial. Salim Ali (1972 : 244) writing about this bird comments "A confirmed commensal of man, almost an element of his social system. Very useful as a municipal scavenger and an indispensable ally to neglectful or incompetent sanitary administrations : Intelligent, inquisitive and impudently familiar, yet excessively wary and alert at all times, possessing an uncanny capacity for scenting and avoiding danger and distinguishing a harmless human from one not to be trusted. Gregarious, sociable, clannish, cunning, and omnivorous—other essential qualifications for successful coexistence with man"

OBSERVATION

The Indian House Crow, *Corvus splendens* has been observed to breed only once in a year, for a short duration of three to four months during summer in the major part of its range in India. (Baker, 1922: 33; Hume, 1889 : 9; Lamba, 1963:123; Salim Ali, 1972: 91) The author has been working on the nidification breeding biology of Common Indian birds in various parts of India for more than 20 years (Lamba, 1963 THROUGH 1970). He has not come across this species breeding in winter anywhere in India except Ratnagiri and Goa, where it breeds in winter (Lamba, 1975 : 38). Both Hume (1889:9) and Baker (1922:33; 1932:16) have also recorded this species breeding at Ratnagiri in Winter.

DISCUSSION

The author found it quite intriguing that a bird which breeds only once a year and prefers to breed elsewhere in summer should breed in Ratnagiri and Goa in winter again. A search in the existing orni-

thological literature revealed that Baker (1932:16) as well as Salim Ali & Ripley (1972:245) had offered some explanations for the second breeding in the House Crows. Baker (1932:16) writes, "In the two seasons I believe there are two sets of birds breeding and not the same lot of birds breeding twice and rearing two broods, for nests which are used annually are never used twice in the same year." Where as Salim Ali & Ripley (1972: 245) maintain that " Some birds (probably of the previous year, C.15 or 16 months old) breed October-December."

The studies on the breeding biology of birds all over the world indicate that the breeding activity in birds is initiated by a complex of factors like:—

- a. Natural instinct.
- b. Physiological changes, brought about by the changing conditions of the habitat and the various ensuing ecological stimuli such as quantum, of sunshine, temperature, precipitation and availability of food etc.

It has been the experience of various workers all over the world that these factors effect different species differently in the same or different areas of the globe. Rowen and Bissonnetee (in Linsdale, 1933) attached paramount importance to light (more sunshine), claiming it to be the biggest single factor responsible for breeding activity in birds. Linsdale (1933) commenting on their theory writes "If the time of the beginning of the breeding cycle were entirely or even largely determined by the length of day, we might expect birds in the same latitude to have closely similar calendar for breeding activities." In the same paper he shows that in two such regions in Western United States viz. California and Kansas, the height of the breeding season is attained in April, May in California and in June in Kansas, the differences in season depending upon temperature and precipitation. Winterbottom (1935) had found in three districts of North Rhodesia in the same latitude birds breeding at different times, temperature, humidity and altitude being the determining factors. Skutch (1950) has observed the Humming birds in Western highlands of Guatemala to commence nesting when the days start becoming shorter.

Pitt (1929) illustrated the stimulating influence of warm weather and restricting influence of cold on the breeding activities of some avian species in Norway. Pickwell (1931) established a correlation between the temperature and the start of nesting in the case of *Otocoris alpestris praticola*. Nice (1937) observed that the song sparrow started laying days after the maximum day | temperature averaged 22.9°C for 3 successive days at Interpont (Ohio U.S.A.). But in Central America and India a number of species have been observed when the temperatures are falling (Vantyne & Berger, 159 : 314; Lamba, 1963 : 111).

In the desert areas of Africa and Australia, Moreau (1950) and Keast and Marshall (1954) often found the rainfall as the stimulus for reproduction, whereas in Western Guatemala Skutch (1950) found a great majority of birds nesting at the height of the dry season.

Moreau (1936) has found a "single breeding season of surprisingly short duration" in the birds of evergreen forests in the East Africa. He discusses as possible stimuli, light, temperature, precipitation and food supply, deciding against any "single factor Hypothesis." Nothing could therefore be more logical than Skutch's (1950 : 212) conclusion after his prolonged studies on the breeding of Central American birds, that "If any single astronomic or climatic cycle tends directly to stimulate the reproductive activities of birds, its action is so weak that any species which finds conditions peculiarly favourable for reproduction at some divergent season of the year may escape its control."

In order to have a better idea of some of these factors involved at Ratnagiri and Goa I requested Mr. C.R.V. Raman, Dy. Director General of Observatories at Poona for climatological data for Ratnagiri and Marmugoa from 1968-1970, which he was kind enough to supply. This data comprises of Mean Maximum and Mean Minimum temperature, mean monthly rainfall, mean monthly humidity and mean monthly length of the day and is tabulated for Ratnagiri (Table I) and Marmugoa (Table II) separately. For the sake of comparison similar data for Poona is also given (Table III).

A study of this data reveals both at Ratnagiri and Goa the general climatic conditions of temperature, rainfall, humidity and length of the day during April-May, the main breeding season before the onset of Monsoons; and November-December, the secondary breeding season after the rainy season, are almost similar. The Mean Maximum temperature ranges from 31.1°C to 33.5°C in April-May and 31.6°C to 33.8°C in November-December. During the rest of the year it remains 2-5°C lower. The mean minimum temperature during April-May for both areas is highest i.e. 25.1 to 27.8°C. In November-December it again rises but only upto a maximum of 24.3°C.

The mean relative humidity for both the areas in April-May remains 72-75%. It increases up 91% during the rains and again drops to 50% to 74% in November-December.

The mean monthly rainfall for Ratnagiri and Goa during April-May is 0.00 mm. to 64.1 mm. It shoots upto 866 mm. to 1417 mm. during the rains and again drops down to 0.00 mm. to 55.7 mm. during November-December.

The mean length of the day increases during April-May at Ratnagiri and Goa ranging from 12.5 to 13 hours. In November-December it

TABLE—I : RATNAGIRI

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	ANNUAL
<i>Mean of daily maximum temperature : °C.</i>													
1968	30.2	29.2	32.1	31.5	31.8	30.8	28.9	29.1	30.0	32.5	33.7	32.4	
1969	31.5	30.7	31.4	33.0	33.5	31.4	28.9	29.3	28.3	32.2	32.5	33.1	
1970	30.5	30.0	30.2	32.1	—	29.7	29.3	28.4	28.8	31.5	33.8	32.0	
<i>Mean of daily minimum temperature : °C.</i>													
1968	19.3	18.9	22.8	24.4	25.9	25.3	24.3	24.8	23.9	22.8	21.7	20.5	
1969	18.8	19.9	23.0	26.3	27.6	25.1	24.5	24.3	23.6	23.7	23.7	21.7	
1970	19.2	19.7	21.7	25.5	—	24.6	24.5	24.2	23.8	23.5	20.0	19.9	
<i>Mean relative humidity (%) 0830 hrs. I.S.T.</i>													
1968	66	74	66	75	73	85	90	86	89	73	56	60	
1969	67	74	81	74	72	88	90	91	91	78	71	59	
1970	73	72	74	73	—	89	87	90	91	82	50	53	
<i>Rainfall (mm)</i>													
1968	0.0	0.0	0.3	13.2	0.0	728.2	717.4	166.1	203.3	113.1	1.3	0.0	
1969	0.0	0.0	0.0	0.0	0.7	654.4	1417.7	422.6	740.5	37.6	55.7	0.0	
1970	0.0	0.0	0.0	0.3	—	1020.6	850.8	639.3	160.3	30.6	0.0	0.0	
<i>Maximum possible hours of Sunshine.</i>													
(Length of day Bombay)													
	11.2	11.5	12.0	12.5	13.0	13.3	13.2	12.8	12.2	11.8	11.3	11.1	

TABLE—II : MARMUGOA

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	ANNUAL
<i>Mean of daily maximum temperature : °C.</i>													
1968	29.7	28.6	30.8	31.2	31.1	29.6	28.1	28.5	29.0	30.6	32.5	31.6	
1969	30.2	30.0	—	32.2	32.5	29.9	28.4	28.8	28.0	30.4	31.6	32.4	
1970	—	29.8	29.8	—	—	29.9	29.2	28.2	28.9	31.4	33.8	32.6	
<i>Mean of daily minimum temperature °C.</i>													
1968	21.1	21.8	24.1	25.1	26.3	25.0	23.7	24.3	24.1	23.7	23.6	22.5	
1969	21.2	22.3	—	27.0	27.8	24.6	24.2	24.2	23.6	24.4	24.3	23.6	
1970	—	22.1	23.5	—	—	24.5	24.0	23.9	23.8	24.7	23.0	19.8	
<i>Mean relative humidity (%) 0830 Hrs. I.S.T.</i>													
1968	65	75	70	74	72	87	89	86	87	77	60	62	
1969	66	74	—	73	72	86	86	—	89	80	74	62	
1970	—	71	76	—	—	89	88	90	86	83	60	54	
<i>Rainfall (mm)</i>													
1968	0.0	0.0	0.0	64.1	6.8	644.3	1062.4	148.0	116.8	181.8	16.4	0.0	
1969	0.0	0.0	—	1.5	2.2	866	596.5	283.7	574.5	30.5	75.1	0.2	
1970	—	0.0	0.0	0.2	0.0	768.9	661.6	975.1	200.1	21.9	0.0	0.0	
<i>Maximum possible hours of sunshine.</i>													
(Length of day Bombay)													
	11.2	11.5	12.0	12.5	13.0	13.3	13.2	12.8	12.2	11.8	11.3	11.1	

TABLE—III : POONA

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	ANNUAL
<i>Mean of daily maximum temperature : °C.</i>													
1968	28.4	31.9	34.7	37.9	37.8	33.2	28.5	27.5	30.4	31.2	29.9	29.4	
1969	30.2	33.6	37.3	39.4	38.2	32.7	28.1	27.8	28.4	32.9	31.2	29.3	
1970	30.0	32.8	35.7	38.4	37.5	31.0	28.1	27.0	28.4	31.7	30.4	29.1	
<i>Mean of daily minimum temperature : °C.</i>													
1968	10.0	11.3	16.1	19.8	21.4	23.3	22.3	21.4	21.0	16.6	12.3	10.7	
1969	9.0	12.2	16.8	21.2	23.3	23.3	22.5	21.4	20.9	17.6	16.7	13.1	
1970	11.2	13.8	16.0	21.5	23.5	22.9	22.0	21.7	20.8	18.3	10.3	6.6	
<i>Mean Relative Humidity (%) 0830 Hrs. I.S.T.</i>													
1968	77	64	51	40	47	71	82	81	82	75	67	67	
1969	71	59	48	46	53	75	83	87	84	69	70	60	
1970	68	67	49	46	58	78	85	88	83	80	58	63	
<i>Rainfall (mm).</i>													
1968	0.1	0.0	0.9	0.0	0.0	67.1	89.2	60.0	138.6	87.8	11.0	0.4	
1969	0.0	0.0	0.0	5.5	0.0	118.4	276.2	214.7	118.2	6.3	13.2	0.4	
1970	0.0	0.0	0.0	3.3	48.3	84.4	132.9	79.6	39.4	108.8	0.0	0.0	
<i>Maximum possible hours of Sunshine.</i>													
(Length of day Bombay)													
	11.2	11.5	12.0	12.5	13.0	13.3	13.2	12.8	12.2	11.8	11.3	11.1	

is decreasing from 11.3 to 11.1 hours. But we have to consider the amount of Sunshine which increases suddenly after the cloudy days of the rainy season.

Another, rather strong factor accredited with the initiation of avian breeding which could not be ascertained directly is the "amount of food available for the nestlings" But as the House Crow almost entirely lives off the Human race; it might be safe to presume that the amount of food available to House Crow in both these areas in November-December is not substantially less than that available in April-May.

CONCLUSION

On account of the foregoing observations I am inclined to believe that some House Crows breed at Ratnagiri and Goa again after rains in November-December because climatic factor involved in breeding of Crows are duplicated at that time. This belief is further strengthened by a comparison of the climatological data of Poona (Table III), where the House Crow breeds only once a year in April-May, to that of Goa and Ratnagiri. At Poona we find that the mean maximum temperature during April-May is 37.5°C to 39.4°C. In November-December it never rises above 31.2°C. Similarly the mean minimum temperature of 19.8°C to 23.8°C of April-May drops further down to 6.6°C to 16.7°C. The mean relative humidity in November-December, 58% to 70% is much higher than that of April-May, which is only 40% to 58%. The mean monthly rainfall in April-May (0.00 to 48.3 mm.) is much more than that of November-December (0.00 to 13.2 mm.).

The climatic conditions, of April-May at Ratnagiri, Goa and Kerala are duplicated only to some extent in November-December but they fail to reach the "optimum" to effect the whole population.

ACKNOWLEDGEMENTS

The Author would like to express his gratitude to the Director, Zoological Survey of India, for the facilities; to Drs. Salim Ali, and Biswamoy Biswas, for the valuable discussion on this topic and Mr. S.R.V Raman, Deputy Director General (Climatology), Indian Meteorological Department, Poona for the valuable Meteorological data compiled for the study.

SUMMARY

The Common House Crow, *Corvus splendens* breeds throughout India at the height of Summer Season, invariably before the onset of rains between April and July. In some parts of India, like Ratnagiri, and Goa however, this crow has been observed to breed again after the rains in November-December.

While investigating the cause of this second spurt of breeding activity in this species after a gap of barely 4-5 months, it was discovered that accredited climatic stimuli causative of avian breeding like temperature, rainfall, humidity quantum of light etc., are duplicated in November-December in these localities, thereby compelling some House Crows to breed.

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ON A COLLECTION OF ODONATA FROM MANIPUR WITH NEW RECORDS

By

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(With 1 Text-figure)

INTRODUCTION

Manipur state of the Indian Union is situated on the Indo-Burma frontier. The state is mostly covered with hill ranges having an average altitude of 200 M, surrounding a large central basin. Present study is based on a fairly good collection of odonata from the state present in the Eastern Regional Station, Zoological Survey of India, made in two successive years 1974 and 1975. Collection localities are mostly around Loktak lake in the south-east corner of the central basin and in the hilly regions further south around Churachandpur and Singant.

The only odonate (sub) species so far reported from Manipur is *Ischnura rufostigma annandalei* Laidlaw by Bhasin (1953). Present study reveals the existence of 22 odonate species and subspecies in the state, 11 of which are Oriental, the rest, having four Ethiopian representatives, have a wider distribution in Palaeartic and Australian regions. Collection localities and distribution of all the 22 species and subspecies have been given in the text along with taxonomic notes for some of them and additional description of the inadequately known subspecies *Ischnura rufostigma annandalei* Laidlaw.

SYSTEMATIC ACCOUNT

Suborder ZYGOPTERA

Family PLATYCNEMIDIDAE

Copera annulata (Selys, 1863)

Material examined.—1 ♂; 11 Km from Moirang on Churachandpur road, coll. A. R. Lahiri, 19.iii.1974.

Length : ♂ abd.+app. 36.5, hindwing 23.0 mm; postnodals: forewing 16, hindwing 14.

A teneral specimen with dark areas on dorsum of head not properly developed.

Distribution.—Manipur (present record). Extends from Eastern India (Assam) to Malaysia.

Family COENAGRIONIDAE

Pseudagrion australasiae Selys, 1876

Material examined.—1 ♂, Fagakchaokhia, coll. A. R. Lahiri, 19.iii. 1974.

Length: ♂ abd.+app. 32.5, hindwing 22.5 mm; postnodals: forewing 12, hindwing 10.

The specimen agree with the description of Javan specimens (Fraser, 1933) in the markings of the Postclypeus and that of the 2nd abdominal segment. Fraser (op. cit.) recorded this species as *P. bengalense* Laidlaw, which has been synonymised with *P. australasiae* Selys (Lieftinck, 1954).

Distribution.—Manipur (present record). Extends from Eastern India (Bengal and Assam) through Burma and Malaysia to Australia.

Ceriagrion fallax cerinomelas Lieftinck, 1927

Material examined.—1 ♂, 4 Km south of Singnat coll. A. R. Lahiri, 26.iii.1974.

Length : ♂ abd.+app. 32.0, hindwing 21.5; postnodals; forewing 14, hindwing 12.

Distribution.—Manipur (present record). The subspecies is recorded from Western Himalayas (Simla), Nepal and China (Yunan).

Enallagma parvum Selys. 1876.

Material examined—2 ♂, Nongthukong and Fagakchaokhia, coll. A. R. Lahiri, 16 and 19.iii. 1974.

Length: ♂ abd.+app. 18.0, hindwing 12.0 mm; postnodals: forewing 7, hindwing 6.

Distribution.—Manipur (present record). Recorded distribution of the species is from Ceylon through India to Burma.

Aciagrion tillyardi Laidlaw, 1919.

Material examined.—2 ♂, 4 Km south of Signat, coll. A. R. Lahiri, 26.iii.1974.

Length: ♂ abd.+app. 25.0—26.0, hindwing 15.0—17.0 mm; postnodals: forewing 11, hindwing 10—11.

Distribution.—Manipur (present record). Originally described from Cherrapunji (Meghalaya), the species is also reported from Malaysia.

***Ischnura aurora aurora* Brauer, 1865.**

Material examined.—8 ♂, Tahmu fish Farm near Moirang, Nungthukong, Fagakchaokhai, Churachandpur and 3 Km. north of Signat, coll. A. R. Lahiri, 15-28.iii. 1974, 1♂, Tobungbasti, coll. M. Dutta, 27.iii. 1975.

Length: ♂ abd.+app. 19.5—21.5, hindwing 11.0—12.0 mm; postnodals: forewing 7, hindwing 5—6.

Distribution.—Manipur (present record). This is a wind-borne species scatteredly distributed throughout Indo-Australian and Pacific regions.

***Ischnura rufostigma annandalei* Laidlaw 1919.**

(Text-fig. 1 A-I)

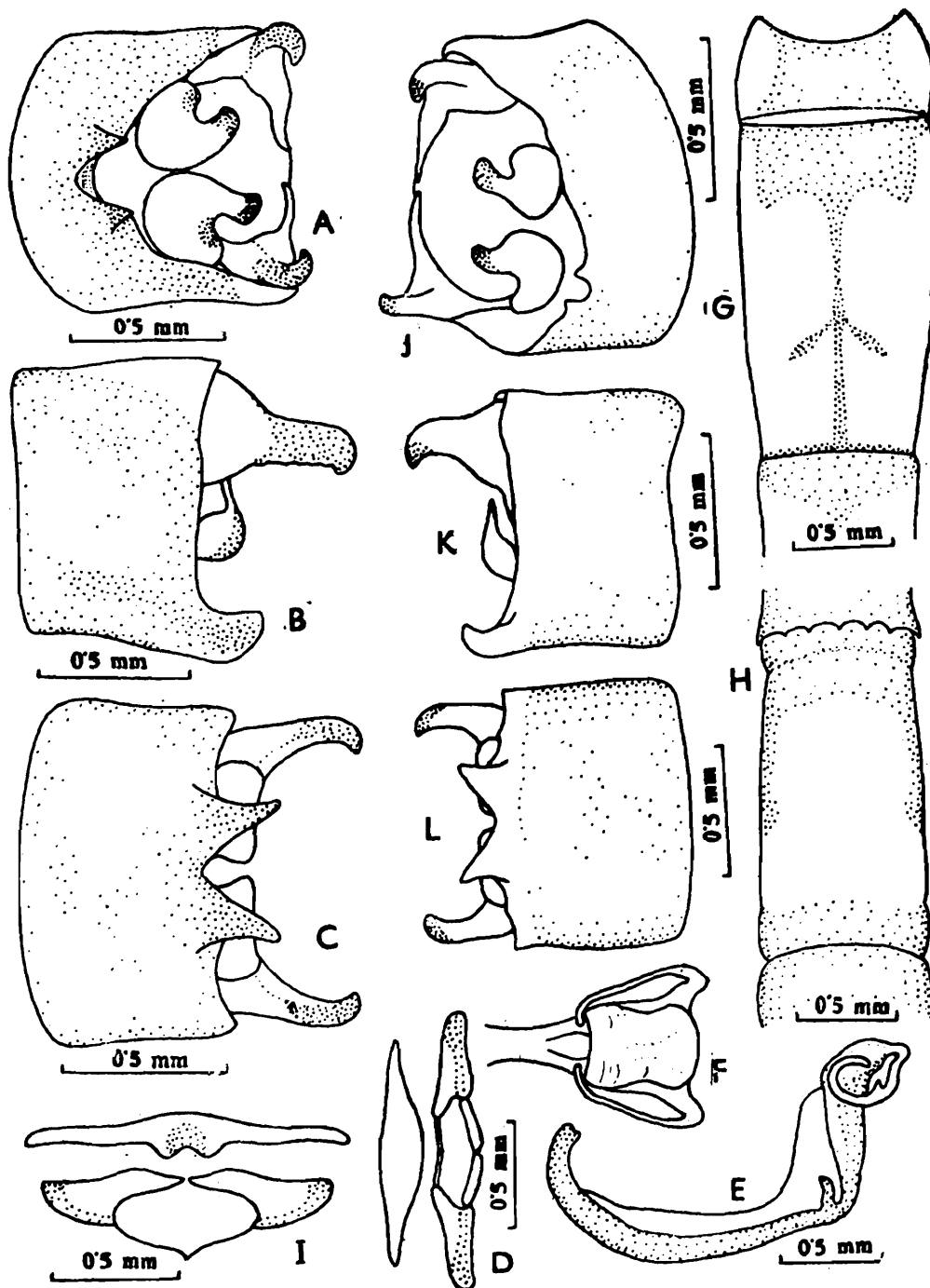
Material examined.—20 ♂, 14 ♀, Tahmu Fish Farm, Moirang and Loktak lake near this spot "Over Floating humous vegetation", Coll. A. R. Lahiri, 15-20.iii. 1974; 1 ♂, Nongthukong village, Coll. M. Dutta, 21.iii. 1975.

Length: ♂ abd.+app. 22.5—25.0, hindwing 14.5—15.5; ♀, 24.0, 16.0—16.5 mm; postnodals: ♂ forewing 8-9, hindwing 6-7; ♀ 8-9, 7.

Laidlaw (1919) described *Ischnura annandalei* from Upper Burma (Inle Lake) as a district species, but Lieftinck (in litt.) considered it a subspecies of *Ischnura rufostigma* Selys, which it resembles markedly in general built, shape and colouration of the pterostigma and that of the anal appendages. A close study of long series of both sexes in present collection revealed that the subspecies is inadequately described, moreover, the use of the abdominal markings to separate it from *I. mildredae* Fraser (see Fraser, 1933) is erroneous. As such additional description of *I. r. annandalei* Laidlaw and its distinguishing characters from allied species and subspecies is provided here:

Male.—Prothorax with posterior lobe (Text-fig. 1 D) simple and rounded. Mesostigmal plate (Text-fig. 1 D) with each lamina triangular and tilted up at postero-outer margin. Abdomen with segment 1 black on dorsum, the sides as well as apical annule greenish yellow (Text-fig. 1 G). Intermediate segments (2-6) bright reddish orange, with intersegmental joints and a dorsal marking on segment 2 black, the latter shaped as in Text-fig. 1 H. Remaining segments as well as tubercles black, broadly marked with blue on segment 8 (Text-fig. 1 H), while segment 10 is yellowish on sides and beneath. Anal appendages (Text-fig. A-C) ochreous, the superiors tipped with black, the inferiors more broadly so; superiors much shorter than inferior, rounded and extended ventrally and slightly outwardly into a blunt flattened projection; inferiors more than half the length of segment 10, broad at base,

narrow thereafter, broadly pointed at its tip, where it turns inwards and slightly upwards. Penis (Text-fig. 1 E-F) with its apex produced into a short coiled flagella on either side.



Text-fig. 1. A-I. *Ischnura rufostigma annandalei*, A-C male anal appendages; A, postero dorsal, B, lateral, C, dorsal view; D, male, posterior lobe of prothorax and mesostigmal plate; E-F penile organ; E, lateral view, F, apex more magnified in dorsal view; G-H male abdominal markings; T, segments 1-3; G, segment 8; I, Female posterior lobe of prothorax and mesostigmal plate; J-L, *Ischnura rufostigma rufostigma*, male anal appendages; J, postero dorsal, K, lateral, L, dorsal view.

Female.—Prothorax with posterior lobe (Text-fig. 1 J) tripartite, the mid lobe squarely produced backwards and is arched. Mesostigmal plate (Text-fig. 1, I) with laminae similar to male, but broader and

broadly connected with anterior carina. Abdomen similar to male in isochromatic form, but in heterochromatic form, pale greenish yellow on sides and beneath; segment 1 and 2 somewhat reddish on dorsum, the latter bearing a pear shaped black mark; remaining segments broadly marked with black dorsal stripe, constricted at base on segments 3-6.

Remark.—From the nominate species. *I. r. annandalei* Laidlaw differs in having the blue marking on segment 8, black markings on segment 2, 8 and the tubercles and finally in having more robust anal appendages, the inferiors being more extensively marked with black. From *I. mildredae* Fraser, *I. r. annandalei* differs in having very broad (vs small and rounded) blue markings on segment 8. (also see Fraser, 1933).

In Loktak Lake *I. r. annandalei* Laidlaw was found in large numbers swarming across the ridges grown over scattered and floating humous vegetation, which are employed as fishing spots by the local fishermen. However the subspecies was all-together absent in the hilly regions further south, where the nominate species was collected.

Distribution.—Manipur (present record), Imphal; also Burma, Mamyo and Inle lake.

***Ischnura rufostigma rufostigma* Selys 1876**

(Text-fig. 1, J-L)

Material examined.—1 ♂, 4 Km south of Singnat, Coll. A. R. Lahiri, 26.iii.1974.

Length: ♂ abd.+app. 19.0, hindwing 13.5 mm; postnodals: forewing 8, hindwing 6—7.

The specimen under study agrees well with existing description of the species (Fraser, 1933), but is considerably smaller (abdomen 19.0 vs 23.0 mm) and the 2nd segment is marked with a narrow mid-dorsal carinal stripe falling short of apex. The tubercles as well as apical border of segment 10 is unmarked with black. Anal appendages (Text-fig. 1J-L) specially the inferiors are comparatively shorter and less robust than *I. r. annandalei* Laidlaw.

Distribution.—Manipur (present record). The subspecies is confined to North India(?) Kashmir, Bihar, Bengal and Assam.

***Ischnura senegalensis* (Rambur, 1842)**

Material examined.—1 ♂, 1 ♀, Fagakehaokhiaj, Coll. A. R. Lahiri, 19.iii.1974.

Length: ♂ abd.+app. 23.0, hindwing 15.0; ♀ 23.5, 16.0 mm; postnodals: ♂, ♀ forewing 7.8, hindwing 6.

Distribution.—Manipur (present record). Extends from Africa through India, Ceylon, Burma and Malaysia to Japan.

Agriocnemis femina femina (Brauer, 1868)

Material examined.—2 ♂, 3 ♀, Moirang, Nongthukong and Fago-kchaokhaij, coll. A. R. Lahiri, 16—19.iii.1974; 3 ♂, 1 ♀, Kangrai, Coll. M. Dutta, 22.iii.1975.

Length: ♂ abd.+app. 17.5—18.0, hindwing 10.5; ♀ 19.0—20.0, 12.5—13.0 mm; postnodals: ♂ forewing 6, hindwing 5; ♀ 7-9, 6-7.

Distribution.—Manipur (present record). The subspecies extends from Ceylon, through eastern India (Assam) and Burma to the Pacific Islands.

Agriocnemis pygmaea (Rambur, 1842)

Material examined.—5 ♂, Moirang, Nongthukong and Churachandpur; Coll. A. R. Lahiri, 16—24.iii.1974. 4 ♂, 3 ♀, Keibul, Sendra and Gulzang, Coll. M. Dutta 20—25.iii. 1975.

Length: ♂ abd.+app. 17.5—19.5, hindwing 11.0—12.0, ♀ 18.0—20.0, 12.0—13.0 mm; postnodals: ♂ forewing 6—7, hindwing 5—6, ♀ 8, 6.

The specimens under study agrees with Shillong forms as described by Pinhey (1974), but the males are larger in size from all forms described by Pinhey (op. cit.), (abdomen without appendages 17.0—19.0 vs 16.0—17.0 mm). The females correspond in size with those described from Mahe.

Distribution.—Manipur (present record). The species is widely distributed from Africa through India, Ceylon, Burma and Malaysia to Australia and the Pacific islands.

Family CALOPTERYGIDAE

Neurobasis chinensis chinensis (Linnaeus, 1758)

Material examined.—2 ♂, Likhai village, Coll. A. R. Lahiri, 27.iii.1974.

Length: ♂ abd.+app. 44.0—49.0, hindwing 34.0 mm; antenodales: forewing 35—39, hindwing 33—38, postnodals: forewing 54—58, hindwing 62—68.

Distribution.—Manipur (present record). Extends from Ceylon through North India to Indochina, Thai, Malaya and Sumatra; Nepal.

Family LIBELLULIDAE

***Orthetrum glaucum* (Brauer, 1865)**

Material examined.—1 ♂, Kangrai, Coll. *M. Dutta*, 22.iii.1975.

Length: ♂ abd.+app. 28.0, hindwing 31.0 mm; antenodals: forewing 13, hindwing 10; postnodals: forewing 10, hindwing 11—12.

Distribution.—Manipur (present record). The species is distributed from Western India and Ceylon to Malaysia; Nepal.

***Orthetrum pruinatum neglectum* (Rambur, 1842).**

Material examined.—1 ♂, Bughmang, Coll. *A. R. Lahiri*, 22.iii.1974, 2 ♂, Saikot, Coll. *M. Dutta*, 23.iii.1975.

Length: ♂ abd.+app. 29.0, hindwing 35.0 mm; antenodals: forewing 7½, hindwing 6; postnodals: forewing and hindwing 6.

Distribution.—Manipur (present record). The range of distribution of this species extends from Ceylon and India through Burma, Malaysia to China and Taiwan; Nepal.

***Orthetrum sabina sabina* (Drury, 1770)**

Material examined.—1 ♂, Churachandpur, Coll. *A. R. Lahiri*, 24.iii.1974.

Length: ♂ abd.+app. 31.0, hindwing 33.5 mm; antenodals: forewing 13, hindwing 9—10; postnodals: forewing 9, hindwing 11.

Distribution.—Manipur (present record). Extends from northeast Africa eastward across Asia to Australia and Pacific islands; Nepal.

***Potamarcha congener* (Rambur, 1842)**

Material examined.—1 ♀, Likhai village, Coll. *A. R. Lahiri*, 22.iii.1974.

Length: ♀ abd.+app. 27.5, hindwing 31.5 mm; antenodals: forewing 13½, hindwing 11—12; postnodals: forewing 10—11, hindwing 11—12.

Distribution.—Manipur (present record). The species extends from Ceylon and India to Burma and Malaysia.

***Acisoma panorpodes panorpoides* Rambur, 1842.**

Material examined.—1 ♀, Sendra, Coll. *M. Dutta*, 20.iii.1975.

Length: ♀ abd.+app. 19.0, hindwing 23.0 mm; antenodals: forewing 7—8, hindwing 6; postnodals: forewing and hindwing 7.

Distribution.—Manipur (present record). Widely spread from Western India and Ceylon to China, southern Japan and Taiwan; southwards to Celebes and the Moluccan islands.

***Diplacodes trivialis* (Rambur, 1842)**

Material examined.—1 ♀, Sendra, Coll. *M. Dutta*, 20.iii.1975.

Length: ♀ abd.+app. 21.0 hindwing 20 mm; antenodals: forewing $7\frac{1}{2}$, hindwing 6; postnodals: forewing and hindwing 6.

Distribution.—Manipur (present record). Extends from the Seychelles through Ceylon and India to Australia and Western Pacific; Nepal.

***Crocothemis servilia servilia* (Drury, 1770)**

Material examined.—4 ♂, 2 ♀, Saikot, Sendra road, 5 Km. east of Moirang and 4 Km. south of Singnat, Coll. *A. R. Lahiri*, 21—27.iii. 1974.

Length: ♂ abd.+app. 25.0—26.0, hindwing 29.5—30.5, ♀ 23.0, 29.0 mm; antenodals: ♂ forewing $11\frac{1}{2}$, hindwing 9, ♀ $9\frac{1}{2}$ — $11\frac{1}{2}$, 9; postnodals: ♂ forewing 9-10, hindwing 10-11; ♀ 9-10, 10.

Distribution.—Manipur (present record). The subspecies extends from Mesopotamia through Ceylon, India, Burma and Malaysia to Australia and Japan; Nepal.

***Palpopleura sexmaculata sexmaculata* (Fabricius, 1787).**

Material examined.—2 ♂, 1 ♀, Churachandpur and Singnat, Coll. *A. R. Lahiri*, 24 and 25.iii.1974; 1♂, 1 ♀, Kongvai, Coll. *M. Dutta*, 22.ii.1975.

Length: ♂ abd.+app. 14.0—15.0, hindwing 17.5—18.5, ♀ 15.0, 18.5—19.5 mm; antenodals: ♂ forewing 9— $11\frac{1}{2}$, hindwing 7-8, ♀ $10\frac{1}{2}$ —13, 7-8; postnodals: ♂ forewing 5-6, hindwing 4-5, ♀ 5, 4-5.

About half of the specimens in both sexes exhibited complete distal antenodals in either of the wings. Similar admixture of complete and incomplete antenodal nervures have been reported for *Brachythemis contaminata* (Fabricius), *Diplacodes trivialis* (Rambur) and *Crocothemis s. servilia* (Drury) by Raychaudhuri *et al* (1969) and Lahiri *et al*. (1970).

Distribution.—Manipur (present record). Extends from Ceylon and India through Malaysia, Indochina to China; Nepal.

***Trithemis aurora* (Burmeister, 1839)**

Material examined.—1 ♂, 1 ♀, Saikot, Coll. *M. Dutta*, 23.iii.1975.

Length: ♂ abd.+app. 24.0, hindwing 29.0, ♀ 20.5, 25.5 mm; antenodals: ♂ forewing $11\frac{1}{2}$ — $12\frac{1}{2}$, hindwing 10, ♀ $11\frac{1}{2}$ — $12\frac{1}{2}$, 9; postnodals: ♂ forewing 9, hindwing 10-11, ♀ 7-8, 9-10.

Distribution.—Manipur (present record). The species extends from Ceylon and India through Burma as far as Philippines, Celebes and Timor; Nepal.

Trithemis festiva (Rambur, 1842).

Material examined.—1 ♀, Kangraj, Coll. M. Dutta, 22.iii.1975.

Length: ♀ abd. + app. 23.0, hindwing 29.5 mm; antenodals: forewing $10\frac{1}{2}$ — $11\frac{1}{2}$, hindwing 7; postnodals: forewing 6, hindwing 6-7.

Distribution.—Manipur (present record). Extends from Ceylon and India through Burma to New Guinea; Nepal.

ACKNOWLEDGEMENTS

The author is thankful to the Director, Zoological Survey of India, Calcutta, for providing opportunity to do this work, to the officer-in-Charge, Eastern Regional Station, Zoological Survey of India, Shillong for providing working facilities and to Dr. M.A. Lieftinck for confirming identification of some of the species dealt with in this paper.

SUMMARY

21 odonate species and subspecies have been recorded for the first time from Manipur state of the Indian Union. Additional description has been provided for *Ischnura rufostigma annandalei* Laidlaw, the only odonate subspecies which was so far recorded from the state. Necessary collection data and distribution of all the 22 odonate species and subspecies have been provided along with taxonomic notes for some of them.

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ON THE GENUS *RHIZOPHAGUS* HERBST
(COLEOPTERA : RHIZOPHAGIDAE)
AND DESCRIPTION OF A NEW SPECIES
FROM INDIA

by

T SENGUPTA AND D. N. BISWAS

Zoological Survey of India, Calcutta

(With 1 Text-figure)

INTRODUCTION

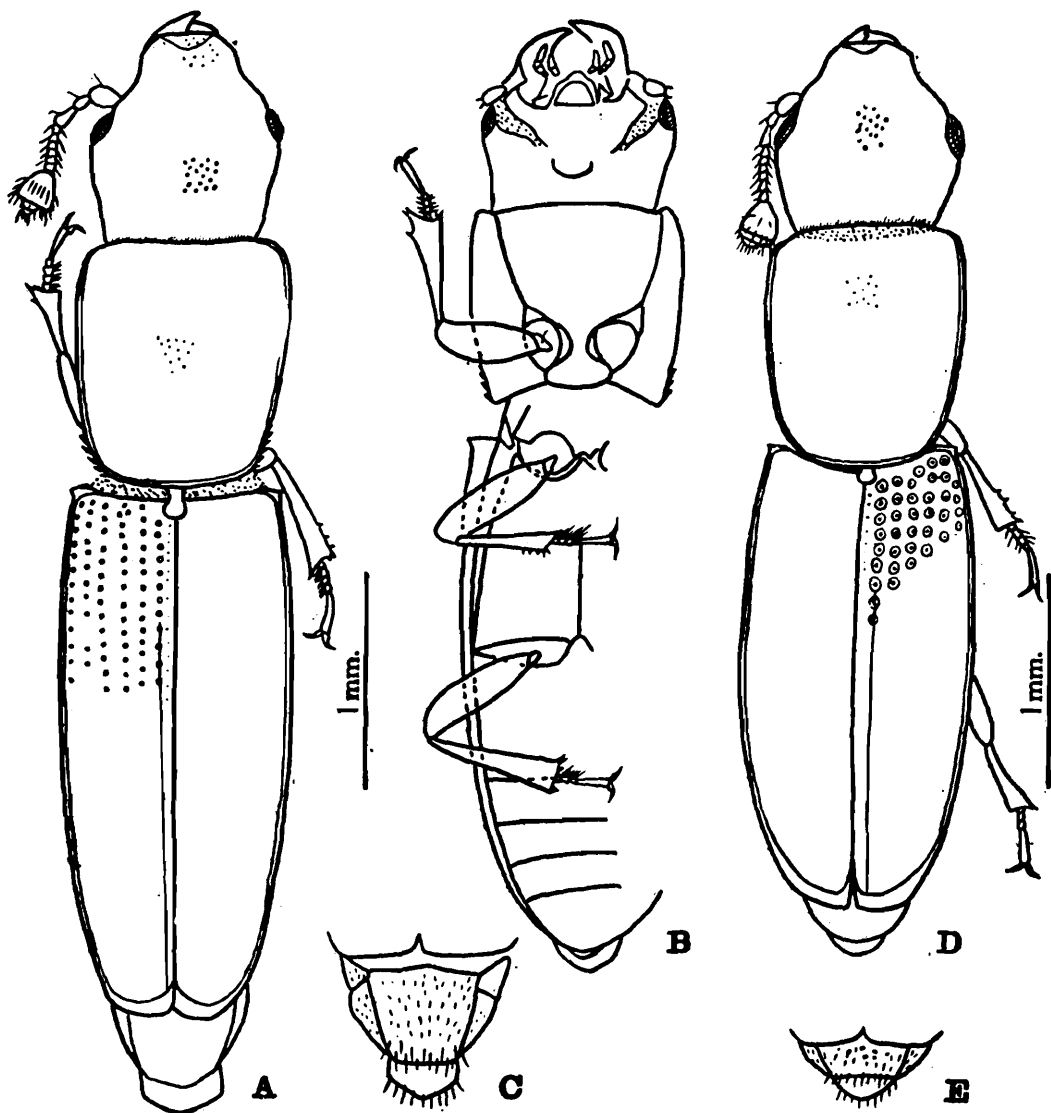
The genus *Rhizophagus* belongs to the family Rhizophagidae : Clavicornia : Cucujoidea : Polyphaga. Crowson (1955) proposed four subfamilies Rhizophaginae, Monotominae, Thioninae and Lenacinae under the family Rhizophagidae. The sub-family Rhizophaginae includes only one genus *Rhizophagus* Herbst, which has been subdivided into four subgenera *Rhizophagus* s. str., *Eurhizophagus* Méquignon, *Anomolophagus* Reitter and *Cyanostolus* Ganglbauer. Johnson (1964) provided a key to the subgenera of *Rhizophagus* in his work "The British species of the genus *Rhizophagus*" Representatives of the genus are commonly found under bark, fungus infested wood and their distribution is restricted to warm temperate zone of the world. Méquignon (1913) described the only species *R. indicus* from Dehra Dun: Uttar Pradesh : India, based on single specimen (♂) under the family Nitidulidae, collected by F. Cladow, and deposited in Indian Museum Registration No. 1881/14. One of us (Sengupta), while working as Pool-Officer (C.S.I.R.), has collected two specimens from Kashmir, which is the second new species recorded from India.

Rhizophagus Herbst.—Species ranging from about 2 to 5 mm., elongated more or less parallel-sided, easily recognisable from other related families of clavicornia by its typical antennal club (Text-fig. 1 A) and from other subfamilies of Rhizophagidae by its almost fully exposed front trochantin, middle coxal cavities distinctly open outwardly, without head constriction behind the eyes.

Head.—without stridulatory files and fronto-clypeal suture, antennal insertions hidden, eyes not projected. Antenna 10-jointed with typical club (Text-fig. 1 A). Ventral side often with well developed antennal

cavities (Text-fig. 1 B), without longitudinal lines. Mandible with short apical teeth, mola rather poorly developed; maxillae with well developed galea and lacinia, palpi with apical segment fusiform; labial palpi with apical segment fusiform.

Thorax.—Prothorax elongate, pronotum without prebasal impression. Front coxae rather closely situated, cavities transverse, trochantins fully exposed, cavities internally and externally closed behind. Mesocoxae narrowly separated, cavities open outwardly, meso-epimera extending to the coxal cavities, sternal fitting between mesocoxae with a single knob. Metacoxae rather closely situated and transverse. Legs with trochanters simple and short, tibiae widened at apex, tarsi simple, tarsal formula 5-5-4 in male and, 5-5-5 in female.



Text-fig. 1.—A-C *Rhizophagus Pahalgamus* n. sp. A. Dorsal view, B. Ventral view, C. Posterior segments of abdomen; D & E. *Rhizophagus indicus* Meguignon D. Dorsal view, E. posterior segments of abdomen.

Elytra and Wing.—Elytra elongated, parallel-sided, truncated at apex exposing last abdominal tergites. Elytral puncturation in regular rows, epipleura complete upto apex. Wing venation reduced, without anal and radial cell.

Abdomen.—Elongated, first ventrite markedly long, intercoxal process moderately narrow and pointed at apex, without femoral lines. Tergite 7 markedly long, 6 pairs of spiracles lying on edges of tergites, tergite 7 without spiracles. Aedeagus short uninverted cucujoid-type and without articulated parameres. Ovipositor with separate paraprots, valvifers, coxites and minute style attached to outer faces of coxites-

Larva of *Rhizophagus* is described by Boving and Craighead (1931); head with cucujoid-type frontal suture; ocelli 2 on either side of head; mandible with two apical teeth, mola well developed, prostheca slender and pointed; maxillary mala falciform, maxillary articulating area well developed; labial palpi two-jointed; urogomphi short and characteristically branched; spiracles bicameral; legs rather short, claws simple with two-tarsungular setae lying side by side.

Known Indian species are not metallic in colour as in subgenera *Cyanostolus* and *Anomolophagus*, and second elytral interstice not broad as in subgenus *Eurhizophagus*, therefore placed under the subgenus *Rhizophagus* s. str.

***Rhizophagus pahalgamus* n. sp.**

Over-all length 4.70 mm.; length of antenna 0.80 mm.; width of head across eyes 1.00 mm.; width of Prothorax across front margin 0.80 mm.; width of elytra across middle 1.10 mm.; length of elytra 2.40 mm.

General Shape.—(Text-fig. 1 A) narrow, elongated, almost parallel sided, dorsally and ventrally depressed, dorasally glabrous and uniformly blackish brown.

Head (Fig. A) elongated, broadest across eyes and narrowed behind, eyes coarsely faceted, vertex of head more coarsely and slightly densely punctured than pronotum, anterior part of head more finely and sparsely punctured than that of vertex of head, clypeus (Text-fig. 1 A) broad, its apical margin almost straight, anterior part of clypeus with a distinct curved impressed line, labrum not visible. Antenna rather short, 10-jointed, insertions hidden, scape moderately large, pedicel small, about two-third of length of joint 3, joints 4-9 short and equal, club typical (Text-fig. 1 A) *Rhizophagid*-like and densely pubescent. Prothorax slightly longer than wide, widest in front margin and progressively slightly narrowed behind, lateral and hind margin uniformly bordered, front margin with a row of fine setae, front angles obtusely

rounded, hind angles rounded with 5 spines on each side (Text-fig. 1 A), puncturation on pronotum distinct but smaller and slightly sparser than vertex of head. Lateral and basal margins narrowly bordered, front margin with a row of small hairs. Elytra elongated, almost parallel-sided, slightly narrowed posteriorly, lateral margin bordered, humeral angles with calosities (Text-fig. 1 A). 9 rows of distinct punctures extending up to the apex, scutellary striole not distinct but with a row of minute punctures extending up to the apex. First row of punctures near scutellum with a distinct impressed line which extending to posterior three-fourths. Puncturation on elytra distinct slightly larger than that of vertex of head. Scutellum glabrous and its apical margin rounded (Text-fig. 1 A). Last two exposed abdominal segments as figured (Text-fig. 1 C). Leg (Text-fig. 1 B) with trochanter short, simple end with a single distinct seta. Ventral side glabrous with distinct punctures. Front coxal cavities slightly transverse with exposed trochantins and externally distinctly closed behind, prosternal process broad at apex (Text-fig. 1 B), anterior part of prosternal process with distinct undulated transverse ridges.

Holotype (♂) and a Paratype.—India : Kashmir : Pahalgam (7000 ft.) 30.5.1972 (*T. Sengupta*), on fungusy bark of a fallen tree, deposited in the collection of the Zoological Survey of India, Calcutta.

The chief characters in which *Rhizophagus indicus* Méquignon differs from *R. pahalgamus* sp. n. are given below :—

<i>R. indicus</i> ♂ (Text-fig. 1 D & E)	<i>R. pahalgamus</i> ♂ (Text-fig. 1 A-C.)
1. Colour redish brown	1. Colour blackish brown.
2. Hind angles of prothorax smooth (Fig. D.)	2. Hind angles of prothorax with 5 spines (Fig. A)
3. Elytral puncturation as figured (Fig. D)	3. Elytral puncturation different (Fig. A)
4. Exposed part of apex of abdomen of male as figured (Fig. E)	4. Exposed part of apex of abdomen different (Fig. C)
5. Species (Fig. D) comparatively shorter and broader, length 4.10 mm. long and maximum width across middle of elytra 1.10 mm.	5. Species (Fig. A) more elongated and narrower, length 4.70 mm. and width across middle of elytra 1.10 mm.

ACKNOWLEDGEMENT

This study has been carried out in Zoological Survey of India, Calcutta. We are indebted to Director, Zoological Survey of India for provision of all requisite facilities. We would also like to thank Mr. D. Mandal of Zoological Survey of India for translating the literature,

SUMMARY

A new species of *Rhizophagus* Herbst is described from India and the genus *Rhizophagus* is redefined.

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RE-SURVEY OF THE TERMITE FAUNA OF RAJASTHAN, INDIA, AND ITS ZOOGEOGRAPHY

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(With 4 Tables and 23 Text-figures)

INTRODUCTION

1. *General*

Rajasthan is the large westernmost State of India, covering 3,42,274 sq. km. (ca. 1.32,152 sq. miles). Two-thirds of it, lying W and NW of the diagonally running Aravalli Hills, is very arid and forms the bulk of the Great Indian Desert; the remaining one-third, lying S and SE of the Aravallis is relatively wet. It has 26 administrative districts (Text-fig. 1).

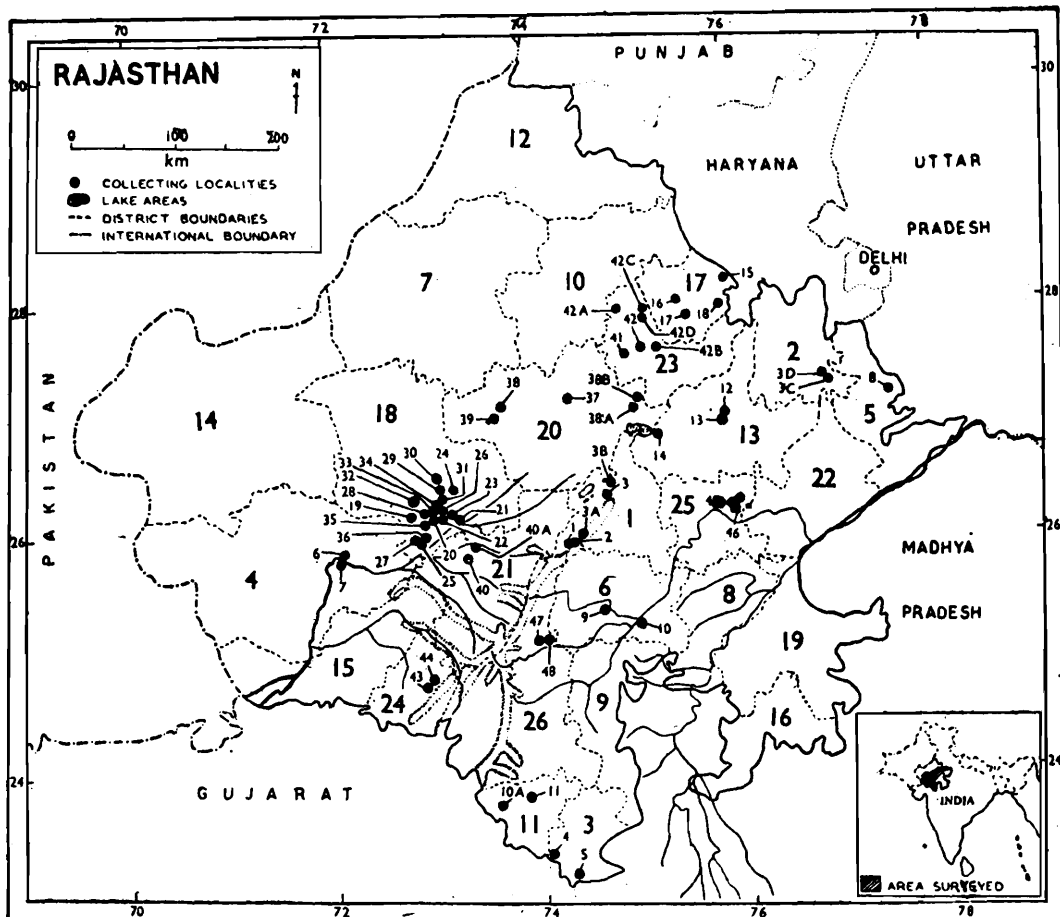
Until 1960, only 7 species of termites (Insecta : Isoptera) were known from Rajasthan. As a result of active exploration and study, Roonwal and Bose (1964) recorded 19 species and subspecies in their monograph. In the following 10 years (1964-73), we ourselves and parties from the Desert Regional Station, Zoological Survey of India have made intensive collections around Jodhpur and from several other districts of Rajasthan. As a result, one family (Kalotermitidae), one subfamily (Termitinae), 2 genera (*Incisitermes* and *Angulitermes*) and the following 14 species have been added to the Rajasthan fauna:—

1. *Incisitermes didwanaensis* Roonwal & Verma
2. *Microcerotermes palestinensis* Spaeth
3. *M. sakesarensis* Ahmad
4. *Angulitermes jodhpurensis* Roonwal & Verma
5. *Odontotermes brunneus* (Hagen)
6. *O. dehraduni* (Snyder)

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7. *O. distans* Holmgren & Holmgren
8. *O. feae* (Wasmann)
9. *O. giriensis* Roonwal & Chhotani
10. *O. gurdaspurensis* Holmgren & Holmgren
11. *O. latiguloides* Roonwal & Verma
12. *O. parvidens* Holmgren & Holmgren
13. *O. wallonensis* (Wasmann)
14. *Microtermes unicolor* Snyder



Text-fig. 1. Map of Rajasthan, showing the collecting localities for termites. (Inset : India, showing the area surveyed.) Large numerals (1—26) : Administrative Districts : 1, Ajmer. 2, Alwar. 3, Banswara. 4, Barmer. 5, Bharatpur. 6, Bhilwara. 7, Bikaner. 8, Bundi. 9, Chittorgarh. 10, Churu. 11, Dungarpur. 12, Ganganagar. 13, Jaipur. 14, Jaisalmer. 15, Jalore. 16, Jhalawar. 17, Jhunjhunu. 18, Jodhpur. 19, Kota. 20, Nagaur. 21, Pali. 22, Sawai Madhopur. 23, Sikar. 24, Sirohi. 25, Tonk. 26, Udaipur. Small numerals (1—48, etc.) : Collecting localities as listed in Table 1.

One species, *Trinervitermes heimi* (Wasmann), has been sunk as a junior synonym of *T. biformis* (Wasmann), and the following subspecies raised to full species rank:—

Microcerotermes tenuignathus laxmi Roonwal & Bose, raised to *M. laxmi* Roonwal & Bose.

Microcerotermes championi raja Roonwal & Bose, raised to *M. raja* Roonwal & Bose.

Microcerotermes tenuignathus tenuignathus Holmgren, now regarded simply as *M. tenuignathus* Holmgren, without any subspecies.

Odontotermes bellahunisensis guptai Roonwal & Bose, raised to *O. guptai* Roonwal & Bose.

Odontotermes brunneus kushwahi Roonwal & Bose, raised to *O. kushwahi* Roonwal & Bose.

The termite fauna of Rajasthan now comprises of 32 species spread over 4 families and 14 genera, as follows:—

List of termites known from Rajasthan

Note : Species (or subspecies) from Rajasthan listed by Roonwal and Bose (1964) are marked with an asterisk (*); the rest are additional records.

Family I. KALOTERMITIDAE

1. *Incisitermes didwanaensis* Roonwal & Verma

Family II. HODOTERMITIDAE

2. *Anacanthotermes macrocephalus** (Desneux)

Family III. RHINOTERMITIDAE

Subfamily (i) PSAMMOTERMITINAE

3. *Psammotermes rajasthanicus** Roonwal & Bose

Subfamily (ii) HETEROTERMITINAE

4. *Heterotermes indicola** (Wasmann)

Subfamily (iii) COPTOTERMITINAE

5. *Coptotermes heimi** (Wasmann)

Family IV. TERMITIDAE

Subfamily (i) AMITERMITINAE

6. *Speculitermes cyclops cyclops** Wasmann
7. *Amitermes belli** (Desneux)
8. *Synhamitermes quadriceps** (Wasmann)
9. *Eremotermes neoparadoxalis** Ahmad
10. *E. paradoxalis** Holmgren
11. *Microcerotermes laxmi** Roonwal & Bose
[*M. tenuignathus laxmi* R. & B.]
12. *Microcerotermes palestinensis* Spaeth
13. *Microcerotermes raja** Roonwal & Bose
[*M. championi raja* R. & B.]

14. *Microcerotermes sakesarensis* Ahmad
15. *Microcerotermes tenuignathus** Holmgren
[*M. t. tenuignathus* Holmg.]

Subfamily (ii) TERMITINAE

16. *Angulitermes jodhpurensis* Roonwal & Verma

Subfamily (iii) MACROTERTITINAE

17. *Odontotermes brunneus* (Hagen)
18. *O. dehraduni* (Snyder)
19. *O. distans* Holmgren & Holmgren
20. *O. feae* (Wasmann)
21. *O. giriensis* Roonwal & Chhotani
22. *O. guptai* Roonwal & Bose
[*O. bellahunisensis guptai* R. & B.]
23. *O. gurdaspurensis* Holmgren & Holmgren
24. *O. kushwahi** Roonwal & Bose
[*O. brunneus kushwahi* R. & B.]
25. *O. latiguloides* Roonwal & Verma
26. *O. obesus** (Rambur)
27. *O. parvidens* Holmgren & Holmgren
28. *O. wallonensis* (Wasmann)
29. *Microtermes mycophagus** (Desneux)
30. *M. obesi** Holmgren
[Syn. *M. anandi* Holmgren]
31. *M. unicolor* Snyder

Subfamily (iv) NASUTITERMITINAE

32. *Trinervitermes biformis** (Wasmann)
[Syns. *T. heimi* (Wasmann) and *T. longinotus* (Snyder)]

In the present paper, we have dealt with 29 species which constitute either new records from Rajasthan or are extensions of range in this area. Measurements (taken as defined in Roonwal, 1970a) and illustrations are provided only in those species for which they were not given in the earlier monograph (Roonwal and Bose, 1964). For a general account of the biology of several of the species, *vide* Roonwal (1970b). For distributional purposes, the records of Ahmad (1955) and Chaudhri and Ahmad (1972) for Pakistan and Bangla Desh were useful for comparison.

Ecological and zoogeographical importance of Rajasthan : A detailed faunistic study of so large an area as Rajasthan is in itself a desideratum. This need is further accentuated by the fact that the area is ecologically and zoogeographically of unusual interest. Ecologically, it is two-thirds arid and grades into semi-arid and wet areas, so that the ecological distri-

bution of the various species can be compared. Zoogeographically, the area forms a border zone between the western portion of the Palaearctic Region and the Oriental Region. For both these purposes, this taxonomic account, along with the earlier monograph of Roonwal and Bose (1964), provide the basic taxonomic framework. Zoogeography is discussed at the end.

2. Abbreviations used

Alt., Altitude, above mean sea-level.

Dist., District.

Ex., Exs., Out of; also example(s).

Im., Imago.

L., Length.

Pw., Pseudoworker.

S., Soldier.

Sev., Several.

Syn(s), Synonym(s).

Type-loc., Type-locality.

W., Width.

Wk., Worker.

COLLECTIONS AND THE COLLECTING LOCALITIES

(Table 1 and Text-fig. 1)

TABLE 1. Collecting Stations for termites included in the present paper (also *vide* Text-fig. 1 where the Stations are indicated by the Serial Nos. given in this Table).

Collecting Stations		Approximate latitude (N)	Approximate longitude (E)
1		2	3
1. Ajmer District (No. 1 in Fig. 1)			
1.	Beratia village, <i>ca.</i> 6 km. from Bar	25°50'	74°16'
2.	Forest plantation, near Beratia village, <i>ca.</i> 3 km. from Bar.	25°50'	74°15'
3.	Forest plantation, <i>ca.</i> 6 km. from Ajmer.	26°25'	74°35'
3A.	Sendra, <i>ca.</i> 13 km. E. of Bar on Ajmer road	25°50'	74°17'
3B.	Taragarh Fort, Ajmer	26°27'	74°42'
2. Alwar District (No. 2 in Fig. 1)			
3C.	Jugrabar village, <i>ca.</i> 22 km. from Alwar.	27°20'	76°50'
3D.	Sahejpur Roadside, <i>ca.</i> 18 km. from Alwar	27°25'	76°48'
3. Banswara District (No. 3 in Fig. 1)			
4.	Danpur village	23°50'	74°21'
5.	Hill near Kuthumbi	23°30'	74°35'
4. Barmer District (No. 4 in Fig. 1)			
6.	Balotra	25°50'	72°15'
7.	Mevanagar (Nakhora), <i>ca.</i> 6 km. SW of Balotra	25°45'	72°10'

Collecting Stations	Approximate latitude (N)	Approximate longitude (E)
1	2	3
5. Bharatpur District (No. 5 in Fig. 1)		
8. Noah village, <i>ca.</i> 7 km. E of Bharatpur	27°12'	77°35'
6. Bhilwara District (No. 6 in Fig. 1)		
9. Danta-ka-Khera	25°21'	74°32'
10. Mandalgarh	25°10'	75°05'
7. Dungarpur District (No. 11 in Fig. 1)		
10A. Nallah, <i>ca.</i> 12 km. W of Bichiwara	23°45'	73°26'
11. Sabella	23°50'	73°40'
8. Jaipur District (No. 13 in Fig. 1)		
12. Amber, <i>ca.</i> 10 km. N. of Jaipur	27°00'	75°50'
13. Jaipur	26°55'	75°52'
14. Sambhar Lake	26°54'	75°13'
9. Jhunjhunu District (No. 17 in Fig. 1)		
15. Jhojhu village, <i>ca.</i> 62 km. SE of	28°30'	76°05'
16. Jhunjhunu	28°05'	75°24'
17. Khokund village, <i>ca.</i> 25 km. NE of Raghunathgarh	27°45'	75°35'
18. Moi village, <i>ca.</i> 46 km. SE of Jhunjhunu.	28°30'	75°55';
10. Jodhpur District (No. 18 in Fig. 1)		
19. Agolai, <i>ca.</i> 45 km. W of Jodhpur	26°15'	72°35'
20. Arnaji, <i>ca.</i> 33 km. S of Jodhpur	26°18'	73°04'
21. Banar, <i>ca.</i> 15 km. NE of Jodhpur	26°15'	73°05'
22. Beriganga, <i>ca.</i> 20 km. N of Jodhpur	26°10'	73°04'
23. Bisalpur, <i>ca.</i> 30 km. W of Jodhpur	26°10'	73°15'
24. Borunda	26°25'	73°45'
25. Dipla village, <i>ca.</i> 58 km. W of Jodhpur	26°10'	72°35'
26. Jodhpur	26°18'	73°04'
27. Kalyanpur village, <i>ca.</i> 68 km. W of Jodhpur	26°00'	72°35'
28. Kaylana Lake <i>ca.</i> 10 km. W of Jodhpur	26°15'	72°55'
29. Khokaria village, <i>ca.</i> 11 km. N of Jodhpur	26°20'	73°05'
30. Mathania, <i>ca.</i> 30 km. NW of Jodhpur	26°32'	72°59'
31. Mandore, <i>ca.</i> 12 km. N of Jodhpur	26°20'	73°00'

Collecting Stations		Approximate latitude (N)	Approximate longitude (E)
1		2	3
32.	Megalasia village, <i>ca.</i> 10 km. W of Jodhpur	26°15'	72°50'
33.	Pratapsagar	26°20'	73°05'
34.	Rohila village, <i>ca.</i> 8 km. W of Jodhpur	26°18'	73°00'
35.	Salawas village, <i>ca.</i> 18 km. W of Jodhpur	26°05'	72°55'
36.	Satlana village, <i>ca.</i> 56 km. SW of Jodhpur	25°55'	72°55'
11. Nagaur District (No. 20 in Fig. 1)			
37.	Didwana	27°20'	74°30'
38.	Nagaur	27°11'	73°41'
38A.	Panchota village, <i>ca.</i> 12 km. from Maroth	27°03'	75°05'
38B.	Solayana village, <i>ca.</i> 4 km. S of Maroth	27°08'	75°10'
39.	Soyala village, <i>ca.</i> 20 km. SW of Nagaur	26°55'	73°20'
12. Pali District (No. 21 in Fig. 1)			
40.	Hemawas Dam, near Pali	25°40'	73°20'
40A.	Sardarsamand	25°54'	73°25'
13. Sikar District (No. 23 in Fig. 1)			
41.	Badalas village, <i>ca.</i> 20 km. SW of Sikar	27°25'	75°00'
42.	Harshnath, <i>ca.</i> 25 km. NW of Sikar	27°30'	75°18'
42A.	Lachmangarh, <i>ca.</i> 25 km. NW of Sikar	27°45'	75°00'
42B.	Palsana, <i>ca.</i> 20 km. SE of Sikar	27°25'	75°20'
42C.	Pipardi village, <i>ca.</i> 10 km. NE of Sikar	27°40'	75°20'
42D.	Purohiton-ka-Bas, <i>ca.</i> 5 km. NE of Sikar	27°38'	75°18'
14. Sirohi District (No. 24 in Fig. 1)			
43.	Mount Abu	24°25'	72°45'
44.	Oria village, near Mt. Abu	24°30'	72°45'
15. Tonk District (No. 25 in Fig. 1)			
45.	Banasthali, <i>ca.</i> 56 km. SE of Jaipur	26°27'	75°55'
46.	Newai village, <i>ca.</i> 60 km. SE of Jaipur	26°25'	75°55'
16. Udaipur District (No. 26 in Fig. 1)			
47.	Amet, <i>ca.</i> 50 km. NE of Udaipur	25°15'	73°55'
48.	Olna-khera, near Amet	25°10'	74°00'
TOTAL: 60 Stations			

Termites studied for the present account comprised about 187 vials collected mostly during the 10-year period (1964-73), and were obtained from 60 stations in 16 districts (Table 1 and Text-fig. 1) situated mostly in the central, eastern and southern Rajasthan, largely leaving out the western and north-western desert area except the eastern fringe (Jodhpur, etc.). Of these 16 districts, 9 were repeats from those mentioned in the earlier monograph (Roonwal and Bose, 1964) and 7 were districts not covered earlier. In this way, between the present and the earlier accounts, 24 out of the total of 26 districts of Rajasthan have been covered as follows, only two relatively small districts viz., Chittorgarh and Jhalawar, thus remaining unsurveyed:—

Districts of Rajasthan indicating where termite surveys have been carried out

Notes : * Districts covered in the earlier monograph (Roonwal and Bose, 1964).

+ Districts covered in the present account.

- | | |
|-----------------|---------------------|
| 1. Ajmer+ | 14. Jaisalmer* |
| 2. Alwar+ | 15. Jalore* |
| 3. Banswara+ | 16. Jhalawar |
| 4. Barmer** | 17. Jhunjhunu** |
| 5. Bharatpur+ | 18. Jodhpur** |
| 6. Bhilwara+ | 19. Kota* |
| 7. Bikaner* | 20. Nagaur** |
| 8. Bundi* | 21. Pali** |
| 9. Chittorgarh | 22. Sawai Madhopur* |
| 10. Churu* | 23. Sikar** |
| 11. Dungarpur+ | 24. Sirohi** |
| 12. Ganganagar* | 25. Tonk+ |
| 13. Jaipur** | 26. Udaipur** |

SYSTEMATIC ACCOUNT

Family 1. KALOTERMITIDAE

1. *Incisitermes didwanaensis* Roonwal & Verma 1973

(Text-fig. 2)

Roonwal & Verma, 1973, c. p. 390.

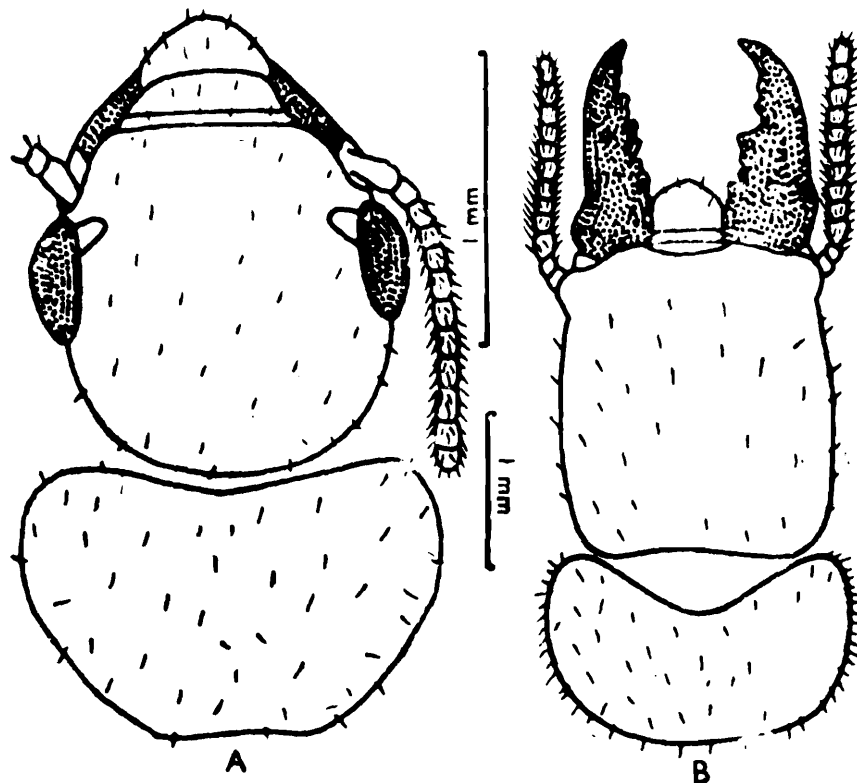
Castes known.— Im. (dealate ♀), S., Pw.

Material.—A dealate ♀ imago, and several soldiers and pseudoworkers;

Measurements.—For details, see Roonwal and Verma, 1973c.

Distribution.—Didwana (Nagaur Dist., Rajasthan).

Remarks.—The above (Roonwal and Verma, 1973c) is the third record of the genus from the orient and the first one from India. The other two oriental species are from the Philippines (*I. mcgregori* Light and *I. taylori* Light).



Text-fig. 2. *Incisitermes didwanaensis* Roonwal & Verma. Didwana (Nagaur Dist., Rajasthan). Head and pronotum, dorsal view. (A) Imago (dealate ♀). (B) Soldier.

Family II. HODOTERMITIDAE

2. *Anacanthotermes macrocephalus* (Desneux)

Hodotermes macrocephalus Desneux, 1906, p. 344.

Castes known.—Im., S., Wk.

Material.—35 vials, 1964-73, mostly S. and Wk., and a few Im., from Rajasthan thus : (i) Barmer Dist. : Balotra and Mevanagar (Nakhora). (ii) Jodhpur Dist. : Agolai, Arnaji, Beriganga, Bisalpur, Jodhpur, Kalyanpur, Kaylana, Mathania, Megalasia, Rohila, Salawas and Satlana.

Distribution.—From E. Afghanistan, via Pakistan (Baluchistan, Sind, Punjab) to western Rajasthan in India. The present records add a few more localities in western Rajasthan. The species does not seem to go much further east beyond Jodhpur.

Remarks.—Swarming in Jodhpur occurs in August. This is an arid zone species. For its distribution in Rajasthan in relation to vegetation and soil, vide Roonwal and Bose (1973). Sex ratios, body-weight in dealates and sexual dimorphism in external body-parts of imagoes have been discussed by Roonwal and Rathore (1972).

Family III. RHINOTERMITIDAE

Subfamily (i) HETEROTERMITINAE

3. *Heterotermes indicola* (Wasmann) 1902

(Text-fig. 3)

Leucotermes indicola Wasmann, 1902, *Zool. Jb. (Syst.)*, Jena, 17 (1), pp. 118-119, S., Wk.

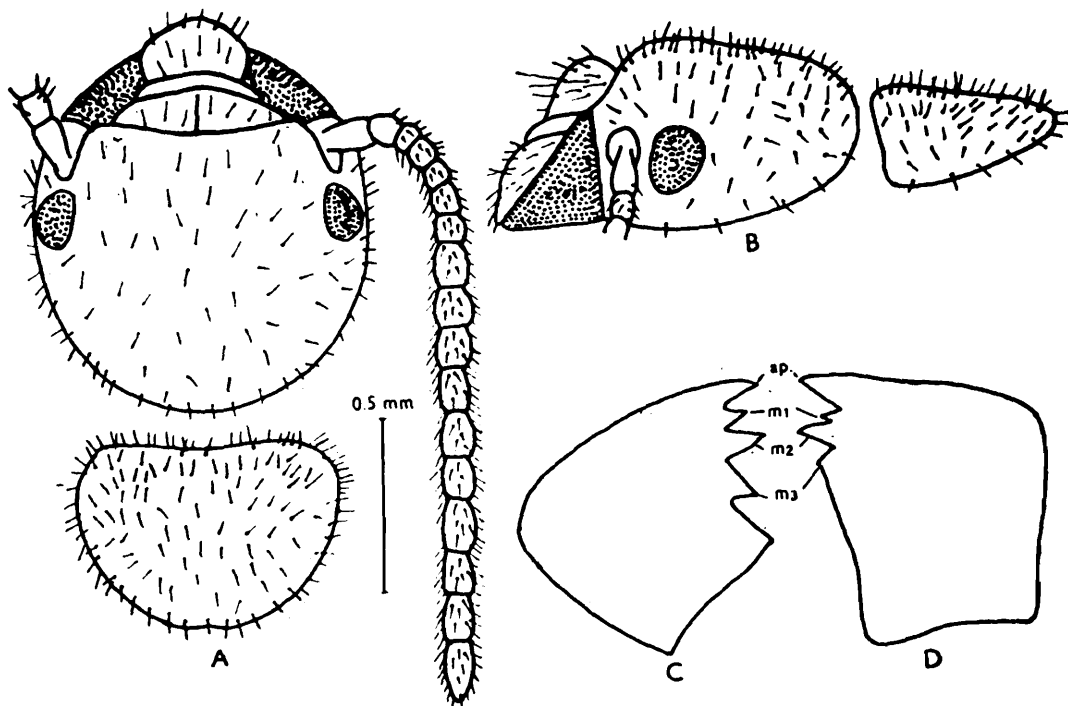
Castes known.—Im., S., Wk.

Material.—5 vials, 1972-73, Im., S., Wk., Jodhpur city; imagoes from swarms and soldiers and workers from wood-work in houses.

Measurements (mm.), etc.

Imago (1 ex., Jodhpur)

1. Total length with wings	10.0
2. Total length without wings	5.0
3. Head-length to tip of labrum	1.26
4. Head-length to mandible-base	0.84
5. Max. width of head, with eyes	0.89
6. Max. height of head	0.58
7. Labrum (Median L × W)	0.14 × 0.30
8. Eyes (L × W)	0.23 × 0.18
9. Min. eye-antennal distance	0.027
10. Pronotum (L × W)	0.37 × 0.68
11. No. of antennal segments	17



Text-fig. 3. *Heterotermes indicola* (Wasmann). Imago. Jodhpur (Rajasthan) : (A) Head and pronotum, dorsal view. (B) Ditto, side view. (C), (D) Left and right mandibles, respectively.

ap., apical teeth; *m1-m3*, marginal teeth 1-3 respectively.

For measurements of soldiers from Rajasthan, *vide* Roonwal and Bose (1964).

Distribution.—Widely distributed in Pakistan and North India south to about 20°N latitude.

Remarks.—The present is the first breeding record, as indicated by the presence of imagoes, from Rajasthan. Swarming occurs in Jodhpur in July and August in the early part of the night (8—8.30 P.M.). The species was found to seriously damage wood-work in houses in Jodhpur city.

Subfamily (ii) COPTOTERMITINAE

4. *Coptotermes heimi* (Wasmann)

(Text-fig. 4)

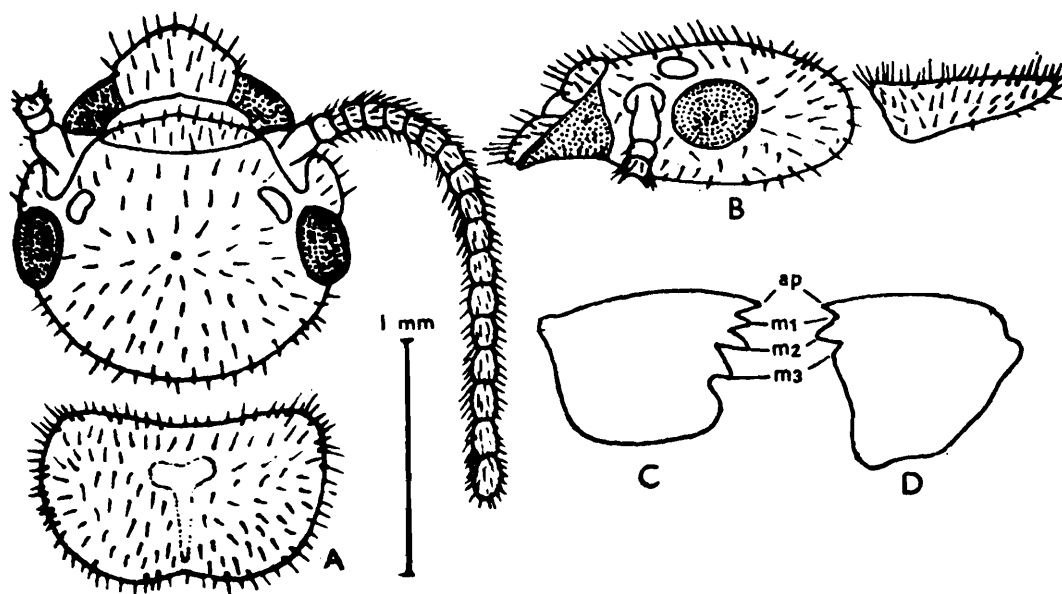
Arrhinotermes heimi Wasmann, 1902, *Zool. Jb. (Syst.)*, Jena, 17 (1), p. 104, Pl. 4, Im.

Coptotermes heimi (Wasm.), 1962*b*, Roonwal & Chhotani, p. 38.

Castes known.—Im., S., Wk.

Material.—5 vials, 1973, Im., S., Wk., from Rajasthan, thus: (i) Jodhpur Dist.: Jodhpur. (ii) Sikar Dist.: Pipardi village and Purohitonka-Bas.

For measurements of imagoes *see* Roonwal and Chhotani (1962 *b*) and for soldiers, Roonwal and Bose (1964).



Text-fig. 4. *Coptotermes heimi* (Wasmann). Imago (alate ♂). Jodhpur (Rajasthan). (A) Head and pronotum, dorsal view. (B) Ditto, side view. (C), (D), Left and right mandibles respectively.

ap., apical teeth; *m1—m3*, marginal teeth 1-3 respectively.

Distribution.—Widely distributed almost all over India and Pakistan. First recorded from Rajasthan by Roonwal and Bose (1964) from the districts of Jaisalmer, Jodhpur, Pali, Nagaur and Jaipur; the present records from the Sikar district are new.

Remarks.—Breeding, as indicated by the presence of imagoes, from Rajasthan is here recorded for the first time. Swarming in Jodhpur occurs from end-May to early August (31 May to 3 August) at night (ca. 8 to 9 P.M.).

Family IV. TERMITIDAE

Subfamily (i) AMITERMITINAE

5. *Speculitermes cyclops cyclops* Wasmann

(Text-fig. 5)

Speculitermes cyclops Wasmann, 1902, *Zool. Jb. (Syst.)*, Jena, 17 (1), pp. 160-162, Im., Wk.; Roonwal and Sen-Sarma, 1960, p. 16.

Castes known.—Im. (not Rajasthan); Wk.

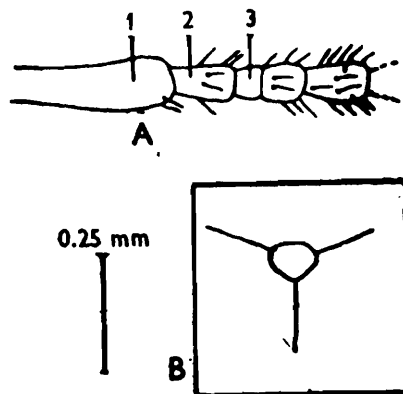
Material.—A vial, sev. Wk.; Nallah, ca. 10 km. E of Bichiwara (Dungarpur Dist.), P. D. Gupta & Party coll., 11. iii. 1972, ex under stone.

Measurements (mm.), etc.

Workers (1 ex., Dungarpur Dist.)

1. Total length	6.8
2. Head-length to mandible-base	1.16
3. Max. width of head	1.32
4. Mid-dorsal spot (L × W)	0.21 × 0.21
5. Pronotum (L × W)	0.47 × 0.79
6. No. of antennal segments	15

Distribution.—Found in the relatively moist areas of North India (eastern and southern Rajasthan, Uttar Pradesh, Madhya Pradesh) and Maharashtra; and Pakistan. Records from Burma are doubtful.



Text-fig. 5. *Speculitermes cyclops cyclops* (Wasmann). Worker. Bichiwara (Dungarpur Dist., Rajasthan). (A) Basal segments of a 15-segmented antenna, showing the subdivision of segment 3 (of a 14-segmented antenna) into two segments (3 and 4). (B) Mid-dorsal spot on head.

Remarks.—From Rajasthan it was hitherto known only from the Kota district; the present record from the Dungarpur district extends the range further south. In Rajasthan it occurs only in the wet zone (open or dense forests). The number of worker antennal segments, normally 14, is here often 15 (by the subdivision of segment 9). The soldier caste is mostly wanting in the genus (*vide* Roonwal and Chhotani, 1960).

6. *Amitermes belli* (Desneux) 1906

Termes belli Desneux, 1906, p. 352.

Castes known.—Im., S., Wk.

Material.—A vial, 6 S., sev. Wk., Jodhpur, N. S. Rathore coll., 8, iv. 1973, ex *neem* tree.

For measurements of imagoes and soldiers from Rajasthan, *vide* Roonwal and Bose (1964).

Distribution.—Pakistan (Baluchistan, N.W.F.P., Sind, Punjab) and western India (Rajasthan).

Remarks.—It is an arid to wet zone species; for its distribution in Rajasthan in relation to soil and vegetation, *vide* Roonwal and Bose (1973).

7. *Eremotermes neoparadoxalis* Ahmad 1955

Ahmad, 1955, p. 252.

Castes known.—S., Wk.

Material.—5 vials, 1964-72, S., Wk., Jodhpur Dist. (Agolai, Beriganga, Jodhpur and Satlana).

Distribution.—Pakistan (Sind, Baluchistan, N.W.F.P.) and western India (Rajasthan and Delhi). In Rajasthan known from the districts of Jodhpur (present record), Bikaner and Jaipur.

Remarks.—It is an arid zone species.

8. *Eremotermes paradoxalis* Holmgren 1913

(Text-fig. 6)

Eremotermes paradoxalis Holmgren, 1913, *J. Bomaay nat. Hist. Soc.*, Bombay, 22 (1), pp. 115-116. S., Wk.

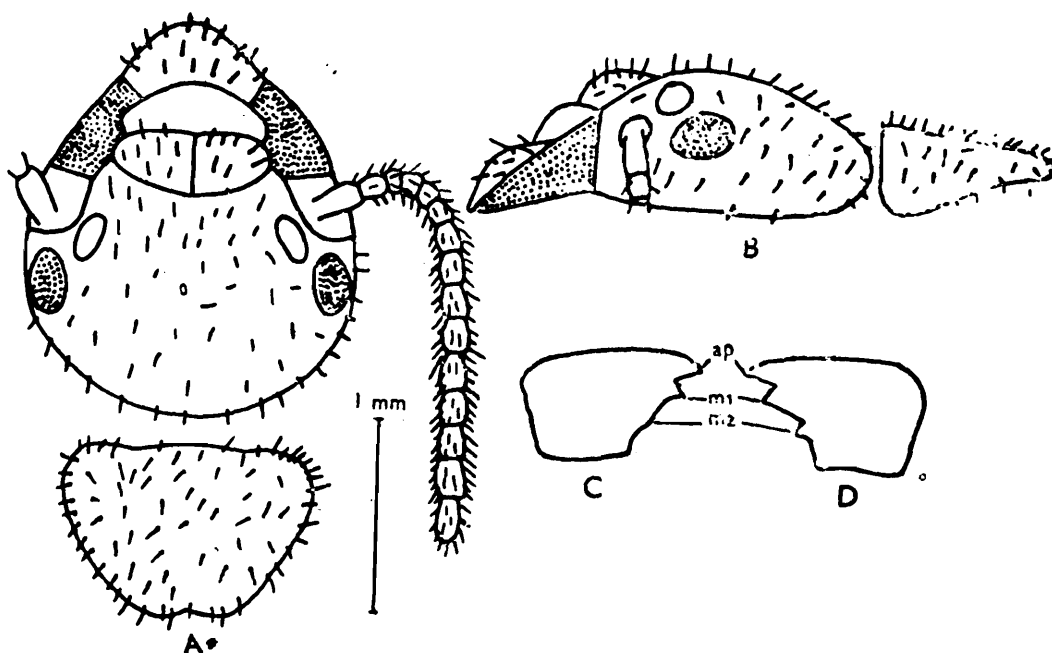
Castes known.—Im., S., Wk.

Material.—5 vials, 1969-73, Im., S., Wk., Jodhpur (Jodhpur Dist.).

Measurements (mm.) etc.

Imagoes (8 exs., Jodhpur)

1. Total length with wings	8.9—10.3
2. Total length without wings	5.1—5.7
3. Head-length to tip of labrum	1.00—1.05
4. Head length to mandible-base	0.52—0.74
5. Max. width of head with eyes	0.70—0.89
6. Max. height of head	0.40—0.53
7. Labrum (Median L × W)	0.08—0.16 × 0.27—0.37
8. Eyes (L × W)	0.18—0.22 × 0.15—0.19
9. Ocelli (L × W)	0.10—0.11 × 0.08—0.09
10. Min. eye-ocellus distance	0.027—0.036
11. Min. eye-antennal distance	0.027—0.045
12. Pronotum (L × W)	0.32—0.47 × 0.52—0.68
13. No. of antennal segments	15



Text-fig. 6. *Eremotermes paradoxalis* Holmgren. Imago. Jodhpur (Rajasthan) A) Head and pronotum, dorsal view. (B) Ditto, side view. (C), (D), Left and right mandibles respectively.

ap., apical teeth; m1—m2, marginal teeth 1 and 2 respectively.

For measurements of soldiers from Rajasthan, *vide* Roonwal and Bose (1964).

Distribution.—Widely distributed in India (Rajasthan, Punjab, Delhi, and Peninsular India down to Kerala); and Pakistan (Punjab, N.W.F.P.).

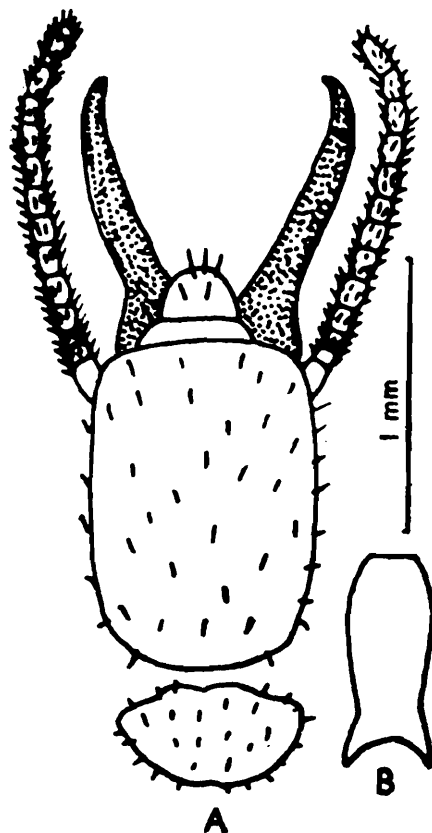
Remarks.—In Rajasthan it was hitherto known from the districts of Nagaur, Jaipur and Kota; the present is the first record from the Jodhpur district. The present is also the first record of breeding in Rajasthan. Swarming occurs at Jodhpur during June and August in the afternoons and evenings (*ca.* 4.45 to 7.30 P.M.). It is a semi-arid zone species.

9. *Microcerotermes palestinensis* Spaeth 1962

(Text-fig. 7)

(Nec Emerson of authors, *vide* discussion in Roonwal, 1974.)*Castes known*.—Im. (not Rajasthan), S., Wk.*Material*.—2 vials : (i) 3 S., sev. Wk., Mathania (Jodhpur Dist.), S. C. Verma & N. S. Rathore coll., 3 viii.1970, mixed with *Odontotermes obesus* (ex mound). (ii) 2 S., sev. Wk., Amet (Udaipur Dist.), S. C. Verma coll., 16.vii.1972, ex earthen runway on 'Khejri' (*Prosopis spicigera* Linn.).*Measurements* (mm.), etc.*Soldiers* (3 exs., Mathania and Amet, Rajasthan)

1. Total length with mandibles	5.0—5.3
2. Head-length with mandibles	2.21—2.26
3. Head-length to mandible-base	1.26
4. Max. width of head	0.95
5. Max. height of head	0.68—0.74
6. Length of mandibles (left; right)	1.0; 1.0
7. Postmentum (Median L × W)	0.58 × 0.32
8. Pronotum (L × W)	0.32—0.37 × 0.63—0.68
9. Mandible-Head Index (Left Mandible-length/Head-length to mandible-base)	0.79
10. No. of antennal segments	13

Distribution.—India (western and southern Rajasthan, e.g., Jodhpur and Udaipur Dists.), and West Asia (Israel).Text-fig. 7. *Microcerotermes palestinensis* Spaeth. Soldier. Amet (Udaipur Dist., Rajasthan). (A) Head and pronotum, dorsal view. (B) Postmentum, *in situ*.

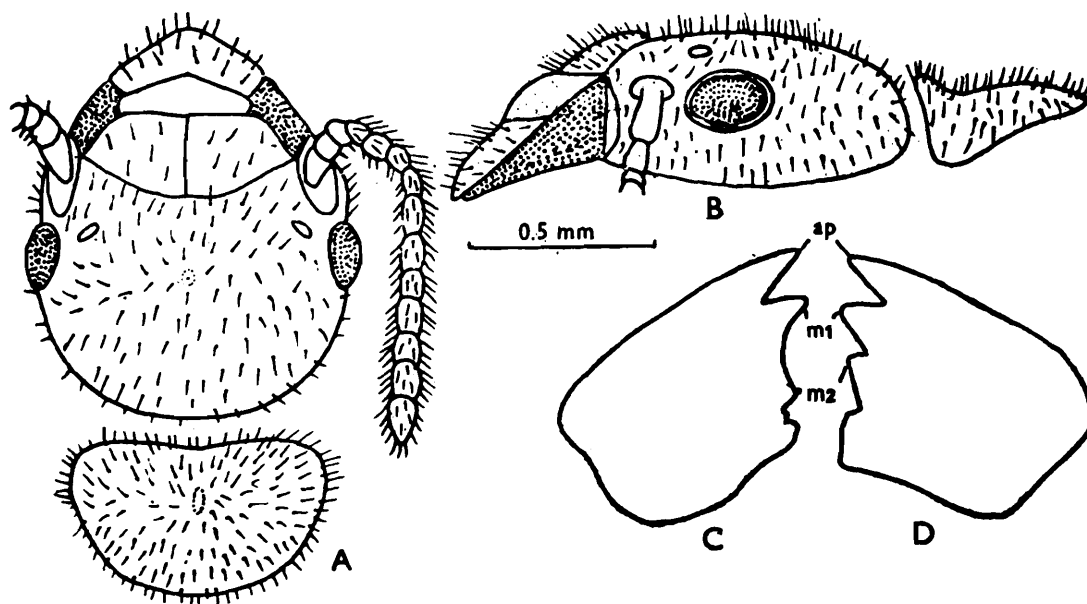
Remarks.—This is the first record from India. The species was originally described from Israel (an arid area) and this widely separated discontinuous distribution is of interest. In India it has been found both in the semi-arid areas as well as in relatively wet forested zones. The shape and distribution of micrasters on its wing-membranes have been described by Roonwal, Verma and Rathore (1974).

10. *Microcerotermes raja* Roonwal and Bose 1964

(Text-fig. 8)

Microcerotermes championi raja Roonwal & Bose, 1964, p. 26.

Castes known.—Im., S., Wk.



Text-fig. 8. *Microcerotermes raja* Roonwal & Bose (*M. championi raja* R. & B.). Imago. Jodhpur (Rajasthan). (A) Head and pronotum, dorsal view. (B) Ditto, side view. (C), (D), Left and right mandibles respectively.

ap., apical teeth; *m1-m2*, marginal teeth 1 and 2 respectively.

Material.—8 vials, Im, S., Wk., 1969-73, districts of Jodhpur (Jodhpur and vicinity) and Nagaur (Salayana village, ca. 4 km. S of Maroth).

Measurements (mm.), etc.

Imago (4 exs., Jodhpur)

1. Total length with wings	8.0—9.8 (48 exs.)
2. Total length without wings	3.2—6.2 (54 exs.)
3. Head-length to mandible-base	0.95—1.00
4. Max. head-width with eyes	0.72—1.42 (54 exs.)
5. Labrum (Median L × W)	0.11—0.15 × 0.39
6. Eyes (max. × min. diameter)	0.18 × 0.16
7. Ocellus (max. × min. diameter)	0.072 × 0.045
8. Min. eye-ocellus distance	0.07—0.08
9. Pronotum (L × W)	0.47 × 0.74—0.79
10. No. of antennal segments	14

Distribution.—Rajasthan : Jodhpur and Nagaur Dists., as above.

Remarks.—It is a semi-arid zone species. The imago has been described by Roonwal, Verma and Rathore (1973) who have also made observations on gallery-system, swarming, etc. Swarming at Jodhpur occurs in the day (about 11 A.M. — 3 P.M.) during the monsoon for a period of about six weeks (end-June to second week of August). The shape and distribution of micrasters on wing-membrane have been described by Roonwal, Verma and Rathore (1974), and sex ratios and sexual dimorphism in external body-parts discussed by Roonwal and Verma (1973). Roonwal and Rathore (*in press, c*) have discussed its swarming and egg-laying.

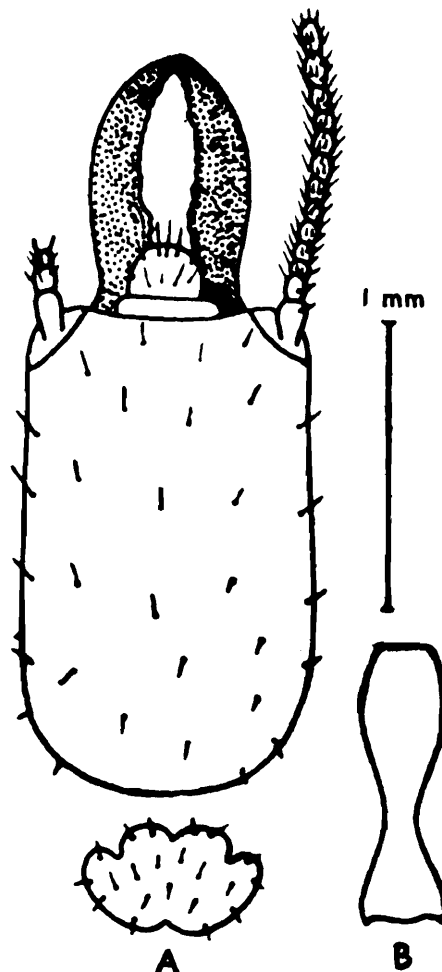
11. *Microcerotermes sakesarensis* Ahmad 1955

(Text-fig. 9)

Ahmad, 1955, p. 247.

Castes known.—S., Wk.

Material.—A vial, sev. S., Wk., Sambhar Lake (Jaipur Dist.), S. C. Verma coll., 6.ii.1972, ex wood.



Text-fig. 9. *Microcerotermes sakesarensis* Ahmad. Soldier. Sambhar Lake (Jaipur Dist., Rajasthan). (A) Head and pronotum, dorsal view. (B) Postmentum, *in situ*.

*Measurements (mm.), etc.**Soldiers* (2 exs., Sambhar Lake)

1. Total length with mandibles	5.3
2. Head-length with mandibles	2.47—2.58
3. Head-length to mandible-base	1.63—1.74
4. Max. width of head	0.95
5. Length of mandibles (left; right)	0.89; 0.89
6. Pronotum (L × W)	0.37 × 0.63
7. No. of antennal segments	13

Distribution.—India (Sambhar Lake, Jaipur Dist., Rajasthan); and Pakistan (Punjab, N.W.F.P.).

Remarks.—This is the first record from India. It is evidently an arid zone species.

12. *Microcerotermes tenuignathus* Holmgren

Microcerotermes tenuignathus Holmgren, 1913, *J. Bombay nat. Hist. Soc.*, Bombay, 22 (1), pp. 116-117. S., Wk. (major and minor).

Microcerotermes t. tenuignathus Roonwal & Bose, 1964, p. 28.

Castes known.—S., Wk.

Material.—2 vials : (i) 2 S., sev. Wk., Agolai (Jodhpur Dist.), P. D. Gupta coll., 17.vii.1965, ex under stone. (ii) 2 S., sev. Wk., Jodhpur, S. C. Verma coll., 22.vii.1970, ex wood.

Distribution.—Western India (Gujarat and Rajasthan); and Pakistan (Baluchistan, N.W.F.P., Punjab, Sind). In Rajasthan it is known from the districts of Barmer, Jaisalmer, Jodhpur, Jaipur and Kota. The present is the first record from Jodhpur proper.

Subfamily (ii) TERMITINAE

13. *Angulitermes jodhpurensis* Roonwal & Verma (in press)

(Text-fig. 10)

Roonwal & Verma, *in press*. Im., S., Wk.

Castes known.—Im., S., Wk.

Material.—2 vials, 1972-73, Im., S., Wk., Jodhpur.

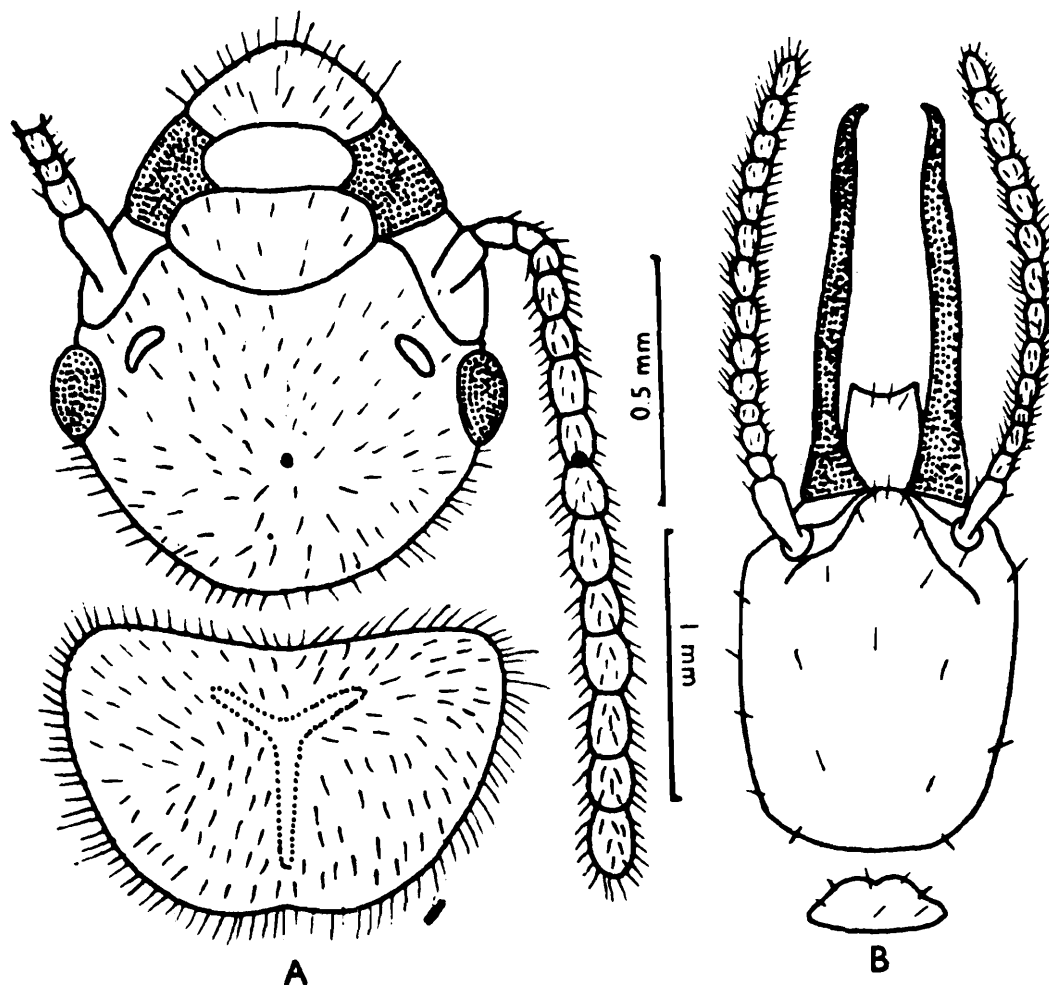
*Measurements (mm.), etc.**Imagoes* (5 exs., Jodhpur)

1. Total length with wings	10.0—11.0
2. Total length without wings	6.0—7.0
3. Head-length with mandibles	1.00—1.11
4. Head-length to mandible-base	0.68—0.84
5. Max. width of head with eyes	0.95—1.00
6. Max. height of head	0.53
7. Labrum (Median L × W)	0.09 × 0.36
8. Eyes (max. × min. diameter)	0.23—0.25 × 0.20—0.22
9. Pronotum (L × W)	0.47—0.53 × 0.89—0.95
10. No. of antennal segments	15

Soldiers (5 exs., Jodhpur)

1. Total length with mandibles	3.7—4.7
2. Head-length with mandibles	2.42—2.74
3. Head-length to mandible-base	1.11—1.32
4. Head-length with frontal projection	1.32
5. Max. width of head	0.95—1.00
6. Max. height of head	0.58
7. Max. length of mandibles (left; right)	1.32—1.42; 1.32—1.42
8. Labrum (Median L × W)	.25 × 0.210
9. Postmentum (Median L × W)	0.32—0.27
10. Pronotum (L × W)	0.21 × 0.58—0.63
11. No. of antennal segments	14

Distribution.—India : Jodhpur (Rajasthan).



Text-fig. 10. *Angulitermes jodhpurensis* Roonwal & Verma. Head and pronotum, dorsal view. Jodhur (Rajasthan). (A) Imago (♀). (B) Soldier.

Remarks.—Swarming occurs in August in the afternoon (for fuller details of breeding, *vide* Roonwal and Verma, 1974). The shape and distribution of micrasters on wing-membranes have been described by Roonwal, Verma and Rathore (1974). The shape and the width/

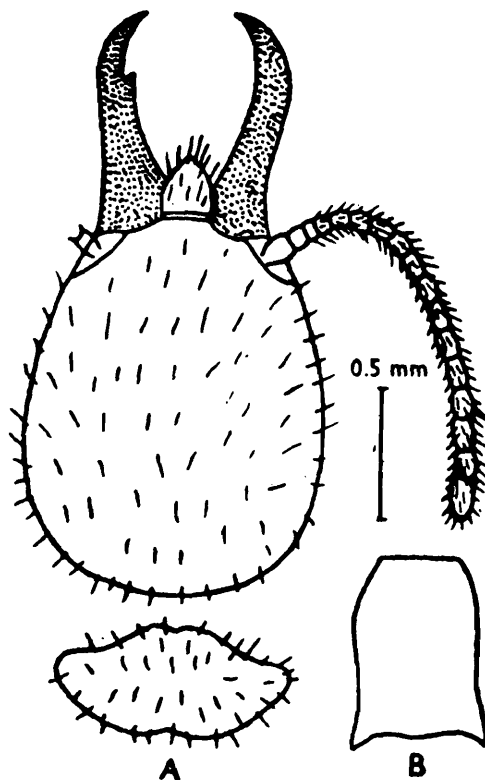
length ratio of eggs have been discussed by Roonwal (1973b). Egg-laying, hatching, etc. have been described by Roonwal and Rathore (in press, c).

Subfamily (iii) MACROTERMITINAE

14. *Odontotermes brunneus* (Hagen)

(Text-fig. 11)

Termes brunneus Hagen, 1858, *Linn. Entom.*, Berlin, 12, p. 133 Im., S.



Text-fig. 11. *Odontotermes brunneus* (Hagen). Soldier. Banasthali (Tonk Dist., Rajasthan). (A) Head and pronotum, dorsal view. (B) Postmentum, *in situ*.

Castes known.—Im. (not Rajasthan), S., Wk.

Material.—A vial, 2 S., sev. Wk., Banasthali (Tonk Dist.), Y. P. Sinha coll., 7.x.1973, ex. log of wood.

Measurements (mm.), etc.

Soldier (1 ex., Banasthali, Tonk Dist.)

1. Total length with mandibles	5.0
2. Head-length with mandibles	2.31
3. Head-length to mandible-base	1.32
4. Max. width of head	1.21
5. Length of mandibles (left; right)	1.0; 1.0
6. Distance of tooth from apex in left mandible	0.32
7. Left Mandibular Index (Tooth distance/Mandible-length)	0.32
8. Pronotum (L × W)	0.47 × 1.05
9. No. of antennal segments	16

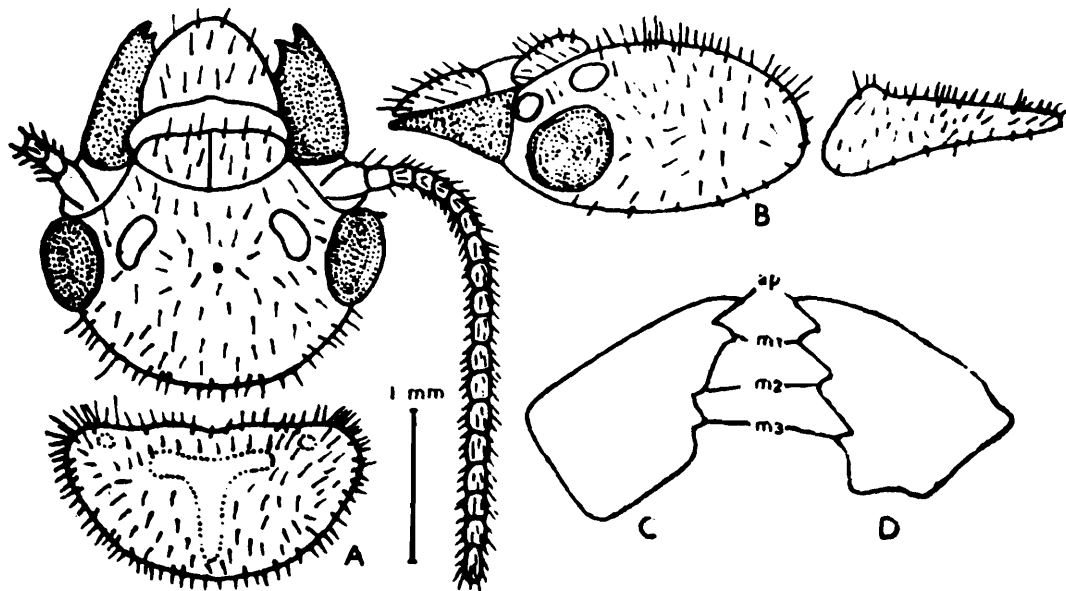
Distribution.—Widely distributed in India. (Sri Lanka records given by some authors are doubtful.) This is the first record from Rajasthan.

Remarks.—The structure of its dome-shaped earthen mounds has been described by Roonwal (1973a) from Gujarat.

15. *Odontotermes dehraduni* (Snyder) 1934

(Text-fig. 12)

Termes (Termes) dehraduni Snyder, 1934, *Proc. U. S. natnl. Mus.*, Washington, 82 (16), pp. 6—7. Im.



Text-fig. 12. *Odontotermes dehraduni* (Snyder). Imago. Jodhpur (Rajasthan). (A) Head and pronotum, dorsal view. (B) Ditto, side view. (C), (D), Left and right mandibles, respectively.

ap., apical teeth; m1—m3, marginal teeth 1-3 respectively.

Castes known.—Im. only.

Material.—A vial, sev. Im., Jodhpur, P. D. Gupta coll., 5.vii.1965, ex light-trap.

Measurements (mm.), etc.

Imago (2 exs., Jodhpur)

1. Total length with wings	27.5—27.9
2. Total length without wings	13.4
3. Head-length to tip of labrum	2.79—2.89
4. Head-length to mandible-base	1.84
5. Max. width of head with eyes	2.58—2.63
6. Labrum (Median L × W)	0.58 × 0.79
7. Eyes (L × W)	0.74 × 0.63
8. Ocelli (L × W)	0.32 × 0.42
9. Min. eye-ocellus distance	0.11
10. Pronotum (L × W)	1.05—1.16 × 2.05—2.21
11. No. of antennal segments	19

Distribution.—North India (Dehra Dun, Uttar Pradesh; Delhi; and Jodhpur, Rajasthan); and Pakistan (Jhelum Dist.; Lahore and Rawalpindi).

Remarks.—This is the first record from Rajasthan. Only imagoes (at swarms) have so far been obtained. Swarming occurs at Jodhpur in early July at night; at other places, from end-June to early September. In Delhi, Vishnoi (1957*b*) reported sporadic swarming in small numbers in early monsoon (end-June and July) at night.

16. *Odontotermes distans* Holmgren & Holmgren 1917

(Text-fig. 13)

Odontotermes distans Holmgren & Holmgren, 1917, *Mem. Dept. Agric. India (Ent.)*, Calcutta, 5 (3), p. 153. Im.

Castes known.—Im. (Rajasthan); S., Wk. elsewhere.

Material.—A vial, sev. Im., Khokaria village, ca. 11 km. N of Jodhpur (Jodhpur Dist.), R. C. Sharma & Party coll., 16.viii.1972, ex ground.

Measurements (mm.), etc.

Imagoes (2 exs., Jodhpur)

1. Total length with wings	27.0—28.0
2. Total length without wings	14.0—15.0
3. Head-length to tip of labrum	3.26—3.31
4. Head-length to mandible-base	1.74—1.84
5. Max. width of head with eyes	2.63—2.74
6. Labrum (Median L × W)	0.58—0.68 × 1.0
7. Eyes (L × W)	0.63 × 0.53—0.58
8. Ocelli (L × W)	0.26 × 0.16
9. Min. eye-ocellus distance	0.26
10. Pronotum (L × W)	1.16 — 1.32 × 2.47—2.53
11. No. of antennal segments	19

Distribution.—Widely distributed in India (Uttar Pradesh, especially the northern hilly areas; Rajasthan; West Bengal; Assam; Tamil Nadu); going up to ca. 2100 metres.

Remarks.—This is the first record from Rajasthan. Swarming occurred on 16 July, in the evening (6.30 P. M.).

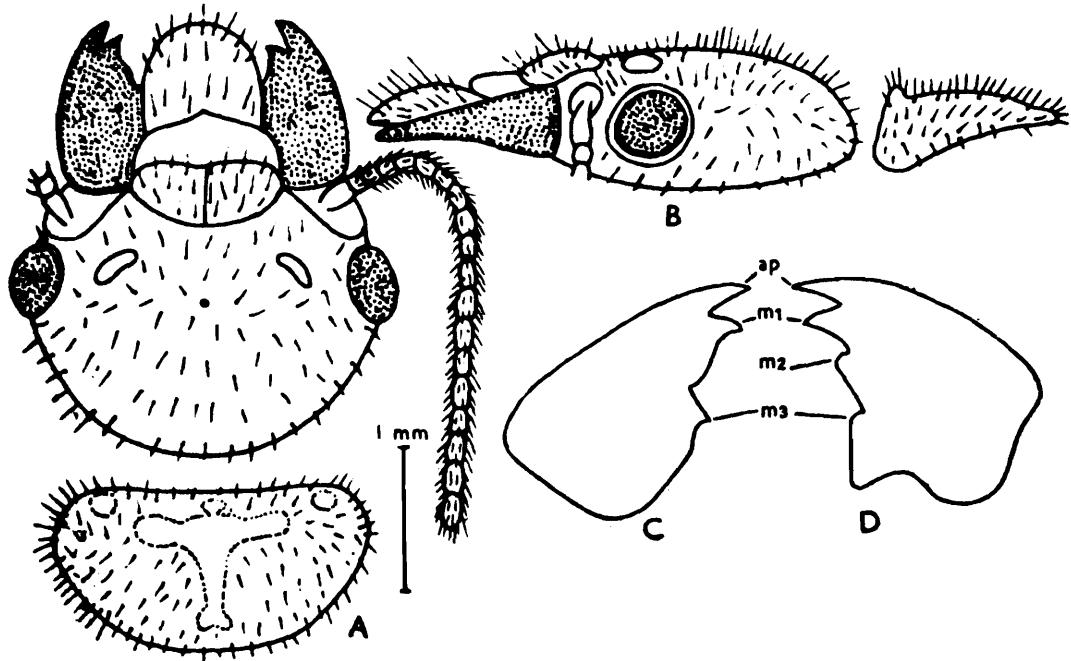
17. *Odontotermes feae* (Wasmann)

(Text-fig. 14)

Termes feae Wasmann, 1896, *Ann. Mus. Stor. nat. Genova*, Genoa, (2) 16, pp. 625-626. S., Wk.

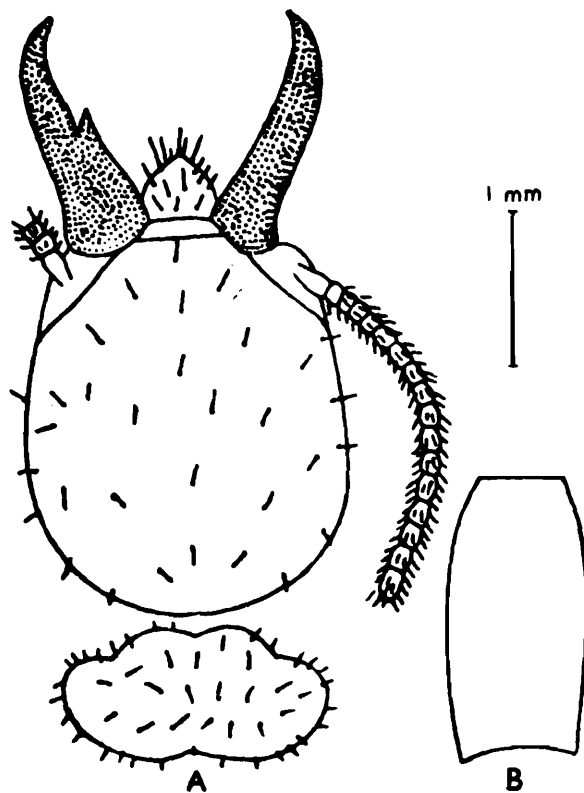
Castes known.—Im. (not Rajasthan), S., Wk.

Material.—2 vials, 1972, S., Wk., Mt. Abu and Oria village (near Mt. Abu), Sirohi Dist.



Text-fig. 13. *Odontotermes distans* Holmgren & Holmgren. Imago (alate ♂). Khokharia village (Jodhpur Dist., Rajasthan). (A) Head and pronotum, dorsal view (B) Ditto, side view. (C), (D) Left and right mandibles, respectively.

ap., apical teeth; *m1—m3*, marginal teeth 1-3 respectively.



Text-fig. 14. *Odontotermes feae* (Wasmann). Soldier. Oria village near Mt. Abu (Sirohi Dist., Rajasthan). (A) Head and pronotum, dorsal view. (B) Postmentum, *in situ*.

*Measurements (mm.) etc.**Soldiers (3 exs., Mt. Abu)*

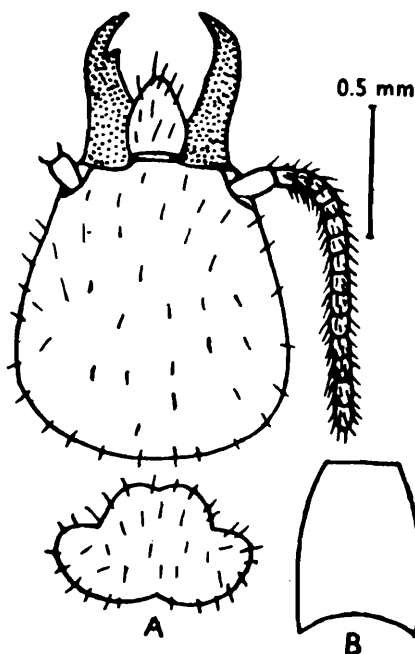
1. Total length with mandibles	7.6—9.6
2. Head-length with mandibles	4.16—4.21
3. Head-length to mandible-base	2.58—2.63
4. Max. width of head	2.21—2.26
5. Labrum (Median L × W)	0.37 × 0.53
6. Length of mandibles (left; right)	1.53; 1.53
7. Distance of tooth from apex, in left mandible	0.74—0.79
8. Postmentum (Median L × W)	1.74 × 0.84
9. Pronotum (L × W)	0.89—0.94 × 1.63—1.68
10. No. of antennal segments	17

Distribution.—Widespread in India, Sri Lanka and farther east (Bangla Desh, Burma, Thailand).

Remarks.—This is the first record from Rajasthan.

18. *Odontotermes giriensis* Roonwal & Chhotani 1962

(Text-fig. 15)

Roonwal & Chhotani, 1962 *a*, p. 341.*Castes known.*—S., Wk.

Text-fig. 15. *Odontotermes giriensis* Roonwal & Chhotani. Soldier. Didwana (Nagaur Dist., Rajasthan). (A) Head and pronotum, in dorsal view. (B) Postmentum, *in situ*.

Material.—(i) A vial, a few S., Wk., Didwana (Nagaur Dist.), S. C. Verma coll., 3.viii. 1972, ex soil. (ii) A vial, a few S., Wk., Palsana (Sikar Dist.), I. Prakash coll., 29.xii.1973.

*Measurements (mm.), etc.***Soldiers (2 exs., Didwana, Nagaur Dist.)**

1. Total length with mandibles	4.2—4.5
2. Head-length with mandibles	1.89—1.95
3. Head-length to mandible-base	1.16—1.21
4. Max. width of head	1.11
5. Max. height of head	0.63—0.68
6. Labrum (Median L × W)	0.26 × 0.21—0.26
7. Length of mandibles (left; right)	0.74; 0.74
8. Postmentum (Median L × W)	0.79 × 0.53
9. Pronotum (L × W)	0.53 × 0.84
10. No. of antennal segments	15

Distribution.—Eastern India: Meghalaya and Arunachal Pradesh [N.E.F.A.] and Western India (Rajasthan : Nagaur and Sikar Dists.); and Bangla Desh.

Remarks.—This is the first record from Rajasthan. The widely discontinuous distribution (the eastern area in the wet forest zone and the western in the semi-dry zone) is of interest. Examples from the two areas are exactly alike and cannot be separated.

19. *Odontotermes guptai* Roonwal & Bose 1962

Odontotermes bellahunisensis guptai Roonwal & Bose, 1962a, p. 588.

Castes known.—S., Wk.

Material.—A vial, 4 S., sev. Wk., Berata village ca. 5 km. from Bar (Ajmer Dist.), R. C. Sharma coll., 10.viii.1973, ex under stone.

Distribution.—Western India (widely distributed in Rajasthan in both dry and wet districts, viz., Sikar, Jhunjhunu, Bikaner, Nagaur, Ajmer and Udaipur); and Pakistan.

Remarks.—This is the first record from the Ajmer district.

20. *Odontotermes guardaspurensis* Holmgren & Holmgren 1917

(Text-fig. 16)

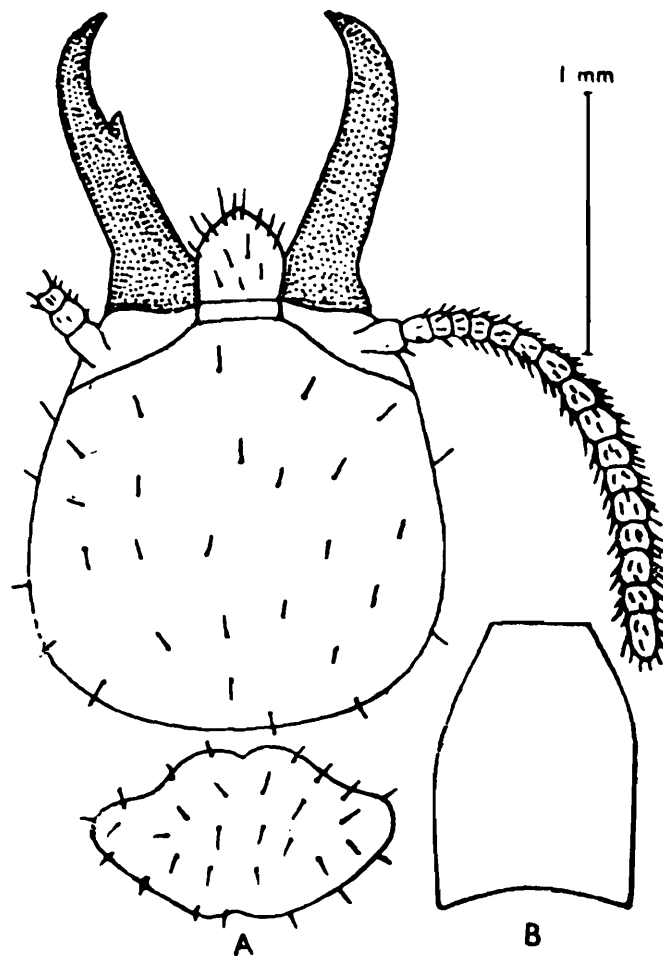
Odontotermes (Cyclotermes) obesus guardaspurensis Holmgren & Holmgren, 1917, *Mem. Dept. Agric. India (Ent.)*, Calcutta, 5 (3), pp. 149-150. Im., S., Wk.

Odontotermes gurdaspurensis Chatterjee and Thakur, 1967, *Indian Fo r. Rec. (Ent.)* Delhi, 11 (1), pp. 36-38.

Castes known.—Im. (not Rajasthan), S., Wk.

Material.—9 vials, S., Wk., 1972-73, from Rajasthan, thus : Jodhpur, Nagaur, Ajmer, Bharatpur and Banswara Districts.

Z. S...29



Text-fig. 16. *Odontotermes gurdaspurensis* Holmgren Holmgren. & Soldier. Danpur village (Banswara Dist., Rajasthan). (A) Head and pronotum, dorsal view. (B) Postmentum, *in situ*.

Measurements (mm.), etc.

Soldiers (3 exs., Banswara Dist.)

1. Total length with mandibles	5.8—7.1
2. Head-length with mandibles	2.47—2.79
3. Head-length to mandibles-base	1.42—1.58
4. Max. width of head	1.26—1.53
5. Max. height of head	0.74—0.79
6. Length of mandibles (left; right)	1.11—1.21 × 1.11—1.21
7. Distance of tooth from apex, in left mandible	0.37—0.42
8. Labrum (Median L × W)	0.32—0.42 × 0.32—0.42
9. Postmentum (Median L × W)	0.79—0.95 × 0.53—0.58
10. Pronotum (L × W)	0.53—0.79 × 1.05—1.16
11. No of antenal segments	17

Distribution.—Widely distributed in western and northern India (Punjab, Haryana, Rajasthan, and Muzaffarabad Dist., Kashmir); and Pakistan (Punjab, N.W.F.P., Baluchistan).

Remarks.—This is the first record from Rajasthan where it occurs in the wet to semi-arid zones, west up to Jodhpur District and south up to Banswara District, but seems to be absent from the very arid western districts. In the wet area (Banswara District) it was taken from a mound.

21. *Odontotermes kushwahi* Roonwal & Bose 1964

Odontotermes brunneus kushwahi Roonwal and Bose, 1964, p. 33.

Castes known.—S., Wk.

Material.—A vial, sev. S., Wk., Amet (Udaipur Dist.), S. C. Verma coll., 16.viii.1972, ex soil.

Distribution.—Western India (Rajasthan : Udaipur Dist.; and Gujarat : Kaira Dist.); and South India (Tamil Nadu : Salem Dist.).

Remarks.—The present lot is also from the Udaipur District where the type came from. Its discontinuous distribution is noteworthy.

22. *Odontotermes latiguloides* Roonwal & Verma

(Text-fig. 17)

Odontotermes latiguloides Roonwal & Verma, 1973b, p. 83.

Castes known.—S., Wk.

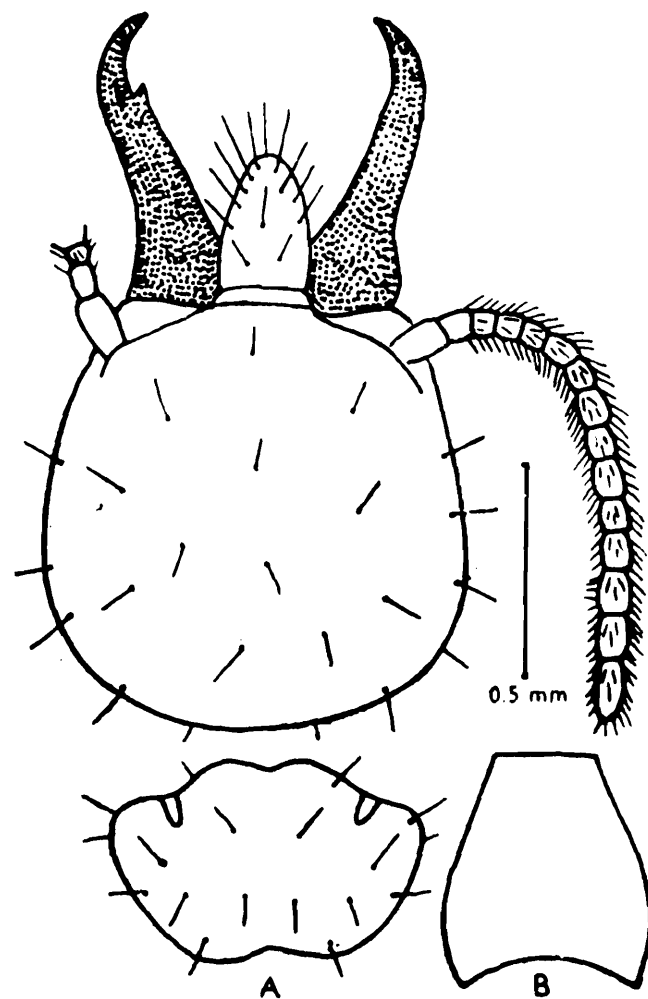
Material.—12 vials, 1964-73, S., Wk., from 8 wet and semi-arid districts of Rajasthan (except the western arid zone), as follows : Jhunjhunu, Sikar, Jaipur, Jodhpur, Bhilwara, Sirohi, Banswara and Dungarpur.

Measurements (mm.), etc.

Soldiers (14 exs., Rajasthan)

1. Total length with mandibles	3.8—5.1
2. Head-length with mandibles	1.79—2.16
3. Head-length to mandible-base	1.00—1.26
4. Max. width of head	1.00—1.21
5. Max. height of head	0.53—0.74
6. Max. length of mandibles	0.79—0.89
7. Distance of tooth from apex, in left mandible	0.26—0.34
8. Labrum (Median L × W)	0.26—0.37 × 0.26—0.32
9. Postmentum (Median L × W)	0.53 × 0.47
10. Postmentum Index (W/Median L)	0.92
11. Pronotum (L × W)	0.47—0.58 × 0.79—0.95
12. No. of antennal segments	17

Distribution.—Widespread in Rajasthan; recorded from 8 districts as given above; up to ca. 1200 m. altitude (Mt. Abu). Apparently confined to moist forests or gardens and areas where the vegetation is rich due to large quantities of subsoil water (e.g., Borunda). Absent in the very arid western areas of Rajasthan.



Text-fig. 17. *Odontotermes latiguloides* Roonwal & Verma. Soldier. Mandalgarh, Bhilwara Dist., Rajasthan). (A) Head and pronotum, dorsal view. (B) Postmentum, *in situ*.

23. *Odontotermes obesus* (Rambur)

Termes obesus Rambur, 1842, *Hist. natur. Insecta Néuroptères*, Paris, p. 304. Im.

Castes known.—Im., S., Wk.

Material.—26 vials, 1971-73, Im. (5 vials), and mostly S. and Wk. from the following districts of Rajasthan : Ajmer, Bhilwara, Jaipur, Jhunjhunu, Jodhpur, Nagaur, Pali, Sikar and Udaipur.

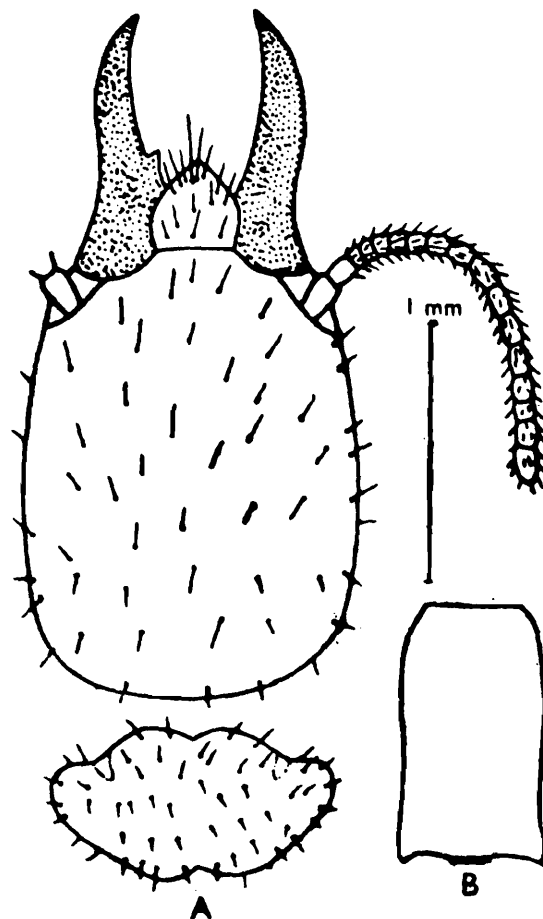
Distribution.—Common all over India, Pakistan and Bangla Desh. Occurs all over Rajasthan in both wet and dry areas.

Remarks.—The present record is new for the Rajasthan districts, of Bhilwara and Jhunjhunu. Very common and highly variable as regards size of soldiers and workers. Imagoes were obtained at Jodhpur from swarms on 16 August (light swarm) and 18 August (very heavy swarm) in the early part of the night (*ca.* 8-9 P.M.).

24. *Odontotermes parvidens* Holmgren & Holmgren 1917

(Text-fig. 18)

Odontotermes (Odontotermes) parvidens Holmgren & Holmgren, 1917, *Mem. Dept. Agric. India (Ent.)*, Calcutta, 5(3), p. 154.



Text-fig. 18. *Odontotermes parvidens* Holmgren & Holmgren. Soldier. Khokund village (ca. 25 km. NE of Raghunathgarh, Jhunjhunu Dist., Rajasthan). (A) Head and pronotum, dorsal view. (B) Postmentum, *in situ*.

Castes known.—S. only from Rajasthan; S., Im., Wk. from other parts of India.

Material.—A vial, 2 S., Khokund village, ca. 25 km. NE from Raghunathgarh (Jhunjhunu Dist.), Y P. Sinha & Party coll., 27.ix.1973, ex cowdung. (Mixed with *O. obesus*.)

Measurements (mm.), etc.

Soldiers (2 exs., Jhunjhunu Dist.)

1. Total length with mandibles	6.1
2. Head-length with mandibles	2.89—2.95
3. Head-length to mandible-base	1.84—1.89
4. Max. width of head	1.47
5. Max. length of mandibles (left; right)	1.05; 1.05
6. Distance of tooth from apex, in left-mandible	0.63
7. Left Mandibular Index (Tooth distance/Mandible-length)	0.60
8. Postmentum (Median L × W)	1.16 × 0.58
9. Pronotum (L × W)	0.63—0.68 × 1.05
10. No. of antennal segments	16—17

Distribution.—Widely distributed in Pakistan (up to ca. 1525 m. alt., N.W.F.P.), India, Bangla Desh and Burma.

Remarks.—This is the first record from Rajasthan.

25. *Odontotermes wallonensis* (Wasmann) 1902

(Text-figs. 19 and 20)

Termes obesus sub sp. *wallonensis* Wasmann, 1902, *Zool. Jb. (Syst.)*, Jena, 17 (1), p. 106. Im., S.

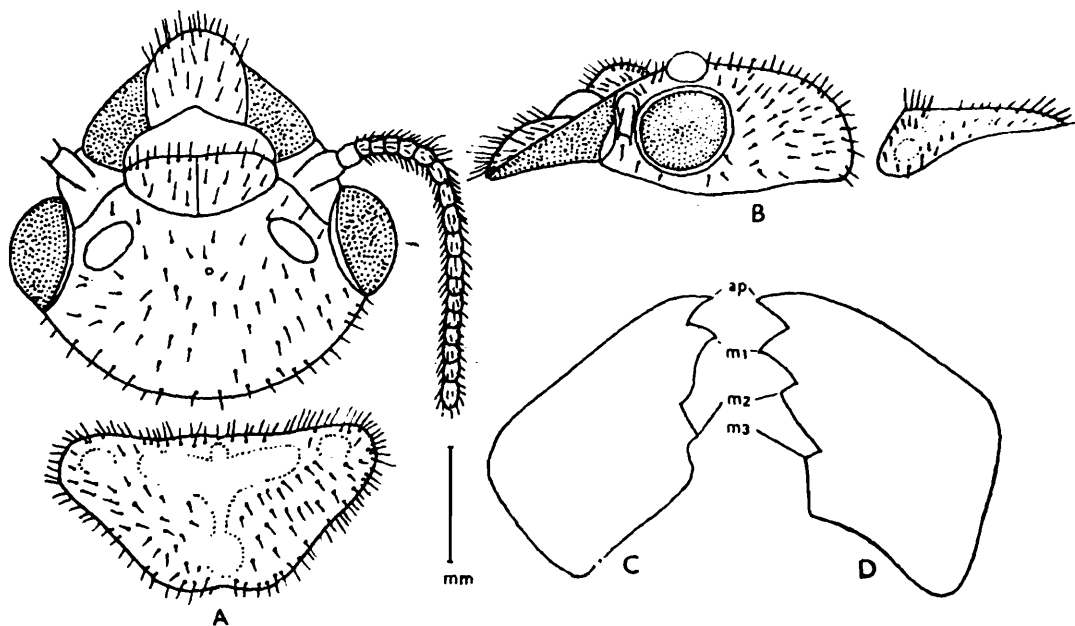
Castes known.—Im., S., Wk.

Material.—2 vials, Bar (Ajmer Dist.), one with sev. Im., 9.viii.1973, at light; the other with sev. S., ex under stone.

Measurements (mm.), etc.

Imago (1 ex., Bar, Ajmer Dist.)

1. Total length with wings	30.0
2. Total length without wings	15.0
3. Head-length to tip of labrum	3.26
4. Head-length to mandible-base	2.0
5. Max. width of head with eyes	3.10
6. Max. height of head	1.32
7. Labrum (Median L × W)	0.68 × 1.0
8. Eyes (L × W)	0.95 × 0.79
9. Ocelli (L × W)	0.42 × 0.32
10. Min. eye-ocellus distance	0.11
11. Pronotum (L × W)	1.42 × 2.79
12. No. of antennal segments	19



Text-fig. 19. *Odontotermes wallonensis* (Wasmann). Imago ♂. Forest plantation, ca. 3 km. E of Bar village (Ajmer Dist., Rajasthan). (A) Head and pronotum, dorsal view. (B) Ditto, side view. (C), (D) Left and right mandibles respectively.

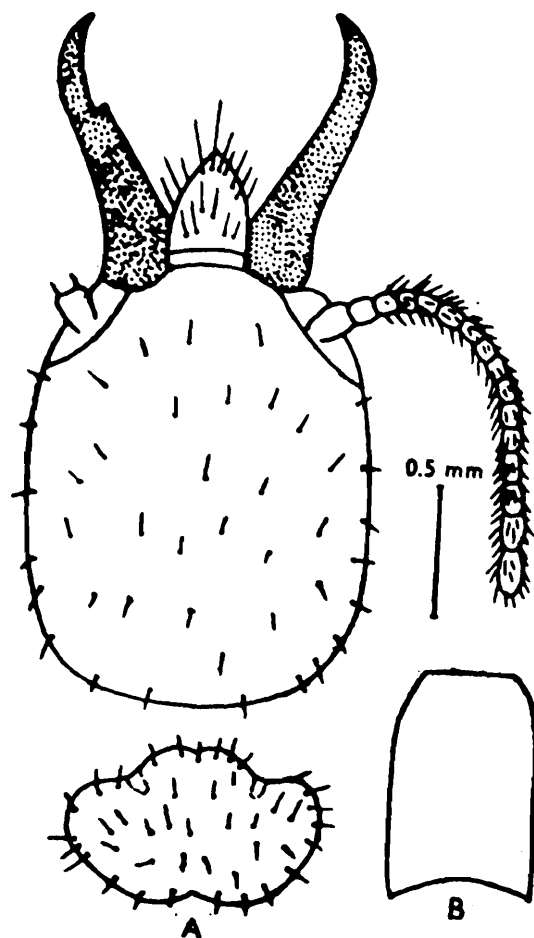
ap apical tooth; *m1-m3*, marginal teeth 1-3 respectively.

Soldier (1 ex. Bar, Ajmer Dist.)

1. Total length with mandibles	5.3
2. Head-length with mandibles	2.84
3. Head-length to mandible-base	1.68
4. Max. width of head	1.42
5. Labrum (Median L × W)	0.42 × 0.37
6. Length of mandibles (left; right)	1.16; 1.16
7. Distance of tooth from apex, in left mandible	0.47
8. Postmentum (Median L × W)	0.89 × 0.58
9. Pronotum (L × W)	0.63 × 1.05
10. No. of antennal segments	16

Distribution.—Widespread in India from central Rajasthan (Bar, Ajmer Dist.), Gujarat and Delhi in the west to Orissa in the east; and the whole of Peninsular India.

Remarks.—This is the first record from Rajasthan. Swarming was noted at Bar (Ajmer Dist.) on 9 August.



Text-fig. 20. *Odontotermes wallonensis* (Wasmann). Soldier. Forest plantation, ca. 3 km. E of Bar village (Ajmer Dist., Rajasthan). (A) Head and pronotum, dorsal view. (B) Postmentum, *in situ*.

26.- *Microtermes mycophagus* (Desneux) 1906

Termes mycophagus Desneux, 1906, p. 348.

Castes known.—Im., S., Wk.

Material.—27 vials, 1972-73, Im., S., Wk., from following districts in Rajasthan : Jaipur (Sambhar Lake), Nagaur (Didwana); and Jodhpur (mostly imagoes from swarms) and Sikar (Palsana).

Distribution.—India (western and northern Rajasthan, east to Sikar and Alwar Dists.; and Delhi); and Pakistan (Sind, Punjab, N.W.F.P., Baluchistan).

Remarks.—Common in arid and semi-arid areas. Swarming occurred at Jodhpur from 26 June to 22 August at night (8 to 9 P.M.). It is an arid zone species (for its distribution in Rajasthan in relation to soil and vegetation, *vide* Roonwal and Bose, 1973).

27. *Microtermes obesi* Holmgren 1913

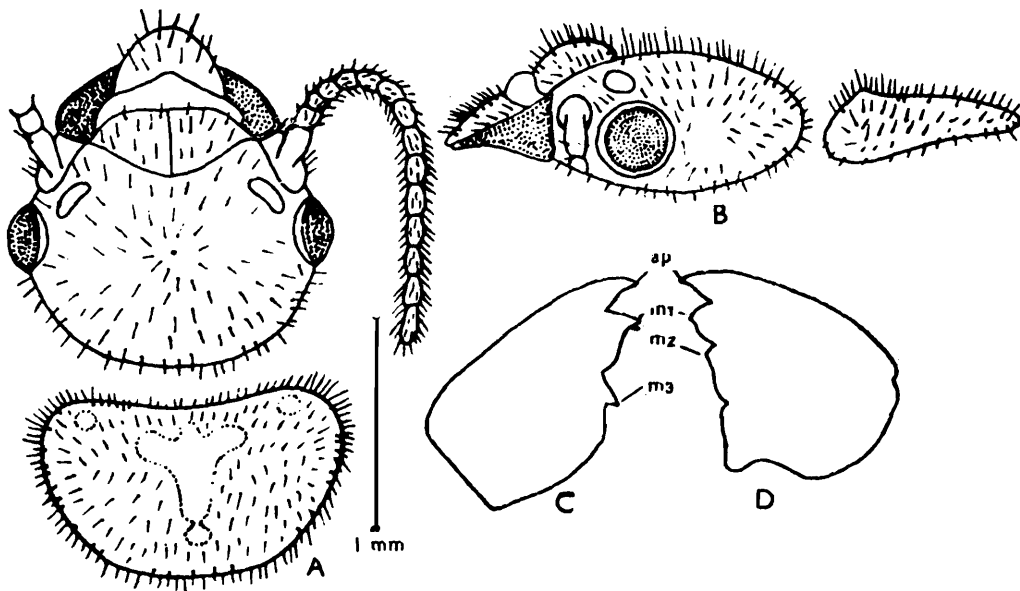
(Text-fig. 21)

(Synonym : *M. anandi* Holmgren)

Microtermes obesi Holmgren, 1913, *K. Svensk. Vetensk. Akad. Handl.*, Stockholm, 50 (2), p. 150. Im.

Microtermes anandi Holmg., Roonwal & Bose, 1964, p. 39.

Castes known.—Im., S., Wk.



Text-fig. 21. *Microtermes obesi* Holmgren (synonym *M. anandi* (Holmgren). Imago, Jodhpur. (Rajasthan). (A) Head and pronotum, dorsal view. (B) Ditto, side view. (C), (D) Left and right mandibles, respectively.

ap., apical teeth; *m1-m3*, marginal teeth 1-3 respectively.

Material.—12 vials, 1965-72, Im., S., Wk., from the following districts in Rajasthan : Jodhpur, Nagaur, Jaipur and Udaipur.

*Measurements (mm.), etc.**Imagoes (4 exs., Jodhpur)*

1. Total length with wings	14.1—14.8
2. Total length without wings	9.4—10.2
3. Head-length to mandible-base	1.53—1.83
4. Max. width of head with eyes	1.58—1.79
5. Labrum (Median L × W)	0.26—0.39 × 0.68
6. Eyes (max. × min. diameter)	0.38—0.39 × 0.31—0.33
7. Min. eye-ocellus distance	0.05
8. Pronotum (L × W)	0.95—1.05 × 1.37—1.58
9. No. of antennal segments	15

For measurements of soldiers, *vide* Roonwal and Bose (1964).

Distribution.—Widespread in India (including Rajasthan), Pakistan and Bangla Desh; also reported from Sri Lanka.

Remarks.—The present records from the Rajasthan districts of Nagaur and Udaipur are new. The species seems to occur in both dry and wet areas. Swarming occurred at Jodhpur from 14 June to 17 August during the day (about 11 A.M. to 1.30 P.M.). For further details of swarming, post-swarming behaviour, egg-laying and hatching, *vide* Roonwal and Rathore (in press, *b*).

28. *Microtermes unicolor* Snyder

(Text-fig. 22)

Microtermes unicolor Snyder, 1933, *Proc. biol. Soc. Wash.*, Washington, 46, pp. 92-93. Im.

Microtermes pubescens Snyder, 1933, *Proc. U. S. natnl. Mus.*, Washington, 82 (Art. 16), p. 9. S.

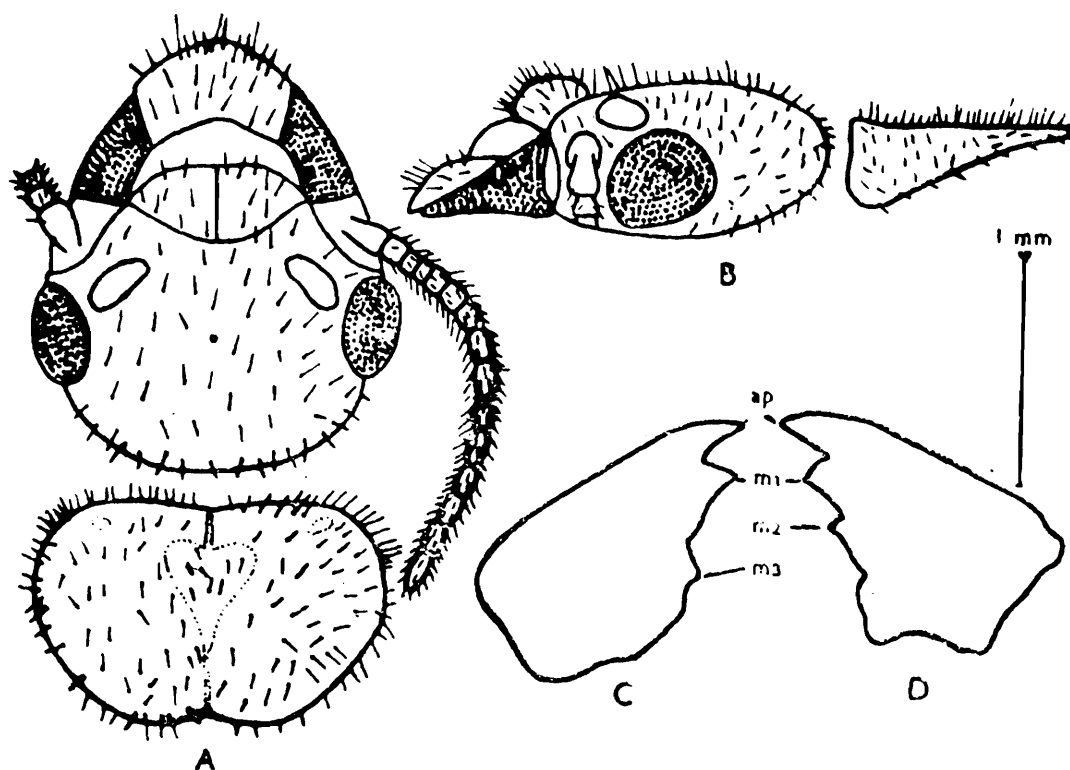
Castes known.—Im. (Rajasthan), S. and Wk. (Uttar Pradesh).

Material.—3 vials, Im., 1965-72, Jodhpur Dist. (Mandore, Banar, Jodhpur).

*Measurements (mm.), etc.**Imagoes (5 exs., Jodhpur Dist.)*

1. Total length with wings	17.3—18.7
2. Total length without wings	9.4—10.8
3. Head-length to tip of labrum	1.63—1.84
4. Head-length of mandible-base	1.05—1.16
5. Max. width of head with eyes	1.58—1.68
6. Max. height of head	0.58—0.68
7. Labrum (Median L × W)	0.26 × 0.42—0.53
8. Eyes (L × W)	0.41—0.47 × 0.36—0.42
9. Lateral ocelli (L × W)	0.18—0.23 × 0.14—0.18
10. Min. eye-antennae distance	0.045—0.063
11. Pronotum (L × W)	0.84—0.95 × 1.42—1.53
12. No. of antennal segments	15

Distribution.—Pakistan (Punjab, N.W.F.P., Sind), western and north-western India, e.g., Rajasthan (Jodhpur Dist.) and Uttar Pradesh (Dehra Dun); and Bangla Desh.



Text-fig. 22. *Microtermes unicolor* Snyder. Imago. Jodhpur (Rajasthan). (A) Head and pronotum, dorsal view. (B) Ditto, side view. (C), (D) Left and right mandibles respectively.

ap., apical teeth; *m1-m3*, marginal teeth 1-3 respectively.

Remarks.—This is the first record from Rajasthan. Swarming occurred at Jodhpur and vicinity during 5 July to 20 August at night (about 8.45 P.M.). (Also *vide* Roonwal and Rathore, *in press, b*, for further observations on swarming.)

Subfamily (iv) NASUTITERMITINAE

29. *Trinervitermes biformis* (Wasmann)

[Synonyms : *T heimi* (Wasmann) and *T longinotus* (Synder)]

1902. *Eutermes biformis* Wasmann, *Zool. Jb. (Syst.)*, Jena, 17 (1), p. 133. Im., S., Wk.

Castes known.—Im., S. (dimorphic), Wk.

Material.—7 vials, 1964-73, S., Wk., from the following districts of Rajasthan : Ajmer, Bhilwara, Jodhpur, Pali and Udaipur.

Distribution.—Widely distributed in western and southern India (Rajasthan, Madhya Pradesh, Maharashtra, Karnatak and Tamil Nadu); and Sri Lanka; also Pakistan (Punjab).

Remarks.—Roonwal and Bose (1964) had first recorded it from Rajasthan (districts of Jaipur, Kota, Nagaur and Udaipur); the present are new records from the districts of Ajmer, Bhilwara, Jodhpur and Pali, thus considerably extending its range, especially to the western, semi-arid areas of Jodhpur and Nagaur.

ZOOGEOGRAPHY AND ECOLOGY

1. *General*

Rajasthan, the westernmost State of India, lies close to, almost adjoining, the traditional eastern border of the Western Palaearctic Zone whose eastern limit is the River Indus, so that it is not surprising that the area is, like Pakistan east of the Indus, in some respects transitional and not sharply defined. This is specially so for the Vertebrates (*vide infra*, Discussion), but is less marked for other groups of animals. In the Isoptera, for example, only a small part shows Palaearctic facies, the bulk being Oriental but of Ethiopian origin).

Sclater's (1855) zoogeographical divisions based on birds, amplified further on the basis of other major groups of animals, are accepted today virtually without substantial change (*vide* Beaufort, 1951, for the world; and Roonwal and Ali, 1965, for the Indian fauna). These regions, which have also been widely adopted by termitologists for faunistic and zoogeographical purposes (Snyder, 1949; Emerson, 1955), are as follows: Nearctic, Neotropical, Palaearctic, Ethiopian, Malagasy, Oriental (Indo-Malayan of some authors), Australian and Papuan.

2. *Generic and Specific Analyses*

(Table 2)

For the zoogeographical status of the genera, the earlier analysis of Emerson (1955) and the general evolutionary trends of the order Isoptera as summarised by Weidner (1966, 1970) have been of considerable help.

For generic endemism, Emerson's (1955) definition is : "*Endemic genera* are those genera found only in a single major zoogeographical region." For the present purpose "endemism" has been evaluated only in terms of Rajasthan which is a vast enough extent of landmass (3,42,274 sq. km.) to justify a more restricted approach. In this limited sense, no genus is endemic in Rajasthan, but a few species are.

Family KALOTERMITIDAE

1. Genus *Incisitermes* Krishna

This is a widespread genus with some 25 species occurring in the Papuan region (Fiji, Hawaii, etc.), Asia (the Philippines, India), North

TABLE 2.—Zoogeographical distribution of the termite species of Rajasthan (Western India).

Abbreviations: + Present;— absent; Eth., Ethiopian; Nt., Neotropical; Or., Oriental; Pal., Palaearctic.

Species	INDIA				Pakistan	Rest of Oriental Region	Afghanistan	Rest of West Asia (upto Mediterranean)	Else-where	Zoogeographical status	Endemism	Origins
	Rajasthan only	Rest of India	North India down to lat. 20°N	Peninsular India below lat. 20°N								
FAMILY I. KALOTERMITIDAE												
1. <i>Incisitermes didwanaensis</i> Roonwal & Verma	+	—	—	—	—	—	—	—	—	Or.	+	?
FAMILY II. HODOTERMITIDAE												
2. <i>Anacanthotermes macrocephalus</i> (Desneux)	+	—	—	—	+	—	+	—	—	Pal.	—	Pal.
Family III. RHINOTERMITIDAE												
Subfamily (i)												
PSAMMOTERMITINAE												
3. <i>Psammotermes rajasthanicus</i> (Roonwal and Bose)	+	—	—	—	+	—	—	—	—	Or.	—	Eth.
Subfamily (ii)												
HETEROTERMITINAE												
4. <i>Heterotermes indicola</i> (Wasmann)	—	+	+	—	+	+	+	—	—	Or.	—	?
Subfamily (iii)												
COPTOTERMITINAE												
5. <i>Coptotermes heimi</i> (Wasmann)	—	+	+	+	+	+	—	—	—	Or.	—	Or.
Family IV. TERMITIDAE												
Subfamily (i)												
AMITERMITINAE												

Table 2 — Cond.

6. <i>Speculitermes cyclops</i> Wasmann	—	+	+	+	+	—	—	—	—	Or.	—	Nt. (distantly)
7. <i>Amitermes belli</i> (Desneux)	+	—	—	—	+	—	—	—	—	Or.	—	?
8. <i>Synhamitermes quadriceps</i> (Wasmann)	—	+	+	+	—	+	—	—	—	Or.	—	Or.
						(Bangla Desh)						
9. <i>Eremotermes neoparadoxalis</i>	—	+	+	—	+	—	—	—	—	Or.	—	Or.
10. <i>Eremotermes paradoxalis</i> Holmgren	—	+	+	+	+	+	—	—	—	Or.	—	Or.
11. <i>Microcerotermes laxmi</i> Roonwal & Bose	+	—	—	—	—	—	—	—	—	Or.	+	Eth.
12. <i>Microcerotermes palestinensis</i> Spaeth	+	—	—	—	—	—	—	+	—	Or.	—	Eth.
								Israel				
13. <i>Microcerotermes raja</i> Roonwal & Eose	+	—	—	—	—	—	—	—	—	Or.	+	Eth.
14. <i>Microcerotermes sakesarensis</i> Ahmad	+	—	—	—	+	—	—	—	—	Or.	—	Eth.
15. <i>Microcerotermes tenuignathus</i> Holmgren	—	+	+	—	+	—	—	—	—	Or.	—	Eth.
												(Rajasthan, Gujarat)
Subfamily (ii) TERMITINAE												
16. <i>Angulitermes jodhpurensis</i> Roonwal & Verma	+	—	—	—	—	—	—	—	—	Or.	+	Or.
Subfamily (iii) MACROTERMITINAE												
17. <i>Odontotermes brunneus</i> (Hagen)	—	+	+	+	—	+	—	—	—	Or.	—	Eth.
						(Sri Lanka)						
18. <i>O. dehraduni</i> (Snyder)	—	+	+	—	+	—	—	—	—	Or.	—	Eth.
19. <i>Odontotermes distans</i> Holmgren & Holmgren	—	+	+	+	—	—	—	—	—	Or.	—	Eth.

America, Mexico, Central and South America and the West Indies. Three species are found in the Oriental region, viz., two in the Philippines (*mcgregori* Light and *taylori* Light) and one in Rajasthan, India (*didwanaensis* Roonwal & Verma). The origin of the genus is difficult to establish. Almost half the number of known species are from the Neotropical region (southern U.S.A., Mexico, Central America and the West Indies), and it is probable that the genus originated there (*vide* also Krishna, 1961, p. 387). Thence it may have spread to Oceania (the Papuan region) and the Orient in the early Mesozoic age before the continents drifted apart in the sense of Wegener (1922), but the route is by no means clear. If the eastward migrations occurred through North Africa, the genus is to-day absent, there, possibly by extinction. *I. didwanaensis* might represent a remnant on the route farther east, leading to the Philippines and the islands of the Papuan region. If this line of argument is correct, *I. didwanaensis*, while being restricted to Rajasthan and thus endemic and Oriental, must be regarded against the background of the probable distant Neotropical origin of the genus.

Family HODOTERMITIDAE

2. Genus *Anacanthotermes* Jacobson

This is a small subtropical genus of large harvester or grass-cutting desert termites, with some 10 species which occur from West and Central Asia to Western India (Rajasthan east up to Jodhpur), with one species, *A. viarum* (König), going down to the drier regions of South India.

According to Emerson (1955, p. 482), the genus probably arose "in the Southern Palaeartic steppes and deserts and dispersed eastwards to tropical Indomalaya." This event must have occurred early enough (Miocene or Pliocene) to allow time for the genus to reach South India and evolve a second species.

The sole Rajasthan species, *A. macrocephalus* (Desneux), occurs from Eastern Afghanistan *via* Pakistan (Baluchistan, Sind, Punjab) to Western India (western Rajasthan : Districts of Bikaner, Barmer and Jodhpur, its easternmost limit being Jodhpur and vicinity, i.e., up to the eastern edge of the Indian Desert). Like most other members of the genus, *A. macrocephalus* should be regarded as a Palaeartic species derived from its other Palaeartic fellow species, though Harris (1970) excludes it from his Palaeartic list.

Ecologically, *A. macrocephalus*, though an arid zone species (*cf.* *Psammotermes*, below), occurs in soils which have a little clay or loam or gravel and on which some natural vegetation can subsist in the presence of irrigation or natural water and where the land is capable of being cultivated.

Family RHINOTERMITIDAE

Subfamily (i) PSAMMOTERMITINAE

3. Genus *Psammotermes* Desneux

This is a small genus of arid zone or sand termites occurring from North Africa across West Asia to Western India, including the drier western parts of the Indian Desert. Its 8 known species largely occur in the Ethiopian region, with one species going north to the fringe of North African temperate desert (Mediterranean belt of the Palaearctic) and one to the dry steppe zone in Madagascar. Thus, the genus is essentially Ethiopian and desertic, and Emerson (1955, pp. 483, 484) had concluded that this situation "indicates a dispersion from Africa at least by Eocene times."

The single Rajasthan species, *P. rajasthanicus* Roonwal & Bose, is essentially a desertic and sand species, occurring in Western Rajasthan (Barmer, Jaisalmer and Bikaner districts) and the adjoining parts of Pakistan (Sind, coastal Baluchistan, Punjab). Its soldiers are trimorphic.

It is Oriental in distribution but is not endemic to Rajasthan. Essentially, it is an extension of the Ethiopian element, as already suggested by Roonwal and Bose (1960, 1962, 1964) and Roonwal, Chhotani and Bose (1962), into the Palaearctic-Oriental border area. West of it is found *P. hybostoma* Desneux, from Southern Arabia (Muscat) to the Sahara in North Africa (Desneux, 1904, p. 25).

Subfamily (ii) HETEROTERMITINAE

4. Genus *Heterotermes* Froggatt

This genus, with numerous species, is cosmopolitan, occurring throughout the tropical and subtropical termite belt, and its species, are present in the Nearctic, Neotropical, Ethiopian (poor), Oriental and Australian regions. Its phylogenetic and geographical origins are not clear. It is a rather primitive genus among the Rhinotermitidae, and is, according to Emerson (1955, pp. 483, 499), "presumed to have arisen in the tropics before the Cretaceous separation of Australia from Indomalaya"; but its exclusion from the greater portion of the Ethiopian region is puzzling, and odd representatives there, and elsewhere, are probably later introductions.

The sole Rajasthan species, *H. indicola* (Wasmann), is widespread (Afghanistan, Pakistan, North India and Bangla Desh.) It is not endemic to Rajasthan but is broadly Oriental and belongs to the group of four oriental species which occur in the Indian Subregion, viz., *ceylonicus* Holmgren (Sri Lanka); *gretrúdae* Roonwal (the western sub-Himalayas), *indicola* (Wasmann) (*supra*) and *malabaricus* Snyder (South India).

Subfamily (iii) COPTOTERMITINAE

5. Genus *Coptotermes* Wasmann

Like *Heterotermes*, this genus too is widespread. Some 54 living species are known and are distributed in the Papuan, Australian, Oriental, Ethiopian and Neotropical regions, and introduced in some others. About half the number of known species are Oriental, and that region is generally regarded as its place of origin, from which it has spread elsewhere (Emerson, 1955, p. 484).

Of the 24 Oriental species, 8 are found in the Indian Sub-region (Roonwal and Chhotani, 1962 *b*). The sole species occurring in Rajasthan viz., *C. heimi* (Wasmann) (synonym *C. parvulus* Holmgren) is widespread in Pakistan, India and Bangla Desh and should be regarded as broadly Oriental.

Family TERMITIDAE

Subfamily (i) AMITERMITINAE

6. Genus *Speculitermes* Wasmann

This genus, which is characterised among other things by the extreme rarity of the soldier caste (formerly believed to be altogether absent), is closely allied to the mainly Neotropical *Anoplotermes* (a soldierless genus) with which it forms a close complex. *Speculitermes* occurs in South America (4 species) and the Oriental region (10 species) and may, on the basis of the richness of the species, be regarded as Oriental, though the *Anoplotermes-Speculitermes* Complex as a whole probably arose in the Neotropics, and thence got dispersed in the early Mesozoic, or somewhat later, to the Orient before the three southern continents drifted apart in Wegener's (1922) sense (as already suggested by Roonwal, Chhotani and Bose, 1962; and Roonwal and Chhotani, 1966), though its absence in Africa remains a puzzle.

S. cyclops cyclops Wasmann occurs in the whole of India (except Assam where *S. c. rongrensis* Roonwal & Chhotani is found) and Pakistan (submontaneous parts of the Punjab). Its Burmese records need confirmation. It is Oriental and is restricted to the Indian Sub-region; it is not endemic to Rajasthan. Ecologically it occurs in moderately moist forests, with or without gravelly or stony soil, and where there is some decaying vegetable matter on which it feeds; it avoids open, arid areas.

7. Genus *Amitermes* Silvestri

This large genus, with some 115 species, is widespread, occurring in the following regions : Australian (56), Oriental (6), Ethiopian (32), Palearctic (6), Nearctic (8) and Neotropical (7). Its two principal

centres, viz., Australia and Tropical Africa, are wide apart, and the intervening Oriental Region is poor. Emerson (1955, p. 472) considered it "mainly tropical", but he was not then aware of the exceptional richness of the Australian fauna (*vide* Gay, 1968).

The origin of *Amitermes* is not clear. Its primitive relatives are Oriental, and this feature, viewed in conjunction with its present areas of abundance, would suggest an Oriental-Australian origin on the one hand and an almost equally feasible Oriental-Ethiopian origin on the other.

Ecologically, the genus seems to be versatile, equally at home in tropical forests and more open habitats and even in hot deserts. This feature is well illustrated by the six Oriental species half of which occur in tropical forests (Malaya, Thailand, Sumatra) and the other half in deserts (Pakistan and western Rajasthan). The sole Rajasthan species, *A. belli* (Desneux), occurs in both arid and wet habitats in Rajasthan and adjoining Pakistan. Zoogeographically, it is Oriental but not endemic to Rajasthan.

8. Genus *Synhamitermes* Holmgren

This small, fairly advanced amitermitine genus contains only four species and has a discontinuous distribution—in the Neotropics (South America, one species) and the Orient (India, Bangla Desh and Sri Lanka, 3 species), a discontinuity which can best be explained, as in so many other cases, on the basis of Wegener's (1922) Continental Drift Theory. The genus probably arose in the Oriental region where it is best represented today. The sole Rajasthan species, *S. quadriceps* (Wasmann), is widespread in India (Maharashtra, Rajasthan and Bangla Desh), and is found in moist forested areas. It is Oriental but not endemic to Rajasthan.

9. Genus *Eremotermes* Silvestri

This small genus, with only 10 species, occurs from North and Central Africa *via* West Asia to Pakistan and India. The zoogeographical distribution is : Palaearctic 3, Ethiopian 1, and Oriental (Pakistan and India) 6. It is a genus of small, whitish desert termites which live a subterranean life in small colonies. It probably arose in the Oriental region where its greatest concentration lies, and thence migrated west to Africa. The two Rajasthan species are distributed as follows:—

(i) *E. neoparadoxalis* Ahmad : Pakistan (Sind, Baluchistan, N.W.F.P.) and Western India (western Rajasthan and Delhi). It is a dry and semi-dry zone species.

(ii) *E. paradoxalis* Holmgren : Widely distributed in India (Western India, e.g., Rajasthan including both dry and moist districts east up

to Kota; Delhi; east up to Bihar; Madhya Pradesh; and Peninsular India down to Kerala); and Pakistan (Sind, Punjab, N.W.F.P.). It is ecologically more versatile and is found both in arid, desertic areas as well as in the more moist forest belts.

Both species are Oriental, but not endemic to Rajasthan.

10. Genus *Microcerotermes* Silvestri

This large genus, with some 117 species, is widespread, occurring in all the major zoogeographical regions except the Neotropical, but the majority of the species (73%) are concentrated almost equally in the Oriental and the Ethiopian regions. The distribution is briefly as follows : Papuan (5 species), Australian (11), Oriental (40), Ethiopian (45), Malagasy (5), Palaearctic (6), and Neotropical (5). The genus probably originated in tropical Africa in the Mesozoic period before it separated from South Asia by Continental Drift, and thence spread to other areas, both moist and dry, and today an appreciable number of species are found in both arid and semi-arid areas too.

The five Rajasthan species have the following distribution; ecologically, they occur largely in arid and semi-arid areas, but some also in moist zones:—

(i) *M. laxmi* Roonwal & Bose : Western India (Bikaner District, Rajasthan). (ii) *M. palestinensis* Spaeth : Western India (Rajasthan : Jodhpur and Udaipur districts) and West Asia (Israel). (iii) *M. raja* Roonwal & Bose : Western India (Rajasthan : Jaipur District) and Pakistan (Punjab, N.W.F.P.). (iv) *M. sakesarensis* Ahmad : Western India (Rajasthan : Jaipur District) and Pakistan (Punjab, N.W.F.P.). (v) *M. tenuignathus* Holmgren : Western India (Gujarat and Rajasthan) in both semi-dry and moist areas) and Pakistan (all over).

Thus, all the five are Oriental and only two of them, *M. laxmi* and *M. raja*, are endemic to Rajasthan.

Subfamily (ii) TERMITINAE

11. Genus *Angulitermes* Sjöstedt

This small genus, formerly regarded as mainly Ethiopian, has now been found to be abundant in the Orient, especially in the Indian Sub-region, and the zoogeographical distribution of its 20 known species is as follows:— Ethiopian 5; Palaearctic (Israel) 1 and Oriental (Pakistan, India, Bangla Desh, Burma) 14. According to Emerson (1955, pp. 480, 485), the subfamily Termitinae, where *Angulitermes* belongs, probably arose in the Ethiopian region (where it is best represented) in the early Mesozoic period, before the Cretaceous, and thence spread elsewhere. *Angulitermes*, however, is a medium-specialised

genus, and is much better represented in the Oriental than in the Ethiopian region, and its origin in the Oriental region is more feasible. Ecologically, the genus is wholly subterranean, occurring in dry as well as moist areas.

The sole Rajasthan species, *A. jodhpurensis* Roonwal & Verma, has hitherto been found only in Jodhpur, situated on the eastern fringe of the Indian Desert. It is Oriental, and is endemic to Rajasthan.

Subfamily (iii) MACROTERMITINAE

12. Genus *Odontotermes* Holmgren

This is a large and specialised genus, with some 169 species, confined to the Ethiopian (90 species) and the Oriental (79) regions, one of the latter ones also extending to the Papuan. Its members cultivate fungi and several of them build conspicuous earthen mounds. Ecologically, the genus is versatile and its representatives occur in both tropical rain forests as well in open grasslands and even semi-deserts; in very arid areas, e.g., western Rajasthan, the mound-building species do not as a rule construct mounds.

According to Emerson (1955, p. 486), "the fungus-growing termites or Macrotermitinae are clearly of Ethiopian origin from some extinct group that shared the primitive characters of both the Macrotermitinae and the Nasutitermitinae and was itself probably derived from the primitive Amitermitinae. All ten genera of the Macrotermitinae are Ethiopian."

Odontotermes, the majority of whose species are Ethiopian, may thus well be regarded as having originated in tropical Africa, and thence spread to the Orient relatively late (Micoene or Pliocene?) through some ecologically suitable corridor. At present the Oriental species occur throughout South and South-east Asia from Pakistan *via* India, Nepal and Bangla Desh to South China, Indonesia and the Philippines.

The 12 Rajasthan species are distributed as follows:—

- (i) *O. brunneus* (Hagen) : Widely distributed in India and Sri Lanka.
- (ii) *O. dehraudni* (Snyder) : North India (Uttar Pradesh, Delhi, Rajasthan) and Pakistan.
- (iii) *O. distans* Holmgren & Holmgren : Widely distributed all over India.
- (iv) *O. feae* (Wasmann) : Widely distributed in India and further east: (Nepal, Bangla Desh, Burma, Thailand).
- (v) *O. giriensis* Roonwal & Chhotani : India (western part, e.g., Rajasthan; and eastern part, e.g., Meghalaya and Arunachal Pradesh); and Bangla Desh.
- (vi) *O. guptai* Roonwal & Bose : Rajasthan, in both dry and moist districts. Endemic to Rajasthan.
- (vii) *O. gurdas-*

purensis Holmgren & Holmgren : North India (Rajasthan, Haryana, Punjab, Kashmir); and Pakistan. (viii) *O. kushwahi* Roonwal & Bose : India (western part, e.g., Rajasthan and Gujarat; and southern part, e.g., Tamil Nadu. (ix) *O. latiguloides* Roonwal & Verma : Rajasthan (absent in very dry western desert; occurs elsewhere). Endemic to Rajasthan. (x) *O. obesus* (Rambur) : Widespread in Pakistan, India and Bangla Desh. (xi) *O. parvidens* Holmgren & Holmgren : Widespread in South Asia (Pakistan, India, Bangla Desh, Burma). (xii) *O. wallonensis* (Wasmann) : Widespread in India. All these 12 species are Oriental and only two of them, *O. guptai* and *O. latiguloides*, are endemic to Rajasthan.

13. Genus *Microtermes* Wasmann

This genus contains some 58 species which are confined to the Ethiopian (40 species), Malagasy (5) and Oriental (13) regions. Its representatives share many of the ecological characteristics of *Odontotermes* and often live in the mounds of, or in close association with, the latter; and they also grow fungi. Like *Odontotermes*, this specialised genus also probably had an Ethiopian origin and thence spread to India rather late (Miocene of Pliocene ?) through some ecologically suitable corridor.

The three Rajasthan species are distributed as follows:—

(i) *M. mycophagus* (Desneux) : Western India (Rajasthan and Delhi); and Pakistan. (ii) *M. obesi* Holmgren : South Asia (Pakistan, all India, Bangla Desh, Sri Lanka). (iii) *M. unicolor* Snyder : Pakistan, western and north-western India (Rajasthan and Uttar Pradesh); and Bangla Desh. All the three species are Oriental, and none is endemic to Rajasthan.

Subfamily (iv) NASUTITERMITINAE

14. Genus *Trinervitermes* Holmgren

This medium-sized genus with nasute soldiers, which are often dimorphic or even trimorphic, is mainly Ethiopian and contains some 63 species as follows:— 56 Ethiopian, 1 Palaearctic (Arabia), and 6 Oriental. As suggested by Emerson (1955, p. 481), it probably arose in the "Ethiopian region when a tropical savanna was established in the Miocene..." and "invaded India from Africa in the Miocene, or more probably, in the Pliocene, through a tropical savanna or steppe corridor." The sole Rajasthan species, *T. biformis* (Wasmann), is widespread in India (western and Peninsular India) and also occurs in Pakistan and Sri Lanka. It is Oriental, but not endemic to Rajasthan.

4. Discussion

(a) Zoogeographical composition :

From the analyses given above (also Table 2), it will be seen that the 32 Rajasthan termites are composed of two zoogeographical elements,

viz., an overwhelmingly Oriental element (31 species, or 97%) alone with a tiny Palaearctic one (one species, or 3 %) The following six species (19%) are endemic:—

KALOTERMITIDAE :

Incisitermes didwanaensis

TERMITIDAE :

AMITERMITINAE : *Microcerotermes laxmi* and *M. raja*.

TERMITINAE : *Angulitermes jodhpurensis*.

MACROTERMITINAE : *Odontotermes guptai* and *O. latiguloides*.

The phylogenetic distribution of the 32 species is as follows:—

KALOTERMITIDAE	1 species, or 3.1 %
HODOTERMITIDAE	1 species, or 3.1 %
RHINOTERMITIDAE	3 species, or 9.4 %
PSAMMOTERMITINAE	1 species, or 3.1 %
HETEROTERMITINAE	1 species, or 3.1 %
COPTOTERMITINAE	1 species, or 3.1 %
TERMITIDAE	27 species, or 84.4 %
AMITERMITINAE	10 species, or 31.3 %
TERMITINAE	1 species, or 3.1 %
MACROTERMITINAE	15 species, or 46.9 %
NASUTITERMITINAE	1 species, or 3.1 %

The primitive families (the first three) are poorly represented (15.6%), the higher one, the Termitidae, constituting the remaining 84.4 %. Among the Termitidae itself, the more primitive subfamilies, the Amitermitinae and the Termitinae, constitute 34.4 %, and the other two 50 %. This distribution would suggest that the bulk of the fauna is probably of more recent origin (Miocene or Pliocene ?), and since these subfamilies are probably of Ethiopian origin, this part is probably an immigrant from Africa relatively late.

Among the primitive families, a single species, *I. didwanaensis*, is endemic, the remaining five endemics being from the higher groups.
(b) *Origins* (Tables 2 and 3)

It will be seen from the above analyses that the Rajasthan termite fauna (which is today overwhelmingly Oriental in its facies) is, *in origin* largely Ethiopian (68 %), and to a much lesser extent Oriental (15.6 %); it has tiny fractions which are Palaearctic (1 species, *Anacanthotermes macrocephalus*) and distantly Neotropical* (1 species, *Speculitermes cyclops*), and a small proportion (9.4 %) of doubtful origin (Table 3).

* In distant origin (the *Anoplotermes-Speculitermes* complex).

TABLE 3.—Summary of zoogeographical origins of the Rajasthan termite fauna.

Present-day status (and number of species)	Origins	
	Number of species	Percentage
Palaeartic : 1	Palaeartic : 1	3.1 %
Oriental : 31	Ethiopian : 22	68.8 %
	Oriental : 5	15.6 %
	Neotropical : 1	3.1 %
	Doubtful : 3	9.4 %

The present-day geographical situations of termite genera and species depend upon numerous factors of origin operating through long geological periods—such as land configurations (emergences and submergences), climates, ecological changes, adaptations, migrations, rates of evolution, etc. For Rajasthan termites we have material to discuss only some of these factors, especially migrations (dispersals), local evolution (endemism) and ecological adaptations.

(c) *Paucity of geological evidence*

The origin of termites from blattoid type ancestors is widely accepted on the basis of morphological similarities in blattids and primitive termites (such as the Mastotermitidae) and the degenerative reduction in the imagoes and workers of the higher termites of such primitive characters as the anal lobe of the hindwing, the number of antennal segments, the Y-suture of the head, the two lateral ocelli, the styli, the external genitalia, etc.; and on the development of social organisation.

Fossil evidence from geological history is not helpful since the earliest known termites are from periods as late as the early Tertiary or the late Cretaceous and such fossils are indistinguishable from modern isopteran genera (Imms, 1937; Weidner, 1966, 1970). The Problattodea (long extinct), which are regarded as the distant ancestors of both the Blattodea and the Isoptera, arose in the late Carboniferous or early Devonian.

A portion of western Rajasthan was, in pre-Mesozoic times (from the Permian onward) under the sea which withdrew by the Pliocene so that some termites might have invaded the dried up land in more recent times. No termite fossils have been found in Rajasthan, and geological evidence thus provides little guidance in zoogeographical matters. It may be presumed (*vide* Roonwal, Chhotani and Bose, 1962) that the primitive elements which were evolved earlier (e.g., *Anoplotermes-Speculitermes* complex), came from South America before the southern continents separated from one another in terms of the Continental Drift Theory of Wegener (1922). Those higher ones (Termitidae) which came from Africa, and were evolved later, probably also came

later (Miocene or Pliocene?) through some ecologically suitable corridor between Africa and South Asia; that was also the time when the sea receded from western Rajasthan.

(d) *Ecological considerations and migrations*

The present-day ecological characteristic of Rajasthan—its desiccation—is a recent feature, less than 10,000 years old. Before that event the land was well forested and verdant and presumably sustained a richer, more varied and a more tropical fauna than today. Desiccation probably resulted in (i) the early elimination of the inadaptable species; and (ii) the intrusion, mainly from the western desertic and savanna regions on the west, e.g., Iran, West Asia and even the Sahara, of such arid zone species, or allies, as *Eremotermes neoparadoxalis*, *Microcerotermes palestinensis*, *M. sakesarensis* and *M. tenuignathus*. This was a second series of intrusions, the first ones having occurred in geological times mainly from Africa (for the Ethiopian elements) and from South India-Malaya area (for the Oriental elements). The sole Palaearctic element, *Anacanthotermes*, probably came from the Iran-Central Asia region quite early (Miocene or Pliocene?) so as to allow it enough time to reach South India where it has evolved into a second species, *A. viarum*; the other species stopped short at the eastern border of the Indian Desert.

(e) *Endemism* (Table 4)

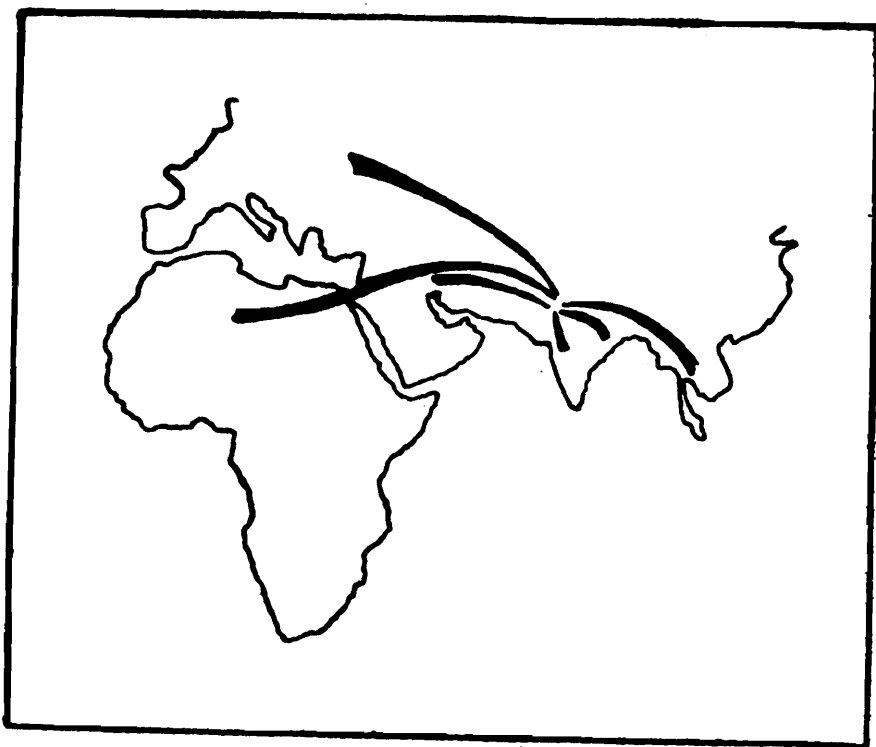
Six endemic species are presumed to have evolved locally. None of the genera concerned is endemic—some have an Ethiopian origin (*Microcerotermes*, *Odontotermes*), one an Oriental origin (*Angulitermes*), while for the primitive genus *Incisitermes* the origin is uncertain. Termite endemism in Rajasthan, a dry area, is only 19%. This is in contrast to some of the tropical rain-forest areas in India where high endemism (58.8%) occurs (Table 4).

TABLE 4.—Degree of endemism in the termite fauna in some arid and rain-forest areas in Indian Region.

Area	Percentage of endemism	Source
Rajasthan (mostly arid)	16 %	Present account
Assam region (tropical rain-forest)	58.8 %	Roonwal & Chhotani (1962, 1965)
Andaman & Nicobar Islands (tropical rain-forest)	58.8 %	Roonwal & Bose (1970)

(f) Comparison with other animals

No information is available on the zoogeographical status of the Rajasthan fauna of other groups of insects or indeed other animal groups except mammals. According to Prakash (1963, 1973), in origin the Rajasthan mammals are 49 % Palaearctic, 51 % Oriental and 2.6 % endemic. Earlier writers (e.g., Blandford, 1901) also stated the presence of a substantial Palaearctic element in the Indian Desert. According to Prakash, the Palaearctic element varies with the group, from zero (Primates, etc.) to 44 (Rodentia) and 100 (Insectivora). Prakash postulates a wide source of immigration of the western (Palaearctic) elements from the Sahara, Iran, Central Asia and even farther west, and for the eastern (Oriental) elements from Peninsular India and South-east Asia (Text-fig. 23). In the absence of detailed analyses, it is difficult to say to what extent this postulate of widespread intrusion is justified.



Text-fig. 23. Postulated immigration routes of the intrusive mammals in the Indian Desert. (After Prakash, 1973.)

ACKNOWLEDGEMENTS

We are indebted to the Officer-in-Charge, Desert Regional Station, Zoological Survey of India, Jodhpur, for kindly placing the Station's termite collections at our disposal. Our thanks are also due to Mr. N. S. Rathore for general help in various ways; and to the Council of Scientific and Industrial Research, New Delhi, for financial assistance.

SUMMARY

1. The taxonomic portion of account is based on an extensive collections (some 187 vials), made during the years 1964-73 from 60 localities in 16 districts of Rajasthan (6 never covered before), and forms a supplement to the earlier monograph of Roonwal and Bose (1964).

2. Several new additions of species and extensions of distributional range have been made to the termite fauna of Rajasthan. The additions are : One family (Kalotermitidae), one subfamily (Termitinae), 2 genera (*Incisitermes* and *Angulitermes*) and the following 14 species:—

1. *Incisitermes didwanaensis* Roonwal & Verma
2. *Microcerotermes palestinensis* Spaeth
3. *M. sakesarensis* Ahmad
4. *Angulitermes jodhpurensis* Roonwal & Verma
5. *Odontotermes brunneus* (Hagen)
6. *O. dehraduni* (Snyder)
7. *O. distans* Holmgren & Holmgren
8. *O. feae* (Wasmann)
9. *O. giriensis* Roonwal & Chhotani
10. *O. gurdaspurensis* Holmgren & Holmgren
11. *O. latiguloides* Roonwal & Verma
12. *O. parvidens* Holmgren & Holmgren
13. *O. wallonensis* (Wasmann)
14. *Microtermes unicolor* Snyder

3. The total number of species from Rajasthan has now risen from 19 in the earlier monograph (Roonwal and Bose, 1964) to 32. (Of the two species of *Trinervitermes* mentioned in the earlier account, *T. heimi* is now regarded as a junior synonym of *T. biformis*.)

4. In many species, new distributional records are given.

5. Measurements and illustrations are given for those species and castes which were not covered in the earlier monograph of Roonwal and Bose.

6. A phylogenetic analysis shows that the primitive families (Kalotermitidae, Hodotermitidae and Rhinotermitidae) are poorly represented (with 15.6 %, 3.1 % and 9.4 % representation respectively). The specialised family, Termitidae, accounts for the remainder (84.4 %).

7. A zoogeographical analysis shows that the *present-day* composition is overwhelmingly Oriental (97%), with only a small Palaearctic element (1 species, 3 %). Six species (19 %) are endemic to Rajasthan.

8. *In origin*, the fauna is largely Ethiopian (68.8 %), to a much lesser extent Oriental (15.6%), and there are tiny fractions of the Palaearctic and Neotropical elements (1 species each), while 3 species (9.4 %) are of doubtful origin.

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