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A REVIEW OF INDIAN GASTEROSTOMES (TREMATODA)

By

C. B. SRIVASTAVA and B. S. CHAUHAN

Zoological Survey of India, Calcutta

I. INTRODUCTION

Gasterostomes come under a single family Bucephalidae Poche, 1907, of digenetic trematodes. They are mostly found as adult parasites in the intestines of marine and freshwater fishes and larval stages in bivalve molluscs and encysted in nerves of fishes. Though enough work has been done on them in India but none has tried to work out their life-history, except Singh and Rai (1965) ; this is very essential to establish the proper status of various species and genera. First record of Gasterostomes in India was made by Verma (1936a & b). He described five new species in the genus *Bucephalopsis* (Diesing, 1855) Nicoll, 1914, viz. *B. fusiformis*, *B. garuai*, *B. magnum*, *B. confusus*, and *B. minimum* ; three species in the genus *Bucephalus* Baer, 1827, viz. *B. aoria*, *B. tridentacularia*, *B. jagannathai* ; and one species in the genus *prosorhynchus* Odhner, 1905 viz. *P. truncatus*. Bhalerao (1937) added *Bucephalopsis karvei*. Srivastava (1938) added one species to the genus *Bucephalopsis*, viz. *B. belonea* ; three species to the genus *Bucephalus*, viz. *B. indicus*, *B. gangeticus*, *B. barina* ; and two species to the genus *Prosohrhynchus*, viz. *P. manteri* and *P. arabiana*. Chauhan (1943) recorded the genera *Rhipidocotyle* Diesing, 1858 and *Neidhartia* Nagaty, 1937, for the first time from this country and added two species to the former, viz. *R. apapnllorum* and *R. ligulum* and one species to the latter genus, viz. *N. microrhyncha*, apart from two previously reported species. He also added one species to the genus *Bucephalopsis*, viz. *B. microrhynchus*. Dayal (1948) created two new genera, *Neobucephalopsis* with *N. bagarius* as its type and *Neoprosohrhynchus* with *N. purius* as its type, apart from adding three new species, viz. *Bucephalopsis sinhai*, *B. thapari*, *B. macronius*, to the genus *Bucephalopsis*. Gupta (1953) added three species to the genus *Neobucephalopsis*, viz. *N. eutropüchthis*, *N. pseudeu-*

tropici and *N. gauhatiensis*. Srivastava (1963) described three species under the genus *Bucephalus*, viz. *B. bagarius*, *B. tritenticularis* and *B. allahabadensis*. Kakaji (1969) described *B. octotenticularis* under the genus *Bucephalus*.

Chauhan (1954) has reviewed all the Bucephalids described from India till then and has pointed out the confused state of their systematics. In spite of excellent works of Eckmann (1932) and Nagaty (1937), available to most of the later workers, there appears much confusion with regard to the systematic position of various Indian species and genera enumerated above. Kniskern (1952) while stressing the need for the study of life-history for proper assessment of the systematics of this group has commented on the value of various structures to be taken into account. Nagaty (1937) and Gupta (1956) have also remarked about the variability in the structure and position of various organs in the individuals of the same species. Present authors had the opportunity to study a series of specimens, including original ones, of most Indian species and observe a wide range of variation in the individuals of the same species. Nature of the holdfast organ (anterior sucker) and location of ovary in relation to testes appear to be most valid characters for erecting a new genus. For evaluating a new species, length of cirrus sac in relation to body length ; number, location and nature of vitelline follicles ; host specificity based on the ecology of the host, giving due consideration to individual variations, may be taken into account. Shape and form of body, small variations in position and shape of gonads and extent and direction of caecum only should not form the basis for the purpose. Presence or absence of receptaculum seminis may also not form a strong character as it was found from the study of a large number of Verma's slides (including types) and many specimens collected by the authors that receptaculum seminis is present in some specimens, whereas, it is not discernible in other specimens of the same series due to factors like massive development of shell glands and thin transparent nature of the receptaculum seminis.

An attempt has been made here to examine systematic position of the Indian Gasterostomes, in the light of our study and observations, which may be found helpful by future workers on the group.

II. SYSTEMATIC ACCOUNT

The classification of the family Bucephalidae mostly followed

is as given by Nagaty (1937) and Dawes (1946). Yamaguti (1958) created three new subfamilies *viz.*, Neoprosorhynchinae, Neidhartinae and Dolichoenterinae, which appear to be unnecessary and require further study. Skrjabin (1962) followed Yamaguti, but maintained Paurorhynchinae Dickermann, 1954 as a separate subfamily.

Family BUCEPHALIDAE Poche, 1907

Subfamily BUCEPHALINAE Nicoll, 1914

Genus 1. **Bucephalus** Baer, 1827

1. **Bucephalus aoria** Verma, 1936

1936. *Bucephalus aoria* Verma, *Proc. natn. Acad. Sci. India*, **6**(1): 87.

Verma (1936a) described this species from *Macrones aor* (= *Mystus aor*) from Allahabad. The number of processes or fimbrae in this species vary from 12 to 22 instead of 14 to 22 as given by Verma.

2. **Bucephalus tridentacularia** Verma, 1936

1936. *Bucephalus tridentacularia* Verma, *Proc. natn. Acad. Sci. India*, **6**(1): 84.

1938. *Bucephalus indicus* Srivastava, *Indian J. vet. Sci.*, **8**: 317-340.

Verma (1936a) described this species from *Macrones aor* (= *Mystus aor*) and *Aoria seenghala* (= *Mystus seenghala*) from Allahabad. Srivastava H. D. (1938) described it from the same host as *B. indicus*. Srivastava C. B. (1963) synonymised the two species on the basis of his study of Verma's original specimens and other specimens collected by him from the type host and locality. Kakaji (1969) tried to revalidate *B. indicus* disregarding the fact that the synonymy was based on the study of Verma's original specimens and not only literature.

3. **Bucephalus jagannathai** Verma, 1936

1936. *Bucephalus jagannathai* Verma, *Proc. natn. Acad. Sci. India*, **6**(3): 252.

This species was collected from the intestine of *Cymbium guttatum* from Puri. The nature of tentacles distinguish this species from other species of the genus having the same number of tentacles.

4. *Bucephalus gangeticus* Srivastava, 1938

1938. *Bucephalus gangeticus* Srivastava, *Indian J. vet. Sci.*, **8**: 321.

This species was described for *Macrones seenghala* (= *Mystus seenghala*) from Allahabad.

5. *Bucephalus barina* Srivastava, 1938

1938. *Bucephalus barina* Srivastava, *Indian J. vet. Sci.*, **8**: 323.

This species was collected from *Sactophagus argus* at Puri.

6. *Bucephalus bagarius* Srivastava, 1963

1963. *Bucephalus bagarius* Srivastava, *Indian J. Helminth.*, **15**(1): 36.

The species was recorded from the intestine of *Bagarius bagarius* (Ham.) from Allahabad.

7. *Bucephalus tritentacularis* Srivastava, 1963

1963. *Bucephalus tritentacularis* Srivastava, *Indian J. Helminth.*, **15**(1): 38.

The species was collected from the intestine of *Bagarius bagarius* (Ham.) from Allahabad. The species is unique in having only three tentacles.

8. *Bucephalus allahabadensis* Srivastava, 1963

1963. *Bucephalus allahabadensis* Srivastava, *Indian J. Helminth.*, **15**(1): 40.

This species was collected from *Bagarius bagarius* (Ham.) from Allahabad.

9. *Bucephalus octotentacularis* Kakaji, 1969

1969. *Bucephalus octotentacularis* Kakaji, *Indian J. Helminth.*, **21**(1): 52.

This species was collected from the intestine of *Wallagonia attu* (= *Wallago attu*) from Lucknow. The number of tentacles in this species are eight.

Genus 2. *Prosorhynchoides* Dollfus, 1929

Syn. *Bucephalopsis* Nicoll, 1914 nec Diesing, 1855

Neobucephalopsis Dayal, 1948

Bucephaloides Hopkins, 1954 syn. nov.

Diesing (1855) erected the subgenus *Bucephalopsis* under the genus *Bucephalus* Baer, 1827 for the cercaria *Bucephalus*

haimeanus Lacaze-Duthiers, 1854, since the digestive system in this cercaria was different from that of cercaria *Bucephalus polymorphus* Baer, 1827 Nicoll (1914) raised the subgenus *Bucephalopsis* to generic rank, with *Bucephalopsis gracilescens* (Rudolphi, 1819) as the type species, assuming that the cercaria *Bucephalopsis haimeanus* develops into adult of *Bucephalopsis gracilescens*.

Dollfus (1929) erected the genus *Prosorhynchoides* with *P. ovatus* (Linton, 1900) as its type species. Nagaty (1937) synonymised the genus *Prosorhynchoides* with the genus *Bucephalopsis*.

Dayal (1948) erected a new genus *Neobucephalopsis* with *N. bagarius* Dayal, 1948 as its type species, and separated it from the genus *Bucephalopsis* (Diesing, 1855) Nicoll, 1914 on the basis of the presence of receptaculum seminis in the former. In our study we find that presence or absence of receptaculum seminis is not an important character (*vide supra*) and the genus *Neobucephalopsis* Dayal, 1948 should be congeneric with the genus *Bucephalopsis*. (See also Chauhan, 1954).

Hopkins (1954) pointed that the cercaria *Bucephalopsis haimeanus* Lacaze-Duthiers, 1854 may or may not develop into the adult of *Bucephalopsis gracilescens* (Rud., 1819) and obviously Nicoll (1914) was not justified to treat the other adult species and cercaria *Bucephalopsis haimeanus* in a single genus *Bucephalopsis*, until the experimental life-history is worked out establishing the connection between cercaria *B. haimeanus* and the adult *B. gracilescens*. Therefore, Hopkins (*op. cit.*) restricted the genus *Bucephalopsis* for the cercaria *B. haimeanus* and transferred all the adult species to his newly erected genus *Bucephaloides*. This system was followed by most of the subsequent workers.

Nagaty (1937) was apparently right in treating *Prosorhynchoides* with type species *P. ovatus* (Linton, 1900) and *Bucephalopsis* with type species *B. gracilescens* (Rud., 1819) congeneric, but gave priority to the latter genus.

We agree with Hopkins (1954) that the genus *Bucephalopsis* should be tentatively retained for *B. haimeanus* till experimental work connects the cercaria *B. haimeanus* with adult stages showing generic characters with *Bucephalopsis gracilescens*. His genus *Bucephaloides*, with type species *Bucephaloides gracilescens*, to accommodate all the known adult species named as *Bucephalopsis*, is, however, untenable, since an earlier name

Prosorhynchoides Dollfus, 1929, is available which is congeneric with species of *Bucephalopsis* for which Hopkins has erected this new genus. The name *Bucephaloides*, therefore, is treated as a junior synonym of *Prosorhynchoides*. All the species now included under *Bucephaloides* are transferred under the genus *Prosorhynchoides* Dollfus, 1929 with *P. ovatus* (Linton, 1900) as type species.

10. ***Prosorhynchoides garuai* (Verma, 1936) n.comb.**

1936. *Bucephalopsis garuai* Verma, *Proc. natn. Acad. Sci. India*, 6(1): 72.

1948. *Bucephalopsis sinhai* Dayal, *Indian J. Helminth.*, 1(1): 53. Syn. nov.

Verma (*loc. cit.*) described this species from *Pseudeutropius garua* (= *Clupisoma garua*) from Allahabad. Srivastava (1938) collected it from *Silonia silondia*. Present authors have collected this from *Eutropiichthys vacha* in addition to the two previously reported hosts. Kakaji (1969) collected it from *Wallago attu*. On studying a series of specimens the authors find that there are considerable variations with regard to position of various organs. Testes vary from symmetrical, diagonal to tandem position, from near cirrus sac to the pharynx; vas deferens is well developed and in some specimens it is as wide as the vesicula seminalis, before opening into it; cirrus sac varies from a straight to curved sickle shaped structure, reaching almost $1/5$ to $1/4$ or more of the body length. Receptaculum seminis is well developed in some specimens and can be traced, along with Laurer's canal, whereas, in others it is completely obliterated due to its thin transparent nature and massive development of shell gland. The same variation is met with in Verma's specimens also, which the authors had the opportunity to examine. Two characters are very consistent, *viz.*, club-shaped or bilobed nature of vitelline follicles and sufficiently smaller size of ovary in relation to testes. These, in the opinion of the authors, should form the distinguishing characters of this species. Kniskern (1952) pointed that 'Y' shaped nature of excretory bladder, as suggested by Verma, is actually tubular with slight indentation at the anterior borders. The present authors are in agreement with this view.

Dayal (*loc. cit.*) separated *Bucephalopsis sinhai* from *Prosorhynchoides garuai* (Verma, 1936) on the basis of vesicula seminalis externa. It appears from his figure that he has confused vas deferens with vesicula seminalis externa. Variations in

vas deferens have been pointed above. Present authors, therefore, consider it as synonym of *P. garuai* (Verma, 1936) as has already been pointed out by Chauhan (1954).

11. *Prosorhynchoides magnum* (Verma, 1936) n. comb.

- 1936. *Bucephalopsis magnum* Verma, *Proc. natn. Acad. Sci. India*, **6**(1): 77.
- 1936. *Bucephalopsis confusus* Verma, *Proc. natn. Acad. Sci. India*, **6**(1): 89.
- 1936. *Bucephalopsis minimus* Verma, *Proc. natn. Acad. Sci. India*, **6**(1): 82.
- 1953. *Neobucephalopsis eutropiichthis* Gupta, *Indian J. Helminth.*, **5**(1): 3. Syn. nov.
- 1953. *Neobucephalopsis pseudeutropei* Gupta, *Indian J. Helminth.*, **5**(1): 6. Syn. nov.

Verma (*loc. cit.*) described this species from *Pangasius buehneri* (= *P. pangasius*) from Allahabad. Srivastava (1938) and Gupta (1956) collected it from *Silonia silondia* from Allahabad and Lucknow respectively. We have collected it from *Clupisoma garua* and *Eutropiichthys vacha* apart from the above hosts.

The cirrus sac varies from 1/3.5 to 1/8 of body length. The size of ovary in relation to testes is also variable; in some it is equal, slightly smaller or slightly bigger. Receptaculum seminis is discernible in some specimens. The vitelline follicles are small, round, 13 to 18 in number on either side of body anterior to caecum.

Bhalerao (1937) regarded it as synonym of *Prosorhynchoides garuai* (Verma, 1936). Nagaty (1937), Srivastava (*loc. cit.*), Chauhan (1943, 1954), Dawes (1946) and Gupta (*loc. cit.*) accepted it as valid species. We are in agreement with this view.

Bhalerao (*loc. cit.*) and Srivastava (*loc. cit.*) considered *Bucephalopsis confusus* Verma, 1936 and *B. minimus* Verma, 1936 synonymous to *Prosorhynchoides garuai*, whereas, Nagaty, Chauhan and Dawes consider them synonymous to the present species. We support this view.

Gupta (*loc. cit.*) described *Neobucephalopsis eutropiichthis* and *N. pseudeutropei* from *Eutropiichthys vacha* and *Pseudeutropius garua* respectively. There does not appear much difference in these two species and *P. magnum* (Verma, 1936). They have been treated as synonyms. The measurements of receptaculum seminis in *B. pseudeutropei* as given by Gupta appear to be incorrect.

12. **Prosorhynchoides fusiformis** (Verma, 1936) n. comb.

1936. *Bucephalopsis fusiformis* Verma, *Proc. natn. Acad. Sci. India*, **6**(1): 68.
 1948. *Bucephalopsis thapari* Dayal, *Indian J. Helminth.*, **1**(1): 56. Syn. nov.
 1948. *Bucephalopsis macronius* Dayal, *Indian J. Helminth.*, **1**(1): 58. Syn. nov.

Verma (*loc. cit.*) collected these parasites from *Eutropiichthys vacha* from Allahabad. Srivastava (1938) and present authors have collected many specimens from the same host. A receptaculum seminis could not be discerned in this species. Vitelline follicles, 7 to 18 in number, are small, round bodies, grouped together on either side of body in the region of anterior sucker. Cirrus sac is $1/4$ to $1/2$ of the body length.

Dayal (*loc. cit.*) described *Bucephalopsis thapari* and *B. macronius* from *Pseudeutropius taakree* and *Macrones seenghala* respectively from Lucknow. He did not compare his specimens with the present species. Differences between these species are of minor nature and may be considered as intra-specific variations. *B. thapari* and *B. macronius* have, therefore, been treated as synonym of *Prosorhynchoides fusiformis* (Verma, 1936).

13. **Prosorhynchoides karvei** (Bhalerao, 1937) n. comb.

1937. *Bucephalopsis karvei* Bhalerao, *J. Helminth.*, **15**: 98.
 1938. *Bucephalopsis belonea* Srivastava, *Indian J. vet. Sci.*, **8**:325.

Bhalerao described this species from *Belone cancila* (= *Xenentodon cancila*) from Poona. Manter and VanCleave (1951) consider it synonymous to *B. magnacetabulum* Nagati, 1937 Chauhan (1943, 1954), Gupta (1956) and Manter (1963) regard it as valid. Present authors support its validity.

Srivastava (*loc. cit.*) described *Bucephalopsis belonea* from *Belone strongylina* from Puri. Chauhan (*loc. cit.*) considered it synonymous to *Bucephalopsis southwelli* Nagaty, 1937 Gupta (*loc. cit.*) made it synonym to *B. karvei*. Present authors agree with this latter synonymy.

14. **Prosorhynchoides microcirrus** (Chauhan, 1943)

1943. *Bucephalopsis microcirrus* Chauhan, *Proc. Indian Acad. Sci.*, B, **17**(4): 98.

Chauhan (*loc. cit.*) described this species from *Sciaena belengeri* from Bombay. The species is characterised by its

long slender body and short cirrus sac. It also possesses cystogenous glands just below the anterior sucker. This form appears to form a connecting link between the genera *Prosorhynchoides* and *Rhipidocotyle*.

15. ***Prosorhynchoides bagarius*** (Dayal, 1948) n. comb.

1948. *Neobucephalopsis bagarius* Dayal, *Indian J. Helminth.*, 1(1): 51.

1953. *Neobucephalopsis gauhatiensis* Gupta, *Indian J. Helminth.*, 5(1): 9. Syn. nov.

Dayal (*loc. cit.*) described this species from *Bagarius bagarius* from Lucknow and made it the type of his new genus *Neobucephalopsis*, which has now been treated as synonym of the genus *Prosorhynchoides*. Gupta (*loc. cit.*) described *N. gauhatiensis* on a single specimen from *Pseudeutropius garua*, and differentiated it from the former species on the basis of the position of testes and length of cirrus sac. Variations in these structures in this group of parasites have already been pointed out. The differences are of minor nature and may be taken as individual variations. *Neobucephalopsis gauhatiensis* has been treated as synonym of *Prosorhynchoides bagarius* (Dayal, 1948).

This species comes very close to *Prosorhynchoides fusiformis* (Verma, 1936) but differs from it in the possession of a receptaculum seminis.

Genus 3. ***Rhipidocotyle*** Diesing, 1855

16. ***Rhipidocotyle ligulum*** Chauhan, 1943

1943. *Rhipidocotyle ligulum* Chauhan, *Proc. Indian Acad. Sci., B*, 17(4): 105.

This species was described from the intestine of *Arius falcarius* from Bombay.

17. ***Rhipidocotyle apapillosum*** Chauhan, 1943

1943. *Rhipidocotyle apapillosum* Chauhan, *Proc. Indian Acad. Sci., B*, 17(4): 107.

This species was collected from the intestine of *Clupea* sp. from Bombay.

18. *Rhipidocotyle septapapillata* Krull, 1934

1934. *Rhipidocotyle septapapillata* Krull, *Trans. Am. Micr. Sci. Soc.*, **53**: 408.

1943. *Rhipidocotyle septapapillata*: Chauhan, *Proc. Indian Acad. Sci.*, B. **17**(4): 110.

Chauhan (1943) collected this species from *Chrysophrys berda* from Bombay, extending the distribution of this species to Arabian Sea.

Subfamily b. PROSORHYNCHINAE Nicoll, 1914

Syn. Neoprosorhynchinae Yamaguti, 1958

Neidhartinae Yamaguti, 1958

Yamaguti (1958) created subfamily Neoprosorhynchinae for the reception of the genus *Neoprosorhynchus* Dayal, 1948. Present authors do not agree with the creation of this subfamily as the genus *Neoprosorhynchus* is closely allied to the genus *Prosorhynchus*, and can well be accommodated under the subfamily Prosorhynchinae, where it was originally placed by its author. Subfamilies Neoprosorhynchinae Yamaguti, 1958 and Neidhartinae Yamaguti, 1958 are dropped.

Genus 4. *Prosorhynchus* Odhner, 1905

19. *Prosorhynchus truncatus* Verma, 1936

1936. *Prosorhynchus truncatus* Verma, *Proc. natn. Acad. Sci. India*, **6**(3): 257.

Verma (*loc. cit.*) collected this species from *Arius jalius* from Puri, Bay of Bengal.

20. *Prosorhynchus manteri* Srivastava, 1938

1938. *Prosorhynchus manteri* Srivastava, *Indian J. vet. Sci.*, **8**: 333.

This species was collected by Srivastava (*loc. cit.*) from *Tetraodon oblongus* from Puri, Bay of Bengal.

21. *Prosorhynchus arabiana* Srivastava, 1938

1938. *Prosorhynchus arabiana* Srivastava, *Indian J. vet. Sci.*, **8**: 336.

Srivastava (*loc. cit.*) collected this species from *Synaptura orientalis* from Karachi (now in Pakistan).

22. *Prosorhynchus* sp. Chauhan, 1943

1943. *Prosorhynchus* sp. Chauhan, *Proc. Indian Acad. Sci.*, B, **17**(4): 117.

Few specimens of this species were collected by Chauhan (*loc. cit.*) from the intestine of *Serranus lanceolatus* from Bombay.

Genus 5. **Neoprosorhynchus** Dayal, 1948

23. **Neoprosorhynchus purius** Dayal, 1948

1948. *Neoprosorhynchus purius* Dayal, *Indian J. Helminth.*, 1(1): 48.

Dayal (*loc. cit.*) described this species as the type of his newly erected genus *Neoprosorhynchus* from *Epinephelus lanceolatus* from Puri.

Genus 6. **Neidhartia** Nagaty, 1937

Nagaty (1937) described the genus *Neidhartia* to accommodate his two new species, *N. neidharti* and *N. ghardagae* under the subfamily Prosorhynchinae. Dawes (1946) considered this genus as a synonym of the genus *Prosorhynchus* Odhner, 1905. Chauhan (1954) and Manter (1963) consider it as a valid genus. Yamaguti (1958) created new subfamily Neidhartinae for this genus. Present authors support the validity of the genus but do not agree with the creation of a new subfamily for it.

24. **Neidhartia microrhyncha** Chauhan, 1943

1943. *Neidhartia microrhyncha* Chauhan, *Proc. Indian Acad. Sci.*, B, 17(4): 112.

Chauhan (*loc. cit.*) described this species from *Psettodes erumei* from Bombay.

25. **Neidhartia neidharti** Nagaty, 1937

1937. *Neidhartia neidharti* Nagaty, *Publ. Fac. Med. Egypt Univ.*, 12: 118.

1943. *Neidhartia neidharti*: Chauhan, *Proc. Indian Acad. Sci.*, B, 17(4): 116.

Chauhan (*loc. cit.*) collected this species from *Belone* sp. from Bombay, extending the distribution of this species to the Arabian Sea.

III. SUMMARY

The systematic position of the Indian Gasterostomes has been reviewed in the light of the studies made by the authors

from their own gasterostome collections and the collections of Verma.

Genus *Bucephaloides* Hopkins, 1954 has been treated as synonym of the genus *Prosorhynchoides* Dollfus, 1929 and all the species included under the former genus have been transferred to the latter genus.

Subfamilies Neoprosorhynchinae Yamaguti, 1958 and Neidhartinae Yamaguti, 1958 have been considered synonyms of the subfamily Prosorhynchinae Nicoll, 1914.

IV. REFERENCES

- BHALERAO, G. D. 1937. Studies on the helminths of India. Trematoda IV. *J. Helminth.*, **15**: 97-103.
- CHAUHAN, B. S. 1943. Trematodes from Indian marine fishes. Part. II. On some trematodes of the Gasterostome family Bucephalidae Poche, 1907, with description of four new species. *Proc. Indian Acad. Sci.*, B, **17**(4): 97-117.
- CHAUHAN, B. S. 1954. Studies on trematode fauna of India. Part III. Subclass Digenea (Gasterostomata). *Rec. Indian Mus.*, **51**: 231-287.
- DAWES, B. 1946. *The Trematoda*. Cambridge University Press.
- DAYAL, J. 1948. Trematode parasites of Indian fishes. Part. I. New trematodes of the family Bucephalidae Poche, 1907. *Indian J. Helminth.*, **1**(2): 47-62.
- DIESING, K. M. 1855. Revision der Cercarieen. *Sb. Akad. Wiss. Wien. (Math. Naturw. Kl.)*, **15**: 377-400.
- DOLLFUS, R. Ph. 1929. Helmintha. I. Trematoda et Acanthocephala. *Fauna des Colonies Francaises*, Paris, **3**(2): 73-114.
- ECHMANN, F. 1932. Beitrage zur kenntnis der Trematoden-Familie Bucephalidae. *Z. ParasitKde*, **5**: 94-111.
- GUPTA, S. P. 1953. Trematode parasites of freshwater fishes. *Indian J. Helminth.*, **5**(1): 1-80.
- GUPTA, S. P. 1956. A redescription of *Bucephalopsis magnum* (Verma, 1936) Srivastava, 1938 and *Bucephalopsis karvei* Bhalerao, 1937. *Indian J. Helminth.*, **8**(2): 112-121.
- HOPKINS, S. H. 1954. The American species of trematode confused with *Bucephalus* (*Bucephalopsis*) *haimeanus*. *Parasit.*, **44**: 353-370.
- KAKAJI, V. L. 1969. Studies on helminth parasites of Indian fishes. Part. III. Some trematode parasites of freshwater fishes of Uttar Pradesh. *Indian J. Helminth.*, **21**(1): 49-80.
- KNISKERN, V. B. 1952. Studies on the trematode family Bucephalidae Poche, 1907. Part. I. A systematic review of the family Bucephalidae. *Trans. Am. Micros. Soc.*, **71**(3): 253-266.
- MANTER, H. W. 1963. Studies on digenetic trematodes of fishes of Fiji, IV. Families Haploporidae, Angiodictyidae, Monorchidae and Bucephalidae. *Proc. helminth. Soc. Wash.*, **30**(2): 224-232.
- MANTER, H. W. & VANCLEAVE, H. J. 1951. Some digenetic trematodes, including eight new species, from marine fishes of La Jolla, California. *Proc. U. S. nat. Mus.*, **101** (3279): 317-318.

- NAGATY, H. F. 1937. Trematodes of fishes from Red Sea. Part. I. Studies on the family Bucephalidae Poche, 1907. *Publ. Fac. Med. Egypt. Univ. Egypt*, **12**: 1-172.
- NICOLL, W. 1914. Trematode parasites of fishes from the English Channel. *J. mar. biol. Ass. U K*, **10**: 466-505.
- SINGH, R. N., & RAI, S. L. 1965. Studies on a new bucephalid cercaria, *Cercaria katangii* sp. nov. (Trematoda: Bucephalidae). *Indian J. Helminth.*, **17**(2): 104-117.
- SKRJABIN, K. I. 1962. In *Trematodes of animals and man*, 20; Academy Sciences, USSR, Moscow: 181-559.
- SRIVASTAVA, C. B. 1963. On three new species of the genus *Bucephalus* Baer, 1827 (Trematoda: Bucephalidae Poche, 1907), with remarks on the systematic position of *B. indicus* Srivastava, 1938. *Indian J. Helminth.*, **15**(1): 36-44.
- SRIVASTAVA, H. D. 1938. Studies on Gasterostomatous parasites of Indian food fishes (with ten text-figs.). *Indian J. vet. Sci.*, **8**: 317-340.
- VERMA, S. C. 1936. Studies on the family Bucephalidae (Gasterostomata). Part. I. Description of new forms from Indian freshwater fishes. *Proc. natn. Acad. Sci.*, **6**(1): 66-89.
- VERMA, S. C. 1936b. Studies on the family Bucephalidae (Gasterostomata). Part. II. Descriptions of two new forms from Indian marine fishes. *Proc. natn. Acad. Sci.*, **6**(3): 252-260.
- YAMAGUTI, S. 1958. *Systema Helminthum*, 1 (1 & 2): 1-1575. Interscience Publ., New York.

ON COLLECTIONS OF SHORE FISHES FROM THE
COROMANDEL COAST, PALK BAY AND GULF OF MANNAR

By

K. V RAMA RAO

Zoological Survey of India, Calcutta

INTRODUCTION

During the years 1955 and 1960-62, the Zoological Survey of India carried out 5 intensive surveys of the Coromandel Coast, Palk Bay and Gulf of Mannar. As a Research Trainee in the marine fish section of the Zoological Survey of India under the Government of India Research Training Scheme 1962-63, the author identified the above shore fish collections and a systematic account of the species is given in the paper. The data under each species includes its first reference, number of specimens collected, their size ranges in total length, area of collection (arranged from north to south), date of collection, collector's name and geographical distribution.

In all, there are 153 species in the present collections. Three species, *Brotula jerdoni* Day, *Lepidotrigla spiloptera* Günther, *Dactyloptena orientalis* (C.V.) were reported as rare forms (Menon and Rao, 1963) and one species, *Omobranchus kallsoma* (Bleeker) was reported as new to Indian waters (Menon and Rao, 1963).

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SYSTEMATIC ACCOUNT

Class I. ELASMOBRANCHII

Order 1. LAMNIFORMES

Family 1. ORECTOLOBIDAE

1. *Chiloscyllium griseum* Müller and Henle

1841. *Chiloscyllium griseum* Müller and Henle, *Syst. Besch.*
Plagiostomen, p. 19 (India; Japan).

Material.—One, 160.0 mm., Marina beach, 11.viii.1961, S.R.S*, Z.S.I., Coll. One, 35.0 mm., Tondiarpet beach, 7.x.1960, A. Daniel Coll.

Distribution.—Red Sea, South Africa, India to Malay Peninsula, China and Japan.

Family 2. CARCHARHINIDAE

2. *Scoliodon palasorrah* (Cuvier)

1829. *Carcharias palasorrah* Cuvier, *Regne Animal*, 2 (ed. 2), 388 (On *Palasorrah* Russell 1803, *Fish. Coromandel*, 1, 9, pl. 15 Vizagapatnam).

Material.—One, 300.0 mm., Off Kundukal point, 15.iii.1955, M. A. S. Menon Coll. One, 407.0 mm., Pamban Bridge (Pamban), 29.ix.1960, A. Daniel Coll.

Distribution.—Red Sea, Arabia, South Africa, India, Ceylon, Malay Peninsula, Gulf of Siam, South China Sea, China, Japan, Java Sea, Philippines.

3. *Scoliodon sorrakowah* (Cuvier)

1829. *Carcharias sorrakowah* Cuvier, *Regne Animal*, 2 (ed. 2), p. 388 (On *Sorrakowah* Russell 1803, *Fish. Coromandel*, 1, p. 9, Vizagapatnam).

Material.—Four, 190.0-190.5 mm., Marina beach, 11.viii.1961, S.R.S., Z.S.I., Coll.

Distribution.—Makran Coast, India, Ceylon, Burma, Malay Peninsula, Gulf of Siam, South China Sea, Japan, Java Sea, Philippines.

Order 2. RAJIFORMES

Family 3. RHINOBATIDAE

4. *Rhinobatos thouiniana* (Shaw)

1804. *Raja thouiniana* Shaw, *Gen. Zool.*, 5: 318 (locality unknown).

Material.—One, 185.0 mm., Marina beach, 22.v.1961, S.R.S., Z.S.I., Coll.

Distribution.—Red Sea, India, Gulf of Siam, Malay Archipelago.

Family 4. TRYGONIDAE

5. *Dasyatis (Himantura) favus* (Annandale)

1909. *Trygon favus* Annandale, *Mem. Indian Mus.*, 2: 25 (Off Orissa)

*Southern Regional Station, Zoological Survey of India Collections.

Material.—Two, 141.0 & 215.0 mm.. Marina beach,
22.v.1961, S.R.S., Z.S.I., Coll.

Distribution.—India, Philippines.

Order 3. TORPEDINIFORMES

Family 5. TORPEDINIDAE

6. *Bengalichthys impennis* Annandale

1909. *Bengalichthys impennis* Annandale, *Mem. Indian Mus.*, 2: 48.
(Orissa coast).

Material.—One, 113.0 mm.. Marina beach, 21.ix.1961,
S.R.S., Z.S.I., Coll.

Distribution.—India, Philippines.

7. *Narcine brunnea* Annandale

1909. *Narcine brunnea* Annandale, *Mem. Indian Mus.*, 2: 45.
(Hooghly river mouth).

Material.—Two, 107.0 & 116.0 mm., Marina beach,
11.viii.1961, S.R.S., Z.S.I., Coll.

Distribution.—India, Ceylon, Philippines.

8. *Narcine timlei* (Bloch and Schneider)

1801. *Raja timlei* Bloch and Schneider, *Syst. Ichth.*, Berlin, 359
(Tranquebar)

Material.—Two, 130.0 & 150.0 mm., Marina beach,
5.vi.1961, S.R.S., Z.S.I., Coll.

Distribution.—India, Ceylon, Malay Archipelago, China,
Philippines, Japan.

9. *Narke dipterygia* (Bloch and Schneider)

1801. *Raja dipterygia* Bloch and Schneider, *Syst. Ichth.*, Berlin, 359
(Tranquebar).

Material.—Three, 113.0-160.0 mm., Marina beach,
21.ix.1961, S.R.S., Z.S.I., Coll.

Distribution.—Arabian Sea, India, Ceylon, Malay Peninsula,
Gulf of Siam, South China Sea, China, Philippines,
Japan.

Class II. TELEOSTOMI

Order 4. CLUPEIFORMES

Family 6. ELOPIDAE

10. *Elops saurus* Linnaeus

1766. *Elops saurus* Linnaeus, *Syst. Nat.*, 1, ed. 12: 518 (Carolina).

Material.—One, 205.0 mm., Porto Novo. 7 v.1960, A. Daniel Coll.

Distribution.—Arabia, Red Sea, East Coast of Africa, Mauritius, Madagascar, India, Ceylon, Andamans, Malay Peninsula, Malay Archipelago, China, Philippines, Queensland, Japan, Hawaii.

Family 7. MEGALOPIDAE

11. *Megalops cyprinoides* (Broussonet)

1782. *Clupea cyprinoides* Broussonet, *Ichth.*, (Oceans between the tropics).

Material.—Two, 181.0 & 188.0 mm., Porto Novo, 7 v.1960, A. Daniel Coll.

Distribution.—East Africa, Zanzibar, Natal, Madagascar, India, Ceylon, Burma, Malay Peninsula, Malay Archipelago, Gulf of Siam, China, Taiwan, Japan, Australia, Melanesia, Micronesia, Polynesia.

Family 8. CLUPEIDAE

12. *Dussumieria acuta* Cuvier and Valenciennes

1847. *Dussumieria acuta* Cuvier and Valenciennes, *Hist. Nat. Poiss.*, 20: 467 (Bombay; Coromandel coast).

Material.—One, 148.0 mm., Chepauk beach, 11. x.1960, A. Daniel Coll. One, 140.0 mm., Triplicane beach, 9. viii.1961, S.R.S., Z.S.I., Coll. Two, 60.0 & 78.0 mm., Tiruchendur, 28. ii.1962, V K. Prem Kumar Coll.

Distribution.—South Arabia, India, Ceylon, Malay Peninsula, Malay Archipelago, China, Philippines.

13. *Harengula vittata* (Cuvier and Valenciennes)

1847. *Clupeonia vittata* Cuvier and Valenciennes, *Hist. Nat. Poiss.*, 20: 352 (Vanikora).

Material.—One, 90.0 mm., Thangachimadam, 14. iii.1955, M. A. S. Menon Coll.

Distribution.—Reunion, Zanzibar, Madagascar, India, Malay Archipelago, Gulf of Siam, Oceanic Islands of Pacific.

14. *Sardinella fimbriata* (Cuvier and Valenciennes)

1847. *Sparatella fimbriata* Cuvier and Valenciennes, *Hist. Nat. Poiss.*, 20: 359 (Malabar).

Material.—One, 137.0 mm., Off Kundugal point, 15. iii. 1955 ; Three, 141.0-148.0 mm., Thangachimadam, 14. iii. 1955, all *M.A.S. Menon* Coll.

Distribution.—India, Ceylon, Burma, Singapore, Malay Archipelago, Gulf of Siam, South China Sea, China.

15. *Sardinella longiceps* Cuvier and Valenciennes

1847. *Sardinella longiceps* Cuvier and Valenciennes, *Hist. Nat. Poiss.*, 20: 273 (Pondicherry).

Material.—Ten, 113.0-120 mm., Tiruchendur, 28. ii. 1962, *V K. Prem Kumar* Coll.

Distribution.—Arabia, Seychelles, India, Ceylon, Andamans, Malay Archipelago, Philippines.

16. *Hilsa kanagurta* (Bleeker)

1852. *Alausa kanagurta* Bleeker, *Verh. Bat. Gen.*, 24: 13, 34 (Batavia, Muntok, East Indies).

Material.—Eighteen, 65.0-113.0 mm., Porto Novo, 8. v. 1960 ; Four, 73.0-103.0 mm., Vellar Estuary (Porto Novo), 5. v. 1960, all *A. Daniel* Coll.

Distribution.—Aden, Zanzibar, India, Ceylon, Malaya, Gulf of Siam, Malay Archipelago, Philippines.

17 *Ilisha elongata* (Bennett)

1830. *Alosa elongata* Bennett, *Mem. Life Raffles*, 691 (Sumatra).

Material.—One, 213.0 mm., Thangachimadam, 14. iii. 1955, *M. A. S. Menon* Coll.

Distribution.—India, Ceylon, Malaya, Gulf of Siam, Malay Archipelago, Taiwan, China, Japan.

18. *Ilisha indica* (Swainson)

1839. *Platygaster indicus* Swainson, *Nat. Hist. Animals*, 2: 294 (On *Ditchoee* Russell 1803, *Fish. Coromandel*, 2: 74, Vizagapatnam)

Material.—Four, 79.0-90.0 mm., Off Kundugal point, 15. iii. 1955, *M. A. S. Menon* Coll.

Distribution.—East Africa, India, Burma, Malay Peninsula, Malay Archipelago, Gulf of Siam, China.

19. *Pellona ditchela* Cuvier and Valenciennes

1847. *Pellona ditchela* Cuvier and Valenciennes, *Hist. Nat. Poiss.*, 20: 314 (On *Ditchelee* Russell 1803, *Fish. Coromandel* 2: 72).

Material.—Two, 128.0 & 131.0 mm., Tondiarpet beach, 7 x. 1960 ; Two, 136.0 & 138.0 mm., Chepauk beach, 11. x. 1960, all A. Daniel Coll.

Distribution.—East Africa, Madagascar, India, Ceylon, Burma, Malaya, Malay Archipelago, Gulf of Siam, Queensland.

20. *Opisthopterus tardoore* (Cuvier)

1829. *Pristigaster tardoore* Cuvier, *Regne Animal*, 2 (ed. 2): 321 (On *Tartoore* Russell 1803, *Fish. Coromandel*, 2: 74, Vizagapatnam).

Material.—Two, 74.0 & 80.0 mm., Chepauk beach, 11. x. 1960, A. Daniel Coll.

Distribution.—India, Ceylon, Burma, Malaya, Malay Archipelago, Gulf of Siam, China.

21. *Nematalosa nasus* (Bloch)

1795. *Clupea nasus* Bloch, *Naturg. Ausland. Fische*, 9: 116, (Malabar).

Material.—One, 95.0 mm., Point Calimere, 7. ii. 1962, V K. Prem Kumar Coll. One, 166.0 mm., Thangachimadam, 14. iii. 1955, M. A. S. Menon Coll.

Distribution.—Iraq, India, Ceylon, Burma, Philippines.

22. *Anodontostoma chacunda* (Hamilton)

1822. *Clupanodon chacunda* Hamilton, *Fish. Ganges*, 246, 383 (Gangetic estuaries).

Material.—One, 98.0 mm., Triplicane beach, 9. viii. 1961, S.R.S., Z.S.I., Coll.

Distribution.—India, Andamans, Burma, Malay Peninsula, Malay Archipelago, Gulf of Siam, Philippines, Oceanic Islands of Pacific.

Family 9. ENGRAULIDAE

23. *Coilia dussumieri* Cuvier and Valenciennes

1848. *Coilia dussumieri* Cuvier and Valenciennes, *Hist. Nat. Poiss.*, 21: 81 (Bombay; Mahe; Pondicherry).

Material.—One, 101.0 mm., Thangachimadam, 14. iii. 1955, M. A. S. Menon Coll.

Distribution.—India, Malaya, Malay Archipelago, Gulf of Siam.

24. *Anchoviella commersonii* (Lacépède)

1803. *Stolephorous commersonii* Lacépède, *Hist. Nat. Poiss.*, **5**: 381, 382 (type locality not mentioned).

Material.—Four, 51.0-70.0 mm., Chepauk beach, 11.x.1960, A. Daniel Coll.

Distribution.—Zanzibar, Mauritius, India, Ceylon, Malaya, Malay Archipelago, Philippines, China, Oceanic Islands of Pacific.

25. *Anchoviella indica* (van Hasselt)

1823. *Engraulis indica* van Hasselt, *Algem. Konst. Letterbode*: 329 (Java).

Material.—Nineteen, 36.0-75.0 mm., Marina beach, 19.iii.1961, S.R.S., Z.S.I., Coll. One, 65.0 mm., Thangachimadam, 14.iii.1955, M. A. S. Menon Coll. Two, 55.0 & 80.0 mm., Tiruchendur, 28.ii.1962, V. K. Prem Kumar Coll.

Distribution.—Zanzibar, India, Andamans, Malay Peninsula, Malay Archipelago, Gulf of Siam, China, Philippines, Oceanic Islands of Pacific.

26. *Anchoviella tri* (Bleeker)

1852. *Engraulis tri* Bleeker, *Verh. Bat. Gen.*, **24**: 40 (Batavia).

Material.—Two, 68.0 & 70.0 mm., Tiruchendur, 28.ii.1962, V. K. Prem Kumar Coll.

Distribution.—India, Malay Peninsula, Malay Archipelago, Philippines.

27 *Thrissocles hamiltonii* (Gray)

- 1833-34. *Thrissa hamiltonii* Gray, *Illust. Indian Zool. Hardwicke*, **2**: 92 (India).

Material.—Two, 68.0 & 83.0 mm., Point Calimere, 11.ii.1962, V. K. Prem Kumar Coll.

Distribution.—India, Ceylon, Malaya, Malay Archipelago, Gulf of Siam, Philippines.

28. *Thrissocles mystax* (Bloch and Schneider)

1801. *Clupea mystax* Bloch and Schneider, *Syst. Ichth.*: 426 (Malabar).

Material.—Two, 122.0 & 150.0 mm., Tondiarpet beach, 7 x.1960; One, 148.0 mm., Chepauk beach, 11.x.1960,

all *A. Daniel* Coll.; Two, 118.0 & 140.0 mm., Rayapuram beach, 23.xi.1961, *S.R.S.*, *Z.S.I.*, Coll.

Distribution.—From India and Ceylon to Malaya, Malay Archipelago, Gulf of Siam, China and also Queensland (Coastal Waters)

29. *Thrissocles setirostris* (Broussonet)

1782. *Clupea setirostris* Broussonet, *Ichth.*, 1: pl. 11 (Tanna, New Hebrides).

Material.—One, 141.0 mm., Tondiarpet beach, 7.x.1960; One, 122.0 mm., Elliots beach, 9.x.1960, all *A. Daniel* Coll. One, 138.0 mm., Triplicane beach, 9.viii.1961, *S.R.S.*, *Z.S.I.*, Coll.

Distribution.—Red Sea, Arabia, east coast of Africa, India, Burma, Malaya, Gulf of Siam, Malay Archipelago, Philippines.

Order 5. SCOPELIFORMES

Family 10. SYNODIDAE

30. *Saurida tumbil* (Bloch)

1795. *Salmo tumbil* Bloch, *Naturng. Ausland. Fische*, 9: 112 (type locality not given).

Material.—Four, 90.0-131.0 mm., Tiruchendur, 28.ii.1962, *V K. Prem Kumar* Coll.

Distribution.—Red Sea, Madagascar, Zanzibar, India, Andamans, Ceylon, Malay Archipelago, Taiwan, China, Philippines, Japan, Australia, Sandwich Island.

31. *Trachinocephalus myops* (Bloch and Schneider)

1801. *Salmo myops* Bloch and Schneider, *Syst. Ichth.*: 421 (St. Helena).

Material.—One, 163.0 mm., Marina beach, 22.v.1961, *S.R.S.*, *Z.S.I.*, Coll.

Distribution.—Natal, India, Malay Archipelago, Taiwan, China, Philippines, Japan, Oceania.

Order 6. CYPRINIFORMES

Family 11. ARIIDAE

32. *Tachysurus sona* (Hamilton)

1822. *Pimelodus sona* Hamilton, *Fish. Ganges*: 172, 376 (Estuaries of Bengal).

Material.—One, 155.0 mm., Thangachimadam, 14. iii. 1955, M. A. S. Menon Coll.

Distribution.—From Bombay, through the seas of India entering estuaries and tidal rivers.

Family 12. PLOTOSIDAE

33. *Plotosus anguillaris* (Bloch)

1794. *Platystacus anguillaris* Bloch, *Naturg. Ausland. Fische*, 8: 61 (type locality not given).

Material.—Seven, 45.0-60.0 mm., Triplicane beach, 19. iii. 1961, S.R.S., Z.S.I., Coll.

Distribution.—Widely distributed in Indo-West Pacific ranging from Red Sea and east coast of Africa to Australia, Japan and Philippines (seas, estuaries and rivers).

34. *Plotosus canius* Hamilton

1822. *Plotosus canius* Hamilton, *Fish. Ganges*: 142, 374 (rivers of Southern Bengal).

Material.—Two, 96.0 & 101.0 mm., Marina beach, 22. v. 1961, S.R.S., Z.S.I., Coll.

Distribution.—India, Ceylon, Burma to Malay Archipelago (seas, estuaries and rivers)

Family 13. BAGRIDAE

35. *Mystus gulio* (Hamilton)

1822. *Pimelodus gulio* Hamilton, *Fish. Ganges*: 201, 379 (Gangetic estuaries).

Material.—Eight, 95.0-193.0 mm., Porto Novo, 7 v. 1960, A. Daniel Coll. Three, 78.0-105.0 mm., Point Calimere, 7 ii. 1962, V K. Prem Kumar Coll.

Distribution.—From the coast of India, Ceylon to Malay Archipelago (estuaries and tidal rivers).

Order 7 ANGUILLIFORMES

Family 14. ANGUILLIDAE

36. *Anguilla bicolor* McClelland

1845. *Anguilla bicolor* McClelland, *Cal. Journ. Nat. Hist.*, 5: 178 (Sandoway on the Malay coast).

Material.—One, 216.0 mm., Marina beach, 21.ix.1961; Three, 81.0-140.0 mm., Adayar river, 20.iv.1961, all S.R.S., Z.S.I., Coll.

Distribution.—India, Andamans, Malay Archipelago (catadromous inhabiting in fresh waters of coastal plains and spawning at sea).

Family 15. MURAENIDAE

37 *Evenchelys macrurus* (Bleeker)

1854. *Muraena macrurus* Bleeker, *Nat. Tijds. Ned. Ind.*, **7**: 324 (Java).

Material.—One, 360.0 mm., Marina beach, 11.viii.1961, S.R.S., Z.S.I., Coll.

Distribution.—Natal, India, Ceylon, Malay Archipelago, Taiwan, New Guinea, Queensland (coastal and estuarine waters entering fresh waters).

Family 16. MURAENESOCIDAE

38. *Muraenesox talabonoides* (Bleeker)

1853. *Conger talabonoides* Bleeker, *Verh. Batavia Genootsch.*, **25**: 20 (Batavia, Java).

Material.—One, 225.0 mm., Point Calimere, 11.ii.1962, V K. Prem Kumar Coll.

Distribution.—India, east to East Indian Archipelago, north to Philippines and China.

Family 17. CONGRIDAE

39. *Ariosoma anago* (Schlegel)

1846. *Conger anago* Schlegel, *Fauna Japan Poiss.*: 259 (Nagasaki Bay, Japan).

Material.—One, 250.5 mm., Marina beach, 22.v.1961, S.R.S., Z.S.I., Coll.

Distribution.—From the coast of Coromandel to Malay Archipelago and Japan.

40. *Uroconger lepturus* (Richardson)

1844-45. *Conger lepturus* Richardson, *Zool. Voy. Sulphur.*: 106, pl. 56, figs. 1-6 (coasts of China).

Material.—One, 240.0 mm., Marina beach, 22.v.1961, S.R.S., Z.S.I., Coll.

Distribution.—From the coast of Oman, India to Malay Archipelago, China and Philippines.

Family 18. OPHICHTHYIDAE

41 *Ophichthys apicalis* (Bennett)

1830. *Ophisurus apicalis* Bennett, *Cat. Zool. Spec.*, (in *Memoir Life Raffles*): 692 (Java).

Material.—One, 240.0 mm., Santhome beach, 8. x. 1960, A. Daniel Coll.

Distribution.—India, China, East Indian Archipelago, Philippines.

42. *Pisoodonophis boro* (Hamilton)

1822. *Ophisurus boro* Hamilton, *Fish. Ganges*: 20, 363 (Ganges River, Bengal).

Material.—Three, 160.0-530.0 mm., Marina beach, 22. xi. 1961, S.R.S., Z.S.I., Coll.

Distribution.—From India to Malay Archipelago, Taiwan, New Guinea (seas and estuaries ascending large rivers far above the tidal influences).

43. *Pisoodonophis cancrivorous* (Richardson)

- 1844-48. *Ophisurus cancrivorous* Richardson, *Voy. "Erebus and Terror"*, *Ichth.*: 97 (Port Essington, Northern Territory).

Material.—Two, 150.0 & 408.0 mm., Elliots beach, 9. x. 1960 ; One, 270.0 mm., Krusadi Island, 1. x. 1960, all A. Daniel Coll.

Distribution.—Arabia, Madagascar, India to Malay Archipelago, China, South to Australia and Samoa (salt and brackish waters)

Order 8. BELONIFORMES

Family 19. HEMIRHAMPHIDAE

44. *Hemirhamphus far* (Forsk.)

1775. *Esox far* Forskal, *Descript. Animal, Hauniae*: 67 (Lohaja, Red Sea).

Material.—Four, 152.0-192.0 mm., Marina beach, 6. x. 1960, A. Daniel Coll.

Distribution.—Widely distributed in the Indo-West Pacific, ranging from the Red Sea and east coast of Africa to

Riu Kiu Islands in the north and the Society Island in the east.

45. *Hemirhamphus gaimardi* Cuvier and Valenciennes

1846. *Hemirhamphus gaimardi* Cuvier and Valenciennes, *Hist. Nat. Poiss.*, 19: 36 (Moluccas, Ambonia, New Guinea, Port Jackson).
Material.—Three, 113.0-157.0 mm., Point Calimere, 11.ii.1962; One, 100.0 mm., Tiruchendur, 28.ii.1962, all A. Daniel Coll.

Distribution.—From Iran, India, Burma to Malay Archipelago, Ambonia, New Guinea, Philippines and Australia (seas and estuaries).

Family 20. EXOCOETIDAE

46. *Cypselurus spilopterus* (Cuvier and Valenciennes)

1846. *Exocoetus spilopterus* Cuvier and Valenciennes, *Hist. Nat. Poiss.*, 19: 113 (Oualan, Caroline Islands).
Material.—One, 175.0 mm., Marina beach, 5.vi.1961, S.R.S., Z.S.I., Coll.

Distribution.—Seas of India to the Malay Archipelago, Oceanic Islands of Pacific.

Order 9. SYNGNATHIFORMES

Family 21. SYNGNATHIDAE

47 *Doryichthys cunculus* Hamilton

1822. *Doryichthys cunculus* Hamilton, *Fish. Ganges*: 12, 362 (estuaries near Calcutta).
Material.—Two, 143.0 & 155.0 mm., Madavakkum Kalley, 19.vii.1961, S.R.S., Z.S.I., Coll.
Distribution.—India (estuaries and tidal rivers ascending far above the tidal influence).

48. *Microphis brachyurus* (Bleeker)

1853. *Syngnathus brachyurus* Bleeker, *Verh. Bat. Gen.*, (East Indian Archipelago).
Material.—Five, 115.0-130.0 mm., Triplicane beach, 19.iii.1961, S.R.S., Z.S.I., Coll.
Distribution.—Tropical Indo-West Pacific from east coast of Africa to the East Indian Archipelago, Philippines, Japan and south east to Society Islands (In fresh, brackish and salt water of rivers and estuaries).

49. *Syngnathoides biaculeatus* (Bloch)

1785. *Syngnathus biaculeatus* Bloch, *Naturg. Ausland. Fische*, **1**: 10 (East Indies).

Material.—One, 175.0 mm., Off Vedalai fishing village, 17 iii.1955, M. A. S. Menon Coll.

Distribution.—Red Sea, east coast of Africa, seas of India, Malay Archipelago, China, Australia.

50. *Syngnathus cyanospilosus* Bleeker

1854. *Syngnathus cyanospilosus* Bleeker, *Nat. Tijds. Ned. Ind.*, **6**: 114 (Banda Islands).

Material.—One, 75.0 mm., Porto Novo, 5.v.1960, A. Daniel Coll.

Distribution.—From the east coast of Africa to seas of India to the Malay Archipelago, Philippines and Taiwan.

51. *Tachyrhampus serratus* (Schlegel)

1850. *Syngnathus serratus* Schlegel, *Fauna Japan Poiss.*, 272, (Nagasaki, Japan).

Material.—One, 225.0 mm., Marina beach, 5.vi.1961, S.R.S., Z.S.I., Coll. One, 181.0 mm., Vellar estuary (Porto Novo), 8. v. 1960, A. Daniel Coll.

Distribution.—From India, Ceylon, Gulf of Siam, Singapore, China and Japan.

Order 10. MUGILIFORMES

Family 22. SPHYRAENIDAE

52. *Sphyraena acutipinnis* Day

1878. *Sphyraena acutipinnis* Day, *Fish. India*: 342 (Sind).

Material.—One, 201.0 mm., Off Kundugal point, 15.iii.1955, M. A. S. Menon Coll.

Distribution.—Indian seas.

53. *Sphyraena obtusa* Cuvier and Valenciennes

1803. *Sphyraena obtusa* Cuvier and Valenciennes, *Hist. Nat. Poiss.*, **3**: 324 (Pondicherry, Malabar, India; Bourbon Island; Port Jackson, Australia).

Material.—One, 148.0 mm., Marina beach, 5.vi.1961, S.R.S., Z.S.I., Coll.

Distribution.—All over the tropical Indian Ocean from the Red Sea and east coast of Africa to Riu Kiu Islands, Philippines, south Australia, New Zealand and Fiji Islands (coastal waters).

Family 23. MUGILIDAE

54. *Liza macrolepis* (Smith)

1849. *Mugil macrolepis* Smith, *Ill. Zool. South Africa*, 4 (no pagination) (rivers and fresh water lakes of South Africa).
Material.—Three, 83.0-86.0 mm., Porto Novo, 8. v. 1960 ; One, 105.0 mm., Vellar estuary, Porto Novo, 5. v. 1960, all A. Daniel Coll. Three, 168.0-22.0 mm., Point Calimere, 11. ii. 1962, V K. Prem Kumar Coll. One, 260.0 mm., Thangachimadam, 14. iii. 1955, M. A. S. Menon Coll.
Distribution.—From East Africa, Madagascar to China and Japan, the Marshall and Tuamotu Islands (in the sea, in rivers and lakes).

55. *Liza vaigiensis* (Quoy and Gaimard)

1825. *Mugil vaigiensis* Quoy and Gaimard, *Voy. "Urairie" Zool.*, : 337, (Waigiu).
Material.—Five, 125.0-135.0 mm., Inshore area of Palk Bay, 28. ix. 1960, A. Daniel Coll.
Distribution.—From the east coast of Africa to the East Indian Archipelago, China, throughout the Philippines, east to Marshall and Tuamotu Islands, south to Australia.

56. *Mugil cephalus* Linnaeus

1758. *Mugil cephalus* Linnaeus, *Syst. Nat.*, London, ed. 10, p. 316 (European Ocean).
Material.—Two, 117.0 & 136.0 mm., Porto Novo, 8. v. 1960, A. Daniel Coll.
Distribution.—Widely distributed in the tropical and temperate waters of the Indian, S. Atlantic and S. Pacific Oceans (common in estuaries entering fresh water).

57. *Mugil tade* Forskal

1775. *Mugil tade* Forskal, *Descript. Animal*, Hauniae : 14, 74 (Arabia).
Material.—Four, 125.0-210 mm., Porto Novo, 7 v. 1960, A. Daniel Coll.

Distribution.—Tropical Indo-Pacific, from the Red Sea to the Philippines, China, Guam and Australia (marine, entering rivers).

Order 11. POLYNEMIFORMES

Family 24. POLYNEMIDAE

58. *Eleutheronema tetradactylus* (Shaw)

1804. *Polynemus tetradactylus* Shaw, *Gen. Zool.* 5: 155 (On Waggelle Russell 1803, *Fish. Coromandel*, 2: 67 Vizagapatnam).

Material.—Two, 99.0 & 162.0 mm., Point Calimere, 11. ii. 1962, V K. Prem Kumar Coll.

Distribution.—Seas of India to the Malay Archipelago, China, Taiwan, Philippines and south to Australia.

Order 12. PERCIFORMES

Family 25. LATIDAE

59. *Lates calcarifer* (Bloch)

1790. *Holocentrus calcarifer* Bloch, *Naturf. Ausland. Fische*, 4: 100, pl. 244 (Japan).

Material.—One, 137.0 mm., Pamban bridge (Pamban), 29. ix. 1960, A. Daniel Coll.

Distribution.—Persian Gulf, India, Burma, Ceylon, Malaya, Gulf of Siam, Amoy, Hainan, Canton, Philippines, Japan, Queensland, Oceanic Islands of Pacific (shallow coasts and river mouths).

Family 26. THERAPONIDAE

60. *Pelates quadrilineatus* (Bloch)

1790. *Holocentrus quadrilineatus* Bloch, *Naturg. Ausland. Fische*, 4: 82 ("The Orient").

Material.—Two, 124.0 & 136.0 mm., Tondiarpet beach, 7. x. 1960; Three, 45.0-120.0 mm., Pamban, 29. ix. 1960; Thirty-two, 27.0-42.0 mm., Krusadi Island, 1. x. 1960, all A. Daniel Coll. Three, 104.0-110.00 mm., Off Kundugal point, 15. iii. 1955, M. A. S. Menon Coll.

Distribution.—Widely spread in the Indo-West Pacific extending from Red Sea, east coast of Africa through Malay Archipelago to Japan, Philippines and Australia (coastal and brackish waters)

61. *Therapon jarbua* (Forsk.)

1775. *Sciaena jarbua* Forskal, *Descript. Animal, Hauniae*, 12: 50 (Djedda, Red Sea).

Material.—One, 115.0 mm., Marina beach, 4.x.1961, S.R.S., Z.S.I., Coll. Nine, 35.0-70.0 mm., Point Calimere, 7 xii.1962; Two, 40.0 & 70.0 mm., Point Calimere, 11.ii.1962, V K. Prem Kumar Coll. One, 131.0 mm., Pamban bridge (Pamban), 29.ix.1960; Eighty-five, 24.0-72.0 mm., Kundugal point, 2.x.1960, A. Daniel Coll.

Distribution.—Widely distributed in the Indo-West Pacific ranging from Red Sea and east coast of Africa to Fiji and Samoa, north to Japan, south to Australia (coastal waters and estuaries).

62. *Therapon puta* Cuvier and Valenciennes

1829. *Therapon puta* Cuvier and Valenciennes, *Hist. Nat. Poiss.*, 3: 131 (Pondicherry; Mahe).

Material.—One hundred and twenty-six, 23.0-51.0 mm., Palk Bay (near lagoon), 3.x.1960, A. Daniel Coll.

Distribution.—Indo-West Pacific ranging from Red Sea and east coast of Africa to New Britain (Bismark Archipelago), and Queensland (coastal and brackish waters).

Family 27. SILLAGINIDAE**63. *Sillago sihama* (Forsk.)**

1775. *Atherina sihama* Forskal, *Descript. Animal, Hauniae*: 13, 70 (Lohaja, Red Sea).

Material.—Three, 54.0-80.0 mm., Point Calimere, 7 ii.1962; Three, 81.0-89.0 mm., Point Calimere, 11.ii.1962, V K. Prem Kumar Coll. One, 193.0 mm., Palk Bay, 28.ix.1960, A. Daniel Coll. Three, 131.0-173.0 mm., Thangachimadam, 14.iii.1955, M. A. S. Menon Coll.

Distribution.—Widely spread from Red Sea and east coast of Africa to Australia, Japan and Oceanic Islands of Pacific (coastal waters and estuaries).

Family 28. CARANGIDAE**64. *Alectis ciliaris* (Bloch)**

1787. *Zeus ciliaris* Bloch, *Naturg. Ausland. Fischè*, 6: 29, pl. 191 (East Indies; Suratte).

Material.—One, 60.0 mm., Santhome beach, 8.x.1960, A. Daniel Coll. Six, 55.0-65.0 mm., Marina beach 5.vi.1961, S.R.S., Z.S.I., Coll.

Distribution.—From the Red Sea and Natal to Japan, Australia and Tahiti.

65. *Alectis indica* (Rüppell)

1828. *Scyris indicus* Rüppell, *Atlas Fische Roth. Meer.*, Frankfurt: 128 (Djedda, Red Sea).

Material.—One, 50.0 mm., Vedalai, 17 iii.1955, M. A. S. Menon Coll.

Distribution.—From the Red Sea and east coast of Africa to China, Australia, the Society Islands and Hawaii.

66. *Atule kalla* (Cuvier and Valenciennes)

1833. *Caranx kalla* Cuvier and Valenciennes, *Hist. Nat. Poiss.*, 9: 49 (Malabar; Mahe; Red Sea).

Material.—One, 129.0 mm., Porto Novo, 9.v.1960, A. Daniel Coll. Twenty-one, 78.0-92.0 mm., Tiruchendur, 28.ii.1962, V K. Prem Kumar Coll.

Distribution.—All over the tropical Indo-Pacific, from Red Sea and east coast of Africa to Australia, Japan, and Oceanic Islands of Pacific.

67 *Atule malam* (Bleeker)

1851. *Selar malam* Bleeker, *Nat. Tijds. Ned. Ind.*, 1: 362 (Batavia, Java).

Material.—One, 152.0 mm., Off Kundugal point, 15.iii.1955, M. A. S. Menon Coll.

Distribution.—India, Andamans, Malay Archipelago, north to China and Taiwan, south to Queensland, Australia.

68. *Atule mate* (Cuvier and Valenciennes)

1833. *Caranx mate* Cuvier and Valenciennes, *Hist. Nat. Poiss.*, 9: 54 (Pondicherry; Seychelles; New Guinea; Anjer Strait).

Material.—One, 155.0 mm., Marina beach, 5.vi.1961, S.R.S., Z.S.I., Coll.

Distribution.—From the Red Sea and Natal to the Hawaiian Islands and Tahiti, north to Riu Kiu Islands, south to Australia.

69. *Caranx chrysophrys* Cuvier and Valenciennes

1833. *Caranx chrysophrys* Cuvier and Valenciennes, *Hist. Nat. Poiss.*, 9, 77 (Seychelles).

Material.—One, 160.0 mm., Thangachimadam, 14. iii. 1955, M. A. S. Menon Coll.

Distribution.—From the east coast of Africa to the Malay Archipelago, Philippines, China, Taiwan, Queensland.

70. *Citula armata* (Forsk.)

1775. *Sciaena armata* Forskal, *Descript. Animal*: 53 (Red Sea).

Material.—One, 160.0 mm., Thangachimadam, 14. iii. 1955, M. A. S. Menon Coll.

Distribution.—From the Red Sea and Madagascar to the Philippines, Japan, Australia and Samoa.

71. *Megalaspis cordyla* (Linnaeus)

1758. *Scomber cordyla* Linnaeus, *Syst. Nat.* ed. 10: 298 (East Indies).

Material.—One, 85.0 mm., Marina beach, 5. vi. 1961, S.R.S., Z.S.I., Coll.

Distribution.—Widely distributed in the Indo-West Pacific ranging from Red Sea, east coast of Africa to Oceanic Islands of Pacific.

72. *Scomberoides tol* (Cuvier and Valenciennes)

1831. *Cnorrinemus tol* Cuvier and Valenciennes, *Hist. Nat. Poiss.*, 8: 385 (Pondicherry).

Material.—One, 255.0 mm., Sinnur (Porto Novo), 9. v. 1960, A. Daniel Coll. One, 248.0 mm., Off Kundugal point, 15. iii. 1955, M. A. S. Menon Coll.

Distribution.—From Red Sea and east coast of Africa to Formosa, Philippines and Japan.

73. *Selaroides leptolepis* (Cuvier and Valenciennes)

1833. *Caranx leptolepis* Cuvier and Valenciennes, *Hist. Nat. Poiss.*, 9: 63 (Java)

Material.—Four, 127.0-134.0 mm., Off Kundugal point, 15. iii. 1955, M. A. S. Menon Coll.

Distribution.—From the coast of Arabia, India, Ceylon to China, Taiwan, Philippines, Riu Kiu Islands, south to Australia and Queensland.

Family 29. LACTARIIDAE

74. *Lactarius lactarius* (Bloch and Schneider)

1801. *Scomber lactarius* Bloch and Schneider, *Syst. Ichth.*, 31 (Tranquebar).

Material.—Five, 41.0-89.0 mm., Chepauk beach, 11.x.1960, A. Daniel Coll. Two, 161.0 & 196.0 mm., Thangachimadam, 14.iii.1955, M. A. S. Menon Coll.

Distribution.—Widely distributed from Red Sea and east coast of Africa to Japan, Australia and Oceanic Islands of Pacific (coastal waters).

Family 30. LUTIANIDAE

75. *Lutianus fulviflamma* (Forsk.)

1775. *Sciaena fulviflamma* Forskal, *Descript. Animal.*: 45 (Arabia).

Material.—Two, 155.0 & 178.0 mm., Vedalai, 11.iii.1955; One, 180.0 mm., Thangachimadam, 14.iii.1955, M. A. S. Menon Coll.

Distribution.—From the Red Sea, east coast of Africa, seas of India to the Malay Archipelago, Philippines, Taiwan, Australia, Fiji and Tahiti.

76. *Lutianus johnii* (Bloch)

1792. *Anthias johnii* Bloch *Naturg. Ausland. Fische*, 6: 113.

Material.—Three, 92.0-117.0 mm., Mandapam Camp, 27 ix.1960, A. Daniel Coll.

Distribution.—Coasts of Africa to Philippines, China, Australia and Tahiti.

Family 31. NEMIPTERIDAE

77. *Nemipterus bleekeri* (Day)

1875. *Synagris bleekeri* Day, *Fish. India*: 92 (Madras).

Material.—Five, 71.0-126.0 mm., Tiruchendur, 28.ii.1962, V K. Prem Kumar Coll.

Distribution.—Seas of India, Ceylon and Malaya.

Family 32. LEIOGNATHIDAE

78. *Leiognathus dussumieri* (Cuvier and Valenciennes)

1835. *Equula dussumieri* Cuvier and Valenciennes, *Hist. Nat. Poiss.* 10: p. 77 (Coromandel coast).

Material.—One, 95.0 mm., Elliots beach, 9.x.1960, A. Daniel Coll.

Distribution.—From Madagascar, coasts of India, Ceylon, Andamans to Australia and Oceanic Islands of Pacific.

79. *Leiognathus insidiator* (Bloch)

1787. *Zeus insidiator* Bloch, *Naturg. Ausland. Fische*, 3: 41, 192 (Suratt, India).

Material.—Fifteen, 25.0-63.0 mm., Triplicane beach, 9.iii.1961, S.R.S., Z.S.I., Coll.

Distribution.—Widespread from the coast of Africa to China, Philippines, and Oceanic Islands of Pacific.

80. *Leiognathus lineolatus* (Cuvier and Valenciennes)

1835. *Equula lineolata* Cuvier and Valenciennes, *Hist. Nat. Poiss.*, 10: 86 (Java; Anjer).

Material.—One, 123.0 mm., Elliots beach, 9.x.1960; Three, 75.0-78.0 mm., Santhome beach, 11.x.1960, A. Daniel Coll. Thirty-three, 31.0-60.0 mm., Rayapuram beach, 23.xi.1961, S.R.S., Z.S.I., Coll.; One, 131.0 mm., Thangachimadam, 14.iii.1955, M. A. S. Menon Coll.

Distribution.—From Madagascar, India and Ceylon to Malaya, Malay Archipelago, Japan and Queensland.

81. *Leiognathus ruconius* (Hamilton)

1822. *Chanda ruconius* Hamilton, *Fish. Ganges*: 106, 371 (Ganges estuaries).

Material.—One, 55.0 mm., Ennur bridge, 5.xii.1961, S.R.S., Z.S.I., Coll.; Eight, 32.0-66.0 mm., Santhome beach, 8.x.1960, A. Daniel Coll. Four, 57.0-72.0 mm., Thangachimadam, 14.iii.1955, M. A. S. Menon Coll.; Six, 21.0-103.0 mm., Tiruchendur, 7.xii.1962, V K. Prem Kumar Coll.

Distribution.—Widespread in Indo-West Pacific ranging from South Africa to Australia, Philippines and Taiwan (shallow coastal and estuarine waters).

82. *Leiognathus splendens* (Cuvier)

1829. *Equula splendens* Cuvier, *Regne Animal*, 2: 212 (on Gomorah korah Russell 1803, *Fish. Coromandel.*, 1: 48, fig. 61, Vizagapatnam).

Material.—Five, 47.0-67.0 mm., Marina beach, 8.iii.1961, S.R.S., Z.S.I., Coll.

Distribution.—From Red Sea, Madagascar, Mauritius, coasts of India, Ceylon to Malay Archipelago, Gulf of Siam, China, Taiwan, Philippines, Queensland and Oceanic Islands of Pacific.

Family 33. GERRIDAE

83. *Gerres filamentosus* Cuvier

1829. *Gerres filamentosus* Cuvier, *Regne Animal*, 2 (ed. 2): 188 (on Wodowahah Russell 1803, *Fish. Coromandel*, 1: 52, Vizagapatnam.)

Material.—Two, 103.0 & 123.0 mm., Thangachimadam, 14.iii.1955, M. A. S. Menon Coll.

Distribution.—Widespread from the Red Sea and east coast of Africa to Philippines, Japan, Queensland and Oceanic Islands of Pacific.

84. *Gerres limbatus* Cuvier and Valenciennes

1830. *Gerres limbatus* Cuvier and Valenciennes, *Hist. Nat. Poiss.*, 6: 476 (Malabar; Pondicherry).

Material.—Two, 62.0 & 66.0 mm., Point Calimere, 11.ii.1962, M. A. S. Menon Coll. One, 137.0 mm., Mandapam Camp, 28.ix.1960, A. Daniel Coll.

Distribution.—Seas of India, Burma, Malaya, Hainan.

85. *Gerres oyena* (Forsk.)

1775. *Labrus oyena* Forskal, *Descript. Animal*,: 35 (Suea; Djedda).

Material.—One, 135.0 mm., Mandapam Camp, 27 ix.1960, A. Daniel Coll.

Distribution.—Red Sea, Zanzibar, Madagascar, India, East Indies, Philippines, Caroline Islands, Fiji, Australia.

86. *Gerres poietii* Cuvier

1829. *Gerres poietii* Cuvier, *Regne. Animal*, 2 (ed. 2): 188 (Moluccas).

Material.—One, 75.0 mm., Mandapam Camp, 28. ix. 1960, A. Daniel Coll.

Distribution.—The Indian Ocean to East Indian Archipelago and Philippines.

87 **Gerres setifer** (Hamilton)

1822. *Chanda setifer* Hamilton, *Fish. Ganges*: 105, 370 (Ganges estuaries).

Material.—Thirty-two, 32.0-63.0 mm., Point Calimere, 7 ii. 1962; Two, 48.0-50.0 mm., Point Calimere, 11. ii. 1962, all V K. Prem Kumar Coll.

Distribution.—Seas of India, Burma, Ceylon, Malaya, Gulf of Siam, Hongkong.

Family 34. POMADASYIDAE

88. **Pomadasys guoraca** (Cuvier and Valenciennes)

1830. *Pristipoma guoraca* Cuvier and Valenciennes, *Hist. Nat. Poiss.*, 5: 256 (on *Guoraca* Russell 1803, *Fish. Coromandel*, 2, p. 24, pl. 132, Vizagapatnam, India).

Material.—One, 87.0 mm., Mandapam Camp, 27. ix. 1960, A. Daniel Coll.

Distribution.—East Coast of Africa to the East Indian Archipelago, and the Philippines.

Family 35. SCIAENIDAE

89. **Johnius dussumieri** (Cuvier and Valenciennes)

1830. *Corvina dussumieri* Cuvier and Valenciennes, *Hist. Nat. Poiss.*, 5: 119 (Malabar).

Material.—Four, 78.0-94.0 mm., Chepauk beach, 11. x. 1960, A. Daniel Coll.

Distribution.—From the coast of Natal to India, Malaya, Malay Archipelago, Gulf of Siam, South China Sea, Korea, Philippines, Oceanic Islands of Pacific.

90. **Johnius semiluctosus** (Cuvier and Valenciennes)

1830. *Corvina semiluctosa* Cuvier and Valenciennes, *Hist. Nat. Poiss.*, 5: p. 106 (Malabar; Goa; Pondicherry).

Material.—One, 92.0 mm., Tiruchendur, 28. ii. 1962, V K. Prem Kumar Coll.

Distribution.—Seas of India to Malay Archipelago, China and Philippines.

91. **Sciaena dussumieri** (Cuvier and Valenciennes)

1833. *Umbrina dissumieri* Cuvier and Valenciennes, *Hist. Nat. Poiss.*, 9: 481 (Coromandel coast).

Material.—One, 122.0 mm., Rayapuram beach, 10.x.1961, S.R.S., Z.S.I., Coll.

Distribution.—East coast of Africa, Madagascar, India, Ceylon, Malaya, Malay Archipelago, Gulf of Siam, South China Sea, Canton, Taiwan, Philippines.

Family 36. LETHRINIDAE

92. **Lethrinus microdon** Cuvier and Valenciennes

1830. *Lethrinus microdon* Cuvier and Valenciennes, *Hist. Nat. Poiss.*, 6 : 295 (Buru).

Material.—Five, 46.0-121.0 mm., Pamban, 29.ix.1960, A. Daniel Coll.

Distribution.—Tropical Indian Ocean to the East Indian Archipelago and the Philippines.

Family 37. MULLIDAE

93. **Mulloidichthys auriflamma** (Forsk.)

1775. *Mullus auriflamma* Forskal, *Descript. Animal* : 10, 30 (Djedda, Red Sea).

Material.—Three, 97.0-107.0 mm., Tiruchendur, 28.ii.1962, V K. Prem Kumar Coll.

Distribution.—Tropical Indo-Pacific from Africa to Hawaii and Marquesas Islands.

94. **Parupeneus indicus** (Shaw)

1803. *Mullus indicus* Shaw, *Gen. Zool.*, 4 : 611 (Indian Sea).

Material.—One, 113.0 mm., Pamban bridge, 29.ix.1960, A. Daniel Coll.

Distribution.—Red Sea and east coast of Africa to Philippines, Southern Japan, Samoa and Tonga Islands (marine, entering river mouths).

95. **Upeneus bensasi** (Schlegel)

1842. *Mullus bensasi* Schlegel, *Fauna Japan Poiss.* : 30 (Bay of Nagasaki).

Material.—One, 69.0 mm., Tiruchendur, 28.ii.1962, V K. Prem Kumar Coll.

Distribution.—From east coast of Africa to India, Malay Archipelago, China, Japan to Philippines.

96. **Upeneus vittatus** (Forsk.)

1775. *Mullus vittatus* Forskal, *Descript. Animal*,: 10, 31 (Djedda, Red Sea).

Material.—One, 134.0 mm., Thangachimadam, 14.iii.1955, M. A. S. Menon Coll.

Distribution.—Widespread in the Indo-West Pacific, ranging from Red Sea and east coast of Africa to Japan, Philippines, Australia and Oceanic Islands of Pacific.

Family 38. DREPANIDAE

97 **Drepane punctata** (Linnaeus)

1758. *Chaetodon punctata* Linnaeus, *Syst. Nat.*, 1, ed. 10, p. 273 (Asia).

Material.—One, 124.0 mm., Thangachimadam, 14.iii.1955, M. A. S. Menon Coll. Two, 44.0 & 51.0 mm., Marina beach, 5.vi.1961, S.R.S., Z.S.I., Coll. Three, 78.0-105.0 mm., Point Calimere, 7.ii.1962, V K. Prem Kumar Coll.

Distribution.—Red Sea and east coast of Africa to Australia, China, Taiwan, Philippines, Queensland, Oceanic Islands of Pacific (coastal and estuarine waters).

Family 39. SCATOPHAGIDAE

98. **Scatophagus argus** (Linnaeus)

1766. *Chaetodon argus* Linnaeus, *Syst. Nat.*, 1, ed. 12: 464 (India).

Material.—Two, 33.0 & 48.0 mm., Point Calimere, 7.ii.1962, V K. Prem Kumar Coll.

Distribution.—Coasts of India, Ceylon, Burma, Malaya, Malay Archipelago, Gulf of Siam, China, Taiwan, Philippines, Australia, Queensland, Oceanic Islands of Pacific (coastal waters entering estuaries, rivers, and lakes).

Family 40. CHAETODONTIDAE

99. **Chaetodon collaris** Bloch

1787. *Chaetodon collaris* Bloch, *Naturg. Ausland. Fische*, 3: 116, pl. 216 (Japan).

Material.—One, 56.0 mm., Vedalai, 17.iii.1955, M. A. S. Menon Coll.

Distribution.—Tropical Indian Ocean to East Indian Archipelago and the Philippines.

Family 41. SCARIDAE

100. **Scarus harid** Forskal

1775. *Scarus harid* Forskal, *Descript. Animal*: 10, 30 (Red Sea, Arabia).

Material.—Three, 115.0-147.0 mm., Thangachimadam, 14.iii.1955, M. A. S. Menon Coll.

Distribution.—In the tropical Indo-Pacific, from Red Sea, east coast of Africa, Madagascar to the Caroline, Samoa and Tuamotu Islands.

Family 42. BLENNIIDAE

101. **Omobranchus kallosoma** (Bleeker)

1858. *Petroscirtes kallosoma* Bleeker, *Nat. Tijds. Ned. Ind.*, 15: 227 (Billiton).

Material.—One, 47.0 mm., Madras Harbour, 7.x.1960, A. Daniel Coll.; One, 54.0 mm., Palk Bay (Mandapam), 13.iii.1955, M. A. S. Menon Coll.

Distribution.—India, East Indian Archipelago, Philippines and Hawaii Islands.

Family 43. BROTULIDAE

102. **Brotula jerdoni** Day

1888. *Brotula jerdoni* Day, *Fish. India Suppl.*: 804 (Madras).

Material.—One, 125.0 mm., Marina beach, 11.viii.1961, S.R.S., Z.S.I., Coll.

Distribution.—Madras coast (Bay of Bengal).

Family 44. SIGANIDAE

103. **Siganus javus** Linnaeus

1766. *Siganus javus* Linnaeus, *Syst. Nat.*, 1, ed. 12: 507 (Java).

Material.—One, 78.0 mm., Pamban bridge, 29.ix.1960, A. Daniel Coll.

Distribution.—Indo-Pacific, from India to the East

Indian Archipelago and Philippines, south to Australia.

104. **Siganus oramin** (Bloch and Schneider)

1801. *Amphacanthus guttatus* var. *oramin* Bloch and Schneider, *Syst. Ichth.*,: 207 (Tranquebar, India).
Material.—One, 123.0 mm., Marina beach, 22.v.1961, S.R.S., Z.S.I., Coll.; Two, 116.0 & 118.0 mm., Mandapam Camp, 27 ix.1960, A. Daniel Coll.
Distribution.—Widespread in Indo-West Pacific, ranging from east coast of Africa to Japan, Australia, Queensland and Oceanic Islands of Pacific.

Family 45. TRICHIURIDAE

105. **Trichiurus haumela** (Forsk.)

1775. *Clupea haumela* Forskal, *Descript. Animal*: 72 (Mochha, Red Sea).
Material.—Three, 220.0-340.0 mm., Tondiarpet beach, 7.x.1960, A. Daniel Coll.
Distribution.—Red Sea, South Africa, India, Ceylon, Malaya, Malay Archipelago, Gulf of Siam, China, Taiwan, Philippines, Japan, Riu Kiu Islands.

106. **Trichiurus savala** Cuvier

1829. *Trichiurus savala* Cuvier, *Regne Animal*, 2 (ed. 2): 219 (Sea of the Indies).
Material.—One, 250.0 mm., Marina beach, 5.ix.1961, S.R.S., Z.S.I., Coll. Three, 145.0-293.0 mm., Sinnar (Porto Novo), 9.v.1960, A. Daniel Coll.
Distribution.—From India and Ceylon to Malaya, Malay Archipelago, Gulf of Siam, China, Japan, Philippines, Queensland (coastal waters entering estuaries).

Family 46. SCOMBRIDAE

107 **Rastrelliger kanagurta** (Cuvier)

1829. *Scomber kanagurta* Cuvier, *Regne Animal*, 2 (ed. 2): 197 (foot note based on *kanagurta* Russell 1803, *Fish. Coromandel*, 2: 28 (Vizagapatnam, India).
Material.—One, 210.0 mm., Off Kundugal point, 15.iii.1955, M.A.S. Menon Coll,

Distribution.—Widespread in Indo-West Pacific ranging from Red Sea and east coast of Africa to Japan, Australia, Oceanic Islands of the Pacific (open sea and coastal waters).

Family 47. CYBIIDAE

108. **Scomberomorus commerson** (Lacépède)

1800. *Scomber commerson* Lacepede, *Hist. Nat. Poiss.*, 2: 598, 600, (type locality not given).

Material.—Two, 80.0 & 165.0 mm., Triplicane beach, 19.iii.1961, S.R.S., Z.S.I., Coll.

Distribution.—Widely distributed in Indo-West Pacific, ranging from Red Sea and east and south coast of Africa to Japan, Australia, Oceanic Islands of the Pacific (coastal and brackish waters).

109. **Scomberomorus guttatus** (Bloch and Schneider)

1801. *Scomber guttatus* Bloch and Schneider, *Syst. Ichth.*: 23 (Tranquebar).

Material.—One, 81.0 mm., Triplicane beach, 19.iii.1961, S.R.S., Z.S.I., Coll.

Distribution.—From Persian Gulf through India and Ceylon to Malay Archipelago, Gulf of Siam, China Taiwan, Philippines (open sea and coastal waters enters rivers)

Family 48. STROMATEIDAE

110. **Pampus argenteus** (Euphrasen)

1788. *Stromateus argenteus* Euphrasen, *Kon. Vet. Akad. Nya. Handl. Stockholm*, Stockholm, 9: 49 (Sea of China)

Material.—Three, 51.0-75.0 mm., Marina beach, 22.v.1961, S.R.S., Z.S.I., Coll.

Distribution.—India, Ceylon, Malay Archipelago, Gulf of Siam, South China Sea, China, Korea, Japan, Riu Kiu Islands, Philippines and Hawaii.

Family 49. ELEOTRIDAE

111. **Eleotris fusca** (Bloch and Schneider)

1801. *Poecilia fusca* Bloch and Schneider, *Syst. Ichth.*: 453 (New Hebrides, in streams).

Material.—Fourteen, 45.0-64.0 mm., Adayar river, 20.iv.1961, S.R.S., Z.S.I., Coll.

Distribution.—From the east coast of Africa to the Philippines, Guam and through Polynesia to the Hawaiian and Marquesas Islands, north to Riu Kiu Islands.

Family 50. GOBIIDAE

112. **Acentrogobius madraspatensis** (Day)

1868. *Gobius madraspatensis* Day, *Proc. zool. Soc. London*: 152 (Madras back waters).

Material.—One, 63.0 mm., Krusadi Island, 1.x.1960, A. Daniel, Coll.

Distribution.—Coromandel coast of India.

113. **Acentrogobius neilli** (Day)

1868. *Gobius neilli* Day, *Proc. zool. Soc. London*: 152 (Madras).

Material.—One, 72.0 mm., Krusadi Island, 1.x.1960, A. Daniel Coll.

Distribution.—Coromandel coast of India.

114. **Apocryptes dentatus** Cuvier and Valenciennes

1837. *Apocryptes dentatus* Cuvier and Valenciennes, *Hist. Nat. Poiss.*, 12: 392 (Pondicherry; Calcutta).

Material.—Two, 138.0 & 140.0 mm., Hare Island, 16.iii.1955, M.A.S. Menon Coll.

Distribution.—Coromandel coast of India.

115. **Ctenogobius nebulosus** (Forsk.)

1775. *Gobius nebulosus* Forskal, *Descript. Animal*: 10, 24 (Djedda, Red Sea).

Material.—One, 80.0 mm., Marina beach, 11.viii.1961, S.R.S., Z.S.I., Coll.

Distribution.—East coast of Africa, Seas of India, Malay Archipelago, Philippines, New Guinea and north-west coast of Australia.

116. **Ctenotrypauchen microcephalus** (Bleeker)

1860. *Trypauchen microcephalus* Bleeker, *Act. Soc. Sci. Indo-Neerl.*, 8, 62 (Sangi-duri, Borneo; in freshwater).

Material.—Two, 85.0 & 88.0 mm., Marina beach, 22.v.1961, S.R.S., Z.S.I., Coll.

Distribution.—From Persian Gulf, India, Andamans to Gulf of Siam, Malay Archipelago and Philippines.

117 *Glossogobius giuris* (Hamilton)

1822. *Gobius giuris* Hamilton, *Fish. Ganges*: 51 (ponds and fresh water rivers of the Gangetic provinces).

Material.—Four, 148.0-216.0 mm., Porto Novo, 7.v.1960, A. Daniel Coll.

Distribution.—From east coast of Africa to Australia and New Caledonia, Philippines, China and Japan (fresh and salt waters).

118. *Oligolepis acutipennis* (Cuvier and Valenciennes)

1837. *Gobius acutipennis* Cuvier and Valenciennes, *Hist. Nat. Poiss.*, 12: 60 (Malabar).

Material.—Six, 51.0-81.0 mm., Marina beach, 26.iv.1961, S.R.S., Z.S.I., Coll.

Distribution.—Natal, India, Ceylon, Andamans to Malay Archipelago, Philippines, New Hebrides (seas and estuaries).

119. *Pseudopocryptes lanceolatus* (Bloch and Schneider)

1801. *Eleotris lanceolata* Bloch and Schneider, *Syst. Ichth*: 67 (Tranquebar).

Material.—Thirteen, 173.0-180.0 mm., Point Calimere, 11.ii.1962, V K. Prem Kumar Coll.

Distribution.—Seas of India to Malay Archipelago.

Family 51. SCORPAENIDAE

120. *Pterois russellii* (Bennett)

1831. *Pterois russellii* Bennett, *Proc. zool. Soc. London*, 1: 128 (on Kodipungi Russell 1803, *Fish. Coromandel*, 2: 25, Vizagapatnam, India).

Material.—One, 130.0 mm., Marina beach, 11.viii.1961, S.R.S., Z.S.I., Coll.

Distribution.—From the east coast of Africa to India, East Indian Archipelago, Philippines, south east to Australia.

121. *Sebastichthys strongia* (Cuvier and Valenciennes)*

1829. *Scorpaena strongia* Cuvier and Valenciennes, *Hist. Nat. Poiss.*, 4: 323 (Caroline Islands).

Material.—Six, 64.0-81.0 mm., Marina beach, 11.viii.1961, S.R.S., Z.S.I., Coll.

Distribution.—From India, Ceylon to Polynesia and Hawaii (coastal waters).

Family 52. SYNANCEIIDAE

122. *Minous monodactylus* (Bloch and Schneider)

1801. *Scorpaena monodactyla* Bloch and Schneider, *Syst. Ichth.*: 194 (type locality not given).

Material.—Two, 60.0 & 65.0 mm., Marina beach, 22.v.1961, S.R.S., Z.S.I., Coll.

Distribution.—Red Sea, Mauritius, Maldives, Iranian Gulf, Coasts of India, Ceylon, South China Sea, Malaya, Malay Archipelago, China and Japan.

Family 53. TRIGLIDAE

123. *Lepidotrigla spiloptera* Günther

1880. *Lepidotrigla spiloptera* Günther, *Challenger Shore Fishes*, 1: 42 (Ki Islands, 140 fathoms).

Material.—One, 120.0 mm., Marina beach, 11.viii.1961, S.R.S., Z.S.I., Coll.

Distribution.—Zanzibar, Natal, Arabian Sea, Bay of Bengal, Sulu Islands, Borneo, Timor Sea, Arafura sea, Off Kei Island, Philippines.

Family 54. PLATYCEPHALIDAE

124. *Platycephalus macracanthus* Bleeker

1869. *Platycephalus macracanthus* Bleeker, *Akad. Wet. Amsterdam Verslag.*, 3(2): 253 (Ambonia).

Material.—One, 147.0 mm., Triplicane beach, 19.iii.1961, S.R.S., Z.S.I., Coll.

Distribution.—India to the Malay Archipelago.

125. *Platycephalus scaber* (Linnaeus)

1758. *Cottus scaber* Linnaeus, *Syst. Nat.*, ed. 10, pt. 1: 451 (East Indies).

Material.—Five, 80.0-175.0 mm., Marina beach, 11.viii.1961, S.R.S., Z.S.I., Coll.

Distribution.—Coasts of Natal and Zululand, Madagascar, India, Ceylon, Andamans, East Indian Archipelago, Gulf of Siam, South China, China, Taiwan (seas and estuaries)

Order 13. DACTYLOPTERIFORMES

Family 55. DACTYLOPTERIDAE

126. *Dactyloptera orientalis* (Cuvier and Valenciennes)

1829. *Dactylopterus orientalis* Cuvier and Valenciennes, *Hist. Nat. Poiss.*, 4: 134 (Mauritius; Waigiu).

Material.—Two, 140.0 & 170 mm., Marina beach, 11.viii.1961, S.R.S., Z.S.I., Coll.

Distribution.—Widely distributed in the Indo West Pacific from east coast of Africa, Madagascar, Somalia, Mauritius to coast of India, Ceylon, Malay Archipelago, China, Japan, Korea, Taiwan, Philippines, coasts of Queensland, New South Wales, New Hebrides, New Caledonia, Riu Kiu Islands, eastwards to Hawaii and Tuamotu Islands.

Order 14. PLEURONECTIFORMES

Family 56. PSETTODIDAE

127 *Psettodes erumei* (Bloch and Schneider)

1801. *Pleuronectes erumei* Bloch and Schneider, *Syst. Ichth.*: 150 (Tranquebar).

Material.—One, 103.0 mm., Marina beach, 5.vi.1961, S.R.S., Z.S.I., Coll.

Distribution.—Widespread from Red Sea and east coast of Africa to Australia, Philippines, Japan.

Family 57. BOTHIDAE

128. *Citharichthys aureus* Day

1878. *Citharichthys aureus* Day, *Fish. India*: 422 (Madras).

Material.—One, 58.0 mm., Sinnur (Porto Novo), 9.v.1960, 9.v.1960, A. Daniel Coll.

Distribution.—Coromandel coast.

129. *Pseudorhombus triocellatus* (Bloch and Schneider)

1801. *Pleuronectes triocellatus* Bloch and Schneider, *Syst. Ichth.*: 145 (East Indian Seas).

Material.—Three, 102.0-108.0 mm., Marina beach, 5.vi.1961, S.R.S., Z.S.I., Coll.

Distribution.—India, Burma, Ceylon, Malay Archipelago, Polynesia.

Family 58. SOLEIDAE

130. *Brachirus albomaculatus* (Kaup)

1858. *Synaptura albomaculata* Kaup, *Arch. Naturg.*, 24: 96 (Coromandel Coast).

Material.—One, 145.0 mm., Triplicane beach, 19.iii.1961, S.R.S., Z.S.I., Coll.

Distribution.—India, Burma, Malaya.

131. *Microbuglossus ovatus* (Richardson)

1846. *Solea ovata* Richardson, *Ichth. China Japan*: 279 (China).

Material.—One, 44.0 mm., Point Calimere, 11.ii.1962, V K. Prem Kumar Coll.

Distribution.—India, Malaya, Malay Archipelago, China, Philippines.

Family 59. CYNOGLOSSIDAE

132. *Cynoglossus bilineatus* (Lacépède)

1802. *Achirus bilineatus* Lacépède, *Hist. Nat. Poiss.*, 4: 659, 663 (China).

Material.—Three, 115.0-135.0 mm., Marina beach, 22.v.1961, S.R.S., Z.S.I. Coll.

Distribution.—Red Sea, Zanzibar, Seychelles, Malaya, Malay Archipelago, China, Japan, Philippines and Queensland.

133. *Cynoglossus brevirostris* Day

1878. *Cynoglossus brevirostris* Day, *Fish. India*: 437 (Madras).

Material.—One, 90.0 mm., Marina beach, 22.v.1961, S.R.S., Z.S.I., Coll.

Distribution.—Coromandel coast.

134. *Cynoglossus cynoglossus* (Hamilton)

1822. *Achirus cynoglossus* Hamilton, *Fish. Ganges*: 132, 373 (Ganges tidal mouths).

Material.—Three, 65.0-70.0 mm., Tiruchendur, 28.ii.1962, V K. Prem Kumar Coll.

Distribution.—Seas and estuaries of India, Penang, Malay Peninsula, Singapore.

135. *Cynoglossus semifasciatus* Day

1878. *Cynoglossus semifasciatus* Day, *Fish. India*: 436 (Madras).

Material.—Two, 78.0 & 113.0.0 mm., Tondiarpet beach, 7.x.1960, A. Daniel Coll.

Distribution.—Coromandel coast.

Order 15. TETRAODONTIFORMES**Family 60. TRIACANTHIDAE****136. *Pseudotriacanthus striglifer* (Cantor)**

1850. *Triacanthus striglifer* Cantor, *Journ. Asiat. Soc. Bengal*, 18 (2): 1345 (Penang).

Material.—One, 150.0 mm., Off Vedalai coast, 17.iii.1955, M. A. S. Menon Coll.

Distribution.—Persian Gulf, Coasts of India, Malaya, Malay Archipelago, Gulf of Siam, China, Philippines.

137 *Triacanthus brevirostris* Schlegel

1850. *Triacanthus brevirostris* Schlegel, *Fauna Japan Poiss.*: 294 (Nagasaki).

Material.—One, 66.0 mm., Point Calimere, 11.ii.1962, V K. Prem Kumar Coll.

Distribution.—Seas of India to Malay Archipelago, Malacca, Gulf of Siam, Tonkin, China, Korea, Southern Japan, Philippines (sea and brackish waters).

138. *Triacanthus indicus* Regan

1903. *Triacanthus indicus* Regan, *Proc. zool. Soc. London*: 184 (India).

Material.—One, 115.0 mm., Marina beach, 22.v.1961, S.R.S., Z.S.I., Coll.

Distribution.—From Gulf of Iran, India, Ceylon, Penang (coastal waters).

Family 61: BALISTIDAE

139. **Abalistes stellaris** (Bloch and Schneider)

1801. *Balistes stellaris* Bloch and Schneider, *Syst. Ichth.*: 476 (Mauritius).

Material.—Two, 40.0 & 90.0 mm., Madras, 22.v.1961, S.R.S., Z.S.I., Coll.

Distribution.—Red Sea, Zanzibar, Mauritius, east and south coast of Africa, India, Malaya, Malay Archipelago, Gulf of Siam, China, Philippines, West Australia, Queensland, Oceanic Islands of Pacific.

Family 62. MONACANTHIDAE

140. **Monacanthus choirocephalus** Bleeker

1852. *Monacanthus choirocephalus* Bleeker, *Verh. Bat. Gen.*, **24**: 19 (Batavia).

Material.—Two, 100.0 & 105.0 mm., Marina beach, 11.viii.1961, S.R.S., Z.S.I., Coll. Two, 71.0 & 80.0 mm., Off Vedalai coast, 17.iii.1955, M. A. S. Menon Coll.

Distribution.—India, Ceylon, Malay Archipelago, Gulf of Siam.

141. **Psilocephalus barbatus** (Gray)

1831. *Anacanthus barbatus* Gray, *Zool. Misc.*: 8 (Singapore).

Material.—Two, 188.0 & 220.0 mm., Off Vedalai coast, 17.iii.1955, M. A. S. Menon Coll.

Distribution.—Coasts of India, Ceylon, Andamans, Penang, Philippines, Queensland, West Australia.

Family 63. OSTRACIONTIDAE

142. **Ostracion cornutus** Linnaeus

1758. *Ostracion cornutus* Linnaeus, *Syst. Nat.*, London, ed. 10: 331 (India).

Material.—One, 238.0 mm., Off Vedalai coast, 17.iii.1955, M.A.S. Menon Coll.

Distribution.—Tropical Indo-Pacific from Natal, Africa to the Philippines, Japan, Australia, the Hawaiian, Society, Tuamotu and Marquesas Islands.

143. *Ostracion gibbosus* Linnaeus

1758. *Ostracion gibbosus* Linnaeus, *Syst. Nat.*, London, ed. 10: 322 (India).

Material.—One, 63.0 mm., Elliots beach, 9.x.1960, A. Daniel Coll. Four, 52.0-152.0 mm., Marina beach, 4.x.1961, S.R.S., Z.S.I., Coll. Two, 137.0 & 151.0 mm., Point Calimere, 11.ii.1962, V K. Prem Kumar Coll.

Distribution.—Indo-Pacific from the Red Sea, Aden, Zanzibar to the East Indian Archipelago and Philippines and north to Japan.

144. *Ostracion nasus* Bloch

1785. *Ostracion nasus* Bloch, *Naturg. Ausland. Fische*, 1: 118 (Nile-evidently an error).

Material.—One, 32.0 mm., Tondiarpet shore, 7.x.1960 ; One, 42.0 mm., Palk Bay, 3.x.1960, all A. Daniel Coll.

Distribution.—Coasts of India, Ceylon, Andamans, Penang, Malay Archipelago, Gulf of Siam, Philippines, W Australia, Queensland, the Pelew, Fiji, Cook, Society and Marquesas Islands.

Family 64. TETRAODONTIDAE**145. *Chelonodon fluviatilis* (Hamilton)**

1822. *Tetrodon fluviatilis* Hamilton, *Fish. Ganges*: 6, 362 (fresh waters of lower Bengal).

Material.—One, 91.0 mm., Marina beach, 11.viii.1961, S.R.S., Z.S.I., Coll.

Distribution.—From India and Ceylon to the Philippines (coastal waters entering rivers and lagoons).

146. *Chelonodon patoca* (Hamilton)

1822. *Tetrodon patoca* Hamilton *Fish. Ganges*: 7, 362 (Gangetic estuaries).

Material.—One, 120.0 mm., Chepauk beach, 16.v.1960 ; Two, 108.0 mm., Santhome beach, 8.x.1960 ; Two, 95.0 & 115.0 mm., Elliots beach, 9.x.1960, all A. Daniel Coll.

Distribution.—Widespread Indo-West Pacific ranging from east coast of Africa to the Philippines and south to Australia (coastal waters, estuaries and lagoons).

147 **Sphoeroides inermis** (Schlegel)

1846. *Tetrodon inermis* Schlegel, *Fauna Japan Poiss.*: 278, (Japan).
Material.—One, 23.0 mm., Elliots beach, 20.x.1961, S.R.S., Z.S.I., Coll.
Distribution.—Widespread in Indo-West Pacific ranging from east coast of Africa to Japan (coastal waters).

148. **Sphoeroides lunaris** (Bloch and Schneider)

1801. *Tetrodon lunaris* Bloch and Schneider, *Syst. Nat.*: 505 (Malabar).
Material.—One, 150.0 mm., Santhome beach, 8.x.1960 ; One, 161.0 mm., Elliots beach, 9.x.1960, all A. Daniel Coll. Seventeen, 67.0-145.0 mm., Rayapuram beach, 1.xii.1961, S.R.S., Z.S.I., Coll.
Distribution.—Widespread in Indo-West Pacific ranging from east coast of Africa to Philippines, north to Japan, Queensland, New South Wales, Fiji and Solomon Islands.

149. **Sphoeroides oblongus** (Bloch)

1786. *Tetrodon oblongus* Bloch, *Naturg. Ausland. Fische*, 2: 6, (East Indies).
Material.—One, 70.0 mm., Marina beach, 5.vi.1961, S.R.S., Z.S.I., Coll.
Distribution.—Widespread in Indo-West ranging from Red Sea, east coast of Africa to Japan, Philippines, West Australia, New South Wales, New Hebrides, the Woodlark, Lord Howe, Kermadec and Samoa Island.

150. **Tetraodon immaculatus** Bloch and Schneider

1801. *Tetrodon immaculatus* Bloch and Schneider, *Syst. Ichth.*: 507 (no type locality).
Material.—Five, 40.0-125.0 mm., Vedalai, 13.iii.1955, M. A. S. Menon Coll.
Distribution. From Red Sea and east coast of Africa to the Philippines, Australia, Guam, Marshall, Gilbert, Samoa and Fiji Islands.

151 **Tetraodon reticularis** Bloch and Schneider

1801. *Tetrodon reticularis* Bloch and Schneider, *Syst. Ichth.*: 506 (Malabar).

Material.—Three, 32.0-81.0 mm., Krusadai Island, 1.x.1960 ; Two, 51.0 & 78.0 mm., Kundugal point (Pamban), 2.x.1960, all A. Daniel Coll.

Distribution.—Coasts of India, Ceylon, Andamans, Penang, Malay Archipelago, Taiwan, China, Philippines, Guam, New Britan, Queensland, Fiji and Thornton Islands.

Order 16. LOPHIIFORMES

Family 65. ANTENNARIIDAE

152. *Antennarius hispidus* (Bloch and Schneider)

1801. *Lophius hispidus* Bloch and Schneider, *Syst. Ichth.*: 142 (Coromandel coast, India).

Material.—Four, 35.0-110.0 mm., Madras, 22.v.1961, S.R.S., Z.S.I., Coll.

Distribution.—Coasts of Natal, Madagascar, Mauritius, Coasts of India, Ceylon, Penang, Malay Archipelago, Gulf of Siam, South China Sea, Hongkong, Philippines, Solomon, Fiji Islands, eastwards to Laysan, Hawaii and Society Islands.

153. *Antennarius nummifer* (Cuvier)

1817. *Chironectes nummifer* Cuvier, *Mem. Mus. Hist. Nat.*, 3: 430 (no type locality).

Material.—One, 70.0 mm., Madras, 5.vi.1961, S.R.S., Z.S.I., Coll.

Distribution.—Red Sea, Persian Gulf, Aden, Maldives, Coasts of India, Ceylon, China, Japan, Philippines, North Australia, the Carolus, Gilbert and Samoa Islands.

ZOOGEOGRAPHICAL REMARKS

The range of distribution of each species in the collection has been carefully investigated and analysed in order to give an idea as to the zoogeographical affinities of the shore fish fauna of the Coromandel coast, Palk Bay and Gulf of Mannar. The shore fishes in the collections are arranged in the following 6 groups according to their zoogeographical relationships.

Group I

The 10 species listed below are endemic to the Indian area.

1. *Tachysurus sona* (Ham.)
2. *Doryichthys cunculus* (Ham.)
3. *Sphyraena acutipinnis* Day
4. *Brotula jerdoni* Day
5. *Acentrogobius madraspatensis* (Day)
6. *Acentrogobius neilli* (Day)
7. *Cynoglossus brevirostris* Day
8. *Cynoglossus semifasciatus* Day
9. *Citharichthys aureus* Day
10. *Apocryptes dentatus* C. V

Group II

The 25 species listed below are found in the Indian and Malayan area only.

1. *Rhinobatos thouniana* (Shaw)
2. *Dasyatis (Himantura) favus* (Ann.)
3. *Bengalichthys impennis* Ann.
4. *Narcine brunea* Ann.
5. *Sardinella fimbriata* (C. V.)
6. *Opisthopterus tardoore* (C.)
7. *Coilia dossumieri* (C. V.)
8. *Anchoviella tri* (Blkr.)
9. *Thrissocles hamiltonii* (Gray)
10. *Plotosus canius* (Ham.)
11. *Mystus gulio* (Ham.)
12. *Muraenesox talabonoides* (Blkr.)
13. *Anguilla bicolor* McClell.
14. *Pisodonophis boŕo* (Ham.)
15. *Ophichthys apicalis* (Bennett)
16. *Gerres limbatus* C. V
17. *Gerres setifer* (Ham.)
18. *Nemipterus bleekeri* (Day)
19. *Cypselurus spilopterus* (C. V.)
20. *Cynoglossus cynoglossus* (Ham.)
21. *Pseudopocryptes lanceolatus* (Bl. Schn.)
22. *Brachiurus albomaculatus* (Kaup)
23. *Platycephalus macracanthus* Blkr.

24. *Tetraodon fluviatilis* Ham.
25. *Monocanthus choirocephalus* (Blkr.)

Group III

The 22 species listed below are common to the Indian and Malayan area including one or more areas (Japanese, Australian or Polynesian) of the West Pacific.

1. *Scoliodon sorrakowah* (C.)
2. *Narcine timlei* (Bl. Schn.)
3. *Ilisha elongata* (Bennett)
4. *Anodontostoma chacunda* (Ham.)
5. *Thrissocles mystax* (Bl. Schn.)
6. *Arisoma anago* (Schlg.)
7. *Tachyrhamphus serratus* (Schlg.)
8. *Eletheronema tetradactylus* (Shaw)
9. *Atule malam* (Blkr.)
10. *Johinus semiluctosus* (C.V.)
11. *Scatophagus argus* (L.)
12. *Trichiurus savala* C.
13. *Omobranchus kallosoma* (Blkr.)
14. *Siganus javus* (L.)
15. *Pampus argenteus* (Euphr.)
16. *Sebastichthys strongia* (C. V.)
17. *Pseudorhombus triocellatus* (Bl. Schn.)
18. *Microbuglossus ovatus* (Richardson)
19. *Triacanthus brevirostris* Schlg.
20. *Psilocephalus barbatus* (Gray)
21. *Ostracion nasus* Bl.
22. *Tetraodon reticularis* Bl. Schn.

Group IV

The 70 species listed below are spread from the East African area (Persian gulf, Arabia and Red sea) to the Malayan area including one or more West Pacific areas (Japanese, Australian or Polynesian).

1. *Chiloscyllium griseum* M. H.
2. *Scoliodon palasorrah* (C.)
3. *Narke dipterygia* (Bl. Schn.)
4. *Dussumieria acuta* (V.)

5. *Harengula vittata* (C. V.)
6. *Sardinella longiceps* C. V
7. *Hilsa kanagurta* (Blkr.)
8. *Ilisha indica* (Swainson)
9. *Pellona ditchella* C. V
10. *Nematalosa nasus* (Bl.)
11. *Anchoviella commersonii* (Lac.)
12. *Anchoviella indica* (V Hass.)
13. *Thrissocles setirostris* (Brouss.)
14. *Trachinocephalus myops* (Bl. Schn.)
15. *Evenchelys macrurus* (Blkr.)
16. *Uroconger lepturus* (Richardson)
17. *Posodonophis cancrivorous* (Richardson)
18. *Hemirhamphus far* (Forsk.)
19. *Hemirhamphus gaimardi* C. V
20. *Syngnathoides biaculeatus* (Bl.)
21. *Microphis brachyurus* (Blkr.)
22. *Syngnathus cyanospilosus* (Bl.)
23. *Sphyraena obtusa* C. V
24. *Liza macrolepis* (Smith)
25. *Liza vaigiensis* (Q. G.)
26. *Mugil tade* (Forsk.)
27. *Therapon putta* C. V
28. *Pelates quadrilineatus* (Bl.)
29. *Atule mate* (C. V.)
30. *Caranx chrysophrys* C. V
31. *Megalaspis cordyla* (L.)
32. *Selaroides leptolepis* (C. V.)
33. *Alectis indica* (Rupp.)
34. *Scomberoides tol* (C. V.)
35. *Lutianus johnii* (Bl.)
36. *Lutianus fulviflamma* (Forsk.)
37. *Leiognathus dussumieri* (C. V.)
38. *Leiognathus insidiator* (Bl.)
39. *Leiognathus lineolatus* (C. V.)
40. *Leiognathus ruconius* (Ham.)
41. *Gerres poietii* C.
42. *Pomadasygus guroca* (C.)
43. *Johnius dussumieri* (C. V.)
44. *Sciaena dussumieri* (C. V.)
45. *Lethrinus microdon* C.V
46. *Mulloidichthys auriflamma* (Forsk.)

47. *Paraupeneus indicus* (Shaw)
48. *Upeneus bensasi* Schl.g.
49. *Chaetodon collaris* Bl.
50. *Scarus harid* (Forsk.)
51. *Trichiurus haumela* (Forsk.)
52. *Scomberomorous guttatus* (Bl. Schn.)
53. *Eleotris fusca* (Bl. Schn.)
54. *Ctenogobius nebulosus* (Forsk.)
55. *Ctenotrypauchen microcephalus* (Blkr.)
56. *Oligolepis acutipennis* (C. V.)
57. *Pterois russellii* Bennett
58. *Minous monodactylus* (Bl. Schn.)
59. *Lepidotrigla spiloptera* Gunther
60. *Platycephalus scaber* (L.)
61. *Psettodes erumei* (Bl. Schn.)
62. *Cynoglossus bilineatus* (Lac.)
63. *Abalistis stellaris* (Bl. Schn.)
64. *Triacanthus indicus* Regan
65. *Pseudotriacanthus striglifer* (Cantor)
66. *Ostracion gibbosus* L.
67. *Chaelonodon patoca* (Ham.)
68. *Tetraodon immaculatus* (Bl. Schn.)
69. *Sphoeroides inermis* (Schlg.)
70. *Antennarius hispidus* (Bl. Schn.)

Group V

The 25 species listed below are wide spread throughout the Indo-West Pacific region ranging from east coast of Africa to the Australian, Japanese and Polynesian areas.

1. *Elop saurus* L.
2. *Megalops cyprinoides* (Brouss.)
3. *Saurida tumbil* (Bl.)
4. *Plotosus anguillaris* (Bl.)
5. *Therapon jarbua* (Forsk.)
6. *Sillago sihama* (Forsk.)
7. *Lactarius lactarius* (Bl. Schn.)
8. *Alectis ciliaris* (Bl.)
9. *Atule kalla* (C. V.)
10. *Citula armata* (Forsk.)
11. *Leiognathus splendens* (C.)

12. *Gerres filamentosus* C.
13. *Gerres oyena* (Forsk.)
14. *Lates calcarifer* (Bl.)
15. *Upeneus vittatus* (Forsk.)
16. *Drepane punctata* (L.)
17. *Siganus oramin* (Bl. Schn.)
18. *Rastrelliger kanagurta* (C.)
19. *Scomberomorous commersonii* (Lac.)
20. *Glossogobius giuris* (Ham.)
21. *Dactyloptena orientalis* (C. V.)
22. *Ostracion cornutus* L.
23. *Sphoeroides lunaris* (Bl. Schn.)
24. *Sphoeroides oblongus* (Bl.)
25. *Antennarius numifer* (C.)

Group VI

This group consists of a single species which is circumtropical in distribution.

1. *Mugil cephalus* L.

The above analysis revealed that out of the 153 species of shore fishes, 10 species or 6.5% are endemic to the Indian area, 25 species or 16.3% are found in the Indian and Malayan area only, 22 species or 14.5% are common to the Indian and Malayan area including one or more areas of the West Pacific, 70 species or 45.8% are spread from the Western Indian Ocean to the Malayan area including one or more areas of the West Pacific, 25 species or 16.3% are widely distributed throughout the Indo-West Pacific region. Only one species *Mugil cephalus* L. forming 0.6% is circumtropical in distribution.

It is clear from the above analysis that excluding endemic forms, 93.5% of the species of shore fishes in the collections are also found in the Malayan area. Menon (1966) pointed out that about 94.0% of the species of shore fishes from Pondicherry and Karaikkal areas, forming the intervening strip of the Coromandel Coast of India, are also found in the Malayan area. Thus, the present study indicates that the shore fish fauna of the Coromandel Coast, Palk Bay and Gulf of Mannar has a very close Malayan affinity.

SUMMARY

In all 153 species of shore fishes are listed including three rare forms and one new record from the fish collections of the Coromandel Coast, Palk Bay and Gulf of Mannar made during the years 1955 and 1960-62. Zoogeography of the shore fishes is briefly discussed.

REFERENCES

- MENON, A. G. K. 1966. On a collection of fish from the Coromandel Coast of India including Pondicherry and Karaikkal areas. *Rec. Indian Mus.*, **59**(4): 369-404.
- MENON, A. G. K. and RAMA RAO K. V. 1963a. Notes on three rare fishes from Madras. *Ann. Zool.*, **4**(5): 47-52.
- MENON, A. G. K. and RAMA RAO, K. V. 1963b. On a new record of the blennioid fish *Omobranchus kallosoma* (Bleeker) from India. *Sci. & Cult.*, **29**: 362.

ON THE GENUS *XENOCATANTOPS* DIRSH & UVAROV
(ORTHOPTERA ACRIDOIDEA : CATANTOPINAE)
IN INDIA

By

S. K. TANDON

Zoological Survey of India, Calcutta

(With 2 Text-figures)

INTRODUCTION

Dirsh and Uvarov (1953) established a new genus *Xenocatantops* for species previously included in *Catantops*, with *Acridium humile* Serville, 1839 as the type species by original designation. Out of the thirteen species dealt with by Kirby (1914) under the genus *Catantops* only the following two i.e., *Catantops dominans* Walker and *Catantops humilis* (Serville) can be referred to the genus *Xenocatantops*. In India, even after nearly two decades of the publication of Dirsh and Uvarov's paper, the name *Catantops* is still being used for what is actually referable to *Xenocatantops*. In this paper, I have included the diagnostic characters and distributional data of the genus *Xenocatantops*. An attempt has also been made towards re-determination of the specimens of the genus present in the collections of the Zoological Survey of India.

SYSTEMATIC ACCOUNT

***Xenocatantops* Dirsh & Uvarov**

1953. *Xenocatantops* Dirsh & Uvarov, *Tijdschr. Ent.*, **96** : 237.

Diagnostic characters.—Size, medium. Antennae thin, filiform, longer or shorter than head and pronotum together. Carinulae of the fastigium of vertex slightly raised. Eyes prominent, interocular distance narrow. Frontal ridge sulcate; Frons in profile straight, slightly sloping backwards. Pronotum weakly constricted half its length; Prosternal tubercle conical, never compressed laterally. Tegmina extend beyond the hind knee or short. Legs fairly slender. Male sub-genital plate sub-conical, supra-anal plate triangular. Male cercus simple with rounded apex. Epiphallus strong, bridge-shaped, ancorae and

lateral plates large. Ovipositor with curved valves. Spermatheca sac-shaped with apical and preapical diverticula.

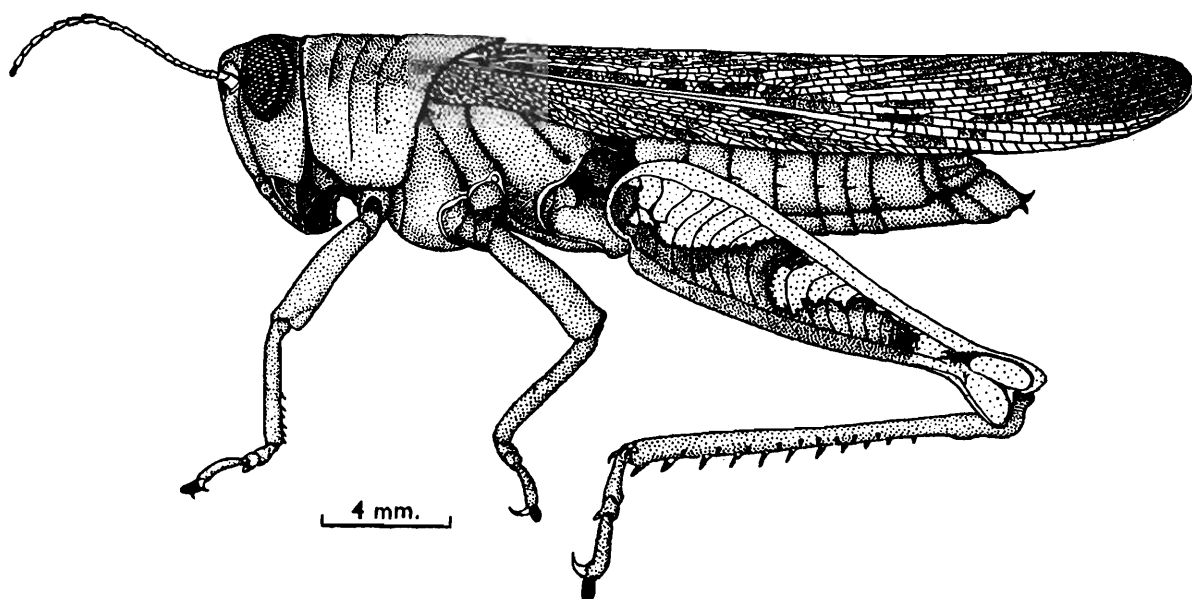
Xenocatantops differs from *Catantops* Schaum, in having constricted pronotum and conical prosternal tubercle.

The genus is represented in India by a single species i.e., *Xenocatantops humilis humilis* (Serville).

***Xenocatantops humilis humilis* (Serville)**

(Text-fig. 1)

1839. *Acridium humile* Serville, *Ins. orth.*: 662.
 1870. *Caloptenus dominans* Walker, *Cat. Derm. Salt. Brit. Mus. Nat. Hist.*, 4: 705.
 1873. *Catantops humilis*: Stal, *Rec. orth.*, 1: 71.
 1914. *Catantops dominans*: Kirby, *Faun. Brit. India, Orth., Acrid.*: 248.
 1914. *Catantops humilis*: Kirby, *ibid*: 250.
 1953. *Xenocatantops humilis humilis* Dirsh & Uvarov, *Tijdschr. Ent.*, 96: 237.

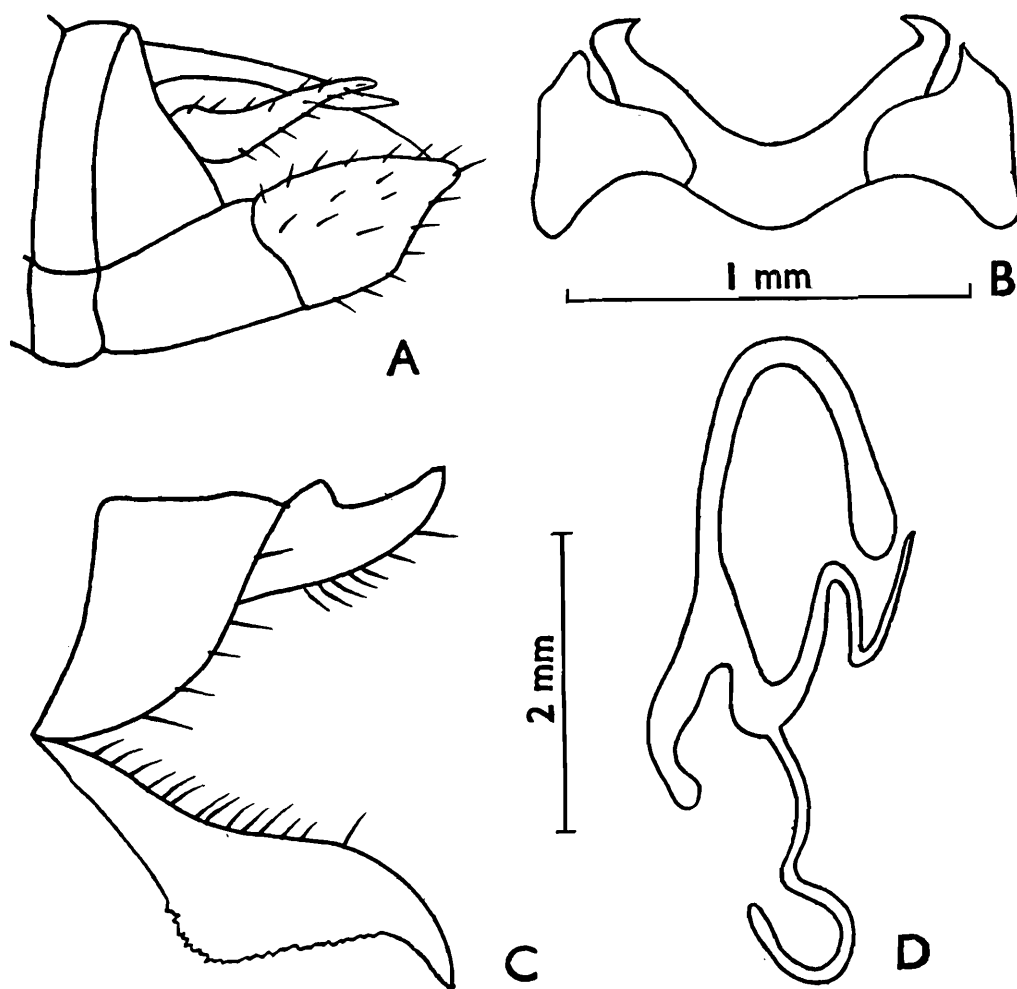


Text-fig. 1. *Xenocatantops humilis humilis* (Serv.), male.

Diagnostic characters.—♂ —Of medium size, body slender. Antennae longer than head and pronotum together, its middle segments more than three times as long as wide. Prosternal tubercle acutely pointed, moderately inclined backwards, apex obtuse. Tegmina extended beyond the hind knees. Sub-genital plate short and obtusely pointed in male (Text-fig. 2, a); Male cercus short, gradually narrowing towards apical third,

slightly incurved apically and obtusely pointed. Epiphallus bridge-shaped, with long ancorae (Text-fig. 2, *b*).

General colouration dull brown to dark brown. Antennae yellowish-brown, with dark apex. Lateral margins of pronotal disc with a dirty yellow stripe. Dorsum of pronotum with brown to dark brown hour-glass-shaped pattern. Elytra brown, sometimes sparsely tessellated with dark patches. Wings hyaline, with basal disc infumated. External disc of hind femur yellow or yellowish-brown, with two dark brown or black bands. The internal disc red or reddish-yellow, with three black spots along the upper margin. Hind tibiae red to dull red, hind tarsus red dorsally, reddish-yellow ventrally, tibial spines red with black tips.



Text-fig. 2. A, End of male abdomen. B, Epiphallus. C, End of female abdomen. D, Spermatheca.

♀—As the male, but larger, ovipositor short, robust (Text-fig. 2, *c*) ; Sub-genital plate longer than wide, obtusangulate.

Spermatheca sac-shaped with apical and preapical diverticula (Text-fig. 2, d).

Range of measurements.—Based on 50 ♂♂ and 50 ♀♀ from different biotopes.

		♂♂	♀♀
Length of body	...	18.0-25.0 mm.	27.5-34.0 mm.
Pronotum	...	3.5-5.2 mm.	6.1-8.0 mm.
Elytra	...	14.5-21.0 mm.	23.0-31.0 mm.
Hind femur	...	9.6-13.0 mm.	12.0-17.8 mm.

Remarks.—Shorter antennae and elytra found in material from mountainous regions and longer antennae and elytra from the plains. General colour varying from brown to dark-brown. Phallic complex and transverse band of hind femur hardly show any variation, which is remarkable in examples from different biotopes. I have come across only a single male example from NEFA having narrow proximal fascia, with black tibiae instead of red. The persistent occurrence of shorter antennae and elytra in the material from high altitude indicates a correlation in the decrease in size with an increase in altitude.

The species is associated with grassy meadows and cultivated fields specially near streams in NEFA. The adults were collected in NEFA during February June, September January from grassy meadows and cultivated fields, particularly paddy. Nymphs were found at Siang and Lohit in early October and in February March, respectively. They were mostly found in groups hiding under the leaves, occasionally occurring in small numbers near the streams.

Material.—104 ♂♂ and 213 ♀♀; Uttar Pradesh : Dehra Dun, Ompta Tehri; 9.iv.1958; 1 ♂, Asarai, 15.vii.1966, 1 ♂; Timli forest, 13.viii.1966, 1 ♂; Lachiwala, 30.ix.1966, 1 ♂, Assam; Charduar, 27.v.1966, 1 ♂; 29.v.1966, 1 ♂; Dibrugarh, 27.ii.1969, 1 ♂ and 2 ♀♀, Dinjan, 27.ii.1969, 1 ♂; Goalpara, Raimona, 5.iv.1957, 1 ♀, Shillong, 8.v.1905, 1 ♀, Sibsagar, 8.v.1905, 1 ♀, Tezpur, (Sonai Rupai forest), 30.xi.1965, 1 ♀, 22.v.1966 1 ♀. NEFA : Kameng Dist.; Bairag Kund, 5.iii.1961, 1 ♀, Kalatung, 17.iii.1961, 3 ♀♀, Sigon, 31.iii.1961, 1 ♂ and 2 ♀♀, Rahung village, 7.iv.1961, 3 ♀♀, Chug village, 14.iv.1961, 1 ♂, Milankang village, 19.iv.1961, 1 ♂ and 2 ♀♀, 20.iv.1961, 1 ♂ and 2 ♀♀, Duplako bank, 31.v.1961, 2 ♀♀, Sigon, 31.v.1961, 2 ♀♀, Nephla. But, 4.vii.1961, 2 ♀♀, Diron Dzong, 24.vii.1961, 1 ♂, Tenga river side, 14.xii.1965, 2 ♂♂ and 2 ♀♀, Elephant flat (Bhaluk Pong), 25.xii.1965, 2 ♂♂

and 2♀♀, Dunn bridge, 4.iv.1966 ; 1♀, 21.iv.1966 ; 1 ♂, Bhaluk Pong, 3.v.1966 ; 1 ♂ and 3♀♀, Pinjuli, 4.v.1966 ; 1 ♂ and 2♂♂, Denling forest, 5.v.1966 ; 1♀, Bhaluk Pong, 6.v.1966 ; 1 ♂ and 2♀♀ ; Kimin, 9.v.1966 ; 2 ♂♂, Dejo, 10.v.1966 ; 2♀♀, Pamir bridge, 17.v.1966 ; 1 ♂, Tamen, 18.v.1966 ; 1 ♂ and 3♀♀, 19.v.1966 ; 3 ♂♂, 20.v.1966 ; 4♀♀, Chukro, 21.v.1966 ; 1 ♂, Bela village, 27.x.1966 ; 1 ♂ and 7♀♀, Pakha camp, 26.x.1966 ; 1 ♂ ; Siang Dist. : Lekhabali, 6.x.1966 ; 1♀, 7.x.1966 ; 1♀, 21.xi.1966 ; 1♀, Dali, 10.x.1966 ; 6♀♀, Pading village, 11.x.1966 ; 2 ♂♂ and 6♀♀, Serum bridge, 14.x.1966 ; 2♀♀, Kambang camp, 16.x.1966 ; 1 ♂, Tarak village, 18.x.1966 ; 1 ♂ and 2♀♀, Old Jinning, 20.x.1966 ; 2 ♂♂ and 8♀♀, Tappi (Dulla), 22.x.1966 ; 25 ♂♂ and 27♀♀, Tappi, 23.x.1966 ; 8 ♂♂ and 6♀♀, Tachidoni, 24.x.1966 ; 6 ♂♂ and 18♀♀, Bame, 30.x.1966 ; 1 ♂ and 12♀♀, Basar, 31.x.1966 ; 4♀♀ ; Lohit Dist : Sunpura, 3.iii.1969 ; 2♀♀, Bolung, 4.iii.1969 ; 3♀♀, Dambuk, 5.iii.1969 ; 5 ♂♂ and 8♀♀, Deopani, 6.iii.1969 ; 2 ♂♂ and 1♀, Sadiya Road, 8.iii.1969 ; 6 ♂♂ and 4♀♀, Teju, 10.iii.1969 ; 5 ♂♂ and 5♀♀, Digaru Road, 11.iii.1969 ; 1 ♂ and 6♀♀, Hayliaung Road, 12.iii.1969 ; 3 ♂♂ and 3♀♀, Lohitpur, 13.iii.1969 ; 1♀, Lohitpur road, 13.iii.1969 ; 5 ♂♂ and 10♀♀, Sitpani (Namsai), 16.iii.1969 ; 1♀ ; Tirap Dist. : Changlong, 5.i.1962 ; 1♀. West Bengal : Calcutta, 1.x.1904 ; 1♀, 16.iv. 1957 ; 1♀, 20.iv.1961 ; 1♀ ; Darjeeling, Rhoni, 2.xi.1944 ; 1♀, Chantong, 16.vi.1957 ; 2♀♀ ; Kurseong, 10.iii.1926 ; 2♀♀, Eagles cragg, Kurseong, 9.iii.1924 ; 1♀. Bihar : Monghyr, 22.ix.1909 ; 1♀, Rameswar Kond, Monghyr, 9.iv.1945 ; 1♂. Madhya Pradesh : Balaghat ; Muki Banjar valley, 4.x.1957 ; 1♀. Tamil Nadu : Madurai, 10.ix.1912 ; 1♀. Kerala : Cochin, 24.ix.1914 ; 1♀. Andaman Islands : Port Blair, 15.iii.1915 ; 1♀.

DISTRIBUTION

Xenocatantops humilis humilis (Serville) occurs in India, Bangladesh, Ceylon, Burma, Thailand ; Malaya, Viet-Nam, Philippines and Indonesia. It is typically a tropical grasshopper. The available material indicates that the species is wide spread in India, particularly in the inner valleys of the Brahmaputra and its tributaries in the North-eastern Himalaya. Mani (1962) found the species sparsely occurring in the inner valleys of North-western Himalaya, particularly in the Spiti. On the

eastern coast the species appears to be rather limited in its distribution, whereas there is no record of its distribution along the western coast excepting from the Kerala coast. In the Indo-gangetic plain the species is again scanty. The species has also been collected from Port Blair in the Andaman Islands.

SUMMARY

The paper deals with the diagnostic characters of the genus *Xenocatantops* Dirsh & Uvarov and the species *Xenocatantops humilis humilis* (Serville). Specimens of the genus present in the collection of the Zoological Survey of India have been studied. It is a typical tropical grasshopper. The species is well distributed in Assam, NEFA and North Bengal in India.

ACKNOWLEDGMENTS

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REFERENCES

- DIRSH, V. M. and UVAROV, B. P. 1953. Preliminary diagnoses of new genera and new synonymy in Acrididae. *Tijdschr. Ent.*, **96**: 231-237.
- KIRBY, W. F. 1914. *The Fauna of British India, including Ceylon and Burma*. Orthoptera (Acrididae). London, ix + 276 pp.
- MANI, M. S. 1962. *Introduction to High Altitude Entomology*—Methuen & Co. Ltd., London, xix + 362 pp.

ON INDIAN AMPHISTOMES

By

R. P. MUKHERJEE and B. S. CHAUHAN

Zoological Survey of India, Calcutta

I. INTRODUCTION

A fairly large number of amphistomes have been recorded from this country, mostly from herbivorous mammals. Deaths due to amphistomiasis in domesticated ruminants have been reported by many workers. So far only a few forms have been recovered from fishes, amphibians and reptiles in this country. Further researches may reveal many new forms from these hosts and particularly from fishes.

A number of classifications have been proposed from time to time for this complicated group of parasites but none of the systems is fully satisfactory with the result that in spite of the great amount of work done on this group in the world, differentiation of some of the species is still difficult. Therefore, until systematic position of different species of these trematodes is clearly known, amphistomiasis will remain a problem.

An attempt has been made in the present paper to give a brief review of our present knowledge of amphistomes with regard to Indian region, particularly to help those workers who are actively engaged in the field. It is now necessary to re-examine the type specimens and to provide correct description, to interpret correctly the different structures and to classify them properly as some of the Indian species appear to have been wrongly classified. This group of parasites is important for the conservation of animal health.

Amphistomiasis in domesticated ruminants has been known from a very early date in India. In some parts it has been known as 'Pitto' and 'Gillar' Indian amphistome collected from horses and elephants was probably first recorded by Cobbold (1875). The amphistomes of horses have been long known in this country as 'Masuri' Cobbold (1875) described three new amphistomes, *Amphistoma collinsi*, *A. stanleyii* and *A. hawkesii* from *Equus caballus*. The same author in the year 1882 added another species, *A. papillatum* from *Elephas indicus*. Later on, the first three species of Cobbold were transferred

to the genus *Pseudodiscus* Sonsino, 1895 and *Pseudodiscus stanleyii* was treated as synonym to *P. collinsi*. The fourth species of Cobbold was transferred to the genus *Pfenderius* erected by Stiles and Goldberger (1910) as *P. papillatus*.

Lewis and McConnel (1876) discovered a new species of amphistome from man in India and described it as *Amphistomum hominis*. A new genus *Gastrodiscoides* was proposed by Leiper (1913) who transferred *A. hominis* in this genus and described it as *G. hominis*. Another species, *G. hominis* var. *suis*, was added into this genus by Verma (1954) which is now considered as synonym to type species. Looss (1907) described a new species *Gastrodiscus secundus* based on the materials collected from mules in Assam.

Stiles and Goldberger (1910) made a valuable contribution on Indian amphistomes and their study was based on a large number of these parasites collected by various workers from this country as well as other parts of the world. Based on the study of the collections made from India they have reported as many as five new species of these trematodes and described them as *Cotylophoron indicum*, *Paramphistomum cauliorchis*, *P. crassum*, *P. papillosum* and *P. indicum*. The first one was described by them from *Ovis aries* and the rest were from *Bos indicus*. The second, third and fourth species of the joint authors were later on transferred into the genus *Calicophoron* Näsmark, 1937 as *C. cauliorchis*, *C. crassum* and *C. papillosum*. The validity of the species *C. crassum* was doubted by Näsmark (1937) and later on this species was treated to be synonym of *C. calicophoron* (Fischoeder, 1901) Näsmark, 1937 and the last species *P. indicum* of the joint authors was merged with *P. cervi* (Schrank, 1790) Fischoeder, 1901. Fukui (1926) collected some amphistomes from an Indian elephant died in Japan and on study this proved to be a new species of a new genus *Tagumaea* and he named it as *T. heterocaeca* but later on this genus was merged with *Pfenderius* Stiles and Goldberger, 1910.

Bhalerao (1931) recovered amphistomes from freshwater turtles and on study he created a new genus *Stunkardia* with *S. dilymphosa* as type species. Srivastava (1934) collected amphistomes from frogs and described a new variety as *Diplodiscus amphichrus magnus*. Harshey (1934) reported three species, *Cotylophoron oyatum*, *C. orientalis* and *C. elongatum*. Later on his first species was merged with *Ceylonocotyle*

scoliocoelium (Fischoeder, 1904) Näsmark, 1937 and the last two with *Cotylophoron indicum* Stiles and Goldberger, 1910. A new species, *Pfenderius birmanicus*, from elephant was added by Bhalerao (1935). The same author in the year 1937 created a new genus *Neocladorchis* to accommodate his new species *N. poonaensis* collected from fish and added three more species, *Helostomatis sakrei* from fish, *Paramphistomum cuonum* from *Cuon dukhunensis* and *P. maplestoni* from *Hyelaphus porcinus*. Pande (1937) described a new species of amphistome, *Diplodiscus mehrai* from frog but this species and the variety described by Srivastava (1934) are now considered to be synonym of *D. amphichrus* Tubangui, 1933. Srivastava (1938) reported a new species, *Gyliauchen ozakii* from fish and proposed two new genera, *Orientodiscus* and *Nicollodiscus*. The parasites of both these genera were collected from fishes. He included two species, *O. lobatum* and *O. jumnai* in his first genus and described his second genus with one species, *N. gangeticus*. Johnson (1939) recovered a new amphistome from an Indian cow and described it as *Paramphistomum magnum* but Yamaguti (1958) erected a new genus *Johnsonitrema* for this species and named it as *J. magnum*.

Thapar and Sinha (1945) created a new genus *Olveria* with *O. indica* as type species. Tandon (1951) added one more species to this genus, *O. bosi*. Gupta (1951) reported *Paramphistomum bathycotyle* Fischoeder, 1901 but this species is now considered to be synonym of *Gigantocotyle explanatum* (Creplin, 1847) Näsmark, 1937. All these species were recorded from domesticated ruminants. Gupta (1958) described two new species, *Cotylophoron madrasensis* and *Ceylonocotyle dawesi* both from domesticated ruminants. Thapar (1960) proposed a new genus *Caballeroia* with *C. indica* as type species and the parasites were collected from fish but neither he has indicated its systematic position nor has given the generic diagnosis. The present authors in their earlier communication gave the generic diagnosis. Out of all the genera compared by Thapar (1960) this genus shows closer affinity with that of *Neocladorchis* Bhalerao, 1937. As such this genus has been classified with the subfamily Clemptodiscinae Skrjabin, 1949 in this paper. Mukherjee (1963) reported two new species from domesticated ruminants and described them as *Cotylophoron bareilliensis* (Mukherjee, 1963) Mukherjee and Chauhan, 1967 and *Ceylonocotyle nasmarki*. Gupta (1963) described *Paramphisto-*

mum epiclitum Fiscoeder, 1904 from farm animals but from the description it appears that he was dealing with *Cotylophoron indicum* Stiles and Goldberger, 1910 as was also pointed out in our earlier communication.

Siddiqi (1965) added three new species to the genus *Orientodiscus* Srivastava, 1938 and described them as *O. linguiformis*, *O. buckleyi* and *O. constrictus* but Mukherjee and Chauhan (1967) considered *O. constrictus* as only valid species and the other two were considered as synonym to *O. lobatum* Srivastava, 1938. All these species were collected from fresh-water turtles by Siddiqi. As pointed out by him his two species, *O. linguiformis* and *O. buckleyi* differ from the known species on the basis of body size, size of oral sucker, sucker ratio, number of lymphatic channel, size of pharyngeal bulb, nature of testes, genital pore at bifurcal zone or slightly posterior to it and size of eggs. These characters are so variable in nature that the slight differences in these characters alone should not be considered as sufficient enough to differentiate the species. Baer (1950) and Dollfus (1950) considered the ratio of pharynx and acetabulum to body length as of no specific value. Rhode (1963) expressed the doubts on number of lymphatic vessels in Srivastava's specimens. Manter and Pritchard (1964) reported that the size of eggs varies considerably in amphistomes. Mukherjee (1966) described a new species, *Calicophoron orientalis* from domesticated ruminants. Dwivedi (1967) described a new genus *Kachugotrema* with a new species *K. amboinensis*. His new genus agrees in all respect with the *Orientodiscus* Srivastava, 1938, so the present authors considered it as synonym to latter genus. The species *K. amboinensis* is also considered synonym to *O. lobatum* Srivastava, 1938 as in their major characters they are identical. Gupta and Gupta (1969) reported two new species, *Cotylophoron chauhani* and *Ceylonocotyle narayani* and erected a new genus *Cochinocotyle* with *C. bovini* as type species. These species are neither included in the present list nor it is possible to study their validity as they are not yet fully described.

Other workers who studied and recorded the known amphistomes, mostly from domesticated animals, from various parts of India and made valuable contributions to our knowledge on the group are Fiscoeder (1901-1903), Gaiger (1910 and 1915), Railliet, Henry and Bauch (1914), Maplestone

(1923), Baylis (1929), Bhalerao (1935), Näsmark (1937), Mōghe (1945) and Thapar (1956)

It is evident from the above review that most of the amphistomes in India have been recorded from mammals and only a few from fishes, amphibians and reptiles and none from birds.

A list of amphistomes so far recorded from Indian region with their systematic position, their hosts, location and locality is given below.

II. LIST OF SPECIES RECORDED FROM INDIAN REGION

Order 1. DIGENEA Van Beneden, 1858

Suborder 1. *PROSOSTOMATA* Odhner, 1905

Family 1. *GYLIAUCHENIDAE* Ozaki, 1933

Subfamily 1. *GYLIAUCHENINAE* Yamaguti, 1958

1. *Gyllauchen ozakii* Srivastava, 1938

1938. *Gyllauchen ozakii* Srivastava, *Indian J. Vet. Sci. Anim. Husb.*, **8**: 367.

Host.—*Harpodon nehereus* (Hamilton)

Location.—Intestine.

Locality.—Karachi.

Family 2. *PARAMPHISTOMIDAE* Fischöder, 1901

Subfamily 2. *CLADORCHINAE* Luhe, 1909

2. *Olveria indica* Thapar and Sinha, 1945

1945. *Olveria indica* Thapar and Sinha, *Indian J. Vet. Sci. Ani. Husb.*, **15**: 219.

Host.—Cattle, buffalo, goat, sheep.

Location.—Rumen.

Locality.—Lucknow, Bareilly and other places.

This is the type species of the genus *Olveria* Thapar and Sinha, 1945.

3. *Olveria bosi* Tandon, 1951

1951. *Olveria bosi* Tandon, *Indian J. Helm.*, **3**: 93.

Host.—*Bos bubalis* Linnaeus, sheep, goat.

Location.—Rumen.

Locality.—Lucknow and other places.

Mukherjee (1960) collected it from the rumen of sheep and goat at Bareilly (U.P.)

4. **Pfenderius birmanicus** Bhalerao, 1935

1935. *Pfenderius birmanicus* Bhalerao, *Indian J. Vet. Sci. Anim. Husb.*, **5**: 1.

Host.—Elephant.

Location.—Intestine.

Locality.—India and Burma.

5. **Pfenderius heterocaeca** (Fukui, 1926)

1926. *Tugumaca heterocaeca* Fukui *Dobutsu-gaku Zasshi*, **38**: 79.

1958. *Pjanderius heterocaeca*: Yamaguti, *Systema Helminthum*, **1**: 967.

Host.—Elephant.

Location.—Intestine.

Locality.—Andamans and Burma.

6. **Pfenderius papillatus** (Cobbold, 1882)

Stiles and Goldberger, 1910

1882. *Amphistoma papillatus* Cobbold, *Trans. Linn. Soc.*, **2**: 223.

1910. *Pfenderius papillatus*: Stiles and Goldberger, *Hyg. Lab. Bull.*, No. 6: 1.

Host.—Elephant.

Location.—Colon.

Locality.—Andamans.

This is the type species of the genus *Pfendorius* Stiles and Goldberger, 1910.

Subfamily 3. *CLEPTODISCINAE* Skrjabin, 1949

7 **Caballeroia indica** Thapar, 1960

1960. *Caballeroia indica* Thapar, *Libro Homonaje al Dr. Eduardo Caballero Y Caballero*: 315.

Host.—*Cirrhina fulungee* (Sykes)

Location.—Intestine.

Locality.—Tungabhadra Dam, Hospet, Madras.

This is the only known species of the genus *Caballeroia* Thapar, 1960.

8. **Neocladorchis poonaensis** Bhalerao, 1937

1937. *Neocladorchis poonaensis* Bhalerao, *J. Helm.*, **15**: 97.

Host.—*Barbus dobsoni* (Day)

Location.—Intestine.

Locality.—Poona.

Bhalerao (1937) proposed a new genus *Neocladorchis* as mentioned earlier in this paper to accommodate this species. Yamaguti (1958), however, considers this genus as synonym to *Cleptodiscus* Linton, 1910. The two genera differ in the size of oral diverticula, presence and absence of the oesophageal bulb, structure of the terminal part of caeca, etc., so the validity of the genus *Neocladorchis* can be established only by further study.

Subfamily 4. *DADAYTREMATINAE* Yamaguti, 1958

9. *Orientodiscus constrictus* Siddiqi, 1965

1965. *Orientodiscus constrictus* Siddiqi, *J. Helm.*, **39**: 377.

Host.—*Trionyx formosus* Gray

Location.—Small intestine.

Locality.—Aligarh.

10. *Orientodiscus lobatum* Srivastava, 1938

1938. *Orientodiscus lobatum* Srivastava, *Indian J. Vet. Sci. Anim. Husb.*, **8**: 367.

Host.—*Silundia gangetica* Hamilton

Location.—Rectum.

Locality.—Ganges.

Yamaguti (1958) considered this species as type. Srivastava (1938) reported another species *O. jumnai* and the parasites were recovered from the same host, *Silundia gangetica* and it was collected from the river Jamuna. This species was separated from the previous species on the basis of the nature of testes.

Subfamily 5. *DIPLODISCINAE* Cohn, 1904

11 *Diplodiscus amphichrus* Tubangui, 1933

1933. *Diplodiscus amphichrus* Tubangui, *Philippine J. Sci.*, **52**: 167.

Host.—Frog.

Location.—Rectum, small intestine.

Locality.—Widely distributed.

Subfamily 6. *GASTRODISCINAE* Monticelli, 1892

12. *Gastrodiscus aegyptiacus* (Cobbold, 1876)
Railliet, 1893

1876. *Diplostoma aegyptiacus* Cobbold, *Veterinarian*, **48**: 733.

Host.—Horse.

Location.—Intestine.

Locality.—Assam and Bengal.

13. **Gastrodiscoides hominis** (Lewis and McConnell, 1876)
Leiper, 1913

1876. *Amphistoma hominis* Lewis and McConnell, *Proc. Asiat. Soc. Bengal*: 182.

1913. *Gastrodiscoides hominis*: Leiper, *Trans. roy. Soc. trop. Med. Hyg.*, **6**: 265.

Host.—Man, pig.

Location.—Intestine.

Locality.—Widely distributed.

14. **Gastrodiscus secundus** Looss, 1907

1907. *Gastrodiscus secundus* Looss, *Ann. trop. Med. Parasit.*, **1**: 123.

Host.—Horse, Mule, Ass, Elephant.

Location.—Caecum.

Locality.—Widely distributed.

15. **Homalogaster paloniae** Poirier, 1883

1883. *Homalogaster paloniae* Poirier, *Bull. Soc. philom. Paris*, 7th. Ser., p. 73.

Host.—Sheep, cattle.

Location.—Caeca, bile duct.

Locality.—Assam, U.P.

This is the type species of the genus *Homalogaster* Poirier, 1883.

Subfamily 7. *GASTROTHYLAECINAE* Stiles and Goldberger, 1910

16. **Carmyerius spatiosus** (Brandes, 1898)
Stiles and Goldberger, 1910

1898. *Gastrothylax spatiosus* Brandes, *Abh. naturf. Ges. Halle*, **26**: 1.

1910. *Carmyerius spatiosus*: Stiles and Goldberger, *Hyg. Lab. Bull.*, No. 6: 1.

Host.—Cattle.

Location.—Rumen.

Locality.—Widely distributed.

17 **Fischoederius cobboldi** (Poirier, 1883)
Stiles and Goldberger, 1910

1883. *Gastrothylax cobboldi* Poirier, *Bull. Soc. philom. Paris*, 7th. Ser: 73.
1910. *Fischoederius cobboldi*: Stiles and Goldberger, *Hyg. Lab. Bull.*, No. 6: 1.
Host.—Cattle.
Location.—Rumen.
Location.—Widely distributed.

18. **Fischoederius elongatus** (Poirier, 1883)
Stiles and Goldberger, 1910

1883. *Gastrothylax elongatus* Poirier, *Bull. Soc. philom. Paris*, 7th. Ser: 73.
1910. *Fischoederius elongatus*: Stiles and Goldberger, *Hyg. Lab. Bull.*, No. 6: 1.
Host.—Cattle.
Location.—Rumen.
Locality.—Widely distributed.

This is the type species of the genus *Fischoederius* Stiles and Goldberger, 1910.

19. **Gastrothylax crumenifer** (Creplin, 1847)
Poirier, 1883

1847. *Amphistomum crumenifer* Creplin, *Arch. Naturg.*, 13: 30.
1883. *Gastrothylax crumenifer*: Poirier, *Bull. Soc. philom. Paris*, Ser: 7: 73.
Host.—Ruminants.
Location.—Rumen.
Locality.—Widely distributed.

This is the type species of the genus *Gastrothylax* Poirier, 1883.

Subfamily 8. *HELOSTOMATINAE* Skrjabin, 1949.

20. **Helostomatis sakrei** Bhalerao, 1937

1937. *Helostomatis sakrei* Bhalerao, *J. Helm.*, London, 15: 97.
Host.—*Labeo calbasu* (Hamilton).
Location.—Intestine.
Locality.—Poona.

Subfamily 9. *JOHNSONITREMATINAE* Yamaguti, 1958.

21 **Johnsonitrema magnum** (Johnson, 1939)
Yamaguti, 1958

1939. *Paramphistomum magnum*, Johnson, *Proc. Pennsylvania Acad. Sci.*, **13**: 68.

1958. *Johusonitrema magnum*: Yamaguti, *Systema Helminthum*, **1**: 975.

Host.—Cow.

Location.—Stomach.

Locality.—India.

This parasite was described as *Paramphistomum magnum* by Johnson (1939) based on the materials collected from the stomach of a cow from India. Yamaguti (1958) created a new genus *Johnsonitrema* and transferred this species into his new genus. Further study of this parasite is necessary to establish the validity of this species and the genus.

Subfamily 10. *NICOLLODISCUSAE* Skrjabin, 1949

22. **Nicollodiscus gangeticus** Srivastava, 1938

1938. *Nicollodiscus gangeticus* Srivastava, *Indian J. Vet. Sci. Anim. Husband.*, **8**: 367.

Host.—*Silundia gangetica* Hamilton

Location.—Large intestine.

Locality.—Ganges and Jamuna.

This is the type species of the genus *Nicollodiscus* Srivastava, 1938.

Subfamily 11. *PARAMPHISTOMINAE* Fishoeder, 1901

23. **Calicophoron calicophorum** (Fischoeder, 1901)
Näsmark, 1937

1901. *Paramphistomum calicophorum* Fischoeder, *Zool. Anz.*, **24**: 367.

1937. *Calicophoron calicophorum*: Näsmark, *Zool. Bid. Fron. Uppsala*, **16**: 1.

Host.—Cattle, sheep, goat.

Location.—Reticulum, Rumen.

Locality.—Widely distributed.

This is the type species of the genus *Calicophoron* Näsmark, 1937

24. *Calicophoron cauliorchis* (Stiles and Goldberger, 1910) Näsmark, 1937

1910. *Paramphistomum cauliorchis* Stiles and Goldberger, *Hyg. Lab.*, No. 6: 1.
 1937. *Calicophoron cauliorchis*: Näsmark, *Zool. Bid. Fron. Uppsala*, **16**: 1.
Host.—Cattle, buffalo.
Location.—Rumen.
Locality.—Punjab, U.P.

25. *Calicophoron orientalis* Mukherjee, 1966

1966. *Calicophoron orientalis* Mukherjee, *Indian J. Helm.*, **18**: 94.
Host.—*Capra hircus* Linnaeus
Location.—Rumen.
Locality.—Bareilly.

26. *Calicophoron papillosum* (Stiles and Goldberger, 1910) Näsmark, 1937

1910. *Paramphistomum papillosum* Stiles and Goldberger, *Hyg. Lab. Bull.*, No. 6: 1.
 1937. *Calicophoron papillosum*: Näsmark, K. I., *Zool. Bid. Fron. Uppsala*, Stockholm, **16**: 1.
Host.—*Bos indicus* Linnaeus
Location.—Rumen.
Locality.—Sanawar.

27 *Ceylonocotyle cuonum* (Bhalerao, 1937) Mukherjee and Chauhan, 1967

1937. *Paramphistomum cuonum* Bhalerao, *J. Helm.*, **15**: 97.
 1967. *Ceylonocotyle cuonum*: Mukherjee and Chauhan, *J. zool Soc. India*, (1965), **17** (1/2): 150.
Host.—*Cuon dukhunensis* Sykes
Location.—Stomach, small intestine.
Locality.—Calcutta Zoo.

28. *Ceylonocotyle dawesi* Gupta, 1958

1958. *Ceylonocotyle dawesi* Gupta, *Res. Bull. Panjab Univ. Zool.*, **140**: 67.
Host.—*Bos indicus* Linnaeus
Location.—Rumen.
Locality.—Madras.

29. **Ceylonocotyle maplestoni** (Bhalerao, 1937)
Mukherjee and Chauhan, 1967

1937. *Paramphistomum maplestoni* Bhalerao, *J. Helm.*, **15**: 97.
1967. *Ceylonocotyle maplestoni* Mukherjee and Chauhan, *J. zool. Soc. India*, (1965), **17** (1/2): 150.
Host.—*Hyelaphus porcinus* Schveber
Location.—Large intestine.
Locality.—Calcutta Zoo.

30. **Ceylonocotyle nasmarki** Mukherjee, 1963

1963. *Ceylonocotyle nasmarki* Mukherjee, *Indian J. Helm.*, **15**: 70.
Host.—*Ovis aries* Blyth
Location.—Rumen.
Locality.—Bareilly.

31 **Ceylonocotyle orthocoelium** (Fischöeder, 1901)
Näsmark, 1937

1901. *Paramphistomum orthocoelium* Fischöeder, *Zool. Anz.*, **24**: 367.
1937. *Ceylonocotyle orthocoelium* Näsmark, *Zool. Bid. Fron. Uppsala*, **16**: 1.
Host.—Ruminants.
Location.—Rumen.
Locality.—Widely distributed.

32. **Ceylonocotyle scoliocoelium** (Fischöeder, 1904)
Näsmark, 1937

1904. *Paramphistolomum scoliocoelium* Fischöeder, *Zool. Jahrb. Syst.*, **20**: 453.
1937. *Ceylonocotyle scoliocoelium* Näsmark, *Zool. Bid. Fron. Uppsala*, **16**: 1.
Host.—Cattle, buffalo, sheep, goat.
Location.—Rumen.
Locality.—Widely distributed.

This is the type species of the genus *Ceylonocotyle*
Näsmark, 1937

33. **Ceylonocotyle spinicephalus** (Tandon, 1955)
Mukherjee, 1960

1955. *Paramphistomum spinicephalus* Tandon, *Indian J. Helm.*, **7**: 35.

1960. *Ceylonocotyle spinicephalus*: Mukherjee, (Thesis submitted for Ph.D. degree of the University of Agra: 107).

Host.—*Bos bubalis* Linnaeus

Location.—Rumen.

Locality.—Lucknow.

**34. *Cotylophoron bareilliensis* (Mukherjee, 1963)
Mukherjee and Chauhan, 1967**

1963. *Cotylophoron skrjabini* Mukherjee, *Indian J. Helm.*, **15**: 70.

1967. *Cotylophoron bareilliensis* Mukherjee and Chauhan, *J. zool. Soc. India*, (1965), **17** (1/2): 150.

Host.—Goat.

Location.—Rumen.

Locality.—Bareilly.

**35. *Cotylophoron cotylophorum* (Fischöeder, 1901)
Stiles and Goldberger, 1910**

1901. *Paramphistomum cotylophorum* Fischöeder, *Zool. Anz.*, **24**: 367.

1910. *Cotylophoron cotylophorum*: Stiles and Goldberger, *Hyg. Lab. Bull.*, No. 6: 1.

Host.—Ruminants.

Location.—Rumen.

Locality.—Widely distributed.

Many workers from India have reported this parasite from the rumen of domesticated ruminants and is believed to be widely distributed and a common species in this country. A large number of cases of amphistomiasis were reported due to the infection of this parasite. The present authors, however, are of the opinion that the distribution of this species in this country is doubtful and it is not so common as is supposed to be.

36. *Cotylophoron indicum* Stiles and Goldberger, 1910

1910. *Cotylophoron indicum* Stiles and Goldberger, *Hyg. Lab. Bull.*, No. 6: 1.

Host.—Ruminants.

Location.—Rumen.

Locality.—Widely distributed.

37 *Cotylophoron madrasensis* Gupta, 1958

1958. *Cotylophoron madrasensis* Gupta, *Res. Bull. Panjab Univ. Zool.*, **14**: 307.

Host.—*Ovis aries* Blyth

Location.—Stomach.

Locality.—Madras.

**38. *Gigantocotyle explanatum* (Creplin, 1847)
Näsmark, 1937**

1847. *Amphistomum explanatum* Creplin, *Arch. Naturg.*, **13**: 30.

1937. *Gigantocotyle explanatum*: Näsmark, *Zool. Bid. Fron. Uppsala*, **16**: 1.

Host.—Cattle, buffalo, sheep, goat.

Location.—Bile duct.

Locality.—Widely distributed.

This is the type species of the genus *Gigantocotyle*
Näsmark, 1937

**39. *Paramphistomum cervi* (Schränk, 1790)
Fischöeder, 1901**

1790. *Fasciola cervi* Schränk, *Kgl. svensk. Vetensk. Acad. nye for L L Stockholm*: 118.

1901. *Paramphistomum cervi*: Fischöeder, *Zool. Anz.*, **24**: 367.

Host.—Ruminants.

Location.—Rumen, bile duct.

Locality.—Widely distributed.

This is the type species of the genus *Paramphistomum*
Fischöeder, 1901 and has been reported from different parts of
this country. The present authors have doubts in its distribu-
tion in this country and if at all found it is not so common
parasite as was described by others.

40. *Paramphistomum goti* Fukui, 1922

1922. *Paramphistomum goti* Fukui, *Dobutsu-gaku. Zass.*, **34**: 19.

Host.—*Bos bubalis* Linnaeus

Location.—Stomach.

Locality.—Lucknow.

Subfamily 12. *PSEUDODISCINAE* Näsmark, 1937.

**41 *Pseudodiscus collinsi* (Cobbold, 1875)
Sonsino, 1895.**

1875. *Amphistomum collinsi* Cobbold, *Veter.*, **48**: 733.

Host.—Horse, ass, elephant, Cattle.

Location.—Caecum, colon,

Locality.—Widely distributed.

This is the type species of the genus *Pseudodiscus* Sonsino, 1895.

42. ***Pseudodiscus hawkesii*** (Cobbold, 1875)
Sonsino, 1895

1875. *Amphistomum hawkesii* Cobbold, *Veter.*, 48: 733.

Host.—Elephant.

Location.—Intestine.

Locality.—Widely distributed.

Subfamily 13. ZYGOCOTYLINAE Ward, 1917

43. ***Stunkardia dilymphosa*** Bhalerao, 1931

1931. *Stunkardia dilymphosa* Bhalerao, *Parasit.*, 23: 99.

Host.—*Batagur baska* (Gray), *Morenia ocellata* (Dunb. & Bib.)

Location.—Rectum.

Locality.—India, Rangoon.

III. SUMMARY

The paper deals with a critical study of the present position of amphistomes recorded so far from the Indian region. A short history of different species and amphistomiasis in India have also been incorporated. The Indian amphistomes have been listed along with their hosts, localities and locations in this paper.

IV. REFERENCES

- BAER, J. G. 1950. Etude critique des helminthes parasites de l'okapi. *Acta Tropica*, 7: 164-186.
- BHALERAO, G. D. 1935. Helminth parasites of domesticated animals in India.—*Imp. Coun. Agri. Res. India*, No. 6: 50-68.
- BUCKLEY, J. J. C. 1939. Observations on *Gastrodiscoides hominis* and *Fasciolopsis buski* in Assam.—*J. Helm.*, 17: 1-12.
- DWIVEDI, M. P. 1967. *Kachugotrema amboinensis* n.g.n.sp (Paramphistomidae: Trematoda).—*Indian J. Helm.*, 19: 45-55.
- DOLLFUS, R. Ph. 1950. Trematodes recoltés au Congo belge par le professeur Paul Brien (mai-août, 1937ffl).—*Ann. Mus. Congobelge. C. Zool.*, 5: 1-136.
- GUPTA, N. K. 1951. On the morphology of *Paramphistomum bathycotyle* Fischöder, 1901 a common amphistome in the bile ducts of Indian bovines.—*Res. Bull. Panjab Univ. Zool.*, 15: 33-38.

- GUPTA, N. K. 1963. On *Paramphistomum epiclitum* Fischöder, 1904, a parasite of the farm animals in the Punjab.—*Res. Bull. Panjab Univ. Zool.*, **14**: 307-311.
- GUPTA, N. K. and GUPTA, P. 1969. Amphistomid parasites of some ruminants at Ernakulam (South India).—*Proc. 56th. Indian Sci. Cong.*, III: 517.
- HARSHEY, K. R. 1934. On amphistome parasite of sheep and goat from Allahabad.—*Proc. Acad. Sci. U. P., Agra and Oudh*, **4**: 95-106.
- MANTER, H. W. and PITCHARD, M. H. 1964. Vermes-trematoda.—*Ann. Mus. Roy. Afr. Centr. Zool.*, **132**: 75-101.
- MOGHE, M. A. 1945. Results of a survey on the nature and incidence of helminth infection in cattle, goats and sheep in the Central Provinces and Berar and Central India.—*Indian J. Vet. Sci. Anim. Husb.*, **15**: 222-230.
- MUKHERJEE, R. P. 1962. Studies on some amphistomatous trematodes of domesticated animals.—*Agra Univ. J. Res. (Sci.)*, **11**: 131-136.
- MUKHERJEE, R. P. 1966. *Calicophoron cauliorchis* (Stiles and Goldberger, 1910) Näsmark, 1937 from Indian Buffalo.—*Indian J. Helm.*, **18**: 1-4.
- MUKHERJEE, R. P. and CHAUHAN, B. S. 1967. Studies on the trematode fauna of India, Part V, Subclass Digenea: Paramphistomidae Fischöder (1901).—*J. zool. Soc. India* (1969), **17** (1 & 2): 150-225.
- PANDE, B. P. 1937. On some digenetic trematodes from *Rana cyanophlyctis* of Kumaon Hills.—*Proc. Indian Acad. Sci.*, **6**: 109-120.
- RHODE, K. 1963. *Orientodiscus fernandoi* n.sp. and *O. hendricksoni* n.sp. (Trematoda, Paramphistomata) from the intestine of *Trionyx* spp. in Malaya.—*J. Helm.*, **37**: 349-358.
- SIDDIQI, A. H. 1965. Three new species of *Orientodiscus* (Trematoda: Paramphistomata) from freshwater turtles *J. Helm.*, **39**: 377-382.
- SRIVASTAVA, H. D. 1934. On new trematodes of frogs and fishes of the United Provinces, India. Part IV. The occurrence and seasonal incidence of infection of certain trematodes in the above hosts.—*Bull. Acad. Sci. U.P. Agra and Oudh*, **4**: 113-119.
- TANDON, R. S. 1951. On a new amphistome, *Olveria bosi* n.sp., from the rumen of buffalo, *Bos bubalis*, from Lucknow. *Indian J. Helm.*, **3**: 93-100.
- THAPAR, G. S. 1956. Systematic survey of helminth parasites of domesticated animals in India.—*Indian J. Vet. Sci. Ani. Husb.*, **26**: 211-271.
- VARMA, A. K. 1954. Human and swine *Gastrodiscoides*.—*Indian J. Med. Res.*, **42**: 475-479.

CONTRIBUTIONS TO THE STUDY OF AQUATIC
BEETLES (COLEOPTERA) 11. ON A COLLECTION OF
GYRINIDAE, DYTISCIDAE, AND HYDROPHILIDAE
FROM ANDAMAN ISLANDS

By

T. G. VAZIRANI

Zoological Survey of India, Calcutta

(With 1 Text-figure)

INTRODUCTION

This is a report on the collection of Gyrinidae, Dytiscidae and Hydrophilidae made by my colleague Shri T. D. Soota, at Port Blair, during 1969. The present collection comprises 10 species—Gyrinidae (1 sp.), Dytiscidae (7 spp.) and Hydrophilidae (2 spp.).

Among the Dytiscidae, except one species viz., *Hydaticus leechi* Sato, all other species have been reported from Andaman Islands, in an earlier paper (Vazirani, 1970); only selected references and material examined have been listed under these species, while references and remarks have been given for species belonging to the other two families.

SYSTEMATIC ACCOUNT

Order COLEOPTERA

Suborder ADEPHAGA

Family GYRINIDAE

Subfamily GYRININAE

1. *Gyrinus smaragdinus* Regimbart

1891. *Gyrinus smaragdinus* Regimbart, *Ann. Mus. Civ. Genova*, (2) 10: 547.

1930. *Gyrinus smaragdinus*: Orchymont, *Cat. Indian Ins.*, pt. 19: 8.
Material.—1 ex., Port Blair, 1.iv.1969.

Remarks.—This species is known from the Eastern Himalayas, Khasi Hills, Shillong, etc. Its distribution extends to Burma, Yunnan, and Indo-China. It is now being reported from the Andaman group of Islands for the first time.

Family DYTISCIDAE
Subfamily LACCOPHILINAE

2. *Laccophilus parvulus* Aube

1838. *Laccophilus parvulus* Aube, in Dejean's, *Species Coleopteres*, 6: 429.
1969. *Laccophilus parvulus*: Vazirani, *Oriental Ins.*, 2: 247.
Material.—3 ex., Port Blair, 1.iv.1969.

3. *Laccophilus basalis* Motschulsky

1859. *Laccophilus basalis* Motschulsky, *Etud. Ent.*, 8: 45.
1969. *Laccophilus basalis*: Vazirani, *Oriental Ins.*, 2: 242.
Material.—4 ex., Port Blair, 1.iv.1969.

4. *Laccophilus sharpi* Regimbart

1889. *Laccophilus sharpi* Regimbart, *Ann. Soc. ent. Fr.*, (6) 9: 151.
1969. *Laccophilus sharpi*: Vazirani, *Oriental Ins.*, 2: 249.
Material.—1 ex., ♀, Port Blair, 1.iv.1969.

Subfamily DYTISCINAE

5. *Eretes sticticus* (Linnaeus)

1767. *Dytiscus sticticus* Linnaeus, *Systema Naturae*, Holmiae, ed. 12, 1(2): 666.
1969. *Eretes sticticus*: Vazirani, *Oriental Ins.*, 2: 255.
Material.—1 ex., Port Blair, 1.iv.1969.

6. *Hydaticus fabricii* Macleay

1833. *Hydaticus fabricii* Macleay, *Annulosa Javanica*: 136.
1969. *Hydaticus fabricii*: Vazirani, *Oriental Ins.*, 2: 266.
Material.—4 ex., Port Blair, 1.iv.1969.

7 *Hydaticus leechi* Sato

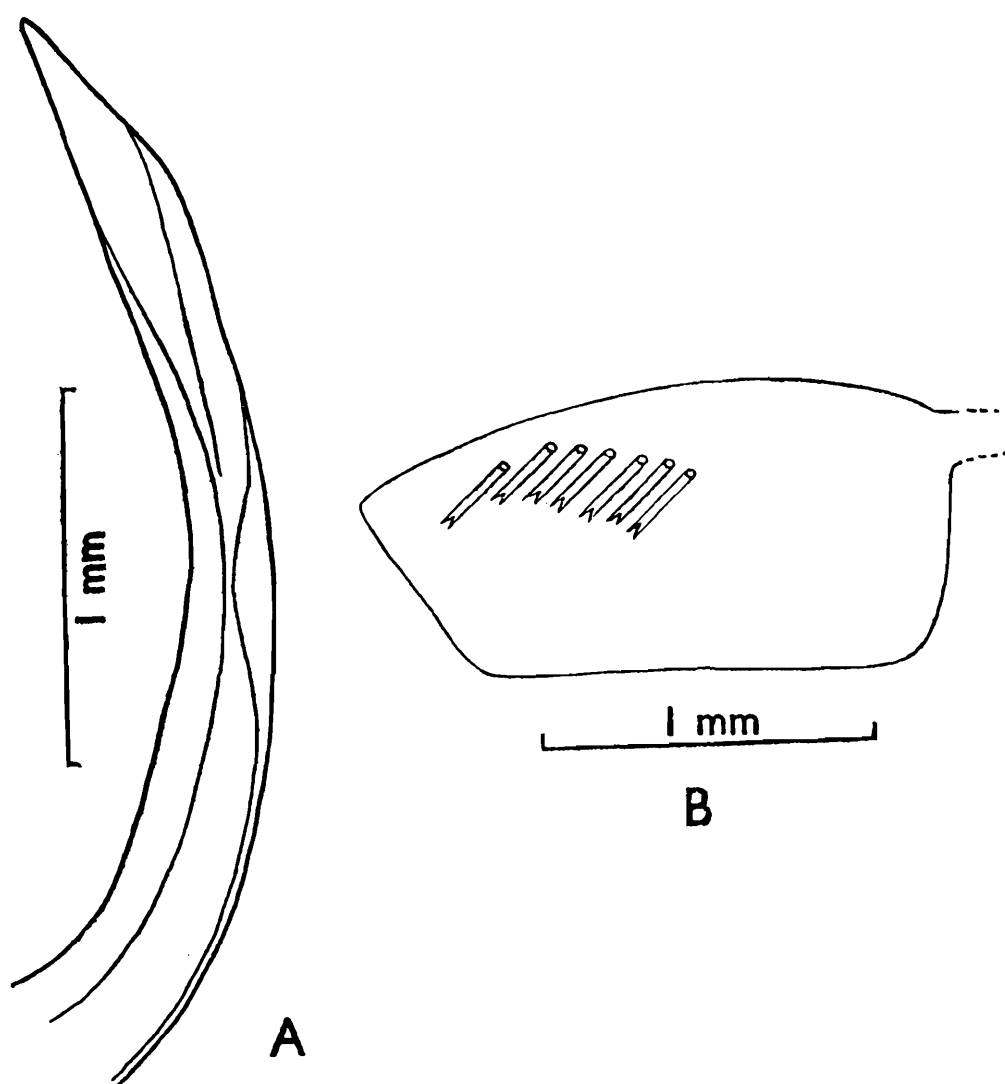
1882. *Hydaticus vittatus* Sharp, *Sci. Trans. R. Dublin Soc.*, 2: 670 (in part).
1899. *Hydaticus vittatus* ab. *quadrivittatus* Regimbart, *Ann. Soc. ent. Fr.*, 68: 328 (in part).
1961. *Hydaticus leechi* Sato, *Trans. Shikoko Ent. Soc.*, 7(1-2): 61.

VAZIRANI, T. G. 1970. Contributions to the study of aquatic beetles (Coleoptera). 9. On a collection of Dytiscidae from S. Andaman Islands. *Oriental Ins.*, New Delhi, 4(2): 177-184.

1961. *Hydaticus leechi* form *subrutilus* Sato, *Trans. Shikoko Ent. Soc.*, 7(1-2) : 61.
1961. *Hydaticus leechi celebesanus* Sato, *Trans. Shikoko Ent. Soc.*, 7 (1-2), 62: figs. 6, 26.
1961. *Hydaticus leechi celebesanus* form *insulans* Sato, *Trans. Shikoko Ent. Soc.*, 7(1-2), 62: fig. 7.
1961. *Hydaticus leechi celebesanus* form *brackeli* Sato, *Trans. Shikoko Ent. Soc.*, 7 (1-2): 62, fig. 8.
1969. *Hydaticus vittatus*: Vazirani, *Oriental Ins.*, 2: 260-262 (in part). *Material*.—7 exs., Port Blair, 1.iv.1969.

Remarks.—Before Sato (1961), *H vittatus*, sensu lato, was considered to be a species of wide geographical range without any clear discontinuities in the distribution.

Sato (1961)* has named several infra subspecific categories. Even male and female from the same locality population have been assigned to different varieties and forms. Besides, these



Text-fig. 1. *Hydaticus leechi* Sato, A. lateral view of penis;
B. bifid spines on the internal face of meta-tibiae.

infrasubspecific categories are no longer recognized after the publication of the International Code of Zoological Nomenclature, 1961.

The exact status of *Hydaticus vittatus* var. *interruptus* Regimbart (1899), known from Borneo and Nicobar Islands, is considered doubtful. No example referable to this 'var'. is present in Paris Museum and could be examined by me. Sato (l.c.) is in error to treat it as a form *H. leechi* without examination of any material. In case the two species are specifically identical, the name *interruptus* Regimbart, 1899 has priority over *leechi* Sato, 1961, and should be applied to this species. Further I am also doubtful about Sato's treatment of *H. lenzi* Schoen. Even if it be a valid species, I very much doubt its distribution, having the same range as *vittatus*. The name *leechi*, is only temporarily applied here, till a thorough revision of this complex, based on the study of 'Type' specimen of each and every 'form', 'var', etc., described is available for study. together with a series of examples from various museums. *H. leechi* Sato, may perhaps only prove to be a subspecies of *quadrivittatus* Blanchard. For the present, I am giving here a comparison of the arrangement of cupules on the male anterior tarsi; in *vittatus* 2 basal median cupules are larger than the two median cupules in the preceding row while in *leechi* (examples from Andaman Islands) the two basal median cupules are smaller than the two median cupules in the preceding row.

There are some differences in the upper margin of the penis (fig. 1A) in the single male example now before me and the figure of penis given by Sato. I consider that this difference comes within the infraspecific variations, as indeed Sato has himself shown for the species *vittatus*. Among the seven examples, there is only a single male. In two female examples, the outer yellow vitta of the elytra is conjoint with the inner vitta. In one female example, there is a reddish-yellow spot at the base of each elytron. Similar reddish spot, was observed by me, in three examples from Java, in Regimbart collection at Paris Museum and these were labelled as *H. vittatus* ab. *lenzi* Schoen. Such spots do not appear to have either any sexual or subspecific significance.

*SATO, M. 1961. *Hydaticus vittatus* (Fabricius) and its allied species (Coleoptera: Dytiscidae). *Trans. Shikoku Ent. Soc.*, 7(1-2): 54-64.

8. **Cybister tripunctatus asiaticus** Sharp

1882. *Cybister asiaticus* Sharp, *Sci Trans. R. Dublin Soc.*, 2: 731.
 1969. *Cybister tripunctatus asiaticus*: Vazirani, *Oriental Ins.*, 2: 290.
Material.—6 ex., Port Blair, 1.iv.1969.

Suborder POLYPHAGA

Family HYDROPHILIDAE

Subfamily HYDROPHILINAE

9. **Sternolopus (s. str.) rufipes** (Fabricius)

1792. *Hydrophilus rufipes* Fabricius, *Ent. Syst.*, 1: 183.
 1928. *Sternolopus (s. str.) rufipes*: Orchymont, *Cat. Indian Ins.*, pt. 14: 121.
 1952. *Sternolopus (s. str.) rufipes*: Vazirani, *Rec. Indian Mus.*, 50: 427.
 1964. *Sternolopus (s. str.) rufipes*: Sato & Miyataka, *Rep. Comm. For. Sci. Res. Kyushu Univ.*, no. 2: 140.

Material.—7 ex., Port Blair, 1.iv.1969.

Remarks.—This species is widely distributed in S. E. Asia, but it is now being recorded from the Andaman Islands for the first time

10. **Regimbartia attenuata** (Fabricius)

1801. *Hydrophilus attenuata* Fabricius, *Syst. Eleuth.*, 253 (Ceylon).
 1928. *Regimbartia attenuata*: Orchymont, *Cat. Indian Ins.*, pt. 14: 138.
 1952. *Regimbartia attenuata*: Vazirani, *Rec. Indian Mus.*, 50: 428.

Material.—13 ex., Port Blair, 1.iv.1969.

Remarks.—Though widely distributed in India and S. E. Asia (including Japan) and Australia, it is now being recorded from Andaman Islands for the first time.

SUMMARY

One species of Gyrinidae, seven species Dytiscidae and two species of Hydrophilidae are reported in this paper. Four species viz. *Gyrinus smaragdinus* Regimbart, *Hydaticus leechi* Sato, *Sternolopus (s. str.) rufipes* (Fabricius) are being recorded from Andaman Islands, for the first time. Subspecies and forms of *leechi* named by Sato (1961), are not recognized here.

A STUDY OF THE FRESHWATER AND ESTUARINE
FISHES OF GOA

2. NOTES ON THE FISHES FOUND WITHIN THE
TERRITORY OF GOA

By

RAJ TILAK

Zoological Survey of India, Calcutta

(With 2 Text-figures)

INTRODUCTION

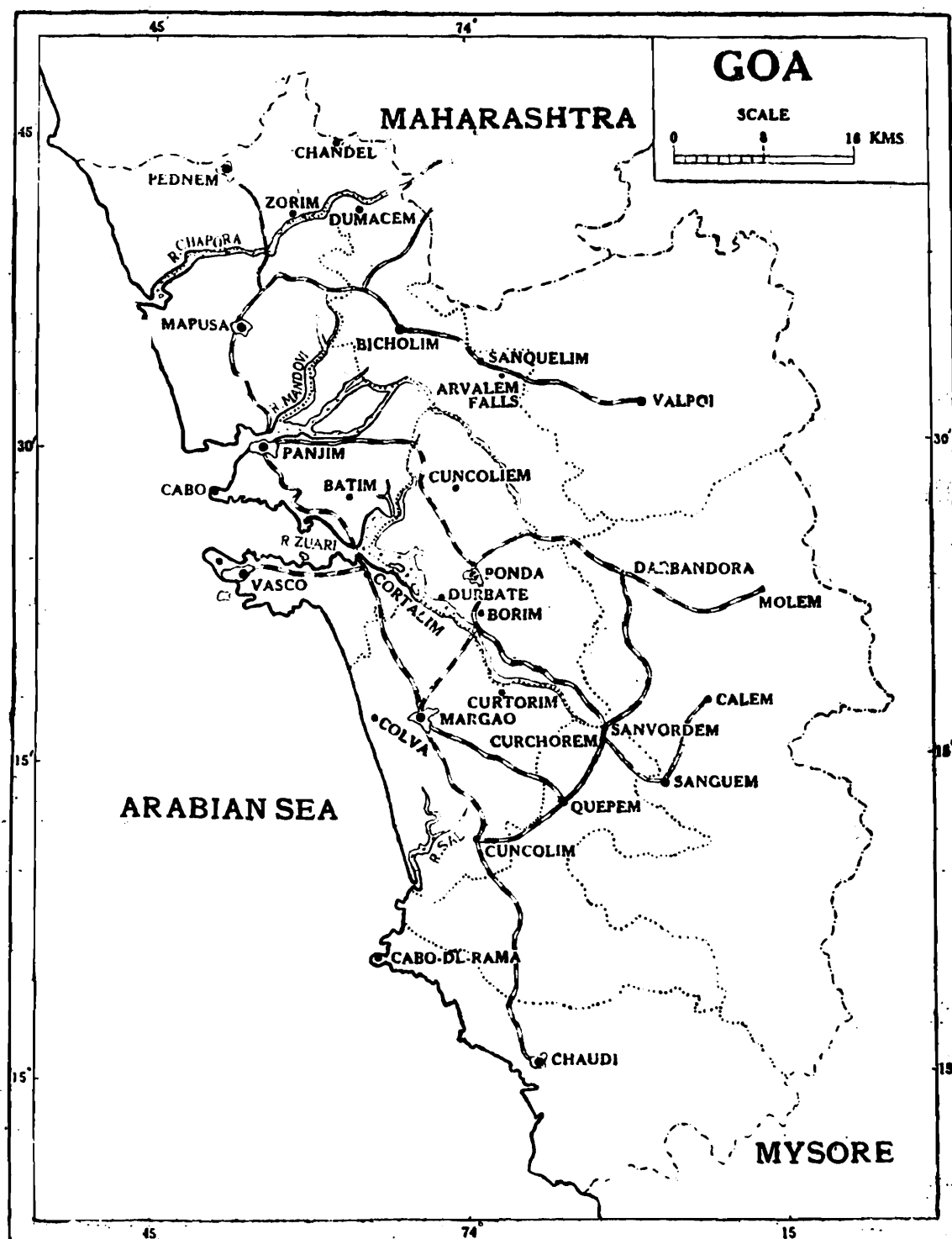
The fauna of Goa has not been surveyed in the past and no information is available. Recently, Zoological Survey of India, and Department of Zoology, Panjab University, Chandigarh have independently and almost simultaneously taken up the survey of the fauna of Goa : Department of Zoology, Panjab University, Chandigarh concentrating only on the marine fauna (Menon et al., 1967 ; Tandon et al., 1967) whereas Zoological Survey of India, Calcutta has made efforts to collect and study marine, freshwater and terrestrial animals.

Through extensive surveys during 1966-69, Zoological Survey of India, Calcutta has obtained a good collection of fishes from fresh- and estuarine waters of Goa and the same have been studied here in detail. There have been a few records of individual species of fishes from Goa : they have been mostly marine fishes (Cuvier, 1829 and Koumans, 1941). Tandon et al. (1967) have given a list of 53 species of marine fishes collected from the in-shore area of Goa. The only freshwater fish, so far recorded from Goa is *Silurus goae* Haig (Haig, 1950).

In the present paper, a record of 51 species from fresh- and estuarine waters of Goa has been made for the first time, thereby putting altogether 52 species on record from this area. A new species of a cobitid (Tilak, in press) and a new sub-species of a cyprinid have been described. The existence of the genus *Acanthophthalmus* in Goa establishes an interesting record of this genus from South-Western India. Many of the other species recorded are taxonomically important. The fish fauna of Goa is of zoogeographical important.

SYSTEMATIC LIST

The fishes are arranged below according to the classification of teleostean fishes by Greenwood et al. (1966). The material of all these species has been studied by the author except that of *Silurus goae* Haig which is included in the list from literature.



Text-fig. 1. Map of Goa, showing important places and localities where collections have been made.

Superorder **ELOPOMORPHA**

Order : **ANGUILLIFORMES**

Suborder : ANGUILLOIDEI**Family : OPHICHTHIDAE**

- (1) *Pisoodonophis boro* (Hamilton)

Superorder CLUPEOMORPHA**Order : CLUPEIFORMES****Suborder : CLUPEOIDEI****Family : CLUPEIDAE**

- (2) *Hilsa (Hilsa) kelee* (Cuvier)
- (3) *Anodontostoma chacunda* (Hamilton)
- (4) *Nematolosa nasus* (Bloch)

Family : ENGRAULIDAE

- (5) *Thrissocles malabaricus* (Bloch)
- (6) *Anchoviella tri* (Bleeker)

Superorder OSTARIOPHYSI**Order : CYPRINIFORMES****Suborder : CYPRINOIDEI****Family : CYPRINIDAE**

- (7) *Garra mullya* (Sykes)
- (8) *Tor putitora* (Hamilton)
- (9) *Puntius filamentosus* (Valenciennes)
- (10) *Puntius amphibius* (Valenciennes)
- (11) *Puntius vittatus* Day
- (12) *Puntius phutunio* Hamilton
- (13) *Puntius sarana subnasutus* (Valenciennes)
- (14) *Puntius sarana orphoides* (Valenciennes)
- (15) *Puntius melanampyx pradhani*, sub. sp. nov.
- (16) *Rasbora daniconius daniconius* (Hamilton)
- (17) *Danio malabaricus* (Jerdon)
- (18) *Oxygaster boopis* (Day)
- (19) *Chela (Neochela) dadyburjori* (Menon)

Family : COBITIDAE

- (20) *Lepidocephalus thermalis* (Valenciennes)
- (21) *Lepidocephalis guntea* (Hamilton)
- (22) *Acanthophthalmus goaensis* Tilak
- (23) *Noemacheilus botia* (Hamilton)

Order : SILURIFORMES**Family : SILURIDAE**

- (24) *Ompok bimaculatus* (Bloch)
- (25) *Silurus goae* Haig

Family : BAGRIDAE

(26) *Mystus malabaricus* (Jerdon)

Superorder **ATHERINOMORPHA**

Order : ATHERINIFORMES

Suborder : *EXOCOETOIDEI*

Family : EXOCOETIDAE

(27) *Zenarchopterus striga* (Blyth)

Family : BELONIDAE

(28) *Belone cancila* (Hamilton)

Family : CYPRINODONTIDAE

(29) *Aplocheilus blocki* (Arnold)

(30) *Aplocheilus lineatum* (Valenciennes)

Superorder **ACANTHOPTERYGII**

Order : CHANNIFORMES

Family : CHANNIDAE

(31) *Channa orientalis* (Bloch & Schneider)

(32) *Channa punctatus* (Bloch)

Order : PERCIFORMES

Suborder : *PERCOIDEI*

Family : CENTROPOMIDAE

(33) *Chanda interrupta* (Bleeker)

(34) *Chanda gymnocephalus* (Lacépède)

(35) *Chanda thomassi* (Day)

Family : CICHLIDAE

(36) *Etroplus suratensis* (Bloch)

(37) *Etroplus maculatus* (Bloch)

Family : SCATOPHAGIDAE

(38) *Scatophagus argus* (Linnaeus)

Family : SCIANIDAE

(39) *Johnius belengerii* (Cuvier)

Family : LUTJANIDAE

(40) *Lutjanus johnii* (Bloch)

(41) *Pomadasys hasta* (Bloch)

Suborder : *MUGILOIDEI*

Family : MUGILIDAE

(42) *Mugil parsia* Hamilton

Suborder : *BLENNIOIDEI*

Family : BLENNIIDAE

(43) *Petroscirtes bipunctatus* Day

(44) *Petroscirtes punctatus* (Valenciennes)

Suborder : **GOBIOIDEI**Family : **GOBIIDAE**

- (45) *Glossogobius giuris* (Hamilton)
- (46) *Awaous grammepomus* (Bleeker)
- (47) *Bathygobius fuscus* (Rüppell)
- (48) *Periophthalmus dipus* Bleeker
- (49) *Periophthalmus variabilis* Eggert
- (50) *Eleotris andamensis* Herre

Suborder : **ANABANTOIDEI**Family : **OSPHRONEMIDAE**

- (51) *Macropodus cupanus* (Valenciennes)

Suborder : **MASTACEMBELOIDEI**Family : **MASTACEMBELIDAE**

- (52) *Mastacembelus armatus* (Lacépède)

SYSTEMATIC NOTES

(1) **Pisoodonophis boro** (Hamilton)

1822. *Ophisurus boro* Hamilton, *Fishes of Ganges*: 20, 363. (Type-locality: estuaries near Calcutta.)

1878. *Ophichthys boro*, Day, *Fishes of India*: 664.

Material.—(i) 2 exs. (283-315 mm. total length), Zuari river, 5 Kms. from Ponda, Durbate, Goa, 17.iv.1966, K. S. Pradhan, Coll.

Distribution.—Marine and estuarine waters of India and Malaya Archipelago, South Africa, Siam, Formosa, China, Philippines, Melanesia etc.

(2) **Hilsa (Hilsa) kelee** (Cuvier)

1829. *Clupea kelee* Cuvier, *Regne Animal*, Ed. 2, 2: 320 (Type-locality: Vizagapatam.)

1965. *Hilsa (Hilsa) kelee*, Whitehead, *Bull. Brit. Mus.*, (N.H.), zool., 12(4): 129.

Material.—(i) 20 exs. (78-88 mm. total length) River Mandovi, near ferry jetty, Betim, Goa (purchased), 29.iii.1966. (ii) 1 ex. (107 mm. total length) Zuari river, near Berim bridge, Goa, 1.iv.1966, all K. S. Pradhan, Coll.

Remarks.—The material agrees with the generic description of *Hilsa* but differs with the subgenus *Hilsa* in the following points.

(i) The gill rakers on the outer hemibranch of the first arch are more than half the length of those on the inner hemibranch.

- (ii) The lateral blotches or a humeral spot are absent.
- (iii) The unbranched rays of the dorsal fin bear a black blotch at the base and the upper half of the fin is dusky black. The tip of the caudal fin is also stained black.
- (iv) The length of the maxilla is smaller than the preorbital length.

Distribution.—Coasts of India, Burma, Siam, Natal, east African coast, Gulf of Aden etc.

(3) *Anodontostoma chacunda* (Hamilton)

1822. *Clupanodon chacunda* Hamilton, *Fishes of Ganges*: 246, 383 (Type-locality: Gangetic estuary.)

1878. *Chatoessus chacunda*, Day, *Fishes of India*: 632.

Material.—(i) 1 ex. (77 mm. total length), Zuari river, near Barim bridge, Goa, 1.iv.1966, K. S. Pradhan, Coll.

Distribution.—Estuaries of Ganges and coasts of India, Andaman, Burma, Malaya Archipelago, Siam, Philippines, Melanesia etc.

(4) *Nematalosa nasus* (Bloch)

1795. *Clupes nasus* Bloch, *Naturg. Ausland. Fische.*, 9: 116 (Type-locality: Malabar.)

1917. *Nematalosa nasus*, Regan, *Ann. Mag. nat. Hist.*, (8) 19: 312.

Material.—(i) 1 ex. (112 mm. total length), Zuari river at Cortalim, Goa, 12.iv.1966, K. S. Pradhan Coll.

Distribution.—Estuaries and seas of India, Burma, Ceylon, Iraq, Philippines etc.

(5) *Thrissocles malabaricus* (Bloch)

1795. *Clupea malabaricus* Bloch, *Naturg. Ausland. Fische.*, 9: 155 (Type-locality: Tranquebar.)

1878. *Engraulis malabaricus*, Day, *Fishes of India*: 625, pl. CLVII, fig. 5.

Material.—(i) 1 ex. (135 mm. total length), Zuari river, Goa, 11.iv.1966, K. S. Pradhan Coll.

Distribution.—Coasts and estuaries of Pakistan and India, Celebes etc.

(6) *Anchoviella tri* (Bleeker)

1852. *Engraulis tri* Bleeker, *Verh. Bat. Gen.*, 24: 40 (Type-locality: Batavia.)

1878. *Engraulis tri*, Day, *Fishes of India*: 630, pl. CLVII, fig. 6.

Material.—(i) 1 ex. (120 mm. total length), Zuari river, Cortalim, Goa, 11.iv.1966, K. S. Pradhan Coll.

Distribution.—Seas and estuaries of India, Pakistan, Malaya Peninsula, Malaya Archipelago, Philippines etc.

(7) *Garra mullya* (Sykes)

1839. *Chondrostoma mullya* Sykes, *Trans. zool. Soc. London*, 2: 359. (Type-locality: Beema river at Dounde.)

1964. *Garra mullya* Menon, *Mem. Indian Mus.*, 14: 212.

Material.—(i) 1 ex. (96 mm. total length), Chandi village, 64 kms. off Ponda, 24.ix.1969, R. C. Sharma Coll. (ii) 1 ex. (37 mm. total length) Cabo-de-Rama, 17.xi.1967, K. S. Pradhan Coll.

Distribution.—Throughout India except Himalaya.

(8) *Tor putitora* (Hamilton)

1822. *Cyprinus putitors* Hamilton, *Fishes of Ganges*: 303, 388. (Type-locality: Eastern parts of Bengal.)

1878. *Barbus tor* (in part), Day, *Fishes of India*: 564.

Material.—(i) 1 ex. (124 mm. total length), Khardeper river, Valpoi, September, 1969, J. Rangel Coll.

Remarks.—The fish is rare in the area and is occasionally captured from rivers. It is characterised by the presence of a continuous labial fold below the chin, large scales on the body, four barbels, last undivided ray of the dorsal strong and smooth and the length of the head more than the height of the body. It is an important commercial fish.

Distribution.—Freshwaters of Punjab. Uttar Pradesh, Himalaya. Bengal. Goa, Pakistan etc.

(9) *Puntius filamentosus* (Valenciennes)

1844. *Leuciscus filamentosus* Valenciennes (in Cuvier & Valenciennes), *Hist. Nat. Poiss.*, 17: 96. (Type-locality: Alleppey.)

1844. *Leuciscus mahecola* Valenciennes (in Cuvier & Valenciennes), *Hist. Nat. Poiss.*, 17: 305, pl. 502.

1868. *Barbus mahecola*, Day, *Fishes of India*: 575, pl. CXL, fig. 5.

1878. *Barbus filamentosus*, Day, *Fishes of India*: 582.

Material.—(i) 24 exs. (69-102 mm. total length), a tributary of Chapora river, near Kansarverman Forest Nursery in Chandel village, Pernem, Goa, 22.xi.1967, K. S. Pradhan & party Coll. (ii) 1 ex. (98 mm. total length), Valus river, 17.ix.1969, R. C. Sharma Coll. (iii) 4 exs. (70-92 mm. total

length), Arvalem water falls, Goa, 28.xi.1967, K. S. Pradhan & party Coll.

Remarks.—Hora (1937) and Hora and Law (1941) have clearly shown that in *Puntius filamentosus* there is marked sexual dimorphism. The males have a few anterior dorsal rays elongated and the snout bears tubercles while these are absent in the females. They have further mentioned that the presence or absence of barbels has no importance. Munro (1955) and Misra (1959) have considered *filamentosus* and *mahecola* synonymous.

Regarding the identity of *P. mahecola* and *P. filamentosus* Day (1878) mentioned 'It is remarkable how very similar the *Barbus Mahicola*, C. V which has 2 barbels, is to the *B. filamentosus*, C. V with none. If a number of examples are examined it will be found that in some these appendages are very minute, the barbels being, as a rule, smallest in specimens obtained further from the hills. In South Canara, the Wynaad, and base of the Neilgherries, where the barbels are large, the *B. Mahicola* abounds : towards Cochin and up the Coromandel coast as far as Madras they are small or absent, and the *B. filamentosus* is the type. Here, undoubtedly, the question must force itself on one's notice, are we dealing with two distinct species, or one in a state of transition ? If the latter, which is the original form ?' In the present material there are specimens with maxillary barbels of different sizes as well as those with only rudiments of these barbels. The last undivided ray of the dorsal fin is weak and jointed. The lateral line is complete. The colouration is very characteristic of the species. The present material contains only female examples.

Distribution.—Freshwaters of Madras, Travancore-Cochin, Mysore, Goa, Ceylon.

(10) *Puntius amphibius* (Valenciennes)

1842. *Capoeta amphibia* Valenciennes (in Cuvier & Valenciennes), *Hist. Nat. Poiss.*, 16 : 282 (Type-locality : Bombay.)

1878. *Barbus amphibius*, Day, *Fishes of India* : 574, pl. CXLII, fig. 8.

Material.—(i) 3 exs. (37-40 mm. total length), a pool in paddy fields, 2 Kms. North-west of Ponda, 14.xi.1967, K. S. Pradhan & party Coll. (ii) 1 ex. (67 mm. total length), Colva road, in a shallow pool of water. Goa, 14.iv.1966, K. S. Pradhan Coll.

Remarks.—This fish is found in abundance in majority of

waters. It is characterised by the presence of two maxillary barbels, the last undivided ray of the dorsal fin weak and articulated and with a dark mark at the base of the caudal fin.

Distribution.—Freshwaters of whole of India (except Himalaya), Ceylon.

(11) *Puntius vittatus* Day

1865. *Puntius vittatus* Day, *Proc. zool. Soc. London*: 303. (Type-locality: Malabar.)

1878. *Barbus vittatus*, Day, *Fishes of India*: 582, pl. CXLIV, fig. 2.

Material.—(i) 5 exs. (35-45 mm. total length), Colva road, Goa, 14.iv.1966, K. S. Pradhan Coll. (ii) 5 exs. (24-29 mm. total length), Cabo-de-Rama, Goa, 17.xi.1967, K. S. Pradhan & Party Coll. (iii) 8 exs. (27-32 mm. total length), Margao, Goa, 25.iii.1968, K. C. Pradhan & Party Coll. (iv) 1 ex. (10 mm. total length), a pond in paddy field, near Colva, Goa, 10.xi.1967, K. S. Pradhan & Party Coll. (v) 35 exs. (21-38 mm. total length), a stagnant pool, South-west of Govt. Rest House, Margao, 23.iii.1966, K. S. Pradhan Coll.

Remarks.—There are only two small examples of this species from Shimoga in the collections of Zoological Survey of India, Calcutta and they are in a bad state of preservation and do not serve a good comparative material. Day (1865, 1878) has not described a dark spot at the anal aperture. Moreover, dark spots anterior to the dorsal fin, below its posterior margin and at the base of the anal are not found in any of the specimens studied in the present collection. The material studied here shows the following characters which require mention. (i) There is a silvery band extending from the operculum to the base of the caudal (ii) There is a dark spot at the base of the dorsal fin in some specimens. (iii) A dark vertical band arises from the base of the 7th dorsal ray and ascends to the top of the anterior dorsal undivided ray. (iv) There is a dark spot at the base of the caudal fin and another at the anus. (v) There is a pair of rudimentary maxillary barbels in some specimens.

Distribution.—Mysore, Wynaad, Madras, Goa, Cutch, Malabar, Ceylon.

(12) *Puntius phutunio* Hamilton

1822. *Cyprinus phutunio* Hamilton, *Fishes of Ganges*: 319, 390. (Type-locality: Ponds of North-east Bengal.)

1878. *Barbus phutunio*, Day, *Fishes of India*: 578, pl. CXLI, fig. 6.

Material.—(i) 2 exs. (26-27 mm. total length), a stream, 1.5 Kms. South-east of Colem Rly. Station, 3.iv.1966, K. S. Pradhan Coll.

Remarks.—The height of the body lies from 2.9-3.5 times in total length. The eye diameter lies 2.4 times in head, nearly half of the snout and equal to the interorbital width. There are 4 vertical bands on the body; the first runs from the back to near the middle of the pectoral fin, the second from the end of the dorsal to the middle of the body, the third from the back to above the end of anal and the fourth a faint one at the base of the caudal. The fins bear no markings.

Distribution.—Orissa, Assam, Bengal, Goa, and Burma.

(13) *Puntius sarana subnasutus* (Valenciennes)

1842. *Barbus subnasutus* Valenciennes (in Cuvier & Valenciennes), *Hist. Nat. Poiss.*, 16: 154. (Type-locality: Pondichery.)

1963. *Puntius sarana subnasutus*, Menon, *Spol. zeyl.*, 30: 69.

Material.—(i) 4 exs. (80-96 mm. total length), Arvalem water falls, Goa, 28.xi.1967, K. S. Pradhan & party Coll.

Remarks.—In the material studied, there is a dark spot before the caudal fin, the spot being deep coloured and prominent. There is a small black spot at the base of the undivided rays of the dorsal. There are 7-8 dark longitudinal rows of spots on the sides. The pharyngeal teeth are crooked at the tips and number 5-3-2/2-3-5.

Distribution.—Peninsular India, Goa etc.

(14) *Puntius sarana orphoides* (Valenciennes)

1842. *Barbus orphoides* Valenciennes (in Cuvier & Valenciennes), *Hist. Nat. Poiss.*, 16: 193. (Type-locality: Java.)

1963. *Puntius sarana orphoides*, Menon, *Spol. zeyl.*, 30: 69.

Material.—(i) 1 ex. (111 mm. total length), Valus river, 8 Kms. east of Forest Rest House, Valpoi, Goa, 16.ix.1969.
(ii) 4 exs. (78-107 mm. T.L.), Valus R., Goa. 17.9.1969, all R. C. Sharma Coll.

Remarks.—The species *P. caudomarginatus*, *P. sewelii* and *P. myitkyinae* are synonymous with this species. The specimens under study have 26 scales in the lateral line, the spine of the dorsal fin is finely serrated posteriorly in 2/3rd of its upper part, a black spot is present at the base of the caudal, the tips of the anal, dorsal and caudal fins are black and there are 6/6

scales in the transverse series. The presence of this species in Goa is of zoogeographical importance.

Distribution.—Manipur, Goa, Burma, Java, Borneo and Siam.

(15) ***Puntius melanampyx pradhani***, subsp. n.

(Text-figs. 2-4)

B III, D $3\frac{3}{8}$, P $1\frac{1}{13-14}$, V $1\frac{1}{8}$, A $3\frac{3}{5}$, C 19

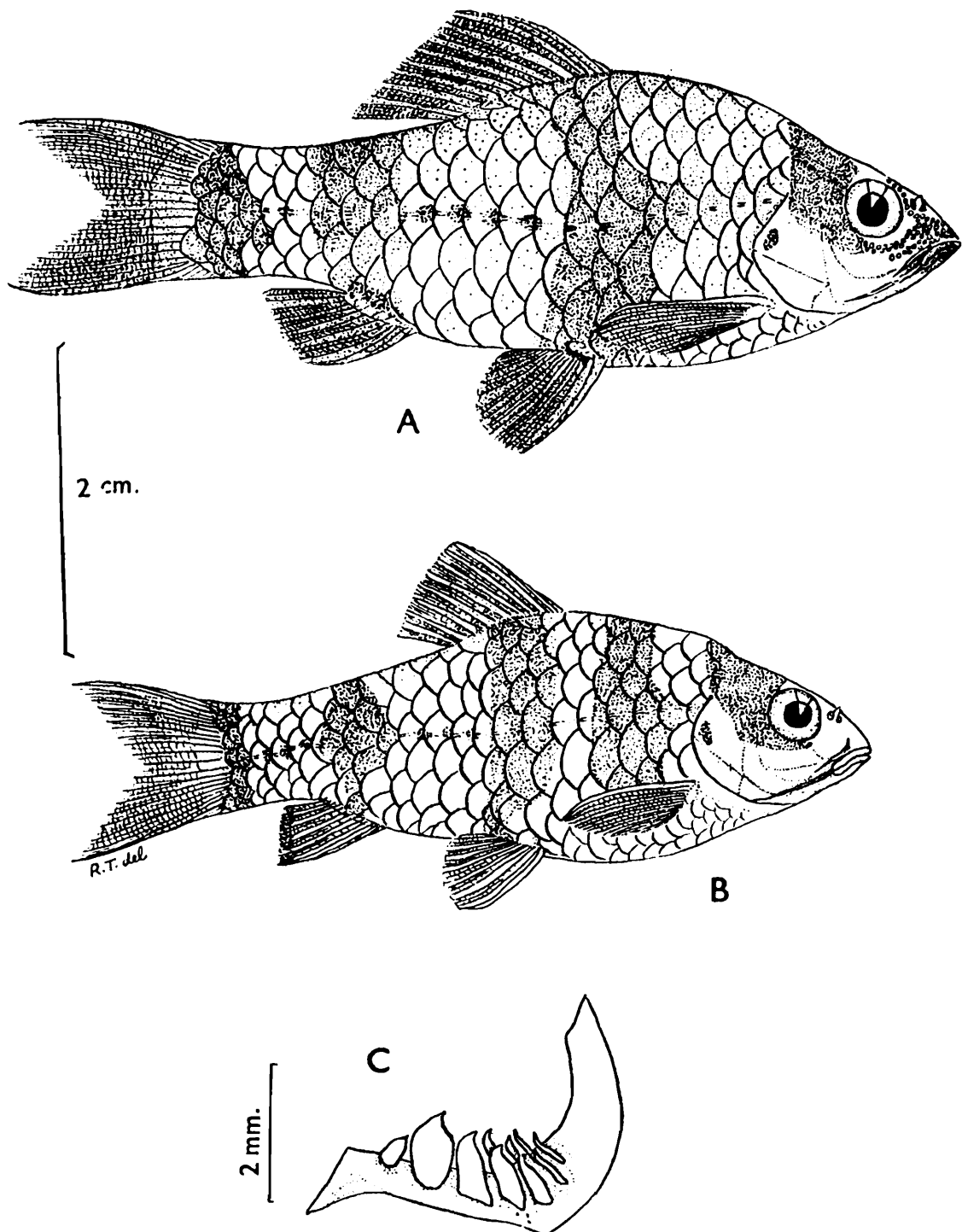
Lat. Line scales : 19-20

Lat. tr. scales : $4\frac{1}{3}$

Pharyngeal teeth : 5-3-2/2-3-5

The body is laterally compressed with the dorsal profile more arched than the ventral. Behind the head, the profile abruptly rises up to the base of the dorsal fin and thereafter it gradually falls till the base of the caudal fin. The length of head lies 4.1-4.58 times in the total length and 3.2-3.58 times in the standard length. The diameter of the eye lies 2.83-3.42 times in the length of head. The snout is pointed; its length lies 2.43-2.87 times in the length of the head. The snout is shorter than or equal to the eye diameter in younger examples (being 0.83-1.08 times of eye diameter) and longer than eye diameter in mature examples (being 1.12-1.14 times of eye). In the male example there are numerous small tubercles on the snout; the rows of tubercles extend back around the front margin of eye as well as below it upto its middle. The female examples are devoid of these tubercles. The interorbital space is almost flat and is 1.14-1.28 times of the eye diameter. The height of the body lies 3.2-3.66 times in the total length and 2.5-2.86 times in standard length. There are two pairs of barbels; the rostral barbels are shorter while the maxillary ones are nearly 1.5 times longer than the eye. The height of the dorsal fin and the length of its base are almost equal and lie 5.0-6.5 times in the total length and 4.6-5.0 times in the standard length. The origin of the dorsal fin lies opposite that of the ventrals and is placed nearer the snout tip than the base of the caudal. The labial fold is interrupted. The last undivided ray of the dorsal fin is weak and articulated. The paired and median fins look more developed and sturdy in the male than in the female. The pectoral fin is equal to the length of head excluding the snout in the female and a somewhat

longei in the male. The pectoral does not reach the base of the ventral in the female but it just does so in the male. The caudal is deeply forked with both the lobes equal.



Text-fig. 2. A. *Puntius melanampyx pradhani*, subsp. n.—Male. B. *Puntius melanampyx pradhani*, subsp. n.—Female. C. *Puntius melanampyx pradhani*, subsp. n.—Pharyngeal teeth and bone.

The pharyngeal teeth are arranged in 3 rows and have pointed and curved tips. The lateral line is complete and pierces through 19-20 scales. The last scale of the longitudinal series lies at the base of the caudal rays. There are 7 scales in

front of the dorsal fin and 12 around the caudal peduncle. There are 3 scales between the lateral line and base of the ventral fin. The height of the caudal peduncle lies 1.00-1.14 times in its length.

Colour : There is a marked sexual dimorphism in this species in colouration as well as in other characters.

The female.—There are five colour bands on the body. The first deeply dark band runs across the nape and, on each side, runs along the posterior margin of the eye. The second band starts from the back nearly 2 scales in front of the base of the dorsal and runs downwards to the middle of the pectoral fin. The third band originates from the base of the anterior four divided rays of the dorsal fin and runs down to behind the base of the pelvic and joins its counterpart of the other side on the ventral side, thus encircling the body completely. The fourth band starts from the back, nearly 2 scales behind the end of the base of the dorsal fin and runs down to the base of the posterior part of the anal fin. The fifth band lies at the base of the caudal fin and its width is equal to the last two scales. In addition to the bands, there are dark spots at the bases of the scales, particularly those along the lateral line, giving the appearance of a row of dark spots. There is a black spot on the operculum. The anterior rays of the dorsal fin are dusky while the tips of both dorsal and anal fins are black. The ventral side of the body is yellowish except a dark band behind the origin of the ventrals.

The male.—The colouration of the male differs from that of the female in the following points.

The tip of the snout, the upper and the lower jaws are darkened stained. The second and the third bands of the body have almost fused with one another. The band at the base of the caudal is broader, covering 3 last scales. The dorsal, the ventrals and the anal fins are uniformly dark with their tips deeply stained. The pectoral and the caudal fins are dusky. The third band extends to the ventral side of the body and covers the area one scale in front and one scale behind the base of the ventral fins.

Material.—Holotype : female (51 mm. total length), Regd. No. Z.S.I.F 6164/2 ; Locality : A stream at Molem, 2 Kms. north-east of Forest Rest House, Goa ; Collector : K. S. Pradhan & party, 21.xi.1967

Paratype : (i) 1 example (59 mm. total length), male,

Regd. No. Z.S.I.F. 6165/2 : Locality : A stream at Molem, 2 Kms. north-east of Forest Rest House, Goa ; Collector : K. S. Pradhan & party, 21.xi.1967.

(ii) 12 examples (35-55 mm. total length), females, Regd. No. Z.S.I.F. 6166/2 ; Locality : Arvalem water falls, Goa ; Collector : K. S. Pradhan, 28.iii.1966.

(iii) 2 examples (25-32 mm. total length), females, Regd. No. Z.S.I.F. 6167/2 ; Locality : a river, uphill, south-west of market at Sanguem, Goa ; Collector : K. S. Pradhan & party, 19.xi.1967

Relationships.—In colouration and shape of the body, the present fish resembles *Puntius pentazona* (Boulenger) but differs in meristic and morphometric characters. Moreover, the last undivided ray of the dorsal fin in *P. pentazona* is strong and posteriorly serrated while that of the present fish is weak and unserrated. The present species has an apparent resemblance with *Puntius nigrofasciatus* (Günther) and *Puntius tetrazona* (Bleeker), although they differ in many important respects. It appears doubtful whether *Puntius singhala* (Duncker) is a Ceylonese subspecies of *melanampyx* because the former lacks barbels while the latter has two well developed pairs.

Chromatic dimorphism has been reported in *Puntius melanampyx* (Day) by Misra (1938) and the same has been confirmed by Hora and Law (1941) and Menon (1961). Hora and Law (1941) reported certain variations in the colouration of the species. The colouration of this species, described by Day (1878), is of the female specimen according to Misra (1959) and Menon (1961) ; Day (1878) has, however, described pores on snout of this fish which indicates that he had male examples also.

The present subspecies differs from *Puntius melanampyx melanampyx* (Day) in the following characters.

(1) The diameter of eye lies 1.14-1.28 times in the inter-orbital width in *pradhani* whereas they are equal in *melanampyx*.

(2) The length of the base of and the height of the dorsal fin in *pradhani* lie 5.9 times in the total length and 4.6 times in the standard length respectively in the male and 6.00-6.5 times in total length and 4.7-5.2 times in standard length respectively in the female examples. On the contrary, in *P. melanampyx melanampyx*, according to Menon (1961), the

length of the dorsal fin lies 3.5-3.75 times in the total length in males and 4.0-4.5 times in the females.

In addition to the above differences, *pradhani* differs from *melanampyx* in colouration.

(1) In the females, there is an additional dark band in front of the dorsal fin. The same is absent in *melanampyx*.

(2) In the male, the two bands, one in front and the other below the dorsal fin, merge into a single wide band whereas the bands on the nape, behind the dorsal and at the base of the caudal fin remain separate. In *melanampyx*, on the other hand, the band below the dorsal fin and above the anal fin merge with one another and only the one on the nape and the other one on the caudal are free.

(16) *Rasbora daniconius daniconius* (Hamilton)

1822. *Cyprinus daniconius* Hamilton, *Fishes of Ganges*: 327, 391.
(Type-locality: rivers of southern Bengal.)

1954. *Rasbora daniconius daniconius*, Brittan, *Monogr. Inst. Sci. & Tech.*, 3: 135.

Material.—(i) 1 example (76 mm. T.L.), a stream 2 Kms. north-east of Forest Rest House, Molem, Goa, 21.xi.67, K. S. Pradhan & party Coll. (ii) 1 example (47 mm. T.L.), a shallow pond, 1 Km. west of Kanservernem Forest Nursery, Pernem, Goa, 22.xi.67, K. S. Pradhan & party Coll. (iii) 1 ex. (46 mm. T.L.), Colem R. near Bridge, Goa, 23.xi.1967, K. S. Pradhan & party Coll. (iv) 5 exs. (31-41 mm. T.L.), a pool in paddy fields, 3 Kms. west of Ponda, Goa, 14.xi.1967, K. S. Pradhan & party Coll. (v) 2 exs. (57-71 mm. T.L.), a shallow pond at Colva road, Goa, 14.xi.1966, K. S. Pradhan Coll. (vi) 3 exs. (44-45 mm. T.L.), an uphill stream, Cabo-de-Rama, Goa, 17.xi.1967, K. S. Pradhan & party Coll. (vii) 1 ex. (42 mm. T.L.), a river at Bicholim, Goa, 12.iv.1966, K. S. Pradhan Coll. (viii) 2 ex. (42 mm. T.L.), Arvalem water falls, Goa, 28.iii.1966, K. S. Pradhan Coll. (ix) 1 ex. (46 mm T.L.), 3 Kms. east of Rest House at Margao, Goa, 25.iv.1966, K. S. Pradhan Coll. (x) 1 ex. (98 mm. T.L.), Chandi village, 64 Kms. off Ponda, 24.ix.1969, R. C. Sharma Coll. (xi) 2 exs. (58-75 mm. T.L.), Valus river, Goa, 17.ix.1969, R. C. Sharma Coll.

Remarks.—The species is characterised by the presence of a symphysial knob in the lower jaw fitting into a notch in the upper jaw, a dark lateral band on the body and the lower lip

without lateral extensions. It is an important larvivorous fish and is found in majority of the ponds and nullas.

Distribution.—Freshwaters throughout India, Pakistan, Ceylon. Burma. Malaya etc.

(17) **Danio malabaricus** (Jerdon)

1849. *Perilampus malabaricus* Jerdon, *Madras J. Litt. & Sci.*, **15**: 325 (Type-locality: Madras.)

1878. *Danio malabaricus*, Day, *Fishes of India*: 595, pl. CL, fig. 7.

Material.—(i) 23 exs. (51-82 mm. total length), a tributary of river Chapora, Pernem, Goa, 22.xi.1967, K. S. Pradhan Coll. (ii) 1 ex. (75 mm. total length), Arvalem water falls, Goa, 28.xi.1967, K. S. Pradhan & party Coll. (iii) 32 exs. (56-70 mm. total length), a river flowing along a hill near market at Sanguem, Goa, 19.xi.1967, K. S. Pradhan & party Coll. (iv) 6 exs. (54-92 mm. total length), Chandi village, 64 Kms. off Ponda, 24.ix.1969, R. C. Sharma Coll. (v) 1 ex. (80 mm. total length), Valus river, Goa, 17.ix.1969, R. C. Sharma Coll.

Remarks.—There are 11-13 branched rays in the dorsal fin and 15-17 in the anal. In a specimen from Sanguem, the anal fin has 18 branched rays, a number not known to be present in any of the Indian forms of the genus. The pectoral fins are almost equal to the length of head. The curved pharyngeal bone bears 3 rows of conical teeth (5-4-2) on each side although Day (1878) recorded 5-3-2 for this genus. The barbels are small and the lateral line is complete.

Distribution.—Peninsular India and Ceylon.

(18) **Oxygaster boopis** (Day)

1873. *Chela boopis* Day, *Proc. zool. Soc. London*: 708. (Type-locality: South Canara.)

1878. *Chela boopis*, Day, *Fishes of India*: 602, pl. CLII, fig. 4.

Material.—(i) 4 exs. (35-71 mm. total length), a tributary of river Chapora, Pernem, Goa, 22.xi.1967, K. S. Pradhan & party Coll.

Remarks.—The material resembles the description of this species by Day (1878) but differs in having the height of the body less than the length of the head, being 5.46-5.54 times in total length (Vs/ 5.0-5.25 times in total length). The pharyngeal teeth are conical and arranged in three rows (5-4-2/2-4-5).

Distribution.—South Canara, Mysore, Goa etc.

(19) **Chela (Neochela) dadyburjori** (Menon)

1951. *Laubuca dadyburjori* Menon, *Rec. Indian Mus.*, **49**(1): 1. (Type-locality: Cochin.)
1958. *Chela (Neochela) dadyburjori*, Silas, *J. Bombay nat. Hist. Soc.*, **55**: 54.

Material.—(i) 1 ex. (27 mm. total length), from a pond in paddy field, Colva road, Goa, 14.iv.1966, K. S. Pradhan Coll. (ii) 1 ex. (29 mm. total length), from a pool of water, Concalim, Goa, K. S. Pradhan Coll. (iii) 4 exs. (29-33 mm. total length), a pond at Colva road, Goa, 14.iv.1966, K. S. Pradhan Coll. (iv) 3 exs. (25-30 mm. total length), a pond 3.5 Kms. south-east of Rest House at Margao, 25.iv.1966, K. S. Pradhan Coll. (v) 1 ex. (29 mm. total length), about 5 Kms., south-west of Govt. Rest House, Margao (from a stagnant pond), Goa, 23.iii.1966, K. S. Pradhan Coll.

Remarks.—The material studied here resembles the description of *C. (N.) dadyburjori* (Menon) but shows differences. In many of the specimens there are no spots, probably they have all merged with one another and formed a straight band extending from the posterior margin of the operculum to the base of the caudal. Those examples which have spots, have only two. The colouration of species is variable to a great extent as is seen in the present material. The length of head lies 4.18-4.5 times in total length (Vs. 3.4-4.0 times), the eye diameter lies 2.25-2.72 times (Vs. 3.0-3.5 times) in head length and height of the body lies 3.94-5.5 times in total length (Vs. 4.1-4.4 times).

Distribution.—Streams, tanks and pools of Cochin, Travandrum, Kerala and Goa.

(20) **Lepidocephalus thermalis** (Valenciennes)

1846. *Cobitis thermalis* Valenciennes (in Cuvier & Valenciennes), *Hist. Nat. Poiss.*, **18**: 78. (Type-locality: Ceylon.)
1968. *Lepidocephalus thermalis*, Banarescu & Nalbant, *Mitt. Hamburg. Zool. Mus. Inst.*, **65**: 346.

Material.—(i) 1 ex. (47 mm. total length), from a pond in paddy field, 3 Kms. north-west of Ponda, 14.xi.1967, K. S. Pradhan & party Coll.

Remarks.—The material examined here resembles the description of the species given by Day (1878) and Banarescu & Nalbant (1968). The length of head lies 6 times in total length.

Distribution.—Peninsular India, Goa.

(21) **Lepidocephalus guntea** (Hamilton)

1822. *Cobitis guntea* Hamilton, *Fishes of Ganges*: 353, 394. (Type-locality: Ponds and freshwater rivers of Bengal.)

1968. *Lepidocephalus guntea*, Banarescu & Nalbant, *Mitt. Hamburg Zool. Mus. Inst.*, **65**: 343.

Material.—(i) 2 exs. (57-64 mm. total length), a pool of water, 13 Kms. south of Margao, 6.iv.1966. (ii) 2 exs. (63-72 mm. total length), a pool at Colva road, Goa, 14.iv.1966. (iii) 2 exs. (63-64 mm. total length), 3.5 Kms. south-east of Rest House at Margao, Goa, 12.iv.1966. all K. S. Pradhan Coll.

Remarks.—There is a marked sexual dimorphism in this species; the male is armed with a flat osseous spine, which is a modification of the inner rays of the pectoral fin. The fish lives in decaying leaves and debris at the bottom of water.

Distribution.—Streams and ponds throughout India except Mysore, Malabar and down.

(22) **Acanthophthalmus goaensis** Tilak

Acanthophthalmus goaensis Tilak, *J. Inland Fish. Soc India* (in press). (Type-locality: Colem river, Goa.)

Material.—(i) 1 ex. (36.5 mm. total length), Colem river, Goa, 16.iv.1966, K. S. Pradhan Coll. It is the holotype material, having Regd. No. Z.S.I.F 6150/2.

Remarks.—Pending publication of the paper (cited above), it should be important to mention a few salient features of the species.

B. III D. 2/6, P. 1/6, V 1/4, A. 2/5, C. 17

There is a bifid spine below the eye. The two nostrils are separate and the anterior is with a tube. The scales are embedded in skin and are minute. There is a dark lateral stripe, running from the eye to the base of the caudal. There are three dark thin bands running from behind the head to the origin of the dorsal and then behind the dorsal, only two of them extend upto the upper edge of the caudal fin. The base of the dorsal fin is 2.66 times in its length and lies in advance of the anal. The height of the dorsal is equal to the depth of the body below it. The distance between the origin of pelvics and the base of caudal fin, when carried anterior to the pelvic base, falls near the end of the pectoral fin. The present species has many differences with the only other species of this genus known from eastern India, i.e. *A. pangia* (Ham.) The record of

this genus from Goa is zoogeographically important (Tilak, in press).

Distribution.—Goa.

(23) **Noemacheilus botia** (Hamilton)

1822. *Cobitis botia* Hamilton, *Fishes of Ganges*: 350, 394. (Type-locality: rivers of northern parts of Bengal.)

1968. *Noemacheilus* (Acanthocobitis) *botia*, Banarescu and Nalbant, *Mitt. Hamburg. Zool. Inst.*, **65**: 332.

Material.—(i) 2 exs. (38-39 mm. total length), a nala in forest, 2 Kms. west of Molem, Rest House, Colva, 7.i.1969, V C. Agarwal Coll.

Remarks.—The material agrees with the description of this species by Rendahl (1948). There are 10 branched rays in the dorsal fin. The lateral line is complete. The colouration is characteristic of the species.

Distribution.—Freshwaters of Panjab, Uttar Pradesh, Jammu & Kashmir, Himalaya, Assam, West Bengal, Bihar, Madhya Pradesh, Maharashtra, North Canara, Goa.

(24) **Ompok bimaculatus** (Bloch)

1797. *Silurus bimaculatus* Bloch, *Ichth. Hist. Nat. Poiss.*, **2**: 17. (Type-locality: Malabar.)

1950. *Ompok bimaculatus*, Haig, *Rec. Indian Mus.*, **48**: 103.

Material.—(i) 1 ex. (259 mm. total length), Valus river, Goa, 20.ix.1969, (ii) 2 exs. (235 mm. total length), Valus river, 18.ix.1969, all R. C. Sharma Coll.

Remarks.—There are 68-72 rays in the anal fin. The whole body, instead of being silvery, is uniformly darkened, so much so that the black spot on the shoulder has been obliterated.

Distribution.—Freshwaters throughout India, Ceylon and Burma.

(25) **Silurus goae** Haig

1950. *Silurus goae* Haig, *Rec. Indian Mus.*, **48**: 77, 100 (Type-locality: Goa and Trivandrum.)

Material and remarks.—No material of this species has been studied here. The type material has been deposited at Natural History Museum, Stanford University, Stanford (California, U.S.A.). This species has been included here from

literature because this is the only species earlier recorded from Goa. The description of the species is available in the paper by Haig (1950).

Distribution.—Trivandrum, Goa etc.

(26) *Mystus malabaricus* (Jerdon)

1849. *Bagrus malabaricus* Jerdon, *Madras J. Litt. & Sci.*, **15**: 338. (Type-locality: mountain streams of Malabar.)

1954. *Mystus (Mystus) malabaricus*, Jayaram, *Rec. Indian Mus.*, **51**: 544.

Material.—(i) 3 exs. (113-152 mm. total length), Valus river, Goa, 20.ix.1969, (ii) 3 exs. (95-100 mm. total length), Valus river, Goa, 18.ix.1969, (iii) 2 exs. (89-92 mm. total length), Valus river, 17.ix.1969, all R. C. Sharma Coll.

Remarks.—The species is characterised by the presence of a very small supraoccipital process which remains embedded in skin. The posterior fontanelle on the head extends behind the posterior edge of the eye. The maxillary barbels reach upto the pelvic fins.

Distribution.—Maharashtra, Goa, Malabar coast, hill ranges of Travancore and Wynaad hills.

(27) *Zenarchopterus striga* (Blyth)

1859. *Hemiramphus striga* Blyth, *J. Asiat. Soc. Bengal*, **27**: 288. (Type-locality: Sandheads, near Calcutta and coast of Ceylon.)

1926. *Zenarchopterus beauforti* Mohr, *Zool. Jahrb.*, **52**: 259. (Type-locality: Muar river, Selangor, Malaya Peninsula.)

Material.—(i) 3 exs. (40.5-58.5 mm. total length), Zuari river, 5 Kms. from Ponda, Durbate, Goa, 17.iv.1966, K. S. Pradhan Coll.

Remarks.—The present material agrees with the description of *Zenarchopterus beauforti* Mohr and *Z. striga* (Blyth) and is hence named as the latter species according to the law of priority. A discussion on this point has been included in an other paper (Tilak, in press). The existence of *Z. striga* (Blyth) from Goa, extends the range of distribution of this species to west coast of India.

Distribution.—Eastern coast of India, Goa, Malaya Peninsula.

(28) **Belone cancila** (Hamilton)

1822. *Esox cancila* Hamilton, *Fishes of Ganges*: 213, 380, pl. 27, fig. 70.
 (Type-locality: ponds and small rivers of Gangetic provinces.)
 1878. *Belone cancila*, Day, *Fishes of India*: 511, pl. CXVIII, fig. 5.
 1962. *Belone cancila*, Mees, *Zool. Verh.*, No. 54: 20.

Material.—(i) 1 ex. (200 mm. total length), Zuari river, near Borim bridge, Goa, 1.iv.1966, K. S. Pradhan Coll. (ii) 1 ex. (164 mm. total length), uphill, a river near market, Sanguem, Goa, 19.xi.1967, K. S. Pradhan & party Coll.

Remarks.—Mees (1962) does not recognise the genus *Xenentodon* Regan which is based on difference in the pharyngeals. There is only one species under the genus *Xenentodon* i.e. *X. cancila*. Mees (1962) has not made any anatomical analysis of the species; probably the status of the genus *Xenentodon* Regan remains undecided. Myers (1960) has pointed out that *Esox hindustancus* Falconer is a synonym of *cancila*.

Distribution.—Freshwaters throughout India, Ceylon, Burma, Pakistan, Siam, Malaya.

(29) **Aplocheilus blocki** (Arnold)

1911. *Hapsocheilus panchax* var. *blocki* Arnold, *Wschr. Aquar. u. Terrar.*, 8: 672. (Type-locality: Madras.)
 1916. *Panchax parvus* Raj, *Rec. Indian Mus.*, 12: 268. (Type-locality: Tanks and Reservoirs in and around Madras city.)
 1959. *Aplocheilus blochii*, Misra, *Rec. Indian Mus.*, 57: 204.

Material.—(i) 2 exs. (27-31 mm. total length), a pond at Kavlem, 2.5 Kms. south of Ponda, 8.iv.1966, (ii) 2 exs. (28-31 mm. total length), 1.5 Kms. south-west of Rest House, Margao, Goa, 11.iv.1966, (iii) 4 exs. (22-32 mm. total length), a shallow pond, 5 Kms. south-west of Rest House, Margao, 23.iv.1966, (iv) 6 exs. (16-28 mm. total length), 1 Km. south-west of Railway station, 7.iv.1966; (v) 1 ex. (31 mm.), Cabo-de-Rama, hill stream, Goa, 17.xi.1967, (vi) 15 exs. (15-33 mm. total length), a pond at Colva road, Goa, 14.iv.1966, (vii) 12 exs. (20-26 mm. total length), a river at Bicholim, Goa, 10.iv.1966, (viii) 1 ex. (27 mm.), a pool 13 Kms. south of Margao, 6.iv.1966, (ix) 7 exs. (21-26 mm. total length), brakish water pond near beach, Colva, Goa, 10.xi.1967, (x) 2 exs. (25-26 mm. total length), a pool in paddy field, near Colva, Goa, 10.xi.1967, (xi) 3 exs. (13-24 mm. total length), Arvalem water falls, Goa, 28.iii.1966, (xii) 5 exs. (28-32 mm. total length), a pool at

Durbate, Goa, 17.iv.1966, (xiii) 21 exs. (13-31 mm. total length), a pool, 3.5 Kms. south-east of Rest House, Margao, 25.iv.1966, all K. S. Pradhan Coll.

Remarks.—The species has been named after Capt. Block. It is an important larvivorous as well as aquarium fish. There is sex dimorphism in the species, the males having the fins more pointed than the females. This is the smallest of the Asiatic species of the genus *Aplocheilus*. Rachow (1927) and Misra (1959) have considered *Aplocheilus parvus* (Raj) as a synonym of *A. blocki* (Arnold). The type material of *A. parvus* has been examined and compared with the present material of *A. blocki* from Goa. The present author is of the opinion that *A. parvus* should fall in the synonymy of *A. blocki*, an earlier name. In the material of both the species, a tuft of teeth is present on the prevomer. The two species resemble each other in majority of the characters.

Distribution.—Fresh- and brackish waters of Madras, Cutch, Gujarat, Goa, Sind, Ceylon etc.

(30) *Aplocheilus lineatum* (Valenciennes)

1846. *Panchax lineatum* Valenciennes (in Cuvier & Valenciennes), *Hist. Nat. Poiss*, 18: 381. (Type-locality: Bombay.)

1959. *Aplocheilus lineatum*, Misra, *Rec. Indian Mus.*, 57: 204.

Material.—(i) 3 exs. (27-28 mm. total length), a pond, 1.5 Kms. south-west of Ponda, Goa, 8.iv.1966, (ii) 10 exs. (37-52 mm. total length), a shallow pool, 1.5 Kms. south-west of Rest House, Margao, Goa, 11.iv.1966, (iii) 1 ex. (46 mm. total length), a pool in paddy field, 3 Kms. west of Ponda, Goa, 14.xi.1967, (iv) 4 exs. (55-56 mm. total length), a shallow pool, colva road, Goa, 17.xi.1966, (v) 4 exs. (25-54 mm. total length), a hill-stream, Cabo-de-Rama, Goa, 17.xi.1967, (vi) 1 ex. (32 mm. total length), Arvalem water falls, Goa, 28.xi.1967, all K. S. Pradhan Coll.

Remarks.—The material is characterised by the following features. The origin of the dorsal fin lies in the caudal region. The cleft of the mouth is wide and the upper jaw is protractile. The teeth in jaws are in bands. There is a transverse fold across the snout. The gill membranes are free, anal rays 15-18 and the third outer ray of the pelvic fin is prolonged.

Distribution.—Fresh- and brackish waters along the coast

of Bombay, Wynaad, Malabar. Travancore-Cochin, Madras. Coromandel, Goa, Ceylon etc.

(31) ***Channa orientalis* Bloch & Schneider**

1801. *Channa orientalis* Bloch and Schneider, *Syst. Ichthyol.*, 496. (Type-locality: India Orientale, Type-specimen probably in Berlin).

1960. *Channa orientalis*, DeWitt, *Stanford Ichth. Bull.*, 7: 81.

Material.—(i) 1 ex. (71 mm. total length), a stream, 2 Kms. north east of Forest Rest House, Molem, Goa, 21.xi.1967, K. S. Pradhan Coll.

Distribution.—Freshwaters throughout India, Andamans, Pakistan, Burma, Ceylon, Afghanistan, Baluchistan, Malaya, Malaya Archipelago, Thailand, Laos, North and South Vietnams, Yunnan, Hainan, etc.

(32) ***Channa punctatus* (Bloch)**

1793. *Ophiocephalus punctatus* Bloch, *Naturg. Ausland. Fische.*, 1: 139, pl. 358. (Type-locality: Malabar coast.)

1876. *Ophiocephalus punctatus*, Day, *Fishes of India*: 367, pl. LXXVIII, fig. 1.

Material.—(i) 1 ex. (78 mm. total length), a pool of water, nearly 13 Kms. south of Margao, Goa, 6.iv.1966, K. S. Pradhan Coll.

Distribution.—Freshwaters throughout India, Pakistan, Burma, Ceylon, Malaya, China, Polynesia etc.

(33) ***Chanda interrupta* (Bleeker)**

1852. *Ambassis interrupta* Bleeker, *Nat. Tijdschr. Ned-Indie*, 2: 696. (Type-locality: Wakai, Ceram and Batavia, Java).

1875. *Ambassis interrupta*, Day, *Fishes of India*, p. 53, pl. XV, fig. 5.

Material.—(i) 1 ex. (25 mm. total length), Zuari river, Courtalim, Goa, 15.xi.1967, K. S. Pradhan & party Coll.

Remarks.—The diagnostic features of the species are the interrupted lateral line, double lower edge of preoperculum serrated, the angle of interoperculum bearing a few denticulations and the preorbital being serrated. There are 11 branched rays in the dorsal and 10 in the anal.

Distribution.—Andamans to Malaya Archipelago. The record of this species from the estuary of Zuari river, Goa, extends the range of distribution of this species further westwards.

(34) **Chanda gymnocephalus** (Lacépède)

1802. *Lutjanus gymnocephalus* Lacépède, *Hist. Nat. Poiss.*, 3: pl. 23, fig. 3. (Type-locality: Sumatra.)

1945. *Chanda gymnocephalus*, Smith, *Bull. U.S. Nat. Mus.*, 188: 483.

Material.—(i) 54 exs. (48-80 mm. total length), Zuari river, near Barim bridge, Goa, 1.iv.1966, K. S. Pradhan Coll.

Remarks.—The length of the 2nd and the 3rd spines of the dorsal fin is variable in relation to the depth of the body below it. It is observed that the comparative length of the dorsal spine in relation to the body depth below it decreases with age. The material is characterised by the presence of double lower edge of the preoperculum serrated. The interoperculum is smooth. The preorbital is serrated. The lateral line is interrupted. There are 10 rays each in the dorsal and anal fins. The scales are ctenoid.

Distribution.—Seas and estuaries of India, Africa, Malaya Archipelago, China etc.

(35) **Chanda thomassi** (Day)

1870. *Ambassis thomassi* Day, *Proc. zool. Soc. London*: 369. (Type-locality: Coast of Canara.)

1875. *Ambassis thomassi*, Day, *Fishes of India*: 52, pl. XV, fig. 2.

Material.—(i) 5 exs. (76-103 mm. total length), Valus river, Goa, 17.ix.1969, R. C. Sharma Coll.

Remarks.—The vertical limb and the double lower edge of the preoperculum serrated. The posterior part of interoperculum is serrated. The preorbital is serrated. There are 11 rays in the dorsal and 10 in the anal.

Distribution.—Coast of Canara upto Cochin, Goa etc.

(36) **Etroplus suratensis** (Bloch)

1785. *Chaetodon suratensis* Bloch, *Syst. Ichthyol.*, pl. 217. (Type-locality: Surat.)

1877. *Etroplus suratensis*, Day, *Fishes of India*: 415, pl. LXXXIX, fig. 6.

Material.—(i) 7 exs. (53-89 mm. total length), Zuari river, near Borim bridge, Goa, 1.iv.1966, K. S. Pradhan Coll.

Remarks.—The material agrees with the description of this species given by Day (1877) but differs in the number of spines and rays in the dorsal and the anal fins. There are 16-18 spines and 14-16 rays in the dorsal and 11-12 spines and 12-13 rays in the anal fin. In young examples, there is a black

ocellus, surrounded by white, at the middle of the soft portion of the dorsal fin; the same is absent in adults.

Distribution.—According to Day (1877) the type-locality of this species, as given by the author of the species, is not Surat, where it does not occur. According to Day (1877) the material was probably collected from Tranquebar. Fresh and estuarine waters of India, upto Orissa, Ceylon etc.

(37) *Etroplus maculatus* (Bloch)

1785. *Chaetodon maculatus* Bloch, *Syst. Ichthyol*: pl. 427, fig. 2. (Type-locality: Unknown.)

1877. *Etroplus maculatus*, Day, *Fishes of India*: 415, pl. LXXXIX, fig. 4.

Material.—(i) 1 ex. (61 mm. total length), Valus river, 8 Kms. east of Forest Rest House, Valpoi, Goa, 16.ix.1969, (ii) 3 exs. (65-96 mm. total length), Valus river, Goa, 17.ix.1969, all R. C. Sharma Coll.

Remarks.—The sides of the body bear three dark blotches. There are 20 spines in the dorsal fin and 15 in the anal. The operculum is smooth and the pelvics have one spine each.

Distribution.—Freshwaters of Madras, South Cananra along Malabar, Goa, Ceylon etc.

(38) *Scatophagus argus* (Linnaeus)

1766. *Chaetodon argus* Linnaeus, *Syst. Nat.* 1 ed. 12: pl. 464. (Type-locality: India.)

1875. *Scatophagus argus*, Day, *Fishes of India*: 114, pl. XXIX, fig. 3.

Material.—(i) 5 exs. (34-45 mm. total length), Zuari, river, near Borim bridge, Goa, Goa, 1.iv.1966, K. S. Pradhan Coll.

Distribution.—Seas and estuaries of India, Ceylon, to China and Australia.

(39) *Johnius belengerii* (Cuvier)

1830. *Corvina belengerii* Cuvier, *Hist. Nat. Poiss.*, 5: 120. (Type-locality: Malabar.)

1876. *Sciaena belengeri*, Day, *Fishes of India*: 191, pl. XLIV, fig. 5.

1936. *Johnius belengeri*, Weber & Beaufort, *Fish. Indo-Austral. Archipel.*, 7: 533.

Material.—(i) 1 ex. (121 mm. total length), Zuari river, Goa, 12.iv.1966, K. S. Pradhan Coll.

Distribution.—Seas of India, Malaya Archipelago and

beyond. Recently two examples of this species have been recorded from freshwater at Poonpoon river, near Patna (Tilak, Mss.)

(40) *Lutjanus johnii* (Bloch)

1692. *Anthias johnii* Bloch, *Natuurg. Ausland. Fische.*, 6: 113, pl. 318. (Type-locality: Surat, India.)

1875. *Lutjanus johnii*, Day, *Fishes of India*: 42, pl. XIII, fig. 1.

1936. *Lutjanus johnii*, Weber & Beaufort, *Fish. Indo-Austral. Archipel.*, 7: 244.

Material.—(i) 1 ex. (195 mm. total length), Zuari river at Cortalim, Goa, 12.iv.1966, K. S. Pradhan Coll.

Remarks.—Weber & Beaufort (1936) have wrongly quoted in the synonymy of this species some of the species mentioned by Day (1875), such as *Mesoprion johnii* (instead of *Lutjanus johnii* on page 42) and *Mesoprion yapilli* (instead of *Lutjanus yapilli* on page 45).

Distribution.—Seas and estuaries of India, Malaya Archipelago and beyond.

(41) *Pomadasys hasta* (Bloch)

1790. *Lutjanus hasta* Bloch, *Naturg. Ausland. Fische.*, 4: 109, (Type-locality: Japan.)

1875. *Pristipoma hasta*, Day, *Fishes of India*: 73, pl. XIX, figs. 3, 4.

1955. *Pomadasys hasta*, Munro, *Marine & Freshwater Fish Ceylon*: 148, fig. 430.

Material.—(i) 1 ex. (158 mm. total length), Zuari river at Cortalim, Goa, 12.iv.1966, K. S. Pradhan Coll.

Distribution.—Seas and estuaries of India, Ceylon, Red sea, East coast of Africa, Malaya Archipelago to Australia etc.

(42) *Mugil parsia* Hamilton

1822. *Mugil parsia* Hamilton, *Fishes of Ganges*: 215, 380, pl. 17, fig. 71. (Type-locality: Freshwater rivers of Bengal.)

1876. *Mugil parsia*, Day, *Fishes of India*, p. 350, pl. LXXV, fig. 2.

Material.—(i) 6 exs. (87-173 mm. total length), Zuari river, Cortalim, Goa, 12.iv.1966, K. S. Pradhan Coll.

Distribution.—Seas and estuaries of India, Ceylon etc.

(43) *Petroscirtes bipunctatus* Day

1876. *Petroscirtes bipunctatus* Day, *Fishes of India*: 327, pl. LXXI, fig. 3. (Type-locality: Calicut.)

Material.—(i) 1 ex. (27 mm. total length), Shallow pool

of water, at Durbate, 5 Kms. from Ponda, Goa, 17.iv.1966, K. S. Pradhan Coll.

Distribution.—Calicut, Goa etc.

(44) **Petroscirtes punctatus** (Valenciennes)

1836. *Blennechis punctatus* Valenciennes (in Cuvier & Valenciennes), *Hist. Nat. Poiss.*, 11: 286. (Type-locality: Bombay.)

1876. *Petroscirtes punctatus*, Day, *Fishes of India*: 326.

Material.—(i) 1 ex. (65 mm. total length), Zuari river, Cortalim, Goa, 11.iv.1966, K. S. Pradhan Coll.

Remarks.—The species is characterised by the following characters. The gill opening is restricted to a small foramen above the base of the pectoral. The ventral fin has 2 rays. There are 34 rays in the dorsal and 23 in the anal. The length of the head is contained 6.5 times in total length. The jaws have fixed teeth and well developed lateral canines.

Distribution.—Seas and estuaries of India to Australia.

(45) **Glossogobius giuris** (Hamilton)

1822. *Gobius giuris* Hamilton, *Fishes of Ganges*: 51, 366, pl. XXXIII, fig. 15. (Type-locality: ponds and freshwater rivers of Gangetic Provinces.)

1876. *Gobius giuris*, Day, *Fishes of India*: 294, pl. LXVII, fig. 1.

1953. *Glossogobius giuris*, Koumans, *Fish. Indo-Austral. Archipel.*, 10: 165.

Material.—(i) 2 exs. (79-110 mm. total length), a river uphill, Sanguem, Goa, 19.xi.1967, K. S. Pradhan & party Coll. (ii) 3 exs. (96-154 mm. total length), Zuari river, 5 Kms. from Ponda, Durbate, Goa, 17.iv.1966, K. S. Pradhan Coll. (iii) 1 ex. (70 mm. total length), a nulla near Colva beach, 12.xi.1967, K. S. Pradhan & party Coll. (iv) 1 ex. (25 mm. total length), a river uphill, Sanguem, Goa, 19.xi.1967, K. S. Pradhan Coll. (v) 1 ex. (108 mm. total length), Valus river, Goa, 17.ix.1969, R. C. Sharma Coll. (vi) 1 ex. (106 mm. total length), Shopura river, 5 Kms. off Ponda, 24.ix.1969, R. C. Sharma Coll.

Distribution.—Fresh- and estuarine waters of India, Ceylon, Andamans, Siam, Malaya Peninsula, China, Japan, Philippines etc.

(46) **Awaous grammepomus** (Bleeker)

1855. *Gobius grammepomus* Bleeker, *Nat. Tijdschr. Ned. Indie*, 9: 200, (Type-locality: Java.)

1953. *Awaous grammepomus*, Koumans, *Fish. Indo-Austral. Archipel.*, 10: 151.

Material.—(i) 1 ex. (106 mm. total length), a river up-hill, near the market at Sanguem, Goa, 19.xi.1967, K. S. Pradhan Coll. (ii) 1 ex. (108 mm. total length), Valus river, 17.ix.1969, R. C. Sharma Coll.

Remarks.—The two specimens of this species examined here resemble the description of the species given by Koumans (1953) but show differences in some respects. The interorbital is half of the eye diameter. In the specimens from Sanguem, the tongue is extremely reduced and its tip is emarginate whereas the same is apparently absent in the example from Valus river. The tongue in *Awaous* is bilobate (Koumans, 1953).

Distribution.—Fresh- and estuarine waters of India, Ceylon, Java, Sumatra, and other nearby islands.

(47) *Bathygobius fuscus* (Rüppell)

1828. *Gobius fuscus* Rüppell, *Atl. Reise N. Afr. Fische*: 137. (Type-locality: Red seas.)

1953. *Bathygobius fuscus*, Koumans, *Fish. Indo-Austral. Archipel.*, 10: 187.

Material.—(i) 2 exs. (53-58 mm. total length), river Mandovi, near ferry jetty, Betim, Goa, 29.iii.1966, K. S. Pradhan Coll.

Remarks.—In this material the ventral fins are united by strong membrane. The two dorsal fins are separate at the base. The teeth in jaws are in many rows. The first rays of both the dorsal fins are soft. The caudal fin is shorter than the head. There are no barbels on the head. The tongue is bilobate. There are no fleshy flaps on the inside of the shoulder girdle. A few of the upper rays of the pectoral fin are silk like.

Distribution.—Seas and estuaries from East coast of Africa and Red Sea, through India to Japan, Philippines, Australia etc.

(48) *Periophthalmus dipus* Bleeker

1854. *Periophthalmus dipus* Bleeker, *Nat. Tijds. Ned. Indie*, 7: 320. (Type-locality: Sumatra.)

1953. *Periophthalmus dipus*, Koumans, *Fish. Indo-Austral. Archipel.*, 10: 212.

Material.—(i) 2 exs. (39-41 mm. total length), Zuari river, Cortalim, Goa, 15.xi.1967, K. S. Pradhan & party Coll.

Distribution.—Andamans, Goa, Sumatra, Java, Borneo, Celebes, etc.

(49) *Periophthalmus variabilis* Eggert

1935. *Periophthalmus variabilis* Eggert, Zool. Jahrb. (Syst.), 66: 63. pls. 3, 4, figs. 13, 14, 15. (Type-locality: Java and Sumatra.)

1953. *Periophthalmus variabilis*, Koumans, Fish. Indo-Austral. Archipel., 10: 205.

Material.—(i) 3 exs. (40-65 mm. total length), Vascodegama, 45 Kms. west of Ponda, Goa, 25.ix.1969, R. C. Sharma Coll.

Remarks.—In this material the ventral fins are slightly united at the base. The eyes are prominent. The bases of the pectoral fins are muscular. The eyes are close together. There are 60 scales along the lateral line.

(50) *Eleotris andamensis* Herre

1939. *Eleotris andamensis* Herre, Rec. Indian Mus., 41: 344. (Type-locality: Andamans.)

1941. *Eleotris andamensis*, Koumans, Mem. Indian Mus., 13: 312.

Material.—(i) 1 ex. (21 mm. total length), a shallow pool at Durbate, Goa, 17.iv.1966, K. S. Pradhan Coll.

Remarks.—The present specimen has been, for the time being, assigned to this species because it resembles the description of this species. This present example is a young form. Koumans (1941) did not see examples of this species. However, there are 7 examples of the Holotype and paratype series in Zoological Survey of India, Calcutta. This material differs from *E. fuscus*. In this specimen, the ventral fins are separate, prevomer is edentulous, the preopercular angle bears a single downwardly curved strong spine, the head is naked between the eyes, the cheek is naked, operculum is partly scaled and there are 56 scales in the lateral line.

Distribution.—Andamans, Goa. The record of this species from Goa is interesting and extends the range of distribution of this species westwards.

(51) *Macropodus cupanus* (Valenciennes)

1831. *Polycanthus cupanus* Valenciennes (in Cuvier & Valenciennes),

Hist. Nat. Poiss., 7: 357. (Type-locality: Arian Coupang river, Pondicherry.)

1909. *Macropodus cupanus*, Regan, *Proc. zool. Soc. London*, 2: 775.

Material.—(i) 2 exs. (37-57 mm. total length), a pond, 1.5 Kms. southwest of Rest House, Margao, Goa, 11.iv.1966, (ii) 1 ex. (49 mm. total length), a shallow muddy pond, 5 Kms. south-west of Rest House, Margao, Goa, 23.iv.1966, (iii) 7 exs. (16-29 mm. total length), a pool, 1 Km. south-west of Railway station, Margao, Goa, 1.iv.1966, (iv) 4 exs. (26-31 mm. total length), a pool at Concalim, 3 Kms. south of Margao, Goa, 6.iv.1966, (v) 1 ex. (60 mm. total length), a pool at Colva road, Goa, 14.iv.1966, (vi) 1 ex. (28 mm. total length), a brackish water pond, near beach, Colva, Goa, 10.xi.1967, (vii) 6 exs. (28-50 mm. total length) a pond, 3 Kms. south east of Govt. Rest House, Margao, Goa, 25.iv.1966, all *K. S. Pradhan* Coll.

Remarks.—In the material studied here, the outer rays of the pelvic fins are much produced. There are 20 spines in the anal fin. The accessory respiratory organs are present. The lateral line is incomplete. The shape of the caudal fin is lanceolate and pointed. The palate is edentulous.

Misra (1959) has misquoted Valenciennes (1831) by putting *Macropodus* as the generic name for the original reference.

Distribution.—Pools and ponds along the coast in India, Ceylon, Pakistan, Malaya, Malaya Archipelago.

(52) *Mastacembelus armatus* (Lacépède)

1800. *Macrogathus armatus* Lacépède, *Hist. Nat. Poiss.*, 2: 286. (Type-locality: Unknown.)

1956. *Mastacembelus armatus*, Sufi, *Bull. Raffles Mus.*, No. 27: 134.

Material.—(i) 1 ex. (173 mm. total length), Valus river, Goa, 20.ix.1969, (ii) 4 exs. (200-300 mm. total length), Valus river, 8 Kms. east of Forest Rest House, Valpoi, Goa, 16.ix.1969, (iii) 2 exs. (187-250 mm. total length), Valus river, Goa, 17.ix.1969, all *R. C. Sharma* Coll.

Distribution.—Fresh- and estuarine waters throughout India, including Himalaya, Pakistan, Burma, Ceylon, Siam, Hainan.

REMARKS ON DISTRIBUTION

Of the 52 species recorded here from Goa waters, 35 occur in other parts of India also. *Puntius filamentosus*

(Valenciennes), *Puntius vittatus* Day, *Puntius sarana subnasutus* (Valenciennes), *Oxygaster boopis* (Day), *Danio malabaricus* (Jerdon), *Chela* (Neochela) *dadyburjori* (Menon), *Lepidocephalus thermalis* (Valenciennes), *Mystus malabaricus* (Jerdon), *Aplocheilichthys blocki* (Arnold), *Aplocheilichthys lineatum* (Valenciennes), *Chanda thomassi* (Day) and *Etroplus maculatus* (Bloch) are endemic to peninsular India. The genus *Etroplus* is an Ethiopian element present in peninsular India and Goa. *Puntius melanampyx pradhani* Tilak, *Acanthophrichthys goaensis* Tilak and *Silurus goae* Haig are endemic to waters of Goa only. *Petroscirtes bipunctatus* Day occurs in Calicut and Goa on a small strip on the western coast of India.

The occurrence of some forms of fishes of Indo-chinese and Malayan sub-regions. (Oriental region), such as the genus *Acanthophrichthys*, *Puntius sarana orphoides* (Valenciennes), *Silurus goae* Haig, *Zenarchopterus striga* (Blyth), *Chanda interrupta* (Bleeker), *Periophthalmus dipus* (Bleeker), *P. variabilis* Eggert, and *Eleotris andamensis* Herre, in Goa is interesting from zoo-geographical point of view. The absence of these fishes in the intervening areas between the Indo-chinese and Malayan sub-regions on the one hand and Goa on the other, presents typical cases of discontinuous distribution, as shown below.

(a) The genus *Acanthophrichthys* is distributed mostly in the Malayan sub-region and one species (*Acanthophrichthys pangia* (Hamilton)) occurs in Indo-chinese sub-region. No record of this genus has earlier been made from the Indian or the Ceylonese sub-regions. The present record of *A. goaensis* Tilak from Goa shows discontinuous distribution in this genus.

(b) *Puntius sarana orphoides* (Valenciennes) has been recorded from the Indo-chinese sub-region (Manipur and Burma, Annandale, 1918 ; Hora, 1921) and the Malayan sub-region (Java, Borneo and Thailand) The presence of this species in Goa is, therefore, interesting.

(c) So far two species of the genus *Silurus* are recorded from India (Haig, 1950). *Silurus goae* Haig occurs in Goa and Trivandrum while *Silurus cochinchinensis* Valenciennes has been recorded from eastern Himalaya, Assam, Mysore, Burma, Siam and Cochin-china (Rau and Bhimachar, 1941 ; Haig, 1950). The distribution of the genus *Silurus* in the Oriental region is, therefore, discontinuous.

(d) *Zenarchopterus striga* (Blyth) has been known from

east coast of India, Ceylon and Malaya peninsula. The presence of this species along western coast of India is interesting.

(e) Other than Goa, *Chanda interrupta* (Bleeker) is known from Andamans and Malaya Archipelago; *Periophthalmus dipus* (Bleeker) occurs around Andamans and further east; *Periophthalmus variabilis* Eggert is distributed from Vizagapatam, Sumatra to Java; and *Eleotris andamensis* Herre is found only in Andamans. The record of these species from Goa and their apparent absence in the intervening areas is interesting.

As regards the distribution of freshwater forms, the Malayan and Indo-chinese elements travelled along the Satpura and Vindya trends of mountains to the Western Ghats in Peninsular India during a few million years ago (Hora, 1937). The dispersal of these species could have been uniform, but for some possible physiographic changes, they died out and vanished from the intermediate regions, causing a discontinuous distribution. *Acanthopthalmus goaensis* Tilak and *Puntius sarana orphoides* (Valenciennes) are typical cases of this nature. After the dispersal of fishes of the genus *Acanthopthalmus* to Goa, where they survived till today, the long and spatial separation distinguished the Goa stock into a separate species. *Silurus goae* Haig is probably a parallel case.

As regards the estuarine forms, their distribution through sea could have taken place because many of them withstand varying degrees of salinity. *Chanda interrupta* (Bleeker), *Periophthalmus dipus* (Bleeker), *Periophthalmus variabilis* Eggert and *Eleotris andamensis* Herre are estuarine and marine forms. They are all Malayan forms which could have taken the route to India through the Bay of Bengal, partly got settled along Andamans and partly migrated westwards around Ceylon to the western coast of India. The contemplated manner of migration of these fishes to Goa is, however, interesting.

SUMMARY

The importance of the present work is realised in view of the earlier knowledge of the fish fauna of Goa, particularly of freshwater, being meagre. In this paper altogether 52 species, occurring in fresh- and estuarine waters of Goa have been recorded. Of these two have been described as new taxa by the present author. Sexual dimorphism in *Puntius melanampyx*

pradhani Tilak has been described. Important points of the morphology and distribution of the species recorded, have been noted. The fish fauna of Goa is interesting from Zoo-geographical point of view. Of the 52 species on record, 31 are distributed in all other parts of India, 11 species are Indian peninsular forms, while the rest are either restricted to Goa and its vicinity or have migrated from Malayan or Indo-Chinese sub-regions.

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REFERENCES

- ANNANDALE, N. 1918. Fish and fisheries of Inle lake. *Rec. Indian Mus.* **14**: 33-64.
- BANARESCU, P. and NALBANT, T. T. 1968. Cobitidae (Pisces, Cypriniformes) collected by the German India Expedition. *Mitt. Hamburg Zool. Mus. Inst.*, **65**: 327-351.
- CUVIER, G. 1829. (In Cuv. & Val.) *Hist. Nat. Poiss.*, **5**: 96.
- DAY, F. 1865. *The fishes of Malabar*, Bernard Quaritch, 15 Piccadilly, London, i-xxxii: 1-293.
- DAY, F. 1875-78. *The fishes of India; being a natural history of the fishes known to inhabit the seas and freshwaters of India, Burma and Ceylon.* (Reprinted in 1958) William Dawson & Co., London: i-xx, 1-778, pls. I-CXCV.
- GREENWOOD, P. H., ROSEN, D. E., WITZMAN, S. H. and MYERS, G. S. 1966. Phyletic studies of teleostean fishes, with a provisional classification of living forms. *Bull. Amer. Mus. Nat. Hist.*, **131** (4): 341-455.
- HAIG, JANET, 1950. Studies on the classification of the catfishes of the Oriental and Palaearctic family Siluridae. *Rec. Indian Mus.*, **48**: 59-116.
- HORA, S. L. 1921. XIX. Fish and fisheries of Manipur with some observations on those of the Naga hills. *Rec. Indian Mus.*, **22**: 165-214, pls. IX-XII.
- HORA, S. L. 1937. Notes on fishes in the Indian Museum. XXVIII. On three collections of fish from Mysore and Coorg, South India. *Rec. Indian Mus.*, **39** (1): 5-28.
- HORA, S. L. and LAW, N. C. 1941. The freshwater fish of Travancore. *Rec. Indian Mus.*, **43**: 233-256, pl. IX.
- KOUMANS, F. P. 1941. Gobioid fishes of India. *Mem. Indian Mus.*, **13**: 205-329.

- KOUMANS, F. P. 1953. Gobioidae. *Fish. Indo-Austral. Archipel.* **10**: i-xiii, 1-423.
- MEES, G. P. 1962. A revision of family Belontiidae, *Zool. Verh.*, **54**: 1-96.
- MENON, A. G. K. 1961. Secondary sexual characters. *Aq. J.*, San Francisco, **32**: 315-317.
- MENON, P. K. B., SAREEN, M. L. and TANDON K. K. 1967. On the marine fauna of Goa: A preliminary survey, Part 1, Mollusca-Pelecypoda, *Res. Bull. Panjab Univ. (N.S.)*, **18** (3-4): 315-320.
- MISRA, K. S. 1938. On a collection of fish from the eastern Ghats.—*Rec. Indian Mus.*, Calcutta, **40** (3): 255-264.
- MISRA, K. S. 1959. An aid to the identification of the common commercial fishes of India and Pakistan. *Rec. Indian Mus.*, **57** (1-4): 1-320.
- MUNRO, I. S. R. 1955. *The marine and freshwater fishes of Ceylon.*—Department of External Affairs, Canberra: i-viii, 1-349, pls. 1-56.
- MYERS, G. S. 1960. A forgotten account of a freshwater belontiid fish from Northern India.—*Stanford Ichth. Bull.*, **7** (4): 245-246.
- RACHOW, A. 1927. *Tropical aquarium fish catalogue.* Aquarien Fische Import and export, Wandsbeck.
- RAU, A. S. and BHIMACHAR, B. S. 1941. The fishes of Mysore state.—*J. Mysore Univ.*, **1**: 141-452.
- RENDAHI, H. 1948. Die Süßwasserfische Burmas. 1. Die Familie Cobitidae.—*Ark. Zool.*, **40A**(2): 1-116.
- TANDON, K. K., MENON, P. K. B. and SAREEN, M. L. 1967. On the marine fauna of Goa: A preliminary survey Part 2. Fishes.—*Res. Bull. Panjab Univ. (N.S.)*, **18** (3-4): 321-324.
- TILAK, R. (in press) A study of the freshwater and estuarine fishes of Goa, 1. *Acanthopthalmus goaensis*, a new cobitid from Goa, with notes on *Zenarchopterus striga* (Blyth). *J. Inland Fish. Soc. India.*
- WEBER, M. and DE BEAUFORT, L. F. 1936. *The fishes of the Indo-Australian Archipelago*, E. J. Brill, Leiden, **7**: 244.

SYSTEMATIC STUDIES ON SOME MORE NEMATODES
FROM THE UNNAMED COLLECTIONS OF THE
ZOOLOGICAL SURVEY OF INDIA

By

T. D. SOOTA and Y. CHATURVEDI

Zoological Survey of India, Calcutta

(With 3 text-figs.)

INTRODUCTION

While working on the unnamed collections of the Zoological Survey of India, the authors came across some nematodes, which, on examination, have been found to belong to 18 species of 14 genera of 11 families. The collection is small but interesting as it brings to light some hitherto unrecorded variations and form new host and locality records. The material is dealt with below.

We are thankful to Dr. A. P. Kapur, Director, Zoological Survey of India, Calcutta, for the kind encouragement in the completion of this paper.

SYSTEMATIC ACCOUNT

Order STRONGYLIDEA Diesing

Family CYATHOSTOMIDAE Yamaguti

Subfamily OESOPHAGOSTOMINAE Railliet

Oesophagostomum dentatum (Rud., 1803) Molin, 1861

1803. *Strongylus dentatus* Rudolphi, *Arch. Zool. u. Zoot.*, 3(2):1.

Material.—Two ♂♂, Z.S.I. Reg. No. W 7036/1, host—pig, locality—Hyderabad (Andhra Pradesh).

Male.—Body 5.7-6.2* long and 0.3-0.33 wide ; cervical groove 0.17-0.18 away from anterior end ; external leaf crown consisting of nine and internal of eighteen small elements ; oesophagus 0.55-0.66 long ; spicules 0.88-0.99 long ; accessory piece 0.11 long ; bursal rays arranged in typical manner.

*All measurements are in millimeters.

Remarks.—The present specimens differ from the earlier descriptions in the spicules being smaller.

***Oesophagostomum columbianum* (Curtice, 1890)**

Stossich, 1899

1890. *Oesophagostoma columbianum* Curtice, *Agric. J.*: 16.

Material.—Several ♂♂ & ♀♀, Z.S.I. Reg. Nos. W 7016-35/1, host—goat, location—large intestine, localities—Jodhpur (Rajasthan), Bareilly (Uttar Pradesh), and Calcutta (West Bengal).

Male.—Body 14.3-15.3 long and 0.44-0.46 wide; cervical groove 0.22-0.24 away from anterior end and cervical papillae situated just behind it; external leaf crown consisting of 22-24 and internal of 42-47 elements; oesophagus 0.88-0.94 long; spicules 0.77-0.83 long; accessory piece 0.077-0.099 long; bursal rays arranged in typical manner.

Female.—Body 18.0-20.9 long and 0.44-0.52 wide; cervical groove 0.24-0.27 away from anterior end; tail 0.44-0.5 long; vulva 1.2-1.3 away from posterior end; eggs 0.055-0.088 × 0.044-0.055 in diameter.

Remarks.—The present specimens differ from the earlier descriptions in the female being longer in body size but the tails being smaller.

***Raillietostrongylus samoensis* (Lane, 1922) Lane, 1923**

1922. *Crassisoma samoense* Lane, *Ann. Mag. nat. Hist.* (9), 9: 684.

Material.—a ♂ and two ♀♀, Z.S.I. Reg. No. W 7006/1, host—Pig, *Sus scrofa*, location — intestine, locality—Hyderabad (Andhra Pradesh).

Male.—Body 5.9 long and 0.31 wide; mouth dorso-subterminal and protected ventrally by a pair of falcate structures; buccal capsule 0.15 × 0.12 in diameter and armed basally with a pair of large subventral bicuspid teeth; cervical papillae 0.5 away from anterior end; oesophagus 0.67 long; spicules equal, 0.47 long; gubernaculum 0.099 long; bursa same as described for the species.

Female.—Body 6.6 long and 0.41 wide; buccal capsule 0.2 × 0.14 in diameter; oesophagus 0.75 long; tail 0.14 long; vulva not clearly discernible due to the body cavity being crowded with eggs; eggs 0.044-0.055 × 0.044-0.055 in diameter.

Remarks.—Cameron (1924) treated this genus as a synonym of *Globocephalus* Molin, which was supported by Yorke and

Maplestone (1926), Baylis (1936), Neveu-Lemaire (1936), and Teixeira de Freitas and Lent (1936). Yamaguti (1935a) maintained its original generic status but later (1961) synonymised it with *Uncinaria* Froelich. This genus was considered valid by Ozerskafa (1955), Popova (1955), and Skrjabin *et al.* (1961), with whom the present authors are in full agreement.

The present description presents many wider ranges of measurements.

Family ANCYLOSTOMATIDAE Nicoll

Subfamily BUNOSTOMINAE Loos

Bunostomum trigonocephalum (Rud., 1808) Railliet, 1902

1808. *Strongylus trigonocephalus* Rudolphi, *Entozoorum sive vermium intestinalium historit naturalis*, Amstelaedami, 1, 527 pp.

Material.—two ♂♂ and two ♀♀, Z.S.I. Reg No. W 7012-13/1, host—goat, location—intestine, locality—Pashulok (Uttar Pradesh).

Male.—Body 10.8-11.0 long and 0.5-0.55 wide ; buccal capsule 0.16-0.18 × 0.13-0.14 in diameter ; lancet and dorsal tooth present ; oesophagus 0.99-1.0 long ; spicules 1.2-1.27 long ; bursal rays arranged in typical manner.

Female.—Body 15.6-17.0 long and 0.55-0.6 wide ; buccal capsule 0.22-0.24 × 0.18-0.19 in diameter ; oesophagus 1.2-1.3 long ; tail 0.26-0.27 long ; vulva 6.8-7.7 away from anterior end ; eggs 0.077 × 0.033 in diameter.

Remarks.—The present specimens differ from the earlier descriptions in the spicules being much longer.

Kalicephalus willeyi Linstow, 1904

1904. *Kalicephalus willeyi* Linstow, *Spolia zeylan.*, 1 : 99.

Material.—a ♀, Z.S.I. Reg. No. W 6989/1, host—Russell's Viper, location—intestine, locality—Birati, 24-Parganas (West Bengal), 4.x.1967

Female.—Body 7.0 long and 0.22 wide ; head 0.22 wide ; capsule 0.18 long ; oesophagus excluding buccal capsule 0.44 × 0.15 in diameter ; nerve ring 0.3 away from anterior end ; tail 0.33 long ; vulva 2.6 away from posterior end.

Remarks.—The present specimen shows some minor variations in measurements from the earlier descriptions.

Kalicephalus indicus Ortlepp, 1923

1923. *Kalicephalus indicus* Ortlepp, *J. Helminth*, **1**: 180.

Material.—Two ♂♂ and a ♀, Z.S.I. Reg. No. W 6990/1, host—*Ptyas mucosus*, location—intestine, locality—Bhasna, 24-Parganas (West Bengal), 10.xi.1965; two ♂♂, Z.S.I. Reg. No. W 6991/1, host—snake, location—intestine, other particulars not available; a ♂, Z.S.I. Reg. No. W 6995/1, host—*Natrix stolatus*, location—intestine; locality—Bhasna, 24-Parganas (West Bengal), 5.viii.1968.

Male.—Body 4.7-6.4 long and 0.21-0.24 wide, head 0.12-0.6 wide; buccal capsule 0.088-0.11 long; nerve ring 0.18-0.19 away from anterior extremity; oesophagus excluding buccal capsule 0.26-0.28 $\times$ 0.099-0.12 in diameter; spicules 0.33-0.39 long; accessory piece 0.12-0.14 long; bursal rays same as described for the species.

Female.—Body 6.2 long and 0.3 wide; head 0.2 wide; buccal capsule 0.14 long; oesophagus 0.29 $\times$ 0.15 in diameter; nerve ring 0.22 away from anterior end; vulva 1.29 from posterior end; tail 0.13 long; eggs 0.055 $\times$ 0.033 in diameter.

Remarks.—The species is here being recorded for the first time from *Natrix stolatus*.

Kalicephalus minutus (Baylis and Daubney, 1922)
Ortlepp, 1923

1922. *Diaphanocephalus minutus* Baylis and Daubney, *Mem. Indian Mus.*, **7**: 332.

Material.—Several ♂♂ and ♀♀, Z.S.I. Reg. No. W 6992/1, host—*Bungarus fasciatus*, location—intestine, locality—Birati, 24 Parganas (West Bengal), 6.iv.1968; Several ♂♂ and ♀♀, Z.S.I. Reg. No. W 6993/1, host and locality same as above, 11.10.1968.

Male.—Body 3.8-6.0 long and 0.16-0.22 wide; head 0.18-0.2 wide; buccal capsule 0.16-0.2 long; oesophagus 0.44-0.52 $\times$ 0.11-0.16 in diameter; nerve ring 0.26-0.33 away from anterior end; spicules unequal, longer 0.44-0.5, smaller 0.3-0.33 long; accessory piece 0.11-0.13 long; bursal rays same as described for the species.

Female.—Body 5.9-6.0 long and 0.24-0.3 wide; head 0.2-0.21 wide; buccal capsule 0.2 long; oesophagus 0.5-0.55 $\times$ 0.18-0.2 in diameter; nerve ring 0.33 away from anterior end; tail

0.24-0.27 long ; vulva 1.76-1.82 away from posterior end ; eggs 0.044-0.055 $\times$ 0.033-0.044 in diameter.

Kalicephalus fimbriatus (Ortlepp, 1923)

1923. *Occipitodontus fimbriatus* Ortlepp. *J. Helminth.*, 1: 169.

Material.—Two ♀♀, Z.S.I. Reg. No. W 6994/1, host—*Bungarus fasciatus*, location—intestine, locality—Birati, 24-Parganas (West Bengal), 6.iv.1968.

Female.—Body 12.3 long and 0.47 wide ; head 0.33 wide ; buccal capsule 0.23 long ; oesophagus 0.77 $\times$ 0.25 in diameter ; nerve ring 0.47 away from anterior end ; tail 0.33 long ; vulva 4.6 away from posterior end ; eggs 0.055 in diameter.

Family TRICHOSTRONGYLIDAE Leiper, 1912

Subfamily HAEMONOCINAE Yamaguti, 1962 (=Haemonchinae Skrjabin and Schulz, 1952)

Haemoncus contortus (Rud., 1803) Cobb, 1898

1803. *Strongylus contortus* Rudolphi, *Zool. u. Zoot.*, 3(2): 1.

Material.—Several ♂♂ and ♀♀, Z.S.I. Reg. No. W 7007/1, host—sheep, *Ovis* sp., location—abomasum, locality—Bareilly (Uttar Pradesh), 5.vi.1965 ; several ♂♂ and ♀♀, Z.S.I. Reg. No. W 7008/1, host—sheep, *Ovis* sp., location—abomasum, locality—Calcutta, 26.x.1962 ; Several ♂♂ and ♀♀, Z.S.I. No. W 7009/1, host—sheep, *Ovis* sp., location—small intestine, locality—Bharari (Uttar Pradesh) ; Several ♂♂ and ♀♀, Z.S.I. Reg. No. W 7010-11/1, host—*Ovis* sp., location—abomasum, locality—Pashulok (Uttar Pradesh).

Male.—Body 14.4-17.6 long and 0.31-0.33 wide ; head 0.022-0.33 wide ; oesophagus 1.27-1.32 long ; nerve ring 0.28-0.33 away from anterior end ; cervical papillae situated 0.33-0.38 from anterior end ; spicules equal, 0.38-0.42 long ; bursa as described by Baylis (1936).

Female.—Body 22.3-25.0 long and 0.44-0.5 wide ; head 0.022-0.033 wide ; oesophagus 1.5-1.65 long ; nerve ring 0.33-0.38 away from anterior end ; cervical papillae situated 0.4-0.42 from anterior end ; tail 0.44-0.55 long ; vulva 4.3-4.4 away from posterior end ; eggs 0.44-0.055 $\times$ 0.044-0.055 in diameter.

Subfamily *MECISTOCIRRINAE* Skrjabin and Orloff, 1934

Mecistocirrus digitatus (V Linstow, 1906)

Railliet and Henry, 1912

1906. *Strongylus digitatus* v. Linstow, *Spolia zeylan.*, 3: 168.

Material.—Several ♂♂ and ♀♀, Z.S.I. Reg. No. W 7017/1, host—calf (cow), location—abomasum, locality—Bareilly (Uttar Pradesh), 1.vi.1965.

Male.—Body 15.8-23.8 long and 0.4-0.5 wide; oesophagus 1.5-2.0 long; nerve ring 0.24-0.33 away from anterior end; spicules 5.2-7.6 long; bursa as described by Baylis (1936).

Female.—Body 16.8-23.4 long and 0.72-0.73 wide; oesophagus 1.4-1.8 long; nerve ring 0.33 away from anterior end; tail 0.22-0.24 long; vulva 0.44-0.55 away from posterior end.

Remarks.—The present specimens differ from the earlier descriptions in the females being smaller in body size and the spicules being longer.

Subfamily *OSWALDOCRUZIINAE* Skrjabin and
Schikhobalova, 1952

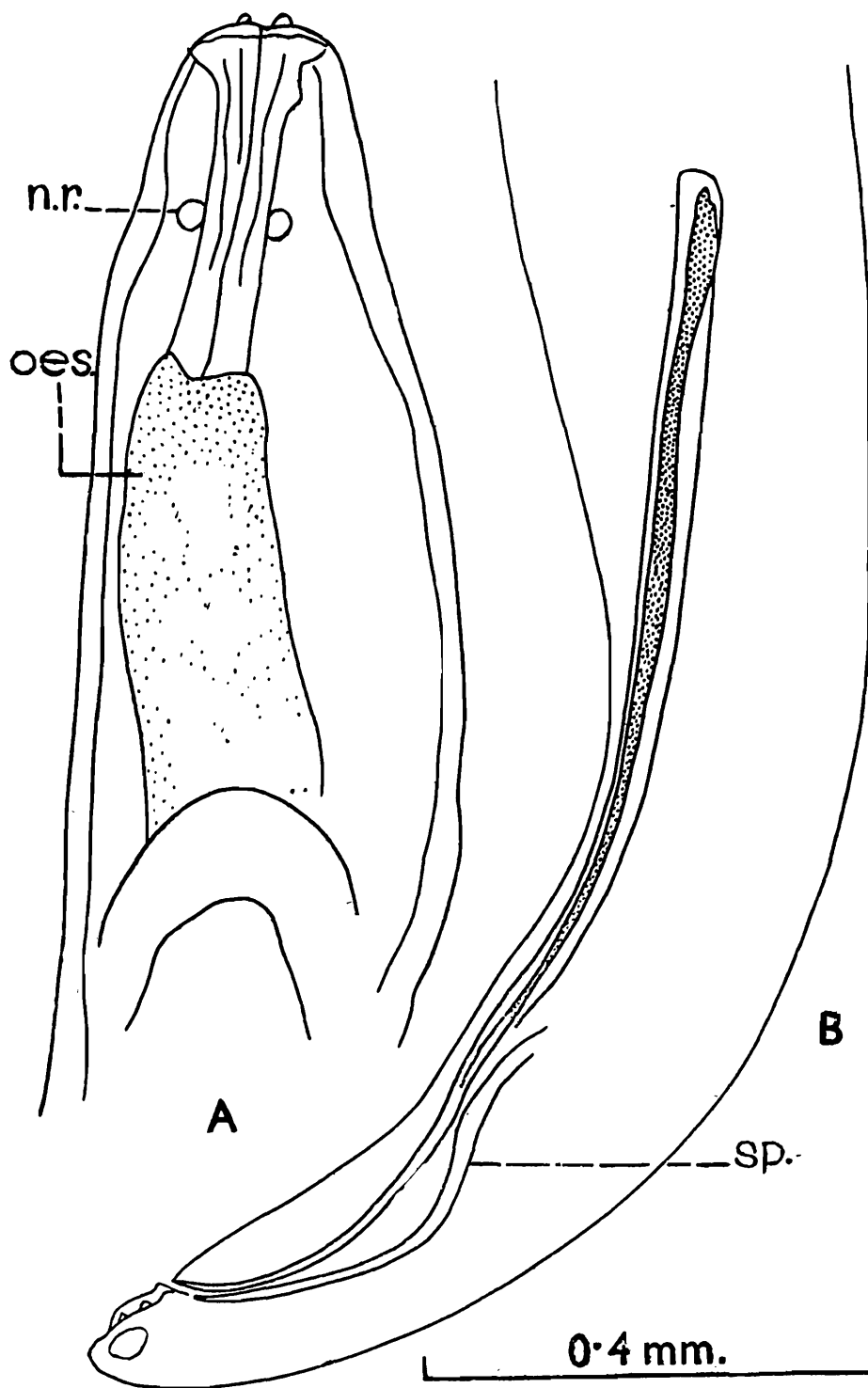
Oswaldocruzia filiformis (Goeze, 1782)

1782. *Ascaris filiformis* Goeze, *Versuch einer Naturgeschichteder Eingeweid ewurmer thierischer Korper Blankenburg*: 471.

Material.—a ♂ and a ♀, Z.S.I. Reg. No. W 6972/1, host—*Rana* sp., location—stomach, locality—Dum Dum, 24-Parganas (West Bengal), 24.iv.1964; several ♂♂ and ♀♀, Z.S.I. Reg. Nos. W 6973-5, 78/1, hosts—*Bufo* sp. and *Rana* sp., locations—liver, stomach and intestine, locality—Birati, 24-Parganas (West Bengal), 27.iv.1965, 7.vi.1965 and 8.vii.1965; two ♂♂ reduce, Z.S.I. Reg. No. W 6976/1, host—*Enhydryis* sp., and a ♀, Z.S.I. Reg. No. W 6977/1, host—*Bufo* sp., location—intestine, locality—Bhasna, 24-Parganas (West Bengal), 28.x.1965 and 12.vii.1967; six ♂♂ and ♀♀, Z.S.I. Reg. No. W 6980/1, host—*Bufo* sp., location—rectum, locality—Chitrakunda, Korraput (Orissa), 7.v.1966.

Male.—Body 4.9-9.0 long and 0.13-0.15 wide; head including vesicle 0.033-0.044 wide; oesophagus 0.38-0.5 long; spicules 0.19-0.2 long; bursal rays arranged in typical manner.

Female.—Body 10-17.2 long and 0.13-0.26 wide; head including vesicle 0.044-0.055 wide; oesophagus 0.044-0.5 long; tail 0.22-0.33 long; vulva 3.3-5.5 away from posterior end; eggs 0.055-0.11 × 0.004-0.055 in diameter.



Text-fig. 1. *Hamatospiculum* sp.

a. female anterior end; b. male, posterior end.

Abbreviations : oes. Oesophagus, nr. nerve ring, sp. spicule

Remarks.—Baylis and Daubney (1923) recorded this species from Nankowry Island of the Nicobar group ; thus the present record appears to be the first from the Indian mainland.

Since so far the species has been recorded among the reptilian hosts from lizards viz., *Lacerta* sp., its present record from a snake (*Enhydris* sp.) is thus the first of its kind from snakes.

Order FILARIIDEA Yamaguti, 1961

Family FILARIIDAE Claus, 1885

Hamatospiculum sp.

(Text-fig. 1a & b)

Material.—Two ♂♂ and several ♀♀ (damaged), Z.S.I. Reg. No. W 7074/1, host—Sparrow hawk (*Accipiter* sp.), location—abdominal cavity, locality—Bikaner (Rajasthan), collector—Dr. B. Biswas, 15.i.1957

Male.—Body 55.0-67.5 long and 0.66-0.68 wide ; oesophagus divided into two portions, anterior 0.33-0.44, posterior 10.2-11.0 long ; nerve ring 0.22 from anterior end ; tail 0.055 long and with very narrow caudal alae ; spicules unequal and dissimilar, left 1.4-2.1, right 0.42-0.44 long ; papillae, only two postanal clearly discernible.

Female.—Body 120 long and 0.88 wide ; anterior oesophagus 0.55 long ; nerve ring 0.27 from anterior end ; vulva not distinct ; eggs 0.044-0.055 × 0.033-0.044 in diameter.

Diplotrianena bargusinica Skrjabin, 1917

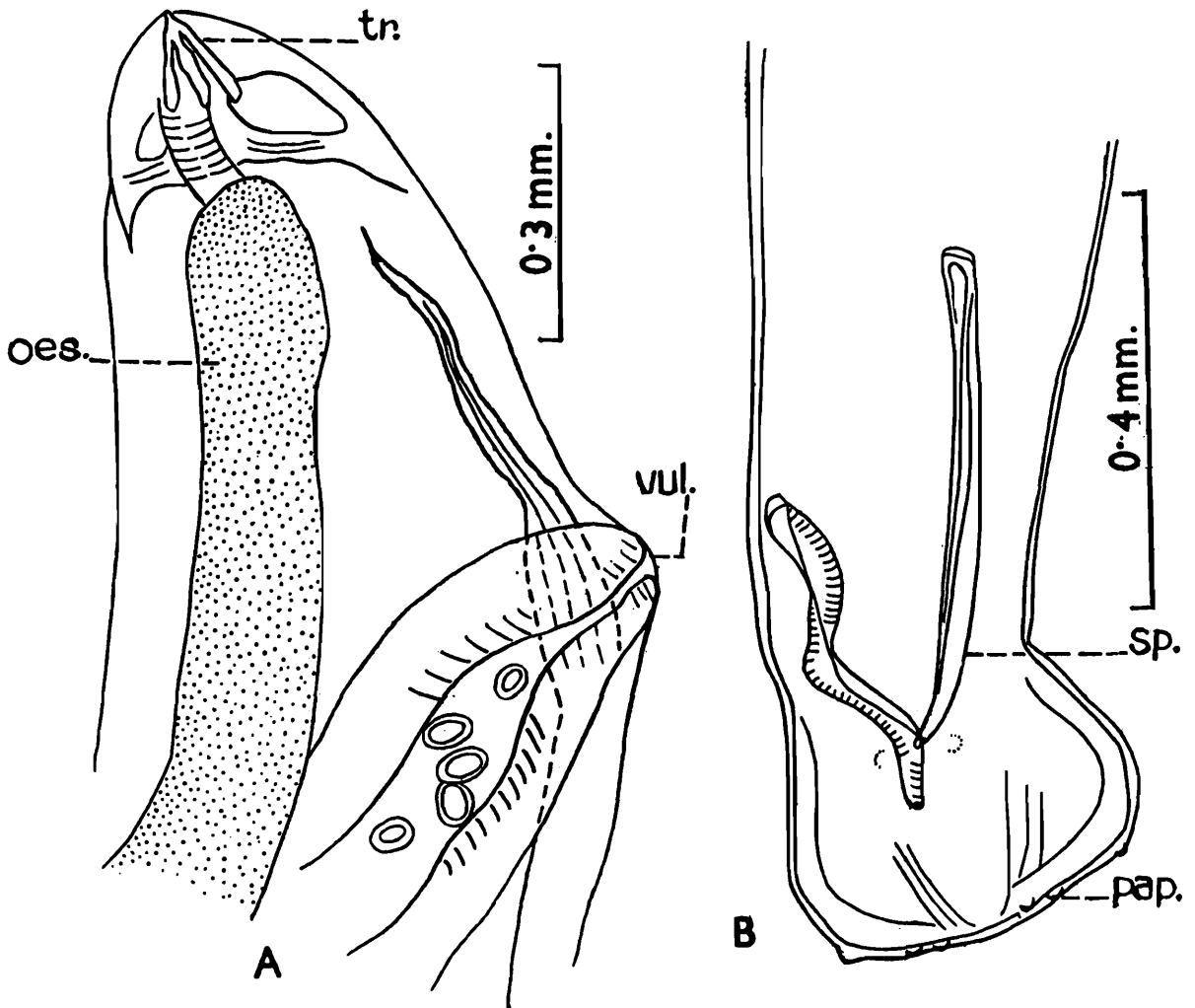
(Text-fig. 2a & b)

1917. *Diplotriana bargusinica* Skrjabin, *Parasitology*, 9(4): 471.

Material.—Several ♂♂ and ♀♀, Z.S.I. Reg. No. W 7042/1, host—*Turdus ruficollis*, location—body cavity, locality—Sangtey, Paro (Bhutan), collector—Shri E. R. S. Holmes, 15.iii.1970.

Male.—Body 31.0-46.4 long and 0.72-0.77 wide ; tridents 0.13-0.14 long ; oesophagus divided into two portions, anterior muscular 0.27-0.31, posterior glandular 3.6-4.8 long ; cloaca subterminal ; spicules unequal and dissimilar, left longer, straight and 0.64-0.66, right shorter, alate, striated, with two spiral curves and 0.38-0.5 long ; caudal papillae, preanal, only one pair clearly discernible, postanal, three pairs and situated along the posterior margin.

Female.—Body 85-107 long and 0.99-1.1 wide; tridents 0.11-0.13 long; oesophagus divided into two portions, anterior muscular 0.22-0.27, posterior glandular 3.3-5.0 long; nerve ring 0.16-0.22, and vulva 0.55-0.88, both from anterior end; eggs 0.033×0.055 in diameter.



Text-fig. 2. *Diplotriaena bargusinica* Skrjabin, 1917.
a. female, anterior end; b. male, posterior end.

Abbreviations : Oes. Oesophagus, pap. papillae, tr. trident, sp. spicule, vul. vulva.

Remarks.—Though the present specimens show some variations from earlier descriptions in respect of body measurements and in the number and arrangement of caudal papillae, in our opinion these variations are intraspecific.

The species has hitherto been recorded from Siberia (Skrjabin, 1917), and Japan (Yamaguti, 1935); and hence its present record from India greatly extends its range of distribution towards the South.

Diplotriaena sp.

The six lots detailed below belonging to the genus *Diplotriaena* from different hosts and localities could not be identified further due to poor preservation.

Material.—Lot 1. Several ♀♀ (fragments), Z.S.I. Reg. No. W 7075/1, host—Roller (*Coracias* sp.), location—body cavity, locality—Kisli, Balaghat (Madhya Pradesh), collector—T D. Soota, 26.1.1954.

Females.—Tridents 0.19 long; anterior oesophagus, 0.27 long; vulva 0.55 from anterior end; eggs 0.055×0.033 in diameter.

Lot 2. Several ♀♀ (fragments), Z.S.I. Reg. No. W 7076/1, host—An undetermined bird, location—body cavity, locality—Waltair (Andhra Pradesh), 17.ii.1947

Female.—Tridents 0.14 long; anterior oesophagus 0.2 long; nerve ring 0.18 and vulva 0.38, both from anterior end; eggs 0.033×0.077 in diameter.

Lot 3. Several ♀♀ (fragments), Z.S.I. Reg. No. W 7077/1, host—Racket-tailed Drongo (*Dicrurus* sp.), location—coelomic cavity, locality—Garampani, Khasi and Jaintia Hills (Meghalaya), collector—Shri H. Khajuria (Indo-German Expd.), 24.xi.1956.

Female.—Body 42.9 long and 0.95 wide; tridents 0.16 long; anterior oesophagus 0.33 and posterior oesophagus 6.6 long; vulva 0.33 from anterior end; eggs 0.044×0.022 in diameter.

Lot 4. Several ♀♀ (fragments), Z.S.I. Reg. No. W 7078/1, host—Bank Myna (*Acridotheres ginginianus*), location—body cavity, locality—Barasat (West Bengal), collector—Dr. B. Biswas, 19.vi.1952.

Female.—Body 0.66 wide; tridents 0.13 long; anterior oesophagus 0.33 long; nerve ring 0.22 and vulva 0.55, both from anterior end; eggs 0.044×0.033 in diameter.

Lot 5. Several ♀♀ (fragments), Z.S.I. Reg. No. W 7079/1, host—Myna (*Acridotheres* sp.), location—body cavity, locality—

Indian Museum compound, Calcutta, collector—Shri J. K. Sen, 21.vi.1954.

Female.—Tridents 0.13 long; anterior oesophagus 0.22 long; vulva 0.55 from anterior end; eggs 0.044×0.033 in diameter.

Lot 6. Two ♂♂ and several ♀♀ (fragments), Z.S.I. Reg. No. W 7080/1, host—Yellow-cheeked Teat (*Parus ? xanthogenys*), location—body cavity, locality—Jawai, Mount Abu (Rajasthan).

Male.—Tridents 0.088 long; anterior oesophagus 0.33 long; nerve ring 0.22 from anterior end; spicules unequal and dissimilar, left 1.05, right 0.58 long.

Female.—Eggs $0.022-0.044 \times 0.022-0.033$ in diameter; embryos $0.088-0.66 \times 0.0022$ in diameter.

Family DIPETALONEMATIDAE Wehr, 1935

Lemdana sp.

Material.—a ♂ and a ♀, Z.S.I. Reg. No. W 7043/1, host—cuckoo, location—body cavity, locality—Rogulchang, Baratang Island (Andamans), collector—Shri B. S. Lamba, 20.iii.1964.

Male.—Body 18.7 long and 0.55 wide; spicules very unequal, longer 3.2, shorter 0.33 long; tail 0.055 long and without alae; caudal papillae not discernible.

Female.—Body 35.6 long and 0.88 wide; eggs 0.022×0.044 in diameter.

Remarks.—Though the present specimens show some variations from the earlier descriptions, but due to their poorly preserved state specific identification has not been possible.

The genus is being recorded here for the first time from Andaman Islands.

Order SPIRURIDEA Diesing, 1861

Family SPIRURIDAE Orley, 1885

Physocephalus sexlatus (Molin, 1860) Diesing, 1869

Material.—Two ♂♂ and three ♀♀, Z.S.I. Reg. No. W 6941/1, host—Indian Gerbil, *Tatera indica*, location—stomach, locality Kolayat, Bikaner (Rajasthan), collector—Dr. V C. Agrawal, 13.ix.1960.

Male.—Body 8.9-9.5 long and 0.22-0.24 wide ; three lateral alae present and originating at the level of the junction of pharynx and oesophagus ; pharynx $0.12-0.18 \times 0.044$ in diameter and with 17-20 annular thickenings ; oesophagus 2.2-2.9 long ; tail 0.11-0.12 long, rounded and with a small spike ; caudal alae asymmetrical, 0.82-1.05 long ; longitudinal cuticular ridges present on caudal end ; spicules unequal, left 0.99-1.0 and right 0.25-0.27 long ; papillae clearly discernible only eight pairs, four pedunculate, preanal and sublateral in position (postanals not traceable), four sessile, minute, postanal and subventral.

Female.—Body 11.0-14.7 long and 0.2-0.38 wide ; pharynx $0.13-0.16 \times 0.055$ in diameter and with 20 annular thickenings ; oesophagus 3.85 long ; tail 0.077-0.11 long ; vulva not discernible due to the body being crowded with eggs ; eggs 0.011-0.022 in size.

Remarks.—The species forms the first host and locality records.

Found in association with members of the genus *Streptopharagus*.

Family GNATHOSTOMATIDAE Lane, 1923

Tanqua tiara (v. Linstow, 1879) Blanchard, 1904

1879. *Ascaris tiara* v. Linstow, Württemb. Naturw. Jahresh, Jaheg, 35 : 320.

Material.—Four ♂♂ and nine ♀♀, Z.S.I. Reg. No. W 6943/1, host—*Varanus* sp., location—stomach, locality—Bhasna, 24-Parganas (West Bengal), collector—Y Chaturvedi, 22.vii.1968.

Male.—Body 15-22 long and 0.44-0.66 wide ; cuticular striations present on body, more prominent in anterior region and 0.055-0.066 apart from one another ; head 0.16-0.2 long ; head bulb 0.27-0.33 in diameter ; cervical sacs 0.66-0.72 long ; oesophagus 3.0-3.96 long ; tail 0.37-0.38 long ; spicules 0.77-0.83 long ; papillae eight pairs, three preanals and five postanals.

Female.—Body 22-30 long and 0.88-1.2 wide at the maximum ; head 0.2-0.22 long ; head bulb 0.33-0.37 in diameter ; cervical sacs 0.77-0.88 long ; oesophagus 4-4.5 long ; tail 0.33-0.35 long ; vulva 4.5-5.5 away from posterior end ; eggs $0.044-0.066 \times 0.033-0.044$ in diameter.

Tanqua anomala (v. Linstow, 1904) Baylis, 1916

1904. *Heterakis anomala* v. Linstow, *Spolia zeylan.*, 1(4): 97.

Material.—Several ♂♂ and ♀♀, Z.S.I. Reg. Nos. W 6944-51/1, hosts—*Natrix piscator*, *N. stolatus*, *Enhydriis* sp., *Dryophis* sp., location—stomach, locality—Birati and Bhasna, 24-Parganas (West Bengal), collector—Shri S. C. Roy.

Male.—Body 25-30 long and 0.66-1.3 wide; cuticular striations present on body and 0.066-0.11 apart from one another; head 0.22-0.25 long; head bulb 0.31-0.33 in diameter; cervical sacs 0.5-0.66 long; oesophagus 3.8-4.2 long; tail 0.5-0.6 long; spicules 1.4-1.5 long; papillae eight pairs, three preanal and five postanal.

Female.—Body 29-35 long and 1.2-1.3 wide, cuticular striations 0.088-0.11 apart from one another; head 0.22-0.27 long; head bulb 0.27-0.32 in diameter; cervical sacs 0.82-0.88 long; oesophagus 4.4-4.8 long; tail 0.66-0.72 long; vulva 8.8-11.6 away from posterior end; eggs 0.055 × 0.066 in diameter.

Remarks.—The species is here being recorded for the first time from all the above hosts excepting *Natrix piscator*.

Family CAMALLANIDAE Railliet and Henry, 1915

Camalltnides prashadi Baylis and Daubney, 1922

1922. *Camallanides prashadi* Baylis and Daubney, *Mem. Indian. Mus.*, 7(4): 325.

Material.—Several ♂♂ and ♀♀, Z.S.I. Reg. Nos. 6952-61/1, hosts—*Natrix piscator*, *N. stolatus*, *Enhydriis* sp., *Ptyas mucosus*, localities—different places in 24-Parganas (West Bengal).

Male.—Body 3.7-6.6 long and 0.088-0.18 wide; cuticular striations on body not prominent excepting in the specimens from *Ptyas mucosus* where they are prominent just behind the head; buccal valves 0.055-0.066 long and 0.066-0.077 wide, "rods" 0.033-0.044 long and attached to buccal valves on either side by chitinoid bodies as described by Baylis (1939), they are of different shapes and different shades of yellow, though sometimes much faded due to which not clearly discernible; posterior ring 0.033-0.044 wide; oesophagus divided into two parts, anterior muscular, 0.21-0.27 long, and posterior glandular, 0.27-0.4 long; nerve ring 0.11-0.12 away from anterior end; tail small, 0.088-0.12 long and with caudal alae,

the terminal portion lacking the alae and is curved ventrally excepting in specimens from *Ptyas mucosus* where it is straight; papillae, pedunculate, preanal five pairs, and postanal five pairs, excepting in the specimens from *Ptyas mucosus* where preanals are eight pairs and postanals nine pairs, the latter divided into four groups of 2:3:3 and 1; spicules unequal and dissimilar, right broad, alate and 0.16-0.24 long, left slender, 0.11-0.16 long; accessory piece triangular, 0.022-0.033 long.

Female.—Body 5-18.3 long and 0.19-0.5 wide; buccal valve 0.066-0.088 $\times$ 0.088-0.11 in diameter; rods 0.044-0.12 long; posterior ring 0.033-0.044 wide; anterior portion of oesophagus 0.31-0.36 and posterior 0.38-0.55 long; nerve ring 0.14-0.2 away from anterior end; tail 0.3-0.55 long; vulva 2.3-7 away from anterior end and situated on a tubular appendage; the body cavities of female worms crowded with embryonated eggs excepting in the specimens from *Ptyas mucosus*.

Order TRICHURIDEA Yamaguti, 1961

Family TRICHURIDAE Railliet, 1915

Trichuris globulosa (v. Linstow, 1901) Ransom, 1911

1901. *Trichocephalus globulosus* v. Linstow, *Arch. Mikrask. Anat.*, 58(1): 182.

Material.—Several ♂♂ and ♀♀, Z.S.I. Reg. No. W 6962/1, host—goat, location—rectum, locality—Chitrakunda, Koraputt (Orissa), collector—Shri K. C. Kansal, 12.5.1966; Z.S.I. Reg. No. W 6963-64/1, host—goat, location—caecum, locality—Calcutta, 6.i.1962; Z.S.I. Reg. No. 6966-67/1, host—goat, location—caecum, locality—Etah (Uttar Pradesh), collector—Shri G. Ramakrishna; Several ♂♂ and ♀♀, Z.S.I. Reg. No. W 6983/1, host—*Axis axis*, location—rectum, locality—Jodhpur (Rajasthan), 5.x.1962.

Male.—Body with slender oesophageal, and thicker and shorter posterior portion, the latter 16.5-22.6 long and 0.53-0.77 wide; spicule 4-7.7 long and 0.055-0.088 thick, thickness increasing near the distal end and again narrowing to give a “sabre-like” shape; general characters as also the distal spines on the spicular sheath which are longer than proximal ones are as described by Baylis (1939) but the distal end agrees with

Ortlepp (1937) rather than Baylis as our specimens (excepting those from *Axis axis*) show no swelling or partially or fully everted sheath showing globular structure.

Female.—Thick part of body 14-19.8 long and 0.88-0.99 wide ; vulva 13.8-17.6 away from posterior end and with spines on its lips ; vagina showing few curves and lined anteriorly heavily with spines (as already given by Baylis), excepting in the specimens from chital (*Axis axis*) which show still fewer curves and smaller region with spines.

Remarks.—The species is being recorded here for the first time from *Axis axis*.

***Trichuris ovis* (Abildgaard, 1795) Smith, 1908**

Material.—Several ♀♀, Z.S.I. Reg. No. W 6968/1, host—goat, location—caecum, locality—Bareilly (Uttar Pradesh) 7.vi.1965.

Female.—Thick part of body 17-20 long and 0.8 wide ; vulva 16.5-18.0 away from posterior end and protruded in a tubular form ; eggs 0.055×0.033 in diameter.

***Trichuris* sp.**

(Text fig. 3a and b)

Material.—a ♀, Z.S.I. Reg. No. W 6984/1, host—*Bandicota indica*, location—intestine, locality—Howrah (West Bengal), collector—Y Chaturvedi, 7.xii.1967

Female.—Body 18.7 long and 0.28 wide at the maximum ; thick part of body 7.5 long ; vulva 7.5 away from posterior end and not everted ; vagina 0.73 long, straight, and without convolutions and spines ; eggs 0.066×0.044 in diameter.

Remarks.—Though the present specimen shows some variation in the vagina, in the absence of males specific identification is not possible.

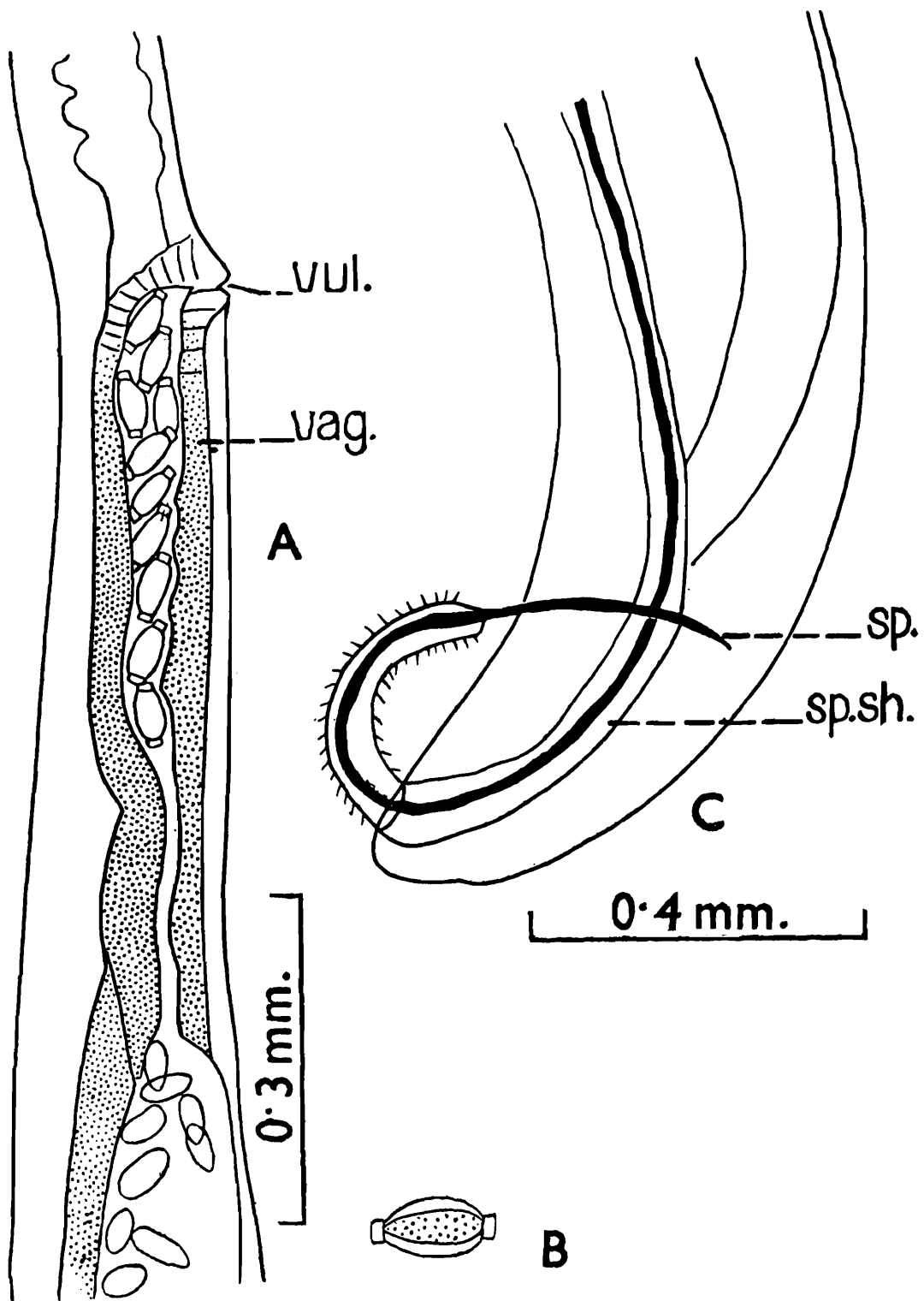
***Trichuris* sp.**

(Text Fig. 3C)

Material.—Two ♂♂ Z.S.I. Reg. No. W 6976/1, host—unknown, locality—Bikaner (Rajasthan), 1.x.1962.

Male.—Thick part of body 6.6 long and 0.35 wide ; spicule 1.2 long ; spicular sheath covered with spines of even length.

Remarks.—Though the present specimen shows some variations in the spines on its spicular sheath ; in the absence of females we hesitate to assign it any specific rank.



Text-fig. 3. *Trichuris* sp.

a. female, anterior end ; b. egg ; c. male, posterior end.

Abbreviations : sp. spicule, sp. sh. spicular seath, vag. vagina, vul. vulva.

SUMMARY

The paper deals with 18 species of nematodes from the unnamed collection of the Zoological Survey of India. Interesting variations and new host and locality records have been furnished.

REFERENCES

- BAYLIS, H. A. 1936. Fauna of British India, including Ceylon and Burma. *Nematoda*, Vol. I, 408 pp.
- BAYLIS, H. A. 1939. Fauna of British India, including Ceylon and Burma. *Nematoda*, Vol. II, 274 pp.
- BAYLIS, H. A. and DAUBNEY, R. 1923. A further report on parasitic nematodes in the collection of the Zoological Survey of India. *Rec. Indian Mus.*, **25**: 551-575.
- CAMERON, T. W. M. 1924. On the nematode genus *Globocephalus* Molin, 1861. *J. Helminth.*, **2**(2): 65-76.
- NEVEU-LEMAIRE, M. 1936. *Traite de Helminthologie medicale de veterinaire*, Paris.
- ORTLEPP, R. J. 1937. Whipworms from South African ruminants. *Onderst. J. Vet. Sc. and Anim. Ind.*, **9**(1): 91-100.
- OZERSKAJA, V. N. 1953. Parasitic worm fauna of wild boar. *Turdy VIGIS*, **5**: 75-81.
- POPOVA, T. I. 1964 (1955). *Strongylids of animals and man*. 236 pp. (English). Israel Programme for Scientific Translations, Jerusalem.
- SKRJABIN, K. I. 1917. Sur quelques nematodes de oiseaux dela Russie. *Parasitology*, **9**(4): 460-481.
- SKRJABIN, K. I., SHIKHOBALOVA, N. P., SCHULZ, R. S., POPOVA, T. I., BOEV, S. N., and DELYAMURE, S. L. 1961 (1952). *Key to parasitic nematodes. Strongylata* (English text) 890 pp. Israel Program for Scientific Translations, Jerusalem.
- TEIZEIRA DE FREITAS, J. F. and LENT, H. 1936. Estudo sobre O genero *Globocephalus* Molin, 1861. *Mem. Inst. Osw. Cr.* **31**(1): 69-80.
- YAMAGUTI, S. 1935. Studies on the helminth fauna of Japan. Pt. 12. Avian nematodes, I. *Jap. J. Zool.*, **6**: 403-431.
- YAMAGUTI, S. 1935(a). Studies on the helminth fauna of Japan, Pt. 13. Mammalian nematodes. *Jap. J. Zool.* **6**(2): 433-457.
- YAMAGUTI, S. 1961. *Systema helminthum*. Vol. 3 pts. 1 & 2, 1261 pp. New York.
- YORKE, W. and MAPLESTONE, P. A. 1926. *The nematode parasites of vertebrates*. 536 pp.

COMPARATIVE MORPHOLOGICAL STUDIES ON THE
GIRDLES AND LIMB BONES OF THE GENUS
PANTHERA OKEN (CARNIVORA : MAMMALIA)

By

A. K. MANDAL

Zoological Survey of India, Calcutta

(With 4 plates)

INTRODUCTION

Skeleton of animals has attracted the attention of anatomists since long, mainly because it forms the solid framework of the body in relation to which other structures are oriented. However, all components of the skeletal framework have not received equal treatment. For instance, though the craniology of various mammalian groups has been extensively studied, information about the appendicular skeleton, specially that of Carnivora, is still meagre. Mivart (1881), Kelson (1946), Hopwood (1947), Davis (1949), Hildebrand (1954), Cantuel (1955) and Ondrias (1961) have given accounts to the morphology of skeleton in different carnivores, but none has dealt with the differential character of the various species. The present study was undertaken towards filling up the lacuna in our knowledge of carnivore osteology.

As a first step, four species of the genus *Panthera*, namely *Panthera leo* (Linn.) (the Lion), *P. tigris* (Linn.) (the Tiger), *P. pardus* (Linn.) (the Leopard) and *P. uncia* (Schreber) (the Snow Leopard) were selected for study. The fifth species of the genus, the neotropical *P. onca* (the Jaguar) could not be studied for want of material.

The investigation has been confined to the morphology of the long bones and girdles in the four Indian species of this genus, and attempt has been made to correlate the diversity in structure with the habits and habitats of these species, and to assess the degree of specialisation achieved in each.

The Lion is an inhabitant of semi-forested areas with plenty of scrub; it is a powerful leaper but does not climb trees. The Tiger chiefly lives in grasslands, and reedy swamps,

though may be, occasionally, associated with dense forests. It is not arboreal, but it can swim well. The Leopard can climb trees with great ease. It lives mainly in forests but may also be found in broken, rocky hill-sides and scrub-covered country. The Snow Leopard is denizen of a different type of habitat. It does not inhabit forests, but occupies rocky mountains above tree-line where it can move about with great facility. It descends to lower levels from its normal haunts upto the forest-zone (2,000 m) during the acme of the winter.

MATERIAL AND METHOD

Most of the skeletons studied belonged to the Zoological Survey of India, but some were received on loan from the American Museum Natural History, New York, and the Zoological Institute, Academy of Sciences of U.S.S.R., Leningrad.

In all, 40 skeletons were examined, as detailed below. Of these 2 unsexed examples of *P. leo*, 2 ♂ and 1 ♀ of *P. tigris* were from captive specimen of Zoological Gardens, and the others were of wild animals.

<i>P. leo</i> ,	2 ♂ , 2 ♀ , 2 unsexed
<i>P. tigris</i> ,	9 ♂ , 9 ♀ , 2 unsexed
<i>P. pardus</i> ,	5 ♂ , 4 ♀ , 1 unsexed
<i>P. uncia</i> ,	2 ♂ , 2 ♀ .

The skeletons of both the sides were examined. In order to avoid the variation due to age, only those skeletons where the epiphysial sutures were closed or obliterated, were studied. Morphological characters are mentioned for the genus first, followed by those for the different species.

OBSERVATIONS

SCAPULA

(Pl. 1, figs. 1-8)

Flat, more or less triangular; spine somewhat straight, slightly inclined towards infraspinous fossa; coracoid border rounded, more convex at lower end; junction between vertebral and coracoid borders distinct marked by a prominent rounded thick area; coracoid process generally pointed, hook-like slightly projecting out, subscapular surface more concave, with five or six prominent ridges for muscular attachment,

The main feature by which the scapula can be specifically differentiated is its outline and the contour of spine. The spine is somewhat linear in the Lion and slightly overhangs towards infrascapular fossa. In the Tiger and the Leopard, it is broad in the middle, more so in the former. It is more inclined towards the fossa in the Tiger but almost erect in the Leopard. The spine is also linear throughout but more inclined towards the fossa in the Snow Leopard. In the Tiger and the Leopard, the acromion is slender and curved at the end like a hook, more so in the latter. It is broad and almost straight in the Lion and the Snow Leopard. The metacromion is broad and fan-shaped in the Tiger, but slender and hook-like in the Leopard. It is elongated and massive on the base in the Lion and the Snow Leopard. The coracoid margin is uniformly curved without forming any angle in the Lion and the Leopard, whereas an obtuse angle is formed just below the middle in the Tiger and almost at the middle in the Snow Leopard. On the costal side, the scars for *m. serratus magnus* and *m. lavator anguli scapulae* are placed just behind the spine. It is somewhat rectangular in the Tiger, elongated or diamond-shaped in the Leopard, and rhomboidal in the Lion. In the Snow Leopard the shape is intermediate between those of the Lion and the Tiger. The coracoid process is stumpy in the Lion and rudimentary in the Snow Leopard. It is fairly well-developed and directed backward in the Tiger, but small and slightly curved in the Leopard.

HUMERUS

(Pl. 2 figs. 1-4)

Massive, more or less cylindrical; bicipital groove wide; deltoid ridge prominent, placed more towards outer margin; surface for *m. infraspinatus* well developed; greater and lesser tuberosities heavy and broad; olecranal fossa narrow and deep with prominent external edge; supinator ridge fairly well developed.

The humerus of the Leopard is almost linear. It is slightly curved inward in the Snow Leopard, and more so in the Lion. In the Tiger, this curvature is intermediate between those of the Lion and the Snow Leopard. The deltoid tuberosity is strongly developed in the Tiger and the Leopard, more so in the former. It is less developed in the Lion and least in the

Snow Leopard. The outer and inner margins of the deltoid tuberosity meet posteriorly to form the crest. This fusion takes place above the middle of the shaft in the Lion, at the mid-point in the Tiger, in between the two in the Leopard and a little below the middle in the Snow Leopard. The humeral crest is more prominent in the Tiger and the Leopard than in the Lion and the least in the Snow Leopard. The prominent teres tubercle is placed equidistant from the outer and inner margins in the Lion and the Snow Leopard ; towards the inner margin in the Tiger, but in the Leopard it lies between the inner margin and the middle point.

RADIUS

(Pl. 2, figs 5 & 6)

Shaft rather flattened, slightly curved, head oval or kidney-shaped, lateral border flattened, medial border relatively sharp, styloid process elongated and fairly well developed.

The scars for the *m. pronator teres* and *m. supinator brevis* are situated almost in the middle axes in the Lion and the Snow Leopard, slightly proximal to it in the Tiger and distal to it in the Leopard. In the Lion and the Snow Leopard, prominent ovate tubercle for *m. biceps* is placed close to the lateral border, but in the Tiger, nearly half of it lies on the volar surface and the rest on the lateral border. In the Leopard, it has shifted more towards the volar surface. The styloid process is elongated and pointed in the Tiger but less so in the Snow Leopard. In the Lion and the Leopard, it is broader at the base and appears less elongated.

ULNA

(Pl. 2, figs. 7-9)

Shaft heavy, strongly built, more or less straight, tuberosity for radial surface highly developed ; olecranon provided with a single process towards its outer extremity.

The ulna can be specifically differentiated by the nature of a deep fossa, situated in front of a smooth area on the proximal end of the olecranon, where the *m. triceps* are inserted. In the Leopard, the lateral margin is tumid, more promi-

nent and placed upwards than the medial margin. In the Lion, the lateral and medial margins are equally strong and the former is more anteriorly situated than that in the Leopard. In the Tiger, the lateral margin is thick, and more anteriorly projected than in the Lion ; whereas the medial margin is thin and less elevated than the lateral margin as in the Leopard. In the Snow Leopard, the thick and prominent medial margin is projected more anteriorly than the thick lateral.

INNOMINATE

(Pl. 3, Figs. 1-4)

Ilium slightly concave on outer surface, crest convex, arched and parabolic ; outer surface of acetabulum projected out, obturator foramen uniformly narrow towards anterior end ; acetabular process of ischium less developed in male than in female ; pubis slender in female but stout in male.

The ischiatic process which forms the acetabulum is depressed in the Lion and slightly less so in the Snow Leopard. It is elevated in the Tiger and the Leopard but to a lesser extent in the latter. The outer border of the acetabulum is broad in the Lion and the Leopard, and narrow in the Tiger and the Snow Leopard. The acetabular notch is prominent in the Tiger, less so in the Snow Leopard and the Leopard, and the least in the Lion. It is directed downward, inside the acetabulum in the Lion, upwards in the Tiger, and more or less straight in the Leopard and the Snow Leopard. The obturator foramen is oval in the Lion and the Snow Leopard, somewhat elliptical in the Tiger, and perfectly elliptical in the Leopard.

FEMUR

(Pl. 4, fig. 1 & 2)

Shaft sub-cylindrical, more or less straight, head broadly rounded ; dorsal surface of neck thick and straight ; greater trochanter straight ; trochanteric fossa shallow and wide ; lesser trochanter fairly well developed, knobbed, placed a little away from trochanteric fossa ; *linia aspra* well developed.

In the Lion, the shaft is more arched at the distal end than that of the Tiger and the Snow Leopard, but in the Leopard,

it is almost straight. The head is broad and wide in the Lion but less so in the Snow Leopard. In the Tiger and the Leopard, it is stumpy. The trochanteric fossa is broader in the Lion and the Snow Leopard than those in the Tiger and the Leopard.

In the Lion the lateral ridge is well developed. The distance between the lesser trochanter and the head is maximum in the Tiger, minimum in the Lion and intermediate between the two in the Leopard and the Snow Leopard. The greater trochanter is placed a little higher than the head in the Lion and in others it is almost at the same level as the head. The points of origin of the *m. gastrocnemius* on the inner surface above the condyle are well defined in all the species studied.

TIBIA

(Pl. 4, figs 3-5)

Crest flattened, highly developed, with a prominent ridge on outer side ; popliteal notch fairly well developed, with prominent outer tuberosity.

The crest of the tibia is prominent in the Lion and arched towards the outer side with a deeper concavity on the lateral surface than that of the Tiger. In the Leopard, it is less prominent than that of the Tiger, and it is least prominent in the Snow Leopard. The furrow for the attachment of *m. gastrocnemius* on the inner surface of the tibia is prominent and deep in the Leopard, slightly less so in the Tiger, and rather shallow in the Lion and the Snow Leopard.

FIBULA

(Pl. 4, fig. 6 & 7)

Shaft slender, reduced ; outer surface concave ; proximal end bluntly expanded ; distal end flattened with notched extremity.

Of the long bones of *Panthera* studied, the fibula shows much individual variation. It is stronger in the Tiger than in the Lion. It is heavier in the Snow Leopard than in the Leopard. The head of the fibula in the Lion is more expanded than that of the Tiger. In the Snow Leopard it is less developed than that of the Tiger, and least so in the Leopard.

DISCUSSION

Limbs have dual function of locomotion and supporting the body, the girdles serving as a bridge between the axial skeleton and limbs.

The appendicular skeleton in species of the genus *Panthera* has the same general plan and components, but the latter exhibit certain structural modifications to suit the particular habits and ways of life of each species.

The four species of larger cats of the genus *Panthera*, dealt with here, are all predators who have the ability for swift and sustained running, as well as capability to stalk their prey noiselessly and slowly. Not only can they successfully stalk their prey and overpower it, but they can also escape swiftly when sensing danger. Additionally, forelimbs of the big cats are capable of paralysing even larger prey with a powerful blow, capable of dislocating the cervical vertebrae and of tearing away large chunks of flesh from the body of the victim.

The elongated scapulae of the Lion and Leopard, and the deltoid crests placed towards the proximal end of the humerii, are specialisations for speed, as they assist in large angular movement, necessary for quick progression, through the muscles attached over them. In addition, the presence of moderately developed scars in the radius of the Lion indicate moderately developed extensor muscles; the latter are responsible for the fast running of the animal. The cursorial habits of the Lion and Leopard are further emphasised by the weak pubis and downwardly directed acetabulae (Howell, 1944) and by the development of large femoral head and the reduction of fibulae which restrict their movement in the lateral and sagittal planes (Hildebrand, 1954). Moreover the well-developed greater trochanter in all the four species studied indicates the presence of a powerful gluteal group of muscles, which are essential for running and leaping.

Combined with the capacity for fast running, all these cats are also capable of jumping, a faculty in which the hind limbs are more involved than the fore-limbs. The comparatively longer ischio-pubic region of the pelvis as compared to the ilium in them apparently facilitates in jumping. Among the four species of *Panthera*, the Leopard is structurally best adapted for jumping because of a well-defined trochlear groove indicating fairly well-developed gastrocnemius muscle which assists

in giving the animal necessary poise preparatory to the rapid final leap. The Tiger, the Snow-leopard and the Lion, in which the tibial groove has undergone gradual reduction, are structurally less proficient in ability to jump than the Leopard.

Finally, among the four species, the Leopard shows the greatest ability for climbing which is reflected in the moderately erect scapular spine which gives facility for raising of thorax. The power to rotate the forearm, indicated by the well developed scars for the flexor muscles, is another feature of importance in climbing exhibited by the Leopard.

In conclusion, it can be said that the appendicular skeleton in the four species of the genus *Panthera* is strong and distinctly oriented for powerful muscle attachments that give these cats the power to run fast, jump and, as in the case of the Leopard, to climb. The specific differences in the axial skeleton can be correlated to their particular habits and in spite of much individual variations the morphological characters furnish easy and reliable clues to specific identity of each cat.

SUMMARY

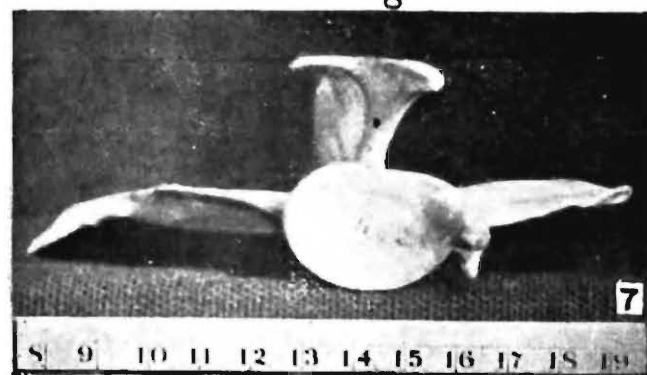
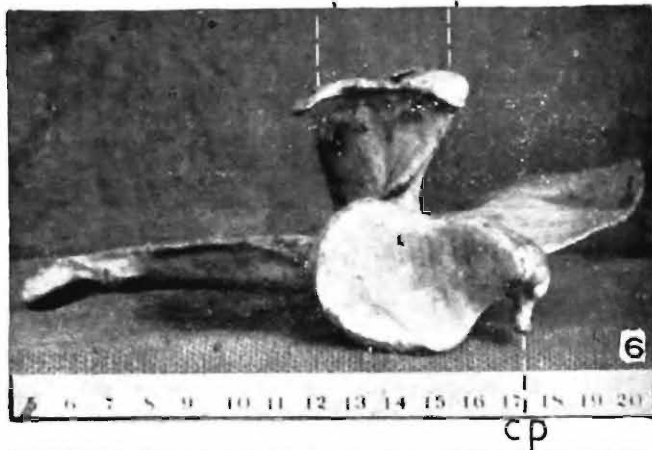
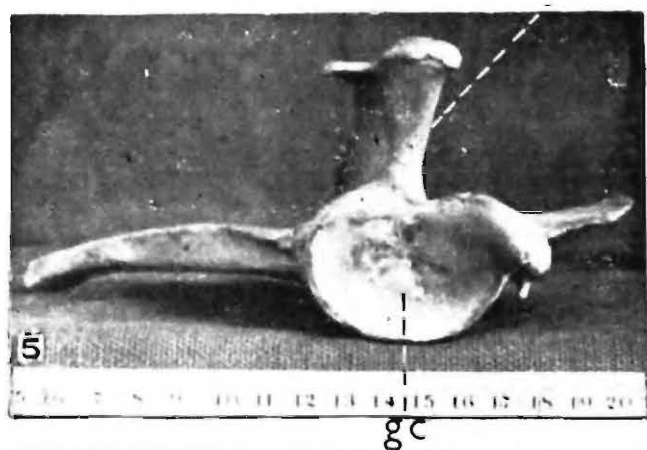
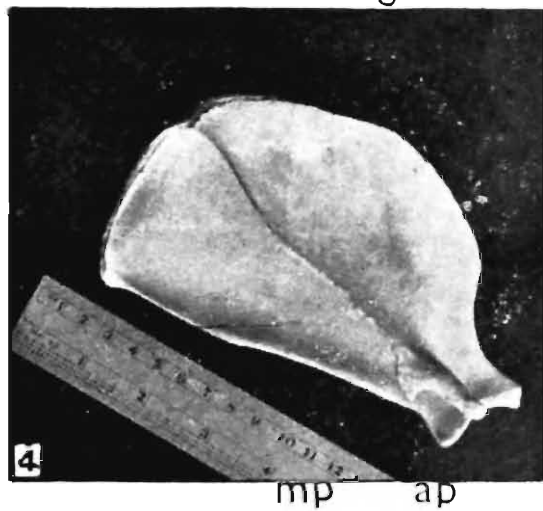
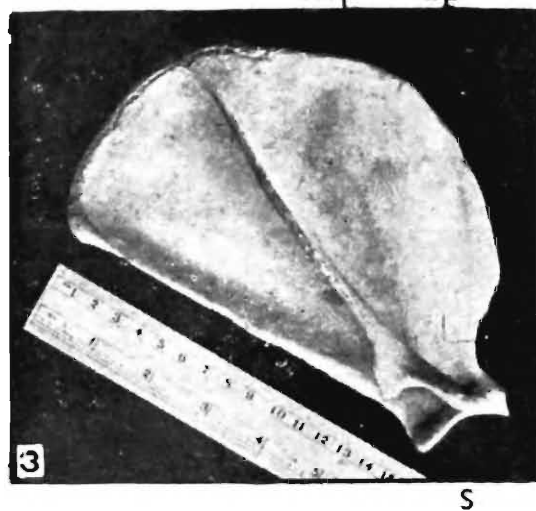
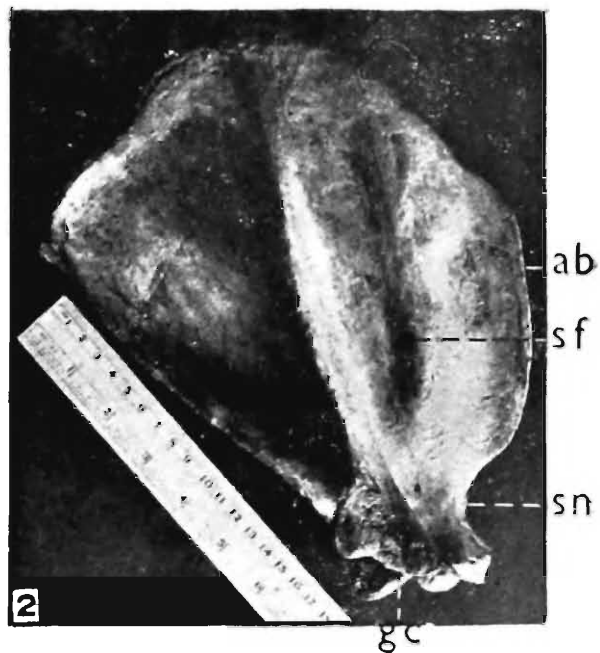
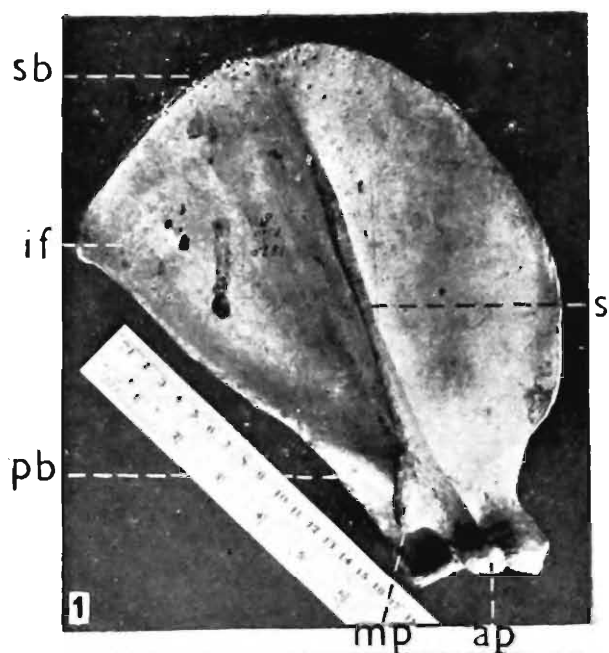
The morphological characters of the girdles and limb bones of four species of the genus *Panthera*, viz. *P. leo*, *P. tigris*, *P. pardus* and *P. uncia* have been studied. Certain features which aid in differentiating these species, are presented here and the salient ones have been summarised in a tabular form. Further an attempt has been made to correlate these differences with their habits.

ACKNOWLEDGMENTS

My thanks are due to Dr. A. P. Kapur, Director, Zoological Survey of India for placing the material for study at my disposal ; to Dr. B. Biswas and Dr. K. K. Tiwari, Superintending Zoologists, Zoological Survey of India, for going through the manuscript and for helpful discussions ; to Dr. V. C. Agrawal and other colleagues for sundry help and to Dr. G. Topal, a visiting mammalogist from Hungary, for helping me in photography. I am indebted to the authorities of the American Museum of Natural History, New York and the Zoological Institute Leningrad, Academy of Sciences U.S.S.R. for the loan of some skeletal material.

REFERENCES

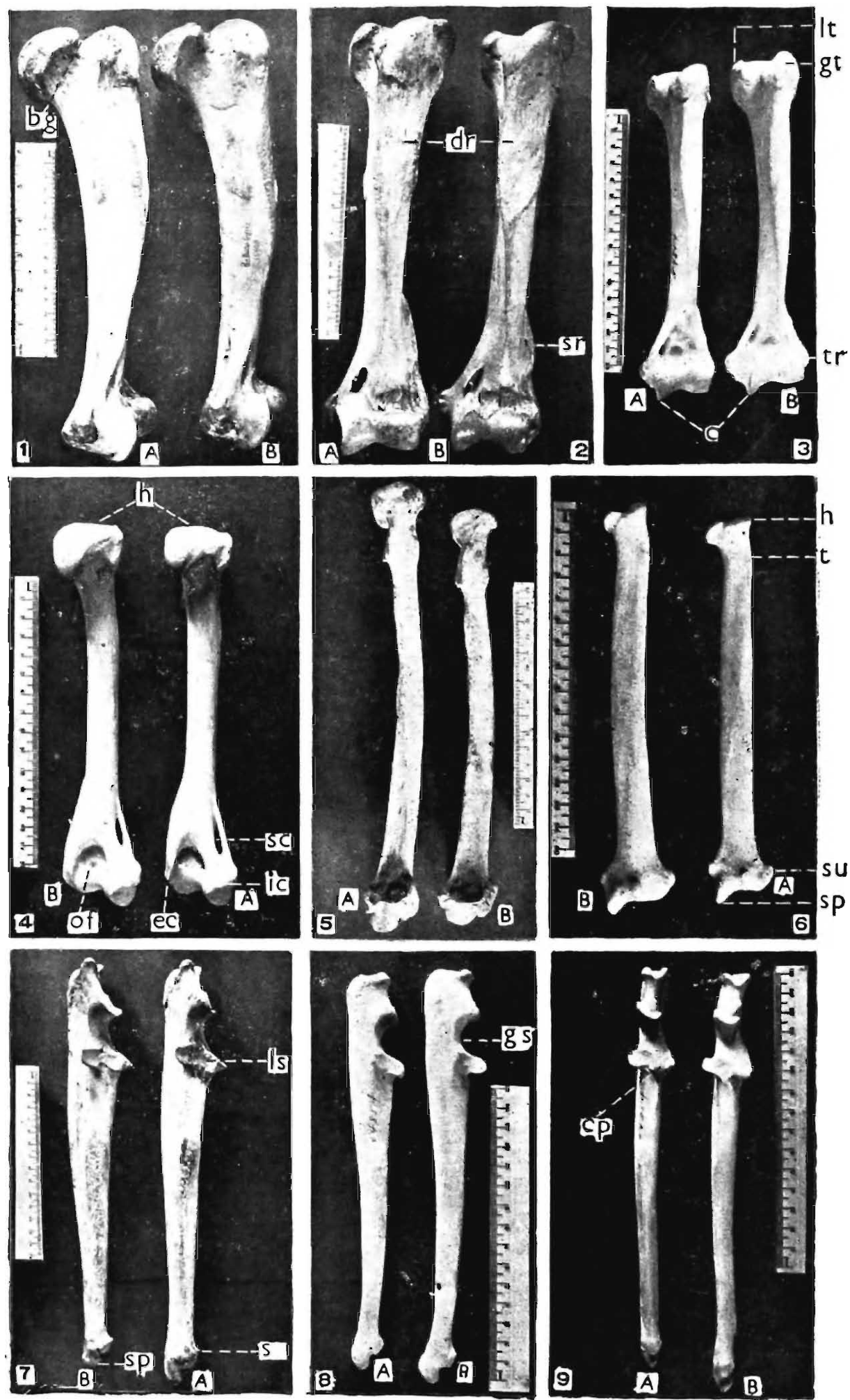
- CANTUEL, P. 1955. Remarques sur le squelette D'un chat sauvage *Felis sylvestris* Schreber. *Mammalia*, **19**: 470-477, 8 figs.
- DAVIS, D. D. 1949. The shoulder architecture of Bear and other Carnivores. *Fieldeana, Zool.*, **31**: 285-305, 8 figs.
- HOPWOOD, A. T. 1947. Contributions to the study of some African Mammals III. Adaptations in the bones of the fore limb of lion, leopard and cheetah. *J. Linn. Soc. London*, **41**: 159-271, 5 figs.
- HOWELL, A. B. 1944. *Speed in animals* Chicago: 270 + xii.
- HILDEBRAND, M. 1954. Comparative morphology of the body skeleton in recent Canidae. *Univ. Calif. Publ. Zool.*, **52**: 399-470, 4 pls. 30 figs.
- KELSON, K. R. 1946. Notes on the comparative osteology of the Bobcat and the House cat. *J. Mammal., Baltimore*. **27**: 255-264, 4 figs.
- MIVART, G. ST. (1881) *The cat. An introduction to the study of the backboneed animals especially mammal.* John Murray, London: 557 + XXIII.
- ONDRIAS, J. C. 1961. Comparative osteological investigations on the front limbs of European Mustelidae *Ark. Zool.*, (2) **13**: 311-320, 4 figs, 4 tables.



EXPLANATION OF PLATE 1

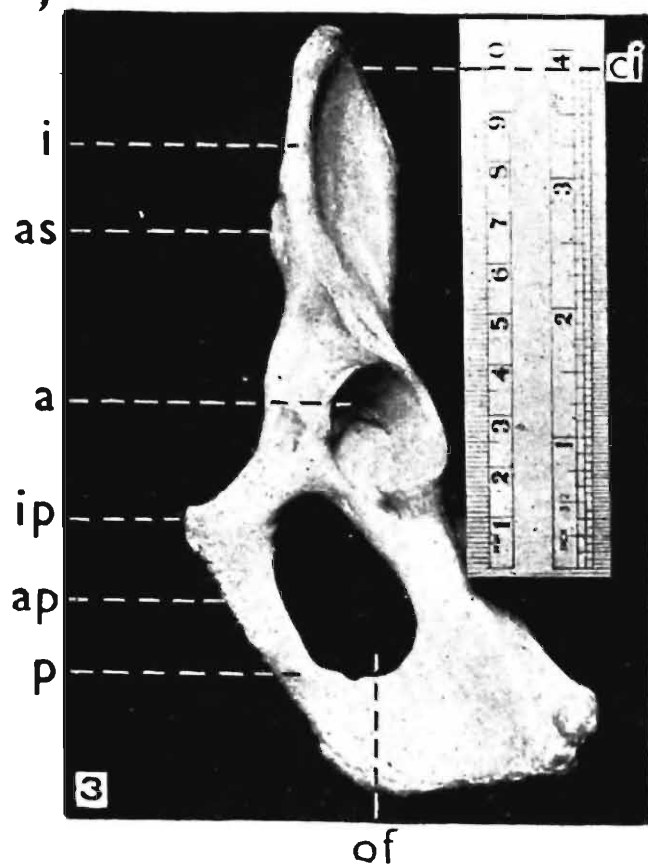
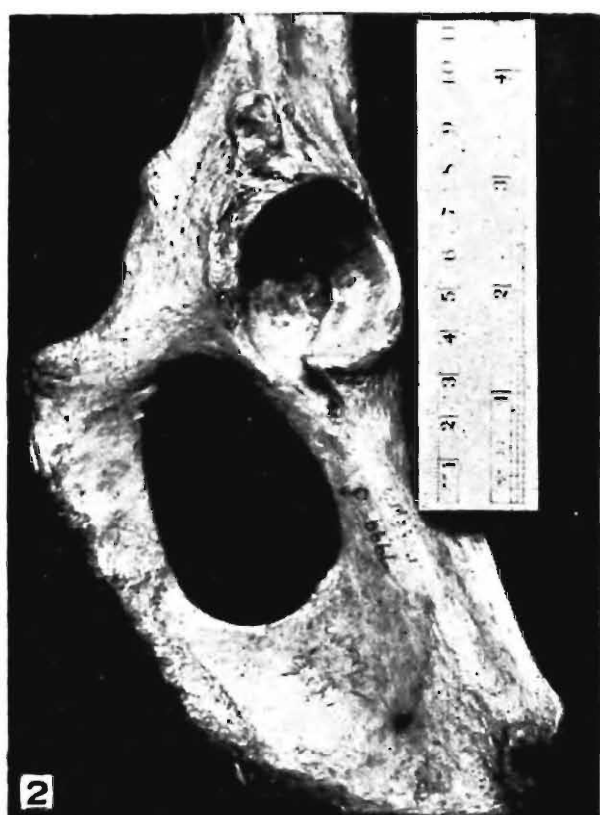
- Fig. 1. Dorsal view of right scapula of *Panthera leo*
- Fig. 2. Dorsal view of right scapula of *Panthera tigris*
- Fig. 3. Dorsal view of right scapula of *Panthera pardus*
- Fig. 4. Dorsal view of right scapula of *Panthera uncia*
- Fig. 5. End-on view of right scapula of *P. leo*
- Fig. 6. End-on view of right scapula of *P. tigris*
- Fig. 7. End-on view of right scapula of *P. pardus*
- Fig. 8. End-on view of right scapula of *P. uncia*

Abbreviations: ab = anterior border; ap = acromion process; cp = coracoid process; gc = glenoid cavity; if = infra spinatus fossa; mp = metacromion process; pb = posterior or axillary border; s = spine; sb = superior border; sf = supra spinatus fossa; sn = supra scapular notch.



EXPLANATION OF PLATE 2

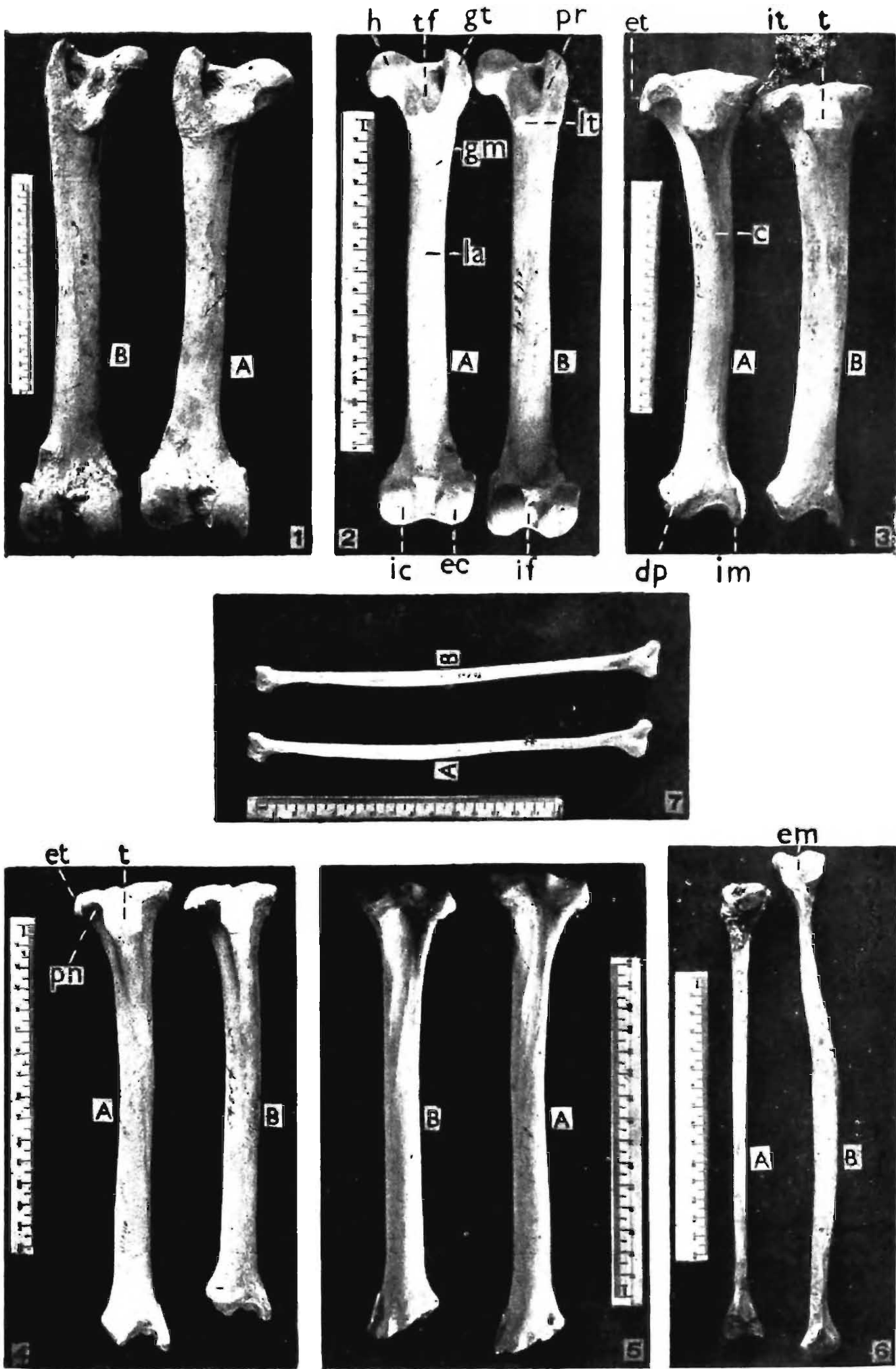
- Fig. 1. Lateral view of left humerus of *Panthera leo* (A) *Panthera tigris* (B)
- Fig. 2. Front view of left humerus of *P. leo* (A) and *P. tigris* (B)
- Fig. 3. Front view of left humerus of *Panthera pardus* (A) and *Panthera uncia* (B)
- Fig. 4. Back view of left humerus of *P. pardus* (A) and *P. uncia* (B)
- Fig. 5. Lateral view of right radius of *P. leo* (A) and *P. tigris* (B)
- Fig. 6. Front view of right radius of *P. pardus* (A) and *P. unica* (B)
- Fig. 7. Lateral view of right ulna of *P. leo* (A) and *P. tigris* (B)
- Fig. 8. Lateral view of right ulna of *P. pardus* (A) and *P. unica* (B)
- Fig. 9. Front view of right ulna of *P. pardus* (A) and *P. unica* (B)
- Abbreviations:—bg = bicipital groove; c = condyle; cp = coronoid process; dr = deltoid ridge; ec = external condyle; gs = greater sigmoid cavity; st = greater tuberosity; h = head; ic = internal condyle; ls = lesser sigmoid cavity; lt = lesser tuberosity; of = olecranal fossa; s = surface for radius; sc = supra condyloid foramen; sp = styloid process; sr = supinator ridge; su = surface for Ulna; t = tuberosity; tr = trochlea.



EXPLANATION OF PLATE 3

- Fig. 1. Part of left os innominatum of *Panthera leo*
 Fig. 2. Part of left os innominatum of *Panthera tigris*
 Fig. 3. Left os innominatum of *Panthera pardus*
 Fig. 4. Left os innominatum of *Panthera uncia*

Abbreviations:—a = acetabulum; ap = articular surface of pubis;
 as = articular surface; ci = crest of ilium; i = ilium;
 ip = ilio-pectineal eminence; of = obturator foramen; P =
 pubis; st = suspensory tuberosity; ti = tuberosity of ischium.



EXPLANATION OF PLATE 4

- Fig. 1. Front view of left femur of *Panthera leo* (A) and *Panthera tigris* (B)
- Fig. 2. Front view of right femur of *Panthera uncia* (A) and *Panthera pardus* (B)
- Fig. 3. Front view of right tibia of *Panthera leo* (A) and *Panthera pardus* (B)
- Fig. 4. Front view of right tibia of *Panthera uncia* (A) and *Panthera pardus* (B)
- Fig. 5. Back view of right tibia of *Panthera uncia* (A) and *Panthera pardus* (B)
- Fig. 6. Back view of right fibula of *Panthera leo* (A) and *Panthera tigris* (B)
- Fig. 7. Back view of right fibula of *Panthera uncia* (A) and *Panthera pardus* (B)

Abbreviations:—c = crest; dp = descending process; ec = external condyle; em = external malleolus; et = external tuberosity; gm = crest for *m. gluteus maximus*; gt = greater trochanter; h = head; ic = internal condyle; if = inter condyloid fossa; im = internal malleolus; it = internal tuberosity; la = linea aspra; lt = lesser trochanter; pn = popliteal notch; pr = posterior inter-trochanter ridge; t = tuberosity;; tf = trochanteric fossa.

NOTES ON A COLLECTION OF GALERUCINAE
(COLEOPTERA : CHRYSOMELIDAE) FROM N. E. INDIA

By

T. G. VAZIRANI AND R. K. KACKAR

Zoological Survey of India, Calcutta

INTRODUCTION

This report is based on the collection of Chrysomelidae subfamily Galerucinae—which have been collected by various survey parties from the Zoological Survey of India in Assam, Sikkim and N.E.F.A. regions.

These surveys were conducted by our colleagues as shown below :—

Dr. A. G. K. Menon	Sikkim, 1959	(A.G.K.M.)
Dr. K. C. Jayramakrishnan	N.E.F.A., 1961	(K.C.J.)
Shri S. Biswas	N.E.F.A., 1961	(S.B.)
Shri G. Ramakrishna	Sikkim, 1962	(G.R.)
Dr. S. K. Bhattacharyya &	Assam, 1965	(S.K.B. &
Dr. A. N. T. Joseph		A.N.T.)

This collection comprises 22 species, spread over 13 genera. One new species *Merista jayrami* Vazirani, has also been described earlier by the senior author (1970). There are ten species which constitute new records from Sikkim. Many species known from Assam etc. are also now reported from N.E.F.A.

LIST OF SPECIES OF THE SUBFAMILY GALERUCINAE

1. *Merista dohrni* (Baly)
2. *M. sexmaculata* (Kollar & Redtenbacher)
3. *M. trifasciata* (Hope)
4. *M. fallax* Harold
5. *Oides maculata* (Olivier)
6. *O. scutellata* (Hope)
7. *Aulacophora foveicollis* (Lucas)
8. *Agetocera hopei* Baly
9. *Hoplasoma unicolor* (Illiger)
10. *Paridea* (*Paridea*) *octomaculata* (Baly)
11. *P. (P.) perplexa* (Baly)

12. *Mimastra cyanura* (Hope)
13. *Cneorane rubricollis* (Hope)
14. *C. rugulipennis* Baly
15. *Dercetis flavocincta* (Hope)
16. *Monolepta signata* (Olivier)
17. *Aplosonyx chalybaeus* Hope
18. *A. duvivieri* (Jacoby)
19. *Leptarthra abdominalis* Baly
20. *L. collaris* Baly
21. *Gallerucida bicolor* (Hope)
22. *Hylaspes longicornis* Baly

SYSTEMATIC ACCOUNT

Order	COLEOPTERA
Family	CHRYSOMELIDAE
Subfamily	GALERUCINAE

1. *Merista dohrni* (Baly)

1861. *Leptarthra dohrni* Baly, *J. Ent. Lond.*, London, 1: 203.
 1936. *Merista dohrni*: Maulik, *Fauna Brit. India, Chrysomelidae: Galerucinae*, London: 143.

Material.—1 ex., Western Sikkim, 8.iv.1959 A.G.K.M. Coll.; 2 exs., Kameng N.E.F.A., Membachur, 9.vi.1961, K.C.J. Coll.

Remarks.—It is known to occur in Darjeeling, Khasi hills, Manipur, Burma (Ruby mines) and is now being reported from Sikkim and Kameng Div. of N.E.F.A.

2. *Merista sexmaculata* (Kollar & Redtenbacher)

1848. *Galleruca sexmaculata* Kollar & Redtenbacher, in Hugel's, *Kaschmir und des Reich der Siek*, Stuttgart, 4: 555.
 1936. *Merista sexmaculata*: Maulik, *Fauna Brit. India, Chrysomelidae: Galerucinae*, London: 145.

Material.—2 exs., Sikkim: Thombyak, 30.v.1959, A.G.K.M. Coll.; 1 ex., Sikkim: Twing, 10.v.1962, S. Ali; 2 exs., N.E.F.A.: Kameng Div., 20.vi.1961, K.C.J. Coll.

Remarks.—It is so far reported from Western Himalayas (Kashmir, Mukteswar, Almora, Mussoorie, Sundedhung valley), Eastern Himalayas (Kurseong, Darjeeling, Gangtok, Gopaldhara) and Orissa. The new record from N.E.F.A. adds to the range of its distribution in Eastern Himalayas.

3. *Merista trifasciata* (Hope)

1831. *Galleruca trifasciata* Hope in Gray's, *Zool. Miscellany*, London: 28.

1936. *Merista trifasciata*: Maulik, *Fauna Brit. India, Chrysomelidae: Galerucinae*, London: 147.

Material.—Sikkim: 9 exs., Thombe, 13-14.vi.1959; 6 exs., Yanthang, 31.vii.1959; 23 exs., Lachen, 24.vi.1959; 1 ex., Yoong, 31.viii.1959; 5 exs., Rishikola, 8.v.1959; 1 ex., Mangan, 11.viii.1959; 1 ex., Dentam, 4.iv.1959; 1 ex., Lingship, 24.iv.1959, all A.G.K.M. Coll. N.E.F.A.: Kameng Div., Bomdila, 30.vi.1961, K.C.J. Coll.

Remarks.—This species is distributed throughout Himalayan region including Sikkim, and the present record from N.E.F.A. adds to its range of distribution in the Eastern Himalayas.

4. *Merista fallax* Harold

1880. *Merista fallax* Harold, *Stettin. ent. Ztg.*, 41: 143.

1936. *Marista fallax*: Maulik, *Fauna Brit. India, Chrysomelidae: Galerucinae*, London: 148.

Material.—Sikkim: 3 exs., Mangan 9.v.1959; 1 ex., Teng, 30.vii.1959; 1 ex., Chungthang, 12.v.1959; 1 ex., Lachung, 6.vii.1959; 1 ex., Tothapani, 10.iv.1959, all A.G.K.M. Coll.; 1 ex., Lingship, 18.v.1959, G.R. N.E.F.A.: Kameng Div., 2 exs., Ankaling, 17.v.1961; 1 ex., Dengzi, 29.v.1961; Kalktang, 30.v.1961; 1 ex., Bokklar, 28.v.1961, all K.C.J. Coll.

Remarks.—This species is reported throughout the Eastern Himalayas including Sikkim: Gangtok; Assam: Mishmi hills; W Bengal: Buxar Duars.

5. *Oides maculata* (Oliver)

1807. *Adorium maculata* Olivier, *Entomologie, ou Histoire Naturelle des Insectes* 5, no. 92 bis, p. 611.

1936. *Oides maculata*: Maulik, *Fauna Brit. India, Chrysomelidae: Galerucinae*, London: 113.

Material.—Sikkim: 1 ex., Rishikhola, 7.v.1959, A.G.K.M. Coll. N.E.F.A.; Kameng Div., 1 ex. Ankaling, 24.vi.1961, K.C.J. Coll.

Remarks.—This species is very widely distributed in India: Uttar Pradesh, W Bengal, Assam, Andaman Islands and also recorded from Sikkim; Burma; Indonesia and Cambodia.

6. *Oides scutellata* (Hope)

1831. *Adorium scutellata* Hope, in Gray's, *Zool. Miscellany*, London: 28.

1936. *Oides scutellata*: Maulik, *Fauna Brit. India, Chrysomelidae: Galerucinae*, London: 119.

Material.—1 ex., Sikkim: Famthang, 17.xi.1959, A.G.K.M. Coll.

Remarks.—This is a very widely distributed species. Originally reported from Nepal, it has also been reported from Himachal Pradesh: Simla; Uttar Pradesh: Almora, Kumaon, Ranikhet, Nainital; Assam: Khasi hills. It is now being reported from Sikkim for the first time.

7 *Aulacophora foveicollis* (Lucas)

1849. *Galeruca foveicollis* Lucas, *Exploration scientifique de l'Algerie* Zoologie, 2, Insectes, Paris: 542.

1936. *Aulacophora foveicollis*: Maulik, *Fauna Brit. India, Chrysomelidae: Galerucinae*, London: 173.

Material.—N.E.F.A.; 1 ex. Kameng Div., 4.vii.1961 S.B. Coll.

Remarks.—It is a widely distributed species extending from North Africa (Algeria, Egypt, Cyprus) Himalayan and sub-himalayan regions in India, to Burma and Andaman Islands.

8. *Agetocera hopei* Baly

1865. *Agetocera hopei* Baly, *Trans. ent. Soc. Lond.*, (3) 2 (5): 438.

1936. *Agetocera hopei*: Maulik, *Fauna Brit. India, Chrysomelidae: Galerucinae*, London: 130.

1963. *Agetocera hopei*: Gressit and Kimoto, *Pac. Ins. Mon.*, 1 B: 496.

Material.—Sikkim: 1 ex., Manshithang, 26.vii.1959; 1 ex., Bichhu, 14.vii.1959; 1 ex., Lingship, 24.iv.1959, all A.G.K.M. Coll.; N.E.F.A.: Kameng Div., Ankaling 26.v.1961, K.C.J. Coll.

Remarks.—It is distributed throughout the Himalayan range, extending to Burma and Java. It is reported in India from Uttar Pradesh, N. Bengal, Assam, Manipur and also from Sikkim and Tibet.

9. *Hoplasoma unicolor* (Illiger)

1800. *Galeruca unicolor* Illiger, in Wiedemann, *Arch. fur Zool. u. Zoot.*, 1 (2): 135.

1936. *Hoplasoma unicolor*: Maulik, *Fauna Brit. India, Chrysomelidae: Galerucinae*, London: 161.

1963. *Hoplasoma unicolor* : Gressit and Kimoto, *Pac. Ins. Mon.*, 1 B : 499.

Material.—N.E.F.A. : 1 ex., Kameng Div., Ankaling, 24.v.1961, K.C.J. : Assam : 3 exs., Missimari, 1.xi.1965, S.K.B. & A.N.T.J. Coll.

Remarks.—It is a very widely distributed species in Oriental Region.

10. *Paridea (Paridea) octomaculata* (Baly)

1886. *Aulacophora octomaculata* Baly, *J. Linn. Soc.*, 20 : 17.

1936. *Paridea octomaculata* : Maulik, *Fauna Brit. India, Chrysomelidae : Galerucinae*, London : 504.

1963. *Paridea (Paridea) octomaculata* : Gressit and Kimoto, *Pac. Ins. Mon.*, 1 B : 514.

Material.—Sikkim : 2 exs., Lachen, 9.vi.1959 ; 1 ex., Thombu, 14.vi.1959 ; 1 ex., Yathang, 15.vi.1959 ; 1 ex., Lathung, 15.v.1959 ; 4 exs., Sachu, 16.v.1959, all A.G.K.M. Coll. ; 1 ex., Dickchu, 6.v.1962 ; 1 ex., Shishney, 2.v.1962, G.R. Coll. N.E.F.A. : 1 ex., Kameng Div., 8.v.1961, K.C.J. Coll.

Remarks.—It is earlier reported in India : Assam, Manipur, Uttar Pradesh : Mussoorie and Almora (in Western Himalayas) and Tibet. It is now being reported from Sikkim and N.E.F.A. region for the first time.

11. *Paridea (Paridea) perplexa* (Baly)

1879. *Aulacophora perplexa* Baly, *Cistula Entomologica*, London, 2 : 447.

1936. *Paridea perplexa* : Maulik, *Fauna Brit. India, Chrysomelidae : Galerucinae*, London : 505.

1963. *Paridea (Paridea) perplexa* : Gressit and Kimoto, *Pac. Ins. Mon.*, 1 B : 514.

Material.—Sikkim : 1 ex., Chu fun fun, 14.v.1959, A.G.K.M. Coll. ; 1 ex., Singhik, 14.v.1962, G.R. Coll.

Remarks.—It is known to occur in Assam, Manipur, W Bengal (Mungphu) and Burma. It is now being recorded from Sikkim for the first time.

12. *Mimastra cyanura* (Hope)

1831. *Auchenia cyanura* Hope, in Gray's, *Zool. Miscellany*, London : 29.

1936. *Mimastra cyanura* : Maulik, *Fauna Brit. India, Chrysomelidae : Galerucinae*, London : 529.

1963. *Mimastra cyanura* : Gressit and Kimoto, *Pac. Ins. Mon.*, 1 B : 536.

Material.—Sikkim : 1 ex., Mangan, 9.v.1959, A.G.K.M. Coll.

Remarks.—It occurs in Kashmir, Northern India, Manipur and also in Burma, Nepal and S. China. It is now being reported from Sikkim for the first time.

13. *Cneorane rubricollis* (Hope)

1831. *Galleruca rubricollis* Hope, in Gray's *Zool. Miscellany*, London : 29.

1936. *Cneorane rubricollis* : Maulik, *Fauna Brit. India, Chrysomelidae : Galerucinae*, London : 338.

Material.—Sikkim : 2 exs., Yanthang, 16.vi.1959, A.G.K.M. Coll. ; 1 ex., Kewzing, 19.v.1962, G.R. Coll. ; N.E.F.A. : 1 ex., Kameng Div., Moshing, 3.vi.1961, K.C.J. Coll., 1 ex., Nyukmar, 21.iv.1961, K.C.J. Coll.

Remarks.—Earlier reported from Nepal ; India : North Bengal, Bihar and Assam, it is now being recorded from Sikkim for the first time.

14. *Cneorane rugulipennis* Baly

1886. *Cneorane rugulipennis* Baly, *Trans. ent. Soc.*, 1886 : 27.

1936. *Cneorane rugulipennis* : Maulik, *Fauna Brit. India, Chrysomelidae : Galerucinae*, London : 339.

Material.—N.E.F.A. : 1 ex., Kameng Div., 22.iv.1961, K.C.J. Coll.

Remarks.—It is distributed through out Himalayan belt including Burma. Its record from N.E.F.A. fills in one of the gaps in its known distribution.

15. *Dercetes flavocincta* (Hope)

1831. *Galleruca flavocincta* Hope, in Gray's, *Zool. Miscellany*, London, 1831 : 29.

1936. *Dercetes flavocincta* : Maulik, *Fauna Brit. India, Chrysomelidae : Galerucinae*, London : 355.

Material.—Sikkim : 1 ex., Phom, 28.vi.1959 ; 1 ex., Gangtok, 17.vii.1959, all A.G.K.M. Coll. ; 1 ex., Dickchu, 15.v.1962, 4 exs., Kewzing, 19.v.1962, all G.R. Coll.

Remarks.—Earlier reported from Nepal ; India : W Bengal and Assam, it is now being reported from Sikkim for the first time.

16. *Monolepta signata* (Olivier)

1808. *Galleruca signata* Oliver, *Entomologie, ou Histoire Naturelle des Insectes*, Paris, 6, no. 93 : 665.
 1936. *Monolepta signata* : Maulik, *Fauna Brit. India, Chrysomelidae : Galerucinae*, London : 410.
 1963. *Monolepta signata* : Gressit and Kimoto, *Pac. Ins. Mon.*, 1 B : 633.
Material.—Assam : 6 exs., Missimari, 1.xi.1965, S.K.B. & A.N.T.J Coll.

Remarks.—This species is known from India : Assam, S. India ; Ceylon, Burma, Tibet, S. China, Thailand, Indo-China, and Hong Kong.

17 *Aplosonyx chalybaeus* (Hope)

1831. *Calleruca chalybaeus* Hope, in Gray's, *Zool. Miscellany*, London, 1831 : 28.
 1936. *Aplosonyx chalybaeus* : Maulik, *Fauna Brit. India, Chrysomelidae : Galerucinae*, London : 614.
 1963. *Aplosonyx chalybaeus* : Gressit and Kimoto, *Pac. Ins. Mon.*, 1 B : 653.

Material.—Sikkim : 3 exs., Rishikhola, 5.iv.1959 ; 1 ex., Naga, 2.viii.1959 ; 1 ex., Thombyak, 2.vi.1959, all A.G.K.M. Coll. ; 1 ex., Singhik, 14.v.1962 ; 1 ex., Kewzing, 19.v.1962, all G.R. Coll. ; 1 ex., Rhanack, 3.v.1962 ; 1 ex., Rongli, 2.v.1962, S. Ali. Coll. N.E.F.A. : Kameng Div. : 1 ex., Milankang, 19.iv.1961 ; 5 exs., Salari, 23.vii.1961 ; 1 ex., Dengzi, 29.v.1961, all K.C.J. Coll.

Remarks.—It is found along the Himalayan Range from Nepal to Burma, also Tibet and Vietnam. Its present record from Sikkim and N.E.F.A. fills gaps in its distribution.

18. *Aplosonyx duvivieri* (Jacoby)

1900. *Haplosonyx duvivieri* Jacoby, *Mem. Soc. Ent. Belg.*, 7 : 130.
 1936. *Aplosonyx duvivieri* : Maulik, *Fauna Brit. India, Chrysomelidae : Galerucinae*, London : 618.

Material.—N.E.F.A. : Kameng Div., Bitselling, 16-25.v.1961, K.C.J Coll.

Remarks.—So far known to occur in Assam : Khasi hills, it is now being reported from N.E.F.A.

19. *Leptarthra abdominalis* Baly

1861. *Leptarthra abdominalis* Baly, *J. Ent. Lond.*, 1 : 203.
 1936. *Leptarthra abdominalis* : Maulik, *Fauna Brit. India, Chrysomelidae : Galerucinae*, London : 610.

Material.—Sikkim : 1 ex., Rishikhola, 7.v.1959 ; 1 ex., Manul, 10.v.1959, 1 ex., Grazing, 27.iv.1959, all A.G.K.M. Coll.

Remarks.—It is known to occur in Eastern Himalayas, Darjiling, Mungphu and is now being reported from Sikkim.

20. *Leptarthra collaris* Baly

1878. *Leptarthra collaris* Baly, *Cistula Entomologica*, London, 2: 382.

1936. *Leptarthra collaris*: Maulik, *Fauna Brit. India, Chrysomelidae, Galerucinae*, London: 611.

Material.—Sikkim : 1 ex., 1959, A.G.K.M. Coll.

Remarks.—It is known to occur in Western Himalayas: Murree, Thobba, Chamb. Present record from Sikkim adds to the eastwards range of its distribution.

21. *Gallerucida bicolor* (Hope)

1831. *Galleruca bicolor* Hope, in Gray's, *Zool. Miscellany*, London, 1831: 29.

1936. *Gallerucida bicolor*: Maulik, *Fauna Brit. India, Chrysomelidae, Galerucinae*, London: 554.

Material.—Sikkim : 1 ex., Lingship, 25.iv.1959 ; 1 ex., Bugtan, 9.iv.1959 ; 1 ex., Lachen, 25.v.1959, all A.G.K.M. Coll. ; 7 ex., Makai Bari, 30.vi.1962 ; 3 exs., Shishney, 2.v.1962 ; 1 ex., Rongli, 29.iv.1962, all G.R. Coll.

Remarks.—This species is widely distributed in sub-himalayan region, lower Burma and Western Ghats. It is now being recorded from Sikkim for the first time.

22. *Hylaspes longicornis* Baly

1865. *Hylaspes longicornis* Baly, *Trans. ent. Soc.*, (3) 2: 436.

1936. *Hylaspes longicornis*: Maulik, *Fauna Brit. India, Chrysomelidae: Galerucinae*, London: 602.

Material.—Sikkim : 1 ex., Lachen, 6.vi.1959, A.G.K.M. Coll.

Remarks.—It is already known from Assam and Burma and Sikkim. Gresseit and Kimoto, 1963, have placed this genus as a synonym of *Gallerucida* Motschulsky, as synonym nov., but in the absence of any reasons given by them, we retain it as a separate genus.

SUMMARY

Twenty two species of Chrysomelidae: Galerucinae are recorded in this paper from Sikkim and N.E.F.A. regions of

India. Ten of these species constitute new records from Sikkim and many species so far known from Assam are also now recorded from N.E.F.A.

REFERENCES

- VAZIRANI, T. G. 1970. On a new species of *Merista* Chapuis (1895) [Insecta Coleoptera : Chrysomelidae] from India. *Rec. zool. Surv. India*, **64** [1966] : 109-110.
- GRESSITT, J. L. and KIMOTO, S. 1963. The Chrysomelidae (Coleopt.) of China and Korea. Part 2. *Pacific Ins. Mon.*, **1 B** : 301-1026.

FAUNA OF RAJASTHAN, INDIA.
PART 3. MOLLUSCA. NO. 2.
DISTRIBUTION OF SOME PELECYPODA

By

P. D. GUPTA

*Desert Regional Station,
Zoological Survey of India, Jodhpur*

(With 1 Text-figure)

INTRODUCTION

Recently, Ray and Mukherjee (1969) in their report on the molluscan fauna of Rajasthan listed six species of bivalves, of which only four species, belonging to two different families, are represented in the present collection from Bharatpur, Bhilwara, Chittorgarh, Dungarpur, Jodhpur, Pali, Sirohi, Tonk and Udaipur Districts. These species are *Lamellidens corrianus* (Lea), *Indonaia caerulea* (Lea) and *Parreysia corrugata* (Müller) belonging to the family Unionidae and *Corbicula striatella* Deshayes belonging to the family Corbiculidae. An attempt is made here to add a few more important localities to the list of distribution of these molluscs, which were not recorded by Ray and Mukherjee, and thereby extending their range further in that region including even the forest and semi-arid areas and also well-watered areas towards southern and south-eastern tracts of Rajasthan.

Names of collectors have been abbreviated as follows: *DSM*, Dr. D. S. Mathur ; *KCK*, Shri K. C. Kansal ; *ML*, Shri Moti Lal ; *PDG*, Dr. P. D. Gupta ; *RNB*, Shri R. N. Bhargava ; *VCA*, Dr. V. C. Agrawal.

SYSTEMATIC ACCOUNT

Family 1. UNIONIDAE

1. *Lamellidens corrianus* (Lea)

1834. *Unio corrianus* Lea, *Trans. Amer. Phil. Soc.*, **6**: 65.

1969. *Lamellidens corrianus*: Ray & Mukherjee, *Rec. zool. Surv. India*, **61**: 431.

Material.—*Bharatpur District*: (i) 1 ex., R. Banganga near Nekpur Head, *Ca* 3 km. S. of Pinjora Rly. Station. Lat. 27°06'N. & Long. 77°24'E., 1.iii.69. (ii) 1 ex., Ghana Sanctuary, Lat. 27°10' N. & Long. 77°31' E., 1.iii.69, all *PDG* Coll.

Bhilwara District: (iii) 2 exs., Mandal Tank, *Ca* 18 km. N. of Bhilwara, Lat. 25°25' N. & Long. 74°30' E., 29.iii.64, *RNB* Coll.

Chittorgarh District: (iv) 1 ex., R. Gambhiri, *Ca* 3 km. E. of Chittorgarh Rly. Station, Lat. 24°51' N. & Long. 74°39' E., 14.iii.64, *VCA* Coll.

Sirohi District: (v) 1 ex., R. Banas, *Ca* 3 km. NE. of Abu Road Rly. Station, Lat. 24°29' N. & Long. 72°47' E., 6.iii.64, *VCA* Coll.

Remarks:—The largest shell, measuring 44 mm. in length, 22 mm. in height and 13 mm. in thickness, was collected from Nekpur Head of River Banganga (Bharatpur District). The exact locality of the specimen studied by Ray & Mukherjee (1969) was not known. The localities noted here seem to extend the range of this species in the forest and well-watered areas probably representing the boundary of its distribution towards semi-arid tracts. This inference derives support from Annandale, Prashad and Aminuddin (1921, p. 606) indicating that it is commonly found in ponds or very sluggish streams.

2. *Indonaila caerulea* (Lea)

1834. *Unio caerulea* Lea, *Trans. Amer. Phil. Soc.*, **4**: 95.

1969. *Indonaila caerulea*: Ray & Mukherjee, *Rec. zool. Surv. India*, **61**: 430.

Material.—*Chittorgarh District*: (vi) 2 exs., R. Gambhiri, *Ca* 3 km. E. of Chittorgarh Rly. Station, Lat. 24°51' N. & Long. 74°39' E., 14.iii.64. (vii) 5 exs., R. Berach, *Ca* 5 km. NW. of Chittorgarh Rly. Station, Lat. 24°53' N. & Long. 74°36' E., 14.iii.64, all *VCA* Coll.

Dungarpur District: (viii) 1 ex., Surpur ki Nadi, *Ca* 4 km. NW of Dungarpur, Lat. 23°35' N. & Long. 74°20' E., 26.iii.64, *RNB* Coll.

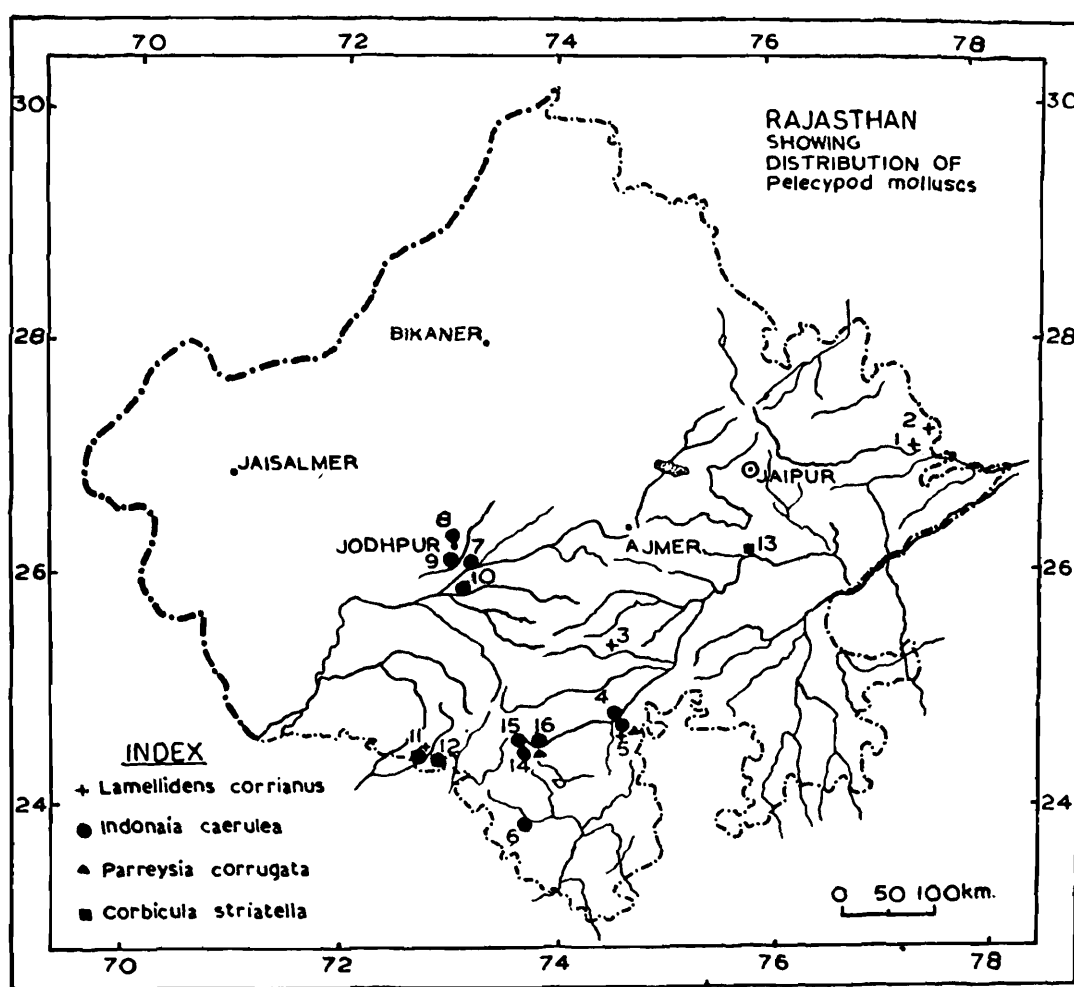
Jodhpur District: Bisalpur, *Ca* 35 km. S. of Jodhpur, Lat. 26°18' N. & Long. 73°27' E. (ix) 1 ex., 9.iii.64, *VCA* Coll. Kailana, Lat. 20°15' N. & Long. 72°55' E. (x) 35 exs., 19.iii.68, *DSM* Coll. (xi) 1 ex., 5.iv.68, *DSM* Coll. Kuri Reservoir,

Ca 20 km. S. of Jodhpur, Lat. $26^{\circ}30'$ N. & Long. $73^{\circ}35'$ E.
 (xii) 2 exs., 20.vii.63, *ML* Coll. (xiii) 4 exs., 26.ii.64, *VCA* Coll.
 (xiv) 7 exs., 30.viii.67, *PDG* Coll.

Pali District : (xv) 1 ex., Sardar Samand, Lat. $25^{\circ}54'$ N. & Long. $73^{\circ}25'$ E., 5.vii.63, *KCK* Coll.

Sirohi District : (xvi) 5 exs., R. Banas, *Ca* 3 km. NE. of Abu Road Rly. Station, Lat. $24^{\circ}29'$ N & Long. $72^{\circ}47'$ E., 6.iii.64.
 (xvii) 25 exs., Nullah pond, *Ca* 16 km. E. of Abu Road Rly. Station, Lat. $24^{\circ}27'$ N & Long. $72^{\circ}53'$ E., 9.iii.64, all *VCA* Coll.

Udaipur District : (xviii) 1 ex., Pichola lake, Lat. $24^{\circ}33'$ N. & Long. $73^{\circ}41'$ E., 17.iii.64. (xix) 1 ex., Sarup Sagar, Lat.



(Map copied from School Atlas published by Survey of India)

Text-Fig. 1.—1. R. Banganga (Bharatpur Dist.); 2. Ghana Sanctuary (Bharatpur Dist.); 3. Mandal Tank (Bhilwara Dist.); 4. R. Berach (Chittorgarh Dist.); 5. R. Gambhiri (Chittorgarh Dist.); 6. Surpur ki Nadi (Dungarpur Dist.); 7. Bisalpur (Jodhpur Dist.); 8. Kailana (Jodhpur Dist.); 9. Kuri Reservoir (Jodhpur Dist.); 10. Sardar Samand (Pali Dist.); 11. R. Banas (Sirohi Dist.); 12. Nullah Pond (Sirohi Dist.); 13. R. Banas (Tonk Dist.); 14. Pichola Lake (Udaipur Dist.); 15. Sarup Sagar (Udaipur Dist.); 16. Udaisagar (Udaipur Dist.).

24°35' N. & Long. 73°35' E., 18.iii.64. (xx) 2 exs., Udaisagar, Ca 15 km. E. of Udaipur Rly. Station, Lat. 24°33' N. & Long. 73°50' E., 20.iii.64, all VCA Coll.

Remarks.—Ray & Mukherjee (1969) recorded *I. coerulea* from Chittorgarh, Pali and Udaipur Districts only. The material in hand shows the occurrence of this species in Dungarpur, Jodhpur and Sirohi Districts also, thereby extending its distribution throughout the Aravalli Range (Fig. 1).

3. *Parreysia corrugata* (Müller)

1774. *Mya corrugata* Müller, *Vermes Terrestres et Fluviales*, pt. 2: 214.

1915. *Parreysia (Parreysia) corrugata*: Preston, *Fauna Brit. India*: 154.

Material.—*Chittorgarh District*: (xxi) 1 ex., R. Gambhiri, Ca 3 km. E. of Chittorgarh Rly. Station, Lat. 24°51' N. & Long. 74°39' E., 14.iii.64, VCA Coll.

Udaipur District: (xxii) 4 valves, Udaisagar Ca 15 km. E. of Udaipur Rly. Station, Lat. 24°33' N. & Long. 73°50' E., 20.iii.64, VCA Coll.

Remarks.—So far this species was known only from Chittorgarh District. But it is reported here from Udaipur District also.

Family 2. CORBICULIDAE

4. *Corbicula striatella* Deshayes

1854. *Corbicula striatella* Deshayes, *Proc. zool. Soc. Lond.*, **22**: 344.

1969. *Corbicula striatella*: Ray & Mukherjee, *Rec. zool. Surv. India*, **61**: 431.

Material.—*Tonk District*: (xxiii) 5 valves, R. Banas, Ca 7 km. NE. of Tonk City, Lat. 26°11' N. & Long. 75°52' E., 13.ii.69, PDG Coll.

Remarks.—This is the second report of this species from Rajasthan. Ray & Mukherjee (1969) recorded it from River Gambhiri, a tributary of eastern R. Banas near Chittorgarh.

ACKNOWLEDGEMENT

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REFERENCES

- ANNANDALE, N., PRASHAD, B. AND AMIN-UD-DIN. 1921. The aquatic and amphibious Mollusca of Manipur. *Rec. Indian Mus.*, **22**(4): 529-632.
- RAY, H. C. AND MUKHERJEE, A. 1969. Fauna of Rajasthan, India, Pt. 3. Mollusca. *Rec. zool. Surv. India*, **61**(3-4): 403-436.

STUDIES ON THE EMBRYOLOGY AND POST-
EMBRYONIC DEVELOPMENT OF *ACROBELINEMA*
CORNIS KHERA (NEMATODA CEPHALOBIDAE) WITH
SPECIAL REFERENCE TO DEVELOPMENT OF GONADS

By

S. KHERA

Zoological Survey of India, Calcutta

(With 2 Tables and 6 Text-figures)

INTRODUCTION

Maupas (1900), Potts (1910), Honda (1925), Nigon (1949) and others have contributed to the knowledge of reproduction of free-living nematodes. Recently, Triantaphyllou and Hirschmann (1964) have given a review of this phenomenon in plant and soil nematodes. Barring the work of Seshadri (1964) on *Criconemoides xenoplax*, which he did while in the U.S.A., the development and life cycle of plant-parasitic and free-living nematodes have not been studied in India.

Khera (1967a) reported successful culturing of *Acrobelinema cornis* Khera, a free-living nematode, in the medium containing callus tissue, on plain water-agar medium, and on nutrient medium without males, although sperm were observed in the uterus of the females (Khera, 1967). Treating it as a logical extension of the culture work, studies were taken up on the embryology and the post-embryonic development of the nematode, with special reference to gonads so as to find out as to when the sperm made their appearance in the life cycle.

The author wishes to thank Dr. A. P. Kapur, Director, Zoological Survey of India, for providing necessary facilities and Shri K. S. Pradhan for assistance.

MATERIAL AND METHODS

Stock cultures of *Acrobelinema cornis* were maintained in the laboratory on water agar and nutrient agar at room temperature (21-28°C) (Khera, 1967a).

Several methods were employed in preparing nematodes for morphological and anatomical investigations. For a detailed study of the development of the genital primordia, van Weerd's (1960) method was employed. By this procedure the nematodes were stained pink except the genital primordia and certain nuclei of the ventral chord which were stained red. Hirschmann's (1962) method using 1% acetic orcein was also employed. Both the staining techniques gave not very constant results. The use of hot polychrome methylene blue gave better results (Roques & Jude, 1940 in : Gray, 1954). Nematodes killed by gentle heat and mounted in 4% formalin and calcium carbonate (Baker, 1945) were used for measurements and study of various systems. This method obviated granulation. The various measurements of the different larvae and adult have been represented by de Man's formula.

For embryological studies, normal uncleaved eggs were mounted in water in Maximov tissue culture slides under cover-slip and sealed with vaseline-paraffin wax mixture. The preparation was examined from time to time till the first and the last eggs hatched.

The notation of the cells in the embryological studies is after Hyman (1951).

For the chronological development studies, fifty normal uncleaved eggs were inoculated in each of the twenty tubes of nutrient agar after sterilization for 10-15 minutes with 0.5% hibitane diacetate. First examination of the tube was done 24 hours before the average time taken by the eggs to hatch in the embryological studies. Thereafter one tube was examined daily and the stage of development of egg/larvae recorded.

The sperm material was examined without using any stains, as well as with acidulated methyl green. Preparation of smears was of no help. Schneider's aceto-carmin as well as Delafield haematoxylin-eosin combination were used in the smears.

EXPERIMENTAL RESULTS

Egg and Embryonic Development

(Text-figures 1 & 2).

The eggs of *Acrobelinema cornis* were laid singly and at single-celled stage. In no case cleavage or further development

took place within the parent body. The eggs were oval and the two poles equally rounded. The average size of 50 eggs in different stages of embryonic development was $51\ \mu\text{m}$ (range $44\text{--}57\ \mu\text{m}$) by $26\ \mu\text{m}$ (range $22\text{--}31\ \mu\text{m}$). The outside cover consisted of a tough egg-shell surrounding the protoplasm which was composed of closely packed, round globules of fairly uniform size. On the shrinkage of the egg protoplasm away from the walls, presence of vitelline membrane was revealed. This shrinkage left the so-called peri-vitellar space between the vitelline membrane and the egg-shell near the poles, giving rise to extra-vitellar cavity.

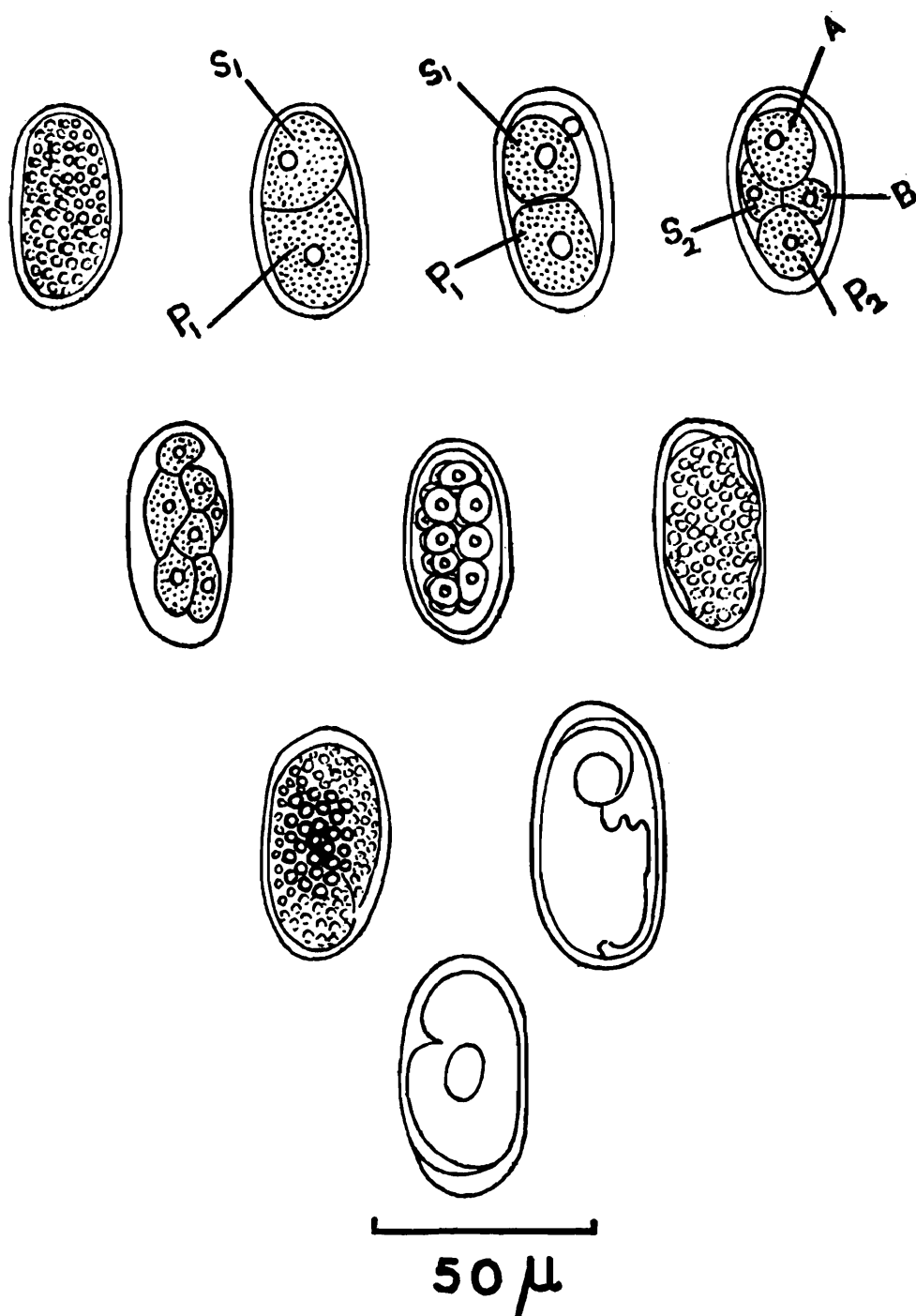
When eggs were placed in an aqueous solution of 5% crystal violet, the vitelline membrane was not penetrated by the stain and the blastomeres remained unstained. After heating (up to *ca* 60°C) or after treating with ordinary fat solvents like chloroform, acetone or benzene, the crystal violet coloured the entire egg dark violet indicating a possible lipoidal mechanism in the vitelline membrane.

As much as 15% of all the eggs recovered did not develop any further, most of the undeveloped eggs being of abnormal proportions (length/width either 2.25 or more, or 1.75 or less).

The usual time between the appearance of eggs in the uterus and egg laying was about eight hours.

After cleavage had started, the presence of a single polar body in some eggs became apparent. Since the polar body occurred inside the vitelline membrane, it follows that it was formed after the vitelline membrane had been laid down.

The protoplasm of the unicellular egg exhibited continuous streaming movement and its rearrangement marked the beginning of the first cleavage of the unicellular egg. The cleavage was holoblastic, and as would be seen later, spiral. The first division took place at right angles to the longitudinal axis of the egg, resulting in a large posterior blastomere (P_1) and a slightly smaller anterior cell (S_1). The polar body was located near the anterior pole, although not exactly at the pole. In the two-celled stage, the two nuclei showed up as large rounded clear spaces, one approximately in the centre of each cell. The protoplasm became finely granular and streamed continually in each blastomere, especially immediately before cell division. The second cleavage was longitudinal, both the anterior and posterior cell dividing: S_1 into A and B, and P_1 into S_2 and P_2 . Simul-



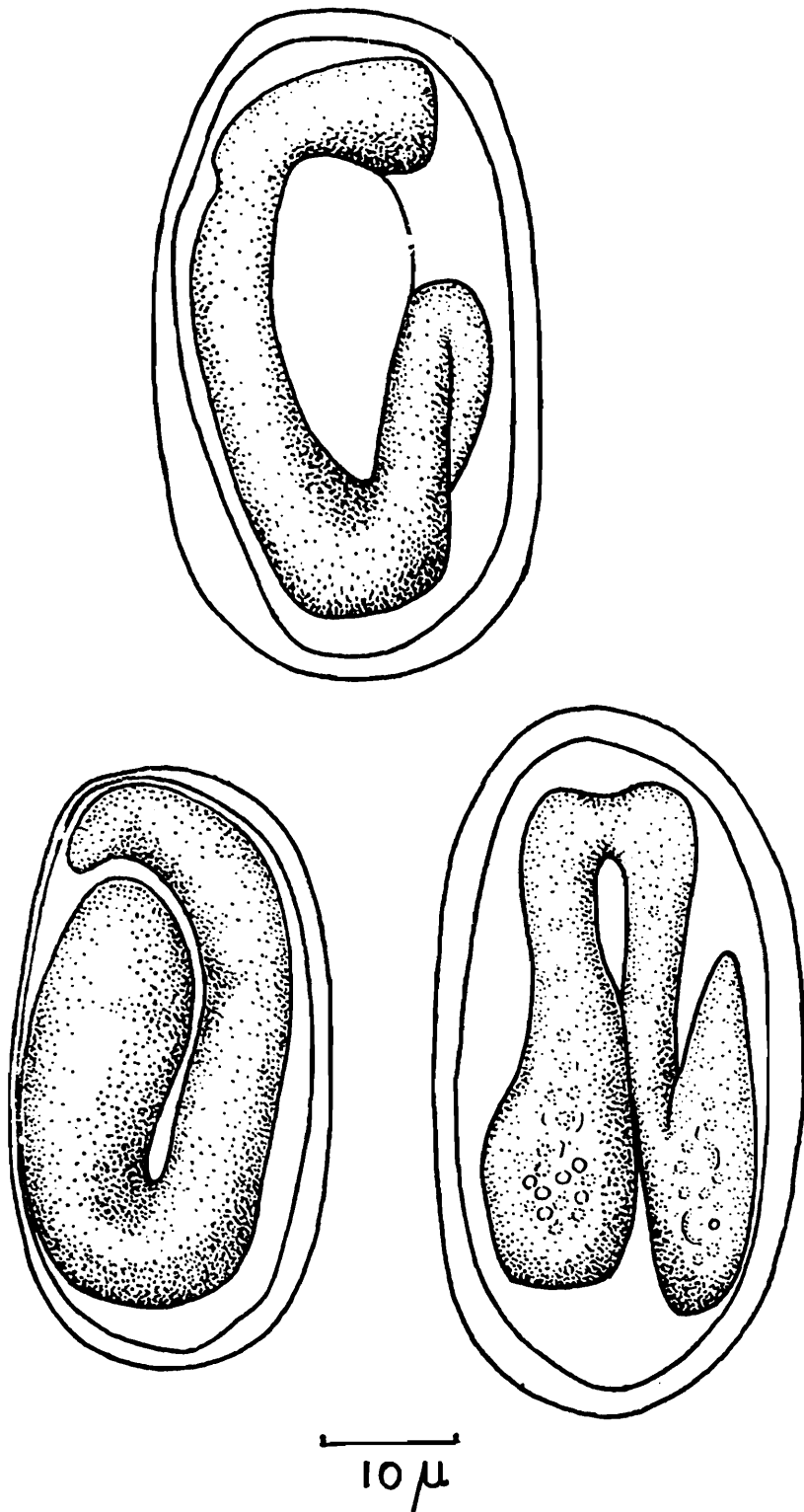
Text-fig. 1. *Acrobelinema cornis*. Eggs in various stages of development.

taneously with the cleavage, cells B and S₂ underwent spiral movement with the result that rhomboid shape, characteristic of the four-celled stage of nematodes, was obtained.

About twelve hours after the single-celled egg was laid, it had developed to a seven-celled form ; in the subsequent cleavages the picture became more and more obscure and ultimately a multicellular stage was reached after another twelve hours.

Details of gastrulation were difficult to follow but some stages could be discerned. A band of small, lighter ectodermal

cells was formed around large, darker endoderm cells in the centre ; cell differentiation thus becoming obvious. Protoplasmic streaming was considerable, the ectoderm cells divided actively, especially at the anterior end, forming a clear area of small cells, the hyaline region. This stage is known as the early "tadpole stage" [Anderson and Darling (1964) and Clark (1967)]. This took another eight hours after the formation of the multi-cellular stage.



Text-fig. 2. *Acrobelinema cornis*. Embryonated eggs.

Twenty four hours after the formation of the multicellular stage, the embryo had lengthened considerably, resulting in a single flexure. From this stage onward the embryo could be observed to move about within the egg-shell. Lengthening of the "tadpole" continued until the end of the third day after the egg was first laid. The embryo now acquired another flexure. The embryo at this stage has often been termed as "pre-larva". Four days after the egg formation in the uterus, the larva was fully developed. Hatching occurred within twelve hours; its details were not observed except that the larva, to begin with, moved vigorously within the egg-shell, then became relatively immobile and finally uncoiling itself just before hatching.

It thus took about 100 hours for the egg to hatch after being laid.

Careful examination did not reveal the presence of moulted cuticle either in the egg-shell with the larva or within the empty egg-shell. From this and from the facts ensuing, it seems that all the four moults are undergone outside the egg-shell and it is the first larval stage that hatches.

Process of Moulting

Larvae approaching the moulting stage became more sluggish in their movement. Later they became quiescent with occasional contractions, and finally straight and immobile. The first indication of moulting was a retraction of the protoplasm in the cephalic region away from the cuticle (hereafter called the moulted cuticle). The entire stoma, as far as could be distinguished, remained in the moulted cuticle. The cuticular lining of the terminal excretory duct was also shed. The protoplasm then reorganized to form a new cephalic region with a faintly visible stoma. Simultaneously with these processes in the anterior region, the cuticular lining of the rectum moulted. The old cuticle apparently stretched, since its annulations became more and more indistinct. This caused the cuticle to loosen around the body. In the final stage of transition period (from one moult to next stage) the new organs became clearly defined: the stoma became distinct; the lining of the excretory pore became sclerotized; and the internal lining of the rectum became reorganized. In one case observed the cast cuticle broke somewhere near the nerve ring and the excretory pore.

With the completion of stoma, the new cuticle was formed,

although the next stage was surrounded by the moulted cuticle for some time.

Larval stages

As has been shown by Conte (1900), Clapham (1930), Binge-fors (1957), and van Weerd (1958, 60), the measurements of actual size of nematode larvae alone are not a reliable indication of the stage of development because size is influenced by environmental factors. The various stages of *Acrobelinema cornis* were, therefore, studied in terms of the anatomical differentiation and development of gonads. The development of gonads only was found useful in distinguishing different stages.

Post-embryonic Development

First Larval Stage¹

(Text-figure 3)

Length = 169-190 μm ; a = 18-21; b = 2.4-2.6; c = 13-15.

The first stage larvae at hatching were fully developed and resembled the adults and other larval stages in the general shape. The larvae possessed very small probolae whose arrangement and structure were difficult to interpret. Stoma also was not clearly visible. The oesophagus measured 68-73 μm in length and possessed a poorly delineated isthmus and only a slightly swollen oesophageal bulb, with doubtfully discernible valvular apparatus. Nerve ring and excretory pore could not be seen. Tail measured 13-14 μm in length. The minute rounded genital primordium, formed of a single cell, was located at 70% of the body-length from the anterior end. The larva went into first moult about sixteen hours after hatching.

First Moult²

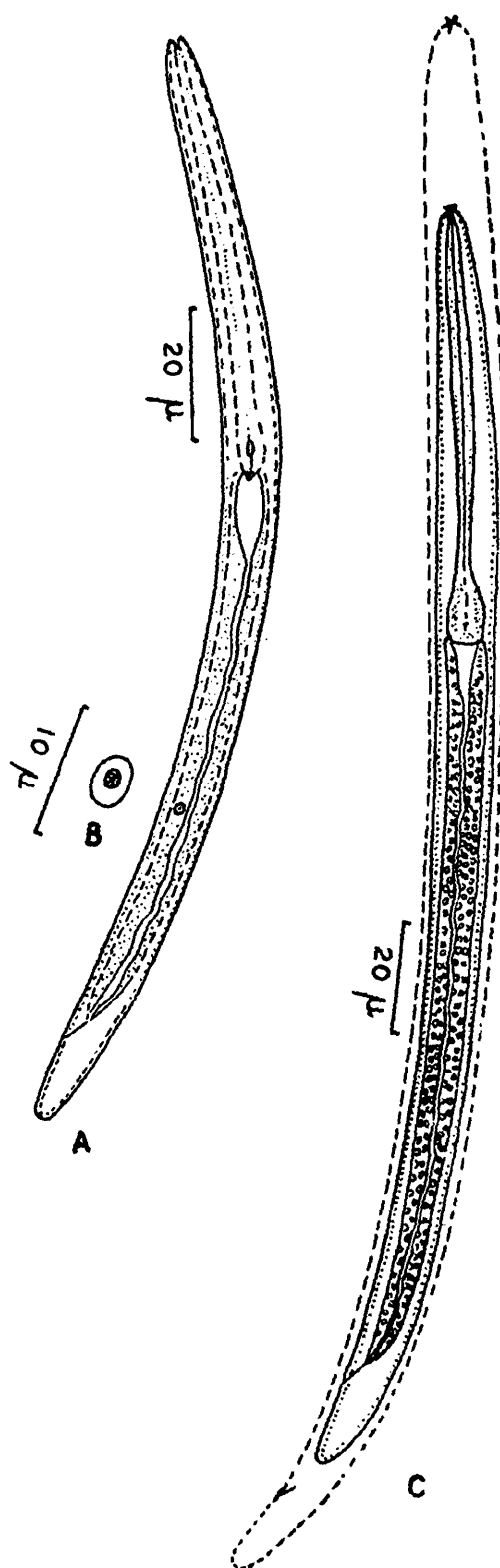
(Text-figure 3)

Length = 195-235 μm ; a = 20-22; b = 2.5-2.9; c = 13-16.

The stage being small in size and with additional cuticle, the details could not be worked out. Oesophagus measured

¹ Description based on 25 freshly hatched first stage larvae.

² Description based on 14 specimens.



Text-fig. 3. *Acrobelinema cornis*. A. First larval stage.
B. Genital primordium of first larval stage.
C. First moult stage.

78-85 μ m in length. Isthmus started getting delineated and the characteristic valvular apparatus of the end bulb made its appearance. Tail measured 13-17 μ m long. The first moult lasted for eight hours on an average.

Second Larval Stage³

(Text-figure 4)

Length = 228-260 μm ; a = 20-23; b = 2.8-3; c = 14-17

Probolae were slightly larger in size than in the first stage; their details still could not be observed. The small stoma, 3 μm in length, could now be distinguished; its components still could not be determined. The oesophagus increased in length to 80-87 μm and took on a normal shape, the isthmus, posterior bulb and its valvular apparatus assuming the shape as found in the adult. Nerve ring was situated at 48-52 μm from anterior end. Tail measured 14-18 μm in length. A spindle-shaped genital primordium was located at approximately 64-67% of the body-length. The genital primordium consisted of three nuclei—one large central germinal nucleus, bordered anteriorly and posteriorly by two smaller somatic nuclei. The germinal portion of the primordium was thus set apart from the somatic portion at this stage only. Two of the nuclei in the region of ventral chord nuclei became more prominent and stained moderately heavy. Both were situated posterior to the genital primordium. This stage lasted for sixteen hours on an average after which it went into second moult.

Second Moult⁴

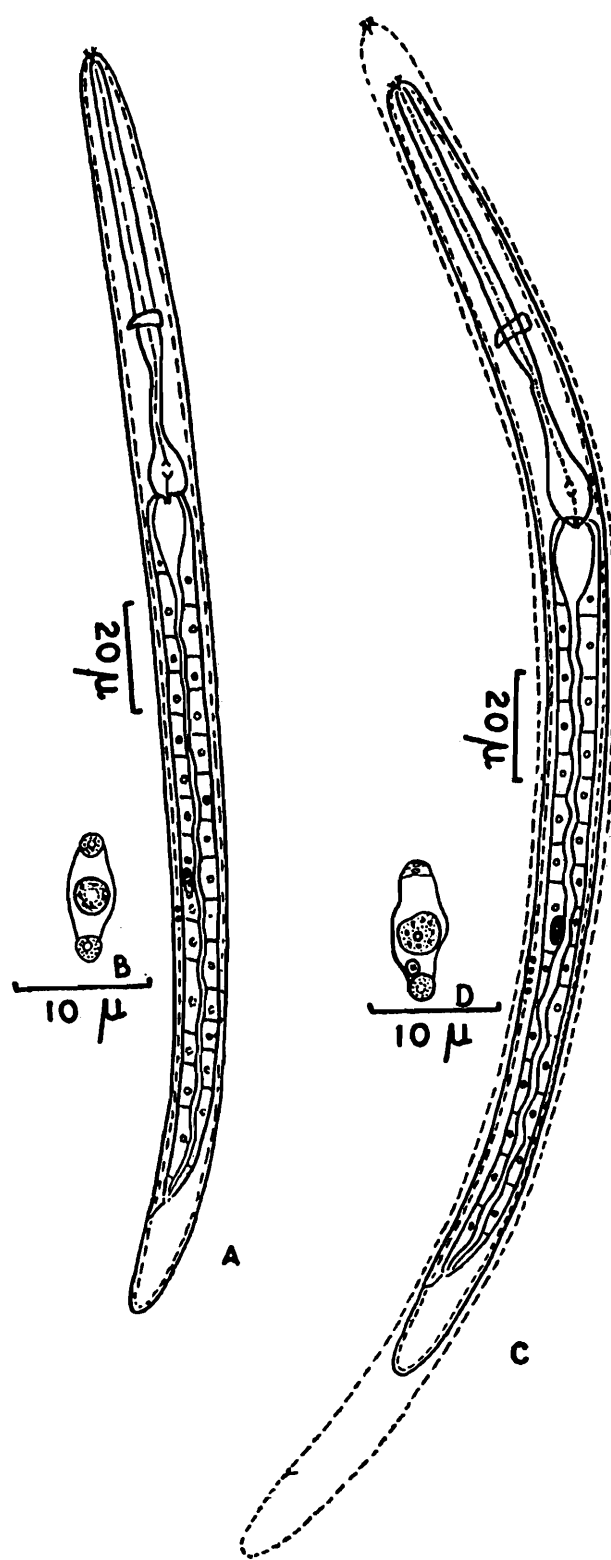
(Text-figure 4)

Length = 240-320 μm ; a = 20-24; b = 3.0-3.3; c = 15-19.

Details of stoma could not be worked out. Oesophagus and tail respectively measured 80-100 μm and 17-21 μm in length. The two somatic nuclei of the genital primordium underwent a division. The anterior somatic nucleus divided once, resulting in the formation of two cells that would, after further divisions, form the female gonoduct. The division of the posterior nucleus resulted in two nuclei. One of these remained as cap cell nucleus at the posterior tip of the gonad throughout the life of the nematode. The other nucleus, the epithelial nucleus, migrated anterior to the germinal nucleus.

³Description based on 20 specimens.

⁴Description based on 12 specimens.



Text-fig. 4. *Acrobelinema cornis*. A. Second larval stage.
 B. Genital primordium of second larval stage.
 C. Second moult stage. D. Genital primordium of second moult stage.

Each of the moderately heavy staining ventral chord nuclei divided once during the second moult, thus resulting in group of four nuclei all situated *in tandem* posterior to the primordium:

The derivatives of the various nuclei could be traced separately throughout the development of the gonad, since they appeared different and stained differentially in cases where such preparations were successful. The large germinal nucleus with coarse granules stained heavily. The cap cell nucleus and the epithelial nuclei of the gonad stained faintly. The nuclei of the cells of gonoduct were small and stained rather dark.

The second moult lasted for eight hours on an average.

Third Larval Stage⁵

(Text-figure 5)

Length = 380-480 μm ; a = 21-24; b = 3.2-3.3; c = 21-24.

In the early third larval stage there occurred a sudden increase in size of the nematode as well as in the activity of the genital primordium.

Three labial probolae, each with two bifurcations, could be seen at this stage. Stoma measured 5 μm in length and could be distinguished as segmented. Oesophagus measured 120-145 μm and tail 18-22 μm in length. Nerve ring was situated at 80-88 μm from anterior end. Excretory pore, situated just behind nerve ring at 83-92 μm from anterior end, could be detected for the first time in the life-cycle.

The anterior two cells meant to produce gonoduct divided rapidly and instead of proceeding anteriorly were reflexed, growing posteriorly along the ventral side. In the rest of the primordium, which was pushed dorsally, the germinal nucleus divided once, the two resultant nuclei being arranged side by side. The epithelial nucleus in the meantime divided twice to form four epithelial nuclei. Cap cell was present as usual. Four ventral chord nuclei were still there.

The third larval stage lasted for about 36 hours after which period it went through the third moult.

Third Moult⁶

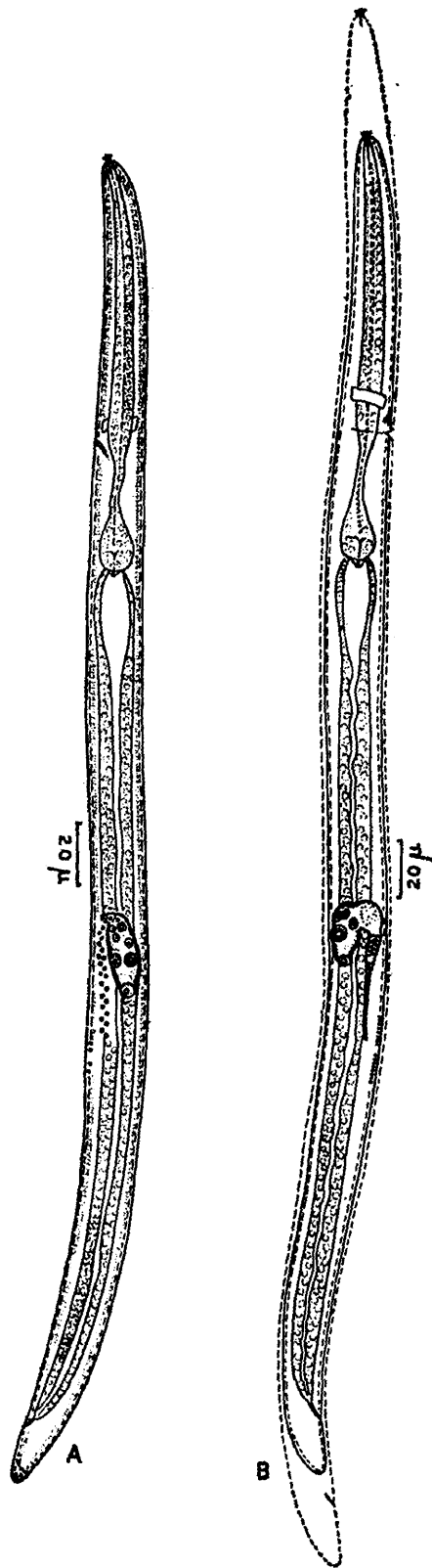
(Text-figure 5)

Length = 450-520 μm ; a = 21-24; b = 3.25-3.5; c = 21-24.

Oesophagus measured 140-160 μm long. Nerve ring was

⁵ Description based on 22 specimens.

⁶ Description based on 14 specimens.



Text-fig. 5. *Acrobelinema cornis*. A. Third larval stage.
B. Third moult stage.

situated at 86-92 μm and excretory pore at 96-104 μm from anterior end. Tail measured 19-24 μm in length.

Slight differentiation in the gonoduct had set in. One of the germinal nuclei and one epithelial nucleus disappeared. Connected to the gonad antero-ventrally, a chamber (? recepta-

culum seminis) containing a large number of rounded refringent sperm could be seen. This chamber was marked off from both the gonad and the gonoduct by constrictions at either end. Probably the germinal nucleus and the epithelial nucleus which disappeared, had something to do with the formation of the sperm. The chamber might have been formed either by the cells that formed the gonoduct or by the epithelial cell whose nucleus had disappeared. This being a very transitory phase, the details could not be worked out. Cap cell was present as usual.

The four specialized ventral chord nuclei underwent further division and at the third moult were arranged in two groups of eight nuclei each in the vicinity of the posterior region of the developing gonad. These nuclei later took part in the formation of vagina. Their arrangement in two groups had already indicated the future position of vagina which would be located ventrally between them.

The third moult lasted for about twelve hours on an average.

Fourth Larval Stage⁷

(Text-figure 6)

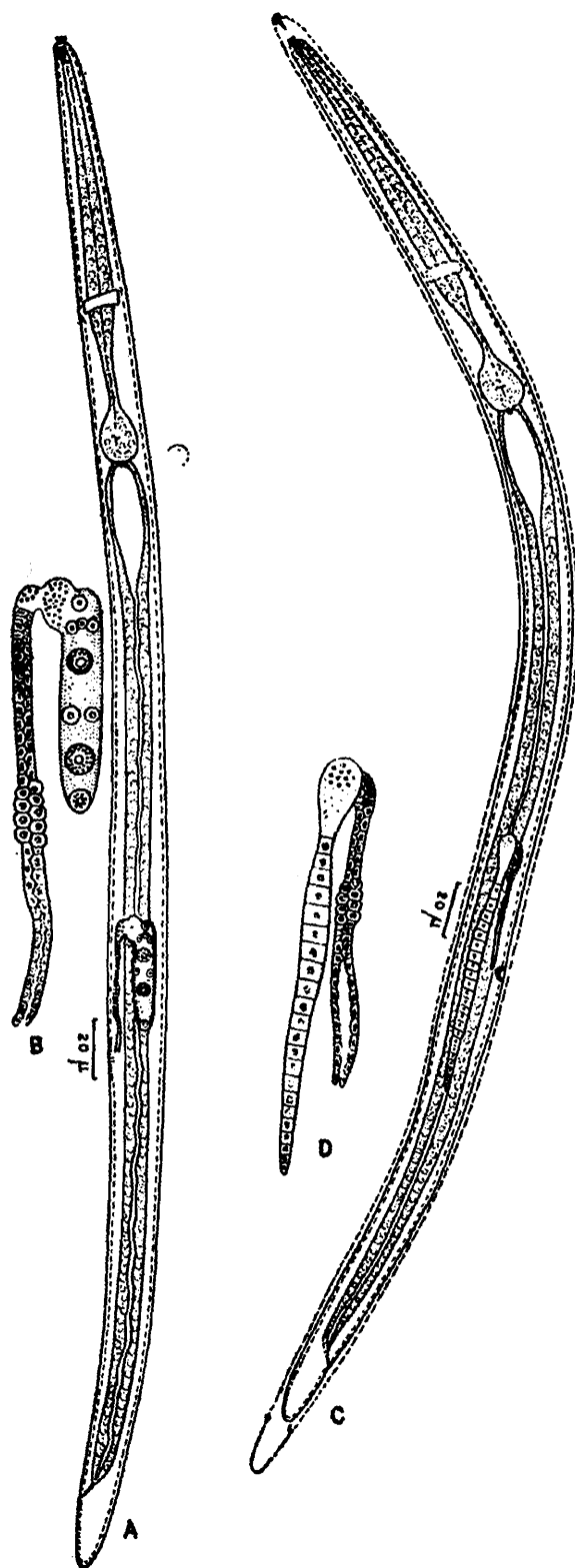
Length = 500-550 μm ; a = 21-26; b = 3.45-3.6; c = 22-24; V = 64-65.

Stoma measured 7 μm , oesophagus 140-165 μm and tail 21-25 μm in length. Nerve ring and excretory pore were situated respectively at 87-95 μm and 92-100 μm from anterior end.

During the fourth stage the germinal portion of the primordium started increasing in size and the gonoduct became more or less differentiated. The remaining one germinal nucleus divided once; the two resultant oögonial nuclei were arranged this time *in tandem*. The epithelial nuclei also increased in number but their ultimate fate could not be determined. Probably they formed the epithelium of the ovary. The anterior narrow part of the gonoduct, the oviduct, consisted of two rows of five columnar epithelial cells with transversely elongated nuclei. The oviduct was followed by a region of 5-6 larger cells in two rows with oval nuclei which formed one or two temporary spermathecae in the adult. The spermatheca(e) constituted the modified anterior end of uterus and was followed by a

⁷Description based on 15 specimens.

slightly widened part consisting of sixteen large, coarsely granulated cells with spherical nuclei, the quadricolumella. Behind the quadricolumella, the uterus narrowed to form another short, constricted region with two rows of three narrow epithelial



Text-fig. 6. *Acrobelinema cornis*. A. Fourth larval stage.
 B. Developing gonad of the fourth larval stage.
 C. Fourth moult. D. Developing gonad of the fourth moult stage.

cells each. This region was followed in sequence by a number of other flattened epithelial cells, the uterus proper. Some of the specialized ventral chord nuclei started migrating so as to form, later on, the vagina and the vulva.

Fourth larval stage lasted for about 30 hours on an average.

Fourth Moul⁸

(Text-figure 6)

Length = 525-610 μm ; a = 21-27; b = 3.5-3.85; c = 22-25; V = 66-70.

Oesophagus measured 145-170 μm in length. Nerve ring and excretory pore were situated respectively at 90-100 μm and 98-110 μm from anterior end. Tail measured 22-28 μm long.

The ovary became very much elongated owing to increase in the number of oögonial nuclei, and the cell membranes became indistinct. The epithelial nuclei could not be traced. The vagina and vulva completed their development. The two groups of eight specialized ventral chord nuclei migrated inside, creating the lumen of vagina between them. Four nuclei came to lie posteriad, four anteriad in the median plane, and four took a dorsolateral position on each side of the vagina. After the last moult the cuticular lining of the vagina was formed and the uterus connected with the vagina.

The fourth moult lasted for about 18 hours.

After the hatching it took about six days for the larva to undergo all the moults and become a young female, or about ten days from a single celled egg to a young female.

The female started laying eggs within forty hours.

The average number of eggs laid by a single female was 70 (range 50-85).

DISCUSSION

A single polar body has been found in *Acrobelinema cornis*. Hirschmann (1962) and Clark (1967) have described a single polar body in *Ditylenchus triformis* and *Nacobbus serendipiticus*, respectively, whereas van Weerdt (1960) has described up to two polar bodies in *Radopholus similis*, of which at least one is extra-vitellar. The polar body is extra-vitellar in *D. triformis*

⁸ Description based on 8 specimens

also. In *A. cornis* and *N. serendipiticus* it is enclosed within the vitelline membrane.

Many workers (Pai, 1928 ; Stewart, 1921 ; Gadd & Loos, 1941 ; Raski, 1950 ; Skotland, 1957 ; van Gundy, 1958 ; Triantaphyllou & Hirschmann, 1960 ; van Weerd, 1960 ; Yuksel, 1960 ; French & Barraclough, 1961 ; Rhoades & Linford, 1961 ; Hirschmann, 1962 ; Loos, 1962 ; Seshadri, 1964 ; and Clark, 1967), while working on different species of nematodes, have reported that first moult takes place inside the egg-shell and the egg hatches into second stage larva. Linford & Oliveira (1940), however, failed to detect the pre-hatch moult in *Rotylenchus uniformis*. The pre-hatch moult, according to Maggenti (1961), may also be absent in *Plectus parietinus*. Thomas (1965) has also described the four larval stages outside the egg-shell in *Acrobeles complexus*. In *A. cornis* also first stage larva is hatched. This is further supported by Lee's (1965) observation that in free living nematodes the eggs usually release a first stage larva.

Mechanism of the egg-hatching seems to be as under : The vigorous movement of larva inside the egg-shell, coupled probably with the enzymatic activity of the larva was possibly responsible for breaking down the vitelline membrane of the egg-shell, thus making the latter permeable. The larva could then take up water, which resulted in an increase in hydrostatic pressure in pseudocoelom. As a result, the larva became relatively immobile, enlarged and exerted pressure on the shell, eventually rupturing it. Uncoiling of the larva at this stage could also be partially responsible for rupturing the egg-shell. This mechanism, except the uncoiling part, has already been proposed by Wilson (1958) in *Trichostrongylus*.

In plant nematodes, on the contrary, the larva generally exhibits vigorous movements inside the egg-shell just before hatching (Dropkin *et al.*, 1958 ; di Edwardo, 1960 ; Rhoades & Linford, 1961 ; Shepherd, 1961 and Clark, 1967) although Ellenby (1957) was unable to detect any movement in the larvae of *Heterodera rostochiensis* within the egg. Dropkin *et al.* (1958), Shepherd (1961) and Clark (1967) showed that the larvae made a series of rapid thrusts with the mouth spear against the egg-shell until the latter was pierced. A hatching factor in *Heterodera* spp. is fairly, and in *H. rostochiensis* absolutely, essential (Shepherd, 1962 ; Wallace, 1963). Onions (1955) reported no hatch of *H. rostochiensis* in water. Vigilier-

chio & Lownsberry (1960) showed increased hatching in three species of *Meloidogyne* with root diffusates. In some zooparasitic nematodes the egg-shell is pierced with the pointed tail (Silvermann & Campbell, 1959)

Process of moulting has been studied by various workers (Linford & Oliveira, 1940 ; van Gundy, 1958 ; Rhoades & Linford, 1961 ; and Hirschmann, 1962) Their results indicate that the nematode stops feeding and becomes sluggish or inactive just before moulting. In *Acrobelinema cornis* also the larvae approaching moulting stage first become sluggish, and later quiescent and immobile.

van Gundy (1958) and Wallace (1963) stated that old cuticle might be discarded by simple abrasion against soil particles. Since the present studies were carried out in the soft medium (agar), the question of abrasion does not arise. In *A. cornis* the breaking of cuticle took place just after the formation of the new cuticle, stoma, and excretory and rectal linings when the nematodes again started moving vigorously. The breaking of the cuticle in the nervous cum excretory region is similar to that found in *Trichostrongylus*, *Haemonchus* and *Ostertagia*—all animal nematodes (Lapage, 1935), although its mechanism was not studied.

In water, the development from the single cell stage to larva took five days for *Paratylenchus projectus* (Rhoades & Linford, 1961), about five days for *Ditylenchus dipsaci* (Yuksel, 1960), 3-5 days for *Hemicycliophora arenaria* (van Gundy, 1959), 4-11 days for *Radopholus similis* (van Weerd, 1960) 11 days for *Plectus parietinus* (Maggenti, 1961), 11-13 days for *Cricone-moides xenoplax* (Seshadri, 1964), 12-17 days for *Nacobbus serendipiticus* (Clark, 1967). In *A. cornis* it took about four days for the larva to appear from the single cell stage.

The general development of the gonad of *A. cornis* resembles that of *Ditylenchus trifurmis* (Hirschmann, 1962). There is only one germinal nucleus in the genital primordium in both these species but the difference lies in the stage at which the germinal nucleus starts dividing. The development is also similar to that of *Turbatrix aceti* (Pai, 1928) except in the number of germinal nuclei in the genital primordium. Hirschmann's surmise (1962) that a similar pattern may be obtained in various monodelphic nematodes seems to be correct.

The presence of a single germinal nucleus in the germinal primordium disproves the contention of Chitwood & Chitwood

(1950) and van Weerdt (1960) that all nematodes have two germinal nuclei regardless of the number of gonads in the adult. Genital primordia with one germinal nucleus have been described by Strassen (1892) and Wülker (1923) in animal parasitic nematodes, and by Hirschmann (1962) in a plant nematode.

Pai (1928) first distinguished clearly between germinal and somatic nuclei in the genital primordium of *Turbatrix aceti*. He also traced the derivative of each nucleus throughout the development of gonad. van Weerdt (1960) was able to distinguish between germinal and somatic cells up to third moult in *Radopholus similis*. Hirschmann (1962) traced the derivatives of germinal nucleus and two epithelial nuclei of the primordia of *Ditylenchus triformis* up to the adult stage. In the present case, the derivatives of the germinal and somatic nuclei of the genital primordium have been traced separately and the differentiation into various parts of the gonad of the adult followed, as far as possible.

The cap nucleus in *A. cornis* is derived from the first division of the posterior somatic nucleus. It does not divide later, but remains part of the epithelium of the ovary. This, while supporting the viewpoint of Pai (1928), Chitwood and Chitwood (1950), Hirschmann (1962) and others, is contrary to Musso's (1930) opinion, that the cap cell, in general, can be considered as a germinal stem cell that gives rise to germinal nuclei as well as epithelial nuclei. In *Ditylenchus triformis* it is the anterior somatic nucleus which forms the cap cell but this is due to outstretched condition of ovary in *D. triformis* as compared to the reflexed ovary of *A. cornis*.

The various parts of the female gonoduct are similar to those described for *Ditylenchus* spp. by Wu (1958) and Hirschmann (1962). Even the quadricolumella is present and it is composed of sixteen cells. Only the post-vulvar sac is absent. van Weerdt (1960) reported several ventral chord nuclei with a different staining capacity, appearing for the first time during the third larval stage of the female in *Radopholus similis*. Hirschmann (1962) could see two such nuclei in second stage, four in the second moult and the third larval stage, eight in the third moult stage, sixteen (two groups of eight cells) in the fourth larval stage and fourth moult stage. In the latter, these cells were responsible for the formation of vagina. Observations similar to Hirschmann's (1962), are also recorded in case of *A. cornis*.

The most significant finding is the syngonic protandrous condition of the nematode, the most interesting feature being that the sperm appear in third moult stage and are stored in a sac-like chamber. The exact source of sperm and the formation of the chamber is not evident, but probably one of the germinal nuclei is responsible for sperm formation and the epithelial cell for the formation of the chamber. It is of interest to note that hermaphroditism (syngonic or digonic) has been described only in the adults so far (Triantaphyllou & Hirschmann, 1964). Formation of sperm in a larval stage is being recorded for the first time.

Overgaard Nielson (1949) determined the time required for development from egg to egg in a number of fresh-water nematodes as follows : *Alaimus primitivus*, *Prismatolaimus dolichurus*, and *Plectus cirratus*, 20-30 days ; *Achromadora dubia*, *Wilsonema auriculatum*, and *Plectus parvus*, 20 days ; *Anaplectus granulosus*, 25 days ; *Tripyla setifera*, 30-40 days. *Acrobeles complexus*, on asparagine-mannitol agar with micro-organisms takes 32 days from egg to egg : six days for embryonic and 25 days for post-embryonic development (Thomas, 1965). The length of life cycle (egg to adult) varies in plant parasitic nematodes from 10-14 days in *Aphelenchoides ritzemabosi* (French & Barraclough, 1961 ; Wallace, 1960) to 42-56 days in *Tylenchulus semipenetrans* (van Gundy, 1958). *Acrobelinema cornis*, a seemingly saprozoic form, completes its life cycle in about ten days (four days for embryonic development and six days for post-embryonic development), and it takes twelve days from egg to egg. A high rate of reproduction in *A. cornis* can be attributed to the short duration of life cycle as well as high rate of egg production. The latter confirms Chitwood and Allen's (1965) view that saprozoic rhabditids would present a higher figure of egg production.

Hirschmann (personal communication) commenting on the author's work (1967a) has expressed her opinion that it was unlikely that nematodes would thrive and multiply on water agar without any N-source. The present author agrees with Hirschmann, but is of the view that it was quite likely that the nematodes utilize nitrogenous material from the excretory matter produced by the katabolic activities or from other nematodes which died in the culture. In that case there seems to be no hope of ever attaining an ideal of a holidic medium

or even of a meridic medium as enunciated by Dougherty (1960).

SUMMARY

In *Acrobelinema cornis* all the four moults occur outside the egg shell. It takes about twelve days from egg to egg stage.

A single germinal nucleus has been found in the genital primordium.

A. cornis is syngonic and protandrous; the sperm appear in the third moult stage and are stored in a sac-like chamber. Thereafter, it develops, more or less, like any other female nematode. Formation of sperm in a larval nematode is being recorded for the first time.

The time taken for development and percentage recovery, and the measurements and de Manian values of different stages of larvae and adult are given in tables no. 1 and 2, respectively.

REFERENCES

- ANDERSON, R. V. & DARLING, H. M. 1964. Embryology and reproduction of *Ditylenchus destructor* Thorne, with emphasis on gonad development. *Proc. helminth. Soc. Wash.*, **31**: 240-256.
- BAKER, J. R. 1945. *Cytological technique*. London, Methuen. 211 pp.
- *BINGEFORS, S. 1957. Studies on breeding red clover for resistance to stem nematode. *Vaxtodling*, **8**: 1-123.
- CHITWOOD, B. G. & ALLEN, M. W. 1965. Nemata. In: Ward and Whipple's *Fresh-water Biology*. 2nd ed. Ed. W. T. Edmondson. New York, John Wiley: 368-401.
- CHITWOOD, B. G. & CHITWOOD, M. B. 1950. *An Introduction to Nematology*. Rev. ed., Baltimore, Monumental Printing Co., 213 pp.
- CLAPHAM, P. A. 1930. On variations in size of the nematode worm *Rhabditis succaris* n.sp. produced by different culture media. *J. Helminth.*, **8**: 211-222.
- CLARK, S. A. 1967. The development and life history of the false root knot nematode, *Naccobus serendipiticus*. *Nematologica*, **13**: 91-101.
- *CONTE, A. 1900. De l' influence du milieu nutritif sur le developement des nematodes libres. *C. r. Seanc. Soc. Biol.*, **52**: 374-375.
- DOUGHERTY, E. C. 1960. Cultivation of Aschelminthes, especially Rhabditid Nematodes. In: *Nematology fundamentals and recent advances with emphasis on plant parasitic and soil forms*. Ed. Sasser, J. N. & Jenkins, W. R., Chapel Hill, U. North Carolina: 297-318.
- DROPKIN, V. H., MARTIN, G. C. & JOHNSON, R. W. 1958. Effect of osmotic concentration of hatching of some plant parasitic nematodes. *Nematologica*, **3**: 115-126.

- di EDUARDO, A. A. 1960. Time lapse studies of movement, feeding and hatching of *Pratylenchus penetrans*. *Phytopathology*, **50**: 570.
- ELLENBY, C. 1957. Some physiological aspects of the hatching mechanism of the potato root eelworm, *Heterodera rostochiensis* Wollenweber. *Symposium. Insect and Foodplant*: 95-102.
- FRENCH, N. & BARRACLOUGH, R. N. 1961. Observations on the reproduction of *Aphelenchoides ritzemabosi* (Schwartz). *Nematologica*, **6**: 89-94.
- GADD, C. H. & LOOS, C. A. 1941. Observations on the life history of *Anguillulina pratensis*. *Ann. appl. Biol.*, **28**: 160-179.
- van GUNDY, S. D. 1958. The life history of the citrus nematodes *Tylenchulus semipenetrans* Cobb. *Nematologica*, **3**: 285-294.
- van GUNDY, S. D. 1959. The life history of *Hemicycliophora arenaria* Raski (Nematoda; Criconematidae). *Proc. helminth. Soc. Wash.*, **26**: 67-72.
- GRAY, P. 1954. *The microtomist's formulary and guide*. London, Constable & Co. 794 pp.
- HIRSCHMANN, H. 1962. The life cycle of *Ditylenchus triformis* (Nematoda: Tylenchida) with emphasis on post-embryonic development. *Proc. helminth. Soc. Wash.*, **29**: 30-43.
- HONDA, H. 1925. Experimental and cytological studies on bisexual and hermaphrodite free living nematodes, with special reference to problems of sex. *J. Morphol.*, **40**: 191-233.
- HYMAN, L. H. 1951. *The Invertebrates: Acanthocephala, Aschelminthes, and Entoprocta. The Pseudocoelomate Bilateria*. Vol. III. New York, Mc Graw Hill. 572 pp.
- KHERA, S. 1967. *Acrobelinema cornis* n.g., n.sp. subfamily Acrobelinae Thorne from rhizosphere of millets from India. *Indian J. Helminth.*, **19**: 159-163.
- KHERA, S. 1967(a). Studies on the culturing of a free-living nematode *Acrobelinema cornis* Khera. *Indian J. Helminth.*, **19**: 164-167.
- LAPAGE, G. 1935. The second ecdysis of infective nematode larvae. *Parasitology*, **27**: 186-206.
- LEE, D. L. 1965. *The physiology of nematodes*. San Francisco, W. H. Freeman. 154 pp.
- LINFORD, M. B. & OLIVEIRA, J. M. 1940. *Rotylenchulus reniformis* nov. gen. n.sp., a new nematode parasite of roots. *Proc. helminth. Soc. Wash.*, **7**: 35-42.
- LOOS, C. A. 1962. Studies on the life history and habits of the burrowing nematode, *Radopholus similis*, the cause of black, head disease of banana. *Proc. helminth. Soc. Wash.*, **29**: 43-52.
- MAGGENTI, A. R. 1961. Morphology and biology of the genus *Plectus* (Nematoda: Plectidae). *Proc. helminth. Soc. Wash.*, **28**: 118-130.
- *MAUPAS, E. 1900. Modes et formes de reproduction des nematodes. *Arch. Zool. exp. gen.*, **8**: 463-624.
- *MUSSO, R. 1930. Die Genitalrohren von *Ascaris lumbricoides* und *megalcephala*. *Z. wiss. Zool.*, **137**: 274-363.
- *NIGON, V. 1949. Les modalites de la reproduction et determinisma

- du sexe chez quelques nematodes libres. *Annls. Sci. nat. (b)*, (11) 11: 1-132.
- ONIONS, T. G. 1955. The distribution of hatching within the cyst of the potato-root eelworm, *Heterodera rostochiensis*. *Q. Jl. microsc. Sci.*, 96: 495-513.
- OVERGAARD NIELSEN, C. 1949. Studies on the soil microfauna. II. The soil inhabiting nematodes. *Natura Jut.*, 2: 1-131.
- *PAI, S. 1928. Die Phasen des Lebenscyclus der *Anguillula aceti* Ehrbg. und ihre expermentell-morphologische Beeinflussung. *Z. wiss. Zool.*, 131: 292-344.
- POTTS, F.A. 1910. Notes on free-living nematodes. I. The hermaphrodite species. *Q. Jl. microsc. Sci.*, 55: 433-484.
- RASKI, D. J. 1950. The life history and morphology of the sugar beet nematode, *Heterodera schachtii* Schmidt. *Phytopathology*, 40: 135-152.
- RHOADES, H. L. & LINFORD, M. B. 1961. Biological studies on some members of the genus *Paratylenchus*. *Proc. helminth. Soc. Wash.*, 28: 51-59.
- SESHADRI, A. R. 1964. Investigations on the biology and life cycle of *Criconemoides xenoplax* Raski, 1952. (Nematoda: Criconematidae) *Nematologica*, 10: 540-562.
- SHEPHERD, A. M. 1961. Hatching and hatching factors In: Jones, F. G. W. Nematology Department. *Rep. Rothamsted exp. Stn.*, 127-128.
- SHEPHARD, A. M. 1962. *The emergence of larvae from cyts in the genus Heterodera*. Tech. Bull. Commonw. Agr. Bur., Farnham Royal, Bucks, 90 pp.
- SILVERMAN, P. H. & CAMPBELL, J. A. 1969. Studies on the parasitic worms of sheep in Scotland. I. Embryonic and larval development of *Haemonchus contortus* at constant conditions. *Parasitology*, 49: 23-38.
- SKOTLAND, C. B. 1957. Biological studies of the soybean cyst nematode. *Phytopathology*, 47: 623.
- STEWART, F. H. 1921. The anatomy and biology of the parasitic *Aphelenchi*. *Parasitology*, 13: 160-179.
- *STRASSEN, O. ZUR 1892. *Bradynema rigidum* v. Sieb. *Z. wiss. Zool.*, 54: 655-747.
- THOMAS, P. R. 1965. Biology of *Acrobeles complexus* Thorne, cultivated on agar. *Nematologica*, 11: 395-408.
- TRANTAPHYLLOU, A. C. & HIRSCHMANN, H. 1964. Reproduction in plant and soil nematodes. *A. Rev. Phytopath.*, 2: 57-80.
- VIGILERCHIO, D. R. & LOWNSBERRY, B. F. 1960. The hatching response of *Meloidogyne* species to the emanations from the roots of germinating tomatoes. *Nematologica*, 5: 153-157.
- WALLACE, H. R. 1960. Observations on the behaviour of *Aphelenchoides ritzemabosi* in chrysanthemum leaves. *Nematologica*, 5: 315-321.
- WALLACE, H. R. 1963. *The biology of plant parasitic nematodes*. London, Edward Arnold. 280 pp.

- van WEERDT, L. G. 1958. Studies on the biology of *Radopholus similis* (Cobb, 1893) Thorne, Part II. *Nematologica*, **3**: 189-196.
- van WEERDT, L. G. 1960. Studies on the biology of *Radopholus similis* (Cobb, 1893) Thorne, 1949. Part III. Embryology and post-embryonic development. *Nematologica*, **5**: 43-51.
- WILSON, P. A. G. 1958. The effect of weak electrolyte solutions on the hatching rate of the eggs of *Trichostrongylus retortaeformis* (Zeder) and its interpretation in terms of a proposed hatching mechanism of strongyloid eggs. *J. exp. Biol.*, **35**: 584-601.
- WU, L. Y. 1958. Morphology of *Ditylenchus destructor* Thorne, 1945 (Nematode: Tylenchidae), from a pure culture, with special reference to reproductive systems and oesophageal glands *Can. J. Zool.*, **36**: 569-576.
- *WÜLKER, G. 1923. Über Fortpflanzung und Entwicklung von *Allantonema* und verwandten Nematoden. *Ergbn. Fortschr. Zool.*, **5**: 389-507.
- YUKSEL, H. S. 1960. Observations on the life cycle of *Ditylenchus dipsaci* on onion seedling. *Nematologica*, **5**: 289-296.

*Not seen in original.

Table I.—Development of *Acrobelinema cornis* in Nutrient Agar at 21-28°C

Number of eggs inoculated in each tube = 50
Recovery in %

Age (hours after inocu- lation)	I L	I M	II L	II M	III L	III M	IV L	IV M	A
76									
88									
100	94								
112	80	12							
124		20	70						
136		2	80	4					
148			8	34	40				
160				4	72				
172				2	70				
184					20	54			
196						8	60		
208							62		
220							54	6	
232*									
244								12	46

* Not examined at 232 hours.

A = Adult; L = Larval Stage; M = Moulting Stage.

Table II.—Measurements & de Manian values of various stages and adults of *Acrobelinema cornis*

	I L	I M	II L	II M	III L	III M	IV L	IV M	A
Lth	169- 190 (177)	195- 235 (210)	228- 260 (245)	240- 320 (290)	380- 480 (425)	450- 520 (485)	500- 550 (530)	525- 610 (570)	620- 750 (670)
Oes	68- 73	78- 85	80- 87	80- 100	120- 145	140- 160	140- 165	145- 170	165- 190
T	13- 14	13- 17	14- 18	17- 21	18- 22	19- 24	21- 25	22- 28	25- 31
a	18- 21	20- 22	20- 23	20- 24	21- 24	21- 24	21- 26	21- 27	22- 28
b	2.4- 2.6	2.5- 2.9	2.8- 3	2.9- 3.3	3.2- 3.3	3.25- 3.5	3.45- 3.6	3.5- 3.85	3.8- 4
c	13- 15	13- 16	14- 17	15- 19	21- 24	21- 24	22- 24	22- 25	22- 26
Gp	70	?	64- 67						
V							64- 66	66- 70	70- 73

A = Adult; Gp = Position of genital primordium in percentage from anterior end; L = Larval Stage; Lth = Total length in μm ; M = Moulting Stage; Oes = Oesophageal length in μm ; T = Tail length in μm . Other values as in de Manian formula.

ON THE SHORE FISHES OF GOA

By

P. K. TALWAR

Zoological Survey of India, Calcutta

INTRODUCTION

There is very little published information on the marine ichthyofauna of Goa. Our meagre knowledge of the shore fish fauna of this region is derived mainly from the papers of Cuvier and Valenciennes (1828, 1830), Norman (1928), Koumans (1941), Haig (1950), Chandy (1953), Tandon, Menon and Sareen (1967) and Murthy (1969). The present study is based on the collections of Dr. S. W. Kemp, Dr. A. W. Herre, Mr. P. F. Jones, material donated by the Karnatak College, Dharwar (Mysore State) and on surveys undertaken by the Zoological Survey of India in recent years (1966-1969).

The study reveals the occurrence of 168 species belonging to 109 genera and 67 families. The species, mainly littoral forms of the western coast of India, are apparently representative of the more frequent forms. Although several are new distributional records and are of special taxonomic interest, none are new forms.

A systematic account of the collections giving details of the number of examples, size-range in standard length unless otherwise stated, locality, date of collection, name of collector and geographical distribution of each species, is given. Descriptive notes of the species reported for the first time from the Indian coast or the Arabian Sea, are also given with the idea of recording intra-specific variations.

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SYSTEMATIC ACCOUNT

Class I. ELASMOBRANCHII

Order 1. LAMNIFORMES

I. Family ORECTOLOBIDAE

1. *Chiloscyllium griseum* Müller & Henle

1841. *Chiloscyllium griseum* Müller & Henle, *Syst. Besch. Plagiostomen*: 19.

Material.—1 ex., 320 mm. T L., Goa, 16.x.38, A. W Herre Coll.

Distribution.—Widespread, east coast of South Africa, the Red Sea, through India, Ceylon to the Philippines, China and Japan.

2. *Chiloscyllium indicum* (Gmelin)

1789. *Squalus indicus* Gmelin in Linnaeus, *Syst. Nat.*, 1: 1503.

Material.—2 exs., 142-150 mm. T L., Calangute, 30.iii.66, K. S. Pradhan Coll.; 1 ex., 245 mm. T L., Vasco, 25.iv.69, R. C. Sharma Coll.

Distribution.—Widespread, east coast of Africa, the Red Sea, India, Ceylon, the East Indies, the Philippines and China.

II. Family LAMNIDAE

3. *Alopias vulpinus* (Bonnaterre)

1788. *Squalus vulpinus* Bonnaterre, *Tab. encyclop. Ichth.*: 9, fig. 349.

Material.—2 exs., 280-377 mm. T L., Colva, 19.xii.68, V C. Agrawal Coll.

Distribution.—Widespread, east coast of South Africa, Arabia, through India, Ceylon, the Philippines, Japan to California and Chile.

III. Family CARCHARHINIDAE

4. *Scoliodon sorrakowah* (Cuvier)

1829. *Carcharias sorrakowah* Cuvier, *Regne Animal.*, 2 (ed. 2): 388.

Material.—5 exs., 222-303 mm. T L., Calangute, 30.iii.66; 3 exs., 285-375 mm. T L., Goa, 27.xi.67, K. S. Pradhan Coll.

Distribution.—From the Mekran coast, India, Ceylon, Burma, through the East Indies to the Philippines and Japan.

Order 2. RAJIFORMES

IV. Family DASYATIDAE

5. *Dasyatis* (*Himantura*) *bleekeri* (Blyth)

1860. *Trygon bleekeri* Blyth, *J. Asiat. Soc. Beng.*, **29**: 41.

Material.—1 ex., 113 mm. disc, Goa, 14.vii.35; 1 ex., 115 mm. disc, Goa, 12.xi.37, A. W. Herre Coll.

Distribution.—India, Ceylon, Burma, Malaysia, Borneo and the Philippines.

6. *Dasyatis* (*Himantura*) *uarnak* (Forsk.)

1775. *Raja uarnak* Forskal, *Descript. Animal.*: viii, 18.

Material.—1 ex., 137 mm. disc, Goa, 1938.

Distribution.—Widespread in the tropical Indian Ocean.

7 *Dasyatis* (*Amphotistus*) *imbricatus* (Schneider)

1801. *Raja imbricata* Schneider, *Syst. Ichth.*: 366.

Material.—1 ex., 172 mm. disc, Goa, 1938.

Distribution.—Western Indian Ocean, India, Ceylon, through the East Indies to the Philippines and China.

Class II. TELEOSTOMI

Order 3. CLUPEIFORMES

V. Family CLUPEIDAE

Subfamily 1. CLUPEINAE

8. *Herklotsichthys bulan* (Bleeker)

1849. *Clupalosa bulan* Bleeker, *Verh. Batav. Genootsch.*, **22**: 12.

Material.—2 exs., 72-80 mm., Goa, 1938.

Distribution.—Red Sea, Zanzibar, India, the East Indies, the Philippines and China.

9. *Escualosa thoracata* (Valenciennes)

1847. *Kowala thoracata* Valenciennes, *Hist. nat. Poiss.*, **20**: 363.

Material.—11 exs., 58-63 mm., Calangute, 30.iii.66; 2 exs., 70-86 mm., Baina, 9.iv.66; 3 exs., 53-54 mm., Vasco, 9.iv.66, K. S. Pradhan Coll.

Distribution.—India, Burma, Malaysia and the East Indies.

10. *Sardinella fimbriata* (Valenciennes)

1847. *Spratella fimbriata* Valenciennes, *Hist. nat. Poiss.*, 20: 359.

Material.—1 ex., 102 mm., Calangute, 30.iii.66; 15 exs., 69-72 mm., Baina, 9.iv.66; 42 exs., 67-75 mm., Vasco, 9.iv.66; 2 exs., 85-89 mm., Colva, 10.xi.67; 6 exs., 82-84 mm., Betul, 18.xi.67, K. S. Pradhan Coll.

Distribution.—Mauritius, the Red Sea, India, the East Indies, the Philippines and Taiwan.

11. *Sardinella longiceps* Valenciennes

1847. *Sardinella longiceps* Valenciennes, *Hist. nat. Poiss.*, 20: 273.

Material.—1 ex., 128 mm., Goa, 1938.

Distribution.—Widespread, the east coast of Africa, India, the East Indies and the Philippines.

Subfamily 2. *ALOSINAE*12. *Hilsa ilisha* (Hamilton)

1822. *Clupanodon ilisha* Hamilton, *Fish. Ganges*: 243, pl. 19, fig. 73.

Material.—1 ex., 132 mm., Goa, 12.xi.37, A. W. Herre Coll.

Distribution.—Persian Gulf, India, Pakistan, Ceylon and Burma.

13. *Hilsa kelle* (Cuvier)

1829. *Clupea kelee* Cuvier, *Regne Animal*, 2: (2nd ed.) 320.

Material.—1 ex., 128 mm., Goa, 12.xi.37, A. W. Herre Coll.

Distribution.—East African coast, Persian Gulf, India, Thailand, Malaysia and the East Indies.

Subfamily 3. *PRISTIGASTERINAE*14. *Ilsha indica* (Swainson)

1838. *Platygaster indicus* Swainson, *Nat. Hist. Anim.*, 2: 294.

Material.—1 ex., 54 mm., Calangute, 30.ii.66, K. S. Pradhan Coll.

Distribution.—India, Thailand, Malaysia, the East Indies and China.

15. *Opisthopterus tardoore* (Cuvier)

1829. *Pristigaster tardoore* Cuvier, *Regne Animal*, 2: (2nd ed.) 321.

Material.—2 exs., 43-52 mm., Calangute, 30.iii.66 ; 2 exs., 140-145 mm., Cancona, 6.iv.66 ; 1 ex., 118 mm., Goa, 27.xi.67, K. S. Pradhan Coll.

Distribution.—India, Thailand, Singapore and the East Indies.

16. *Pellona ditchela* Valenciennes

1847. *Pellona ditchela* Valenciennes, *Hist. nat. Poiss.*, 20: 314.

Material.—1 ex., 54 mm., Calangute, 30.iii.66, K. S. Pradhan Coll. ; 1 ex., 102 mm., Vasco, 25.ix.69, R. C. Sharma Coll.

Distribution.—East coast of Africa, India, Singapore, the East Indies, the Philippines and Taiwan.

Subfamily 4. DOROSOMATINAE

17 *Nematalosa nasus* (Bloch)

1795. *Clupea nasus* Bloch, *Naturges. ausland. Fische*, 9: 116, pl. 429, fig. 1.

Material.—2 exs., 63-78 mm., Goa, 26.xi.38, A. W Herre Coll.

Distribution.—Gulf of Aden, Persian Gulf, India, Burma, Thailand, Singapore, the East Indies and the Philippines.

VI. Family DUSSUMIERIIDAE

18. *Dussumeria acuta* Valenciennes

1847. *Dussumeria acuta* Valenciennes, *Hist. nat. Poiss.*, 20: 407, pl. 606.

Material.—1 ex., 114 mm., Goa, 1938, A. W Herre Coll. ; 1 ex., 120 mm., Goa, 1938, ? Coll. ; 4 exs., 50-58 mm., Calangute, 30.iii.66 ; 2 exs., 108-113 mm., Goa, 27.xi.67, K. S. Pradhan Coll. ; 5 exs., 97-127 mm., Colva, 15.xii.68, V C. Agrawal Coll. ; 4 exs., 105-110 mm., Vasco, 25.ix.69, R. C. Sharma Coll.

Distribution.—Widespread, East coast of Africa, East Mediterranean, Red Sea, India and the Indo-Australian Archipelago.

VII. Family ENGRAULIDAE

19. *Setipinna phasa* (Hamilton)

1822. *Clupea phasa* Hamilton, *Fish Ganges*: 240, 282.

1878. *Engraulis telera* Day, *Fish India*: 627, pl. 158, fig. 2.

Material.—1 ex., 190 mm., Goa, 1938, A. W. Herre Coll.

Description.—D 14. A 72. Gill-rakers 15+18. Scutes 15+7

Depth of body 3.9, length of head 5.9; both in standard length. Eye diameter 5.1 in head length, greater than interorbital width. Mouth slightly oblique; maxilla reaches gill opening. Dorsal origin slightly behind anal, nearer snout than to caudal base. Pectoral with its upper rays elongated, reaches anterior third of anal. Caudal well forked. Colour in alcohol—pale brownish on back, sides and lower surface silvery white.

Distribution.—This species is principally an estuarine or freshwater form (*vide* Jones & Menon, 1952) and has previously been reported only from the eastern coast of India, Burma, Ceylon and the Andaman Islands. Whitehead (1967b) gives the distribution of the genus *Setipinna* Swainson as Bay of Bengal to Korea. The present record extends the range of distribution of the genus *Setipinna* to the Arabian Sea.

20. *Stolephorus heterolobus* (Rüppell)

1837. *Engraulis heteroloba* Rüppell, *Neue Wirbelth., Fische*, 79: pl. 4.

Material.—1 ex., 74 mm., Vasco, 25.iv.69, R. C. Sharma Coll.

Distribution.—East African coast, the Red Sea, India, Singapore, the East Indies, Taiwan and Japan.

21. *Stolephorus macrops* Hardenberg

1933. *Stolephorus baganensis macrops* Hardenberg, *Nat. Tijdschr. Ned. Indie*, 93 (2): 260.

Material.—3 exs., 74-83 mm., Banulia, 14.ix.69, R. C. Sharma Coll.

Distribution.—Gulf of Aden (?), India and the East Indies.

22. *Stolephorus tri* (Bleeker)

1852. *Engraulis tri* Bleeker, *Verh. Batav. Genootsch.*, 24: 40.

Material.—1 ex., 96 mm., Goa, 1938, ? Coll.; 18 exs., 27-41 mm., Calangute, 30.iii.66, K. S. Pradhan Coll.; 9 exs., 103-143 mm., Vasco, 25.ix.69, R. C. Sharma Coll.

Distribution.—India, Singapore and the East Indies.

23. *Thryssa dussumieri* (Valenciennes)

1848. *Engraulis dussumieri* Valenciennes, *Hist. nat. Poiss.*, **21**: 69.

Material.—39 exs., 33-84 mm., Calangute, 30.iii.66 ; 2 exs., 91-100 mm., Goa, 6.iv.66, K. S. Pradhan Coll. ; 20 exs., 78-116 mm., Vasco, 25.ix.69, R. C. Sharma Coll.

Distribution.—India and the East Indies.

24. *Thryssa malabarica* (Bloch)

1795. *Clupea malabaricus* Bloch, *Naturges. ausland. Fische*, **9**: 115, pl. 432.

Material.—5 exs., 114-136 mm., Goa, 1938, ? Coll. ; 2 exs., 146-148 mm., Goa, 11.xi.67, K. S. Pradhan Coll. ; 1 ex., 92 mm., Colva : 19.xii.68., V. C. Agrawal Coll.

Distribution.—According to Whitehead (1967a) this species occurs principally in Indian waters, the record by Menon (1956) from the Persian Gulf probably being referable to *Thryssa hamiltonii* (Gray)

25. *Thryssa purava* (Hamilton)

1822. *Clupea purava* Hamilton, *Fish. Ganges*: 238.

Material.—1 ex., 160 mm., Goa, 12.xi.37, A. W. Herre Coll. ; 4 exs., 30-70 mm., Calangute, 30.iii.66, K. S. Pradhan Coll. ; 9 exs., 103-143 mm., Vasco, 25.ix.69, R. C. Sharma Coll.

Distribution.—Persian Gulf, India, Malaysia and Korea.

26. *Thryssa vitrirostris* (Gilchrist & Thompson)

1911. *Engraulis vitrirostris* Gilchrist & Thompson, *Ann. S. Afr. Mus.*, **6**: 201.

Material.—9 exs., 27-87 mm., Calangute, 30.iii.66, K. S. Pradhan Coll.

Distribution.—East coast of Africa, Madagascar, Persian Gulf, Gulf of Oman and India.

VIII. Family CHIROCENTRIDAE**27 *Chirocentrus dorab* (Forsk.)**

1775. *Clupea dorab* Forskal, *Descript. Animal*: **13**, 72.

Material.—1 ex., 236 mm., Goa, 27.xii.67, K. S. Pradhan Coll.

Distribution.—Widely distributed in the warm waters of

the Indo-West Pacific ranging from the Red Sea and east coast of Africa to Australia and Melanesia.

Order 4. SCOPELIFORMES

IX. Family SYNODONTIDAE

28. *Harpodon nehereus* (Hamilton)

1822. *Osmerus nehereus* Hamilton, *Fish. Ganges*: 209, 380.

Material.—1 ex., 241 mm., Goa, 26.x.38, A. W. Herre Coll.

Distribution.—Widely distributed from the east coast of Africa through India to China and Australia.

29. *Saurida tumbil* (Bloch)

1795. *Salmo tumbil* Bloch, *Naturges. ausland. Fische*, 9: 112.

Material.—1 ex., 136 mm., Calangute, 30.iii.66; 1 ex., 271 mm., Goa, 27.xi.67, K. S. Pradhan Coll; 1 ex., 100 mm., Colva, 19.xii.68., V C. Agrawal Coll.

Distribution.—Widely distributed in the warm waters of the Indo-West Pacific, ranging from the east coast of Africa to Australia, Japan and Hawaii.

Order 5. CYPRINIFORMES

X. Family TACHYSURIDAE

30. *Tachysurus arius* (Hamilton)

1822. *Pimelodus arius* Hamilton, *Fish. Ganges*: 170, 376.

Material.—1 ex., 82 mm., Mormugoa Bay, September, 1916, S. W. Kemp Coll.

Distribution.—India and Burma.

31 *Tachysurus dussumieri* (Valenciennes)

1840. *Aruis dussumieri* Valenciennes, *Hist. nat. Poiss.*, 15: 84.

Material.—2 exs., 80-82 mm., Goa, 14.vii.38, A. W. Herre Coll.

Distribution.—East coast of South Africa, India, Pakistan, Ceylon and Burma.

32. *Tachysurus falcarius* (Richardson)

1844. *Aruis falcarius* Richardson, *Voy. Sulphur Ich.*: 134, pl. 59. fig. 7-9,

Material.—1 ex., 145 mm., Colva, 19.xii.68, V C. Agrawal Coll.

Distribution.—India, Burma, Singapore, the East Indies, the Philippines, China and Japan.

33. *Tachysurus jatius* (Hamilton) comb. nov.

1822. *Pimelodus jatius* Hamilton, *Fish. Ganges*: 171, 376.

Material.—1 ex., 126 mm., Mormugoa Bay, September, 1916, S. W Kemp Coll.

Description.—D.I. 7 ; A. 19 ; P. I. 10 ; G. R. 7 + 1 + 11, lanceolate.

Depth of body 4.8, length of head 3.4 ; both in standard length. Height of head at occiput 1.4, width of head 1.5 ; both in head length. Eye diameter 4.1 in head length, 1.5 in interorbital width, 1.5 in snout length. Upper jaw longer than lower jaw, extent of gape of mouth equals one-third of head length. Posterior portion of head sparsely granulated, occipital process more thickly so ; median longitudinal groove on head narrow and continued almost to base of occipital process which is keeled and reaches the narrow V-shaped basal bone of dorsal fin. Barbels—six, maxillary barbels shorter than head, reach slightly beyond base of pectoral fin ; outer mandibular reach gill opening. Teeth—villiform in a continuous band on premaxillaries, five times as long as wide. Palatal teeth in two small oval groups, globular, separated from premaxillary band by space equal to one and half times length of patch ; length of palatal group less than half eye-diameter ; vomerine teeth absent. Fins—dorsal spine strong, serrated on both sides, as long as head without snout. Pectoral spine slightly shorter than dorsal spine, serrated on both sides. Base of adipose dorsal $4/5$ of rayed dorsal. Caudal (broken) forked. Colour in alcohol—light brownish, silvery below. Fins yellowish, upper edge of rayed and adipose dorsals dusky.

Distribution.—According to Misra (1959) this species occurs in the seas, estuaries and tidal rivers of Orissa, West Bengal, East Pakistan, Burma and Ceylon. The present record from Mormugoa Bay extends its range of distribution to the Arabian Sea.

34. *Tachysurus maculatus* (Thunberg)

1792. *Silurus maculatus* Thunberg, *Kon. Vet. Akad. Oya. Handl. Stockholm*, 13: 31, pl. 1, fig. 2.

Material.—1 ex., 156 mm., Colva, 10.xi.67 ; 3 exs., 150-228 mm., Colva, 11.xi.67, K. S. Pradhan Coll.

Distribution.—Pakistan, India, Ceylon, Malay Archipelago, the Philippines and China.

35. *Tachysurus sagor* (Hamilton)

1822. *Pimelodus sagor* Hamilton, *Fish. Ganges*: 169, 376.

Material.—9 exs., 46-88 mm., Calangute, 30.iii.66, K. S. Pradhan Coll.

Distribution.—India, Pakistan, Malaysia and the East Indies.

36. *Tachysurus thalassinus* (Rüppell)

1835. *Bagrus thalassinus* Rüppell, *Neue Wirebelth., Fische*: 75, pl. 20, fig. 2.

Material.—1 ex., 100 mm., Goa, 1940, ? Coll ; 1 ex., 115 mm., Calangute, 30.iii.66, K. S. Pradhan Coll. ; 1 ex., 135 mm., Banulia, 14.ix.69 ; 5 exs., 89-130 mm., Vasco, 25.ix.69, R. C. Sharma Coll.

Distribution.—Widespread, the Red Sea, Zanzibar through India, the East Indies, to Australia and Polynesia.

XI. Family BAGRIDAE

37. *Mystus gulio* (Hamilton)

1822. *Pimelodus gulio* Hamilton, *Fish. Ganges*: 201, 379, pl. 23, fig. 6.

Material.—1 ex., 172 mm., Goa, 26.ix.38, A. W. Herre Coll.

Distribution.—Seas, estuaries and tidal waters of India, Pakistan, Ceylon, Burma and Malay Archipelago.

Order 6. ANGUILLIFORMES

XII. Family MURAENESOCIDAE

38. *Muraenesox arabicus* (Schneider)

1801. *Muraena arabica* Schneider *Syst. Ichth.*: 488.

Material.—1 ex., 266 mm. T L., Goa, 26.x.38, A. W. Herre Coll. ; 1 ex., 406 mm. T L., Goa, 1938, ? Coll ; 1 ex., 430 mm. T L., Vasco, 25.ix.69, R. C. Sharma Coll.

Distribution.—Widespread, east coast of Africa, Red Sea, Persian Gulf through India, the East Indies to the Philippines, China and Japan.

39. *Thyrsoidea macrurus* (Bleeker)

1854. *Muraena macrurus* Bleeker, *Nat. Tijdschr. Ned. Indie*, 7: 324.

Material.—1 ex., 494 mm. T L., Panjim, 22.ix.69; 4 exs., 626-875 mm. T L., Panjim, 26.iv.69, R. C. Sharma Coll.

Distribution.—Widespread, Natal, India, Ceylon, Taiwan, Palew Islands and Australia.

XIII. Family OPHICHTHYIDAE

40. *Pisoodonophis boro* (Hamilton)

1822. *Ophisurus boro* Hamilton, *Fish. Ganges*: 20: 363.

Material.—5 exs., 286-712 mm. T L., Panjim, 22.ix.69; 2 exs., 380-457 mm. T L., Vasco, 25.ix.69; 1 ex., 340 mm. T L., Panjim, 26.ix.69, R. C. Sharma Coll.

Distribution.—In sea, brackish and freshwaters of India, Singapore, the East Indies and China.

41 *Pisoodonophis cancrivorus* (Richardson)

1844. *Ophisurus cancrivorus* Richardson, *Voy. Erebus and Terror, Fish.*: 97, pl. 40, fig. 6-9.

Material.—1 ex., 450 mm. T L., Goa, 26.x.38, A. W Herre Coll.

Distribution.—East coast of Africa through India, Ceylon, the East Indies to Japan and Australia.

Order 7 BELONIFORMES

XIV. Family BELONIDAE

42. *Tylosurus crocodilus* (Le Sueur)

1821. *Belone crocodila* Le Sueur, *J. Acad. nat. Sci. Philad.*, 2: 129.

Material.—1 ex., 253 mm., Colva, 15.xii.68, V C. Agrawal Coll.

Distribution.—Widespread, east coast of Africa, Red Sea, through the Indian Ocean to Soloman Islands and Tahiti.

XV. Family HEMIRHAMPHIDAE

43. *Hyporhamphus dussumieri* (Valenciennes)

1846. *Hemirhamphus dussumieri* Valenciennes, *Hist. nat. Poiss.*, 19: 33.

Material.—1 ex., 151 mm., Colva, 19.xii.68, V C. Agrawal Coll.

Distribution.—Widespread, east coast of Africa, Red Sea, through India, the East Indies, the Philippines to Australia, the Micronesian and Polynesian Islands.

44. *Hyporhamphus gaimardi* (Valenciennes)

1846. *Hemirhamphus gaimardi* Valenciennes, *Hist. nat. Poiss.*, **19**: 36.

Material.—1 ex., 120 mm., Goa, 26.x.38, A. W. Herre Coll.

Distribution.—Persian Gulf, India, Ceylon, Burma, Malaysia, the East Indies, the Philippines and Australia.

45. *Hyporhamphus georgii* (Valenciennes)

1846. *Hemirhamphus georgii* Valenciennes, *Hist. nat. Poiss.*, **19**: 27.

Material.—1 ex., 212 mm., Colva, 19.xii.68, V. C. Agrawal Coll.; 14 exs., 155-180 mm., Vasco, 25.ix.69, R. C. Sharma Coll.

Distribution.—Widespread, Seychelles, Mauritius, Persian Gulf, through India, Ceylon, the East Indies, the Philippines to Australia, Micronesian and Polynesian Islands.

XVI. Family EXOCOETIDAE

46. *Cypselurus comatus* (Mitchill)

1815. *Exocoetus comatus* Mitchill, *Trans. Lit. Philos. Soc.*, **1**: 448.

Material.—1 ex., 158 mm., Vasco, 25.ix.69, R. C. Sharma Coll.

Distribution.—Western Indian Ocean, India, Ceylon and South Atlantic.

Order 8. SYNGNATHIFORMES

XVII. Family SYNGNATHIDAE

47. *Doryichthys cunculus* (Hamilton)

1822. *Syngnathus cunculus* Hamilton, *Fish. Ganges*: 12.

Material.—1 ex., 98 mm., T. L. Mormugoa Bay, September, 1916, S. W. Kemp Coll.

Distribution.—India and Ceylon.

48. *Syngnathus argyrostictus* Kaup

1856. *Syngnathus argyrostictus* Kaup, *Cat. Lophobr. Fish.*, **33**: 46.

Material.—10 exs., 72-102 mm. T. L., Mormugoa Bay, September, 1916, S. W. Kemp Coll.

Distribution.—India, Malay Peninsula, Taiwan and Japan.

Order 9. CYPRINODONTIFORMES

XVIII. Family CYPRINODONTIDAE

49. *Oryzias melastigma* (Mc Clelland)

1839. *Aplocheilus melastigmus* Mc Clelland, *Asiat. Res. Calcutta*, 19: 301, 427.

Material.—2 exs., 23-36 mm., Colva, 1966, K. S. Pradhan Coll.

Distribution.—Brackish waters and estuaries of Ceylon, Peninsula India through Lower Bengal to Burma.

Order 10. BERYCIFORMES

XIX. Family HOLOCENTRIDAE

50. *Holocentrus lacteo-guttatus* Cuvier

1829. *Holocentrum lacteo-guttatum* Cuvier, *Hist. nat. Poiss.*, 3: 214.

Material.—2 exs., 86-101 mm., Goa, 26.x.38, A. W. Herre Coll.

Description.—D. XII. 12; A IV.9; P. 2.13; Ll. 41-42; L. tr. 3/8. Depth of body 2.7-2.8, length of head 2.9-3.0; both in standard length. Snout length 4.3-4.7, eye diameter 2.5-2.8, length of maxilla 3.0, interorbital width 3.6-3.7, postorbital length 2.3-2.4; all in standard length. Snout profile convex. Maxillary extends to vertical from middle of eye. Nasalia rounded in front, without spines. Jaws equal. Origin of dorsal separated by six scales from occiput. Colour-in-alcohol-golden silvery with slightly developed lighter longitudinal bands; membrane between dorsal spines divided into small milky white upper part and much larger hyaline lower part by darkish band. Minute black spots scattered over head and body.

Distribution.—East coast of Africa, Red' Sea, Ceylon, the East Indies, the Philippines to Hawaii and Tahiti. This is the first record of this species from the Indian coast.

Order 11 MUGILFORMES

XX. Family SPHYRAENIDAE

51. *Sphyraena chrysotaenia* Klunzinger

1884. *Sphyraena chrysotaenia* Klunzinger, *Fische Rothen Meers*, 1: 128, pl. 9, fig. 3.

Material.—1 ex., 125 mm., Goa, 1938, A. W. Herre Coll.; 1 ex., 200 mm., Goa, 1938; 2 exs., 154-177 mm., Vasco, 25.ix.69, R. C. Sharma Coll.

Distribution.—Widespread, east coast of Africa, the Red Sea, India, the East Indies and (?) Philippines.

XXI. Family MUGILIDAE

52. *Mugil carinatus* (Ehrenberg) Valenciennes

1836. *Mugil carinatus* (Ehrenberg) Valenciennes, *Hist. nat. Poiss.*, **11**: 148.

Material.—2 exs., 45-60 mm., Colva, 4.iv.66, K. S. Pradhan Coll.

Distribution.—According to Pillay (1962) this species has been recorded only from Karachi, Bombay and Malabar in the Indian sub-continent besides its original record from the Red Sea.

53. *Mugil cunnesius* Valenciennes

1836. *Mugil cunnesius* Valenciennes, *Hist. nat. Poiss.*, **11**: 114.

Material.—2 exs., 37-48 mm., Colva, 10.xi.67, K. S. Pradhan Coll.

Distribution.—Widespread, the Red Sea, India through the East Indies to the Philippines, China and Australia.

54. *Mugil macrolepis* Smith

1849. *Mugil macrolepis* Smith, *Illustr. Zool. S. Africa*, **4**: pl. 28, fig. 2.

Material.—1 ex., 150 mm., Colva, 4.iv.66; 1 ex., 136 mm., Colva, 11.xi.67; 2 exs., 110-116 mm., Mirampur, 26.xi.67, K. S. Pradhan Coll.

Distribution.—East coast of Africa and Madagascar through India, Ceylon, the East Indies, the Philippines to the Marshall Islands.

55. *Mugil parsia* Hamilton

1822. *Mugil parsia* Hamilton, *Fish. Ganges*: 215, pl. 17, fig. 71.

Material.—1 ex., 46 mm., Colva, 10.xi.67, K. S. Pradhan Coll.

Distribution.—Indo-West Pacific.

56. *Mugil tade* Forskal

1775. *Mugil crenilabris tade* Forskal, *Descript. Animal.*, **14**: 74.

Material.—1 ex., 79 mm., Baina, 9.iv.66 ; 1 ex., 47 mm., Colva, 11.xi.67 ; 2 exs. 100-122 mm., Goa, 27.xi.67, K. S. Pradhan Coll.

Distribution.—Indo-West Pacific.

57 *Mugil* sp.

The following specimens are very young for specific identification.

28 exs., 33-38 mm., Colva, 4.iv.66 ; 1 ex., 27 mm., Colva, 10.xi.67, K. S. Pradhan Coll.

XXII. Family ATHERINIDAE

58. *Pranesus pinguis forskali* (Rüppell)

1835. *Atherina forskalii* Rüppell, *Neue Wirbelth., Fische* : 132, pl. 33, fig. 1.

Material.—52 exs., 50-74 mm., Caisua, 29.iii.66 ; 5 exs., 72-103 mm., Colva, 4.iv.66 ; 2 exs., 47-58 mm., Vasco, 9.iv.66, K. S. Pradhan Coll.

Distribution.—Widespread, the tropical Indian Ocean and Western Pacific.

Order 12. POLYNEMIFORMES

XXIII. Family POLYNEMIDAE

59. *Polynemus heptadactylus* Cuvier

1829. *Polynemus heptadactylus* Cuvier, *Hist. nat. Poiss.*, 3 : 300.

Material.—1 ex., 96 mm., 27.xi.67, K. S. Pradhan Coll. ; 1 ex., 193 mm., Vasco., 15.ix.69, R. C. Sharma Coll.

Distribution.—India and Ceylon to Malay Archipelago.

Order 13. PERCIFORMES

XXIV. Family AMBASSIDAE

60. *Ambassis commersoni* Cuvier

1828. *Ambassis commersonii* Cuvier, *Hist. nat. Poiss.*, 2 : 176, pl. 25.

Material.—6 exs., 41-102 mm., Goa, 1938 ; 6 exs., 39-53 mm., Goa, 26.x.38, A. W. Herre Coll.

Distribution.—Widespread, east coast of Africa, Red Sea, Madagascar, Mauritius, Seychelles, India, Ceylon, the Nicobar Islands, to the Malay Archipelago, the Philippines and Australia.

61. *Ambassis gymnocephalus* (Lacépède)

1802. *Lutjanus gymnocephalus* Lacépède, *Hist. nat. Poiss.*, 3: 23, pl. 23, fig. 3.

Material.—2 exs., 45-59 mm., Calangute, 30.iii.66 ; 21 exs., 39-58 mm., Colva, 4.iv.66, K. S. Pradhan Coll.

Distribution.—Widespread, Indo-West Pacific.

XXV. Family SERRANIDAE

62. *Cephalopholis boenack* (Bloch)

1790. *Bodianus boenack* Bloch, *Naturges. ausland. Fische*, 4: 43.

1828. *Serranus formosus* Cuvier & Valenciennes, *Hist. nat. Poiss.*, 2: 311 (Goa).

Material—2 exs., 166-18 mm., Baina, 9.iv.66, K. S. Pradhan Coll.

Distribution.—East coast of Africa to Southern Japan and North Australia.

63. *Epinephalus diacanthus* (Valenciennes)

1828. *Serranus diacanthus* Valenciennes, *Hist. nat. Poiss.*, 2: 319.

Material.—3 exs., 94-106 mm., Baina, 16.xi.67 ; 2 exs., 91-120 mm., Goa, 27.xi.67 ; 3 exs., 74-113, Calangute, 29.xi.67, K. S. Pradhan Coll.

Distribution.—East coast of Africa through India, the East Indies to the Philippines, China and Japan.

64. *Epinephelus tauvina* (Forsk.)

1795. *Perca tauvina* Forskal, *Descript. Animal.*: 39.

Material.—1 ex., 149 mm., Goa, 1938, A. W. Herre Coll.

Distribution.—Widespread, Red Sea, east coast of Africa through India, Ceylon, the East Indies, the Philippines to Australia, Hawaiian and the Ellice Islands.

XXVI. Family THERAPONIDAE

65. *Autisthes puta* (Cuvier)

1829. *Therapon puta* Cuvier, *Hist. nat. Poiss.*, 3: 131.

Material.—1 ex., 55 mm., Goa, 1938 ; 1 ex., 60 mm., Goa, 27.x.39, A. W. Herre Coll. ; 1 ex., 102 mm., Colva, 11.xi.67 ; 3 exs., 85-110 mm., Betul, 18.xi.67, K. S. Pradhan Coll., 2 exs., 95-97 mm., Colva, 19.xii.68, V. C. Agrawal Coll.

Distribution.—Tropical Indian Ocean ranging from the Red Sea and the east coast of Africa, through the East Indies to Australia.

66. *Eutherapon theraps* (Cuvier)

1829. *Therapon theraps* Cuvier, *Hist. nat. Poiss.*, 3: 129, pl. 53.

Material.—1 ex., 69 mm., Goa, 1938 Coll. ? ; 1 ex., 136 mm., Vasco, 25.ix.69, R. C. Sharma Coll.

Distribution.—Tropical Indian Ocean ranging from the Red Sea through India, the East Indies, the Philippines to Taiwan and Australia.

67. *Therapan jarbua* (Forsk.)

1775. *Sciaena jarbua* Forskal, *Descript. Animal.*: 12, 50.

Material.—1 ex., 106 mm., Goa, 12.xi.37 ; 1 ex., Goa, 1938, A. W. Herre Coll., 2 exs., 42-48 mm., Colva, 1966 ; 4 exs., 76-96 mm., Colva, 10.xi.67 ; 2 exs., 102-118 mm., Baina, 16.xi.67, K. S. Pradhan Coll. ; 2 exs., 63-84 mm., Colva, 19.xii.68, V. C. Agrawal Coll.

Distribution.—Widespread, east coast of Africa, Red Sea through India, the East Indies to Japan, Australia and Polynesia.

XXVII. Family APOGONIDAE

68. *Lepidamia multitaeniatus* (Cuvier)

1828. *Apogon multitaeniatus* Cuvier, *Hist. nat. Poiss.*, 2: 159.

Material.—1 ex., 91 mm., Betul, 18.xi.67, K. S. Pradhan Coll.

Distribution.—Western Indian Ocean, India and the Philippines.

XXVIII. Family SILLAGINIDAE

69. *Sillago (Sillaginopodys) chondropus* Bleeker

1849. *Sillago chondropus* Bleeker, *Verh. Batav. Genootsch.*, 22: 61.

Material.—1 ex., 128 mm., Colva, 4.iv.66 ; 4 exs., 116-121 mm., Colva, November, 1967, K. S. Pradhan Coll.

Distribution.—Mckay (1968-personal communication) recorded this species from the east coast of South Africa, India, Burma, Malaysia, New Guinea and the Philippines.

70. *Sillago sihama* (Forsk.)

1775. *Atherina sihama* Forskal, *Descript. Animal.*: 13, 70.

Material.—1 ex., 100 mm., Goa, 1938, A. W. Herre Coll.; 8 exs., 55-88 mm., Colva, 4.iv.66; 34 exs., 39-94 mm., Colva, 11.xi.67; 3 exs., 76-101 mm., Betul, 18.xi.67; 1 ex., 157 mm., Calangute, 29.xi.67, K. S. Pradhan Coll.; 1 ex., 150 mm., Colva, 19.xii.68, V. C. Agrawal Coll.

Distribution.—Widespread, east coast of Africa, Red Sea through India, the East Indies to Japan, Australia and Melanesia. Günther (1860) reported this species from Nepal which, obviously, is an error.

71. *Sillaginopsis panijus* (Hamilton)

1822. *Cheilodipterus panijus* Hamilton, *Fish, Ganges*: 57, 367.

Material.—1 ex., 183 mm., Colva, 11.xi.67, K. S. Pradhan Coll.

Distribution.—India, Burma and the East Indies.

XXIX. Family CARANGIDAE

Subfamily 1. CARANGINAE

72. *Alectis indicus* (Rüppell)

1828. *Scyris indicus* Rüppell, *Atlas Reise Nordl. Afrika*: 128, pl. 33, fig. 1.

Material.—2 exs., 53-60 mm., Goa, 26.x.38, A. W. Herre Coll.; 1 ex., 78 mm., Vasco, 25.ix.69, R. C. Sharma Coll.

Distribution.—Western Indian Ocean, tropical and sub-tropical Indo-Pacific as far east as Hawaiian Islands.

73. *Atropus atropus* (Bloch)

1801. *Brama atropus* Bloch, *Syst. Ichth.*: 98.

Material.—1 ex., 94 mm., Vasco, 25.ix.69, R. C. Sharma Coll.

Distribution.—India, Ceylon, Thailand, China and Samoa.

74. *Carangoides chrysophrys* (Cuvier)

1833. *Caranx chrysophrys* Cuvier, *Hist. nat. Poiss.*, 9: 77.

Material.—1 ex., 102 mm., Baina, 16.xi.67, K. S. Pradhan Coll.

Distribution.—East coast of Africa, Madagascar, Seychelles, Muscat, India, China and Australia.

75. *Carangoides malabaricus* (Schneider)

1801. *Scomber malabaricus* Schneider, *Syst. Ichth.*: 31.

Material.—1 ex., 110 mm., Goa, 1938, ? Coll. ; 1 ex., 68 mm., Vasco, 25.ix.69, R. C. Sharma Coll.

Distribution.—Widespread, east coast of Africa, Zanzibar, Red Sea, Persian Gulf to India, Ceylon, Burma, the East Indies, the Philippines and Japan.

76. *Caranx elacate* (Jordan & Evermann)

1903. *Carangus elacate* Jordan & Evermann, *Bull. U. S. Fish. Comm.*, 23: 190.

1958. *Caranx elacate*: Williams, *Ann. Mag. nat. Hist.*, (13) 1 (16): 383 [Revision]

Material.—5 exs., 120-133 mm., Betul, 18.xi.67, K. S. Pradhan Coll.

Description.—D. VIII + I. 20-21 ; A. II + 1.15-16 ; P.I. 20-21. Scutes on lateral line straight 30-32, strong ; Gill-rakers 6-7+16-18 = 23-25.

Depth of body 2.5-2.6, length of head 3.0-3.1 ; both in standard length. Eye diameter 3.4-3.5, snout length 3.3-3.6, inter-orbital width 3.8-3.9, postorbital distance 2.1-2.3, pectoral fin 0.9-1.0, pelvic fin 2.1-3.5 ; all in length of head. Eye diameter 0.96-1.04 in snout length. Lateral line curve in lateral line straight 1.2.

Body oblong, nape not elevated and there is a continuous curve from snout to origin of second dorsal fin. Cleft of mouth at or very slightly below level of eye, slightly oblique. Maxilla extends to posterior edge of pupil. Scales on body moderately conspicuous ; breast completely scaled. Lateral line curve joins lateral line straight under 3rd to 5th dorsal ray. Colour-in-alcohol-dusky above, yellowish at midline, silvery-brown below. Dorsal fins dusky especially at tips of spines and rays. Anal, pectorals and pelvics pale.

Distribution.—According to Williams (1958) "the coast of east Africa, Comoro Islands, ?Madagascar, Hawaiian Islands ; probably throughout tropical and subtropical Indo-Pacific Ocean." This is the first record of the species from the Indian coast.

77 *Caranx melampygus* Cuvier

1833. *Caranx melampygus* Cuvier, *Hist. nat. Poiss.*, 9: 116.

Material.—1 ex., 105 mm., Goa, 1938.

Distribution.—Widespread, east coast of Africa, Red Sea, through India, the East Indies, Japan to Tonga and Hawaiian Islands.

78. *Megalaspis cordyla* (Linnaeus)

1758. *Scomber cordyla* Linnaeus, *Syst. Nat.* (ed. 10): 298.

Material.—2 exs., 116-210 mm., Calangute, 30.iii.66, K. S. Pradhan Coll.

Distribution.—Western Indian Ocean, tropical and sub-tropical Indo-Pacific as far east as Hawaiian Islands.

79. *Selar kalla* (Cuvier)

1833. *Caranx kalla* Cuvier, *Hist. nat. Poiss.*, 9: 49.

Material.—6 exs., 102-107 mm., Calangute, 30.iii.66 ; 2 exs., 95-103 mm., Goa, 27.xi.67, K. S. Pradhan Coll. ; 7 exs., 78-107 mm., Colva, 15.xii.68, V C. Agrawal Coll. ; 3 exs., 81-95 mm., Banulia, 14.ix.69 ; 3 exs., 85-87 mm., Vasco, 25.ix.69, R. C. Sharma Coll.

Distribution.—Widespread, east of Africa, Red Sea, through India, Ceylon, the East Indies, the Philippines to Solomon Islands and Sandwich Islands.

80. *Selar melam* Bleeker

1851. *Selar melam* Bleeker, *Nat. Tijds. Ned. Indie*, 1: 362.

Material.—1 ex., 76 mm., Colva, 15.xii.68, V C. Agrawal Coll.

Distribution.—India, the Andamans, Thailand, the East Indies, China, Taiwan and Australia.

Subfamily 2. CHORINEMINAE

81 *Chorinemus lysan* (Forsk.)

1775. *Scomber lysan* Forskal, *Descript. Animal.*: 12, 54.

Material.—1 ex., 160 mm., Calangute, 30.iii.66, K. S. Pradhan Coll.

Distribution.—Widespread, Western Indian Ocean tropical and subtropical Indo-Pacific as far east as Tahiti.

82. *Chorinemus tol* Cuvier

1831. *Chorinemus tol* Cuvier, *Hist. nat. Poiss.*, 8: 385.

Material.—1 ex., 159 mm., Colva, 10.xi.67, K. S. Pradhan Coll. ; 1 ex., 142 mm., Vasco, 25.ix.69, R. C. Sharma Coll.

Distribution.—East coast of Africa, Red Sea, through India, Ceylon, the East Indies, the Philippines to China and Japan.

Subfamily 3. *SERIOLINAE*

83. *Seriolina nigrofasciata* (Rüppell)

1831. *Nomeus nigrofasciata* Rüppell, *Atlas Reise Nordl. Afrika*: 28.

Material.—1 ex., 130 mm., Colva, 19.xii.68, V C. Agrawal Coll.

Distribution.—Widespread, east coast of Africa, Red Sea, India, Ceylon, the East Indies, the Philippines, China, Japan and Australia.

XXX. Family *RACHYCENTRIDAE*

84. *Rachycentron canadus* (Linnaeus)

1766. *Gasterosteus canadus* Linnaeus, *Syst. Nat.* (ed. 12), 1: 491.

Material.—1 ex., 191 mm., Goa, 26.x.38, A. W Herre Coll.; 1 ex., 222 mm., Colva, 11.xi.67, K. S. Pradhan Coll.

Distribution.—Widespread, in all warm seas except the eastern Pacific.

XXXI. Family *LUTIANIDAE*

85. *Lutianus argentimaculatus* (Forsk.)

1775. *Sciaena argentimaculatus* Forskal, *Descript. Animal.*: 47.

Material.—1 ex., 197 mm., Goa, 1940.

Distribution.—Widespread in the Indo-West Pacific, ranging from the Red Sea and east coast of Africa to Riu Kiu Islands and Polynesia.

86. *Lutianus johni* (Bloch)

1792. *Anthias johnii* Bloch, *Naturges. ausland. Fische*, 6: 113, pl. 318.

Material.—1 ex., 134 mm., Goa, 1940, Coll. ? ; 1 ex., 126 mm., Betul, 18.xi.67, K. S. Pradhan Coll.

Distribution.—Widespread, east coast of Africa through India, the East Indies to the Philippines, China, Australia and Polynesia.

87. *Lutianus rivulatus* (Cuvier)

1828. *Diacope rivulata* Cuvier, *Hist. nat. Poiss.*, 2: 414.

Material.—2 exs., 146-179 mm., Betul, 18.xi.67, K. S. Pradhan Coll.

Distribution.—Tropical Indian Ocean to the Philippines, China, Japan, Gilbert and Samoa Islands.

88. *Lutianus russelli* (Bleeker)

1849. *Mesoprion russellii* Bleeker, *Verh. Batav. Genootsch.*, **22**: 41.

Material.—1 ex., 86 mm., Goa, 26.x.38, A. W. Herre Coll.

Distribution.—Widespread, from Madagascar and Zanzibar through India, the East Indies to the Philippines, Japan and Australia.

XXXII. Family NEMIPTERIDAE

89. *Nemipterus japonicus* (Bloch)

1791. *Sparus japonicus* Bloch, *Naturges. ausland. Fische*, **5**: 110.

Material.—1 ex., 141 mm., Goa, 1938.

Distribution.—Widespread, tropical Indian Ocean, the East Indies, the Philippines, China and Japan.

XXXIII. Family GERRIDAE

90. *Gerres punctatus* Cuvier

1830. *Gerres punctatus* Cuvier, *Hist. nat. Poiss.*, **6**: 480.

Material.—1 ex., 87 mm., Baina, 16.xi.67; 1 ex., 94 mm., Goa, 27.xi.67, K. S. Pradhan Coll.; 1 ex., 120 mm., Colva, 19.xii.68, V. C. Agrawal Coll.

Distribution.—Widespread, tropical Indian Ocean, the East Indies, the Philippines, China, Japan, Australia and Melanesia.

91. *Gerres setifer* (Hamilton)

1822. *Chanda setifer* Hamilton, *Fish. Ganges*: 105, 370.

Material.—1 ex., 84 mm., Goa, 1938.

Distribution.—Coasts of India, Ceylon, Burma and Malay Peninsula.

XXXIV. Family LEIOGNATHIDAE

92. *Lelognathus berbis* (Valenciennes)

1835. *Equula berbis* Valenciennes, *Hist. nat. Poiss.*, **10**: 85.

Material.—3 exs., 22-52 mm., Colva, 19.xii.68, V. C.

Agrawal Coll. ; 28 exs., 54-81 mm., Vasco, 25.ix.69., *R. C. Sharma* Coll.

Distribution.—Red Sea, Zanzibar, India, Malaysia, the East Indies and Japan.

93. *Leiognathus blochi* (Valenciennes)

1835. *Equula blochii* Valenciennes, *Hist. nat. Poiss.*, 10: 84.

Material.—2 exs., 44-57 mm., Colva, 4.iv.66., *K. S. Pradhan* Coll. ; 1 ex., 57 mm., Banulia, 14.ix.69. ; 9 exs., 53-65 mm., Vasco, 25.ix.69., *R. C. Sharma* Coll.

Distribution.—India, the East Indies and the Philippines.

94. *Leiognathus daura* (Cuvier)

1829. *Equula daura* Cuvier, *Regne Animal.*, 2: 212.

Material.—1 ex., 61 mm., Calangute, 30.iv.66, *K. S. Pradhan* Coll.

Distribution.—From Arabia to India, through the East Indies to the Philippines and Australia.

95. *Leiognathus insidiator* (Bloch)

1787. *Zeus insidiator* Bloch, *Naturges. ausland. Fische*, 3: 41.

Material.—9 exs., 44-49 mm., Calangute, 30.iii.66 ; 4 exs., 71-80 mm., Goa, 6.iv.66 ; 8 exs., 18-30 mm., Colva, 10.xi.67, *K. S. Pradhan* Coll.

Distribution.—Didespread, east coast of Africa through India, the East Indies to the Philippines, China and Polynesia.

96. *Leiognathus ruconius* (Hamilton)

1822. *Chanda ruconius* Hamilton, *Fish. Ganges*: 106, pl. 12, fig. 35.

Material.—2 exs., 38-67 mm., Calangute, 30.ii.66 ; 1 ex., 75 mm., Goa, 27.xi.67, *K. S. Pradhan* Coll. ; 1 ex., 50 mm., Colva, 19.xii.68, *V. C. Agrawal* Coll. ; 1 ex., 52 mm., Banulia, 14.ix.69 ; 2 exs., 68-72 mm., Vasco, 25.ix.69, *R. C. Sharma* Coll.

Distribution.—Widespread in the Indo West Pacific, ranging from east coast of Africa through India, the East Indies, the Philippines to Australia.

97. *Leiognathus splendens* (Cuvier)

1829. *Equula splendens* Cuvier, *Regne Animal.*, 2 (ed. 2): 212.

Material.—1 ex., 84 mm., Goa, 1938, Coll ? ; 1 ex., 70 mm., Goa, 22.xi.67, *K. S. Pradhan* Coll.

Distribution.—Widespread, Red Sea, Madagascar, Mauritius, India, Ceylon through the East Indies to China, the Philippines, Australia and Polynesia.

XXXV. Family POMADASYIDAE

98. *Pomadasys hasta* (Bloch)

1790. *Lutjanus hasta* Bloch, *Naturges. ausland. Fische*, 4: 109, pl. 246, fig. 1.

Material.—2 exs., 110-127 mm., Goa, 26.x.38, A. K. Herre Coll.; 1 ex., 132 mm., Betul, 18.xi.67, K. S. Pradhan Coll.

Distribution.—Widespread, east coast of Africa through India, the East Indies to the Philippines, China, Japan and Australia.

99. *Pomadasys maculatus* (Bloch)

1797. *Anthias maculatus* Bloch, *Naturges. ausland. Fische*, 7: 9, pl. 326, fig. 2.

Material.—2 exs., 63-84 mm., Calangute, 30.iii.66, K. S. Pradhan Coll.; 2 exs., 52-53 mm., Colva, 19.xii.68, V. C. Agrawal Coll.; 1 ex., 106 mm., Vasco, 25.ix.69, R. C. Sharma Coll.

Distribution.—Widespread, east coast of Africa, through India, the East Indies to the Philippines, China and Australia.

XXXVI. Family SCOLOPSIDAE

100. *Scolopsis margaritifer* (Cuvier)

1830. *Scolopsides margaritifer* Cuvier, *Hist. nat. Poiss.*, 5: 337.

1936. *Scolopsis margaritifer*: Weber and de Beaufort, *Fishes Indo-Australian Archipelago*, 7: 328.

Material.—1 ex., 170 mm., Betul, 18.xi.67, K. S. Pradhan Coll.

Description.—D. X. 9; A. III. 7; P. 2. 17; Ll. 40; Ltr. $3\frac{1}{2}/1/13$; G.R. 6+5, low tubercles.

Height of body 2.2; length of head 3.0 in standard length. Eye diameter 3.2 in head length, slightly more than snout and interorbital width. Maxillary smooth, not reaching vertical from front edge of eye. Teeth in rather broad villiform bands in jaws, outer series slightly enlarged. Preoperculum with five transverse rows of scales, hind border strongly denticulate, and scalloped above edge which is prominent and rounded. Suborbital naked with distinct long spine

reaching to hind border of pupil, with five smaller spines below it. Infraorbital with enlarged, distinct backwardly directed spine below eye. Fins—first and second dorsal spines shorter than third; third to fifth spines subequal, somewhat more than postorbital part of head; following spines slightly shorter. Soft dorsal of equal height as spinous part. First anal spine short, second longest and more robust than third; third as long as dorsal spines. Caudal forked. Colour in alcohol—reddish brown, most scales with silvery spot.

The specimen agrees well with Fowler's (1931) and Weber & de Beaufort's (1936) description of the species except in having a higher number of pectoral rays (2.17 vs. 2.14).

Distribution.—This species has hitherto been reported only from the East Indies, the Philippines, China and North Australia (*vide* Herre, 1953). This is the first record of the species from Indian waters.

XXXVII. Family SCIAENIDAE

101 *Dendrophysa albida* (Cuvier)

1830. *Corvina albida* Cuvier, *Hist. nat. Poiss.*, 5: 93.

Material.—1 ex., 294 mm., Vasco, 25.ix.69, R. C. Sharma Coll.

Remarks.—There is a considerable controversy regarding the systematic status and identity of this species and this has been discussed elsewhere (Talwar, 1970). The species is characteristic in having a pair of minute mandibular barbels and a carrot-shaped Otolithine type of gas-bladder. The species is in fact much more nearly related to the type of *Nibea* Jordan & Thompson than to the species associated with it in *Dendrophysa* Trewavas. The generic relationship of this species is under study.

Distribution.—India, Ceylon, the East Indies, China and Australia.

102. *Dhoma axillaris* (Cuvier)

1830. *Corvina axillaris* Cuvier, *Hist. nat. Poiss.*, 5: 113.

Material.—2 exs., 75-78 mm., Calangute, 30.iii.66; 2 exs., 94-112 mm., Calangute, 29.xi.67, K. S. Pradhan Coll.

Distribution.—India, Ceylon, the East Indies, the Philippines, China and Australia.

103. **Johnius belengeri** (Cuvier)

1830. *Corvina belengerii* Cuvier, *Hist. nat. Poiss.*, 5: 120.

Material.—2 exs., 25-27 mm., Mormogoa Bay, September 1916, S. W. Kemp Coll.; 1 ex., 53 mm., Canacona market, 6.iv.66, K. S. Pradhan Coll.

Distribution.—Natal coast, India, the Andamans, Thailand, Malay Peninsula, the East Indies, China and the Philippines.

104. **Johnius macroptera** (Bleeker)

1853. *Umbrina macropterus* Bleeker, *Nat. Tijdschr. Ned. Indie*, 4: 254.

Material.—1 ex., 67 mm., Mormugoa Bay, September 1916, S. W. Kemp Coll.

Distribution.—Coast of Natal, India, Ceylon and the East Indies.

105. **Pennahia aneus** (Bloch)

1793. *Johnius aneus* Bloch, *Naturges. ausland. Fische*, 7: 135.

Material.—4 exs., 28-43 mm., Calangute, 30.iii.66, K. S. Pradhan Coll.; 1 ex., 107 mm., Vasco, 25.ix.69, R. C. Sharma Coll.

Distribution.—India, Ceylon, the East Indies, the Philippines and China.

106. **Pama pama** (Hamilton)

1822. *Bola pama* Hamilton, *Fish. Ganges*: 79, 368, pl. 32, fig. 26.

Material.—2 exs., 15-16 mm., Mormugoa Bay, September 1916, S. W. Kemp Coll.

Distribution.—India, Burma and the Malay Peninsula.

107. **Otolithes argenteus** (Cuvier)

1830. *Otolithus argenteus* Cuvier, *Hist. nat. Poiss.*, 5: 62.

Material.—2 exs., 34-35 mm., Calangute, 30.iii.66, K. S. Pradhan Coll.

Distribution.—Widespread, east coast of Africa, Madagascar, through India, Ceylon, the East Indies, the Philippines, China and Australia.

108. **Otolithes maculatus** (Cuvier)

1830. *Otolithus maculatus* Cuvier, *Hist. nat. Poiss.*, 5: 64.

Material.—1 ex., 16 mm., Mormugoa Bay, September 1916, S. W Kemp Coll.; 6 exs., 86-115 mm., Canacona market, 6.iv.66, K. S. Pradhan Coll.

Distribution.—India, Burma and the East Indies.

109. *Wak sina* (Cuvier)

1830. *Corvina sina* Cuvier, *Hist. nat. Poiss.*, 5: 122.

Material.—1 ex., 73 mm., Mormugoa Bay, September 1916, S. W Kemp Coll.; 8 exs., 38-72 mm., Calangute, 30.iii.66, K. S. Pradhan Coll.

Distribution.—East coast of South Africa, India, Ceylon, the East Indies, the Philippines and Japan.

110. *Wak vogleri* (Bleeker)

1853. *Otolithus vogleri* Bleeker, *Nat. Tijds. Nederland Indie*, 4: 253.

Material.—3 exs., 89-123 mm., Goa, September 1916, S. W Kemp Coll.; 2 exs., 91-117 mm., Panjim, 27.xi.67, K. S. Pradhan Coll.

Distribution.—East coast of South Africa, India, Ceylon, the East Indies and China.

111. *Wak* sp.

Specific identification is difficult in the following juveniles. 8 exs., 10-15 mm., Mormugoa Bay, September 1916, S. W Kemp Coll.

XXXVIII. Family LACTARIIDAE

112. *Lactarius lactarius* (Schneider)

1801. *Scomber lactarius* Schneider, *Syst. Ichth.*: 31.

Material.—5 exs., 82-170 mm., Vasco, 25.ix.69, R. C. Sharma Coll.

Distribution.—Widespread, Arabia through India, Ceylon, the Philippines and China to Australia.

XXXIX. Family SPARIDAE

113. *Acanthopagrus berda* (Forsk.)

1775. *Sparus berda* Forskal, *Descript. Animal.*: 32.

Material.—2 exs., 186-206 mm., Colva, 11.ix.67, K. S. Pradhan Coll.

Distribution.—Tropical Indo-Pacific from India, the East Indies, the Philippines, China, Japan to Solomon Islands and Australia.

XL. Family MULLIDAE

114. *Mulloidichthys vittatus* (Forsk.)

1775. *Mullus vittatus* Forskal, *Descript. Animal.*: 31.

Material.—2 exs., 67-89 mm., Calangute, 30.iii.66, K. S. Pradhan Coll.

Distribution.—Widespread, east coast of Africa, through India, Ceylon, the East Indies, the Philippines to Melanesia, Micronesia and Polynesia.

XLI. Family DREPANIDAE

115. *Drepane punctata* (Linnaeus)

1758. *Chaetodon punctatus* Linnaeus, *Syst. Nat.* (ed. 10): 273.

Material.—1 ex., 45 mm., Goa, 1924, Coll ?; 2 exs., 36-45 mm., Betul, 18.xi.67, K. S. Pradhan Coll.; 1 ex., 69 mm., Colva, 19.xii.68, V C. Agrawal Coll.

Distribution.—Widespread, east coast of Africa, Red Sea through India, Ceylon, the East Indies to Australia and Polynesia.

XLII. Family SCATOPHAGIDAE

116. *Scatophagus argus* (Linnaeus)

1766. *Chaetodon argus* Linnaeus, *Syst. Nat.* (ed. 12): 464.

Material.—1 ex., 60 mm., Goa, 26.x.38, A. W Herre Coll.

Distribution.—India, Ceylon, Burma, Malay Archipelago, China, the Philippines, Australia, Melanesia and Polynesia.

XLIII. Family POMACANTHIDAE

117 *Pomacanthodes annularis* (Bloch)

1787. *Chaetodon annularis* Bloch, *Naturges. ausland. Fische*, 3: 114.

Material.—1 ex., 188 mm., Baina, 1966, K. S. Pradhan Coll.

Distribution.—India, Ceylon and the East Indies.

XLIV. Family CICHLIDAE

118. ***Eetroplus suratensis*** (Bloch)

1785. *Chaetodon suratensis* Bloch, *Ichth. Hist. Nat.*, Paris, pl. 217.

Material.—2 exs., 90-92 mm., Goa, 1938, Coll. ? ; 1 ex., 65 mm., Colva, 4.iv.66, K. S. Pradhan Coll.

Distribution.—India and Ceylon.

XLV. Family POMACENTRIDAE

119. ***Abudefduf bengalensis*** (Bloch)

1787. *Chaetodon bengalensis* Bloch, *Naturges. ausland. Fische*, 3: 110, pl. 213, fig. 2.

Material.—1 ex., 100 mm., Goa, 1938.

Distribution.—Indo-Pacific, from the Red Sea and Madagascar through India, the East Indies to the Philippines, China and Japan.

120. ***Abudefduf glaucus*** (Cuvier)

1830. *Glyphisodon glaucus* Cuvier, *Hist. nat. Poiss.*, 5: 475.

1960. *Abudefduf glaucus*: Smith, *Ichthyol. Bull. Rhodes Univ.*, 19: 336, pl. 29F.

Material.—1 ex., 58 mm., Goa, 1938.

Description.—D. XIII. 12 ; A. II. 12 ; P. 2. 15.

Depth of body 2.5, length of head 3.4 ; both in standard length. Eye diameter 3.3 in head length, equals interorbital width and snout length, 1.5 in postorbital length. Preopercle smooth ; single opercular spine, broad and flat. Teeth biserial. Three rows of scales on cheeks, preopercle flange naked. Caudal emarginate. Colour-in-alcohol—uniform light yellowish, margin of anal fin and anus black.

Distribution.—Over the whole Western Indian Ocean, the East Indies, the Philippines to the Marshall and Marianas Islands. Menon & Talwar 1972 recently recorded this species for the first time from the Nicobar Islands and the present record is first report from the main coast of India.

121. ***Abudefduf coelestinus*** (Cuvier)

1830. *Glyphisodon coelestinus* Cuvier, *Hist. nat. Poiss.* 5: 464, pl. 348.

Material.—3 exs., 43-46 mm., Calangute, P. F. Jones.

Distribution.—East coast of Africa, through India to the East Indies, the Philippines, Japan and Australia.

XLVI. Family LABRIDAE

122. *Halichoeres nigrescens* (Schneider)

1801. *Labrus nigrescens* Schneider, *Syst. Ichth.*: 263.

Material.—1 ex., 102 mm., Goa, 1938.

Distribution.—Widespread, Zanzibar, India, Ceylon through the East Indies, the Philippines to Australia.

XLVII. Family BLENNIIDAE

123. *Alticus bilineatus* (Peters)

1868. *Salarias bilineatus* Peters, *Monatsber. Akad. Wiss.*: 268.

Material.—1 ex., 50 mm. T. L., Mormugoa Bay, September 1916, S. W. Kemp Coll.

Distribution.—Ceylon, the Andamans, the Philippines to the Tuamotu Islands and Samoa. This is the first record of the species from the main coast of India.

124. *Blennius steindachneri* Day

1873. *Blennius steindachneri* Day, *Proc. zool. Soc. Lond.*: 110.

Material.—6 exs., 23-35 mm. T. L., Mormugoa Bay, September 1916, S. W. Kemp Coll.

Remarks.—The systematic status of this species is still uncertain. According to Weber & de Beaufort (1951) it is probable that this is the Indo-Australian representative of *Blennius cristatus* Linnaeus, which is known as *B. steindachneri* in the Indian Ocean and *B. tonganus* in Polynesia. Smith (1959), however, treated the species as distinct from *B. cristatus* Linnaeus.

Distribution.—East coast of South Africa and the Bay of Bengal. The present record from the west coast of India is, therefore, interesting.

XLVIII. Family SIGANIDAE

125. *Siganus javus* (Linnaeus)

1766. *Tenthis java* Linnaeus, *Syst. Nat.* (ed. 12): 507.

Material.—1 ex., 87 mm., Goa, 1938.

Distribution.—Widespread, Muscat, India, Ceylon, Malay Peninsula, the Philippines, Australia to New Hebrides and Tahiti.

126. ***Siganus oramin*** (Bloch & Schneider)

1801. *Amphacanthus guttatus* var. *oramin* Bloch & Schneider, *Syst. Ichth.*: 207.

Material.—1 ex., 84 mm., Goa, 1938, A. W. Herre Coll.; 1 ex., 88 mm., Calangute, 30.iii.66, K. S. Pradhan Coll.

Distribution.—Widespread, east coast of Africa through India, Ceylon, the East Indies, the Philippines to Australia, Fiji and Samoa.

XLIX. Family ACANTHURIDAE

127 ***Ctenochaetus strigosus*** (Bennett)

1828. *Acanthurus strigosus* Bennett, *Zool. Jour.*, 4: 41.

Material.—1 ex., 192 mm., Goa, 1938.

Distribution.—From the Red Sea and east coast of Africa to the East Indies, the Philippines, Japan, Hawaiian and Tuamotu Islands.

L. Family TRICHIURIDAE

128. ***Trichiurus lepturus*** Linnaeus

1758. *Trichiurus lepturus* Linnaeus, *Syst. Nat.* (ed. 10): 246.

Material.—1 ex., 850 mm. T L., Goa, 26.x.37; 2 exs., 353-354 mm. T L., Goa, 26.x.38; 2 exs., 34-38 mm. T L., Goa, 1938, A. W. Herre Coll.; 5 exs., 302-343 mm. T L., Calangute, 30.iii.66; 1 ex., 479 mm. T L., Goa, 27.xi.67, K. S. Pradhan Coll.; 3 exs., 445-450 mm. T L., Vasco, 25.ix.69, R. C. Sharma Coll.

Distribution.—Widespread, east coast of Africa, Red Sea, through India, Ceylon, the East Indies, the Philippines to Australia.

LI. Family SCOMBRIDAE

129. ***Rastrelliger kanagurta*** (Cuvier)

1817. *Scomber kanagurta* Cuvier, *Regne Animal.*, 2: 197.

Material.—1 ex., 148 mm., Goa, 15.xi.67, K. S. Pradhan Coll.; 1 ex., 152 mm., Colva, 9.xii.68, V. C. Agrawal Coll.; 6 exs., 99-114 mm., Banulia, 14.ix.69; 5 exs., 99-118 mm., Vasco, 25.ix.69, R. C. Sharma Coll.

Distribution.—Red Sea, through India, the East Indies to the Philippines and Fiji.

LII. Family SCOMBEROMORIDAE

130. *Scomberomorus guttatus* (Bloch)

1801. *Scomber guttatus* Bloch, *Syst. Ichth.*: 23, fig. 5.

Material.—1 ex., 188 mm., Goa, 26.x.38, A. W. Herre Coll.; 15 exs., 98-179 mm., Calangute, 30.iii.66, K. S. Pradhan Coll.

Distribution.—Widespread in the Indo-West Pacific, ranging from the Red Sea, east coast of Africa, through India, the East Indies to Japan, Australia, Melanesia and Polynesia.

LIII. Family STROMATEIDAE

131. *Pampus argenteus* (Euphrasen)

1788. *Stromateus argenteus* Euphrasen, *Kongl. Vetensk Akad. Stockholm*, 9: 49.

Material.—2 exs., 148-152 mm., Goa, 27.xi.67, K. S. Pradhan Coll.

Distribution.—India, Ceylon through the East Indies to China, Japan and the Philippines.

132. *Pampus chinensis* (Euphrasen)

1788. *Stromateus chinensis* Euphrasen, *Kongl. Vetensk. Handl. Stockholm*, 9: 53.

Material.—1 ex., 47 mm., Goa, 26.x.38, A. W. Herre Coll.; 3 exs., 53-98 mm., Calangute, 30.iii.66, K. S. Pradhan Coll.

Distribution.—India, Ceylon to Malaysia, the East Indies and China.

133. *Parastromateus niger* (Bloch)

1795. *Stromateus niger* Bloch, *Naturges. ausland. Fische*, 6: 93, pl. 422.

Material.—3 exs., 74-127 mm., Goa, 12.xi.37, A. W. Herre Coll.; 1 ex., 146 mm., Goa, 1938, Coll?; 3 exs., 35-46 mm., Calangute, 30.iii.66; 2 exs., 51-124 mm., Goa, 27.xi.67, K. S. Pradhan Coll.; 3 exs., 70-72 mm., Vasco, 25.ix.69, R. C. Sharma Coll.

Distribution.—Widespread, east coast of Africa, Persian Gulf through the East Indies to the Philippines and Japan.

LIV. Family ANABANTIDAE

134. *Anabas testudineus* (Bloch)

1795. *Anthias testudineus* Bloch, *Naturges. ausland. Fische*, 6: 121, pl. 322.

Material.—4 exs., 18-27 mm., Goa, September 1916, S. W Kemp Coll.; 2 exs., 52-90 mm., Goa, 1938, A. W Herre Coll.

Distribution.—India, Ceylon, Burma, Malay Archipelago, South China and the Philippines.

LV. Family ELEOTRIDAE

135. *Butis amboinensis* (Bleeker)

1853. *Eleotris amboinensis* Bleeker, *Nat. Tijds. Ned. Indie*, 5: 343.

1941. *Butis amboinensis*: Koumans, *Mem. Indian. Mus.* 13: 318 (Goa).

Material.—1 ex., 50 mm. T L., Mormugoa Bay, September 1916, S. W Kemp Coll.

Distribution.—India and the Indo-Australian Archipelago.

136. *Eleotris fusca* (Schneider)

1801. *Poecilia fusca* Schneider, *Syst. Ichth.*: 453.

1941. *Eleotris fusca*: Koumans, *Mem. Indian Mus.*, 13: 312 (Goa).

Material.—3 exs., 40-63 mm., Mormugoa Bay, September 1916, S. W Kemp Coll.

Distribution.—Widespread, east coast of Africa, Red Sea through India, Ceylon to the West Pacific Ocean.

LVI. Family GOBIIDAE

137 *Bathygobius fusca* (Rüppell)

1828. *Gobius fuscus* Rüppell, *Atlas Reisse N. Afr. Fische*: 137.

1941. *Bathygobius fuscus*: Koumans, *Mem. Indian Mus.*, 13: 267 (Goa).

Material.—1 ex., 130 mm., Mormugoa Bay, September 1916, S. W Kemp Coll.

Distribution.—Widespread, Red Sea, the east coast of Africa through India, the East Indies, the Philippines to the Polynesian Islands.

138. *Glossogobius giurus* (Hamilton)

1822. *Gobius giurus* Hamilton, *Fish. Ganges*: 50, 366, pl. 33, fig. 15.

1941. *Glossogobius giurus*: Koumans, *Mem. Indian Mus.*, 13: 256 (Goa).

Material.—1 ex., 121 mm., Goa, 1938, Coll. ? ; 1 ex., 58 mm., Colva, 1966, K. S. Pradhan Coll.

Distribution.—Widespread, east coast of Africa through India, Ceylon, the East Indies, the Philippines to China, Japan and New Caledonia.

139. *Mugilogobius valigouva* (Deraniyagala)

1936. *Vaimosa valigouva* Deraniyagala, *Ceylon Journ. Sci.* (B), **19**: 219, fig. 1.

1941. *Mugilogobius valigouva*: Koumans, *Mem. Indian Mus.* **13**: 271 (Goa).

Material.—1 ex., 29 mm., Mormugoa Bay, September 1916, S. W Kemp Coll.

Distribution.—Ceylon and Goa.

140. *Sicyopterus griseus* (Day)

1858. *Sicydium griseus* Day, *J. Linn. Soc. Lond.*, **13**: 140.

1941. *Sicyopterus griseus*: Koumans, *Mem. Indian Mus.*, **13**: 296 (Goa).

Material.—1 ex., 15 mm. T L., Mormugoa Bay, September 1916, S. W Kemp Coll.

Distribution.—West coast of India.

141. *Stenogobius malabaricus* (Day)

1865. *Gobius malabaricus* Day, *Proc. zool. Soc. Lond.*: 27..

1941. *Stenogobius malabaricus*: Koumans, *Mem. Indian Mus.*, **13**: 217 (Goa).

Material.—1 ex., 60 mm. T L., Mormugoa Bay, September 1916, S. W Kemp Coll.

Distribution.—Backwaters of Madras, some rivers of Malabar and Mormugoa Bay (Goa).

LVII. Family TAENIOIDIDAE

142. *Ctenotrypauchen microcephalus* (Bleeker)

1860. *Trypauchen microcephalus* Bleeker, *Act. Soc. Indo-Neerl.*, **8**: 62.

1941. *Ctenotrypauchen microcephalus*: Koumans, *Mem. Indian Mus.*, **13**: 307 (Goa).

Material.—1 ex., 97 mm. T L., Mormugoa Bay, September 1916, S. W Kemp Coll.

Distribution.—From the Persian Gulf to the Indo-Australian Archipelago.

143. *Odontamblyopus rubicundus* (Hamilton)

1822. *Gobioides rubicundus* Hamilton, *Fish. Ganges*: 37, 365, pl. 5, fig. 9.

1941. *Odontamblyopus rubicundus*: Koumans, *Mem. Indian Mus.*, **13**: 304 (Goa).

Material.—1 ex., 163 mm. T L., Goa, 1940, A. W Herre Coll.

Distribution.—India and the Indo-Australian Archipelago.

144. Trypauchen vagina (Bloch)

1801. *Gobius vagina* Bloch, *Syst. Ichth.*: 75.

1941. *Trypauchen vagina*: Koumans, *Mem. Indian Mus.*, 13: 305 (Goa).

Material.—2 exs., 86-115 mm. T L., Mormugoa Bay, September 1916, S. W Kemp Coll.

Distribution.—From the Persian Gulf to the Indo-Australian Archipelago.

LVIII. Family SCORPAENIDAE

145. Dendroscorpaena cirrhosa (Thunberg)

1793. *Perca cirrhosa* Thunberg, *Nya Handl. Ac. Stockholm*, 14: 193, pl. 7, fig. 2.

Material.—1 ex., 130 mm., Baina, 9.iv.66, K. S. Pradhan Coll.

Distribution.—Widespread, east coast of Africa, Red Sea, the Persian Gulf through India, the East Indies, the Philippines to Tahiti and Society Islands.

146. Parascorpaena aurita (Rüppell)

1838. *Scorpaena aurita* Rüppell, *Neue Wirbelt., Fische*: 106, pl. 37, fig. 2.

Material.—1 ex., 110 mm., Baina, 9.iv.66, K. S. Pradhan Coll.

Distribution.—The Red Sea, east coast of Africa, India, the East Indies and Japan.

LIX. Family SYNANCIIDAE

147 Minous monodactylus (Bloch & Schneider)

1801. *Scorpaena monodactylus* Bloch & Schneider, *Syst. Ichth.*: 194.

Material.—1 ex., 73 mm., Goa, 1938, A. W Herre Coll.

Distribution.—Seas of India, through the East Indies to China.

LX. Family PLATYCEPHALIDAE

148. Grammoplites scaber (Linnaeus)

1758. *Cottus scaber* Linnaeus, *Syst. Nat.* (ed. 10), 1: 264.

Material.—2 exs., 141-168 mm., Goa, 14.vii.35, A. W Herre Coll.

Distribution.—Seas of India to the East Indies.

Order 14. PLEURONECTIFORMES

LXI. Family BOTHIDAE

149. *Pseudorhombus arsius* (Hamilton)

1822. *Pleuronectes arsius* Hamilton, *Fish. Ganges*: 128.

Material.—1 ex., 143 mm., Goa, 1938, A. W. Herre Coll.

Distribution.—Widespread, Indo-West Pacific.

150. *Pseudorhombus javanicus* (Bleeker)

1853. *Rhombus javanicus* Bleeker, *Nat. Tijdschr. Ned. Indie*, 4: 502.

Material.—1 ex., 119 mm., Goa, 1938, A. W. Herre Coll.

Distribution.—India and the Malay Archipelago.

151. *Pseudorhombus triocellatus* (Schneider)

1801. *Pleuronectes triocellatus* Schneider, *Syst. Ichth.*: 145.

Material.—2 exs., 73-86 mm. T L., Goa, 12.xi.37, A. W. Herre Coll; 1 ex., 92 mm. T L., Banulia, 14.ix.69, R. C. Sharma Coll.

Distribution.—Seas of India to the Malay Archipelago.

LXII. Family SOLEIDAE

152. *Solea ovata* Richardson

1845. *Solea ovata* Richardson, *Rep. Brit. Assoc. Adv. Sci.*: 279.

1928. *Solea ovata*; Norman, *Rec. Indian Mus.*, 30: 176 (Goa).

Material.—5 exs., 8-57 mm., Mormugoa Bay, September 1916, S. W. Kemp Coll.

Distribution.—India through the Malay Archipelago to China and the Philippines.

153. *Zebrias synapturoides* (Jenkins),

1910. *Synaptura synapturoides* Jenkins, *Mem. Indian Mus.*, 3: 28, pl. 3, fig. 4.

Material.—1 ex., 149 mm. T L., Goa, 1938, A. W. Herre Coll.

Distribution.—Norman (1928) gives the distribution of this species as the Madras and Malabar coast. The present record extends the range of this species further north to the Goa coast.

LXIII. Family CYNOGLOSSIDAE

154. *Cynoglossus bilineatus* (Lacépède)

1802. *Achirus bilineatus* Lacépède, *Hist. nat. Poiss.*, 4: 569, 663.

Material.—2 exs., 137-335 mm. T L., Colva, 11.xi.67, K. S. Pradhan Coll.

Distribution.—From the Red Sea, through the Indian Ocean to Japan and Australia.

155. *Cynoglossus lida* (Bleeker)

1851. *Plagusia lida* Bleeker, *Nat. Tijdschr. Ned. Indie*, 1: 413.

Material.—6 exs., 73-187 mm., Colva, 11.xi.67, K. S. Pradhan Coll.

Distribution.—Indian Ocean.

156. *Cynoglossus lingua* Hamilton

1822. *Cynoglossus lingua* Hamilton, *Fish. Ganges*: 32, 365.

Material.—1 ex., 235 mm. T.L. Goa, 1938, A. W. Herre Coll.

Distribution.—Coast of India to the East Indies.

157 *Cynoglossus macrostomus* Norman

1928. *Cynoglossus macrostomus* Norman, *Rec. Indian. Mus.*, 30: 204, fig. 20.

Material.—2 exs., 136-140 mm. T L., Betul, 18.xi.67, 3 exs., 130-135 mm. T L., Goa, 27.xi.67, K. S. Pradhan Coll. 7 exs., 100-145 mm. T L., Mormugoa, 14.ix.69; 9 exs., 115-154 mm. T L., Vasco, 25.ix.69, R. C. Sharma Coll.

Distribution.—Norman (1928) gave the habitat of this species as "Portuguese India (?); Orissa; Calcutta" Menon (1970) confirmed the range of distribution of this species on the Goa coast.

158. *Cynoglossus puncticeps* (Richardson)

1845. *Plagusia puncticeps* Richardson, *Rept. Brit. Ass. Adv. Sci.*: 280.

1928. *Cynoglossus puncticeps*: Norman, *Rec. Indian. Mus.*, 30: 205 (Goa).

Material.—2 exs., 70-134 mm. T L., Mormugoa Bay, September 1916, S. W. Kemp Coll.

Distribution.—From Sind (Pakistan), through the Indian Ocean to China.

159. **Paraplagusia bilineata** (Bloch)1785. *Pleuronectes bilineatus* Bloch, *Naturges. ausland. Fische.*, 3: 29.*Material*.—2 exs., 64-107 mm. T L., Colva, 10.xi.67 ; 1 ex., 62 mm. T L., Colva, 11.xi.67, K. S. Pradhan Coll.*Distribution*.—East coast of Africa, through the Indian Ocean to China and Japan.160. **Paraplagusia blochi** (Bleeker)1851. *Plagusia blochii* Bleeker, *Nat. Tijdschr. Ned. Indie.*, 1: 411.*Material*.—1 ex., 244 mm. T L., Panjim, 29.x.69, R. C. Sharma Coll.*Distribution*.—East coast of Africa, through the Indian Ocean to Taiwan.

Order 15. TETRADONTIFORMES

Suborder 1. *BALISTOIDEI*

LXIV. Family ALUTERIDAE

161. **Monacanthus choirocephalus** Bleeker1852. *Monacanthus choirocephalus* Bleeker, *Verh. Batav. Genootsch.*, 29: 19.1955. *Paramonacanthus choirocephalus*: Munro, *Marine and Fresh-water Fishes of Ceylon*: 274.*Material*.—1 ex., 74 mm., Goa, 1938, A. W. Herre Coll.*Description*.—D. II, 29 ; A. 29 ; P. 12. Depth of body 2.3, length of head 2.6 ; both in standard length. Eye diameter 2.2 in snout and more than interorbital width. Gill opening somewhat oblique, upper end below hind border of eye, lower end below hind border of pupil. First dorsal spine below posterior half of eye, front border rough, posterior part with two rows of distinct barbs on sides. Second dorsal spine minute. Origin of anal below second dorsal. Pectoral length 2.6 in head length. Pelvic spine movable, tapering, granulated with spinules on sides and on top. Scales indistinct, skin not very rough. Caudal rounded. Colour-in-alcohol—brownish with indications of two transverse bands on caudal.*Distribution*.—De Beaufort & Briggs (1962) give the range as 'eastern coast of India, Ceylon, Thailand and Cochin China' The present record extends its range of distribution to the Arabian Sea.

LXV. Family TRIACANTHIDAE

162. *Pseudotriacanthus strigilifer* (Cantor)

1849. *Triacanthus strigilifer* Cantor, *J. Asiat. Soc. Beng.*, 18 (2): 363.

Material.—2 exs., 151-184 mm., Baina, 16.xi.67, K. S. Pradhan Coll.

Remarks.—In both the specimens the lateral line is not discernible. Munro (1955) give 'no lateral line' as a family character whereas De Beaufort & Briggs (1962) give 'lateral line conspicuous' as a generic character in this family of fishes.

Distribution.—Persian Gulf, India, Ceylon, Malay Peninsula, China and the Philippines.

163. *Triacanthus blochi* Bleeker

1852. *Triacanthus blochii* Bleeker, *Nat. Tijdschr. Ned. Indie*: 81.

1962. *Triacanthus blochi*: Briggs & de Beaufort, *Fishes Indo-Australian Archipelago*, 11: 271, fig. 72.

Material.—1 ex., 153 mm., Vasco, 25.ix.69, R. C. Sharma Coll.

Description.—D₁ V, D₂ 20; A. 1.15; P 1.11; V.I. Height of body 2.5, length of head 3.0; both in standard length. Eye oval, 2.3 in snout length, 3.4 in head length. Interorbital width almost equal to eye diameter; interorbital space concave. Upper profile of head snout slightly concave. Distance between end of first dorsal and beginning of second dorsal about equal to eye diameter. Base of anal 1.7 in second dorsal. Pectorals rounded, as long as distance between eye and origin of first dorsal. Ventral spine shorter than first dorsal spine. Pelvics between ventral spines narrow, tapering to a point posteriorly. Caudal forked. Caudal peduncle tapering to base of caudal, its length 4.7 in standard length. Colour in alcohol—light brownish above, silvery on sides and below. Fins yellowish.

Distribution.—This is the first record of this species from Indian waters; previously reported only from the East Indies (*vide* Beaufort & Briggs, 1962).

Suborder 2. TETRADONTOIDEI

LXVI. Family TETRAODONTIDAE

164. *Sphoeroides honckeni* (Bloch)

1785. *Tetrodon honckenii* Bloch, *Naturges. ausland. Fische*, 1: 133.

1962. *Sphoeroides honckeni*; de Beaufort & Briggs, *Fishes Indo-Australian Archipelago*, **11**: 386.

Material.—1 ex., 74 mm., Goa, 1938.

Description.—D. 2. 10 ; A. 2. 7, P. 1. 14. Length of head 2.8, 3.7 in total length. Eye diameter 2.2 in snout length, 3.2 in interorbital width, superiorly without free orbital rim. Nostrils paired, on a short papilla. Upper lateral line running from eye along upper sides to upper half of base of caudal. Lower lateral line inconspicuous except on caudal peduncle where it runs along a feeble skin fold. Prickles on occiput, anterior part of back and upper part of sides not reaching dorsal ; underside with prickles, except chin and caudal. Origin of anal below posterior rays of dorsal. Pectorals rounded, 2.0 in head length. Caudal truncate. Colour-in-alcohol—brownish above with many large and smaller oval white spots, creamy below ; the two colours rather sharply separated. Dorsal, anal and pectorals yellowish.

Distribution.—De Beaufort & Briggs (1962) give the distribution as the Cape of Good Hope to Natal, Zanzibar, Madagascar, Mauritius, Tranquebar (?) and China. This is the first definite record from the Indian coast.

165. *Sphoeroides lunaris* (Bloch)

1801. *Tetrodon lunaris* Bloch, *Syst. Ichth.*: 505.

Material.—3 exs., 82-92 mm., Goa, September 1916, S. W. Kemp Coll. ; 1 ex., 54 mm., Goa, 1938.

Distribution.—Widespread, east coast of Africa, Red Sea, through India, Ceylon, the East Indies, the Philippines to Solomon and Fiji Islands.

166. *Sphoeroides spadiceus* (Richardson)

1844. *Tetrodon spadiceus* Richardson, *Fishes Voy. Sulphur*: 123.

Material.—1 ex., 450 mm., Goa, 25.iv.35, A. W. Herre Coll. ; 24 exs., 104-135 mm., Baina, 15/16.xi.67 ; 3 exs., 112-126 mm., Goa, 27.xi.67, K. S. Pradhan Coll. ; 5 exs., 108-140 mm., Vasco, 25.vi.69, R. C. Sharma Coll.

Distribution.—East coast of Africa, Red Sea, India, the East Indies, the Philippines, China, Japan and Australia.

167. *Chelonodon patoca* (Hamilton)

1822. *Tetrodon patoca* Hamilton, *Fish. Ganges*: 7, 363, pl. 16, fig. 2.

Material.—12 exs., 51-61 mm., Calangute, 30.iii.66, K. S. Pradhan Coll. ; 1 ex., 140 mm., Vasco, 25.ix.69, R. C. Sharma Coll.

Distribution.—Widespread, east coast of Africa, through India, Ceylon, the East Indies, the Philippines to Northern Australia and Admiralty Islands.

Order 16. BATRACHOIDIFORMES

LXVII. Family BATRACHOIDIDAE

168. *Austrobatrachus dussumieri* (Valenciennes)

1857. *Batrachus dussumieri* Valenciennes, *Hist. nat. Poiss.*, **12**: 474.

Material.—2 exs., 131-135 mm., Goa, 28.x.38, A. W. Herre Coll.

Distribution.—Seas and estuaries of India to Malay Archipelago.

SUMMARY

This study on the shore fish fauna of Goa is based on the collections of Dr. S. W. Kemp, Dr. A. W. Herre, Mr. P. F. Jones, material donated by the Karnatak College, Dharwar (Mysore) and on recent surveys (1966-69) undertaken by several parties of the Zoological Survey of India, Calcutta. In all 168 species of fish are listed belonging to 109 genera and 67 families. Descriptive notes of the new distributional records are given with a view to recording intra-specific variations.

REFERENCES

- CHANDY, M. 1953. A key for the identification of the catfishes of the genus *Tachysurus* Lacépède, with a catalogue of the specimens in the collection of the Indian Museum (Zool. Surv.). *Rec. Indian Mus.*, **51**: 1-18.
- CUVIER, G. and A. VALENCIENNES. 1828. *Histoire naturelle des Poissons*, Paris, **2**: 311-312.
- CUVIER, G. and A. VALENCIENNES. 1830. *Histoire naturelle des Poissons*, **5**: 106-107.
- DE BEAUFORT, L. F. and BRIGGS, J. C. 1962. In Weber and de Beaufort, *The Fishes of the Indo-Australian Archipelago*. Leiden, **11**: 276-326.
- FOWLER, H. W. 1931. Contributions to the biology of the Philippine Archipelago and adjacent regions. *Bull. U.S. nat. Mus.*, (100) **11**: 277-280.
- GÜNTHER, A. 1860. *Catalogue of the Acanthopterygian fishes in the collection of the British Museum*, **2**: 243-244.
- HERRE, A. W. 1953. *Check List of Philippine Fishes*. Research Report 20. U.S. Govt. Printing Office: 424-425.

- HAIG, J. 1950. Studies on the classification of the catfishes of the oriental and Palearctic family Siluridae. *Rec. Indian Mus.*, **48**: 59-116.
- JONES, S. and P. M. G. MENON. 1952. Observation on the life history, bionomics and fishery of the Gangetic anchovy, *Setipinna phasa* (Hamilton). *J. zool. Soc. India*, **3**(2): 323-333.
- KOUMANS, F. P. 1941. Gobioid fishes of India. *Mem. Indian Mus.*, **13**(3): 205-329.
- MENON, A. G. K. 1970. Specific Identity of the Malabar Sole. *J. mar. biol. Ass. India*, **11**: 311-315.
- MENON, A. G. K. and P. K. TALWAR. 1972. Fishes of the Great Nicobar Expedition, 1966 with description of a new gobioid fish of the family Kraemeriidae. *Rec. zool. Surv. India*, **66** (1-4) [1968]: 35-61.
- MENON, M. A. S. 1956. On a third collection of fish from Iraq. *Rec. Indian Mus.*, **54**: 134-157.
- MISRA, K. S. 1959. An aid to the identification of the common commercial fishes of India and Pakistan. *Rec. Indian Mus.*, **13**: 305-329.
- MUNRO, I. S. R. 1955. *The marine and freshwater fishes of Ceylon. Canberra*, 349 pp.
- MURTHY, V. S. 1969. Catalogue of fishes (excluding from the Laccadavies) in the Reference Collection of the Central Marine Fisheries Research Institute. Bull. No. 10, 36 pp. (Mimeo).
- NORMAN, J. R. 1928. The flatfishes (Heterosomata) of India, with a list of the specimens in the Indian Museum. Part 2. *Rec. Indian Mus.*, **30**: 173-193.
- PILLAY, S. R. 1962. A revision of Indian Mugilidae. Part II. *J. Bombay nat. Hist. Soc.*, **59** (2): 545-576.
- SMITH, J. L. B. 1959. Fishes of the families Blenniidae and Salariae of the Western Indian Ocean. *Ichthyol. Bull. Rhodes University*, (14): 229-252.
- TALWAR, P. K. 1970. Taxonomic status and identity of *Corvina albida* Cuvier, 1830 (Pisces: Sciaenidae). *Proc. Indian Acad. Sci.*, **23**: 191-193.
- TANDON, K. K., P. K. MENON and M. L. SAREEN. 1967. On the marine fauna of Goa: a preliminary survey. Part 2. Fishes. *Res. Bull. (N.S.) Panjab University*, **18**: 321-324.
- WEBER, M. and L. F. DE BEAUFORT. 1936. *The Fishes of the Indo-Australian Archipelago. Leiden*, **7**: 328-329.
- WEBER, M. and L. F. DE BEAUFORT. 1951. *The Fishes of the Indo-Australian Archipelago. Leiden*, **9**: 345-346.
- WHITEHEAD, P. J. P. 1967a. Indian Ocean Anchovies collected by the Anton Brunn and Tellaga, 1963-64. *J. mar. biol. Ass. India*, **9** (1): 13-37.
- WHITEHEAD, P. J. P. 1967b. The clupeoid fishes of Malaya. *J. mar. biol. Ass. India*, **9** (2): 223-79.
- WILLIAMS, F. 1958. The barracudas (genus *Sphyræna*) in British East African Waters. *Ann. Mag. nat. Hist.*, (13) 2 (14), 92-128.

FAUNA OF RAJASTHAN (INDIA):
CRUSTACEA—OSTRACODA

By

MAYA DEB

Zoological Survey of India, Calcutta

(With 13 Text-figures)

INTRODUCTION

The present paper deals with the ostracod crustaceans collected from several localities in Rajasthan by various parties from the Zoological Survey of India during the course of faunistic survey of the Rajasthan desert 1957-1963. The material is rich, not only in number of individuals, but also in the number of genera and species.

In spite of the preponderance of ostracods in the Indian waters, their systematics have received surprisingly little attention in India. The records are patchy, both from the geographical point of view as well as from the time lag between one record and the other. Among the earliest account of Indian ostracods is that of Baird (1859) who recorded four species from Nagpur of which two were new. Other important references are those of Gurney (1906 and 1907), Klie (1927), Arora (1931) and Brehm (1950).

So far seventeen species belonging to ten genera of ostracods have been reported from scattered localities in Maharashtra and Madhya Pradesh, Uttar Pradesh, Bengal, Bihar, Orissa, Assam, Punjab and Simla Hills. There have so far been no records of ostracods from Rajasthan, although this arid tract, abounding in temporary rainwater ponds and tanks, is fairly rich in this group. As a result of the present study twenty species belonging to eight genera have been found to occur in Rajasthan, and seventeen of these are new records for India. Total number of species occurring in India thus becomes 34.

The species reported here were collected mostly from temporary rain-water puddles, ponds and tanks which remain full with water only in rainy season and part or whole of winter. In summer all these dry up, to be filled once again during the following rainy season.

Most of the specimens of ostracods were collected from the benthic habitat in the bottom of the ponds, or from among the aquatic weeds the underside of whose leaves forms an important habitat for the ostracods.

Most of the species reported in this paper also occur in Africa and the South East Asian waters. The Indian examples are, however, somewhat smaller in size than the African ones.

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LIST OF SPECIES OF OSTRACODA FROM RAJASTHAN
DEALT WITH IN THIS PAPER

Class	CRUSTACEA
Subclass	OSTRACODA
Order	PODOCOPA
Family	CYPRIDAE
Subfamily	1. ILYOCYPRINAE

1. *Ilyocypris biplicata* (Koch)
2. *Physocypris armata* (G. W Müller)
3. *Physocypris crenulata* (Sars)

Subfamily 2. CYPRINAE

4. *Cyprinotus megalops* (Sars)
5. *C. ovatus* (Sars)
6. *C. makua* Tressler
7. *C. giesbrechtii* G. W Müller
8. *C. salinus* (Brady)
9. *C. gunningi* (Methuen)
10. *C. incongruens* (Ramdohr)
11. *C. aureus* Sars
12. *Cypris subglobosa* Sowerby
13. *Cypricercus mollis* Furtos
14. *Stenocypris malcolmsoni* (Brady)
15. *S. derupta* Vavra
16. *S. fasciculata* Daday
17. *S. fulleborni* Daday
18. *S. spinosa* Tressler

19. *Cypretta turgida* (Sars)20. *Cypridopsis newtoni* Brady & Robertson

KEY TO GENERA AND SPECIES OF OSTRACODA

Subfamily 1. *ILYOCYPRINAE*

Swimming setae of 2nd antenna extended much beyond the tips of terminal claws. Masticatory process of maxilla short and thick. Tip of 2nd leg with 3 setae, 2 short and one reflexed. Dorsal seta of furca on 2/3 of its length.

1.(a) Shell quadrangular	...	<i>Ilyocypris</i> <i>I. biplicata</i> (only one species)	
(b) Shell oblong, oval	...	<i>Physocypris</i>	... 2
2.(a) Left valve bigger than the right	...	<i>P. armata</i>	
(b) Left valve smaller than the right	...	<i>P. crenulata</i>	

Subfamily 2. *CYPRINAE*

Swimming setae of 2nd antenna do not extend much beyond the tips of terminal claws. Masticatory process of maxilla long and narrow. Tip of 2nd leg with a beak like claw and 1 long seta. Furca with 2 claws and 2 setae or reduced into a flagellum.

1.(a) Shell tumid, margin of one valve tuberculated	...	<i>Cyprinotus</i>	... 2
(b) Shell tumid; margin of valve entire	...	<i>Cypris</i> <i>C. subglobosa</i> (only one species)	
2.(a) Left valve of shell tuberculated	...		... 3
(b) Right valve of shell tuberculated	...		... 4
3.(a) Tip of 2nd leg with a short, thick, curved claw	...	<i>C. magalops</i>	
(b) Tip of 2nd leg with a long, thin, claw		<i>C. ovatus</i>	
4.(a) 3rd maxillary process dentate	...		... 5
(b) 3rd maxillary process entire	...		... 6
5.(a) Both ends of shell acute in dorsal view		<i>C. makua</i>	
(b) Both ends of shell obtuse in dorsal view	...		... 7
6.(a) Furca stout and curved in the middle		<i>C. giesbrechtii</i>	
(b) Furca narrow and curved proximally		<i>C. salinus</i>	
7.(a) Anterior end of shell in dorsal view narrow and straight	...		... 8

- (b) Anterior end of shell in dorsal view
narrow and curved like a beak ... *C. aureus*
- 8.(a) Branchial plate of maxilliped 5-6
rayed ... *C. gunnigi*
(b) Branchial plate of maxilliped 2 rayed ... *C. incongruens*
- 1.(a) Shell moderately tumid; furca long,
narrow, symmetrical, with 2 claws
and 2 setae ... *Cypricercus*
C. mollis
(only one species)
- (b) Shell compressed, oblong; furca
broad, asymmetrical, with 2 claw and
1 seta, dorsal seta absent. ... *Stenocypris* ... 2
- 2.(a) Margin of valves with a broad band
of pore canals ... 3
(b) Margin of valves without a broad
band of pore canals ... 4
- 3(a) Posterior end of shell rounded in side
view ... *S. malcolmsoni*
(b) Posterior end of the shell conical ... *S. derupta*
- 4.(a) Fine hairs on dorsal edge of furca
are not in groups ... 5
(b) Fine hairs on dorsal edge of furca
are in groups ... *S. fasciculata*
- 5.(a) Serrations of the furcal claw in
single succession ... *S. fulleborni*
(b) Serrations of the furcal claw in two
successions ... *S. spinosa*
- 1.(a) Shell tumid, anterior margin of each
valve with a row of radiating septa;
furca reduced to some extent ... *Cypretta*
C. turgida
(only one species)
- (b) Shell tumid; furca reduced to a
whip like flagellum ... *Cypridopsis*
C. newtoni
(only one species)

SYSTEMATIC ACCOUNT

1 *Ilyocypris biplicata* (Koch)

1838. *Cypris biplicata* Koch, *Deutschland Crusteen*, 21, pl. 16.

1928. *Ilyocypris biplicata*: Sars, *Crustacea of Norway*, 9: 106.

Material.—3 vials, (i) 25 exs. ♂♂ & ♀♀, ditch adjacent to main Lake Gudha, 6.xi.58. (ii) 2 exs., Sta. 13, ditch near Rly. Line, Nawa, 28.ix.58, (Nagaur District); all S. Biswas Coll.

(iii) 3 exs., Sta. 13, Ramgarh, Biprasar Tank (Jaisalmer Dist.), 4.i.58 ; K. K. Tiwari & S. Biswas Coll.

Length : 0.7 mm.—1 mm. Width : 0.28 mm.—0.37 mm. Height : 0.39 mm.—0.50 mm. ♂ ♀.

Description.—Shell in lateral view roughly rectangular, anterior half broader than posterior half in dorsal view anterior end pointed, posterior end rounded, two folds present on the side wall. Valve margin beset with hairs and denticles. Furcal ramus strongly curved.

Distribution.—India : Rajasthan (First record) as above ; elsewhere : Europe, Algeria, N. America.

Remarks.—Two folds on the side wall of the carapace, are well marked. Males are common. Specimens are slightly smaller in size than Sars' (1928) specimens from Norway. Opaque white in colour.

2. *Physocypria armata* (Müller)

1897. *Cypria armata* Müller, *Abh. Senckenb. naturforsch. Ges.*, **21** : 261.

Material.—6 exs., Sta. 1, Devdani tank, near Sambhar Lake, (Jaipur Dist.) 2.x.1963 ; K. K. Mahajan Coll.

Length : 0.5 mm.—0.53 mm. Width : 0.3 mm.—0.32 mm. Height : 0.25 mm.—0.35 mm. ♀♀.

Description.—Shell compressed, in profile anterior end more narrowly rounded than the posterior end. In dorsal view it is oblong, surface of shell finely hairy. Swimming setae of 2nd antenna more than twice as long as the last segment. Furca stout with two stout claws and two setae. Dorsal seta on the middle of the dorsal edge of ramus and twice as long as the ventral one.

Distribution.—India : Rajasthan (First Record) ; elsewhere : Madagascar and Natal.

Remarks.—Present specimens are slightly smaller in size and somewhat different in shape, but are otherwise quite identical with Müller's specimens. Brown in colour.

3. *Physocypria crenulata* (Sars)

1903. *Cypria crenulata* Sars, *Arch. Math. Naturv.*, **25** : 32.

Material.—25 exs. Sta. 1. Devdani Tank near Sambhar Lake (Jaipur Dist.) ; 2.x.63 ; K. K. Mahajan Coll.

Length : 0.55 mm.—0.62 mm. Width : 0.3 mm.—0.35 mm. Height : 0.35 mm.—0.40 mm. ♀♀.

Description.—Shell compressed, surface finely hairy. In side view anterior half of the shell narrower than the posterior. Oblong in dorsal view. Right valve slightly bigger in size, margin tuberculate. Furca as in the previous species.

Distribution.—India : Rajasthan (First record) ; elsewhere : Paraguay, Sumatra.

Remarks.—Male not known. Specimens brown in colour. Right valve overlaps the left. Right valve margin is finely tuberculate. Shape of the shell is slightly different from that of the previous species.

Genus *Cyprinotus* Brady

Brady (1885) described the genus *Cyprinotus* from Ceylon for the first time. Sars (1903) while describing *Cyprinotus* from Sumatra created a new genus *Hemicypris* to accommodate two species viz. *C. megalops* and *C. ovatus*, in which the left valve of the shell is smaller and with tuberculate margin. Müller (1912) however, did not consider this to be a character of generic importance, and synonymised *Hemicypris* with *Cyprinotus*.

4. *Cyprinotus megalops* (Sars)

(Text-fig. 1, A-I)

1903. *Hemicypris megalops* Sars, *Arch. Math. naturv.*, 25(8): 27.

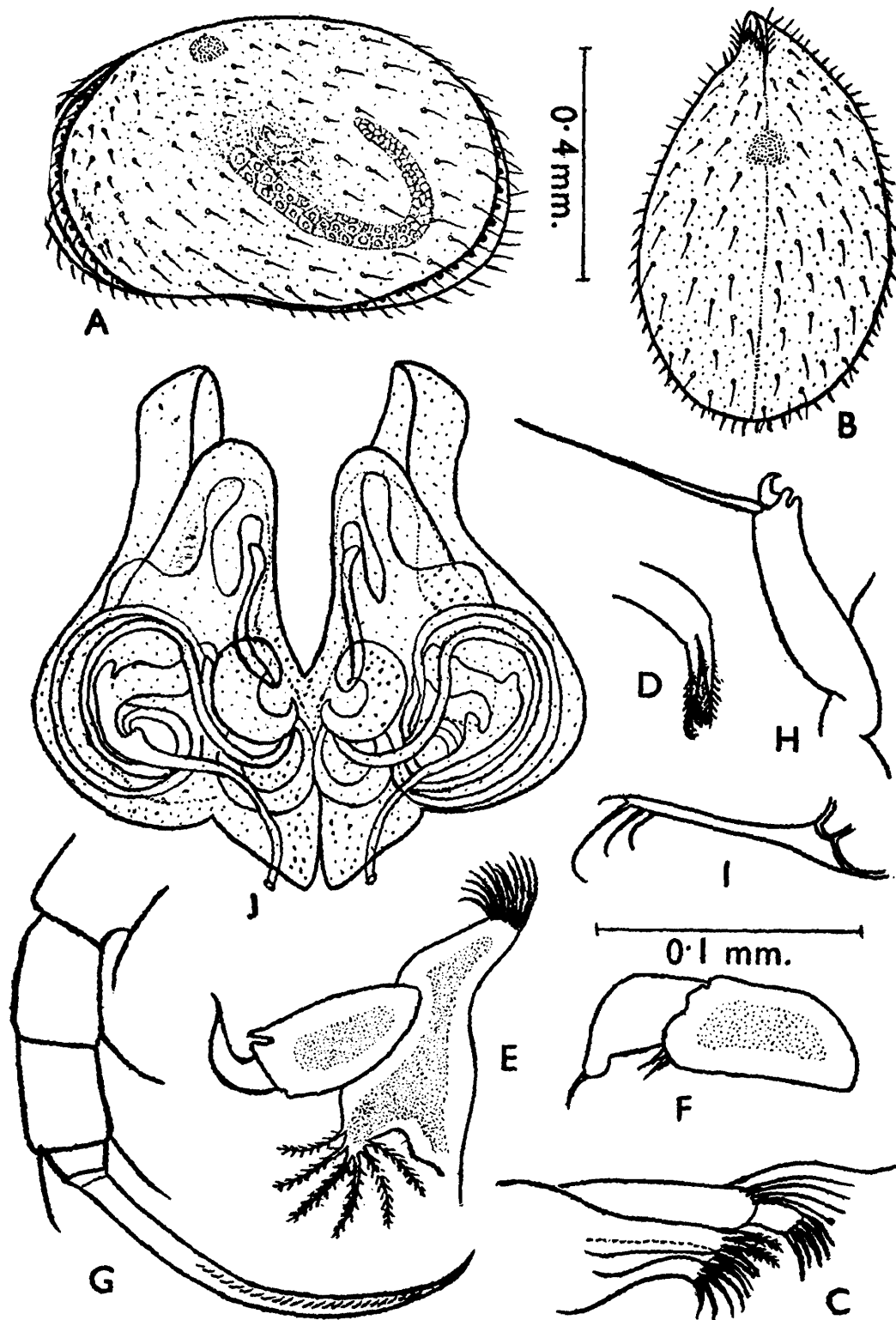
1912. *Cyprinotus megalops*: Müller, *Das Tierreich*, 31: 167.

Material.—9 vials, (i-vi) 6 vials, 10-500 exs., ditches by the side of Railway Line, Gudha, 4.x.58, (vii) 25 exs., ditches near Lake Gudha, 13.x.58, (viii) 6 exs., cemented tank in front of Kyar office, Gudha, 13.x.58 ; all from Nagaur Dist., (ix) 10 exs., Ratan Talao, 2 miles S. W of Japog (Jaipur Dist.) 22.ix.58 ; all S. Biswas Coll.

Length : 0.85 mm.—1.25 mm. Width : 0.44 mm.—0.50 mm. Height : 0.56 mm.—0.75 mm. ♂ ♀.

Description.—Shell of female tumid. Under high magnification valves made up of pentagonal tiles and each tile with a central pore canal with a hair. Left valve smaller with margin tuberculate. Third maxillary process with two dentate setae (Text-fig. 1, C & D). Maxilliped with a distinct branchial plate.

Some male shell slightly smaller than the female, shell surface finely hairy. In dorsal view left valve smaller, margin tuberculate, anteriorly compressed, beak like.



Text-fig. 1. *Cyprinotus megalops* (Sars.), (A). Shell, side view; (B). Same, dorsal view; (C). Maxillary process; (A—C). Same scale; (D). 3rd maxillary process; (E). Maxilliped with clasper; (F). Left clasper; (G). 1st leg; (H). 2nd leg; (I). Furca; (J). Copulatory appendage of ♂; (D—J). Same scale.

Maxillary palp prominent. Terminal segment of 2nd leg with a small curved hook and a long seta.

Distribution.—India : Rajasthan (First Record) ; elsewhere : Sumatra.

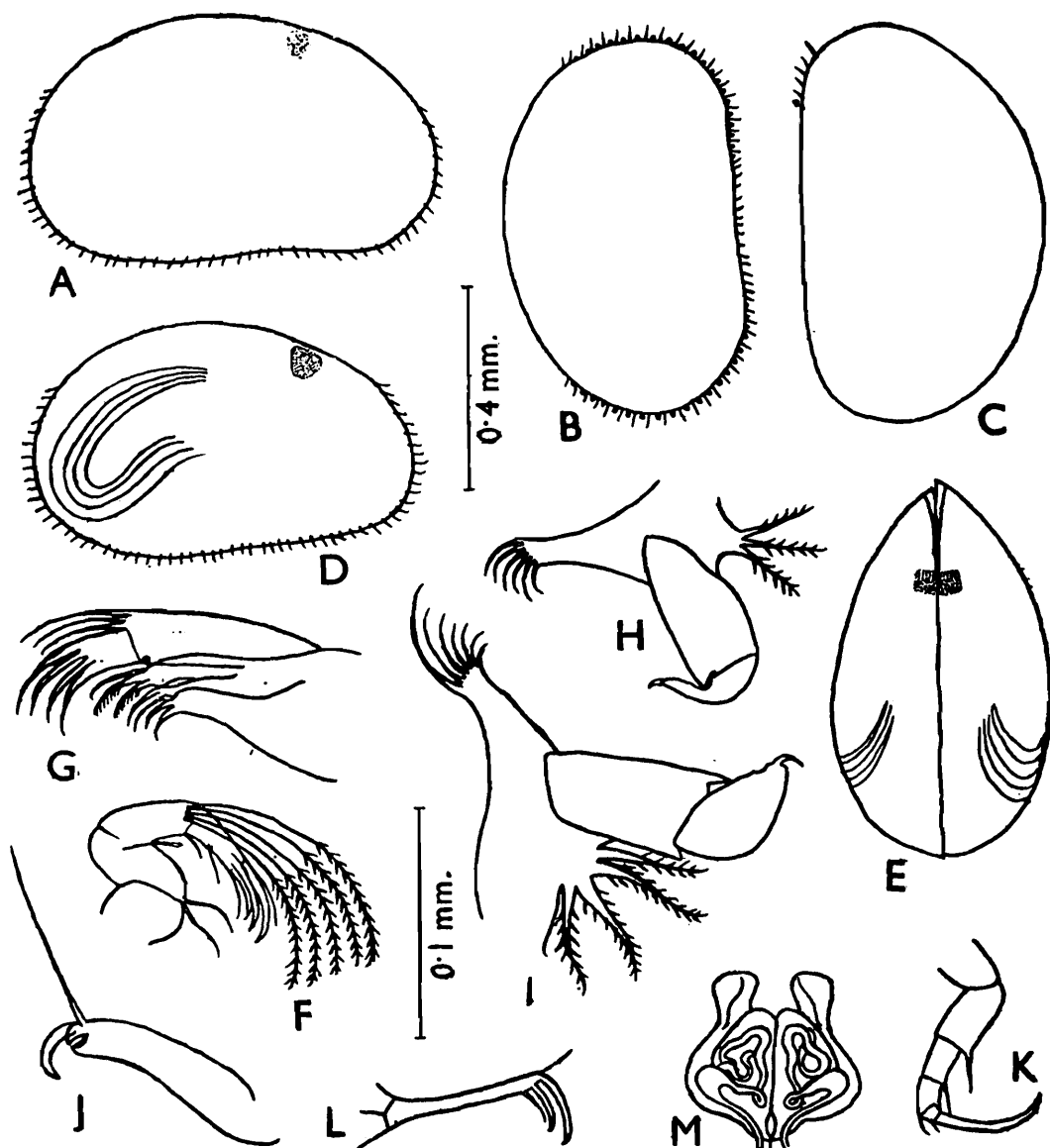
Remarks.—Males of this species are recorded for the first time. Left valve of *C. megalops* small and margin tuberculate.

5. *Cyprinotus ovatus* (Sars)

(Text-fig. 2, A-M)

1903. *Hemicypris ovatus* Sars, *Arch. Math. naturv.*, 25(8): 26.

1912. *Cyprinotus ovatus*: Müller, *Das Tierreich*, 31: 167.



Text-fig. 2. *Cyprinotus ovatus* (Sars), (A). Shell, side view; (B) Left (C) Right valve; (D). Same of ♂ side view; (E). same ♂ dorsal view; (F). 2nd antenna; (A—F). Same Scale; (G). ♂ dorsal view; (F). 2nd antenna; (A—F). Same Scale; (G). Maxilla; (H) & (I). Right and left Maxilliped with clasper; (J) 2nd leg; (G—J). Same scale; (K). 1st leg; (L). Furca; (M). Copulatory appendage of ♂; (K—M). Same scale.

Material.—125 exs., water pool near railway line, Gudha (Nagaur Dist.) ; 2.x.58 ; S. Biswas Coll.

Length : 0.77 mm.—1 mm. Width : 0.45 mm.—0.50 mm. Height : 0.49 mm.—0.62 mm. ♂ ♂

Length : 0.84 mm.—1 mm. Width : 0.49 mm.—0.50 mm. Height : 0.5 mm.—0.62 mm. ♀♀.

Description.—Shell oblong, surface hairy. In profile anterior end more narrowly rounded than the posterior. Left valve smaller than the right, with margin tuberculate. Swimming setae of 2nd antenna (Text-fig. 2, F) much longer than the terminal claws. Third maxillary process dentate. Maxilliped with 3-5 rayed branchial plate.

Males slightly smaller than females, palp of maxilla prominent.

Distribution.—India : Rajasthan (First Record) ; elsewhere : Sumatra.

Remarks.—*C. ovatus* differs from the *C. megalops* in following respects (i) hook-like claw of the 2nd abdominal leg is more prominent in the former, (ii) shape and size of the right and left clasper and copulatory appendage are also different. When seen under high magnification shell sculpture appears to be composed of pentagonal tiles as in *C. megalops*.

6. *Cyprinotus makua* Tressler

(Text-fig. 3, A-M)

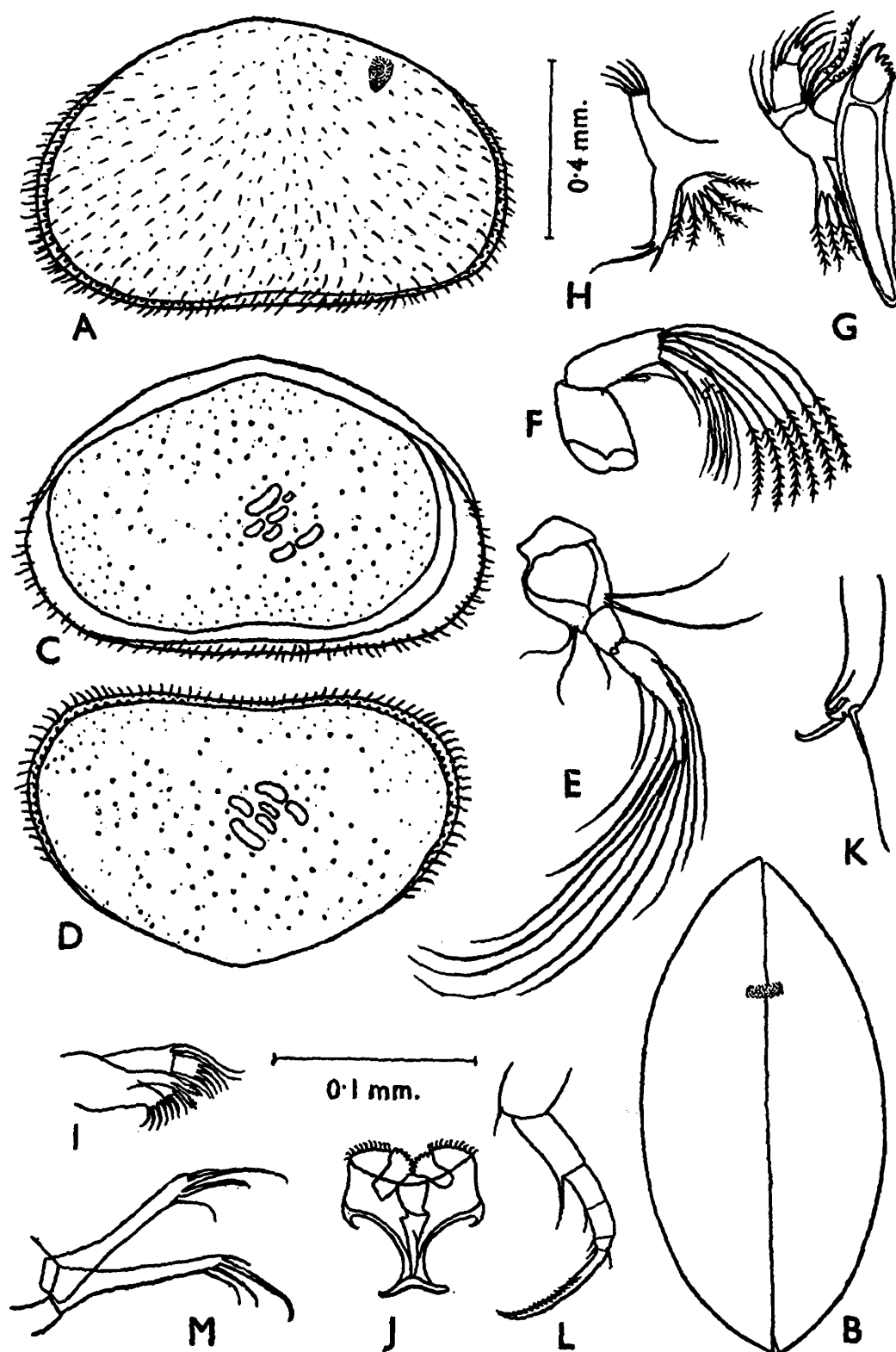
1937. *Cyprinotus makua* Tressler, *Inter. Revue. Ges. Hydrobiol. Hydrogr.*, 34 : 192.

Material.—2 vials (i) 500 exs., Sta. 7 rain-water in a cemented tank, 15.x.58. (ii) 30 exs. Sta. 7, cemented water tank, Gudha Kyar 4.x.58 : (Nagaur Dist.) : all S. Biswas Coll.

Length : 1.13 mm.—1.25 mm. Width : 0.56 mm.—0.62 mm. Height : 0.68 mm.—0.87 mm. ♀♀.

Description.—Shell oblong in dorsal view (Text-fig. 3 B) both the ends pointed. Right valve slightly smaller, margin tuberculate, oval in profile (Text-fig. 3, A) Valves very thin, delicate transparent with scattered pore canals and hairs. Swimming setae of 2nd antenna longer than the terminal claws (Text-fig. 3 F). Third maxillary process with dentate setae.

Distribution.—India : Rajasthan, (First record) ; elsewhere : Island of Oahu, Hawaii.



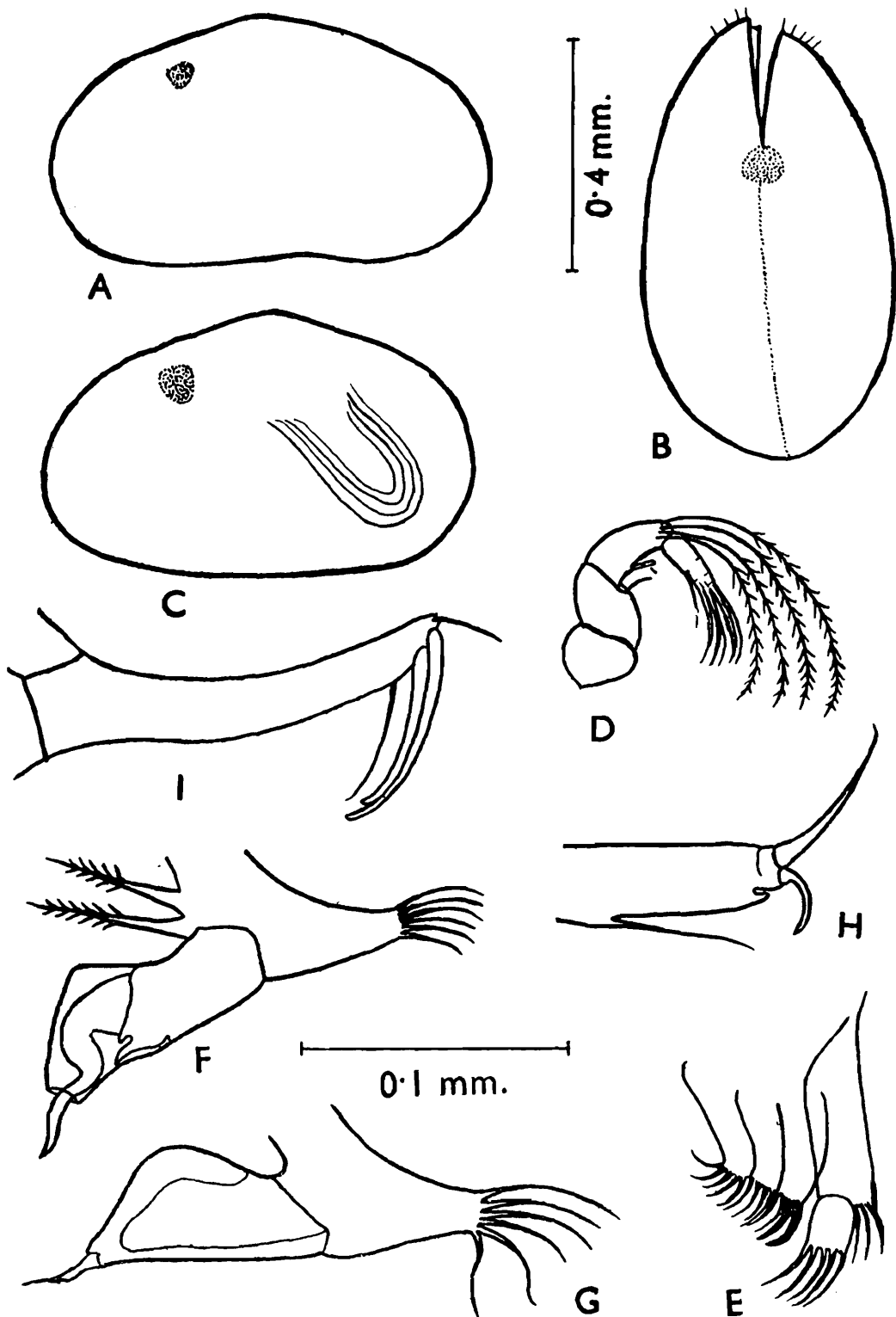
Text-fig. 3. *Cyprinotus makua* Tressler, (A). Shell, side view; (B). Same, dorsal view; (C) & (D). Left and right valve; (A—D). Same scale; (E). 1st antenna; (F). 2nd antenna; (G). Mandible; (H). Maxilliped; (I). Maxilla; (J) Lower lip, (E—J). Same scale; (K). 2nd leg; (L). 1st leg; (M). Furca, (K—M). Same scale.

Remarks.—Present specimens are slightly smaller than the Hawaiian specimens. Valves are very thin, delicate and transparent.

7 *Cyprinotus giesbrechtii* Müller

(Text-fig. 4, A-I)

1898. *Cyprinotus giesbrechtii* Müller, *Abh. Senckahb. naturforsch. Ges.*, 21 : 277.



Text-fig. 4. *Cyprinotus giesbrechtii* Müller, (A). Shell, side view; (B). Same dorsal view; (C). Same ♂, side view; (A—C). Same scale; (D). 2nd antenna; (E). Maxilla; (F & G). Left & right Maxilliped; (H). 2nd leg; (I). Furca; (D—I). Same scale.

Material.—8 ♂♂, 15 ♀♀ & 4 ♂♂ 25 ♀♀ in 2 vials, Sta. 13. Kuchaman Road (Nagaur Dist.) ; 5.ix.58 ; S. Biswas Coll.

Length : 0.79 mm.—1.20 mm. Width : 0.4 mm.—0.62 mm. Height : 0.42 mm.—0.68 mm. ♂♂

Length : 0.82 mm.—1.2 mm. Width : 0.41 mm.—0.62 mm. Height : 0.44 mm.—0.68 mm. ♀♀.

Description.—Shell oblong, both ends rounded in side view. Right valve smaller and margin tuberculate. Third maxillary process with two thick setae (Text-fig. 4 E). Furca (Text-fig. 4, I) broad and bent with two claws and two setae.

Distribution.—India : Rajasthan (First record) ; elsewhere : Aldabra (Madagascar).

Remarks.—Most of the specimens seems to be very young. In males formation of claspers and copulatory appendages are not yet completed. In young specimens furca are bent and broad, in adult they are straight and rather narrow.

8. *Cyprinotus salinus* (Brady)

(Text-fig. 5, A-H)

1868. *Cypris salina* Brady, *Trans. Linn. Soc.*, 26 : 368.

1891. *Cyprinotus salina* : Sars. *Forh. norske med. Selk.*, 1890, Nr. 1 ; 56.

1900. *Cyprinotus salinus* : Müller, *Zoologica*, 30 : 76.

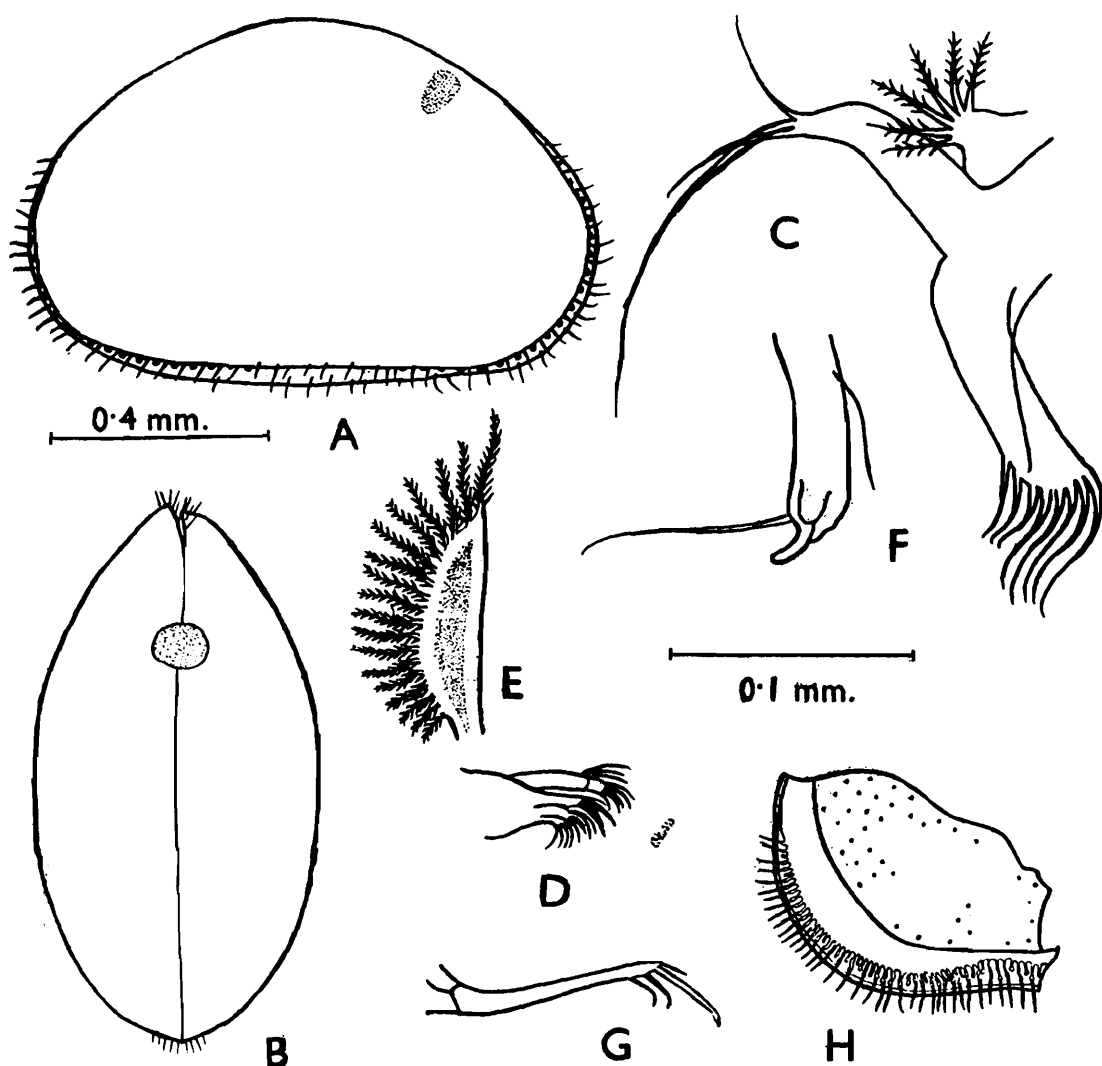
Material.—3 vials, (i) 4 exs. Sta. 7 Stagnant water in a cement tank, Gudha, 1.x.58 ; (ii) 20 exs. Sta. 7, pumping enclosure, Gudha Kyar, 11.x.58, (iii) 15 exs., Sta. 13, rain-water pool near Nawa Kyar., 28.ix.58 ; (Nagaur Dist.) ; all S. Biswas Coll.

Length : 1.19 mm.—1.25 mm. Width : 0.59 mm.—0.62 mm. Height : 0.75 mm.—0.87 mm. ♀♀.

Description.—Shell tumid. In side view both the end broadly rounded, dorsal margin strongly curved. Seen dorsally, shell oval, right valve smaller, margin tuberculate. Pore canals of valve margin distinct and give passage to a hair (Text-fig. 5, H). Third maxillary process with two thick setae but not dentate.

Distribution.—India : Rajasthan (First record) ; elsewhere : Brackish waters of Europe.

Remarks.—In dorsal view shell oblong, anterior and posterior end not acutely pointed. Shape of the shell is different



Text-fig. 5. *Cyprinotus salinus* (Brady), (A). Shell, side view; (B). Same, dorsal view; (A—B). Same scale; (C). Maxilliped; (D). Maxilla; (E). Branchial plate of Maxilla; (F). 2nd leg; (G). Furca; (H). A portion of valve; (C—H). Same scale.

from the other species of the genus. This is a common species occurring in brackish water of Europe. In Rajasthan also all its records are from the Sambhar Lake or confluent areas, where water is brackish during early part of the rainy season, but becomes highly saline later on in dry season, when most of the organisms disappear.

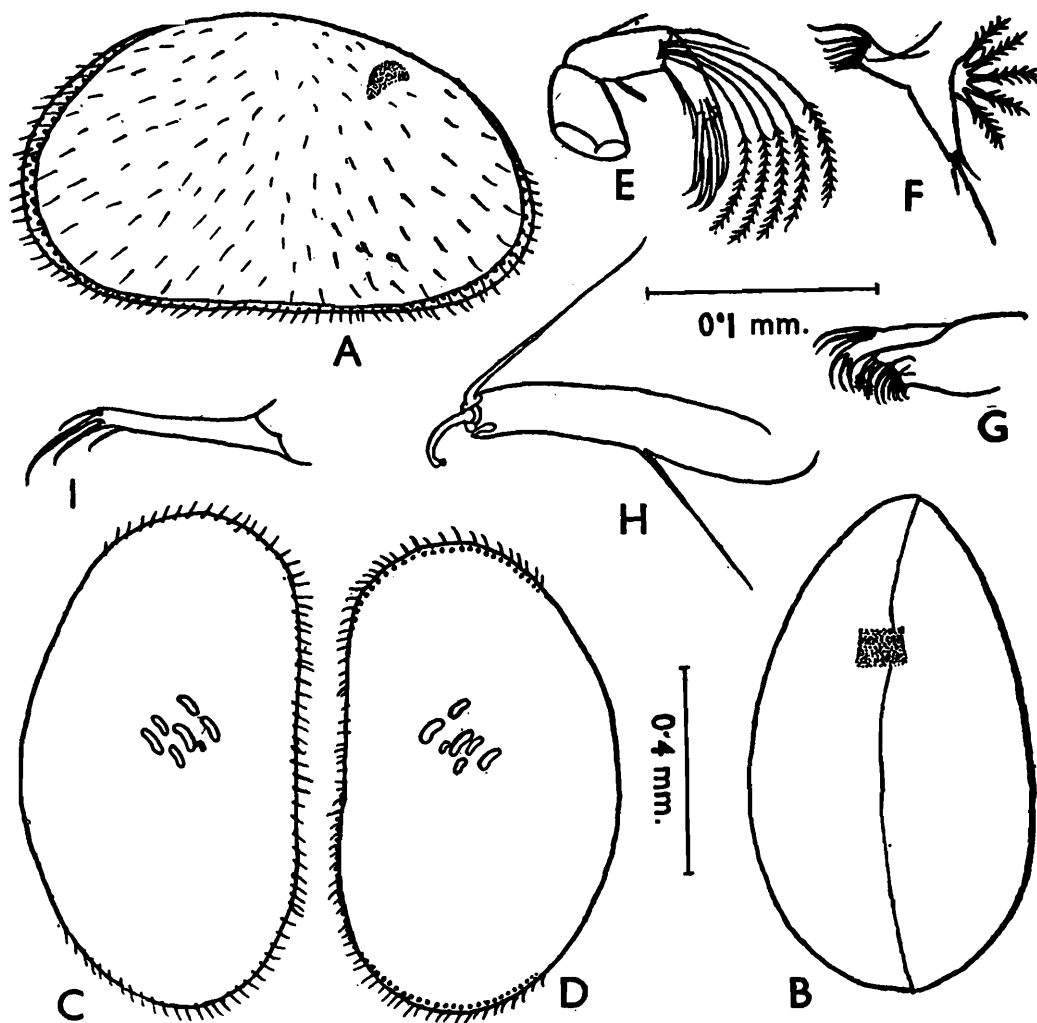
9. *Cyprinotus gunningi* (Methuen)

(Text-fig. 6, A-I)

1910. *Cypris gunningi* Methuen, *Proc. zool. Soc.*, 1 : 153.

Material.—2 vials, (i) 10 exs. Sta. 13. Nawa, in an area separated from Main Lake by Kyar bund. 26.ix.58. (ii) 25 exs.,

Sta. 13, ditch near railway line, 29.ix.58; (Nagaur Dist.);
S. Biswas Coll.



Text-fig. 6. *Cyprinotus gunningi* (Methuen), (A). Shell, side view; (B). Same, dorsal view; (C & D). Left & right valve; (E). 2nd antenna; (F). Maxilliped; (G). Maxilla; (A—G). Same scale; (H). 2nd leg; (I). Furca; (H & J). Same scale.

Length: 1.1 mm.—1.37 mm. Width: 0.6 mm.—0.75 mm.
Height: 0.6 mm.—0.87 mm. ♂ ♀.

Description.—Shell tumid. In lateral view (Text-fig. 6, A) oblong oval in shape, anterior end narrowly rounded. Right valve smaller with margin tuberculate. In dorsal view (Text-fig. 6, B) anterior end narrowly rounded, posterior end quite broad. Shell thin, surface hairy. Swimming setae of 2nd antenna longer than the terminal claws. Third maxillary process with two dentate setae. Furca stout and straight with two claws and two setae.

Distribution.—India: Rajasthan (First Record): elsewhere: Transvaal.

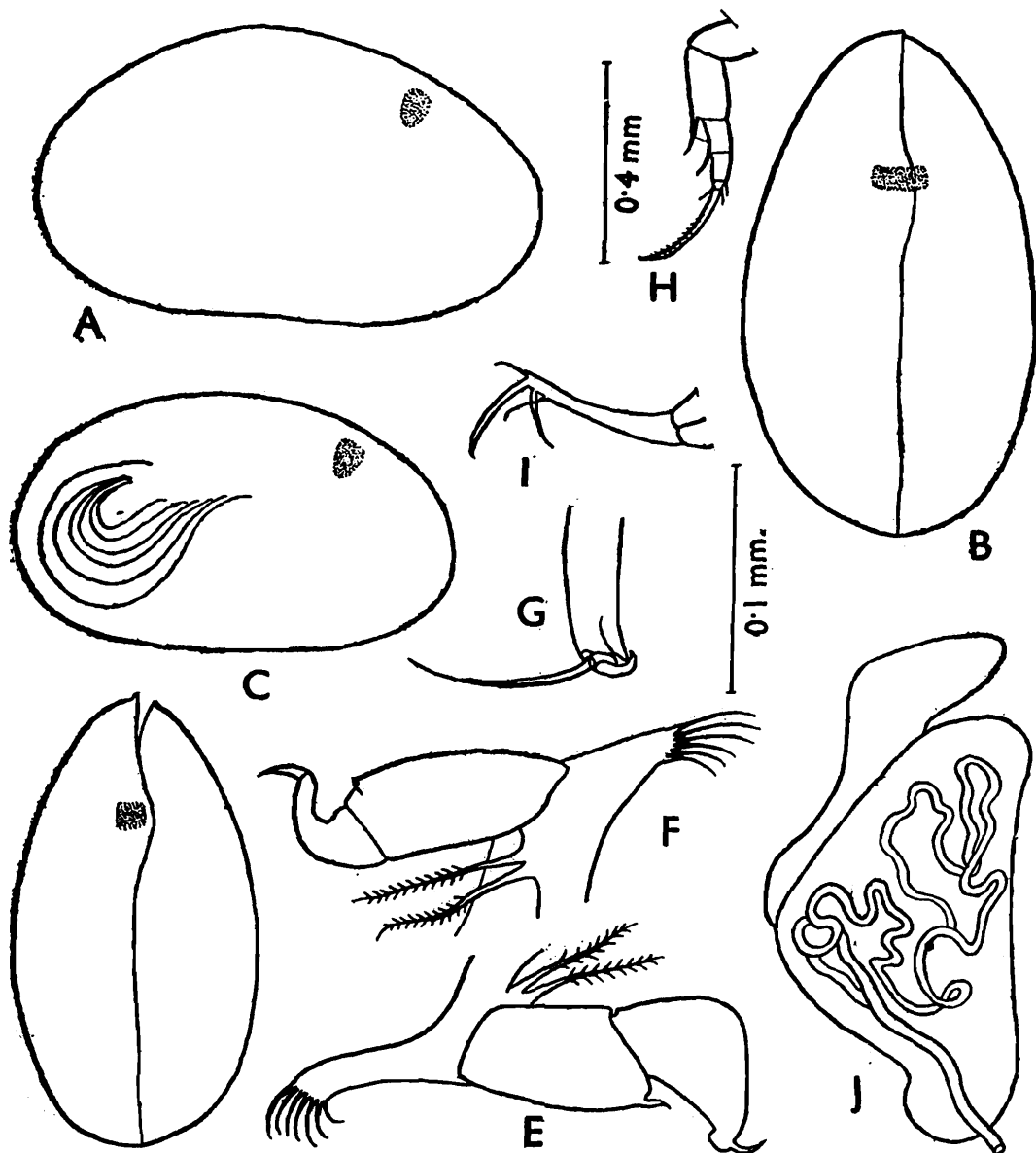
Remarks.—Some males are slightly smaller than the females; present specimens are slightly smaller in size than those from Transvaal. Shape and structure of the copulatory appendage in case of male are, however, quite identical in African and Indian specimens.

10. *Cyprinotus incongruens* (Ramdohr)

(Text-fig. 7, A-J)

1808. *Cypris incongruens* Ramdohr, *Mag. Ges. Fr.*, 21, 86.

1821. *Cypris fusca* Straus, *Mem. Mus. Paris*, 7: 59.



Text-fig. 7. *Cypris incongruens* (Ramdohr), (A). Shell, side view; (B). Same, dorsal view; (C) & (D). Same ♂, side view; (E) (A-D). Same scale; (F). Right Maxilliped; (G). 2nd leg, (H). 1st leg; (I). Furca, (E-I). Same scale.

1903. *Eucypris incongruens*: Daday, *Zool. Jb. Syst.*, **19**: 81.

Material.—45 exs., Sta. 13. Kuchaman Road, Nagaur Dist., 5.ix.58 ; S. Biswas Coll.

Length : 1.05 mm.—1.25 mm. Width : 0.6 mm.—0.68 mm.
Height : 0.62 mm.—0.72 mm. ♂ ♂

Length : 0.93 mm.—2.15 mm. Width : 0.5 mm.—0.80 mm.
Height : 0.54 mm.—1.25 mm. ♀♀.

Description.—Shell oblong in dorsal view. Right valve slightly smaller and margin tuberculate. Males slightly smaller in size. Right and left claspers of maxilliped in male dissimilar (Text-fig. 7, E & F).

Distribution.—India : Rajasthan (First Record) ; Elsewhere : Central Asia, Europe, N. America, Brazil, N. & S. Africa.

11. *Cyprinotus aureus* (Sars)

(Text-fig. 8, A-K)

1895. *Cypris aureus* Sars, *Skr. Videnskelsk.*, (8): 34.

1896. *Cyprinotus aureus*: Sars, *Arch. Math. Naturv.*, **19**(1): 25.

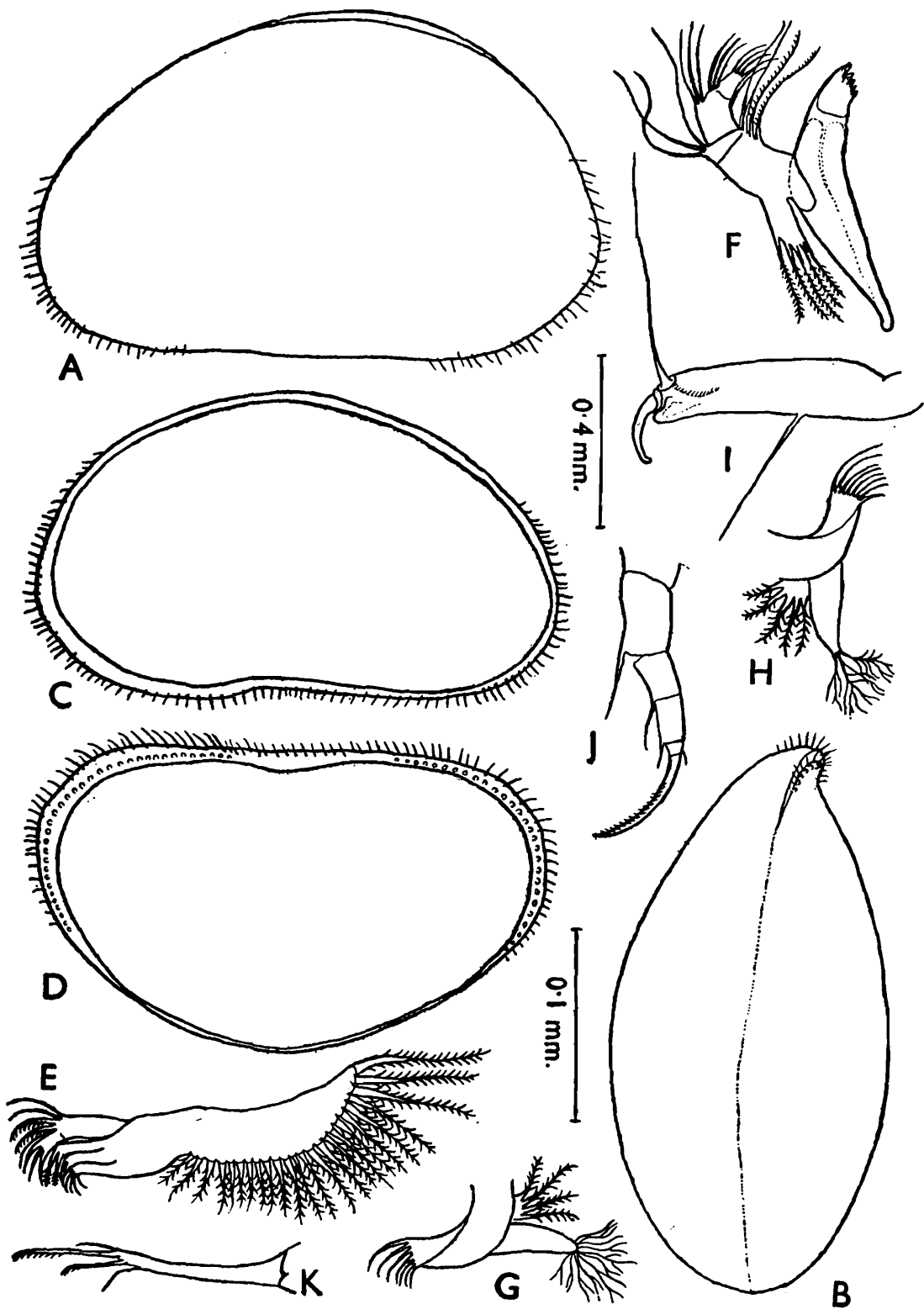
Material.—3 vials, (i) & (ii) 10. & 6 exs. from a ditch near railway station, Gudha, 1957, 8.xi.58. (iii) 10 exs. freshwater ditch at Gudha, (Nagaur Dist.) ; S. Biswas Coll.

Length : 1.40 mm.—1.68 mm. Width : 0.7 mm.—0.75 mm.
Height : 0.9 mm.—1 mm. ♀♀.

Description.—Shell tumid. Anterior half of the shell narrower than the posterior half in side view. Right valve smaller and margin tuberculate. In dorsal view posterior end broadly rounded, anterior end beak like, narrow. (Text-fig. 8, B) and curved towards the right side.

Distribution.—India : Rajasthan (First Record) ; elsewhere : Africa.

Remarks.—Shell is opaque white in colour, and roughly semi-circular in side view. Shape of the shell different from that in other species of the genus. Unlike the other species the palp of maxilliped has a bunch of fine hairs on its head.



Text-fig. 8. *Cyprinotus aureus* Sars, (A). Shell, side view; (B). Same, dorsal view; (C & D). Left & right valve; (A—D). Same scale; (E). Maxilla; (F). Mandible; (G & H). Maxillipeds; (I). 2nd leg; (J). 1st leg; (K) Furca; (E—K). Same scale.

12. *Cypris subglobosa* Sowerby

1840. *Cypris subglobosa* Sowerby: Malcolmson: *Tr. geol. Soc. Lond.* Ser. 2, 5: 47.
 1859. *Cypris subglobosa*: Baird, *Proc. zool. Soc.*, 27: 232.
 1885. *Chlamydotheca subglobosa*: Brady, *J. Linn. Soc. Zool.*, 19: 300.
 1906. *Eurycypris subglobosa*: Vavra, *Zool. Zb. Syst.*, 23: 420.

Material.—4 vials contains 8-40 exs. of ♀♀; (i) Sta. Narayana, Canal water of Dhobola Talao, 29.x.58, (ii) Narayana Talao, 2.xi.58. (iii) Sta. Dudu Talao, $\frac{1}{2}$ mile S. of Rest House (Jaipur Dist.) (iv) Bala Talao ca. 3 miles S. E. of Julga Lake (Jaipur dist.) 24.xi.58; all S. Biswas Coll.

Length: 1.75 mm.—1.87 mm. Width: 1.4 mm.—1.47 mm. Height: 1.2 mm.—1.28 mm. ♀♀.

Description.—Shell sculptured uniformly with blunt, teethlike projections. In dorsal view anterior end narrower than posterior. Valves dissimilar, right valve with a lamellar flap anteriorly, posterior end narrow. Valve margin hairy.

Distribution.—India: Rajasthan (First Record) as above; Nagpur; elsewhere: Ceylon, Java, Europe and America.

Remarks.—Males of this species are not known so far. The shell is ivory white to greenish in colour. The author considers *C. granulata* Daday (1898) from Ceylon as conspecific with the present species. Müller (1912) also doubted the correctness of the identity of *granulata* and treated it as a doubtful species.

13. *Cypricercus mollis* Furtos

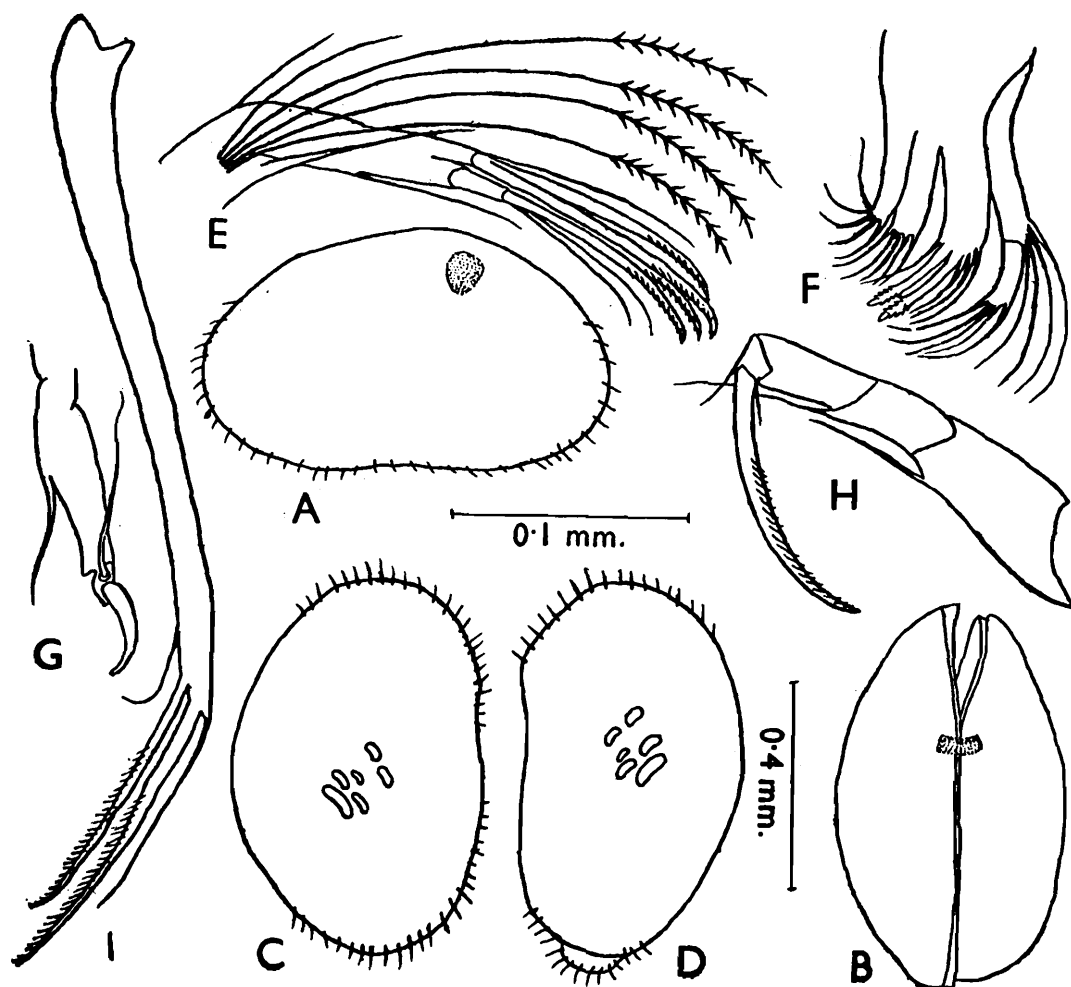
(Text-fig. 9, A-I)

1936. *Cypricercus mollis* Furtos, *Amer. Midl. Nat.*, 17: 491.

Material.—25 exs. in a vial; Sta. 6, around the University compound (Jaipur Dist.); 26.ix.63; K. K. Mahajan Coll.

Length: 0.75 mm.—1 mm. Width: 0.45 mm.—0.62 mm. Height: 0.44 mm.—0.60 mm. ♀♀.

Description.—Shell oblong (Text-fig. 9, A), surface smooth, sparsely hairy. In dorsal view right valve smaller and overlapped by the left, its greatest width in the middle. Valve margins entire, with broad marginal fringes. An extra flap or posterior flange attached to the posterior margin of the right valve. Swimming setae of the 2nd antenna, extended up to the tips of terminal claws. Terminal segment of the maxillary palp longer than broad, 3rd maxillary process with two dentate processes.



Text-fig. 9. *Cypricercus mollis* Furtos, (A). Shell, side view; (B). Same dorsal view; (C & D). Left & right valve, (A--D). Same scale; (E). 2nd antenna; (F). Maxilla; (G). 2nd leg; (H). 1st leg; (I). Furca; (E--I). Same scale.

(Text-fig. 9, F). Furca long and narrow (Text-fig. 9, I) and weakly 'S' shaped, with two claws and 2 setae (Text-fig. 9, F).

Distribution.—India: Rajasthan (First Record); elsewhere: N. America.

Remarks.—Females of this species were unknown so far. They are being reported for the first time. Present specimens are slightly bigger in size than the males described by Furtos (1936). There are slight difference in the shape of carapace also when seen in profile. In other respect present material agrees with Furtos' description.

14. *Stenocypris malcolmsoni* (Brady)

1859. *Cypris cylindrica*, var. *major* Baird, *Proc. zool. Soc.*, **27**: 233.

1886. *Cypris malcolmsoni* Brady, *J. Linn. Soc. Zool.*, **19**: 297.

1890. *Stenocypris malcolmsoni*: Sars, *For. Med. Selsk.*, (8); 28.

Material.—3 vials; (i) 10 exs., Sta. Narayana, canal water of Dhobole Talao. 29.x.58, (ii) 5 exs., Sta. 7, temporary rain-water in a cemented tank 15.x.58 (Jaipur Dist.). *S. Biswas* Coll. (iii) 2 exs., Gadisar, eastern side of Dak Bunglow (Jaisalmer Dist.); 28.xii.57; *K. K. Tiwari* and *S. Biswas* Coll.

Length: 1.7 mm.—1.88 mm. Width: 0.54 mm.—0.62 mm. Height: 0.74 mm.—0.87 mm. ♀♀.

Description.—Shell compressed, oblong both the ends rounded, in side view. A broad band of pore canals present throughout the margin except on dorsal side, each pore canal allowing passage to one hair. Scattered pores present on the surface of the valves. Furcal ramii dissimilar, ventral seta of furca as long as the ventral claw.

Distribution.—India: Rajasthan (First Record); Simla, Gharwal, Mirzapur; elsewhere: Ceylon, Australia, Sumatra, Celebes, & E. Africa.

15. *Stenocypris derupta* Vavra

(Text-fig. 10, A-L)

1906. *Stenocypris derupta* Vavra, *Zool. Jb. Syst.*, 23: 426.

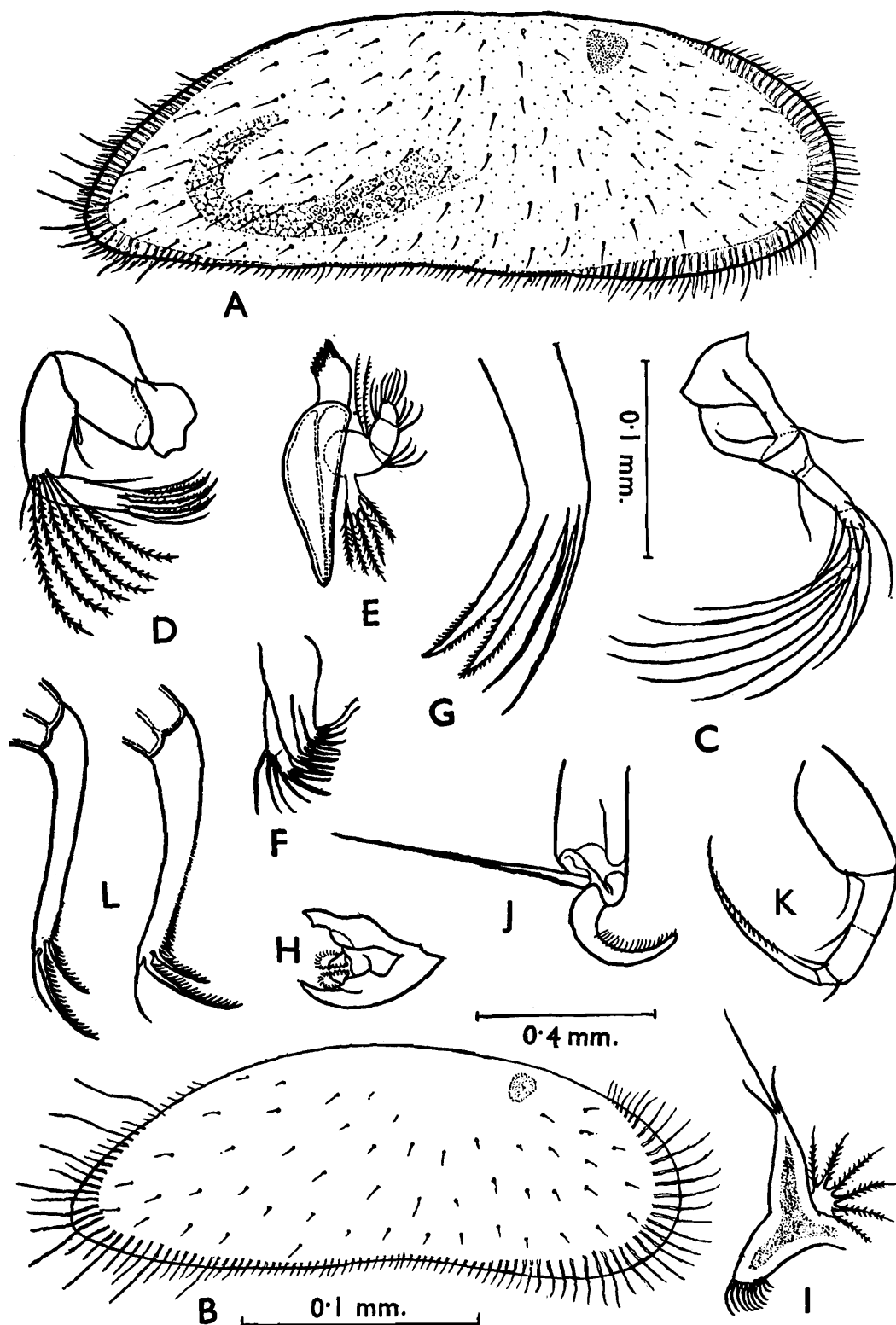
Material.—2 exs., Sta. Narayana, canal water of Dhobla Talao (Jaipur Dist.); 29.x.58; *S. Biswas* Coll.

Length: 2.37 mm.—2.50 mm. Width: 0.62 mm.—0.68 mm. Height: 1 mm.—1.12 mm. ♀♀.

Description.—Shell oblong, anterior end broadly rounded, posterior end rounded narrowly in side view. Broad band of pore canal present on the valve margin. Furcal ramii stout and dissimilar (Text-fig. 10 K).

Distribution.—India: Rajasthan (First Record); elsewhere: Western Java.

Remarks.—Unlike Vavra's (1906) specimens, stumpy angular projection on the ocular region of shell is not so prominent in the present specimens and seta of the 3rd maxillary process is not smooth but dentate. The specimens are light brown in colour.



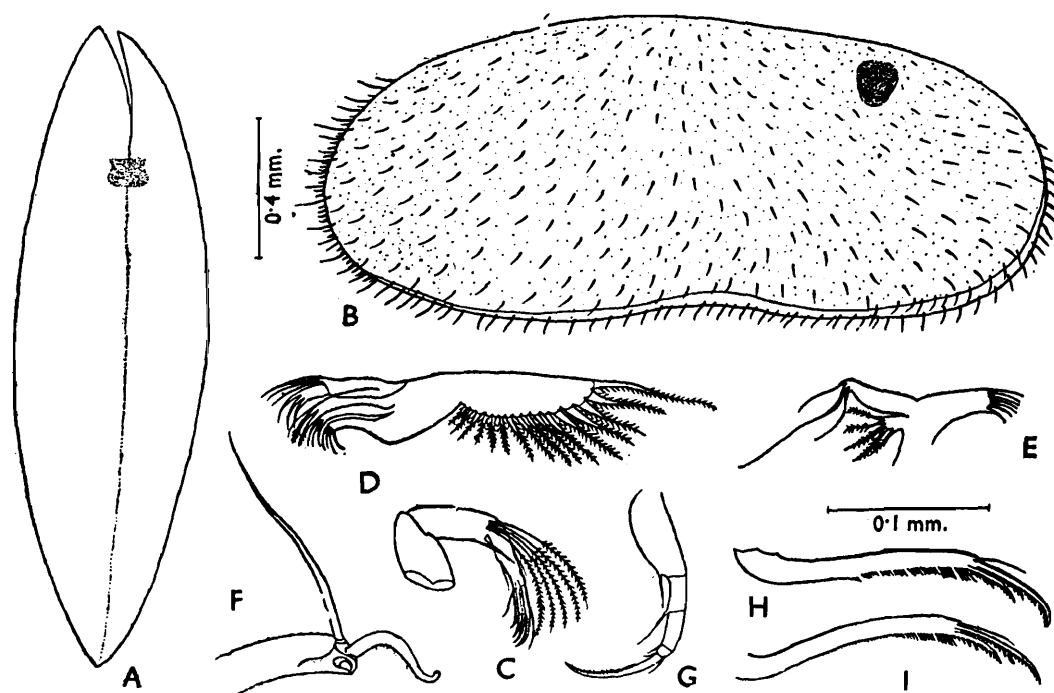
Text-fig. 10. *Stenocypris derupta* Vavra, (A). Shell, side view of young; (B). Same, adult side view; (C). 1st antenna; (D). 2nd antenna; (E). Mandible; (F). Maxilla, (A, C, D, E, F). Same scale; (G). 3rd Maxillary process; (H). Lips; (I). Maxilliped; (J). 2nd leg; (K). 1st leg; (L). Furcal ramii; (G—L). Same scale.

16. *Stenocypris fasciculata* Daday

(Text-fig. 11, A-I)

1910-11. *Stenocypris fasciculata* Daday, *Zoologica*, 23: 190.

Material.—3 vials. (i) 15 exs., Sta. Dudu Talao, $\frac{1}{2}$ mile south of Rest House, 8.i.59, (ii) 30 exs., Bala Talao, ca. 3 miles S. E. of Julga Lake, 4.ii.58 both from Jaipur dist., all S. Biswas Coll., (iii) 20 exs., Tank in village Agolai (Jodhpur Dist.), 2.xii.63., K. N. Nair and R. N. Mukherjee Coll.



Text-fig. 11. *Stenocypris fasciculata* Daday, (A). Shell, dorsal view; (B). Same side view; (A & B). Same scale; (C). 2nd antenna; (D). Maxilla; (E). Maxilliped; (F). 2nd leg; (G). 1st leg; (H) & (I). Furcal ramii; (C—I). Same scale.

Length : 2.1 mm.—2.50 mm. Width : 0.55 mm.—0.62 mm. Height : 0.9 mm.—1 mm. ♀♀.

Description.—Shell oblong in side view, both ends broadly rounded, valve margin hairy; scattered pores and hairs present throughout the whole surface (Text-fig. 11, B). Right valve slightly smaller. Furcal ramii (Text-fig. 11, H, I) dissimilar, hairs in groups on the dorsal edge of the ramus.

Distribution.—India : Rajasthan (First Record); elsewhere : E. Africa.

Remarks.—Swimming setae of the 2nd antenna not extended beyond the tips of terminal claws. The specimens are greyish to greenish in colour.

17 *Stenocypris fulleborni* Daday

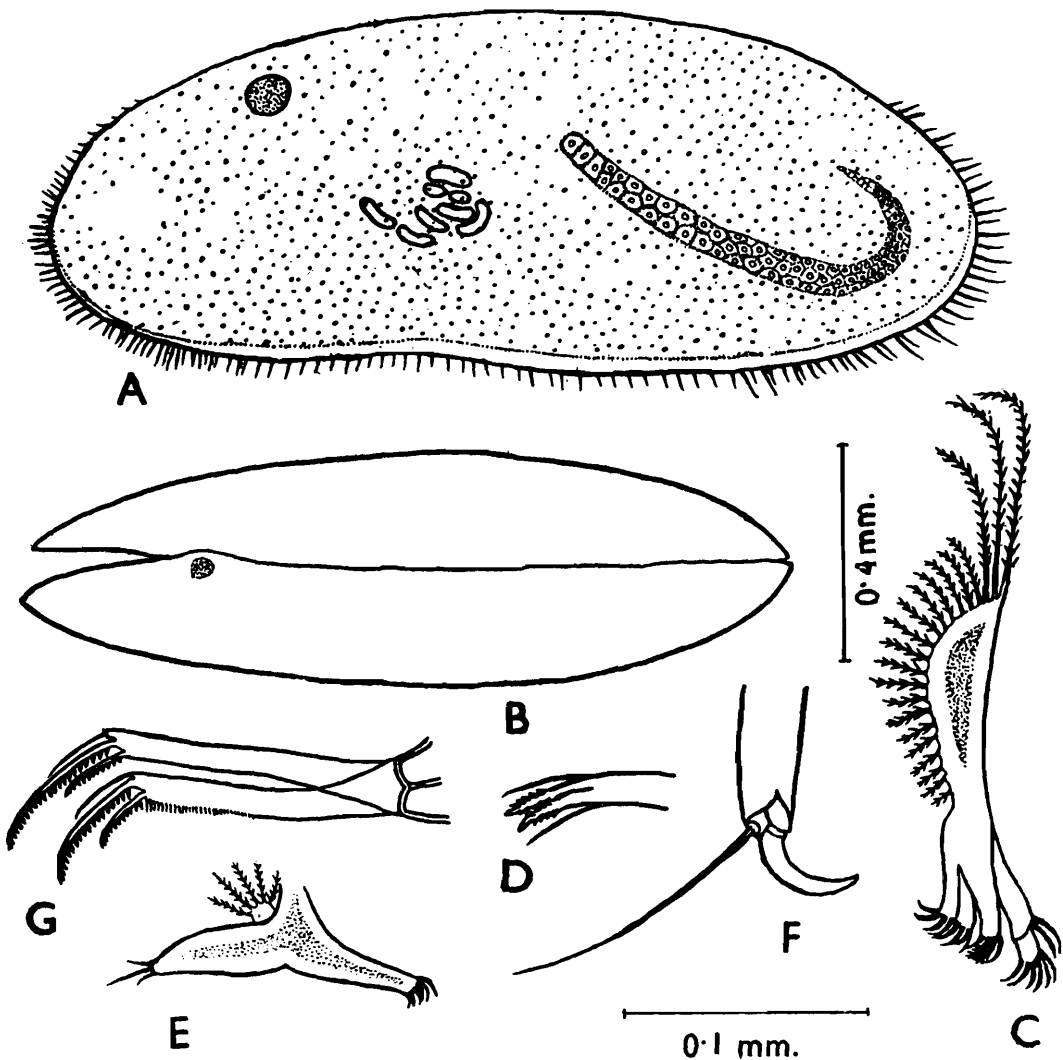
(Text-fig. 12, A-G)

1910-11. *Stenocypris fulleborni* Daday, *Zoologica*, 23: 59.

Length : 1.7 mm.—2 mm. Width : 0.46 mm.—0.50 mm.

Height : 0.73 mm.—0.87 mm. ♀♀.

Material.—Lot (A & B) consists of 8 vials. (i) 10 exs., Sta. 7, pool near Kyar bund, Gudha, (ii) 3 exs., a ditch near railway station, Gudha, (iii) 8 exs., ditch in Gudha, (iv) 2 exs., Sta. 13. rainwater pool near Nawa Kyar, (v) 9 exs., Sta. 6. Main Lake Gudha (Nagaur Dist.), S. Biswas Coll., 1957-1958. Lot. B. (vi) 10 exs., Sta. Narayana, ditches at Barbaryan, (vii) 6 exs., Chapparwara Bund Reservoir, 30.ix.58, S. Biswas Coll. (viii) 25 exs., Devdani Tank, K. K. Mahajan Coll. 2.x.63 (Jaipur Dist.).



Text-fig. 12. *Stenocypris fulleborni* Daday, (A). Shell, side view; (B). Same, dorsal view; (A—B). Same scale; (C). Maxilla; (D). 3rd maxillary process; (E). Maxilliped; (F). 2nd leg; (G). Furca; (C—G). Same scale.

Description.—Shell oblong, both ends broadly rounded in side view. Right valve slightly smaller than the left. Furcal ramii (Text-fig. 12, G) stout and dissimilar, one straight and the other bent, with fine hairs on dorsal edge.

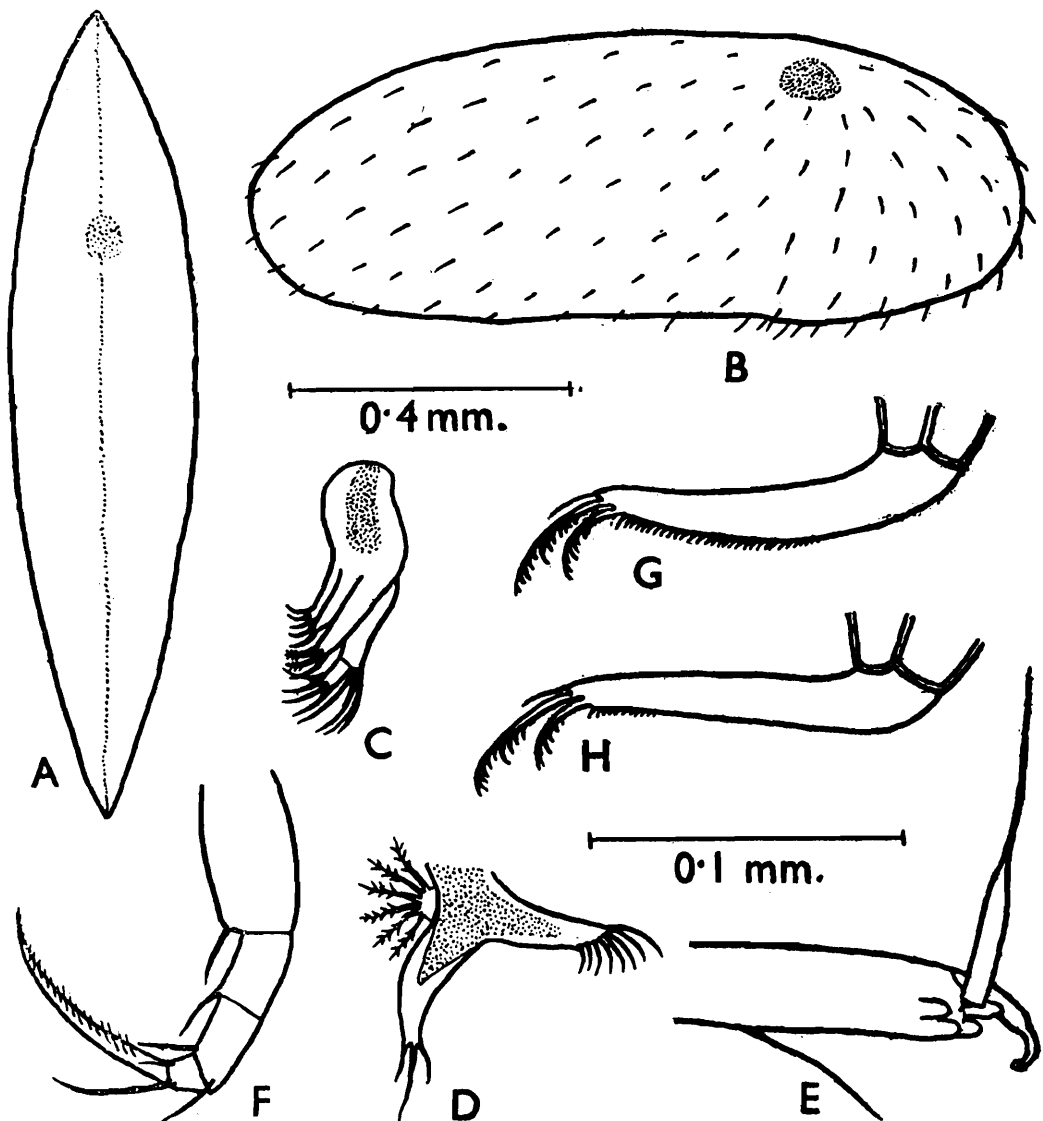
Distribution.—India: Rajasthan (First Record); elsewhere: E. Africa.

Remarks.—Specimens are greyish to yellowish brown in colour. They are almost identical with the African specimens. The figures given by Daday (1910) seems to be not accurate.

18. *Stenocypris spinosa* Tressler

(Text-fig. 13, A-N)

1937. *Stenocypris spinosa* Tressler, *Inter. Revue, Ges. Hydrobiol. Hydrogr.*, 34: 202.



Text-fig. 13. *Stenocypris spinosa* Tressler, (A). Shell, dorsal view; (B). Same, side view; (A—B). Same scale; (C). Maxilla; (D). Maxilliped; (E). 2nd leg; (F). 1st leg; (G). & (H). Furca; (C—H). Same scale.

Material.—2 vials, (i) 10 exs., Bala Talao, 3 miles S. E. of Julga Lake, 24.xi.58, S. Biswas Coll. (ii) 1 ex., Sta. Ramgarh, Biprasar (Jaisalmer Dist.), 7.i.58, K. K. Tiwari and S. Biswas Coll.

Length : 1.1 mm.—1.75 mm. Width : 0.3 mm.—0.37 mm. Height : 0.42 mm.—0.50 mm. ♀♀.

Description.—Shell oblong, transparent, very soft and delicate. Anterior and posterior ends broadly rounded in the side view. Fine scanty hairs present on the surface of the shell. Spindle shaped, in dorsal view with both ends pointed. Furcal ramii dissimilar (Text-fig. 13, G & H), and prominent in size.

Distribution.—India : Rajasthan (First Record) : elsewhere : Camaguin Island, Philippines.

Remarks.—This species was established on a single female specimen. The present material also consists of females only and agrees, in all respects, with the original description. Specimens are grey in colour and slightly smaller in size than the holotype.

19. *Cypretta turgida* (Sars)

1896. *Cypridopsis turgida* Sars, *Arch. Math. Naturv.*, **18** : 62.

1924. *Cypretta turgida* : Sars, *Ann. S. Afri. Mus.*, **20** : 147.

Material.—9 exs., Sta. Narayana, ditch at Barbaryan, (Jaipur Dist.), 1.xi.58, S. Biswas Coll.

Length : 0.75 mm.—0.87 mm. Width : 0.60 mm.—0.62 mm. Height : 0.55 mm.—0.58 mm. ♀♀.

Description.—Shell small tumid, anterior end obtusely pointed and posterior end broadly rounded in dorsal view. Valve margins beset with a broad band of pore canals anteriorly. Surface of the valves marked with deep brownish patches. Furca with two long whip like setae and a fine dorsal seta.

Distribution.—India : Rajasthan (First Record) ; elsewhere ; China, New Zealand, Australia, Madagascar and Africa.

Remarks.—Male not so far recorded in this species. The Indian specimens are light brown in colour.

20. *Cypridopsis newtoni* Brady & Robertson

1870. *Cypridopsis newtoni* Brady & Robertson, *Ann. Mag. nat. Hist.*, **Sr(4) 6** : 14.

1898. *Cypridopsis aldabrae* Müller, *Abh. Senckenb. naturforsch. Ges.*, 21: 281.

Material.—6 vials, (i) 25 exs., ditch near main Lake Gudha, 19.ix.58. (ii) 30 exs., cemented water tank Gudha Kyar, 4.x.58. (Nagaur Dist.) S. Biswas Coll. (iii) 15 exs., Sta. 4. Ramgarh, Biprasar Tank, 4.i.58, (iv) 5 exs., Sta. 3. Gadisar, eastern side of Dak Bunglow, 28.xi.57 (v) 4 exs., Sta. 1. Phalodi, Sivsar, (Jodhpur Dist.). 16.xii.57, K. K. Tiwari and S. Biswas Coll. (vi) 500 exs. Sta. 1. Devdani Tank (Jaipur Dist.), 2.x.63, K. K. Mahajan Coll.

Length : 0.76 mm.—0.87 mm. Width : 0.36 mm.—0.45 mm. Height : 0.46 mm.—0.50 mm. ♀♀.

Length : 0.63 mm.—0.75 mm. Width : 0.31 mm.—0.37 mm. Height : 0.41 mm.—0.45 mm. ♂ ♂

Description.—Shell tumid, bean like, egg shaped in dorsal view, anterior end broader in profile. Valves thin, delicate, margin and surface of the shell finely hairy. Furca modified into long whip like structure.

Distribution.—India : Rajasthan (First Record) ; elsewhere : Ceylon, N. America and Europe.

Remarks.—Specimens are ivory white to light brown in colour. Furca are modified into a flageller structure.

SUMMARY

Twenty species of ostracods, belonging to 8 genera, collected from Rajasthan between 1957 and 1963, are described in the present paper. Of these, seventeen species are new records from Indian sub-continent and all the twenty are newly recorded from Rajasthan. Except for seven species the remaining ones are represented by females only.

REFERENCES

- ARORA, G. L. 1931. Entomostraca (Water Fleas) of Lahore. *Bull. Dept. Zool. Punjab Univ.*, 1: 79-99.
- BAIRD, W. 1859. Description of some new recent Entomostraca from Nagpur collected by Rev. S. Hislope. *Proc. zool. Soc.*: 213-234.
- BRADY, G. S. 1885. Notes on Entomostraca collected by Mr. A. Haly in Ceylon. *J. Linn. Soc. Zool.*, 19: 293-317.
- BREHM, V. 1950. Contributions to the Fresh Water Fauna of India, Pt. 2. *Rec. Indian Mus.*, 48: 9-28, 8 figs.
- DADAY, E. 1898. Mikroskopische süßwasserthiere aus Ceylon. *Supplement to Termes. Fuzetak*, 21: 123.

- DADAY, E. 1910. Untersuchungen über die Süßwasser-Mikrofauna Deutsch—Ostafrikas., *Zoologica*, **23**: 159-235.
- FURTOS, N. C. 1936. Freshwater Ostracoda from Florida and North Carolina. *Amer. Midl. Nat.*, **17**: 491-522.
- GURNEY, R. 1906. On some freshwater Entomostraca in the collection of the Indian Museum. *J. Asiatic Soc. Bengal*, **2**: 273-281.
- GURNEY, R. 1907. Further Notes on Indian Freshwater Entomostraca. *Rec. Indian Mus.*, **1**(1): 21.
- KLIE, D. 1927. Zur Kenntnis der Mikrofauna Von Britisch Indien. I. Ostracoda. *Rec. Indian Mus.*, **29**: 157-165.
- MÜLLER, G. W. 1912. Ostracoda. (*Das Tier Reich.* **31**), Berlin. 1-434.
- SARS, G. O. 1903. Fresh-water Entomostraca from China and Sumatra. *Arch. f. Math. Naturv.* **25**, nr. 8.
- SARS, G. O. 1925. An account of the Crustacea of Norway. **9**. Ostracoda. Bergen.
- VAVRA, V. 1906. Ostracoden von Sumatra, Java, Siam den Sandwich-Inseln und Japan. (Reise von Dr. Walter Volz.) *Zool. Jahrb.*, **23**: 413-438.

NOTES ON A COLLECTION OF MAMMALS FROM GOA

By

V C. AGRAWAL

Zoological Survey of India, Calcutta

(With 4 Tables)

INTRODUCTION

After the merger of Goa with the Indian Union, the Zoological Survey of India sent several parties to explore the faunal wealth of this place. This paper is based on the material brought by me during 1968-69 and on a few specimens already present in the National Zoological Collections of the Zoological Survey of India. These collections are the first authentic record from Goa. All measurements are in millimetres and have been taken after Pocock (1939) for *Carnivora*, Khajuria (1952) for *Chiroptera* and Roonwal and Agrawal (1966) for the rest except those which are self explanatory. The colour names in the text with initial capital letters are according to Ridgway's (1886) nomenclature. Except where otherwise mentioned, all the collections have been made by me.

I am thankful to Dr. A. P. Kapur, Director, Zoological Survey of India, Calcutta, for providing facilities for this work and to Dr. B. Biswas, Superintending Zoologist, for suggestions. The assistance provided by the Conservator of Forests, Goa, Daman and Diu, during the collection work is gratefully acknowledged.

Abbreviations.—The following abbreviations have been used in the text.

C' - C'	distance between outer surface of upper canines.
cb.,	Condylbasal length.
CR.,	Cranial rostrum measured from front of orbit to anterior extremity of nasal.
cw.,	Cranial width.
dst.,	length of upper diastema.
E.,	length of ear.
FA.,	length of forearm.
HB.,	length of head and body.
HF.,	length of hind foot.
iw.,	interorbital width.

$i' - m^3$.,	length of toothrow from first upper incisor to third molar
l .,	total length
ml .,	mandibular length
$m^3 - m^3$.,	distance between outer surface of third upper molars
m_1 .,	length of the first lower molar
nas .,	nasal length
on .,	Occipitonasal length
orb .,	length of orbit
pf .,	length of anterior palatal foramina
pl .,	length of palate
pow .,	post orbital width.
pm^4 .,	length of fourth upper premolar
tb .,	length of tympanic bulla
Tib .,	length of tibia
Tl .,	length of tail
TR .,	length of maxillary toothrow
zw .,	Zygomatic width

Physiography : Goa lies between latitude $14^{\circ}.5'-15^{\circ}.45'N$ and longitude $73^{\circ}.45'-74^{\circ}.2'E$, covering an area of approximately 3600 Sq. Km. Tucked between the Western Ghats and the Arabian Sea, it has a warm tropical climate with an average temperature of $21^{\circ}c$ throughout the year. The South-West monsoon results in an annual precipitation of about 305 cm., mostly between June to September.

The western part of Goa has an approximately 105 km. long coastal line displaying luxuriant growth of palms and coconut trees. The eastern tract is ornamented with a vast stretch of dense hilly forest, extending from Valpoi in the north to Canacona in the south. The vegetation in the forest area comprises Teak (*Tectona grandis*), Bamboo (*Bambusa* sp.), Sal (*Shorea robusta*) Babul (*Acacia arabica* and *A. juliflora*), Jamun (*Eugenia jambulana*), Cotton (*Bombax malabaricum*), Cashew-nut (*Anacardia occidentale*), Mango (*Mungifera indica*), Rubber (*Sicus elastica*) Neem (*Azadirhata indica*), Banyan (*Ficus bengalensis*), Peepal (*Ficus religiosa*) and various kinds of bushes.

The soil has a reddish hue because of the presence of manganese and iron ores. In addition, various kinds of natural salts like Ichthyophthalmite, Stilluti, Apophyllite, Heliotrope etc. and basalt salts, dikes and columnar basalts are also present.

Localities.—The following are the main collection localities.

Margao : It lies on latitude $15^{\circ}15'N$ and longitude $73^{\circ}.55'E$ and at an altitude of 25.5 metres from sea level.

Molem : Situated on Panjim—Belgaum Highway, about 5 km. N. of Colem railway station, it lies on latitude $15^{\circ}2'N$ and longitude $74^{\circ}15'E$.

Poinguinim : A small village situated at a distance of ca. 10 km. S. of Canacona and ca. 35 km. S. of Margao. It lies on latitude $15^{\circ}N$ and longitude $74^{\circ}E$.

Valpoi : Situated approximately 50 km. N. of Colem railway station, it lies on latitude $15^{\circ}3'N$ and longitude $74^{\circ}05'E$.

SYSTEMATIC ACCOUNT

Order INSECTIVORA

Family SORICIDAE

***Suncus murinus caerulescens* (Shaw)**

1800. *Sorex caerulescens* Shaw, *Genl. Zool. Mamm.*, 1 : 533 (India).

1831. *Sorex giganteus* Geoffroy, *Voy. Belanger Indes Orient. Zool.*, : 117 (Bengal).

Material.—1 ♂ ; Margao ; 20.xii.1968.

Measurements.—External : *HB* 149 ; *Tl* 95 ; *HF* 23 ; *E* 15.

Skull : *Cb* 38.2 ; *on* 33.3 ; *iw* 6.2 ; *cw* 15 ; *C'-C'* 4.6 ; *i'-m*^s 16.4 ; *pl* 18.2 ; *ml* 18.7

The subspecies is supposed to be restricted (*vide* Ellerman and Morrison-Scott, 1951) to Bengal, Bihar and E. Nepal. Its occurrence at Bombay and in Ceylon was attributed by Lindsay (1929) and Phillips (1925, p. 189) respectively as casual and carried over to these places by human agencies like railway and ship. Its presence at Goa too, suggests that the subspecies, irrespective of its mode of dispersal, has established itself throughout Peninsular India and Ceylon, probably due to its commensal habit.

This shrew was one of the three, regularly visiting the kitchen of a hotel, where it was trapped. It is treated as a sacred animal and commonly called as 'Ganpati' by the local people.

Order PRIMATES

Family CERCOPITHECIDAE

***Presbytis entellus achates* (Pocock)**

1928. *Pithecus entellus achates* Pocock, *J. Bombay nat. Hist. Soc.*, 32 : 488. (Haunsbhavi, Dharwar, India).

Material.—1 ♀ (Juv.) ; Poinguinim ; 25.xii.1968.

Measurements.—External : *HB* 400 ; *tl* 600 ; *HF* 130 ; *E* 40
Skull : Broken.

Dorsal colour is darker than that of *Presbytis entellus entellus*. Manus and pes are not as black as in specimens of this subspecies from Dharwar—probably due to difference in age.

Order CHIROPTERA

Suborder MEGACHIROPTERA

Family PTEROPIDAE

Pteropus giganteus giganteus (Brünnich)

1782. *Vespertilio gigantea* Brünnich, *Dyrenes Historie*, 1: 45 (Bengal, India).

Material.—1 ♂ ; Molem ; 11.ix.1969 ; R. C. Sharma Coll.

Measurements.—External : *HB* 220 ; *FA* 154 ; *Tib* 71.

Skull : *l* 66.5 ; *cb* 63.8 ; *zw* 33.1 ; *cw* 24.4 ; *CR* 24.7 ; *pl* 35.3 ;
TR 26 ; *m³-m³* 18.6 ; *ml* 48.8.

The bat was collected from an old house.

Rousettus leschenaulti (Desmarest)

1820. *Pteropus leschenaulti* Desmarest, *Encycl. Meth. Mammalia*, 1: 110 (Pondicherry, India).

Material.—1 ♂ ; Margao ; 19.xii.1968 ; 2 ♀ (1 Juv.) ;
Poinguinim ; 24 and 25.xii.1968.

Measurements.—External : 1 ♂ ; *HB* 113 ; *E* 19 ; *FA* 80 ;
Tib 35.

1 ♀ ; *HB* 112 ; *E* 20 ; *FA* 86 ; *Tib* 40.

Skull : 1 ♂ ; *l* 37.1 ; *cb* 35.5 ; *zw* 21 ; *cw* 15.2 ; *pl* 20.2 ;
CR 11.3 ; *m³-m³* 11 ; *TR* 13.4 ; *ml* 28.6.

1 ♀ ; *l* 37.2 ; *cb* 35.7 ; *zw* 23.1 ; *cw* 15.8 ; *pl* 20 ;
CR 12.6 ; *m³-m³* 11 ; *TR* 13.6 ; *ml* 29.

One specimen collected in December had a foetus in her womb in early stage of development. Brosset (1962) found females with newly born young in March, August and October. Thus the breeding season seems to extend throughout the year.

Cynopterus brachyotis ceylonensis Gray

1870. *Cynopterus marginatus* var. *ceylonensis* Gray, Cat. Monkeys, Lemurs and Fruit-eating Bats, Brit. Mus. London (Ceylon).

Material.—3 ♂, 1 ♀; Poinguinim; 24 and 26.xii.1968.

Measurements.—External: 3 ♂; *HB* 87-95 (92); *E* 16-17 (16.7); *FA* 65-66 (65.5); *Tib* 25.5-26.5 (26.1). 1 ♀; *HB* 89; *E* 17; *FA* 66; *Tib* 26.

Skull: 3 ♂; *l* 29.5-31 (30); *cb* 28.5-30.2 (29.1); *zw* 18-20.5 (19.4); *cw* 12-13 (12.6); *pl* 15-16.7 (15.8); *CR* 7.3-7.6 (7.5); *TR* 9.5-10 (9.8); *m*³-*m*³ 9-9.7 (9.4); *ml* 22-23.8 (22.9).
1 ♀; *l* 29; *cb* 28.5; *zw* 18; *cw* 12.5; *pl* 15.5; *cr* 7.7; *TR* 9.5; *m*³-*m*³ 9.0; *ml* 22.2.

The subspecies has hitherto been known only from Ceylon. The present collection not only extends its distribution further north but is also its first authentic record from India.

***Cynopterus sphinx sphinx* (Vahl)**

1797. *Vespertilio sphinx* Vahl, *Skr. nat. selsk. Copenhagen*, 4(1): 123 (Tranquebar, Madras, India).

1912. *Cynopterus sphinx gangeticus* Anderson, *Ann. Mag. nat. Hist.*, 6: 623 (Lucknow, U.P., India).

Material.—1 ♀; Margao; 20.xii.1968; 1 ♂; Valpoi; 18.ix.1969.

Additional material examined.—4 , 4 ♀; W Bengal; 3 ♂, 3 ♀; Tripura; 1 ♂, 1 ♀; Assam; 1 ♂, 2 ♀; Burma; 1 ♂, 1 ♀; Andaman Islands.

Measurements: External: 1 ♂: *HB* 95; *E* 20.5; *FA* 73; *Tib* 27.5.

1 ♀: *HB* 107; *E* 20; *FA* 76; *Tib* 31.

Skull: 1 ♂: *l* 33.2; *cb* 32.2; *zw* 21.3; *cw* 13.5; *pl* 17.2; *m*³-*m*³ 10.2; *TR* 11.7; *CR* 8.8; *ml* 24.

1 ♀: *l* 34.3; *cb* 33.4; *zw* 21.4; *cw* 14.3; *pl* 18.5; *m*³-*m*³ 9.3; *TR* 12; *CR* 9.3; *ml* 26.7

Andersen (1912) described the subspecies *Cynopterus sphinx gangeticus* from Lucknow (U.P.) and differentiated it from *C.s. sphinx* "as conspicuously larger" viz forearm 73-78 vs 66-73.5, tibia 28.5-31 vs 25-27.5 and greatest length of skull 33-36 vs 31.5-34.5. Chaturvedi (1969) felt difficulty in the identification of specimens of *C.s. sphinx* from Andamans up to subspecific level due to their overlapping measurements. A thorough examination of material from the distributional range of both the subspecies reveals that, contrary to those mentioned by Andersen (1912), there are no differences in their external

and cranial measurements (Table 1). Moreover, these can not be differentiated on the basis of colour as the same is very varied ranging from wood-Brown to Seal-Brown and masked with individual variation. I would, therefore, regard *Cynopterus s. gangeticus* a synonym of *C.s. sphinx*.

Suborder MICROCHIROPTERA

Family RHINOLOPHIDAE

Rhinolophus rouxi rouxi Temminck

1835. *Rhinolophus rouxi* Temminck, *Mon. Mamm.*, 2: 30b (Pondicherry and Calcutta, India).

Material.—1 ♂, 2 ♀: Poinguinim; 23 and 29.xii.1968.

Measurements.—External: 1 ♂; *HB* 62; *E* 20; *FA* 48; *Tib* 22.

2 ♀; *HB* 58-60(59); *E* 20; *FA* 48; *Tib* 22 (in both).

Skull: 1 ♂; *l* 21.2; *cb* 19; *zw* 11; *cw* 9.6; *pl* 6.8; *TR* 8.4; *ml* 15.

1 ♀; *l* 20; *cb* 18; *zw* 10.8; *cw* 9.2; *pl* 6.5; *TR* 8.1; *ml* 14.6.

The dorsal colour of above mentioned specimens ranges from Drab to Broccoli-Brown and the ventral from Cream to Cream-Buff rather than dark brown above and mouse-grey on the ventral surface (Andersen, 1917).

Family VESPERTILIONIDAE

Subfamily VESPERTILIONINAE

Pipistrellus dormeri dormeri (Dobson)

1875. *Scotozous dormeri* Dobson, *Proc. zool. Soc. London*: 373 (Bellary Hills, India).

1915. *Scotozous dormeri caurinus* Thomas, *J. Bombay nat. Hist. Soc.*, 24: 33 (Junagadh, Gujarat).

Material.—1 ♂; Margao; 18.xii.1968.

Additional material examined.—1 ♂, 1 ♀; Sind; 7 ♂, 11 ♀; Rajasthan; 1 ♂, 1 ♀; Bihar; 1 ♂, 1 ♀; Deccan.

Measurements.—External: 1 ♂: *HB* 50; *Tl* 41; *E* 12.5; *FA* 38; *Tib* 15.

Skull: 1 ♂: *l* 14.6; *cb* 13.8; *zw* 9.6; *cw* 7.2; *TR* 5.2; *pl* 6.7; *m*³-*m*³ 7.0; *ml* 10.5.

Thomas (1915) differentiated *Pipistrellus dormeri caurinus* from *P. d. dormeri* on the colour of fur (hoary grey *vs.* brown) and larger skull and tooth row. An analysis of measurements (Table 2) of *Pipistrellus dormeri* from ranges of both the subspecies shows that there is no significant difference in the length of forearm, skull and tooth row. Further, contrary to Khajuria's assertion (1965) that second upper incisor is practically absent in adults of the nominate subspecies, it, though small, is present in all but two specimens of each of the subspecies, present at my disposal.

Although, majority of specimens under study are spirit-preserved and partially bleached, a few fresh ones from Goa, Bihar, Rajasthan and Gujarat show that the dorsal colour ranges from Sepia to Broccoli-Brown and the ventral from white mixed with light brown to pale yellow or pinkish, irrespective of localities. On the basis of above facts, there is no justification for maintaining the subspecies *Pipistrellus dormeri caurinus* and I would treat it as a synonym of *Pipistrellus d. dormeri*.

Ecological remarks : This bat was collected twice in solitary condition, once from a hole in a coconut tree and another from a crack in the dried bed of a tank, and in groups of seven and eleven (both males and females) from crevice in between the upper beam of the door and the wall of a deserted house. Brosset (1962) also referred about a colony of five females found under the tile of a roof. All these suggest that the latter two are the most favourite roosting place.

Five specimens collected in the last week of July from Rajasthan (Agrawal, 1967b) and one in September from Sind, were found to be pregnant, all carrying a foetus in early or late stages of development. It is, therefore, concluded that this bat breeds at least from July to September.

Subfamily KERIVOULINAE

Kerivoula picta picta (Pallas)

1767. *Vespertilio pictus* Pallas, *Spic. zool.*, 3: 7 (Peninsular India).

Material.—1 ♀ ; Goa ; April 1918 ; L. De Souza Coll.

Measurements.—External : FA 31.3 ; Tib 12.2.

Skull : l 13.8 ; cb 13 ; zw 8.2 ; cw 6.7 ; pl 7.7 ; iw 3.1 ;

TR 5.2 ; ml 10.

This species has a very wide range of distribution extending from Ceylon and peninsular India to Burma, Malaya and Borneo. The present collection is the first authentic record from Goa.

Family MEGADERMATIDAE

Megaderma spasma horsfieldi Blyth

1863. *Megaderma horsfieldi* Blyth, *Cat. Mammal. Mus. Asiat. Soc. Bengal*, p. 23 (India).

Material.—1 ♂, 2 ♀; Valpoi; 13.i.1969.

Measurements.—External: 1 ♂; *HB* 70; *E* 37; *FA* 61; *Tib* 33.5; 2 ♀; *HB* 66-73(70); *E* 36-36(36); *FA* 57-58 (57.5); *Tib* 31-32 (31.5).

Skull: 1 ♂: *l* 25; *cb* 22.5; *zw* 14.2; *cw* 11; *pl* 9.8; *TR* 9.9; *ml* 17.4.

1 ♀: *l* 24.9; *cb* 22.2; *zw* 13.8; *cw* 10.8; *pl* 9.2; *TR* 9.5; *ml* 17.2.

This bat was seen in a colony of about 25-30 individuals of both sexes, roosting in a hollow tree trunk, with many exits.

Order CARNIVORA

Family FELIDAE

Felis chaus kelaarti Pocock

1939. *Felis chaus kelaarti* Pocock, *Fauna Brit. India, Mammalia*, 1: 300 (Cheddikulam, N.P., Ceylon).

Material.—1 ♀: Molem; 6.i.1969.

Measurements.—External: *HB* 570; *Tl* 245; *HF* 140; *E* 63. Skull: *l* 101.5; *cb* 91; *zw* 64.8; *iw* 17.6; *pow* 33; *C'-C'* 23; *pm*⁴ 11.5; *m*₁ 9.7; *ml* 61.7

Dorsal colour of body cream-buff to greyish-buff with a prominent mid-spinal stripe; latter Ochraceous mixed with black, lighter at anterior than posterior half; tip of ears black, as usual; stripes on the upper portions of legs faint, probably developing.

Family VIVERRIDAE

Viverricula indica indica (Desmarest)

1817. *Viverra indica* Desmarest, *Nouv. Dict. nat. Hist.*, 7: 170 (India).

Material.—3 ♂; Molem; 5-7.i.1969.

Measurements.—External: 3 ♂; *HB* 560-585 (572); *Tl* 350-380 (361); *HF* 92-99 (97); *E* 38-41 (39).

Skull: 3 ♂; *l* 94.4-98.5 (97.1); *cb* 92.5-96.4 (94.6); *zw* 44-45.8 (45); *iw* 12.2-13.5 (13); *pow* 12.4-14.2 (13.3); *C'-C'* 15.3-16.5 (15.9); *pm*⁴ 8.0-8.3 (8.1); *m*₁ 7.3-7.5 (7.4); *ml* 61.6-64.8 (63.2)

The animal is of common occurrence throughout Peninsular India as far north as Chilka lake, Orissa. However, this is the first record from Goa.

Order ARTIODACTYLA

Family TRAGULIDAE

Tragulus meminna (Erxleben)

1777. *Moschus meminna* Erxleben, *Syst. Regn. Anim. Mamm.*: 322 (Ceylon).

Material.—1 ♂ (Juv.); Bela village ca. 10 KM. SE. of Poinguinim; 29.xii.1968.

Measurements.—External: *HB* 443; *Tl* 300; *E* 46.5.

Skull: *On* 97.3; *cb* 93.8; *iw* 24.4; *nas* 31; *tb* 15.7; *pl* 59; *pf* 12.5; *ml* 75.6.

The last molar had not yet erupted in both the jaws.

The specimen was collected at mid-night in a dense forest.

It was roaming in a pair.

Order LAGOMORPHA

Family LEPORIDAE

Lepus nigricollis nigricollis F Cuvier

1823. *Lepus nigricollis* F. Cuvier, *Diet. Sci. Nat.*, 26: 307 (Madras, India).

Material.—2 ♂; Valpoi; 12 and 13.i.1969.

Measurements.—External: 2 ♂: *HB* 425-445 (435); *Tl* 86 (in both); *HF* 102-103; *E* 89 (in both).

Skull: 2 ♂: *on* 82.7-85.4 (84); *cb* 74.5-75.5 (75); *zw* 39.4-40.1 (39.7); *tb* 9.5-9.6 (9.55); *nas* 35.0-37.2 (36.1); *TR* 13.7-13.8 (13.75); *cw* 27.0-27.2 (27.1); *pf* 20.5-22.0 (21.2); *pl* 33.5-35.3 (34.4); *ml* 59.5-60 (59.7).

Dorsal colour rufous-brown mixed with black; postero-

dorsal portion slaty with subterminal white bands; external tip of ears and dorsal side of tail black or dark brown rather than rufous-brown (Blanford, 1891); Colour of sole deep ferruginous in one and tawny-Ochraceous in the other.

Order RODENTIA

Family SCIURIDAE

***Ratufa indica indica* (Erxleben)**

1777. *Sciurus indicus* Erxleben, *Syst. Regn. Anim. Mamm.*, : 420 (Bombay Presidency, India).

Material.—4 ♂, 2 ♀; Molem; 2-4.i.1969; 1 ♂: Sonaulim ca. 12 Km. SE. of Molem; 6.i.1969.

Measurements.—External: 5 ♂; *HB* 340-392 (370); *Tl* 410-440 (426); *HF* 78-84 (82); *E* 25-27 (26). 2 ♀: *HB* 360-378 (369); *Tl* 423-425 (424); *HF* 81-82 (80.5); *E* 26 (in both).

Skull: 5 ♂; *on* 73-76 (74.2); *zw* 42.5-46.5 (44.8); *iw* 28.2-32 (30); *tb* 14.4-15.7 (15); *nas* 23-25 (24.1); *TR* 14.3-15.2 (14.6); *pl* 31-32.6 (31.6); *orb* 23.2-24 (23.6). 2 ♀: *on* 70-73 (71.5); *zw* 43.7-45 (44.3); *iw* 27.2-28.2 (27.7); *tb* 13.8-14.5 (14.1); *nas* 23-23.8 (23.4); *TR* 14-15 (14.5); *pl* 30.5-31 (30.7); *orb* 22.6-23.5 (23.1).

Dorsal colour of the body and tail, in general, resembles that of *Ratufa indica indica* in being deep red throughout. In two examples from Goa and one example from Satara (Maharashtra), the upper arm and the proximal one-fourth portion of tail, however, are black or blackish brown, thus resembling *R. indica centralis*. The specimens from Goa are further interesting in having the hind foot longer than that of *indica* but subequal to *centralis* (Table 3). Otherwise, the measurements are more or less similar to *indica*. Ellerman (1963) also mentioned about a specimen from Samasgi (Dharwar) as transitory towards *centralis* in colour and conjectures that the intergradation has taken place in this area. The above observations support Ellerman's view. Thus Goa and Satara also appear to fall under the zone of intergradation.

***Funambulus tristriatus tristriatus* (Waterhouse)**

1837. *Sciurus tristriatus* Waterhouse, Charlesworth's *Mag. nat. Hist.*, 1: 496-499 (Madras, India).

Material.—4 ♂, 1 ♀ (Juv.) ; Poinguinim ; 22-27.xii.1968 ;
1 ♀ : Arvalem village, ca 12 Km. NW of Valpoi ;
12.i.1969.

Measurements.—External : 3 ♂ ; HB 145-158 (153) ;
TL 140-153 (148) ; HF 37-38 (37.5) ; E 15-16 (15.5).
1 ♀ ; HB 143 ; TL — ; HF 36 ; E 15.

Skull : 3 ♂ ; on 40-42.8 (41.6) ; zw 23-24 (23.5) ; iw 12.3-
13.6 (13) ; tb 7.4-7.7 (7.6) ; nas 12-13.5 (12.8) ;
TR 8 (in all) ; orb 12-12.6 (12.3) ; pl 20-22.5 (21.4).

Dorsal stripes ranging from pale buff to brownish as in *numarius* (Wroughton, 1919) and intermediate bands from brown to blackish ; middle portion of the underside of tail, testis and inguinal region ranging from Cadmium-Orange to Saturn-Red rather than deep red (Ellerman, 1963)

Ecological remarks : This squirrel prefers to live in semi-dense forests near human habitation in contrast to the Indian Giant Squirrel, *Ratufa indica*, which confines itself to tall trees in deep jungles. It is a shy animal and spends most of its time on trees rather than on the ground, which shows that the species is more arboreal than the Northern Palm Squirrel, *Funambulus pennanti* (Agrawal, 1965). The stomach contained vegetative matter mainly pieces of some juicy fruit.

Family MURIDAE

Subfamily GERBILLINAE

Tatera indica hardwicki (Gray)

1843. *Gerbillus hardwickei* Gray, *List. Mamm.*, : 132 (Dharwar, India). Based on Elliot's description of the Dharwar Tatera, 1839, *Madras J. Litt. Sci.*, 10 : 211.

Material.—2 ♂ (1 Juv.) ; Nova Gova ; Feb. 1938 ; *Col. Dett Mello* Coll. 2 ♀ (1 Juv.) ; Poinguinim ;
26-28.xii.1968 ; 1 ♀ ; Molem ; 4.i.1969.

Measurements.—External : 1 ♂ : HB 149+ ; TL 191 ; HF 42 ;
E 22.2 ♀ : HB 149-170 (160) ; TL 186-195 (190) ;
HF 44 (in both) ; E 23-24.5 (23.7).

Skull : 1 ♂ : on 46.5 ; iw 7.2 ; pl 25.3 ; TR 6.5 ; nas 20.2 ;
pf 8.7 ; tb 10.8.

2 ♀ : on 41.6-47.3 (44.4) ; iw 6.9-7.7 (7.3) ; pl 22.1-
25.5 (23.8) ; TR 6.4-6.5 (6.45) ; nas 17-19.5 (18.2) ;
pf 7.5-9.0 (8.3) ; tb 10.8-11.8 (11.3).

Specimens from Goa are slightly darker (Broccoli-Brown) dorsally than those from Dharwar and Kanara present in the National Zoological Collection.

Ellerman (1963, p. 410) is of the opinion that the southern subspecies of *Tatera indica* namely *hardwickei*, *cuvieri* and *ceylonica* do not differ from each other in colour but may apparently be differentiated on the basis of external measurements viz the length of tail and hind foot. But the above data show that the length of hind foot (26-29%, mean 28%, of head & body length) overlap those of the other two subspecies. However, the subspecies can still be differentiated from *cuvieri* by its shorter tail and longer anterior palatal foramina and from *ceylonica* by narrow interorbital width of skull (Agrawal, 1967a).

A specimen collected on Jan. 4, 1969, was found to be pregnant and had three embryos.

Subfamily MURINAE

Bandicota indica indica (Bechstein)

1800. *Mus indica* Bechstein, *Veber Vierf. Thiere*, 2: 497 (Pondicherry, India).
 1801. *Mus malabarica* Shaw, *Genl. Zool.*, 2: 54 (Malabar, India).
 1804. *Mus gigantea* Hardwicke, *Trans. Linn. Soc. London*, 7: 306 (Hardwar, U.P., India).

Material.—3 ♂, 1 ♀; Margao; 16-20.xii.1968.

Measurements.—External: 3 ♂; HB 262-280 (272); TL 265-289 (275); HF 52-54 (53); E 26-32 (29).
 1 ♀; HB 262; TL 289; HF 54; E 31; mammae 3+3=12.

Skull: 3 ♂; on 54.8-58.4 (56.7); cb 56.2-59.8 (58.2); zw 29.8-32 (31.2); iw 7.8-8.8 (8.4); tb 9.2-10 (9.5); nas 22-23.8 (23); pl 33-35.5 (34.3); pf 10.2-10.7 (10.5); TR 9.5-10 (9.8); dst 19-20.5 (19.7).

1 ♀; on 57.6; cb 58.2; zw 30.5; iw 8.5; tb 9.7; nas 23.3; pl 34.3; pf 9.8; TR 9.8; dst 20.

Wroughton (1919) maintained the species *gigantea*, *malabarica* and *indica* on the size of hind foot (viz over 60 mm., about 58 mm. and between 48-51 mm. respectively). Later, Ellerman (1947) synonymised *malabarica* and *gigantea* with the nominate subspecies of *indica* with the comment that the specimens of *indica* (one from Ootacamund and another from

Coonoor, Nilgiri Hills) which have been taken into account by Wroughton for differentiating this species from *malabarica* are nothing but small individuals. He further remarked that the difference between the smallest *malabarica* and the largest *indica* was much less than that between the smallest and largest specimens of *malabarica* and therefore it was most likely that the supposed size differences between the two named forms would cease to exist on further availability of specimens. Recently Tiwari *et al* 1971 have resuscitated *malabarica* from W Ghats at subspecific level and differentiated it from *indica* on the basis of longer head-and body, tail, hind foot and skull, by taking into consideration a subadult specimen from Salem (Madras) and the same two specimens of *indica* which were used by Wroughton. However, specimens from Goa, Western Ghats, do not remarkably differ in measurements (Table 4) from those of Madras, thus supports Ellerman's view.

***Rattus rattus* Wroughton Hinton**

1919. *Rattus rattus wroughtoni* Hinton, *J. Bombay nat. Hist. Soc.*, **26** : 384 (Coonoor, Nilgiri Hills, India).

Material.—1 ♂ ; Poinguinim ; 25.xii.1968.

Measurements.—External : *HB* 165 ; *TL* 195 ; *HF* 34 ; *E* 22.5.

Skull : *on* 39.2 ; *iw* 5.3 *tb* 7.0 ; *nas* 14 ; *pl* 21 ; *TR* 6.5 ; *pf* 6.8.

Dorsal colour of the body olive medially and Hair-Brown on sides rather than brownish throughout ; ventral colour white mixed with Sulphur-yellow.

***Rattus rattus rufescens* (Gray)**

1837. *Mus rufescens* Gray, *Ann. Mag. nat. Hist.*, **1** : 585 (Dharwar, India).

Material.—2 ♀ : Molem ; 3 and 7.i.1969 ; 4 ♂ , 2 ♀ ; Valpoi ; 12-14.i.1969.

Measurements.—External : 1 ♂ ; *Hb* 179 ; *TL* 250+ ; *HF* 36 ; *E* 23. 4 ♀ ; *HB* 163-183 (172) ; *TL* 213-241 (226) ; *HF* 32-35 (33.5) ; *E* 22-23 (22.7).

Skull : 1 ♂ ; *on* 43.4 ; *iw* 6 ; *tb* 7.6 ; *nas* 16 ; *pl* 23 ; *TR* 6.3 ; *pf* 8 ; *dst* 11.8. 4 ♀ ; *on* 39.8-43.7 (41.6) ; *iw* 5.6-6.3 (6.0) ; *tb* 6.8-7.6 (7.1) ; *nas* 14.7-15.6 (15.2) ;

pl 21-23 (21.8) ; *TR* 6.2-6.7 (6.4) ; *pf* 6.2-7.6 (7.0) ;
dst 9.8-12 (10.9).

These rats were collected by using bread and fried fish as bait, from kitchen and vegetable shops.

***Rattus blanfordi* (Thomas)**

1881. *Mus blanfordi* Thomas, *Ann. Mag. nat. Hist.*, 7: 24 (Kadapa, Madras, India).

Material.—1 ♂ ; Valpoi ; 21.ix.1969.

Measurements.—External : *HB* 158 ; *Tl* 172 ; *HF* 37 ; *E* 25.

Skull : *on* 45.4 ; *zw* 21.4 ; *tb* 7.8 ; *nas* 17.9 ; *pl* 23 ; *TR* 6.4 ;
pf 8.3 ; *iw* 7.

Dorsal colour Seal-Brown medially and light fawn on sides ; distal one-fifth portion of tail white and slightly haired.

Skull having the anterior palatal foramina only 18% and palate over 50% of occipito-nasal length rather than about 20% and less than 50% respectively, mentioned by Ellerman (1963).

***Mus booduga* (Gray)**

1837. *Leggada booduga* Gray, *Charlesworth's Mag. nat. Hist.*, 1: 586 (Southern Mahratta, India).

Material.—1 ♂ ; Molem ; 11.ix.1969 ; R. C. Sharma Coll.

Measurements.—External : *HB* 61+ ; *Tl* 63 ; *HF* 14 ; *E* 11.
 (Measurements taken from spirit preserved specimen).

Skull : *on* 18.5 ; *TR* 3.4.

Ventral colour greyish-white and tail unicolored instead of bicolored.

The mouse was collected at night from the paddy field.

SUMMARY

The present paper is based on a collection of mammals from Goa. This belongs to 22 species and subspecies. The collection is significant in being the first authentic record from this area. The report also incorporates ecological observations made in the field.

As a result of this study, variations in coloration, size etc. have been recorded in a number of forms. The Ceylon fruit-bat, *Cynopterus brachyotis ceylonensis* Gray has been recorded for the first time from India and the distributional range of the

House shrew, *Suncus murinus cerulescens* (Shaw) has been extended from Bengal, Bihar and E. Nepal to whole of Peninsular India and Ceylon. The short-nosed fruit bat, *Cynopterus sphinx gangeticus* Anderson and the Dormer's bat, *Pipistrellus dormeri caurinus* Thomas have been synonymised with *Cynopterus sphinx sphinx* (Vahl.) and *Pipistrellus dormeri dormeri* (Dobson) respectively. The taxonomic status of *Tatera indica hardwickei* (Gray) and *Bandicota indica indica* (Bechstein) has also been discussed.

REFERENCES

- AGRAWAL, V. C. 1965. Observations on habits of five-striped squirrel, *Funambulus pennanti* in Rajasthan. *J. Bengal nat. Hist. Soc.*, **34**: 76-83.
- AGRAWAL, V. C. 1967a. Taxonomic study of skulls of Oriental Rodents in relation to ecology. *Rec. Indian Mus.*, **60**: 125-326, 30 pls.
- AGRAWAL, V. C. 1967b. New records of mammals from Rajasthan. *Labdev J. Sci. Tech. India*, **5**: 342-344.
- ANDERSEN, K. 1917. On the so called colour phases of rufous Horse-Shoe bat of India (*Rhinolophus rouxi* Temminck). *J. Bombay nat. Hist. Soc.*, **25**: 260-273.
- BLANFORD, W. T. 1891. The fauna of British India, Mammalia. London (Taylor and Francis).
- BROSSET, A. 1962. The bats of central and western India. *J. Bombay nat. Hist. Soc.*, **59**: 1-57, 583-624, & 707-746.
- CHATURVEDI, Y. 1969. Two new records of bats from Assam and Andaman Islands. *Labdev J. Sci. Tech. India*, **7(B)**: 74-75.
- ELLERMAN, J. R. 1947. A key to Rodentia inhabiting India, Ceylon and Burma based on collections in the British Museum. Part 2. *J. Mammal.*, **28(4)**: 357-387.
- ELLERMAN, J. R. 1961 (1963). *The Fauna of India including Pakistan, Burma and Ceylon. Mammalia*. 3 [Rodentia], 1 & 2, Delhi (Govt. of India).
- ELLERMAN, J. R. and MORRISON-SCOTT, T.C.S. 1951. *Checklist of Palaearctic and Indian Mammals*. London (Brit. Mus. nat. Hist.).
- KHAJURIA, H. 1952. Taxonomic status of some Indian Chiroptera. *Rec. Indian Mus.*, **50**: 113-128.
- KHAJURIA, H. 1965. On the genus *Scotozous* Dobson (Chiroptera, Vespertilionidae). *Curr. Sci.*, Bangalore, **34**: 640-641.
- LINDSAY, H. M. 1929. Scientific results from the Mammal Survey No. XLVIII. Indian Shrews. *J. Bombay nat. Hist. Soc.*, **33**: 326-340.
- PHILLIPS, W. W. A. 1925. A guide to the Mammals of Ceylon. *Spolia zeylonica*, Colombo, **13**: 143-193.

- POCOCK, R. I. 1939. *The Fauna of British India, Mammalia, Vol. 1. Primates and Carnivora* (in part). London (Taylor and Francis).
- RIDGWAY, R. 1886. *Nomenclature of colors*. Boston (Little Brown & Co.).
- ROONWAL, M. L. and AGRAWAL, V. C. 1966. Measurements of Rodents (Mammalia) especially their skull for taxonomic purposes. *Rec. Indian Mus.*, **60** (1 & 2): 81-93, 3 pls.
- THOMAS, O. 1915. Scientific results from the Mammal Survey No. XI. A. On pipistrels of the genera *Pipistrellus* and *Scotozous*. *J. Bombay nat. Hist. Soc.*, **24**: 29-34.
- TIWARI, K. K., GHOSE, R. K. & CHAKRABARTY, S. 1971. Notes on a collection of small mammals from W. Ghats with remarks on the status of *Rattus rufescens* (Gray) and *Bandicota indica malabarica* (Shaw). *J. Bombay nat. Hist. Soc.*, **68**: 378-384.
- WROUGHTON, R. C. 1919. Summary of the results from the Indian Mammal Survey. Part 3. *J. Bombay nat. Hist. Soc.*, **26**: 338-379, 776-802.

Table 1.—Measurements of *Cynopterus sphinx* from the distributional range of *C. sphinx sphinx* and *C. s. gangeticus*.

Locality→ Measurements ↓	Lucknow U.P.*	Bengal	Tripura	Assam	Burma	Andaman Islands	Goa
No. of examples	6 ♂, 10 ♀	4 ♂, 4 ♀	3 ♂, 3 ♀	1 ♂, 1 ♀	1 ♂, 2 ♀	1 ♂, 1 ♀	1 ♂, 1 ♀
<i>External :</i>							
Fore arm	70.2—77.3 (74.2)†	67—76 (71.8)	64—77 (70)	69.5—74 (72)	72—74 (73.2)	72.5—76.5 (74.5)	73—76 (74.5)
Tibia	26.7—32.2 (29.1)	24.5—30 (27.7)	25—30 (27.5)	25.5—28 (26.7)	27.5—28 (27.6)	— —	27.5—31 (29)
<i>Skull :</i>							
Greatest length	31.2—34.7 (33.5)	31.7—34.5 (33.5)	32.5—33.7 (33.1)	30.6	33	33—34 (33.5)	33.2—34.3 (33.8)
Zygomatic width	20.8—22.6 (21.7)	18.8—22.3 (20.6)	20.3—21.3 (20.9)	19.3	20.5	21.3—21.5 (21.4)	21.3—21.4 (21.4)
Cranial width	13.1—14.6 (14.3)	13.2—15.0 (14.1)	13.6—13.9 (13.8)	13.6	14.8	13.5—14.4 (14)	13.5—14.3 (13.9)
Tooth-row	10.2—12.0 (11.3)	10.5—12.0 (11.0)	10.7—11.6 (11.1)	10.3	10.4	11.5—12 (11.7)	11.7—12.0 (11.8)
Mandibular length	23.7—26.7 (25.8)	23.5—26.3 (25.1)	23—24.5 (23.6)	23	25.2	25.5—26 (25.8)	24—26.7 (25.4)

*Measurements after Khajuria (1952).

†Figures in parentheses show mean measurements.

Table 2.—Measurements of *Pipistrellus dormeri* from different localities in India.

Locality→ Measurements ↓	Sind	Rajasthan	Gujarat	Bihar	Deccan	Goa
No. of examples	1 ♂, 1 ♀	7 ♂, 11 ♀	4 ♂, 3 ♀ *	1 ♂, 1 ♀	2 ♂, 1 ♀	1 ♀
<i>External :</i>						
Fore arm	32.5—34.5 (33.5)	34—37 (35.6)	34—36 (35)	34—35 (34.5)	33.5—35 (34.2)	38
<i>Skull :</i>						
Greatest length	13.7—13.8 (13.75)	13.4—14.2 (13.7)	14—14.5 (14.3)	13.6—13.7 (13.65)	13.2—13.6 (13.4)	14.6
Zygomatic width	9.8—9.9 (9.85)	9.8—10.6 (10.1)	10—10 (10)	9.7—10 (9.85)	— —	9.6
Tooth-row	5.3—5.5 (5.4)	5.2—5.6 (5.3)	5.6—6.0 (5.9)	5.3—5.5 (5.4)	5.2—5.3 (5.25)	5.2

Figures in Parentheses show mean measurements.

*Measurements after Brosset (1962).

Table 3.—External and cranial measurements of *Ratufa indica indica* and *R. indica centralis*.

Name of Subspecies & locality	No. of examples	Head & Body	Tail	Tail as % of HB	Hind foot	Hind foot as % of HB	Ear	Occipito- nasal length	Tooth-row
<i>Ratufa indica indica</i>	3 ♂	370—380 (375)*	370—405 (391)	97—108% (104%)	57—76 (69)	15.2—20% (18.4%)	26—29 (27)	71.9—74.1 (73.2)	14.5—14.9 (14.8)
(Satara & Dharwar)	8 ♀	340—370 (351)	380—447 (419)	110—130% (119%)	59—77 (68)	16.8—21.4% (19.3%)	26—33 (28.4)	68.3—74.9 (71.7)	14.1—15.5 (14.8)
Goa	5 ♂	340—392 (370)	410—440 (426)	109—120% (115%)	78—83 (81)	21.1—23.2% (21.8%)	25—27 (26)	73—76 (74.2)	14.3—15.2 (14.6)
	2 ♀	360—378 (369)	423—440 (431)	116—117% (116.5%)	80—81 (80.5)	21.4—22.2% (21.8%)	26—26 (26)	70—73 (71.5)	15—15.5 (15.25)
<i>Ratufa indica centralis</i>	11 ♂	309—365 (343)	375—450 (414)	110—130% (120%)	72—81 (76)	20.5—23.6% (22.1)	26—30 (28)	68—74.3 (72)	13.8—15.2 (14.4)
(M.P., Orissa, Mysore)	10 ♀	314—407 (350)	385—460 (415.5)	109—130% (119%)	74—84 (77)	20.5—23.2% (22%)	25—32 (28.2)	69.8—76.4 (72.8)	14—15.5 (14.6)

*Figures in Parentheses show mean measurements.

Table 4.—External and cranial measurements of *Bandicota indica indica* from Goa (Western Ghats) and Madras.

Locality	No. of examples	Head & body	Tail	Hind foot	Ear	Occipito-nasal length	Tooth-row
Goa	3 ♂, 1 ♀	262—280 (270)†	265—289 (279)	52—54 (53)	26—32 (30)	54·8—58·4 (57)	9·5—10 (9·8)
Madras	2 ♀	230—255* (242)	275—295 (285)	54—54 (54)	26—30 (28)	55·7—57 (56·3)	10—10 (10)

†Figures in parentheses show mean measurements.

*Measurements taken from spirit preserved specimens.

THE HELMINTH FAUNA OF ANDAMAN AND
NICOBAR ISLANDS TREMATODA

By

T. D. SOOTA, C. B. SRIVASTAVA AND R. K. GHOSH

Zoological Survey of India, Calcutta

(With 2 Text-figures)

INTRODUCTION

The present paper deals with the study of a small collection of trematodes obtained during the Andaman and Nicobar Survey, 1969 (February-April) led by the first author. The specimens belong to three species *viz.*, *Brachylecithum andamanensis* Soota, Srivastava and Ghosh; 1970 ; *Acanthoparyphium cambelensis* Soota, Srivastava and Ghosh, 1969 and *A. lobatum* Soota, Srivastava and Ghosh, 1970. These species are described in detail below. All measurements are in mm.

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SYSTEMATIC ACCOUNT

Family DICROCOELIIDAE

Subfamily DICROCOELIINAE

Genus **Brachylecithum** Strom, 1940

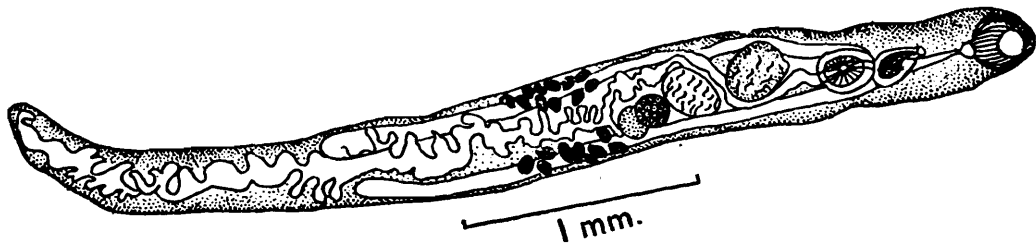
1. **Brachylecithum andamanensis** Soota,
Srivastava & Ghosh, 1970

(Text-fig. 1)

1970. *Brachylecithum andamanensis* Soota, Srivastava & Ghosh, *Proc. 57th Indian Sci. Cong.*: 465.

Material.—Holotype—one, Z.S.I. Reg. No. W 7051/1 ; host—white-collared king-fisher (*Halcyon chloris*) ; location—intestine ; locality—Maya Bunder (Middle Andaman) ; 25.iii.1969, T. D. Soota Coll. Paratypes—3, Z.S.I. Reg. No. W 7052-54/1. Other details as for holotype. (All specimens extremely fragile).

Description.—Body smooth, thin, elongated, 3.73-4.09 long, 0.36-0.41 in maximum width in testicular or ovarian zone. Oral sucker, subterminal, almost round, $0.18-0.20 \times 0.16-0.18$.



Text-fig. 1. *Brachylecithum andamanensis* Soota, Srivastava & Ghosh.

Acetabulum in anterior third of body, slightly larger than oral sucker, measures $0.20-0.27 \times 0.20-0.22$. Pharynx muscular, round, $0.04-0.05$ in diameter. Oesophagus very short, $0.13-0.17$ in length. Caeca asymmetrical, reaching up to posterior fourth of the body length. Testes tandem, round or oval, separated by uterine loops, measure $0.21-0.23 \times 0.22-0.25$ and $0.16-0.23 \times 0.17-0.25$. Cirrus sac just anterior or overlapping the acetabulum, measures $0.14-0.20 \times 0.72-0.90$. Vesicula seminalis bipartite. Ovary post-testicular, round, $0.11-0.13$ in diameter. Receptaculum seminis and shell gland well developed, postero-lateral to ovary. Uterine coils extensive, form ascending and descending loops from post-ovarian region. Coils pass through spaces between ovary and posterior testis and inter-testicular space. Genital pore pre-bifurcal. Vitellaria limited in extent, extending a short distance from acetabular zone. Vitelline follicles constant in number, 12 on left and 9 on right side. Eggs yellow, elliptical, numerous, $0.012-0.016 \times 0.063-0.090$. Excretory bladder Y-shaped. Excretory pore terminal.

Discussion.—The present species bears close resemblance to *Brachylecithum halcyonis* (Yamaguti, 1941), *B. strigio* (Yamaguti, 1939), *B. stunkardi* Pande, 1939 and *B. chapmani* Singh, 1962, but differs from the first species in the number of vitelline follicles, ratio of the two suckers, and size of the gonads; and from the remaining three it differs in absence of lateral processes of acetabulum, in size of ovary, and nature of vitelline follicles. This species, however, stands apart from all other known species of the genus in having a unique character *viz.*, 12 vitelline follicles on left and 9 on the right side.

Family ECHINOSTOMATIDAE

Subfamily ECHINOSTOMATINAE

Genus *Acanthoparyphium* Dietz, 1909

2. *Acanthoparyphium lobatum* Soota,
Srivastava & Ghosh, 1970

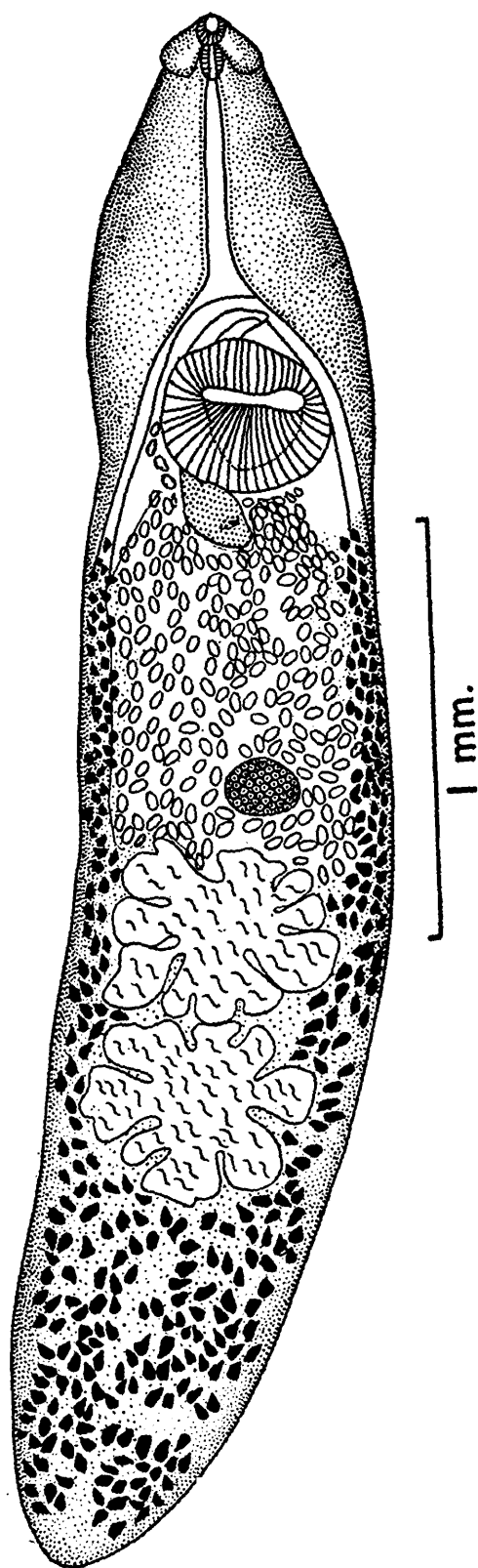
(Text-fig. 2)

1970. *Acanthoparyphium lobatum* Soota, Srivastava & Ghosh, *Proc. 57th Indian Sci. Cong.*: 465.

Material.—Holotype—one, Z.S.I. Reg. No. W 7046/1, host—Plover (*Pherialis* sp., location—intestine, locality—Maya Bunder (Middle Andaman), 25.iii.1969, *T. D. Soota* Coll. Paratypes—4, Z.S.I. Reg. No. W 7047-50/1. Other particulars as for holotype.

Description.—Body elongate, tapering at both ends, 6.84-7.20 long, 1.26-1.46 in maximum width, spinulate, spines sparse in posterior region. Head-collar armed with single uninterrupted row of 26-28 spines. Oral sucker terminal, $0.14-0.16 \times 0.13-0.18$. Prepharynx 0.07 long. Pharynx $0.10-0.14 \times 0.11$. Oesophagus slender, 0.76-0.83 long. Caeca reaching posterior extremity, terminal ends dilated. Acetabulum in anterior third of the body, 0.72-0.83 in diameter. Testes post-acetabular, deeply lobed, tandem, measure $0.72-0.81 \times 0.85-0.88$ and $0.72-0.85 \times 0.81-0.86$ respectively. Cirrus sac long, post-bifurcal, surpassing acetabulum, enclosing vesicula seminalis, measures $1.01-1.39 \times 0.18-0.24$. Genital pore median, postbifurcal. Ovary small, almost round, equatorial, pre-testicular, submedian, $0.25-0.27 \times 0.25-0.29$. Shell gland complex posterolateral to ovary. Vitelline follicles extend laterally from acetabulum to posterior extremity, contiguous in post-testicular zone. Uterine coils confined mostly to pre-testicular and post-acetabular zone. Eggs yellow, elliptical, operculate, $0.081-0.09 \times 0.036-0.054$.

Discussion.—Genus *Acanthoparyphium* Dietz, 1909 contains seven species as discussed by Soota *et al.* (1969, 1970a). The present species bears close resemblance to *Acanthoparyphium oethodromi* Tubangui, 1933 but differs from it in the nature of lobulation of testes, in the extension of body spines, in the position of shell gland complex, in length of cirrus sac and in the size of body and eggs.



Text-fig. 2. *Acanthoparyphium lobatum* Soota, Srivastava & Ghosh.

3. *Acanthoparyphium cambellensis* Soota,
Srivastava & Ghosh, 1969

1969. *Acanthoparyphium cambellensis* Soota, Srivastava & Ghosh, *Proc. 56th Indian Sci. Cong.*: 503-504.

1970. *Acanthoparyphium cambellensis* Soota, Srivastava & Ghosh, *Proc. Indian Acad. Sci.* 72 (6): 243.

Material.—12 exs., Z.S.I. Reg. No. W 7055/1, Host—golden plover (*Pherialis dominica*), location—intestine, locality—Maya Bunder (Middle Andaman), 26.iii.1969, T. D. Soota Coll..

Remarks.—Soota *et al.* (1969, 1970a) described this species from the same host from Cambell Bay, Great Nicobar Island. Some of the measurements of the present specimens are given below :

Body $4.23-5.22 \times 0.63-0.77$; Oral sucker $.09-0.1 \times 0.1-0.11$, Pharynx $0.09-0.1 \times 0.06-0.11$; Acetabulum $0.31-0.4 \times 0.31-0.39$; testes $0.31-0.45 \times 0.24-0.4$ and $0.38-0.54 \times 0.24-0.36$ respectively ; ovary $0.12-0.18 \times 0.13-0.15$; eggs $0.08-0.09 \times 0.03-9.95$.

SUMMARY

The paper deals with the description of three species of trematodes from birds from Andaman Islands. Of these, two have been fully described and some of the measurements of the third species have been incorporated and its distribution range extended.

REFERENCES

- SOOTA, T. D., SRIVASTAVA, C. B. & GHOSH, R. K. 1969. Studies on the helminth fauna of the Great Nicobar Island. Pt. I. Trematoda. *Proc. 56th Indian Sci. Cong. Pt. III.*, Abstracts: 503-504.
- SOOTA, T. D., SRIVASTAVA, C. B. & GHOSH, R. K. 1970. The helminth fauna of Andaman and Nicobar. Part. I. Trematoda. *Proc. 57th Indian Sci. Cong.*, Pt. III; Abstracts: 465.
- SOOTA, T. D., SRIVASTAVA, C. B. & GHOSH, R. K. 1970a. Studies on the helminth fauna of the Great Nicobar Island. Pt. I. Trematoda. *Proc. Indian Acad. Sci.*, 72(6): 241-250.

CONTRIBUTION TO THE STUDY OF
AQUATIC BEETLES (COLEOPTERA)
12. ON A COLLECTION OF DYTISCIDAE FROM
GUJARAT WITH DESCRIPTION OF A NEW SPECIES

By

T. G. VAZIRANI

Zoological Survey of India, Calcutta

(With 1 Text-figure)

INTRODUCTION

The Gujarat State lies in the south-west corner of India, and the area selected for making collections is the region known as Saurashtra or Kathiawar. The collections were made at different places in three districts *viz.*, Junagadh, Jamnagar and Surendranagar.

Hitherto only a single species of Dytiscidae was known from Junagadh, Gujarat. The present collection comprises 22 species spread over 14 genera. There is one new species in this collection. Twentyone species are being recorded from this area for the first time.

It was interesting to collect the larva of *Sandracottus dejeani* Aube, which has been described separately (Vazirani, 1971).

Keys to genera and species of Dytiscidae, known from India, are available in my papers 1965, 1969, a, b, 1970 and in press).

This list is not considered exhaustive as only 3 districts could be surveyed in a short period of less than 4 weeks. It is considered desirable to publish the present list, since it is very difficult to say when it will be possible to visit other districts. Some diagnostic characters are also provided for each species, to facilitate identification by those who may be interested in preliminary identification in the field.

The fauna of Gujarat is compared with that of the neighbouring states of Rajasthan in the north and Maharashtra in the south.

LIST OF SPECIES

Family DYTISCIDAE

Subfamily NOTERINAE

1. *Hydrocoptus subvittulus* Aube
2. *Canthydrus laetabilis* (Walker)

Subfamily LACCOPHILINAE

3. *Laccophilus chinensis inefficiens* Walker
4. *L. flexuosus* Aube
5. *L. parvulus* Aube
6. *L. sharpi* Regimbart

Subfamily HYDROPORINAE

7. *Hydrovatus fuscus* Sharp
8. *Herophydrus musicus* (Klug)
9. *Hyphydrus (Apriophorus) flavicans* Regimbart
10. *H. (A.) intermixtus* (Walker)
11. *Peschetius toxophorus* Guignot
12. *P. quadricostatus* (Aube)
13. *Guignotus flammulatus* (Sharp)
14. *G. pendjabensis* Guignot
15. *G. gujaratensis* sp. n.
16. *Yola consanguinea* (Regimbart)

Subfamily COLYMBETINAE

17. *Copelatus mysorensis* Vazirani

Subfamily DYTISCINAE

18. *Eretes sticticus* (Linnaeus)
19. *Hydaticus vittatus* (Fabricius)
20. *H. luczonicus* Aube
21. *Sandracottus dejeani* (Aube)
22. *Cybister tripunctatus asiaticus* Sharp

AN ACCOUNT OF COLLECTING STATIONS

Junagadh Dist., Visavadar—3.ix.1969. This place is situated between the river Dharpar to the north and Popatdi and Mayari rivers to the south. On the eastern side it is more or less bounded by the railway line. All these three rivers originate in the eastern hills, about 10 miles up stream. These rivers get swollen

during heavy showers of the monsoon but very soon, within 4-5 days most of the water drains away, leaving behind nothing more than a small stream. The bed of all the three rivers is made up of gravel and boulders. There is no vegetation, floating or submerged, in any of these rivers.

There are no ponds in the vicinity of this small village and water is generally very scarce.

Junagadh Dist., Sasangir, 8.ix.1969: It is sanctuary area for the Indian Lion. River Hiran flows near the guest house. There is a dam upstream on this river, only a small amount of water is let off through sluices. Near the guest house, at the time of collection, the velocity of water flow current was considerable. From the pools, in the bed of the course of the river, some beetles were collected. There was some algal growth, in these pools.

There had been intermittent rainfall between 14.vii.69 to 15.viii.69.

9.ix.1969—3 km. from guest house, on road to Kankai. Collecting in a rain-fed road side ditch, revealed the presence of a single specimen of *Sandracottus dejeani* (Aube) and its larvae. Further down the road and acrossing it, runs a small stream, which falls by about 4-6 meters and drains into the river Hiran. A good collection of beetles was obtained in this stream and its connecting pools, which had a fairly luxuriant growth of vegetation (algae, floating and submerged aquatic plants).

10.ix.1969—Visited the same stream but went up stream, as far as possible. Ecological conditions were the same.

11.ix.1969.—Collections were made in 4-5 streams, on the jungle roads between Sasangir and Jambuthla, on the boundry of the sanctuary area.

Jamnagar: This city is situated on the bank of the river Nagmati and is only about 15 km. from the sea. It had received its normal rainfall of about 28 cm. between 14.vii.1969 to 15.viii.1969 at frequent intervals but it had not rained since then. Thus the period/time for colonization of rain-fed ponds/pools can be estimated approximately between 4-8 weeks.

14.ix.1969. Khera Braja, about 14 km. to the south of Jamnagar. There is a stone quarry. The ditches were filled with rain water and submerged aquatic plants were also present. Many species were found in these pools. There was a larger

and shallow pool, without any aquatic vegetation and this had only a couple of species of *Guignotus*.

15.ix.1969. A medium-sized rain-fed pond, about 10 km. from Jamnagar, on the road to Rajkot, on the left hand side between the river Nagmati and Dhuvavao river, while there was no submerged aquatic vegetation, the sides were thick with grass etc.; the water was very muddy but was being used by animals for drinking.

Quite a number of species have been collected at this spot.

16.ix.1969. Bedeshwar, about 2km. to the south of Jamnagar, a large pond, with thick vegetative growth along the edges.

Surendranagar Dist., Surendranagar : This place is situated on the bank of the Bhogava river. But this river has now been completely dammed upstream. Only a small portion of excess water is diverted through the side channels.

This place is situated on the bank of the Bhogava river. But this river has now been completely dammed upstream. Only a small portion of excess water is diverted through the side channels.

The rainfall had been much below average during the year ; there were not many road-side ditches.

18.ix.1969. Between the dam and the road bridge, there are many pools around the small main stream, which follows a zig zag course. Though the quantity of water in the stream is very limited, the latter is perennial because of the large dam upstream. Substratum is hard, mostly gravel, with very small quantity of alluvial soil. Submerged or floating vegetation is lacking but there is quite a luxurious growth of grass on the edges of these ponds.

19.ix.1969. After crossing the above mentioned road bridge, there is a road to Rajkot. Near the first main triway crossing, are a few road side ditches of medium size, shallow, with muddy substratum and without any vegetation. Obviously water had accumulated in these ditches due to the earlier rains.

20.ix.1969. Collections were made just below the dam. Ecological conditions were similar to those on 18.ix.1969.

21.ix.1969. Down stream of the same river, near Wadhwan town. Ecological conditions were similar to those on 18.ix. 1969,

SYSTEMATIC ACCOUNT

Order COLEOPTERA

Family DYTISCIDAE

Subfamily NOTERINAE

***Hydrocoptus subvittulus* Motschulsky**

1860. *Hydrocoptus subvittulus* Motschulsky, *Etud. Ent.*, 8: 43.
 1968. *Hydrocoptus subvittulus*: Vazirani, *Oriental Ins.*, 1: 99.
 1969. *Hydrocoptus subvittulus*: Vazirani, *Oriental Ins.*, 2: 223.
 1970. *Hydrocoptus subvittulus*: Tonapi & Ozarkar, *J. Bombay nat. Hist. Soc.*, 66(2): 313, pl. III, fig. 5 (wrong identification).
Material.—1 ex., Surendranagar, 19.ix.1969.

Diagnosis.—Length 1.80-2.20 mm. Apex of anterior tibiae without curved spurs. Puncturation on elytra arranged in indistinct rows.

Remarks.—This species is so far known in India from Assam, Bihar, Maharashtra, Orissa and West Bengal. It is now being recorded from Gujarat for the first time.

2. *Canthydrus laetabilis* (Walker)

1858. *Hydroporus laetabilis* Walker, *Ann. Mag. nat. Hist.*, 3 (2): 205.
 1969. *Canthydrus laetabilis*: Vazirani, *Oriental Ins.*, 2: 229.
Material.—1 ex., Sasangir, 9.ix.1969; 1 ex., Jamnagar, 15.ix.1969; 19 ex., 18.ix.1969; 1 ex., 19.ix.1969; 5 ex., 20.ix.1969; 10 ex., 21.ix.1969, Surendranagar.

Diagnosis.—Length 2.25-2.7 mm. Apex of anterior tibiae with curved spurs. Prosternal process moderately broad, truncate posteriorly. Pronotum testaceous; elytra brownish-black with two basal orange-yellow spots arranged transversely and one transverse irregular spot situated post-medially.

Remarks.—This is a very widely distributed species from Belgian Congo in Africa to W Pakistan, India, Nepal, Burma and Ceylon. In India also it is very widely distributed. Though not so far known from Gujarat, it is already reported from adjoining states of Maharashtra and Rajasthan.

Subfamily LACCOPHILINAE

3. *Laccophilus chinensis inefficiens* Walker

1858. *Laccophilus chinensis* Boheman, K. SV. *Fregatten Eugenies Resa* Coleopteres, 2: 21.

1859. *Laccophilus inefficiens* Walker, *Ann. Mag. nat. Hist.*, (3) 3: 51.
 1969. *Laccophilus chinensis inefficiens*: Vazirani, *Oriental Ins.*, 2: 243.
 1971. *Laccophilus chinensis inefficiens*: Vazirani, *Oriental Ins.*, 4: 443 (Goa).

Material.—4 ex., Sasangir, 9.ix.69 ; 1 ex. Same locality, 10.ix.69 ; 1 ex., Jamnagar, 16.ix.69.

Diagnosis.—Length 3.2-3.6 mm. Elytra testaceous, markings consisting of brown/black irrotations, with a sub-basal fascia having six short anteriorly radiating (converging to base) lines.

Remarks.—This subspecies occurs in India, Burma, Ceylon and West Pakistan. In India, it has been reported from Assam, Bihar, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Uttar Pradesh, West Bengal, Himachal Pradesh and Goa.

It is now being recorded from Gujarat for the first time.

4. *Laccophilus flexuosus* Aube

1838. *Laccophilus flexuosus* Aube, In Dejean's *Species Coleopteres*, 6: 430.

1969. *Laccophilus flexuosus*: Vazirani, *Oriental Ins.*, 2: 245-246.

Material.—6 ex., 14.ix.69, Jamnagar ; 3 ex., same locality, 15.ix.69 ; 2 ex. ; same locality, 16.ix.69.

Diagnosis.—Length 3.1-4.25 mm. Elytra testaceous, markings consisting of very fine flexuosus lines, somewhat darker in posterior half.

Remarks.—This species is widely distributed from West Pakistan, India to Indonesia (Sumatra). In India it has been reported from Andhra Pradesh, Bihar, Madhya Pradesh, Madras, Maharashtra, Mysore, Orissa, Rajasthan, Uttar Pradesh, West Bengal and Himachal Pradesh.

It is now being recorded from Gujarat for the first time.

5. *Laccophilus parvulus* Aube

1838. *Laccophilus parvulus* Aube, in Dejean's *Species Coleopteres*, 6: 429.

1969. *Laccophilus parvulus*: Vazirani, *Oriental Ins.*, 2: 247.

1969. *Laccophilus parvulus*: Tonapi & Ozarkar, *J. Bombay nat. Hist. Soc.*, 66 (2): 314.

1970. *Laccophilus parvulus*: Vazirani, *Oriental Ins.*, 4 (2): 178 (Andaman Islands).

1971. *Laccophilus parvulus*: Vazirani, *Oriental Ins.*, 4: 442 (Goa).

Material.—26 ex., 14.ix.69 ; 7 ex., 15.ix.69 ; 54 ex., 16.ix.69, Jamnagar ; 3 ex., 18.ix.69 ; 2 ex., 21.ix.69, Surendranagar.

Diagnosis.—Length 2.75-3.7 mm. Pronotum testaceous, often with narrow streak of black towards the middle of anterior and posterior margins. Elytra testaceous to ferruginous, with undulating longitudinal black lines sometimes confluent in two and two, sometimes reduced to five or six such lines with anterior and posterior fascia.

Remarks.—This species is very widely distributed from West Pakistan, India, Ceylon to 'Indo-China' In India it has been reported from Andhra, Assam, Bihar, Goa, Madhya Pradesh, Maharashtra, Madras, Manipur, Orissa and Rajasthan. It is now being recorded from Gujarat for the first time.

6. *Laccophilus sharpi* Regimbart

1889. *Laccophilus sharpi* Regimbart, *Ann. Soc. ent. Fr.*, (6) 9: 151.

1969. *Laccophilus sharpi*: Vazirani, *Oriental Ins.*, 2: 249.

Material.—37 ex., 14.ix.69 ; 5 ex., 15.ix.69 ; 3 ex., 16.ix.69, Jamnagar, 1 ex., 18.ix.69 ; 1 ex., 19.ix.69 ; 3 ex., 21.ix.69, Surendranagar.

Diagnosis.—Length 3.5-4.0 mm. Very close to *L. parvulus* but generally larger in size ; the black lines along the middle of anterior and posterior margins of pronotum generally thicker ; elytral zig zag lines clearer and thicker than in *parvulus* but never coalescent. Doubtful specimens can be confirmed only by the study of male genitalia.

Remarks.—This is a very widely distributed species from West Pakistan, India, Ceylon to 'Indo-china' and Indonesia. In India it has so far been recorded from Bihar, Madhya Pradesh, Madras, Maharashtra, Orissa, Rajasthan, Uttar Pradesh, West Bengal. It is now being recorded from Gujarat for the first time.

Subfamily HYDROPORINAE

7 *Hydrovatus fuscus* Sharp

1882. *Hydrovatus fuscus* Sharp, *Sci. Trans. R. Dublin Soc.*, 2: 326.

1970. *Hydrovatus fuscus*: Vazirani, *Oriental Ins.*, 4 (1): 106.

Material.—4 ex., Jamnagar, 15.ix. 69 ; 5 ex., Surendranagar, 18.ix.69 ; 1 ex., same loc., 21.ix.69.

Diagnosis.—Length 2.25-2.5 mm. Elytra testaceous, clypeus rebordered and slightly raised anteriorly ; reticulation on elytra obsolete ; punctation on metasternum and hind coxal plates large, profound and dense.

Remarks.—This species is widely distributed in the Oriental Region. In India it is known from Bihar, Assam, Orissa and West Bengal. It is now being reported from Gujarat for the first time.

8. *Herophydrus musicus* (Klug)

1833. *Hydroporus muscius* Klug, *Symbolae Physicae*, 4: 33.

1970. *Herophydrus musicus*: Vazirani, *Oriental Ins.*, 4 (1): 112.

Material.—4 ex., Jamnagar, 14.ix.69 ; 1 ex., Surendranagar, 21.ix.69.

Diagnosis.—Length 2.5-2.8 mm. Only species of the genus occurring in India. Very near to the genus *Hyphoporus* Sharp (Vazirani, 1969 b). Elytral markings usually consisting of five black longitudinal lines interrupted 2-3 times to form elongate spots but may be reduced to 3 elongate lines each consisting of 1-2 small spots.

Remarks.—This is a very widely distributed species, extending from North Africa, southern parts of U.S.S.R. (Turkistan), through India, Pakistan and Nepal to Burma. In India it is so far known from Andhra Pradesh, Bihar, Madras, Madhya Pradesh, Rajasthan and Uttar Pradesh.

9. *Hyphydrus* (*Apriophorus*) *flavicans* Regimbart

1892. *Hyphydrus flavicans* Regimbart, *Ann. Soc. ent. Belg.*, 36: 113.

1969. *Hyphydrus* (*Apriophorus*) *flavicans*: Vazirani, *Oriental Ins.*, 2: 305.

Material.—3 ex., Jamnagar, 14.ix.69 ; 1 ex., same loc., 15.ix.69 ; 2 ex., same locality, 16.ix.69.

Diagnosis.—Length 4.4-4.2 mm. Punctuation on elytra simple ; pronotum largely testaceous ; all segments of the anterior and middle tarsi concolorous. Male with a small spine on the 2nd abdominal sternite directed backwards ; female with a small fossette situated in the middle of the outer longitudinal black band of the elytra.

Remarks.—This species is known from West Pakistan and India. In India it is reported from Bihar, Madras, Orissa and Rajasthan. It is now being reported from Gujarat for the first time.

10 *Hyphydrus* (*Apriophorus*) *intermixtus* (Walker)

1858. *Hydroporus intermixtus* Walker, *Ann. Mag. nat. Hist.*, (3) 2: 204.

1969. *Hyphydrus* (*Apriophorus*) *intermixtus*, Vazirani, *Oriental Ins.*, 2: 305-306, fig. 13 F.

1969. *Hyphydrus indicus*: Tonapi & Ozarkar, *J. Bombay nat. Hist. Soc.*, 66 (2), 315.

Material.—1 ex., Jamnagar, 15.ix.69.

Diagnosis.—Length 3.5-4.1 mm. *Punctuation* on elytra simple, pronotum largely black in the middle; apical segment of the fore and middle tarsi black; male without a small spine/tubercle on the 2nd abdominal sternite.

Remarks.—This specimen is particularly small in size, measuring about 3.5 mm. only as against earlier records of 3.9-4.1 mm. It is so far known from Ceylon and India: Madras, Maharashtra and Rajasthan. It is now being reported from Gujarat for the first time.

11. *Peschetius toxophorus* Guignot

1943. *Peschetius toxophorus* Guignot, *Bull. Soc. Et. sci. Nat.*, Vaucluse, 1942: 21.

1970. *Peschetius toxophorus*: Vazirani, *Oriental Ins.*, 4: 113.

Material.—3 ex., Visavadar, 3.ix.69; 1 ex., Sasangir, 8.ix.69; 1 ex., same loc., 9.ix.69; 6 ex., same loc., 10.ix.69; 31 ex., same loc., 11.ix.69.

Diagnosis.—Length 2.9-3.35 mm. Head largely black. Elytra with two longitudinal carinae, the inner straight and commencing directly behind the base of elytra and attaining four-fifths of their length, the outer beginning some distance from the humeral region and extending (almost parallel to the inner one) for three fourths of its length and then widely rounded and converging to join the inner carina at its apex.

Remarks.—In India, it is so far known from Bihar, Madras, Maharashtra, Orissa, Rajasthan and Mysore. It is now being reported from Gujarat for the first time.

12. *Peschetius quadricostatus* (Aube)

1838. *Deronectes quadricostatus* Aube, in Dejean's *Species Coleopteres*, 6: 486.

1968. *Peschetius quadricostatus*: Vazirani, *Oriental Ins.*, 1: 108.

1969. *Peschetius quadricostatus*: Tonapi & Ozarkar, *J. Bombay nat. Hist. Soc.*, 66 (2): 315.

1970. *Peschetius quadricostatus*: Vazirani, *Oriental Ins.*, 4: 115,

Material.—1 ex., Sasangir, 9.ix.69; 6 ex., same loc.,

10.ix.69 ; 1 ex., same loc., 11.ix.69 ; 3 ex., Jamnagar, 14.ix.69 ; 1 ex., same loc., 15.ix.69.

Diagnosis.—Length 2.9-3.4 mm. Differs from the above species in having the head reddish brown and punctation on the sixth abdominal sternite less fine.

Remarks.—This species is very common in India, having been reported from Bihar, Kerala (Malabar), Madras, Maharashtra, Orissa and Uttar Pradesh. It is now being reported from Gujarat for the first time.

13. *Guignotus flammulatus* (Sharp)

1882. *Bidessus flammulatus* Sharp, *Sci. Trans. R. Dublin Soc.*, 2: 359.
1969. *Guignotus flammulatus*: Vazirani, *Oriental Ins.*, 2: 313.

Material.—2 ex., Surendranagar, 18.ix.69 ; 4 ex., same loc., 20.ix.69.

Diagnosis.—Length 2.3-2.5 mm. Laterobasal plica of pronotum not continued on the elytra ; elytra testaceous with black markings as under : (i) basal transverse band quite broad and irregular but not touching the suture, (ii) large broad stripe a long suture, indented and irregular on the outer side.

Remarks.—It is a very widely distributed species extending from West Pakistan, India to Southern China and Viet Nam (Tonkin). In India it is recorded from Orissa, Rajasthan, Uttar Pradesh and West Bengal. It is now being recorded from Gujarat for the first time.

14. *Guignotus pendjabensis* Guignot

1954. *Guignotus pendjabensis* Guignot, *Opusc. ent.*, 14: 221.
1969. *Guignotus pendjabensis*: Vazirani, *Oriental Ins.*, 2: 320.
In Press. *Guignotus pendjabensis*, Vazirani, *Oriental Ins.*, (Goa).

Material.—9 ex., Jamnagar, 14.ix.69 ; 13 ex., same loc., 16.ix.69 ; 1 ex., Surendranagar, 18.ix.69 ; 1 ex., same loc., 19.ix.69 ; 1 ex., same loc., 20.ix.69.

Diagnosis.—Length 1.75-1.82 mm. Laterobasal plica on pronotum distinctly continued on elytra ; pronotal plica at least half the length of pronotum ; elytral markings consisting of two parallel longitudinal lines terminating externally in the form of a crochets.

Remarks.—Its known distribution is limited to West Pakistan ; India : Bihar, Goa, Madras, Maharashtra, Madhya

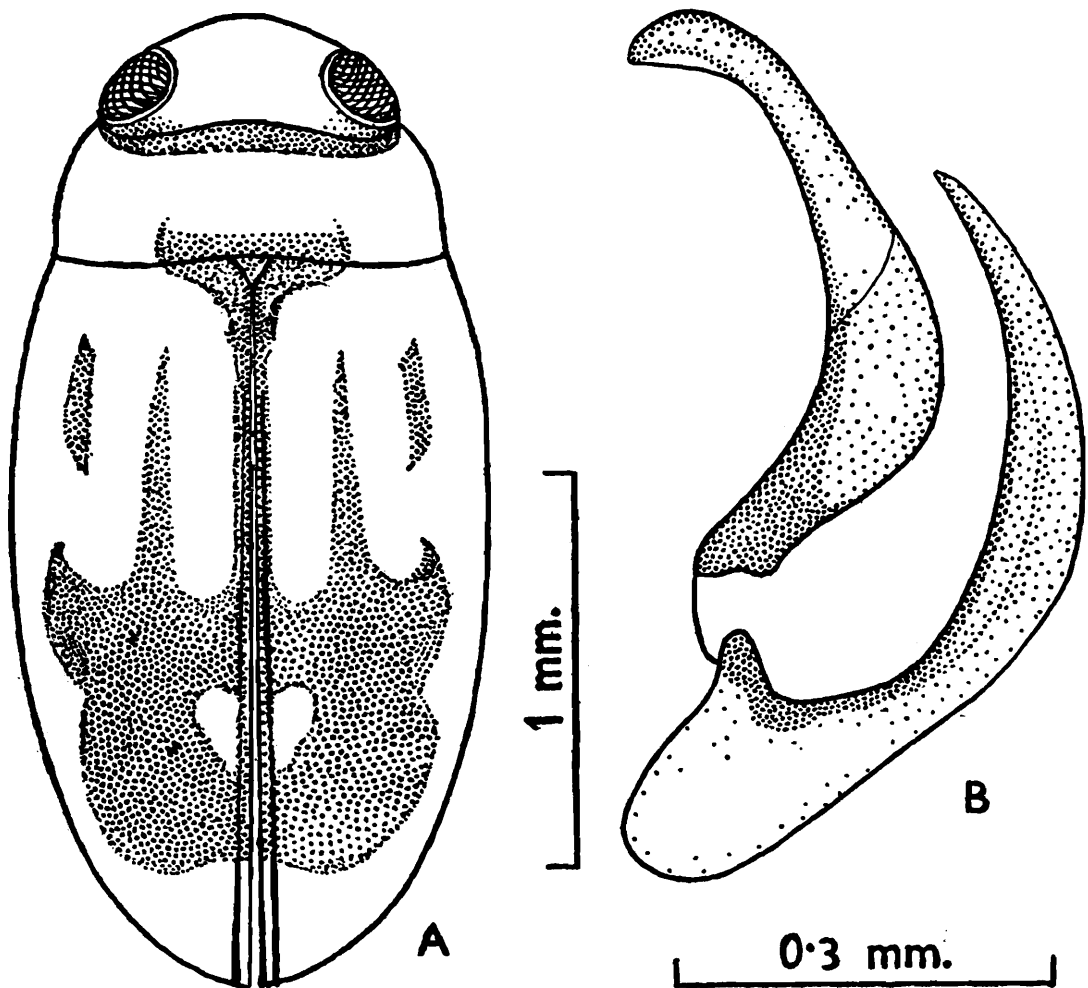
Pradesh, Orissa and Rajasthan. It is now being reported from Gujarat for the first time.

15. *Guignotus gujaratensis* spn.

Length 2.4-2.6 mm. Breadth 1.1-1.2 mm.

Form elongate, a little attenuated posteriorly and between the pronotum and the base of the elytra; dorsal surface pubescent.

Head testaceous, narrowly ferruginous along the posterior border; punctation very fine, irregular and quite sparse; reticulation indistinct; clypeus truncated anteriorly; antennae of moderate size, not exceeding in length the base of the elytra.



Text-fig. 1. *Guignotus gujaratensis* sp.n.—A. Dorsal view
B. Lateral view of penis and paramere.

Pronotum testaceous, ferruginous along the anterior margin and in between the laterobasal plica; sides moderately convex forming a distinct angle with the base of elytra; punctation moderate, irregular, separated by 1-2 times its own diameter

on the disc but very close along the posterior border, between the laterobasal plica ; reticulation obsolete, consisting of minute rounded areoles ; laterobasal plica incurved, small, about one fourth the length of pronotum but hardly continued on the elytra.

Elytra, testaceous with brown markings as shown in the figure ; sutural striae distinct, near the base merging with strong and dense punctation ; pubescence, white, moderate and quite dense ; punctation larger and denser than on the pronotum, very close but not coalescent on the disc ; reticulation distinct, consisting of small rounded areoles ; laterobasal plica generally absent but sometimes continued as a small point in some specimens.

Ventral side ferruginous ; epipleurae and legs testaceous ; penis (text fig. 1 b) quite narrowed towards the apex.

Remarks.—This species comes near to *Guignotus pradhani* Vazirani, in size as well as the character of the laterobasal plica on pronotum, but it is comparatively larger in size viz. 2.4-2.6 mm. as against 2.2-2.4 mm. It chiefly differs from *G. pradhani* in the punctation on elytra being less dense separated by 4-5 times its own diameter as against very close. The elytral markings also differ in these two species.

Holotype ♂, INDIA : Gujarat, Jamnagar, 14.ix.69 (T. G. Vazirani Coll.).

Paratypes, 13 ex. with same particulars as holotype ; 1 ex., same locality, 15.ix.69 ; 2 ex., same locality, 16.ix.69 ; 5 ex., Surrindranagar, 18.ix.69 ; 13 ex., same locality, 19.ix.69 ; 1 ex., same locality, 20.ix.69.

16. *Yola consanguinea* (Regimbart)

1892. *Bidessus consanguineus* Regimbart, *Ann. Soc. ent. Belg.*, **36** : 118.

1968. *Yola consanguinea* : Vazirani, *Oriental Ins.*, **1** : 107.

1969. *Yola consanguinea* : Vazirani, *Oriental Ins.*, **2** : 333.

1969. *Yola consanguinea* : Tonapi and Ozarkar, *J. Bombay nat. Hist. Soc.*, **66** (2) : 315.

Material.—3 ex., Visavadar, 3.ix.69 ; 15 ex., Sasangir, 9.ix.69 ; 9 ex., same loc., 10.ix.69 ; 6 ex., Jamnagar, 14.ix.69.

Diagnosis.—Length 1.7-1.8 mm. Two longitudinal carinae on each elytron, one sub-lateral and the other a little to the median line, both extending from the base to three fourths the length of the elytron.

Remarks.—This species has been considered by Tonapi & Ozarkar (1969) to be rare in Poona, but Vazirani (1968) collected and reported over 100 examples from Poona,

It is so far reported from India : Bihar, Orissa and Maharashtra, and is now being reported from Gujarat for the first time.

Subfamily COLYMBETINAE

17 *Copelatus mysorensis* Vazirani

1970. *Copelatus mysorensis* Vazirani, *Oriental Ins.*, 4: 319.

Material.—1 ex., ♀, Jamnagar, 16.ix.69.

Remarks.—So far known only from its Type locality Shimoga, Mysore, it is now being reported from Gujarat for the first time, which shows that the species is quite widely distributed.

Subfamily DYTISCINAE

18. *Eretes sticticus* (Linnaeus)

1767. *Dytiscus sticticus* Linnaeus, *Systema Naturae*, Holmiae, ed. 12, 1 (2): 666.

1969. *Eretes sticticus*: Vazirani, *Oriental Ins.*, 2: 254.

1969. *Eretes sticticus*: Tonapi & Ozarkar, *J. Bombay nat. Hist.* 66 (2): 34, fig. 8.

1969. *Eretes sticticus*: Vazirani, *Spolia zeylanica*, 31 (2): 402.

1970. *Eretes sticticus*: Vazirani, *Oriental Ins.*, 4 (2): 180 (Andaman Islands).

1971. *Eretes sticticus*: Vazirani, *Oriental Ins.*, 4: 441 (Goa).

Material.—2 ex., Sasangir, 9.ix.69 (associated with larvae).

Diagnosis.—Length 10.0-17.0 mm. Sides of pronotum rebordered ; lateral margins of elytra serrated in posterior half ; elytra testaceous, entirely covered with black irrotations and with some blotched spots.

Remarks.—This species is very common through out the tropical and subtropical regions of the world.

In India it is known from Andhra Pradesh, Assam, Bihar Goa, Kashmir, Madras, Maharashtra, Manipur, Mysore, Orissa, Punjab, Rajasthan, West Bengal, Uttar Pradesh and Andaman Islands. It is now being reported from Gujarat for the first time.

19. *Hydaticus vittatus* (Fabricius)

1775. *Dytiscus vittatus* Fabricius, *Systema Entomologiae*, Appendix: 825.

1968. *Hydaticus vittatus*: Vazirani, *Oriental Ins.*, 1: 110.

1969. *Hydaticus vittatus*: Vazirani, *Spolia zeylanica*, **31** (2): 402.

Material.—4 ex., Sasangir, 10.ix.69; 1 ex., Jamnagar, 15.ix.69.

Diagnosis.—Length 12.0-14.0 mm. Elytra black with longitudinal yellow stripes joined together posteriorly after the middle.

Remarks.—This is quite a widely distributed species in the Oriental Region. Sato (1961) has attempted revision of this species complex but much remains to be done. This species is retained here in its broad sense.

In India it is reported from several states but is now being reported from Gujarat for the first time.

20. *Hydaticus luczonicus* Aube

1838. *Hydaticus luczonicus* Aube, in Dejean's *Species Coleopteres*, **6**: 179.

1968. *Hydaticus luczonicus*: Vazirani, *Oriental Ins.*, **1**: 110.

1969. *Hydaticus luczonicus*: Vazirani, *Oriental Ins.*, **2**: 262.

1969. *Hydaticus luczonicus*: Tonapi and Ozarkar, *J. Bombay nat. Hist. Soc.*, **66** (2): 312.

Material.—2 ex., Sasangir, 10.ix.69.

Diagnosis.—Length 13.0-14.5 mm. Pronotum with a moderately broad median longitudinal black band. Elytra black, with broad yellowish lateral stripe; more or less densely irrotated with black spots having a narrow transverse sub-basal elongation.

Remarks.—It is a very widely distributed species from India to Indo-China & Philippine Islands. In India it is known from Bihar, Gujarat, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Uttar Pradesh and West Bengal.

21. *Sandracottus dejeani* (Aube)

1838. *Hydaticus dejeani* Aube, in Dejean's *Species Coleopteres*, **6**: 165.

1969. *Sandracottus dejeani*: Vazirani, *Oriental Ins.*, **2**: 275.

Material.—1 ex., Sasangir, 9.ix.69 (associated with 2 larvae).

Diagnosis.—11.50-13.0 mm. Apical spurs of the hind tibiae blunt, more or less bifid; head reddish-yellow, black along the posterior border of vertex, without any other spots; elytra black, with golden yellow markings characteristic for the species.

Remarks.—It is limited in distribution to India and West Pakistan. In India it has been reported from Andhra, Bihar, Madhya Pradesh, Orissa, Rajasthan and Uttar Pradesh. It is now being recorded from Gujarat for the first time. The larvae have been described by Vazirani (1971).

22. *Cybister tripunctatus asiaticus* Sharp

1882. *Cybister asiaticus* Sharp, *Sci. Trans. R. Dublin Soc.*, 2: 731.

1969. *Cybister tripunctatus asiaticus*: Vazirani, *Oriental Ins.*, 2: 290.

Material.—1 ex., Surendranagar, 18.ix.69.

Diagnosis.—Length 21.0-30.0 mm. Elytra with a yellow lateral stripe extending to and including the epipleurae.

Female without a rudimental second claw on posterior tarsi and without any sexual sculpture. Male with the basal segment of middle tarsi having a distinct patch of sexual pubescence.

Remarks.—This subspecies is widely distributed in India and the Oriental Region. Though known from most of the Indian states, it is now being recorded from Gujarat for the first time.

SUMMARY

This is a report on the collection of Dytiscidae from Gujarat. The collection was made by the author in the year 1969. Twenty two species, spread over 14 genera are represented in this collection. Of these one is new to science and remaining 21 species are being recorded from this state for the first time.

REFERENCES

- SATO, M. 1961. *Hydaticus vittatus* Fabricius and its allied species (Coleoptera: Dytiscidae). *Trans. Shikoku Ent. Soc.*, 7 (1-2): 54-64.
- TONAPI, G. T. and OZARKAR, V. A. 1969. A study on the aquatic Coleoptera of Poona (Maharashtra). *J. Bombay nat. Hist. Soc.*, 66 (2): 310-316.
- VAZIRANI, T. G. 1965. Revision of the Oriental species of the genus *Platambus* Thomson (Insecta: Coleoptera: Dytiscidae) with description of three new species. *Proc. zool. Soc., Calcutta*, 18: 25-34.
- VAZIRANI, T. G. 1968. Contribution to the study of Aquatic Beetles (Coleoptera). 1. On a collection of Dytiscidae from Western Ghats with descriptions of two new species. *Oriental Ins.*, 1: 99-112 (1967).

- VAZIRANI, T. G. 1969a. Contribution to the study of Aquatic Beetles (Coleoptera). 2. A review of the subfamilies Noterinae, Laccophilinae, Dytiscinae, and Hydroporinae (in part) from India. *Oriental Ins.*, 2 (3-4): 221-341. (1968).
- VAZIRANI, T. G. 1969b. Contribution to the study of Aquatic Beetles (Coleoptera) V. Revision of India Species of *Hyphoporus* Sharp (Dytiscidae). *Bull. Mus. Nat. Hist. nat.*, (2), 41 (1): 203-225.
- VAZIRANI, T. G. 1970. Contributions to the study of Aquatic Beetles (Coleoptera). VI. A review of Hydroporinae: Dytiscidae, in part, from India. *Oriental Ins.*, 4(1): 93-129.
- VAZIRANI, T. G. 1970. Contribution to the study of Aquatic Beetles (Coleoptera). VII. Revision of Indian Colymbetinae, *Oriental Ins.*, 4(3): 303-362.
- VAZIRANI, T. G. 1971. Description of the larva of the Aquatic Beetle *Sandracottus dejeani* (Aube). *Proc. zool. Soc., Calcutta*, 24: 25-28.
- VAZIRANI, T. G. 1971. Contributions to the study of Aquatic Bettles (Coleoptera) 10. On a collection of Dytiscidae from Goa. *Oriental Ins.*, 4: 441-446.

ON A COLLECTION OF GENUS *MELANAGROMYZA*,
HENDEL (AGROMYZIDAE DIPTERA)
FROM NEFA, INDIA

By

S. K. TANDON

Zoological Survey of India, Calcutta

(With 1 Text-figure)

During the course of faunistic survey of Siang district, NEFA in September-November 1966, the author made a small collection of Agromyzidae, which, on examination, was found to belong to the genus *Melanagromyza*. The genus is represented by four species out of which one viz., *Melanagromyza siangensis* is new to science, and the remaining three, *Melanagromyza atomella* (Malloch), *Melanagromyza metallica* (Thompson), and *Melanagromyza polyphaga* Spencer are new records for NEFA. *Melanagromyza* is the most dominant genus in India, with 21 known species, representing about 50% of the total Agromyzidae known from India so far.

I offer my grateful thanks to Dr. A. P. Kapur, Director, Zoological Survey of India, for his keen interest and constant encouragement in this work. I am also thankful to Shri K. S. Pradhan, Superintending Zoologist for his help in various ways during the course of this work.

Abbreviation.—*acr.*, acrostichal bristle; *dc.*, dorsocentral bristle; *ia.*, intra-alar bristle; *np.*, notopleural bristle; *ori*, lower fronto-orbital bristle; *ors.*, upper fronto-orbital bristle; *pa.*, post alar bristle; *sa.*, supra alar bristle.

1. *Melanagromyza atomella* (Malloch)

1914. *Agromyza atomella* Malloch, *Ann. Hist. nat. Mus. Hung.*, 12: 331.

1965. *Melanagromyza atomella*: Tandon, *Agra, Univ. J. Res. (Sci.)*, 14(2): 41.

Material.—1 ♂ and 1 ♀; NEFA: Siang Distt.: Dali camp, 12.x.1966, S. K. Tandon and G. S. Arora Colls.

Remarks.—This species is the smallest of the four species known from this part (1.4-1.6 mm) and belongs to the group with dark squamal fringe and body without metallic sheen. It

is characterised by a fine short bristle on mid tibiae and the costa extending up to vein M_{1+2} .

Distribution.—India : Agra, Kottayam, Siang. Ceylon ; Formosa ; Japan ; Micronesia ; Australia and the Philippines.

2. *Melanagromyza metallica* (Thompson)

1869. *Agromyza metallica* Thompson, *Eugenies Resa* Diptera, Stockholm : 609.

1965. *Melanagromyza metallica* : Tandon, *Agra Univ. J. Res. (Sci)*, 14(2) : 43.

Material.—2 ♀♀, NEFA : Siang Dist. : Lekhabali (Jeep camp), 6.x.1966, S. K. Tandon and G. S. Arora Colls.

Remarks.—This is also a small species (2.2-2.5 mm) and has a white squamal fringe. The mesonotum and abdomen are shining green.

Distribution.—India : Kumli (Kerala) ; Ranchi ; Lekhabali (NEFA). Nepal ; Indonesia ; Philippines ; Congo ; South Africa and Europe.

3. *Melanagromyza polyphaga* Spencer

1961. *Melanagromyza polyphaga* Spencer, *Trans. R. ent. Soc. Lond.*, 113(4) : 75.

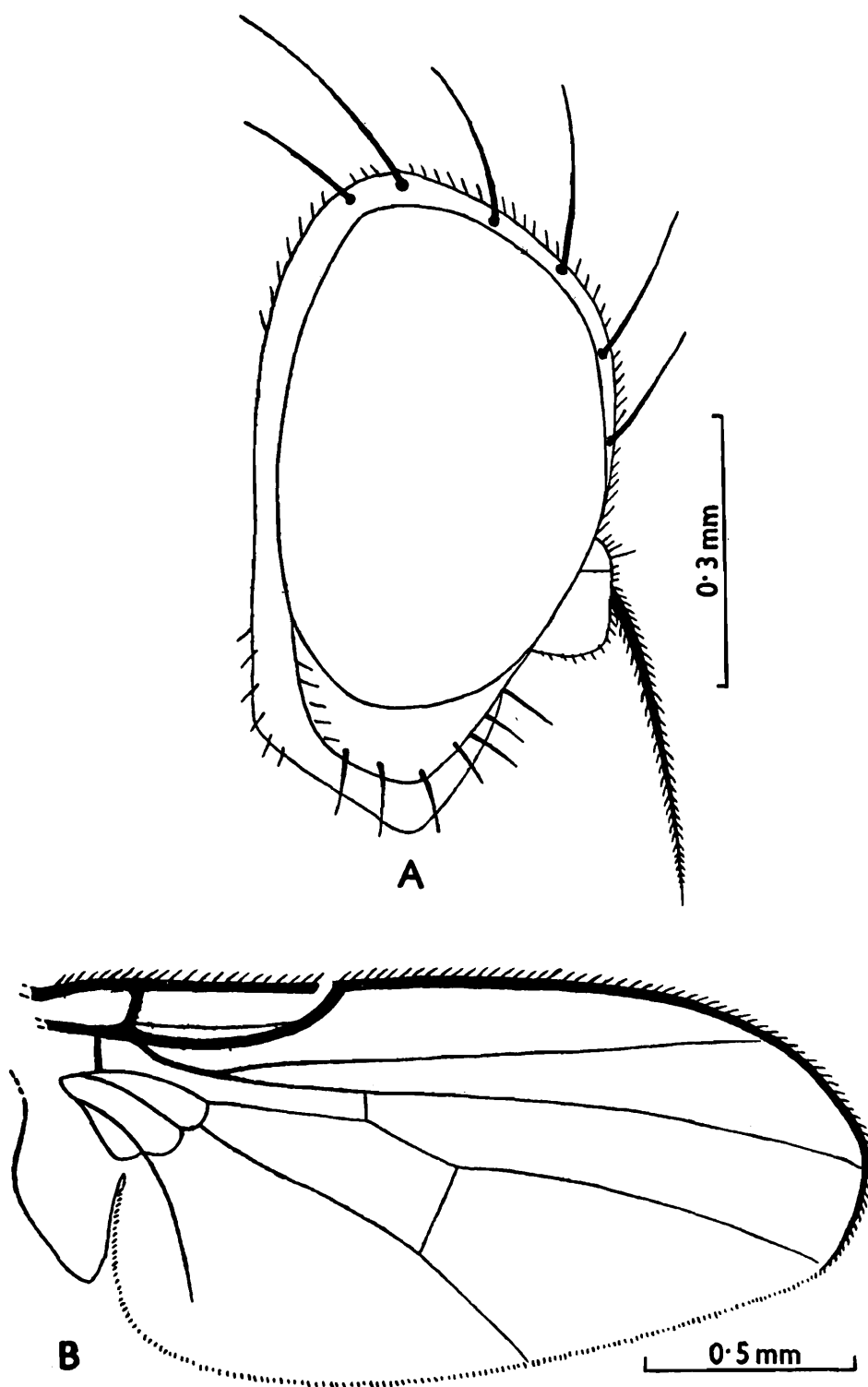
Material.—1 ♂ and 1 ♀, NEFA : Siang : Lekhabali, 7.x.1966, S. K. Tandon and G. S. Arora Colls.

Remarks.—All black species with black squamal fringe, narrow cheeks and weakly pubescent third antennal segment.

4. *Melanagromyza siangensis* sp. n.

Head (fig. a).—Frons twice as long as wide, not projecting in profile, less than the width of eye (1 : 1.3), sides almost parallel and only slightly diverging dorsally ; parafrontals slightly bulged out in profile and about one-fifth as wide as the frontalia ; lunule large, strongly convex dorsally and sparsely pubescent ; ocellar triangle with the dorsal side subequal to the width of frontalia and extending to the base of *ors* ; Fronto-orbital four pairs, two *ors* reclinate and two *ori* proclinate, the former longer than the latter ; cheeks broad about one sixth of the height of eye ; face almost vertical, with narrow carina ; antennal basis noncontiguous, third antennal segment shorter than broad and with sparse white microscopic

pubescence, arista about three times as long as the antenna, hairy.



Text-fig. 1. *Melanagromyza siangensis* sp. n., ♀ Holotype.—a. Head in profile; b.—Wing.

Thorax.—Mesonotum transverse, black; *dc* two, strong, posterior to transverse suture, the first *dc* being one and a half times longer than the second and below the level of *sa*; *acr* in twelve regular rows, extending up to first *dc*; *ia* one, strong and

slightly shorter than first *dc* ; *sa* single and strong ; *pa* one, strong ; *np* two, anterior slightly longer than the posterior ; humeral one ; presutural one.

Wing.—(fig. b).—about 2.2 times as long as broad ; costa reaching M_{1+2} ; Costal ratio of ii, iii, ivth segments 2.2 : 1 : 5 ; cross vein r-m situated beyond the termination of R_1 in costa and on discal cell beyond the middle, about one third of the length of m-m ; ultimate section of R_{4+5} nearly three and a half times as long as penultimate ; ultimate section of M_{3+4} in ratio of 1.5 : 1.

Abdomen.—Ovoid with numerous short setae dorsally, marginal setae long.

Colour.—Head black ; parafrontals and ocellar triangle moderately shining ; lunule dull white ; cheeks black ; antennae black, arista dark ; eyes dark brown with black patches. Mesonotum and scutellum shining black ; pleurae black ; wings hyaline with pale base and brown veins, calypters with fringe white, halteres with white lines between capitellum and pedicel.

<i>Measurements</i>	<i>Body length</i>	<i>Length of wing</i>
♂	2.33 mm	2.33 mm
♀	2.60 mm	2.27 mm

Type specimens.—All the type specimens are deposited in the National Zoological Collections with the Zoological Survey of India as follows—*Holotype* : One female on pin, INDIA : NEFA : Siang, Tappi, 24.x.1966, S. K. Tandon and G. S. Arora Colls. *Paratype* : One male and two females with the same data as for the Holotype.

Affinities.—This species comes nearer to *Melanagromyza alternata* Spencer, but is readily distinguishable by the frons being narrower than the width of eye, deeper jowls, ocellar triangle extending up to the base of *ors* and by the ratio of vein M_{3+4} . The only other entirely black species with white squamal fringe known in Oriental region, is *Melanagromyza surdasi* Tandon but the present species is somewhat larger.

KEY TO THE INDIAN SPECIES OF THE GENUS *MELANGROMYZA*

1. Squamal fringe pale, whitish	...	...	...	2
— Squamal fringe dark, black or brown	...	...	...	12
2. Mesonotum predominantly black, at most with faint metallic tinge	...	...	...	3

— Mesonotum distinctly greenish-coppery or bluish tinge	...	...	...	...	6
3. Mesonotum and abdomen entirely shining black	...	...	...	...	4
— Abdomen greenish-coppery	...	...	...	<i>Sojae</i> (Zehntner)	
4. Large species, wing length (2.6 mm-3.0 mm)	...	...	...	...	5
— Small species, wing length 1.9 mm	...	...	...	<i>surdasi</i> Tandon	
5. Frons wider than eye, cheeks narrow, one twelfth the height of eye	...	...	...	<i>alternata</i> Spencer	
— Frons narrower than eye, cheeks broad, one sixth the height of eye	...	...	...	<i>siangensis</i> Tandon	
6. Very large green species, wing length 3.2 mm; arista conspicuously plumose	...	...	...	<i>indica</i> Tandon	
— Small species	...	...	...	...	7
7. Ocellar triangle greatly enlarged	...	...	...	...	8
— Ocellar triangle acute at apex; mesonotum blackish green	...	...	...	<i>chalcosoma</i> Spencer	
— Ocellar triangle obtuse at apex; mesonotum distinctly green	...	...	...	<i>obtusa</i> (Malloch)	
9. Lunule conspicuously high and narrow, costri- cated by broadened orbits; mesonotum blackish-green	...	...	...	<i>hibisci</i> (Spencer)	
— Lunule lower, approximately in the form of a semicircle	...	...	...	...	10
10. Eyes entirely bare in male, small species, wing length (1.9 to 2.3 mm)	...	...	...	<i>albisquama</i> (Malloch)	
— Eyes in female without distinct patch of hairs	...	...	...	...	11
11. Arista apparently bare	...	...	...	<i>gerverivora</i> Spencer	
— Arista distinctly pubescent	...	...	...	<i>metallica</i> (Thompson)	
12. Frons not appreciably projecting above eyes in profile	...	...	...	...	13
— Frons conspicuously projecting	...	...	...	<i>nigrisquama</i> (Malloch)	

13.	Costa extending only to vein R_5 ...	...	...	14
—	Costa distinctly extending to vein M_{1+2} ...	...	...	15
14.	Last and penultimate section of vein m_4 equal	<i>coffeae</i> (Koningsberger)		
—	Last segment of vein m_4 distinctly shorter than the penultimate ...	<i>theae</i> (Green)		
15.	Ocellar triangle long and narrow, shining black, small shining black species ...	<i>phaseoli</i> (Tryon)		
—	Ocellar triangle shorter ...		...	16
16.	Mesonotum and abdomen with greenish, cop- pery or purplish sheen ...		...	17
—	Mesonotum and abdomen entirely shining or matt black ...		...	18
17.	Mesonotum and abdomen with greenish sheen, small species, wing length 2.17 mm ...	<i>limboi</i> (Tandon)		
—	Mesonotum and abdomen with purplish sheen, large species, wing length 2.33 mm. ...	<i>assamensis</i> (Tandon)		
18.	Orbital setulae all reclinate ...		...	19
—	Orbital setulae reclinate in front, distinctly proclinate at rear ...	<i>beckeri</i> Hendel		
19.	Mid tibiae with bristles ...		...	20
—	Mid tibiae without any differentiated bristles	<i>dolichi</i> Sehgal		
20.	Mid tibiae with fine short bristles, minute species, wing length (1.4-1.6 mm), puparium yellow ...	<i>atomella</i> (Malloch)		
—	Mid tibiae with one strong bristle, large species ...		...	21
21.	Cheeks narrow, one-tenth height of eye, puparium black ...	<i>polyphaga</i> Spencer		
—	Cheeks broad one-fifth to one-sixth height of eye ...	<i>centrosematis</i> de Meijere		

NOTES ON A COLLECTION OF OSTRACODA
FROM DELHI

By

MAYA DEB

Zoological Survey of India, Calcutta

(With 2 Text-figures)

INTRODUCTION

While studying the Indian Ostracoda, the author came across a small collection of unnamed specimens which were collected from a temporary freshwater pond, at Delhi, near the River Yamuna, but unfortunately the name of the collector and date of collections were not given on the labels.

These specimens are identified as *Newnhamia fenestrata* King 1855, *Cyprinctus ovatus* (Sars) 1903, *Cypris subglobosa* Sowerby 1859 and *Cypris ravenala* Brehm 1934, the first and the last species being new records from India, while the other two are reported recently from Rajasthan by the author (Deb, in press)¹. Each species is represented by 50 to 100 examples.

The author is greatly indebted to Dr. A. P. Kapur, Director, Zoological Survey of India for encouragement and providing facilities for this work, and to Dr. K. K. Tiwari and Dr. A. N. P. Ummerkutty, for their help in preparing this paper.

SYSTEMATIC ACCOUNT

1. *Newnhamia fenestrata* King

(Text-fig. 1 a—k)

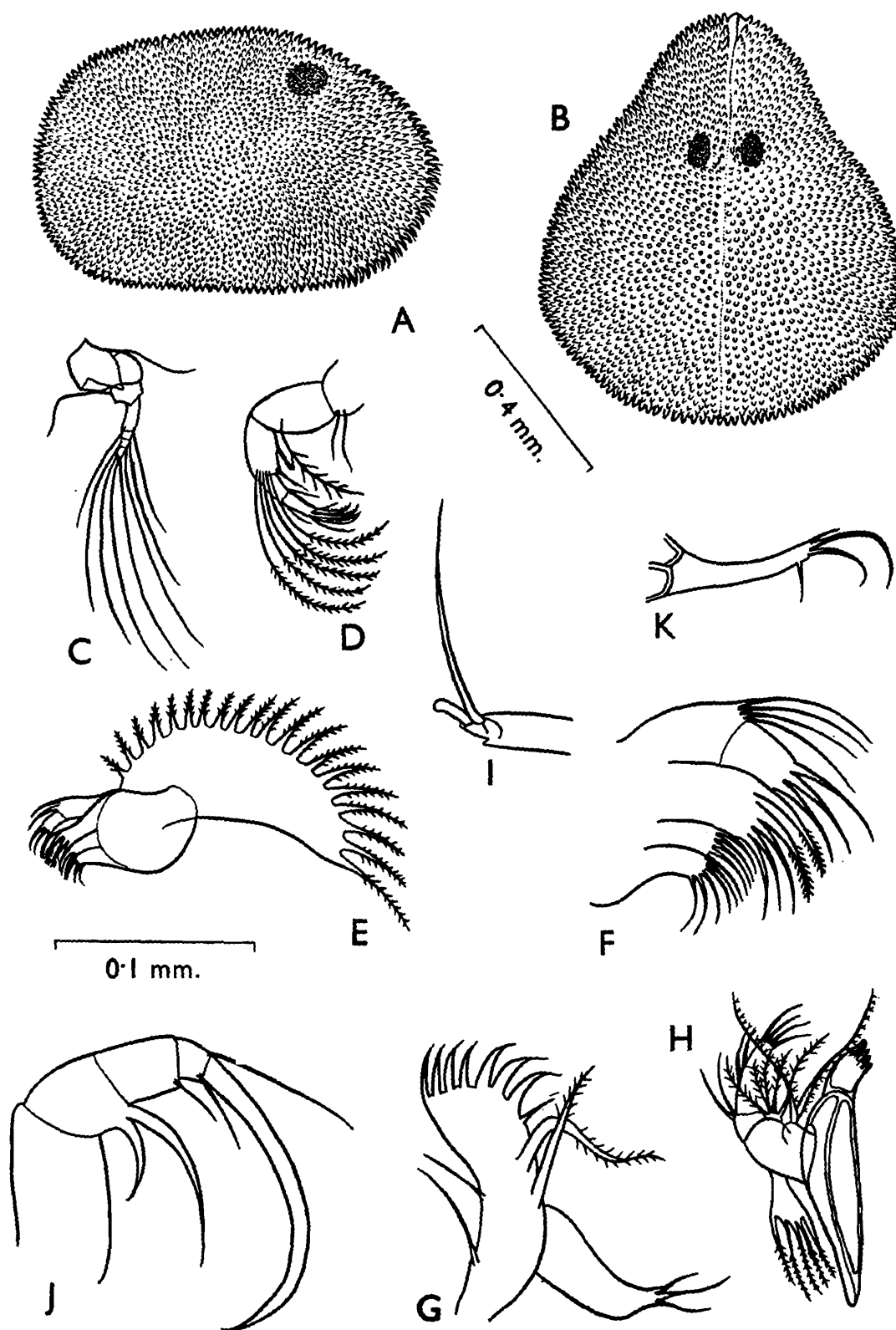
1855. *Newnhamia fenestrata* King, *Proc. Roy. Soc. Van Diemenis Lond.*; **3**: 67.

1889. *Notodromus fenestrata*: Whitelegge, *J. Roy. Soc. N. S. Wales*, **23**: 320.

Material.—75 exs., ♀♀.

Length : 0.87 mm—1.30 mm. Breadth : 0.75 mm—1 mm.
Height : 0.67 mm—0.75 mm.

¹Deb, M. Fauna of Rajasthan (India): Crustacea-Ostracoda, *Rec. zool. Surv. India* (in press).



Text-fig. 1. *Newnhamia fenestrata* King: (A), Shell in side view; (B), Same, dorsal view; (C), 1st antenna; (D), 2nd antenna; (E), Maxilla with branchial plate; (F), Maxillary process; (G), Maxilliped; (H), Mandible; (I), 2nd leg; (J), 1st leg; (K), Furca. A-F, Same scale. G-K, Same scale.

Description.—Shape of shell is pitcher like in dorsal view. with the posterior end broader than the anterior end. In side

view the shell is oblong, with the posterior end broader than the anterior end. Shell is profusely tuberculated throughout the whole surface. Tubercles are pointed and the anterior tubercles are sharper and longer than the posterior ones. Fine hairs are present throughout the whole surface of the shell. No plate like structure is present on the ventral side of the shell. Two eyes are present. Swimming setae of 2nd antenna extended beyond the tips of terminal claws. Maxillary process is short and stout, 3rd maxillary process with two dentate setae. Shape and structures of maxilliped is slightly different from those in other cyprids. Furca stout and curved and are armed with two claws and two setae.

Distribution.—Australia, New Zealand, Bismarck archipelago (New Guinea), India. It is being recorded from India for the first time.

Remarks.—Tubercles on the shell, presence of a pair of eyes, shape and structure of maxilliped are peculiar and uncommon when compared with other cyprids.

2. *Cyprinotus ovatus* (Sars)

1903. *Hemicypris ovatus* Sars, *Arch. Math. Naturv.*, **25**(8): 26.

1912. *Cyprinotus ovatus* Müller, *Das Tierreich*, **31**: 167.

Material.—130 exs., ♂♂ and ♀♀

Length : 0.77 mm—0.87 mm. Breadth : 0.45 mm—0.49 mm.

Height : 0.49 mm—0.5 mm. ♂♂

Length : 0.84 mm—1 mm. Breadth : 0.49 mm.—0.50 mm.

Height : 0.5 mm—0.62 mm. ♀♀.

Distribution.—India : Rajasthan, Delhi. Burma ; Sumatra.

3. *Cypris subglobosa* Sowerby

1840. *Cypris subglobosa* Sowerby, *Tr. geol. Soc. Land. ser 2*, **5**: 47, fs 3.

1859. *Cypris subglobosa* : Baird, *Proc. zool. Soc.*, **27**: 232.

Material.—120 exs., ♀♀.

Length : 1.50 mm.—1.87 mm. Breadth : 1.04 mm.—

1.25 mm. Height : 0.8 mm.—1.12 mm.

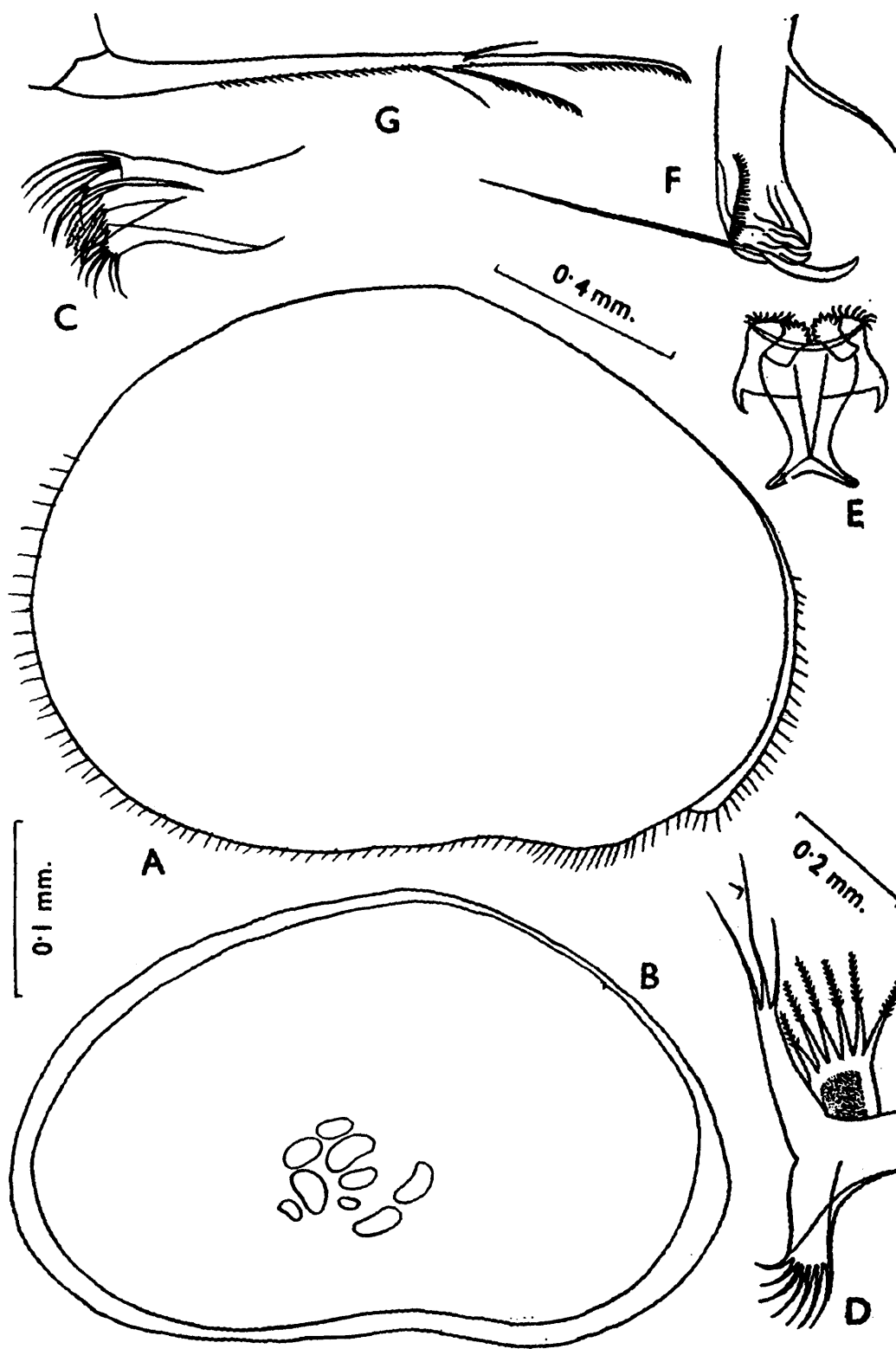
Distribution.—Java, Ceylon, India : Delhi, Nagpur.

4. *Cypris ravenala* Brehm

(Text-fig. 2 a—g)

1934. *Cypris ravenala* Brehm, *Zool. Anz.*, **108**: 74.

Material.—50 exs., ♀♀.



Text-fig. 2. *Cypris ravenala* Brehm: (A), Shell, side view; (B), Left valva; (C), Maxillary process; (D), Maxilliped; (E), Lips; (F), 2nd leg; (G), Furca; A-C, Same scale. D-G, Same scale.

Length : 1.96 mm. Breadth : 1.45 mm. Height : 1.29 mm.

Description.—Shell is very tumid. In dorsal view anterior end is pointed, posterior end broadly rounded, and widest just

behind the middle. Seen from the side posterior end is more broadly rounded than the anterior, and the dorsal margin is strongly arched with an angular bend. Surface of the shell is nearly smooth, except for scattered hairs and pore canals. Anterior margin of right valve is provided with a flap like lamella. Margin of valves are beset with fine hairs and pore canals. Swimming setae of 2nd antenna extend slightly beyond the tips of terminal claws. Maxillary process is long and narrow, 3rd maxillary process has two dentate setae. Furca are straight, long, narrow and with two claws and two setae; dorsal edge of ramus as well as of claws is finely hairy.

Distribution.—This species is being recorded for the first time from India. It is known so far from South America only.

REDESCRIPTION OF *ASTIOTREMA RENIFERUM*
(LOOSS, 1898) LOOSS, 1900 WITH COMMENTS ON
THE STATUS OF THE GENUS *PSEUDOPARAMACRO-*
DEROIDES GUPTA & AGARWAL, 1968
(TREMATODA PLAGIORCHIIDAE)

By

N. VASANTHA KUMARI, C. B. SRIVASTAVA AND
B. S. CHAUHAN

Zoological Survey of India, Calcutta

(With 2 Text-figures)

INTRODUCTION

Looss (1900) proposed the generic name *Astiotrema* for his species *Distoma reniferum* Looss, 1898, since the generic name *Astia* was preoccupied, and renamed the species as *Astiotrema reniferum*. He also included *Distoma impletum* Looss, 1898 under it. Yeh and Fotedar (1958) reviewed the genus *Astiotrema* after studying a series of specimens in detail and recognised only four species viz., *A. reniferum* (Looss, 1898), *A. impletum* (Looss, 1898), *A. odhneri* Bhalerao, 1936 and *A. monticelli* (Stossich, 1904), out of 21 species under this genus described till then. Khalil (1959) further synonymised *A. odhneri* with *A. reniferum*. Dollfus and Simha (1964) agreed with these authors. Siddiqi (1965) synonymised *Astiotrema lobiorchis* Tiwari, 1958 and *A. mehrdi* Tiwari, 1958 with *Astiotrema reniferum*. Present authors accept the arrangement proposed by these workers.

During the course of the study of helminth parasites of fishes of Calcutta, the authors collected some trematodes from *Mystus cavasius* (Ham.) and *Clarias batrachus* (L.). These specimens, on detailed study, are identified as *Astiotrema reniferum* (Looss, 1898). Out of 53 specimens of *Mystus cavasius* and 28 of *C. batrachus* examined in one year, only 9 of the former and 2 of the latter hosts yielded 15 and 10 examples respectively of this parasite in monsoon months. These parasites show a wide range of structural variations and are redescribed below. In the light of the variations studied, the systematic position

of the genus *Pseudoparamacroderoides* Gupta & Agarwal, 1968 is also discussed. All measurements are in millimeters.

SYSTEMATIC ACCOUNT

Family PLAGIORCHIIDAE Luhe, 1901

Subfamily ASTIOTREMATINAE Baer, 1924

Astiotrema Looss, 1900

Syn. *Astia* Looss, 1899 (Preoccupied)

Gauhatiana Dayal & Gupta, 1954

Pseudoparamacroderoides Gupta & Agrawal, 1968
(New Synonymy)

Astiotrema reniferum (Looss, 1898) Looss, 1900

1898. *Distoma reniferum* Looss, Zbl. Bakt. **23**: 453.

1899. *Astia reniferum*: Loss, Zool. Jber. Abst. Syst. **12**: 521.

1968. *Pseudoparamacroderoides Suenghali* Gupta & Agarwal, Indian J. Helminth. **20**(1): 70 (New Synonymy)

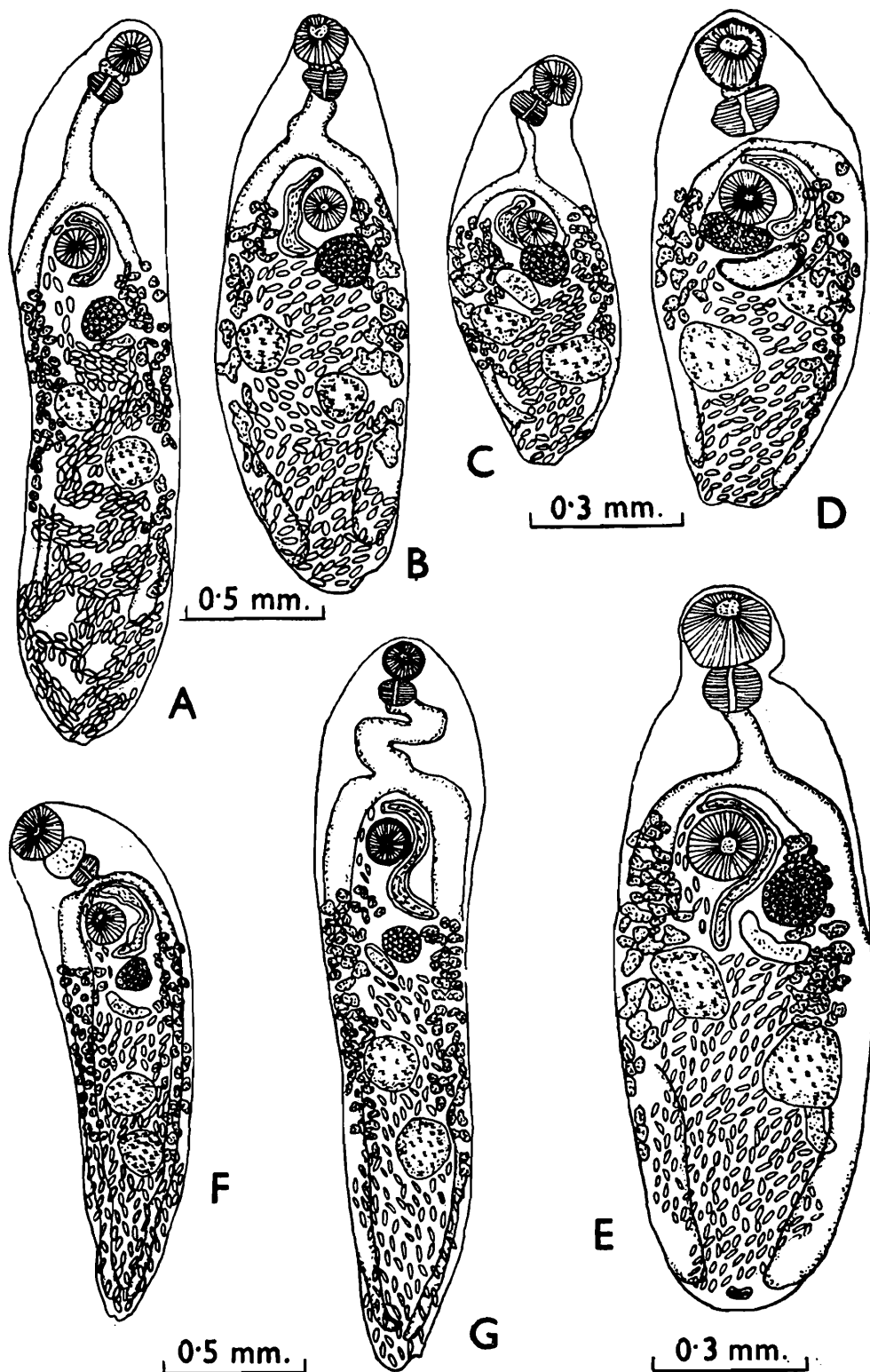
1969. *Pseudoparamacroderoides vittatusi* Kakaji, Indian J. Helminth., **21** (1): 71. (New Synonymy)

Description.—The worms are elliptical with rounded extremities and attenuated anterior end, elongated, or cylindrical with both the margins more or less parallel when expanded. Cuticle is covered with backwardly directed spines. Anterior spines are more prominent than the posterior ones. It measures 0.8—2.9 in length and 0.33—0.69 in maximum breadth in the region between intestinal bifurcation and anterior testis. The ratio of length and breadth being 1 : 2.4—5.8. Mouth is situated slightly behind the anterior extremity, surrounded by a subterminal oral sucker measuring $0.08—0.19 \times 0.08—0.18$. The two suckers are equal or subequal. The mouth is followed by a small prepharynx normally, but in some specimens it is not seen, probably due to state of fixation (text-figs. 1E & G). Pharynx is large, pear shaped or globular, and measures $0.05—0.11 \times 0.05—0.15$. Oesophagus is short to moderately long, measuring 0.03—0.49 in length and 0.02—0.11 in breadth. In some specimens it is twisted 'S'-shaped and the length of the anterior body in such specimens is reduced due to contraction (text-fig. 1G), while in some specimens the oesophagus is not clear and a small space is left between the

intestinal bifurcation and pharynx (text-fig. 1A). Intestinal bifurcation is between the two suckers. Its position changes with the degree of expansion or contraction of the body at the time of fixation. Intestinal caeca are broad to narrow, more or less straight, terminating a little anterior to posterior extremity or midway between the posterior testis and posterior extremity. The acetabulum is median, pre-equatorial, almost equal, slightly bigger or smaller than the oral sucker and measures $0.09-0.17 \times 0.11-0.17$. It is situated at a distance of $0.04-0.27$ from the anterior extremity.

Testes are tandem or obliquely tandem, postequatorial, postovarian intercaecal, roughly equal, oval or spherical, lobed or smooth. Anterior testis lies a little to the left of the median line at a distance of $0.05-0.33$ from the ovary, and measures $0.09-0.19$ in diameter. The distance between the two testes varies greatly. The posterior testis measures $0.09-0.19 \times 0.12-0.22$. The cirrus sac is very long, claviform and it extends from behind the acetabulum to middle of ovary or further backwards (text-fig. 1E). In some specimens it is twisted 'S'-shaped, situated behind the acetabulum due to contraction of the anterior body at the time of fixation (text-fig. 1G); greater part of the cirrus sac is filled with seminal vesicle. Pars prostatica is small, surrounded by prostate cells. Small anterior part of the cirrus sac is occupied by cirrus. Vesicula seminalis externa is absent.

The ovary is spherical or oval in shape, smooth, generally lying slightly to the right of the median line, measuring $0.07-0.17 \times 0.09-0.20$, and situated at a distance of $0.37-1.29$ from anterior extremity. Its position in relation to acetabulum varies greatly, from overlapping the acetabulum to lying between the acetabulum and anterior testis (text-fig. 1A-G). The variation in the position of the ovary and other body organs may be due to the contracted condition of the worm at the time of fixation. It can be seen that in cases where the ovary is near or overlapping the acetabulum (text-figs. 1B, C & D) the ratio between the length and the breadth of the body is very much increased. Oviduct arises from the posterior end of the ovary and is joined by a pear-shaped receptaculum seminis, which lies posterior to the ovary. Common vitelline duct joins the ootype on its posterior side.

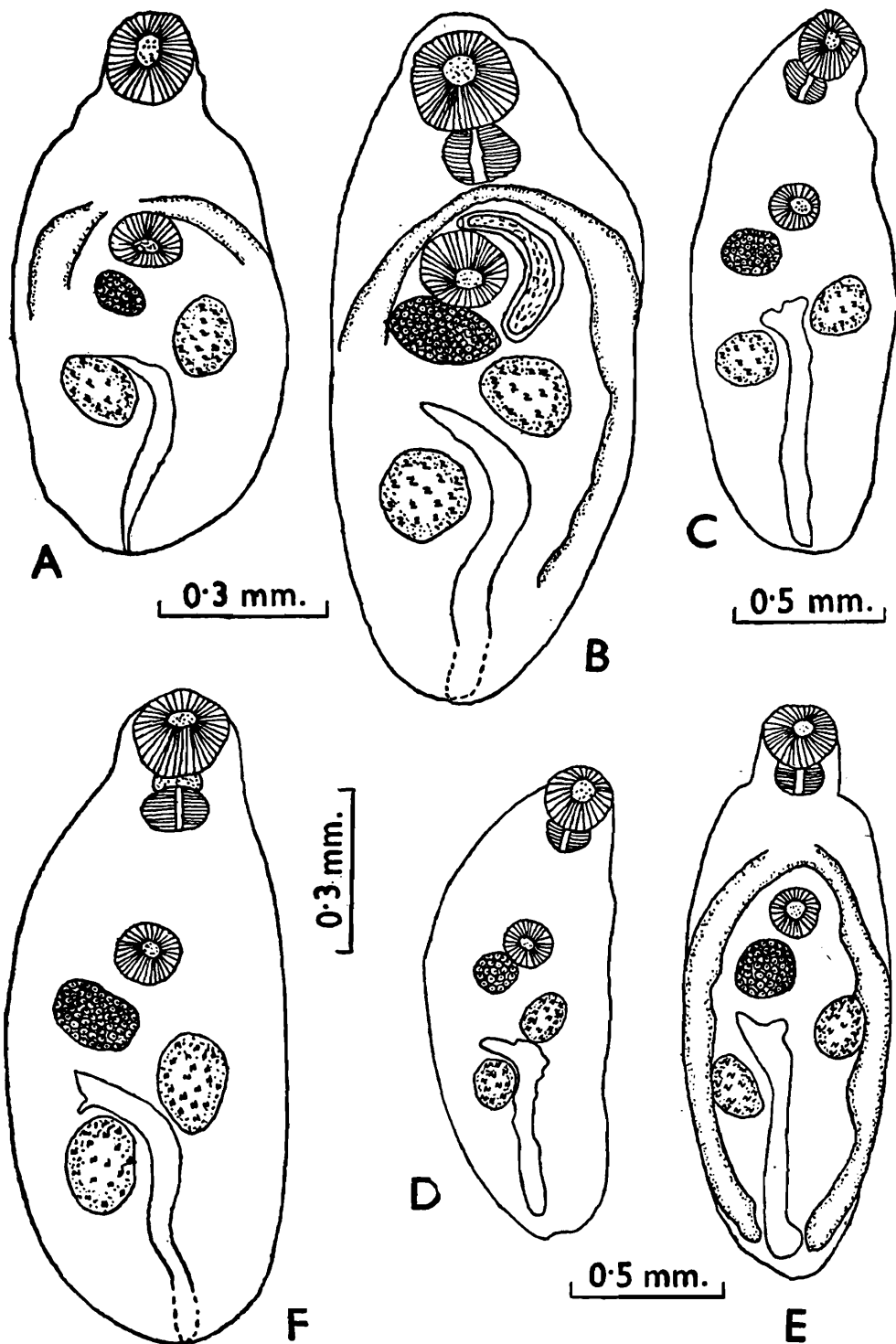


Text-figs. 1A-G—*Astiotrema reniferum* (Looss, 1898) Looss, 1900 showing variations in the position of ovary, cirrus sac, vitellaria and other body organs.

The vitellaria are composed of numerous follicles scattered without any definite arrangement, mostly on lateral sides overlapping the intestinal caeca and at places extending into inter-caecal field. Their distribution extends to a variable length

from near the intestinal bifurcation to posterior end of posterior testis. At times it may extend some distance behind the posterior testis, in which case the distance between the two testes is less than normal.

Genital pore is median or submedian, immediately post-bifurcal and preacetabular, at a distance of 0.26—0.80 from



Text-figs. 2A-F—*Astiotrema reniferum* (Looss, 1898) Looss, 1900 showing variations in the shape and extension of the excretory bladder of the specimens taken from a single host.

anterior extremity. The uterus, which arises from the posterior side of the ootype, is much convoluted and both its descending and ascending limbs pass through the intertesticular space. The descending limb extends almost up to the posterior end or a little anterior to it, forming a large convoluted knot which then passes anteriorly as an ascending limb to the dorsal side of the cirrus sac and opens into the genital pore.

Eggs are numerous, oval in shape with yellowish-brown shell, and measure $0.018\text{--}0.026 \times 0.004\text{--}0.008$.

The shape of excretory bladder shows great amount of variation in its shape and extension. The shape varies from 'I' to 'Y' with intermediate conditions. It extends from the excretory pore to any level from posterior border of the posterior testis to ovary depending upon the stage of fixation (text-figs. 2A to 13). If the worm is in contracted condition the gonads show a tendency of congregation towards anterior part of the body and the excretory bladder extends up to the posterior testis. If it is fixed in extended condition the gonads are displaced to the posterior side and the bladder extends further forwards. Excretory pore is terminal or subterminal.

Discussion.—It is evident from the foregoing description that a great amount of variation exists in this species with regard to the shape and position of gonads, extension of vitellaria and cirrus sac, extension and shape of excretory bladder, extension of caeca, and size and position of suckers, as has already been pointed out by Yeh & Fotedar (*l.c.*) and Khalil (*l.c.*).

Gupta and Agarwal (1968) erected the genus *Pseudoparamacroderoides* to accommodate their new species *P. seenghali* and placed it under subfamily Walliniinae Yamaguti, 1958 in the family Allocreadiidae. Kakaji (1969) added *P. vittatusi* to this genus.

Yamaguti (1958) placed the following genera under the subfamily Walliniinae: *Macroderoides* Pearse, 1924; *Vietsoma* VanCleave & Muller 1932; *Gauhatiana* Dayal & Gupta, 1954; *Paramacroderoides* Venard, 1941; *Parastiotrema* Muller, 1940; *Macrolecithus* Hasegawa & Ozaki, 1926; and *Wallinia* Pearse, 1920. Mehra (1962) upheld the family Macroderoidae McMullen, 1937 and dropped the subfamily Walliniinae without making any comment on the remaining genera included in this subfamily. Yeh and Fotedar (1958) synonymised the genus

Gauhatiana Dayal & Gupta, 1954 with *Astiotrema* Looss, 1900 and the species *Gauhatiana batrachi* Dayal & Gupta, 1954 with *Astiotrema reniferum* (Looss, 1898)

According to Mehra (1966) the family Allocreadiidae is characterised by unspinulate body, usually pre-testicular exceptionally post-testicular uterus but not reaching posterior extremity and tubular or saccular excretory bladder. *Pseudoparamacroderoides* Gupta & Agarwal, 1968 does not possess of any of these characters except the shape of the excretory bladder. Hence it is more appropriate to place it under the family Plagiorchiidae.

The generic diagnosis of the genus *Pseudoparamacroderoides* as given by Gupta & Agarwal (1968) is identical with *Astiotrema* Looss, 1900 but for the position of the ovary, shape of excretory bladder and oral sucker with spines larger than the body spines. The variations with regard to the position of ovary and shape of excretory bladder have been pointed (*vide supra*). Usually the anterior spines are more prominent than the rest of the body spines and at times the spines near posterior extremity are very inconspicuous. So the relative size of the spines alone cannot be taken as valuable differentiating character. The genus *Pseudoparamacroderoides* is, therefore, considered congeneric with the genus *Astiotrema*. The generic characteristics of *Pseudoparamacroderoides* are based on the description of the type species *P. seenghali* Gupta & Agarwal, 1968 which are common to *Astiotrema reniferum* except in the differences like position of ovary and shape of excretory bladder. These differences are no more than individual variations of *Astiotrema reniferum* (text-figs. 1C, A ; 2A & B). Consequently *Pseudoparamacroderoides seenghali* is considered conspecific with *Astiotrema reniferum*. Kakaji (1969) distinguished her new species *Pseudoparamacroderoides vittatusi* in the characters like extension of excretory bladder up to middle of posterior testis, ovary some distance behind acetabulum, receptaculum seminis lateral to ovary, vitellaria extending from anterior end of acetabulum and intercaecal uterine coils. All these characters are seen as individual variations in the specimens of *Astiotrema reniferum* (*vide* text-figs. 1A to G ; 2A). Hence *P. vittatusi* is also found conspecific with *Astiotrema reniferum* (Looss, 1898) Looss, 1900.

Hosts.—Fish : *Clarias batrachus* ; *Mystus cavasius* ; *Mystus*

seenghala; *Mystus vittatus*. Reptiles: *Trionyx nilotica*; *T. gangeticus*; *Chitra indica*; *Emyda granosa*; *Kachuga dhongoka*; *K. kachuga*; *Lissemys punctata*; *Amyda japonica*; *A. maackii*; *A. tuberculata*.

Location.—Intestine.

Distribution.—This species is known from the Ethiopian (North Africa), Oriental (India: Punjab; U.P.: Allahabad, Lucknow; Andhra Pradesh: Hyderabad; West Bengal: Calcutta. Burma), and Palaearctic (China, Korea and Japan), regions.

ACKNOWLEDGMENTS

The authors are thankful to the Director, Zoological Survey of India, Calcutta for the facilities. Thanks are also due to Dr. M. Baburao, Zoological Survey of India, Calcutta for his help in the present study.

SUMMARY

The paper deals with the redescription of *Astiotrema reniferum* (Looss, 1898) Looss, 1900 to incorporate individual variations observed in a series of specimens of this species. Genus *Pseudoparamacroderoides* Gupta & Agarwal, 1968 has been shown congeneric with the genus *Astiotrema* Looss, 1900 and the species *Pseudoparamacroderoides seenghali* Gupta & Agarwal, 1968 and *P. vittatusi* Kakaji, 1969 are shown synonymous to *Astiotrema reniferum*.

REFERENCES

- DOLLFUS, R. PH. and SIMHA, S. S. 1964. Speciation D'un distome du genre *Astiotrema* A. Looss, 1900 D'un Chelonien de Inde. *Bull. du Mus. D'Hist. Nat.*, **36**(2): 262-267.
- GUPTA, S. P. and AGARWAL, V. 1968. *Pseudoparamacroderoides seenghali* n.g. n.sp. (Allocreadiidae: Walliniinae) from the intestine of a freshwater fish *Mystus seenghala* (Sykes) from Lucknow. *Indian J. Helminth.*, **20**: 70-74.
- KAKAJI, V. L. 1969. Studies of helminth parasites of Indian fishes—part III. Some trematode parasites of freshwater fishes of Uttar Pradesh. A new trematode *Pseudoparamacroderoides vittatusi* n.sp. from a freshwater fish *Mystus vittatus* (Bloch). *Indian J. Helminth.*, **21**(1): 71-73.
- KHALIL, L. F. 1959. On a new trematode *Astiotrema sudanensis* n. sp. from a freshwater turtle in Sudan. *J. Helm.*, **33**: 263-266.

- LOOSS, A. 1900. Nachtragliche Bemerkungen zu den Namen der von mir Vorgeschlagenen Distomidengattungen. *Zool. Anz.*, **23**: 601-608.
- MEHRA, H. R. 1962. Revision of Allocreadiidea Nicoll, 1934, Part I. Families: Lepocreadiidae Nicoll, 1934; Deropristiidae n.fam.; Homalometridae n.fam.; and Maseniidae Gupta, 1953. *Proc. Nat. Acad. Sci. India, Sec. B.*, **32**(1): 1-22.
- MEHRA, H. R. 1966. Revision of Allocreadiidea Nicoll, 1934. Part II. Families—Opecoelidae Ozaki, 1925; Opistholebetidae Fukui, 1929; Allocreadiidae Stossich, 1903; Bunoderidae Nicoll, 1914; Acanthocolpidae Luhe, 1909; and Pleorchiidae, Poche, 1925. Part. III. Families—Monorchiidae Odhner, 1911; Asymphyloporidae Mehra, 1962 and Zoogonidae Odhner, 1911. Dixit Press, Allahabad.
- SIDDIQI, A. H. 1965. A new species of the genus *Astiotrema* Looss, 1900 with a key to its species. *J. Helm.*, **39**: 113-116.
- YAMAGUTI, S. 1958. *Systema Helminthum*, 1 (1 & 2ü. Interscience Publisher Inc., New York.
- YEH, L. S. and FOTEDAR, D. N. 1958. A review of the trematode genus *Astiotrema* of the family Plagiorchiidae. *J. Helm.* **32**: (1/2): 17-32.

DIPTERA FROM NEFA AND ASSAM FOOT HILLS
PART III, SIANG FRONTIER DIVISION AND
NORTH LAKHIMPUR

By

A. N. T. JOSEPH AND P. PARUI

Zoological Survey of India, Calcutta

INTRODUCTION

This part deals with the Diptera material collected during third NEFA Survey by Dr. S. K. Tandon and Sri G. S. Arora, who surveyed Siang Frontier Division and North Lakhimpur from September to November, 1966. The distributional records are given only in cases where the species were not reported in 1968.

SYSTEMATIC ACCOUNT

Family TIPULIDAE

1. *Nephrotoma consimilis* (Brunetti)

1911. *Pachyrhina consimilis* Brunetti, *Rec. Indian Mus.*, 6: 268.
1912. *Pachyrhina consimilis* Brunetti: Brunetti, *Fauna Brit. India, Diptera, Nematocera*: 346.
1961. *Nephrotoma consimilis* (Brunetti): Alexander, *Rec. Indian Mus.*, 59: 21.

Material.—1 ex., NEFA, Siang Division, Bame Village, 600 m., 30.x.1966.

2. *Nephrotoma serricornis* (Brunetti)

1912. *Pachyrhina serricornis* Brunetti, *Fauna Brit. India, Diptera, Nematocera*: 341.
1961. *Nephrotoma serricornis* (Brunetti): Alexander, *Rec. Indian Mus.*, 59: 21.

Material.—1 ex., NEFA, Siang Division, Tappi, 600 m., 23.x.1966.

Remarks.—Recorded from Darjeeling, Siliguri and Kurseong, Darjeeling District ; Pusa, Bihar ; also from Gangtok, Sikkim.

3. *Dicranomyia saltans* (Doleschall)

1857. *Limnobia saltans* Doleschall, *Nat. Tijds. Ned. Ind.*, **14**: 390.
 1912. *Dicranomyia saltans* (Doleschall): Brunetti, *Fauna Brit. India*,
Diptera, Nematocera: 373.

Material.—(I) 8 exs., Assam, N. Lakhimpur, Baliwari, 2.x.1966 and (II) 2 exs., NEFA, Siang Division, Tachidoni, 400 m., 24.x.1966.

Remarks.—Head blackish. Basal third of metatarsus black. Brunetti reported the species from Nedumangad, S. India; also known to occur in Java and Philippines.

4. *Hexatoma (Eriocera) gravelyi* (Brunetti)

1918. *Eriocera gravelyi* Brunetti, *Rec. Indian Mus.*, **15**: 337.
 1961. *Hexatoma (Eriocera) gravelyi* (Brunetti): Alexander, *Rec. Indian Mus.*, **59**: 29.

Material.—(I) 1 ex., NEFA, Siang Division, Megha Basti, 125 m., 8.x.1966 and (II) 2 exs., NEFA, Siang Division, Pading Village, 260 m., 11.x.1966.

Remarks.—Marginal cross vein with a small white spot. Recorded from Pashok, Darjeeling District; Tura, Assam.

5. *Eriocera nepalensis* (Westwood)

1835. *Caloptera nepalensis* Westwood, *Ann. Soc. Ent. France*, **4**: 681.
 1912. *Eriocera nepalensis* (Westwood): Brunetti, *Fauna Brit. India*,
Diptera, Nematocera: 543.

Material.—3 exs., NEFA, Siang Division, Bame Village, 600 m., 30.x.1966.

Remarks.—Male hypopygium reddish-yellow.

6. *Gonomyia (Protogonomyia) nigripes* (Brunetti)

1912. *Mesocyphona nigripes* Brunetti, *Fauna Brit. India*, *Diptera*,
Nematocera: 458.
 1961. *Gonomyia (Protogonomyia) nigripes* (Brunetti): Alexander,
Rec. Indian Mus., **59**: 31.

Material.—2 exs., NEFA, Siang Division, Lekhabali, 50 m., 7.x.1966.

Remarks.—Originally described from Darjeeling District.

7 *Conosia irrorata* (Wiedemann)

1828. *Limnobia irrorata* Wiedemann, *Ausser. Zweifl.*, **1**: 574.

1912. *Conosia irrorata* (Wiedemann): Brunetti, *Fauna Brit. India, Diptera, Nematocera*: 497.

Material.—1 ex., NEFA, Siang Division, Old Jining, 500 m., 20.x.1966.

Remarks.—Specimen damaged; antennae and legs missing. The range of distribution includes throughout the Orient; also occurring in China; Japan; Australia.

Family BIBIONIDAE

8. *Plecia fulvicollis* (Fabricius)

1805. *Hirtea fulvicollis* Fabricius, *Syst. Antl.*: 53.

1912. *Plecia fulvicollis* (Fabricius): Brunetti, *Fauna Brit. India, Diptera, Nematocera*: 163.

Material.—(I) 1 ex., Assam, N. Lakhimpur, Bhali Gaon, 2.x.1966; (II) 1 ex., Assam, N. Lakhimpur, Kashi Pather, 2.x.1966; (III) 20 exs., Assam, N. Lakhimpur, Officers Mess, 2.x.1966 and (IV) 5 exs., NEFA, Siang Division, Dali Camp, 300 m., 10—11.x.1966.

Remarks.—In some examples coxae and trochanters black. Recorded from numerous localities in India; also widely distributed throughout the Orient.

9. *Plecia tergorata* Rondani

1875. *Plecia tergorata* Rondani, *Ann. Mus. Civ. Genova*, 8: 462.

1912. *Plecia tergorata* Rondani: Brunetti, *Fauna Brit. India, Diptera, Nematocera*: 164.

Material.—(I) 1 ex., NEFA, Siang Division, Jeep Camp, 140 m., 6.x.1966 and (II) 6 exs., NEFA, Siang Division, Siji Village, 165 m., 8.x.1966.

Remarks.—Reported from Uttar Pradesh; W Bengal; Assam; S. India; also from Upper Burma; Borneo; Java.

Family MYCETOPHILIDAE

10. *Sciara rufithorax* Wulp

1881. *Sciara rufithorax* Wulp, *Dipt. Sumatra Exped.*: 6.

1912. *Sciara rufithorax* Wulp: Brunetti, *Fauna Brit. India, Diptera, Nematocera*: 128.

Material.—1 ex., NEFA, Siang Division, Tarak Village, New Jining, 200 m., 18.x.1966.

Remarks.—Specimen damaged. Recorded from W Bengal ; Assam ; S. India ; also from Ceylon ; Burma.

11. *Sciara rufoabdominalis* Brunetti

1912. *Sciara rufoabdominalis* Brunetti, *Fauna Brit. India, Diptera, Nematocera* : 129.

Material.—(I) 1 ex., NEFA, Siang Division, Dali Village, 200 m., 10.x.1966 and (II) 1 ex., NEFA, Siang Division, Dali Camp. 300 m., 11.x.1966.

Remarks.—Brunetti (l.c.) erected the species on one female from Manipur.

12. *Sciara indica* Walker

1856. *Sciara indica* Walker, *Ins. Saund., Dipt.*, pt. 5 : 419.

1912. *Sciara indica* Walker : Brunetti, *Fauna Brit. India, Diptera, Nematocera* : 130.

Material.—1 ex., NEFA, Siang Division, Basar Village, 550 m., 31.x.1966.

Remarks.—Brunetti (l.c.) redescribed the species on several females from Darjeeling, Kurseong and Siliguri, W Bengal ; Bhim Tal, Uttar Pradesh.

Family SIMULIIDAE

13. *Simulium indicum* Becher

1844. *Simulium indicum* Becher, *J. Asiat. Soc. Bengal*, 53 : 191, pl. 14.

1912. *Simulium indicum* Becher : Brunetti, *Fauna Brit. India, Diptera, Nematocera* : 191.

Material.—(I) 2 exs., NEFA, Siang Division, Tappi, 600 m., 23.x.1966 and (II) 3 exs., NEFA, Siang Division, Tachidoni, 400 m., 24.x.1966.

Family TABANIDAE

14. *Tabanus striatus* Fabricius

1794. *Tabanus striatus* Fabricius, *Ent. Syst.*, 4 : 371.

1911. *Tabanus striatus* Fabricius : Ricardo, *Rec. Indian Mus.*, 4 : 149.

Material.—(I) 1 ex., Assam, N. Lakhimpur, Bhali Gaon, 2.x.1966 and (II) 2 exs., Assam, N. Lakhimpur, Gila Gudi, 4.x.1966,

Remarks.—Distributed widely in India ; also recorded from Ceylon ; Burma ; Malaya ; Sumatra ; Philippines.

15. *Tabanus rubidus* Wiedemann

1821. *Tabanus rubidus* Wiedemann, *Dipt. Exot.*, 69: 14.

1911. *Tabanus rubidus* Wiedemann: Ricardo, *Rec. Indian Mus.*, 4: 155.

Material.—(I) 2 exs., Assam, N. Lakhimpur, Gila Gudi, 4.x.1966 and (II) 1 ex., NEFA, Siang Division, Kambang, 200 m., 15.x.1966.

Remarks.—Reported from Maharashtra ; Bihar ; W Bengal ; Assam ; also from Burma ; Java ; Malaya ; Sumatra ; Siam.

16. *Tabanus fuscomaculatus* Ricardo

1911. *Tabanus fuscomaculatus* Ricardo, *Rec. Indian Mus.*, 4: 183.

Material.—1 ex., NEFA, Siang Division, Dali Village, 200 m, 10.x.1966.

Remarks.—Originally described from Sima, Upper Burma ; and Sikkim.

17 *Corizoneura longirostris* Fabr subsp. *varipes* Ricardo

1911. *Corizoneura longirostris* Fabr. subsp. *varipes* Ricardo, *Rec. Indian Mus.*, 4: 367.

Material.—1 ex., NEFA, Siang Division, Dali Camp, 300 m., 12.x.1966.

Remarks.—Ricardo (l.c.) described the subspecies from Darjeeling, W Bengal ; Sadiya and Mergherita, Assam ; Himalaya ; Trivandrum, S. India ; also from Nepal and Sikkim.

18. *Chrysops designata* Ricardo

1911. *Chrysops designata* Ricardo, *Rec. Indian Mus.*, 4: 383.

Material.—(I) 2 exs., NEFA, Siang Division, Dali Camp, 300 m., 12.x.1966 ; (II) 1 ex., NEFA, Siang Division, Kambang, 200 m., 16.x.1966 and (III) 3 exs., NEFA, Siang Division, Lekhabali, 50 m., 2.xi.1966.

Family BOMBYLIIDAE

19. *Hyperalonia oenomaus* Rondani

1875. *Hyperalonia oenomaus* Rondani, *Ann. Mus. Gen.*, 7: 453.

1920. *Hyperalonia oenomaus* Rondani: Brunetti, *Fauna Brit. India. Diptera, Brachycera*: 185.

Material.—1 ex., NEFA, Siang Division, Kambang, 200 m., 15.x.1966.

Family ASILIDAE

20. *Astochia maculipennis* (Walker)

1855. *Trupanea maculipennis* Walker, *List Diptera British Museum, London*, 7: suppl. 3: 605.

1960. *Astochia maculipennis* (Walker); Ratan Lal, *Catalogue of Indian Insects*, Part 29, Asilidae, Diptera: 21.

Material.—(I) 1 ex., NEFA, Siang Division, Siji Village, 165 m., 8.x.1966 and (II) 1 ex., NEFA, Siang Division, Dali Camp, 300 m., 12.x.1966.

Remarks.—Blackish-brown stripes of mesonotum indistinct. Reported from Khasi Hills, Assam; also from Hongkong. A specimen from Darjeeling also present in ZSI collections.

21. *Heligmoneura gnava* (Wulp)

1872. *Mochtherus gnava* Wulp, *Tijdschr Ent.*, (2) 7: 243.

1960. *Heligmoneura gnava* (Wulp): Ratan Lal, *Catalogue of Indian Insects*, Part 29, Asilidae, Diptera: 34.

Material.—1 ex., NEFA, Siang Division, Tachidoni, 400 m., 24.x.1966.

Remarks.—Male terminalia blackish. Recorded from Kumaon and Dehradun, Uttar Pradesh; also from Java, Sulawesi and Gilolo. Specimens from Sadiya and Mergherita, Assam also present in ZSI collections.

22. *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 ex., NEFA, Siang Division, Dulla Tappi, 500 m., 22.x.1966.

23. *Philodicus javanus* (Wiedermann)

1819. *Asilus javanus* Wiedermann, *Zool. Mag.*, 1 (3): 4.

1960. *Philodicus javanus* (Wiedermann). Ratan Lal, *Catalogue of Indian Insects*, Part 29, Asilidae, Diptera: 36.

Material.—1 ex., Assam, N Lakhimpur, Bhali Gaon, 2.x.1966.

Remarks.—Abdomen with black and white bristles at sides.

Reported from Madras, S. India; also from Ceylon; Sikkim; Banglades; Pakistan; Timor Islands; Borneo; Java; Sumatra. ZSI. Collections also contain specimens from Rajmahal, Bihar; Calcutta and Sukna, W. Bengal; Mazbat, Assam.

24. *Laphria (Pagidolaphria) alternans* Wiedermann

1828. *Laphria alternans* Wiedermann, *Aussereurop. Zweifl. Ins.*, 1: 511.

1960. *Laphria (Pagidolaphria) alternans* Wiedermann: Ratan Lal, *Catalogue of Indian Insects*, Part 29, Asilidae, Diptera: 63.

Material.—1 ex., NEFA, Siang Division, Rimi Bridge, 300 m., 11.x.1966.

Remarks.—Widely distributed in Oriental Region.

Family CONOPIDAE

25. *Physocephala bicolor* Brunetti

1923. *Physocephala bicolor* Brunetti, *Fauna Brit. India, Diptera*, 3: 357.

Material.—1 ex., NEFA, Siang Division, Kambang, 200 m., 16.x.1966.

Remarks.—Brunetti (l.c.) described the species from Darjeeling District; Khasi Hills; Kumaon District; also from Sikkim.

Family SYRPHIDAE

26. *Paragus indicus* (Brunetti)

1908. *Pipizella indica* Brunetti, *Rec. Indian Mus.*, 2: 52.

1923. *Paragus indicus* (Brunetti): Brunetti, *Fauna Brit. India, Diptera*, 3: 33.

Material.—1 ex., NEFA, Siang Division, Old Jining, 500 m., 20.x.1966.

27. *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 ex., NEFA, Siang Division, Tarak Village, 200 m., 18.x.1966.

Remarks.—Hind tibia paler at middle. Recorded from Chapra, Bihar; Sadiya, Assam; Mangaldi, Assam-Bhutan Border; Dhikala, Garhwal District; Bijrani, Naini Tal District; Allahabad; Maddathorai; S. India; also from Pakistan; Ceylon.

28. *Melanostoma orientale* (Wiedemann)

1824. *Syrphus orientale* Wiedemann, *Analec. Ent.*: 36.

1923. *Melanostoma orientale* (Wiedemann): Brunetti, *Fauna Brit. India, Diptera*, 3: 48.

Material.—(I) 1 ex., NEFA, Siang Division, Kambang (around camp), 200 m., 16.x.1966 and (II) 2 exs., NEFA, Siang Division, Old Jining, 500 m., 20.x.1966.

29. *Asarcina ericetorum* (Fabricius)

1781. *Syrphus ericetorum* Fabricius, *Spec. Ins.*, 2: 425.

1923. *Asarcina ericetorum* (Fabricius): Brunetti, *Fauna Brit. India, Diptera*, 3: 63.

Material.—(I) 3 exs., NEFA, Siang Division, Dali Village, 200 m., 10.x.1966; (II) 1 ex., NEFA, Siang Division, Kambang, 200 m., 16.x.1966; (III) 2 exs., NEFA, Siang Division, Tappi, 600 m., 23.x.1966; (IV) 1 ex., NEFA, Siang Division, Tachidoni, 400 m., 24.x.1966 and (V) 1 ex., NEFA, Siang Division, Bame Village, 600 m., 30.x.1966.

30. *Asarcina aegrota* (Fabricius)

1805. *Eristalis aegrota* Fabricius, *Syst. Antl.*: 143.

1923. *Asarcina aegrota* (Fabricius): Brunetti, *Fauna Brit. India, Diptera*, 3: 64.

Material.—(I) 3 exs., NEFA, Siang Division, Dali Camp, 300 m., 12.x.1966; (II) 1 ex., NEFA, Siang Division, Kambang

(around camp), 200 m., 16.x.1966 ; (III) 2 exs., NEFA, Siang Division, Tappi, 600 m., 23.x.1966 ; (IV) 1 ex., NEFA, Siang Division, Tachidoni, 400 m., 24.x.1966 and (V) 2 exs., NEFA, Siang Division, Lekhabali, 50 m., 2.xi.1966.

31. *Syrphus serarius* Wiedemann

1830. *Syrphus serarius* Wiedemann, *Aussereurop. Zweifl. Ins.*, 2: 128.

1923. *Syrphus serarius* Wiedemann: Brunetti, *Fauna Brit. India, Diptera*, 3: 73.

Material.—(I) 1 ex., NEFA, Siang Division, Dali Village, 200 m., 10.x.1966 and (II) 1 ex., NEFA, Siang Division, Bame Village, 600 m., 30.x.1966.

32. *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.

Material.—(I) 1 ex., Assam, N. Lakhimpur, Bhali Gaon, 2.x.1966 ; (II) 1 ex., Assam, N. Lakhimpur, Kashi Pathar, 2.x.1966 ; (III) 3 exs., NEFA, Siang Division, Jeep Camp, 140 m., 6.x.1966 ; (IV) 1 ex., NEFA, Siang Division, Siji Village, 165 m., 8.x.1966 ; (V) 1 ex., NEFA, Siang Division, Dali Village, 200 m., 10.x.1966 ; (VI) 1 ex., NEFA, Siang Division, Sirum Bridge, 200 m., 14.x.1966 ; (VII) 15 exs., NEFA, Siang Division, Kambang, 200 m., 16.x.1966 ; (VIII) 11 exs., NEFA, Siang Division, Tarak Village, 200 m., 18.x.1966 ; (IX) 4 exs., NEFA, Siang Division, New Jining, 200 m., 19.x.1966 ; (X) 2 exs., NEFA, Siang Division, Old Jining, 500 m., 20.x.1966 ; (XI) 6 exs., NEFA, Siang Division, Dulla Tappi, 500 m., 22.x.1966 ; (XII) 8 exs., NEFA, Siang Division, Tappi, 600 m., 23.x.1966 ; (XIII) 5 exs., NEFA, Siang Division, Tachidoni, 400 m., 24.x.1966 ; (XIV) 3 exs., NEFA, Siang Division, Bame Village, 600 m., 30.x.1966 ; (XV) 10 exs., NEFA, Siang Division, Basar Village, 550 m., 31.x.1966 and (XVI) 5 exs., NEFA, Siang Division, Lekhabali, 50 m., 2.xi.1966.

Remarks.—Abdominal colouration extremely varying, so much so in a few examples the yellow marked with dark brown.

33. *Miogramma javana* (Wiedemann)

1824. *Syrphus javanus* Wiedemann, *Anal. Ent.*: 34.

1923. *Sphaerophoria javana* (Wiedemann): Brunetti, *Fauna Brit. India, Diptera*, **3**: 101.

1945. *Miogramma javana* (Wiedemann): Frey, *Notul. ent.*, **25**: 165.

Material.—(I) 1 ex., NEFA, Siang Division, Jeep Camp, 140 m., 6.x.1966; (II) 1 ex., NEFA, Siang Division, Megha Basti, 125 m., 8.x.1966; (III) 1 ex., NEFA, Siang Division, Siji Village, 165 m., 8.x.1966; (IV) 15 exs., NEFA, Siang Division, Dali Village, 200 m., 10.x.1966; (V) 3 exs., NEFA, Siang Division, Rimi Bridge, 300 m., 11.x.1966; (VI) 1 ex., NEFA, Siang Division, Sirum Bridge, 200 m., 14.x.1966; (VII) 1 ex., NEFA, Siang Division, Kambang, 200 m., 16.x.1966; (VIII) 1 ex., NEFA, Siang Division, Tarak Village, 200 m., 18.x.1966; (IX) 1 ex., NEFA, Siang Division, Tachidoni, 400 m., 24.x.1966 and (X) 5 exs., NEFA, Siang Division, Lekhabali, 50 m., 2.xi.1966.

Remarks.—In some examples hind tibia almost wholly dark brown. In a few cases, the yellow marking of second abdominal segment indistinct.

34. *Baccha maculata* Walker

1852. *Baccha maculata* Walker, *Ins. Saund., Diptera*, **3**: 223.

1923. *Baccha maculata* Walker: Brunetti, *Fauna Brit. India, Diptera*, **3**: 119.

Material.—1 ex., NEFA, Siang Division, Dulla Tappi, 500 m., 22.x.1966.

Remarks.—Recorded from Uttar Pradesh (several localities); Simla Hills, Himachal Pradesh; Darjeeling, Kurseong and Siliguri, W. Bengal; Shillong, Cherrapunji and Tura, Assam.

35. *Megaspis errans* (Fabricius)

1787. *Syrphus errans* Fabricius, *Mant. Ins.*, **2**: 337.

1923. *Megaspis errans* (Fabricius): Brunetti, *Fauna Brit. India, Diptera*, **3**: 199.

Material.—1 ex., NEFA, Siang Division, Lekhabali, 50 m., 2.xi.1966.

36. *Megaspis zonatus* (Fabricius)

1787. *Syrphus zonatus* Fabricius, *Mant. Ins.*, **2**: 337.

1923. *Megaspis zonatus* (Fabricius): Brunetti, *Fauna Brit. India, Diptera*, **3**: 203.

Material.—2 exs., NEFA, Siang Division, Kambang, 200 m., 16.x.1966.

Remarks.—More than half of arista plumose. Generally distributed throughout the East as far as Japan.

37 *Helophilus insignis* Walker

1856. *Helophilus insignis* Walker, *Proc. Linn. Soc. London*, 1: 17.

1923. *Helophilus insignis* Walker: Brunetti, *Fauna Brit. India*, Diptera, 3: 207.

Material.—1 ex., Assam, N Lakhimpur, Rangajan, 3.x.1966.

Remarks.—Reported from Calcutta to Assam; also from Burma; Borneo.

38. *Chrysotoxum baphyrus* Walker

1849. *Chrysotoxum baphyrus* Walker, *List. Dipt. Brit. Mus.*, 3: 542

1923. *Chrysotoxum baphyrus* Walker: Brunetti, *Fauna Brit. India*, Diptera, 3: 296.

Material.—1 ex., NEFA, Siang Division, Tarak Village, 200 m., 16.x.1966.

Remarks.—Fourth abdominal tergum blackish; fifth tergum black.

Family SEPSIDAE

39. *Sepsis dissimilis* Brunetti

1909. *Sepsis dissimilis* Brunetti, *Rec. Indian Mus.*, 3: 355.

Material.—(I) 1 ex., Assam, N. Lakhimpur, Bhali Gaon, 2.x.1966 and (II) 1 ex., NEFA, Siang Division, Tappi, 600 m., 23.x.1966.

Remarks.—Brunetti (l.c.) described the species from Rajmahal, Bihar; Garhwal District, Uttar Pradesh; Shasthancottah, S. India.

40. *Sepsis indica* Wiedemann

1830. *Sepsis indica* Wiedemann, *Aussereurop. Zweifl. Ins.*, 2: 467.

1909. *Sepsis indica* Wiedemann: Brunetti, *Rec. Indian Mus.*, 3: 357-359, pl. 13, figs. 9-13.

Material.—(I) 1 ex., Assam, N Lakhimpur, Bhali Gaon, 2.x.1966; (II) 2 exs., NEFA, Siang Division, Dali Village, 200 m., 10.x.1966; (III) 1 ex., NEFA, Siang Division, Dali

Camp, 300 m., 12.x.1966 ; (IV) 3 exs., NEFA, Siang Division, Kambang, 200 m., 15.x.1966 and (V) 1 ex., NEFA, Siang Division, Dulla Tappi, 500 m., 22.x.1966.

41. *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., NEFA, Siang Division, Kambang, 200 m., 15.x.1966.

42. *Sepsis adjuncta* Brunetti

1909. *Sepsis adjuncta* Brunetti, *Rec. Indian Mus.*, 3: 361.

Material.—(I) 1 ex., NEFA, Siang Division, Dali Camp, 300 m., 12.x.1966 and (II) 10 exs., NEFA, Siang Division, Kambang, 200 m., 15.x.1966.

Remarks.—Specimen bearing Reg. No. 4328/H6 with an additional small spine in the fore femur. Originally described from Pallode, S. India.

43. *Sepsis pubipes* Brunetti

1909. *Sepsis pubipes* Brunetti, *Rec. Indian Mus.*, 3: 365.

Material.—(I) 3 exs., NEFA, Siang Division, Dali Village, 200 m., 10.x.1966 ; (II) 5 exs., NEFA, Siang Division, Dali Camp, 300 m., 12.x.1966 ; (III) 6 exs., NEFA, Siang Division, Kambang, 200 m., 15.x.1966 ; (IV) 1 ex., NEFA, Siang Division, Tarak Village, 200 m., 18.x.1966 and (V) 1 ex., NEFA, Siang Division, Bame Village, 600 m., 30.x.1966.

Remarks.—In 12 specimens (Reg. No. 4322/H6 to 4333/H6), fore femur with five long spines in a row towards the tip.

New to India. Originally described from Thamaspur, Nepal ; and Shamdang, Sikkim.

44. *Sepsis viduata* Thomson

1868. *Sepsis viduata* Thomson, *Eugene Resa*: 587.

1909. *Sepsis viduata* Thomson: Brunetti, *Rec. Indian Mus.*, 3: 366.

Material.—(I) 1 ex., NEFA, Siang Division, Dali Camp, 300 m., 12.x.1966 ; (II) 1 ex., NEFA, Siang Division, Tarak Village, 200 m., 18.x.1966 and (III) 1 ex., NEFA, Siang Division, Bame Village, 600 m., 30.x.1966.

Remarks.—Abdominal whitish cross bands faint. Reported from Sukna, Berhampur and Calcutta, W Bengal; Margherita, Assam; Mussoorie, Uttar Pradesh; Maddathorai and Pallode, S. India; also from Burma; Java; Philippines; China.

Family TEPHRITIDAE

45. *Acidia fossata* (Fabricius)

1805. *Tephritis fossata* Fabricius, *Syst. Antl.*, 20: 320.

1913. *Acidia fossata* (Fabricius): Bezzi, *Mem. Indian Mus.*, 3: 144.

Material.—(I) 3 exs., NEFA, Siang Division, Dali Village, 200 m., 10.x.1966; (II) 1 ex., NEFA, Siang Division, Rimi Bridge, 300 m., 11.x.1966; (III) 4 exs., NEFA, Siang Division, Dali Camp, 300 m., 12.x.1966 and (IV) 1 ex., NEFA, Siang Division, Tappi, 600 m., 23.x.1966.

Remarks.—Widely distributed in the Oriental Region.

46. *Spheniscomyla sexmaculata* (Macquart)

1842. *Urophora sexmaculata* Macquart, *Mem. Soc. Lille*, 2: 379.

1913. *Spheniscomyla sexmaculata* (Macquart): Bezzi, *Mem. Indian Mus.*, 3: 148.

Material.—1 ex., NEFA, Siang Division, Basar Village, 550 m., 31.x.1966.

Remarks.—Recorded from Calcutta; Naini Tal, Uttar Pradesh; also from Bangladesh; Malaya; Sulawesi; Ceram; Philippines; Formosa; China; S. Africa.

Family DIOPSIDAE

47 *Teleopsis quadriguttata* (Walker)

1857. *Diopsis quadriguttata* Walker, *Journ. Proc. Linn. Soc.*, 1: 37.

1928. *Teleopsis quadriguttata* (Walker): Brunetti, *Ann. Mag. nat. Hist.*, (10) 2: 270.

Material.—2 exs., NEFA, Siang Division, Tappi, 600 m., 23.x.1966.

Remarks.—Originally described from Malacca; widely distributed in Oriental Region.

Family MUSCIDAE

48. *Musca (Musca) domestica* Linnaeus

1758. *Musca domestica* Linnaeus, *Syst. nat.*, 10: 596.

1965. *Musca (Musca) domestica* Linnaeus: Emden, *Fauna India*, *Diptera*, 7 (1): 54.

Material.—3 exs., NEFA, Siang Division, Dali Village, 200 m., 10.x.1966.

49. *Musca (Musca) domestica vicina* Macquart

1851. *Musca vicina* Macquart, *Mem. Soc. Agric. Arts Lille*, 1850: 226.

1965. *Musca (Musca) domestica vicina* Macquart: Emden, *Fauna India*, *Diptera*, 7 (1): 55.

Material.—3 exs., NEFA, Siang Division, Dali Village, 200 m., 10.x.1966.

50. *Musca (Byomyia) ventrosa* Wiedemann

1830. *Musca ventrosa* Wiedemann, *Aussereurop. Zweifl. Ins.*, 2: 656.

1965. *Musca (Byomyia) ventrosa* Wiedemann: Emden, *Fauna India*, *Diptera*, 7 (1): 60.

Material.—1 ex., NEFA, Siang Division, Tarak Village, New Jining, 200 m., 18.x.1966.

51. *Musca (Byomyia) sorbens* Wiedemann

1830. *Musca sorbens* Wiedemann, *Aussereurop. Zweifl. Ins.*, 2: 418.

1965. *Musca (Byomyia) sorbens* Wiedemann: Emden, *Fauna India*, *Diptera*, 7 (1): 61.

Material.—(I) 1 ex., Assam, N. Lakhimpur, Kashi Pathar, 2.x.1966; (II) 4 exs., NEFA, Siang Division, Lekhabali, 50 m., 6.x.1966; (III) 1 ex., NEFA, Siang Division, Lekhabali, Bank of river, 50 m., 7.x.1966; (IV) 1 ex., NEFA, Siang Division, Dulla Tappi, 500 m., 22.x.1966; (V) 1 ex., NEFA, Siang Division, Bame Village, 600 m., 30.x.1966 and (VI) 1 ex., NEFA, Siang Division, Basar Village, 550 m., 31.x.1966.

52. *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.

Material.—(I) 2 exs., Assam, N. Lakhimpur, Bhali Gaon, 2.x.1966; (II) 1 ex., Assam, N. Lakhimpur, Kashi Pathar, 2.x.1966; (III) 2 exs., NEFA, Siang Division, Megha Basti, 125 m., 8.x.1966; (IV) 1 ex., NEFA, Siang Division, Siji Village, 165 m., 8.x.1966; (V) 1 ex., NEFA, Siang Division,

Sirum Bridge, 200 m., 14.x.1966 ; (VI) 1 ex., NEFA, *Siang Division*, *Tarak Village*, *New Jining*, 200 m., 18.x.1966 and (VII) 2 exs., NEFA, *Siang Division*, *Basar Village*, 550 m., 31.x.1966.

53. *Musca (Ptilolepis) inferior* Stein

1909. *Musca inferior* Stein, *Tijdschr. Ent.*, 52: 213.

1965. *Musca (Ptilolepis) inferior* Stein: Emden, *Fauna India*, *Diptera*, 7 (1): 89.

Material.—1 ex., NEFA, *Siang Division*, *Dali Village*, 200 m., 10.x.1966.

Remarks.—A blood sucking species attacking cattle and horses. Reported from W Bengal (several localities) ; Assam ; Palni Hills and Nilgiri Hills, S. India ; Andaman Islands ; also from Burma ; Malaya ; Indonesia ; Philippines ; Formosa ; S. China.

54. *Orthellia coerulea* (Wiedemann)

1819. *Musca coerulea* Wiedemann, *Zool. Mag.*, 3: 23.

1965. *Orthellia coerulea* (Wiedemann): Emden, *Fauna India*, *Diptera*, 7 (1): 124.

Material.—(I) 1 ex., NEFA, *Siang Division*, *Megha Basti*, 125 m., 8.x.1966 ; (II) 1 ex., NEFA, *Siang Division*, *Siji Village*, 165 m., 8.x.1966 ; (III) 2 exs., NEFA, *Siang Division*, *Dali Village*, 200 m., 10.x.1966 ; (IV) 2 exs., NEFA, *Siang Division*, *Sirum Bridge*, 200 m., 14.x.1966 ; (V) 2 exs., NEFA, *Siang Division*, *Kambang*, 200 m., 15.x.1966 ; (VI) 1 ex., NEFA, *Siang Division*, *Kambang*, around camp, 200 m., 16.x.1966 ; (VII) 11 exs., NEFA, *Siang Division*, *Tarak Village*, 200 m., 18.x.1966 ; (VIII) 2 exs., NEFA, *Siang Division*, *New Jining* (along road), 200 m., 19.x.1966 ; (IX) 17 exs., NEFA, *Siang Division*, *Dulla Tappi*, 500 m., 22.x.1966 ; (X) 10 exs., NEFA, *Siang Division*, *Tappi*, 600 m., 23.x.1966 ; (XI) 6 exs., NEFA, *Siang Division*, *Tachidoni*, 400 m., 24.x.1966 ; (XII) 11 exs., NEFA, *Siang Division*, *Bame Village*, 600 m., 30.x.1966 and (XIII) 21 exs., NEFA, *Siang Division*, *Basar Village*, 550 m., 31.x.1966.

Remarks.—A specimen (Reg. No. 4362/H6) with 3 *prst dc* on the left side. Another specimen bearing Reg. No. 4363/H6 with 2 anterior mesopleurals on the right side. The inner facets of compound eyes in males exhibit variation in size as reported in Part II of the series.

55. *Orthellia indica* (Robineau-Desvoidy)

1830. *Lucilia indica* Robineau-Desvoidy, *Myodaires*: 453.

1965. *Orthellia indica* (Robineau-Desvoidy): Emden, *Fauna India*, *Diptera*, 7(1): 126.

Material.—(I) 1 ex., Assam, N. Lakhimpur, Bhali Gaon, 2.x.1966 and (II) 1 ex., Assam, N. Lakhimpur, Kashi Pathar, 2.x.1966.

56. *Orthellia coeruleifrons* (Macquart)

1851. *Lucilia coeruleifrons* Macquart, *Dipt. Exot. Suppl.*, 4: 248.

1965. *Orthellia coeruleifrons* (Macquart): Emden, *Fauna India*, *Diptera*, 7 (1): 127.

Material.—(I) 1 ex., NEFA, Siang Division, Jeep Camp, 140 m., 6.x.1966 and (II) 2 exs., NEFA, Siang Division, Tachidoni, 400 m., 24.x.1966.

57 *Orthellia claripennis* Malloch

1923. *Orthellia claripennis* Malloch, *Ann. Mag. nat. Hist.*, (9) 12: 515.

1965. *Orthellia claripennis* Malloch: Emden, *Fauna India*, *Diptera*, 7 (1): 130.

Material.—(I) 1 ex., NEFA, Siang Division, Dulla Tappi, 500 m., 22.x.1966; (II) 3 exs., NEFA, Siang Division, Tappi, 600 m., 23.x.1966; (III) 1 ex., NEFA, Siang Division, Tachidoni, 400 m., 24.x.1966 and (IV) 1 ex., NEFA, Siang Division, Basar Village, 550 m., 31.x.1966.

58. *Orthellia chalybea faceta* (Enderlein)

1934. *Neomyia faceta* Enderlein, *Sitzber. Ges. naturf. Fr.*, 1934: 420.

1965. *Orthellia chalybea faceta* (Enderlein): Emden, *Fauna India*, *Diptera*, 7(1): 131.

Material.—(I) 1 ex., NEFA, Siang Division, Tappi, 600 m., 23.x.1966 and (II) 1 ex., NEFA, Siang Division, Bame Village, 600 m., 30.x.1966.

59. *Orthellia diffidens* Walker

1857. *Musca (Pyrellia) diffidens* Walker, *Journ. Proc. Linn. Soc.*, 1: 26.

1965. *Orthellia diffidens* (Walker): Emden, *Fauna India*, *Diptera*, 7 (1): 132.

Material.—(I) 4 exs., NEFA, Siang Division, Dali Village,

200 m., 10.x.1966 ; (II) 1 ex., NEFA, Siang Division, Rimi Bridge, 300 m., 11.x.1966 ; (III) 4 exs., NEFA, Siang Division, Tappi, 600 m., 23.x.1966 and (IV) 1 ex., NEFA, Siang Division, Lekhabali, 50 m., 2.xi.1966.

Remarks.—Distributed in India ; Burma ; Malaya ; Java ; Sumatra ; Borneo ; Siam ; Sulawesi.

60. *Stomoxys calcitrans* (Linnaeus)

1758. *Conops calcitrans* Linnaeus, *Syst. Nat.*, 10: 604.

1965. *Stomoxys calcitrans* Linnaeus: Emden, *Fauna India, Diptera*, 7 (1): 160.

Material.—(I) 5 exs., Assam, N. Lakhimpur, Bhali Gaon, 2.x.1966 and (II) 1 ex., NEFA, Siang Division, Bame Village, 600 m., 20.x.1966.

Family CALLIPHORIDAE

61. *Chrysomya megacephala* (Fabricius)

1784. *Musca megacephala* Fabricius, *Syst. Ent.*, 4: 317.

1940. *Chrysomya megacephala* (Fabricius): Senior-White, Aubertin and Smart, *Fauna Brit. India, Diptera*, 6: 138.

Material.—(I) 3 exs., NEFA, Siang Division, Lekhabali (around camp), 50 m., 6.x.1966 ; (II) 2 exs., NEFA, Siang Division, Dulla Tappi, 500 m., 22.x.1966 ; (III) 1 ex., NEFA, Siang Division, Tachidoni, 400 m., 24.x.1966 and (IV) 1 ex., NEFA, Siang Division, Lekhabali, 50m., 2.xi.1966.

Family HIPPOBOSCIDAE

62. *Hippobosca longipennis* Fabricius

1805. *Hippobosca longipennis* Fabricius, *Syst. Antliat.*: 338.

1967. *Hippobosca longipennis* Fabricius: Maa, *Pacific Insects*, 9 (4): 743.

Material.—4 exs., Assam, N. Lakhimpur, Bhali Gaon, 2.x.1966.

Remarks.—A common parasite of dogs in Old World tropics and subtropics.

SUMMARY

Sixty two species of Diptera from NEFA and Assam are reported in this paper. Of these, one species, i.e. *Sepsis pubipes*

Brunetti (Family, Sepsidae), is recorded for the first time from India. The total number of examples studied are 430.

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REFERENCES

- BRUNETTI, E. 1909. New Oriental Sepsinae. *Rec. Indian Mus.* **3**: 343-372.
- BRUNETTI, E. 1912. *The Fauna of British India* including Ceylon and Burma, Diptera, Nematocera (excluding Chironomidae and Culicidae), Taylor and Francis, London, pp. xxviii + 574.
- BRUNETTI, E. 1923. *The Fauna of British India* including Ceylon and Burma, Diptera, Taylor and Francis, London, **3**, pp. xi + 424.
- JOSEPH, A. N. T. and K. RAMCHANDRA RAO, 1968. Diptera from NEFA and Assam Foot Hills, Part I and II. *Rec. zool. Surv. India*, **66** (1-4): 63-74 and 103-128, (1972).
- JOSEPH, A. N. T. and K. RAMACHANDRA RAO, 1968. Diptera from NEFA and Assam Foot Hills, Part I and II. *Rec. zool. Surv. India*, **66** (1-4): 63-74 and 103-128, (1972).
- RICARDO, G. 1911. A revision of the Oriental species of the genera of the family Tabanidae other than *Tabanus*. *Rec. Indian Mus.* **4**: 321-397.

NEW RECORDS OF SOME PELAGIC POLYCHAETES
FROM THE ARABIAN SEA AND FROM KAVARATTI
AND KALPENI ATOLLS (LACCADIVES)

By

GEORGE PETER

*Indian Ocean Biological Centre,
National Institute of Oceanography,
Ernakulam, Cochin*

(With 3 Text-figs.)

INTRODUCTION

As a part of the oceanographic survey of the Laccadive Islands, plankton samples were collected in 1968 during two cruises to Kavaratti ($10^{\circ}33'N$; $72^{\circ}36'E$) and Kalpeni ($10^{\circ}04'N$; $73^{\circ}38'E$) Islands. These two islands are from the Laccadives which include a chain of atolls in the Arabian Sea, about 300-Km from the southwest coast of India. The polychaete fractions of the samples were sorted out from the collections and studied. Of the 74 samples, 50 were found to contain pelagic polychaetes. Fifteen species belonging to four different families were identified and their distribution was studied.

During the second cruise of 1968, 44 stations were sampled. These included 24 underway stations (Table 1a) and 20 atoll stations at Kavaratti (Table 1b). The underway sampling was done by using a "Plankton Pump" (IOBC Hand Book Vol. III) and the atoll stations were sampled by using a square mouthed version of the WP2 Net (Unesco, 1968) which was made of bolting nylon of 0.2 mm mesh width and had a mouth area of 0.25 m^2 (IOBC Hand Book Vol. III) During the fifth cruise (Table 2) the survey was further carried out at Kalpeni, both within the lagoon and around the atoll, using the same modified version of WP2-Net, but having a mesh width of 0.33 mm. The number of specimens mentioned in this report refers to only half of the samples, as these were halved with the Falsom Plankton Splitter. The other half was used for biomass estimation of total zooplankton.

SYSTEMATICS AND DISTRIBUTION

Much information exists on the systematics of pelagic polychaetes. Notable references are of Stop-Bowitz (1948), Dales (1957) and Tebble (1960, 1962).

Of the fifteen species found in the collections examined three species were new records from Indian Waters.

Family ALCIOPIDAE

Members of this family are exclusively pelagic, transparant and extremely fragile and hence only damaged specimens were frequently present in the samples. The family was represented in the collections by four species.

***Torrea candida* (Delle Chiaji)**

1828. *Alciopa candida* Delle Chiaji, *Descrizione Sulla Storia e notornia degli animale senza vertebro del regno di Napoli*, 3: 88.

Torrea candida Dales and Peter, *J. nat. Hist.* (in press).

Occurrence.—Station numbers 56, 81, 86, 87 and 88 of the cruise LA5/68.

All specimens were small head fragments, the largest measured 10 mm in length upto 15th segment, 1.1 mm in width excluding parapodia and 2.7 mm including parapodia and bristles.

This is not a widely distributed species in the area. All the 7 specimens obtained during night hauls, 6 were from the open ocean, and one from the lagoon at Kalpeni. Curiously enough none was obtained outside the atolls or from the subcontinental coast.

Distribution.—Mediterranean Sea, Atlantic, Pacific and Indian Oceans.

***Rhynchonerella gracilis* Costa**

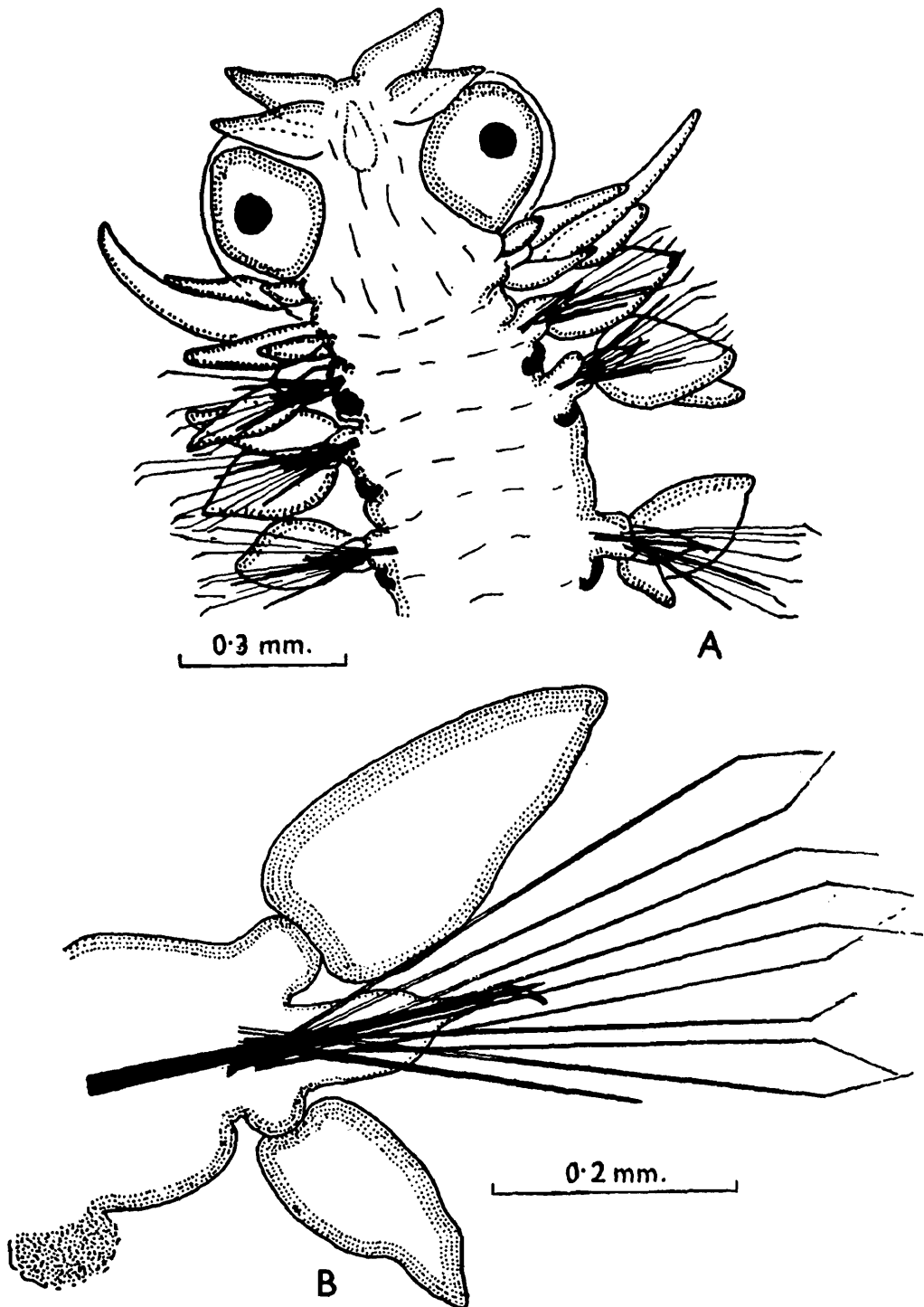
1862. *Rhynchonerella gracilis* Costa, *Anneli Mus. zool. Napoli*, 1: 168.

Rhynchonerella gracilis Dales and Peter, *J. nat. Hist.* (in press).

Three specimens from the open ocean near Kalpeni Island were collected. All were head fragments. The specimen described was 2.7 mm long upto 13th segment and 1.2 mm wide including parapodia and bristles.

Body long, slender, prostomium club shaped, extending beyond eyes, carrying 5 antennae; eyes large and globular

(Fig. 1a) ; 5 pairs of tentacular cirri ; all segments chaetigerous ; all parapodia carry foliaceous dorsal and ventral cirri ; pedal lobe ends in a cirriform appendage (Fig. 1b) ; two types of bristles : simple acicular—two each in anterior feet and one each in posterior ones, and long compound capillaries on all feet ; brownish segmental glands on all segments.



Text-fig. 1A. *Rhynchonerella gracilis* (ventral view of anterior region).
B. 5th parapodium.

This was originally recorded from the Gulf of Naples (Costa, 1862). Subsequently it was recorded from the Mediterranean Sea (Wesenberg Lund, 1939), North Atlantic Ocean (Stop-Bowitz, 1948), Pacific Ocean (Dales, 1957) and North Pacific (Tebble, 1962). The species is now reported for the first time from the Indian waters.

***Plotohormis capitata* Greeff**

1876. *Rhynchonerella capitata* Greeff, *Nova Acta Leopold-Carolin, Akad. Naturf. Dresden*, 39: 74.

Plotohormis capitata Dales and Peter, *J. nat. Hist.* (in press).

Occurrence.—Station numbers 28, 37 and 41 of cruise LA2/68 and 62, 72, 78, 80, 81, 82, 83, 85, 86, 87 and 88 of cruise LA5/68.

All head fragments; varies from 5 mm for 13 segments to 11 mm for 44 segments in length; width 0.5 mm excluding parapodia and bristles and 2 mm including it.

This was the most abundant alciopid in the area investigated. The fact that the maximum number of this species occurred in the open sea indicates that this is an oceanic form.

Distribution.—North and South Atlantic, Northwest Pacific and Indian Oceans and Mediterranean Sea.

***Alciopina parasitica* Claparede and Panceri**

1867. *Alciopina parasitica* Claparede and Panceri, *Atti. Soc. ital. Sci. nat.*, 10: 8.

Alciopina parasitica Dales and Peter, *J. nat. Hist.* (in press).

Occurrence.—Station numbers 56, 69, 78, 80, 81, 82, 83 and 85 of cruise LA5/68.

Biggest specimen 8.9 mm for 32 segments and 1 mm wide without parapodia and bristles. Out of the total of 13 specimens 11 were from oceanic waters north and south of Kalpeni, one from the lagoon and the other from outside the atoll. This was not present in the Kavaratti region.

Distribution.—Pacific Ocean, Atlantic Ocean and Indian Ocean.

Family TYPHLOSCOLECIDAE

All the three genera under this family were represented in the present material. The following five species were identified.

Travisiopsis coniceps (Chamberlin)

1919. *Plotobia coniceps* Chamberlin, *Mem. Mus. comp. Zool. Harvard*, 48: 156.

Travisiopsis coniceps Dales and Peter, *J. nat. Hist.* (in press).

Occurrence.—Station number LA2/17/68.

The single specimen was collected from the open ocean between Kavaratti and Kalpeni Islands during night. The specimen was not in good condition, only the anterior region was well preserved. The head fragment was 2.3 mm long for 12 segments and 0.3 mm broad. This species closely resembled *Travisiopsis lobifera* and could be distinguished by the branched nuchal organs.

Distribution.—Pacific and South Atlantic Oceans.

Travisiopsis lobifera Levinsen

1885. *Travisiopsis lobifera* Levinsen, *Vidensk. selsk. Skr. Kbh.*, 3: 336.

Travisiopsis lobifera Dales and Peter, *J. nat. Hist.* (in press).

Occurrence.—Station numbers 21, 28, 32, 37, 38, 39, 43, 44 and 46 of cruise LA2/68.

This was the most abundant species found in the Laccadive region. 38 specimens were collected from the area examined. All were small and juveniles. Largest specimen measured 5.1 mm for 21 segments with a width of 0.6 mm including parapodia. The species was characterized in the adults with segments varying from 18 to 21.

This species was represented both in open ocean and in the atoll waters of Kalpeni. Two specimens were recorded from the lagoons.

Distribution.—North Atlantic, Pacific and Indian Oceans.

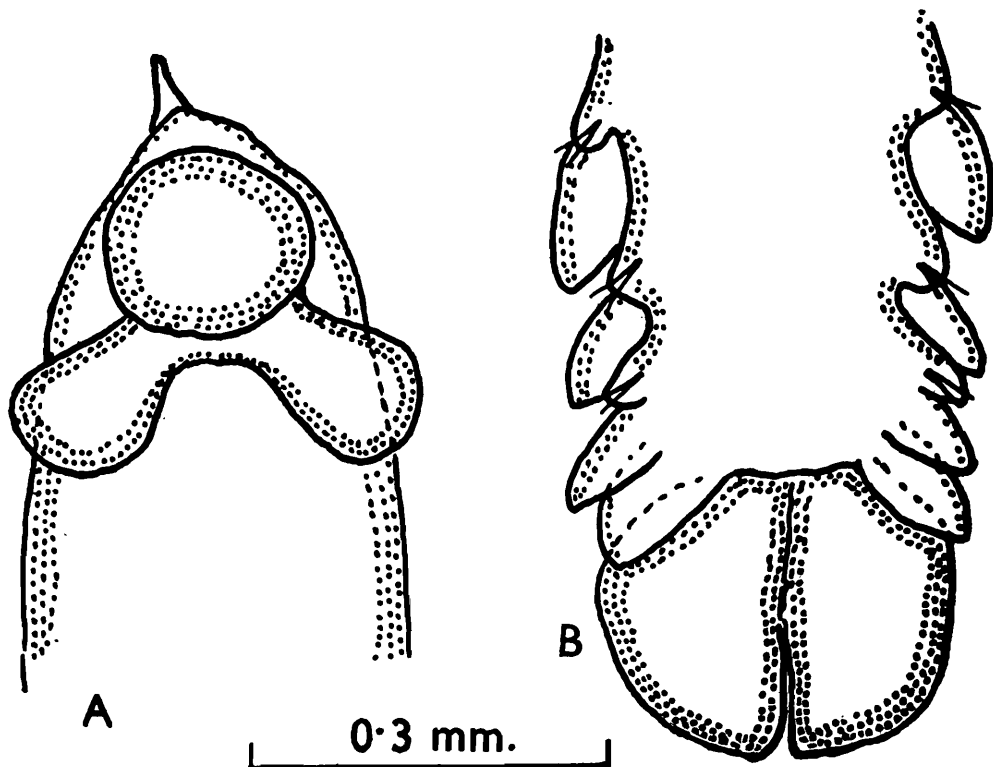
Travisiopsis levinseni Southern

1910. *Travisiopsis levinseni* Southern, *Ann. Mag. nat. Hist.*, (8) 5: 429.

Travisiopsis levinseni Dales and Peter, *J. nat. Hist.* (in press).

The single specimen was from the station number LA2/21/68. It was quite small and had a length of 4.9 mm for 24 segments, and a width of 0.6 mm including parapodial cirri.

Body fusiform, small and delicate; prostomium conical; caruncle almost rounded (Fig. 2a) surrounded by prominent nuchal organs projecting outward obliquely; parapodial cirri large and cordiform; 2-3 simple chaetae were found on every segment from 5th; anal cirri long and oval (Fig. 2b).



Text-fig. 2A. *Traviopsis levinseni* (dorsal view of anterior region).
B. Posterior region.

The original record of the species from North Atlantic by Southern (1910) was from 650-750 fathoms. Dales' (1957) record from the Pacific was also from deep hauls (1000 m). All of the Stop-Bowitz's specimens from New Foundland were from below 1000 m. But curiously enough the present record, for the first time made from the Arabian Sea, is from the surface waters.

***Typhloscolex mulleri* Busch**

1851. *Typhloscolex mulleri* Busch, *Beobachtungen über Anatomie und Entwicklung einiger wirbelloser Seethiere*. Berlin: 115.

Typhloscolex mulleri Dales and Peter J. *nat. Hist.* (in press).

Occurrence.—Station numbers 21, 22, 28, 37, 39 and 41 of cruise LA2/68 and 67, 69, 73, 74, 75, 76, 79, 80, 81, 82, 83, 86 and 87 of cruise LA5/68.

Typhloscolex mulleri was quite abundant in the collections. Largest specimen was only 3.7 mm long for 24 segments and 0.5 mm wide. This species is well represented from Kavaratti and Kalpeni atolls, although most of the specimens come from oceanic waters off Kalpeni.

Distribution.—Cosmopolitan.

***Sagitella kowalewskii* Wagner**

1872. *Sagitella kowalewskii* forme A Wagner, *Trav. nat. St. Petersburg (Trudy Obsch. estest. St. P.)* 3: 342.

Sagitella kowalewskii Dales and Peter, *J. nat. Hist.* (in press).

Occurrence.—Station number LA5/74/68.

Occurs at Kalpeni Atoll. This species also enjoys a world wide distribution. The only specimen collected was 10 mm long for 32 segments and 1.1 mm wide.

Family PHYLLODOCIDAE

A number of worms belonging to this family are adapted to pelagic mode of life. In such forms the body is short and the total number of segments is few. This family was represented in the area under investigation by the following species.

***Lopadorhynchus nationalis* Reibisch**

1895. *Lopadorhynchus nationalis* Reibisch *Ergebn. d. Plankton-Exped. Humboldt Stiftung*, II/c: 38.

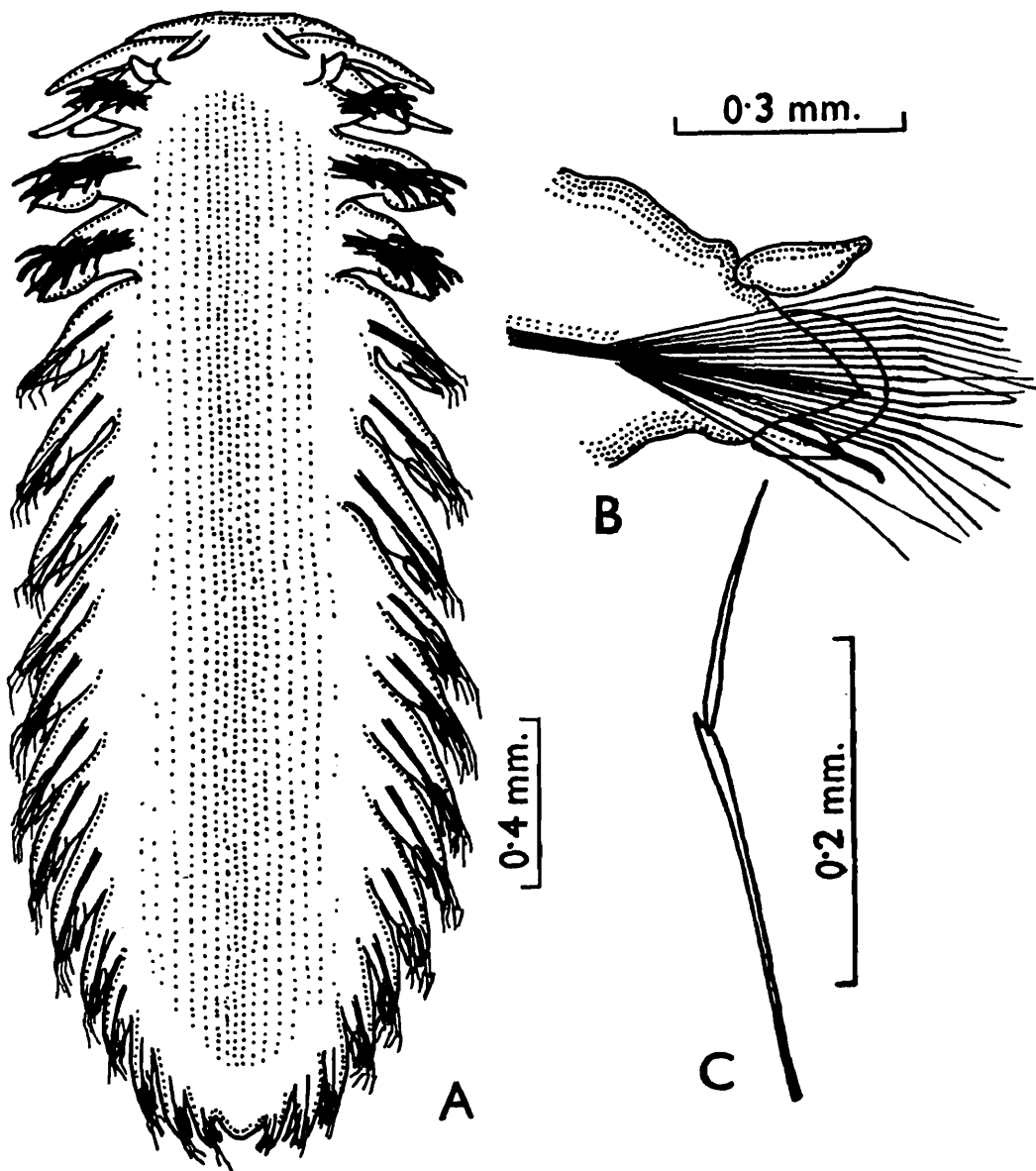
Lopadorhynchus nationalis Dales and Peter, *J. nat. Hist.* (in press).

This single specimen taken from the surface haul at 0051 hours from Kalpeni Lagoon measured 2.8 mm in length for 16 segments and 1.0 mm in width.

This typical oceanic form did not show any variation from its counterparts which have been recorded from other regions of the world. Prostomium broad (Fig. 3a), carrying two long dorsal and two short ventral antennae; eyes absent; three pairs of tentacular cirri, first two pairs long and the third pair smaller, knob like; parapodia uniramous; anterior three pairs shorter and stouter, with dorsal and ventral cirri, carrying 6-8 simple, heavy acicular chaetae only; other parapodia (Fig. 3b) carry only one or two simple chaetae embedded in a fan of compound chaetae in which the end pieces slightly flattened (Fig. 3c); parapodial cirri foliaceous and lanceolate.

This was first recorded from the equatorial part of the Atlantic Ocean by Reibisch (1895). Subsequently more specimens were recorded from Canary Islands and Azores (Fauvel, 1916); Peru (Chamberlin, 1919); Monaco (Fauvel, 1923); Mediterranean Sea (Wesenberg-Lund, 1939); North Atlantic Ocean (Stop-Bowitz, 1948) and Pacific Ocean (Dales, 1957).

This is the first record of the species from the Indian waters.



Text-fig. 3A. *Lopadorhynchus nationalis* (ventral view).
 B. 5th parapodium enlarged.
 C. Single compound bristle magnified.

***Pelagobia longicirrata* Greeff**

1879. *Pelagobia longicirrata* Greeff, *Nova Acta Leopold—Carolin Akad. Naturf. Dresden*, 39: 247.

Pelagobia longicirrata Dales and Peter, *J. nat. Hist.* (in press).

Occurrence.—Station number LA5/86/68.

The specimens were small, having a length of 3 mm for 13 segments and 0.8 mm in width including parapodia and

bristles. This widely distributed species occurs in oceanic waters south of Kalpeni Islands.

Distribution.—Pacific, Atlantic and Indian Oceans.

Phyllodoce castanea (Marenzeller)

1879. *Phyllodoce castanea* Marenzeller, *Denkschr. Akad. wissen., Wien*, 1: 127.

1923. *Phyllodoce castanea* Fauvel, *Fauna de France*, 5: 115.

Occurrence.—Station number LA2/46/68 and LA5/58/68.

This was not a truly pelagic form though very often it is found in the plankton collections. The larger of the two specimens collected, measured 17 mm for 118 segments and the other 12 mm for 52 segments, both being head fragments. The width was 1.6 mm including parapodia and bristles.

Distribution.—Cosmopolitan.

Family TOMOPTERIDAE

Like Alciopids and Typhloscolecids the members of this family are holopelagic. The representation of Tomopteridae in this area was poor, being represented by three species only.

Tomopteris (Johnstonella) nationalis Apstein

1900. *Tomopteris nationalis* Apstein, *Ergebn. d. Plankt. Exp.*, 11(b): 41.
Tomopteris nationalis Dales and Peter, *J. nat. Hist.* (in press).

Occurrence.—Station number LA5/85/68.

Three specimens were recorded from this area. These were quite small, having a length upto 0.5 mm for 12 segments. All came from the night collections made in the open ocean, south of Kalpeni.

Distribution.—Mediterranean Sea, Atlantic and Pacific Oceans.

Tomopteris (Johnstonella) pacifica Izuka

1914. *Tomopteris pacifica* Izuka, *J. Coll. Sci. imp. Univ. Tokyo*, 36: 11.

Tomopteris pacifica Dales and Peter, *J. nat. Hist.* (in press).

Occurrence.—Station number LA5/88/68.

The Single specimen was 6 mm long (7.5 mm including tail) and 2.2 mm wide having 11 segments. It was recorded off Kalpeni Island.

Distribution.—Though widely distributed it is abundant in colder waters of the North Pacific Ocean.

Tomopteris (Tomopteris) cavallii Rosa

1907. *Tomopteris cavallii* Rosa, *Monit. Zool. ital.*, **13**: 176.

Tomopteris cavallii Dales and Peter, *J. nat. Hist.* (in press)

Occurrence.—Station number LA5/78/68.

Collected from the open sea off Kalpeni, consisting of 13 segments with a length of 4 mm and a width of 1.9 mm including parapodia.

Distribution.—Widely distributed in the Pacific Ocean.

GENERAL REMARKS

Over 60% of the specimens of the present collection was from oceanic waters and only 33% from the atolls. This would indicate that the pelagic polychaetes are more confined to oceanic waters.

The occurrence of these worms showed that 80% of the specimens were collected at night. This may be because that these worms are capable of considerable vertical migratory movements. A detailed study of the vertical distribution of pelagic polychaetes should be very interesting.

ACKNOWLEDGEMENTS

I am thankful to Dr. N. K. Panikkar, Director, National Institute of Oceanography, for his kind guidance and to Dr. T. S. S. Rao and Dr. M. J. George for their comments on the manuscript.

TABLE 1A—UNDERWAY SAMPLING STATIONS—CRUISE 2/68

No.	STATION		POSITION	
	Date	Time	Latitude	Longitude
LA 2/7/68	17.10.68	0452	10°57'N	75°40'E
LA 2/8/68	17.10.68	0610	11°13'N	75°35'E
LA 2/9/68	17.10.68	0835	11°15'N	75°46'E
LA 2/10/68	17.10.68	1100	11°15'N	75°46'E
LA 2/11/68	17.10.68	1400	11°15'N	75°46'E
LA 2/12/68	17.10.68	1800	11°14'N	75°35'E
LA 2/13/68	17.10.68	1910	11°11'N	75°23'E
LA 2/14/68	17.10.69	2000	11°08'N	75°15'E
LA 2/15/68	18.10.68	0435	10°55'N	74°00'E
LA 2/16/68	18.10.68	0530	10°53'N	73°45'E
LA 2/17/68	18.10.68	1925	10°08'N	73°20'E
LA 2/18/68	19.10.68	0445	10°35'N	72°33'E
LA 2/19/68	19.10.68	0540	10°35'N	72°37'E
LA 2/20/68	19.10.68	0645	10°33'N	72°37'E
LA 2/21/68	19.10.68	1800	10°24'N	72°39'E
LA 2/22/68	19.10.68	1925	10°09'N	72°42'E
LA 2/23/68	20.10.68	0450	08°43'N	72°56'E
LA 2/24/68	20.10.68	0645	08°24'N	73°04'E
LA 2/25/68	21.10.68	0515	10°05'N	74°40'E
LA 2/46/68	26.10.68	1700	10°20'N	74°02'E
LA 2/47/68	26.10.68	1900	10°16'N	74°23'E
LA 2/48/68	27.10.68	0440	10°06'N	75°23'E
LA 2/49/68	27.10.68	0550	10°03'N	75°41'E
LA 2/50/68	27.10.68	0710	10°00'N	76°00'E

TABLE 1B—ATOLL STATIONS AT KAVARATTI—CRUISE 2/68

No.	STATION	Time	POSITION	
	Date		Latitude	Longitude
LA 2/26 68	20.10.68	1742	10°33'N	72°36'E
LA 2/27/68	„	1802	„	„
LA 2/28/68	„	1828	„	„
LA 2/29/68	„	1848	„	„
LA 2/30/68	„	1918	„	„
LA 2/31/68	„	1946	„	„
LA 2/32/68	„	1956	„	„
LA 2/33/68	„	2021	„	„
LA 2/34/68	„	2102	„	„
LA 2/35/68	21.10.68	2251	„	„
LA 2/36/68	„	2303	„	„
LA 2/37/68	„	2329	„	„
LA 2/38/68	„	2344	„	„
LA 2/39/68	22.10.68	0021	„	„
LA 2/40/68	22.10.68	0036	„	„
LA 2/41/68	„	0109	„	„
LA 2/42/68	„	0141	„	„
LA 2/43/68	„	0151	„	„
LA 2/44/68	„	0214	„	„
LA 2/45/68	„	0238	„	„

TABLE 2—ATOLL STATIONS AT KALPENI—CRUISE 5/68

No.	STATIONS		POSITION	
	Date	Time	Latitude	Longitude
LA 5/55/68	21.12.68	0010	10°04'S	73°36'E
LA 5/56/68	"	0051	"	"
LA 5/57/68	"	0121	"	"
LA 5/58/68	"	0135	"	"
LA 5/59/68	"	0209	"	"
LA 5/60/68	"	0235	"	"
LA 5/61/68	"	0254	"	"
LA 5/62/68	"	0314	"	"
LA 5/66/68	24.12.68	0014	"	"
LA 5/67/68	"	0040	"	"
LA 5/68/68	"	0059	"	"
LA 5/69/68	"	0127	"	"
LA 5/70/68	"	0140	"	"
LA 5/71/68	"	0214	"	"
LA 5/72/68	"	0241	"	"
LA 5/73/68	"	0300	"	"
LA 5/74/68	"	0315	"	"
LA 5/75/68	"	0337	"	"
LA 5/77/68	27.12.68	0020	"	"
LA 5/78/68	"	0040	"	"
LA 5/79/68	"	0057	"	"
LA 5/80/68	"	0115	"	"
LA 5/81/68	"	0137	"	"
LA 5/82/68	"	0147	"	"
LA 5/83/68	"	0430	"	"
LA 5/84/68	"	0445	"	"
LA 5/85/68	"	0502	"	"
LA 5/86/68	"	0522	"	"
LA 5/87/68	"	0537	"	"
LA 5/88/68	"	0555	"	"

REFERENCES

- CHAMBERLIN, R. V., 1919. The Annelida, Polychaeta. *Mem. Mus. Comp. Zool., Harvard* 48: 1-514.
- COSTA, A., 1862. Descrizione di alcuni Annelidi del Golfo di Napoli. *Annali. Mus. zool. Napoli*, 1: 82-90.
- DALES, R. P., 1957. Pelagic polychaetes of the Pacific Ocean. *Bull. Scripps Inst. Oceanogr.*, 7: 95-167.
- FAUVEL, P., 1916. Annelides polychaetes pelagiques prelevant des Campagnes de l'Hirondelle et la Princesse Alice (1885-1910). *Res. Comp. Sci. Monaco, fasc.* 48: 1-152.
- FAUVEL, P., 1923. Polychetes errantes. *Fauna de France*, 5: 1-488.
- REIBISCH, J. G. F., 1895. Die Pelagischen Phyllodociden und Typhloscoleciden der Plankton Expedition. *Ergebn. d. Plankton-Exped. Humboldt-Stiftung*, 2: 1-63.
- SOUTHERN R., 1910. Preliminary note on the Alciopidae, Tomopteridae, and Typhloscolecidae from the Atlantic adjacent to Ireland. *Ann. Mag. nat. Hist.*, (8) 5: 428-429.
- STOP-BOWITZ, C., 1948. Polychaeta from the Michael Sars North Atlantic Deep-Sea Expedition 1910. *Rep. Sci. Results 'Michael Sars' N. Atl. Deep Sea Exped.*, 1910, 5 (8): 1-91.
- TEBBLE, N., 1960. The distribution of pelagic polychaetes in the South Atlantic Ocean. *Discovery Reports*, 30: 161-300.
- TEBBLE, N., 1962. The distribution of pelagic polychaetes across the North Pacific Ocean. *Bull. Br. Mus. nat. Hist.*, (9), 7: 373-492.
- WESENBERG LUND, E., 1939. Pelagic polychaetes of the families Aphroditidae, Phyllodocidae, Typhloscolecidae and Alciopidae. *Rep. on the Danish Oceanographical Expeditions 1908-10 to the Mediterranean and adjacent Sea. Biology*, 2: 1-46.

UNDER WATER OBSERVATIONS—ON A COLLECTION
OF SHRIMPS FROM THE GULF OF MANNAR
OFF TUTICORIN

By

M. J. GEORGE*, K. NAGAPPAN NAYAR** AND S. MAHADEVAN**

(With 1 Text-figure)

INTRODUCTION

While Scuba diving (by K. N. N. and S. M.) in connection with the under water survey of the pearl oyster and chank fishery in the Gulf of Mannar region off Tuticorin on the south-east coast of India a few shrimps were collected. On detailed examination most of them were found to be new records from this region and opportunity is taken to report them here.

Material.—1 male 14 mm and 1 female 15 mm total length, collected from 15 m depth.

SYSTEMATIC ACCOUNT

Section CARIDEA

Subfamily PONTONIINAE

***Periclimenes (Periclimenes) rex* Kemp**

1922. *Periclimenes (Periclimenes) rex* Kemp, *Rec. Indian Mus.*, **27** : 158.

1952. *Periclimenes (Periclimenes) rex*: Holthuis, *Siboga Expeditie*, **39a** : 9.

Material.—1 male 14 mm and 1 female 15 mm total length, collected from 15 m depth.

Distribution.—This species was originally described by Kemp (1922) from a single male specimen obtained from Port Blair, Andaman Islands. This is the first report of the species outside the type locality, extending its distribution considerably in the Bay of Bengal. One female specimen also being present

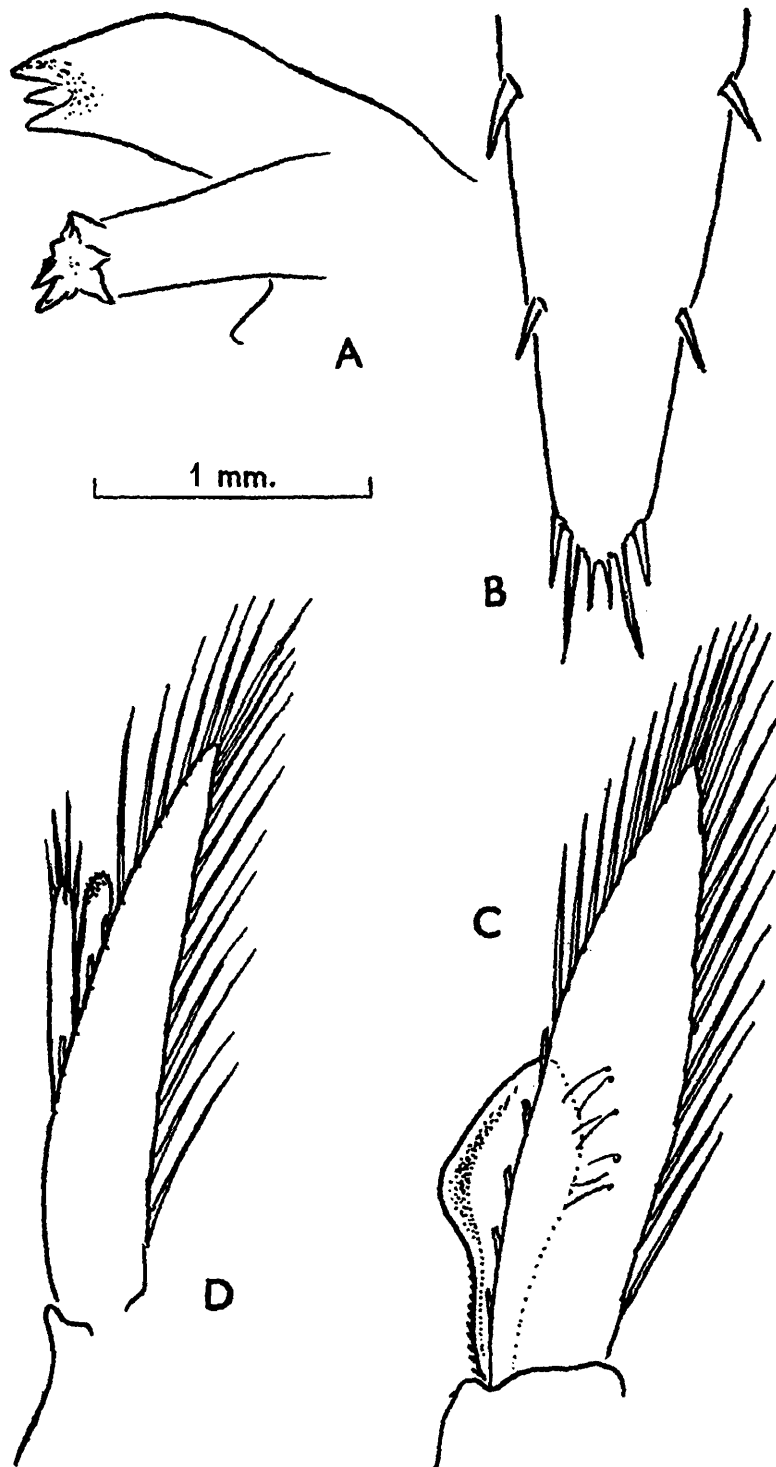
*Present address: Indian Ocean Biological Centre, Post Box 1918, Cochin-18, India.

**Central Marine Fisheries Research Substation, Tuticorin-1.

in the present collection, the female of the species is reported for the first time.

Description.—In most respects the specimens agree with the description given by Kemp (1922), but the female being newly reported a description of some of the important features may be given here.

The rostrum is typically deep in lateral view and the convex upper border only is dentate, bearing 24 small equi-



Text-fig. 1. *Periclimenes* (*Periclimenes*) *rex* Kemp ♀. A—mandible, B—telson, ♂ C—1st pleopod and D—2nd pleopod.

distant teeth like that of a saw. There is no tooth behind on the carapace separated from the rest of the rostral teeth. The strongly convex lower border is edentate. Supraorbital spine absent. Hepatic spine strong and placed on a slightly lower level than the antennal spine which is small.

The basal segment of the antennular peduncle broad and long. The 2nd and 3rd segments equal in size. The lobes at the distal external margins of the 1st and 2nd peduncular segments appear just as in the figure given by Kemp (1922). The mandible (fig. 1a) has no palp and the incissor process ends in 3 teeth. The third maxilliped and first pereopods are similar to that of the male. But the 2nd pereopods in the female are equal in length, both reaching beyond the antennal scale by half the length of the carpus and chela, instead of markedly unequal in male. The merus is about 2 times the length of the carpus which is conical and slightly longer than its greatest breadth. The chela is 1.25 times the length of the carapace and only 2 times the length of the merus. The palm is 2 times the length of the fingers. The teeth on the fingers similar to that of the male. In the 3rd to 5th pereopods the accessory dactylar spines are greatly reduced. The telson is typical with 3 pairs of spines at the tip (fig. 1b).

The 1st and 2nd pleopods of the male are shown in fig. 1c and d. The endopod of the 1st pleopod differs from that of *Periclimenes impar* and *P. indicus* in the absence of the distally directed tooth shown by Holthuis (1952). In the place of this tooth this species has a blunt protuberance which is quite regular unlike in *P. parvus*. The 2nd pleopod resembles that of *P. impar*, but the appendix masculina and interna are more or less of the same length.

The purple colour on the chelae of the anterior pereopods and the entire posterior pereopods (Kemp, 1922) is quite visible even after preservation for a long period. The bright red patches on the body fades to light brown on preservation.

Based on the occurrence of fragments of red sponge with white tips in the same haul as the shrimp was collected, Kemp suggested an association between the sponge and the shrimp. The present specimens were collected from a small, shallow rock pit, the edges of which were covered with seaweeds.

Subfamily PALAEMONINAE

Leander urocaridella Holth

1915. *Urocaridella gracilis*: Borradaile, *Ann. Mag. nat. His.*, (8)15: 210.
1922. *Urocaridella gracilis*: Kemp., *Rec. Indian Mus.*, 8: 122.
1950. *Leander urocaridella* Holthuis, *Siboga Expeditie*, 39a: 28.
1955. *Leander urocaridella* Holthuis, *Zool. Verhand.*, No. 26: 45.

Material.—1 ovigerous female 32 mm, 2 females 34 mm and 28 mm and 4 males 27 mm, 28 mm, 30 mm and 31 mm in total lengths. Depth 13-21 m.

Distribution.—Borradaile (1915, 1917) originally described the species as *Urocaridella gracilis* in the family Pontoniinae from the Maldive Archipelago. Kemp (1922) followed him by reporting it from the Orissa coast and Andaman Islands. Holthuis (1950), obtaining a few specimens from Java Sea and nearby areas, included it in the Palaemoninae under the genus *Leander* giving the nom. nov. *Leander urocaridella*. The present report for the first time from the Gulf of Mannar region extends the distribution of the species down south on the east coast of India.

Remarks.—Although the specimens to hand mostly agree with the descriptions of Borradaile (1917) and Holthuis (1950) slight variations are noticed in certain features. Dorsally the rostrum bears only 6 teeth as against 8 teeth recorded by Holthuis (1950), 2 at the proximal region, 2 in the middle and 2 distally. The ventral margin of the rostrum has 8-9 teeth. The branchiostegal spine, which is shown as the hepatic spine by Borradaile, is strong and placed some distance behind the anterior margin of the carapace, but the tip does not reach beyond that margin. The third maxilliped reaches to the end of the 2nd segment of the antennular peduncle instead of that of the basal segment. Minor variations in the length of the pereopods also exist.

Light reddish speckling on the dorsal hump of the 3rd abdominal segment is conspicuous even after preservation. Browish red patches in the middle and tip of the rostrum, tips and base of the uropods and tip of telson are also seen.

Family RHYNCHOCINETIDAE

Rhynchocinetes durbanensis Gordon

1917. *Rhynchocinetes typus* Stebbing, *Ann. S. Afr. Mus.*, 17: 27
(non *R. typus* M. Edw.).

1936. *Rhynchocinetes durbanensis* Gordon, *Proc. Zool. Soc., London* : 83.
1950. *Rhynchocinetes durbanensis*: Barnard, *Ann. S. Afr. Mus.*, 38: 763.

Material.—2 ovigerous females 43 mm and 45 mm, 2 females 39 mm and 53 mm and 1 male 47 mm in total lengths. Depth 12-20 m.

Distribution.—The species is so far recorded only from Durban. This is the first record from outside the type locality and from Indian waters.

Remarks.—This species was first reported from Durban as *Rhynchocinetes typus* by Stebbing (1917). But later Gordon (1936) examined one of the specimens described by Stebbing present in the British Museum collection and found several differences from the type species. Based on these differences she suggested a nom. nov., *Rhynchocinetes durbanensis* for the species. By recording it again from Durban, Barnard (1950) confirmed this view.

The only species of the genus recorded from Indian waters is *Rhynchocinetes hendersoni* by Kemp (1925) from the Gulf of Mannar. The specimens recorded earlier as *Rhynchocinetes rugulosus* from Tuticorin by Henderson (1893) was later referred to *R. hendersoni* by Kemp. The 7 species of the genus so far recorded, including *Rhynchocinetes hiatti* described recently by Holthuis and Hayashi (1967) fall into two well-defined groups, one with 3 and the other with 2 teeth on the dorsal margin of the carapace behind the rostral articulation as pointed out by Kemp (1925), Gordon (1936) and Holthuis and Hayashi (1967). While *R. hendersoni* falls in the former group, *R. durbanensis* is included in the latter. Thus the present species can easily be distinguished from *R. hendersoni*.

The specimens on hand agree well with the descriptions of Gordon (1936) and Barnard (1950). Carapace possesses 2 post-rostral teeth, supraorbital, antennal and pterygostomian spines. Rostrum with 3 spaced teeth proximally and 7 distally on the upper margin and 15 teeth ventrally. Stylocerite not reaching to distal end of penultimate antennular segment, slightly shorter than the distal spine on the basal segment. Although Gordon (1936) recorded the first pereopods very unequal in a male specimen of 77 mm length, Barnard (1950) observed the first pair of legs equal in a male specimen of 75 mm length. In the present male specimen also the first

pereopods are equal and the thumb and finger agree well with Barnard's description. Abdomen strongly humped at third segment. First pleopod with appendix interna possessing coupling hooks. Second pleopod with appendix interna longer than appendix masculina. Colour bands converging on the hump of the third abdominal segment and on the lateral aspects of the carapace quite conspicuous.

Habit and habitats.—On the rocky sea bottom off Tuticorin this species is commonly seen in the crevices of calcrete rocky hollows and pits in depth range 12 to 25 metres. It is a very active free living form and inhabits the top portion of the deep crevices and moves deeper down and hide for safety in times of emergency. Several of them are found living in one pit, rarely less than 4. These tiny shrimps seem to live in perfect harmony in the company of Serranids, Balistids, *Scolopsia* sp., *Gaterin* sp. and eels which inhabit the same surroundings. They feed on the encrustations on the rocky surface and on the epifauna of crinoids, molluscan shells and polychaete tubes found in the same habitat. Animal remains which settle down or such of those small animals which stray inside the crevices from the seaweeds fringing the pits are also preyed upon by the animals. They appear always busy and restless, scrapping the rocky surface or shuffling across here and there within its domain. Collections were made with the help of a hand net designed for easy manipulation inside the narrow crevices.

Family ALPHEIDAE

Synalpheus stimpsoni (de Man)

1888. *Alpheus stimpsoni* de Man, *Arch. Naturgesch.*, **53**(1): 513.
 1909. *Synalpheus consobrinus*: de Man, *V. Ned. Dierk. Ver.*, **11**(2): 111.
 1911. *Synalpheus consobrinus*: de Man, *Siboga Expeditie*, **39a**(2): 204.
 1966. *Synalpheus stimpsoni* Banner, A. H. & Banner, D. M., *The Siam Society Monograph Series*, No. 3: 46.

Material.—1 male 24 mm total length collected from 15 m depth.

Distribution.—de Man's original specimen was collected from Amboina. Later the species was recorded from Torres Strait, Marshall and Gilbert Islands and from Singapore. This

is the first record of the species from Indian waters and extends the distribution considerably to the west of the type locality.

Remarks.—According to Banner, A. M. & Banner, D. M. (1966) the species show variations in some characteristics and they considered *S. consobrinus* as a synonym of *S. stimpsoni*. In the specimens to hand also some variations are noticed from the description given by Banner & Banner (*op. cit.*). The tip of the rostrum extends to the end of the second segment of the antennular peduncle instead of that of the basal segment. The carina of the rostrum extends slightly posterior to the eye. The first pair of legs are missing in the specimen. The second leg has the 2nd carpal segment somewhat longer than that recorded by Banner & Banner (*op. cit.*) so that the ratio of the segments would be 10 : 2.2 : 2 : 2 : 3. Propodus of 3rd leg bears on inferior surface 2 pairs and 9 single spinules.

Section STENOPODIDEA

Family STENOPODIDAE

Stenopus hispidus (Olivier)

1811. *Palaemon hispidus* Olivier, *Encycl. meth. Hist. nat.*, 8: 666.
1947. *Stenopus hispidus*: Holthuis, *Siboga Expeditie*, 39a: 12 (with synonymy).
1950. *Stenopus hispidus*: Barnard, *Ann. S. Afr. Mus.*, 38: 578.
1955. *Stenopus hispidus*: Holthuis, *Zool. Verhand.*, No. 26: 144.

Material.—3 males 29 mm, 31 mm and 32 mm and 1 ovigerous female 35 mm total length. Depth 13-21 m.

Distribution.—It is a very widely distributed species in the Indo-Pacific and recorded from some areas in the Atlantic also. Although recorded from western Indian Ocean (Borradaile, 1910) and from Trincomalee on the east coast of Ceylon (Müller, 1880) there are no records of the species from the coastal areas of India. This is the first report from Indian coast.

Remarks.—In the number of medio dorsal spines on the rostrum the present material agrees with the specimens described by Barnard (1950), there being 6-7 strong spines, the distal of which reaches beyond the apex. In most characters the specimens agree with the description of Holthuis (1947).

The 2 spines at the distal end of the telson are not very conspicuous.

The anterior portion of the carapace in front of the cervical groove including the rostrum is reddish in colour. A reddish band across the posterior region of the 2nd and entire 3rd abdominal segments and another band covering the posterior half of the 6th abdominal segment and base of the telson and uropods present. The region of the cephalothorax at the base of the pereopods is coloured with a beautiful mixture of blue, violet and red. The 3rd pereopod is banded red at the distal half of the merus, middle region of the carpus, basal part of the propodus and the middle of the propodus including the base of the dactylus.

Habit and habitats.—These shrimps also inhabit the shallow rocky pits, the margins of which are lined with growth of seaweeds, mainly Phaeophyceae (*Sargassum* spp.). They occupy these pits in company with fishes like pomacentrids, serranids and eels, and crinoids and ophiuroids. Characteristically all the specimens were found beyond 13 m depth. Usually a single pair (male and female) inhabits one pit. The presence of these shrimps is detected by the antennae probing out of the hide-out. The male is smaller of the two and less brightly coloured. In one or two instances these shrimps were noticed in the same pits along with *Rhynchocinetes durbanensis* specimens. The shrimp moves quickly by walking, using the elongate slender pair of hind legs and very rarely attempt swimming. The anterior two pairs of slender chelate legs are used in grabbing food material and pushing them into the mouth. The clawed legs are also used to cleanse the antennae and body frequently.

SUMMARY

Five species of shrimps collected during Scuba diving operations in the Gulf of Mannar off Tuticorin on the south east coast of India are recorded. The female of *Periclimenes* (*Periclimenes*) *rex* Kemp is described for the first time. All the species are new records to the region.

REFERENCES

- BANNER, A. H. & D. M. BANNER 1966. The Alpheid shrimp of Thailand.—*The Siam Society Monograph Series*, No. 3: 1-168.

- BARNARD, K. H. 1950. Descriptive catalogue of South African Crustacea (Crabs and shrimps).—*Ann. S. Afr. Mus.*, **38**: 1-837.
- BORRADAILE, L. A. 1915. Notes on Carides.—*Ann. Mag. nat. Hist.*, (8) **15**: 205-13.
- BORRADAILE, L. A. 1910. Penaeidea, Stenopidea and Reptantia from the western Indian Ocean. The Percy Sladen Trust Expedition to the Indian Ocean in 1905, under the leadership of Mr. J. Stanley Gardiner, M. A., Vol. 2, Pt. 10. *Trans. Linn. Soc. London Zool.*, (2) **13**: 257-264.
- BORRADAILE, L. A. 1917. On the Pontoniinae. The Percy Sladen Trust Expedition to the Indian Ocean in 1905, under the leadership of Mr. J. Stanley Gardiner.—*Trans. Linn. Soc. London Zool.*, (2) **17**: 323-96.
- GORDON, I. 1936. On the Macruran genus *Rhynchocinetes*, with description of a new species. *Proc. zool. Soc. London.*, **1936**: 75-88.
- HENDERSON, J. R. 1893. A contribution to Indian carcinology.—*Trans. Linn. Soc. London (Zool.)*, **5** (2): 325-458.
- HOLTHUIS, L. B. 1947. The Decapoda of the Siboga Expedition. Part IX. The Hippolytidae and Rhynchocinetidae collected by the Siboga and Snellius expeditions with remarks on other species.—*Siboga Expeditie*, **39a**: 1-100.
- HOLTHUIS, L. B. 1947a. Biological results of the Snellius Expedition. XIV. The Decapoda Macrura of the Snellius Expedition. I. The Stenopodidae, Nephropsidae, Scyllaridae and Palinuridae.—*Temminckia*, **7**: 1-178.
- HOLTHUIS, L. B. 1950. The Decapoda of the Siboga Expedition. Part X. The Palaemonidae collected by the Siboga and Snellius Expeditions with remarks on other species. 1. Subfamily Palaemoninae.—*Siboga Expeditie*, **39a**: 1-268.
- HOLTHUIS, L. B. 1952. The Decapoda of the Siboga Expedition. Part XI. The Palaemonidae collected by the Siboga and Snellius Expeditions with remarks on other species. II. Subfamily Pontoniinae.—*Siboga Expeditie* **39a**: 1-254.
- HOLTHUIS, L. B. & KEN-ICHI HAYASHI 1967. A new species of shrimp, *Rhynchocinetes hiatti* (Crustacea, Decapoda).—*Annot. Zool. Japon.*, **40**(3): 161-70.
- KEMP, S. 1922. Notes on Crustacea Decapoda in the Indian Museum, XV. Pontoniinae.—*Rec. Indian Mus.*, **27**: 113-288.
- KEMP, S. 1925. Notes on Crustacea Decapoda in the Indian Museum, XVII. On various Caridea.—*Rec. Indian Mus.*, **27**: 249-343.
- MÜLLER, F. 1880. Zur Crustaceanfauna von Trincomali. *Verh. naturf. Ges. Basel.*, **8**: 470-485.
- STEBBING, T. R. R., 1917. South African Crustacea, Part IX.—*Ann. S. Afr. Mus.*, **17**: 23-46.

ON SOME NEW RECORDS OF FISHES FROM THE PULICAT LAKE, EAST COAST OF INDIA

By

M. SELVANATHAN AND M. KALIYAMURTHY

*Central Inland Fisheries Research Institute,
Pulicat Lake Investigation Unit, Ponneri*

INTRODUCTION

The importance of the study of the fish fauna of any area needs no emphasis as it would envisage the beneficial or adverse effect of the uneconomic species in their trophic relationship with their counterparts. The Pulicat lake is one of the coastal brackish water lagoons lying on the east coast of India, towards the south spreading over an area of about 460 sq. km. (Chacko *et al.* 1953). The northern half of the lake is broad and shallow while the southern half is narrow, communicating with the Bay of Bengal directly.

Apart from some observations made on the fish fauna of the Pulicat lake by Chacko *et al.* (1953), no subsequent investigations seem to have been made so far. They recorded sixty five fishes from the lake.

The object of the present report is to determine the present status of the fish fauna reported by earlier workers and to contribute additional notes on the fish fauna collected during the years 1965 and 1966.

The material for the present study was drawn from the catches made by the commercial and departmental gears. The identifications were based on Day (1878), Smith (1949), Koumans (1953), Munro (1955), George (1958) and Misra (1959).

Altogether eighty one species of fishes were recorded from the lake for the first time.

The authors are grateful to Dr. V. G. Jhingran, Director, C.I.F.R.I. and Shri V. R. Pantulu, Senior Research Officer for their constant encouragement. They thank Dr. V. Gopalakrishnan, Research Officer for critically going through the manuscript. They also thank Dr. M. Subrahmanyam for suggesting the problem and revising the manuscript.

LIST OF NEW FISHES RECORDED FROM THE PULICAT LAKE

1. *Anchoviella baganensis* (Hardenberg)
2. *Anchoviella heteroloba* (Rüppell)
3. *Kowala coval* (Cuvier)
4. *Thrissocles dussumieri* (Valenciennes)
5. *Thrissocles malabaricus* (Bloch)
6. *Thrissocles purava* (Hamilton)
7. *Notopterus notopterus* (Pallas)
8. *Saurida tumbil* (Bloch)
9. *Oxygaster clupeoides* (Bloch)
10. *Puntius sophore* (Hamilton)
11. *Plotosus anguillaris* (Bloch)
12. *Pseudeutropius atherinoides* (Bloch)
13. *Anguilla bengalensis* (Gray and Hardwicke)
14. *Thyrsoidea macrura* (Bleeker)
15. *Muraenesox cinereus* (Forsk.)
16. *Strongylura crocodilus* (Le sueur)
17. *Paraxocoetus brachypterus* (Richardson)
18. *Syngnathus cyanospilos* Bleeker
19. *Sphyraena obtusata* Cuvier
20. *Sphyraena jello* Cuvier
21. *Atherina melanostigma* Day
22. *Amphipnous cuchia* (Hamilton)
23. *Ambassis urotaenia* Bleeker
24. *Epinephelus lanceolatus* (Bloch)
25. *Serranus tumilabris* Cuvier and Valenciennes
26. *Pelates quadrilineatus* (Bloch)
27. *Alectis indicus* (Rüppell)
28. *Caranx carangus* (Bloch)
29. *Caranx ire* Valenciennes
30. *Citula armata* (Forsk.)
31. *Scomberoides tala* (Cuvier)
32. *Scomberoides lysan* (Forsk.)
33. *Trachinotus blochii* (Lacépède)
34. *Lutianus vitta* (Quoy and Gaimard)
35. *Nemipterus tolu* (Valenciennes)
36. *Leiognathus blochii* (Valenciennes)
37. *Leiognathus equula* (Forsk.)
38. *Leiognathus insidiator* (Bloch)
39. *Pomadasys maculatus* (Bloch)
40. *Plectorhynchus niger* (Cuvier)
41. *Pseudosciaena diacanthus* (Lacépède)

42. *Sciaena dussumieri* (Valenciennes)
43. *Sciaena russellii* (Cuvier)
44. *Platyglossus dussumieri* (Cuvier and Valenciennes)
45. *Pseudoscarus ghobam* (Forskål)
46. *Parupeneus indicus* (Shaw)
47. *Upeneus tragula* Richardson
48. *Monodactylus argenteus* (Linnaeus)
49. *Sparus berda* Forskål
50. *Ephippus orbis* (Bloch)
51. *Platax pinnatus* (Linnaeus)
52. *Drepane punctata* (Linnaeus)
53. *Tilapia mossambica* (Peters)
54. *Siganus javus* (Linnaeus)
55. *Siganus oramin* (Bloch and Schneider)
56. *Siganus spinus* (Linnaeus)
57. *Acanthurus bleekeri* Günther
58. *Perionobutis koilomatodon* (Bleeker)
59. *Acentrogobius cyanosmos* (Bleeker)
60. *Acentrogobius ornatus* (Rüppell)
61. *Acentrogobius reichei* (Bleeker)
62. *Acentrogobius viridipunctatus* (Cuvier and Valenciennes)
63. *Ctenogobius criniger* (Cuvier and Valenciennes)
64. *Glossogobius biocellatus* (Cuvier and Valenciennes)
65. *Glossogobius giuris* (Hamilton)
66. *Gobius madraspatensis* Day
67. *Oligolepis acutipinnis* (Cuvier and Valenciennes)
68. *Oxyurichthys tentacularis* (Cuvier and Valenciennes)
69. *Pseudapocryptes lanceolatus* (Bloch and Schneider)
70. *Platycephalus scaber* (Linnaeus)
71. *Gymnapistes niger* (Cuvier and Valenciennes)
72. *Pterois volitans* (Linnaeus)
73. *Minous monodactylus* (Bloch and Schneider)
74. *Brachirus orientalis* (Bloch and Schneider)
75. *Cynoglossus puncticeps* (Richardson)
76. *Cynoglossus semifasciatus* Day
77. *Macrogathus aculeatum* (Bloch)
78. *Arothron immaculatus* (Bloch and Schneider)
79. *Chelonodon patoca* (Hamilton)
80. *Gastrophysus lunaris* (Bloch)
81. *Torguigener oblongus* (Bloch)

REMARKS

In addition forty nine species of fishes out of the sixty five species of fishes reported by the previous workers were also recorded. Chacko *et al.* (1953) listed twenty three species of fishes as commercially important. From the present new records *Kowala coval* (Cuvier), *Thrissocles purava* (Hamilton), *Strongylura crocodilus* (Le sueur), *Epinephelus lanceolatus* (Bloch), *Citula armata* (Forsk.) *Pomadasys maculatus* (Bloch), *Pseudosciaena diacanthus* (Lacépède), *Sparus berda* Forskal and *Siganus javus* (Linnaeus) were found economically important, thus raising the number of food fishes of both economic and commercial value to thirty two. Some of them like *S. crocodilus*, *P. maculatus*, *P. diacanthus* etc. showed seasonal abundance, while others were available throughout the year.

Out of the eighty one species newly recorded, seven species were of freshwater origin while the remaining seventy four were from brackish water. The freshwater species were observed during the rainy season only, when the streams swell and enter the lake, incidentally draining some of the freshwater forms. They were confined in distribution to the northern region of the lake. The majority of the salt water species were widely distributed in the lake and appeared to tolerate wide fluctuations in environmental conditions while a few were purely marine and were observed to enter the lake temporarily. It may be noted that the majority of the brackish water species are also known from the sea, confirming the theory that the majority of the brackish water fishes in open estuarine areas are of marine origin. However, the number of individual species is more towards the confluence of the lake with the sea than farther away from the confluence presumably due to divergent environmental parameters. Strictly marine species were always found nearer the confluence while the brackish water species were distributed all over the lake.

From the present study it is apparent that the majority of fishes known from the lake are of marine origin. It is also clear that a few species maintain large populations while the role of other uneconomic species is yet to be established; whether they form the prey or the predator is of significance to the commercially exploited populations. A detailed study of the food and feeding habits of important fishes of the lake is underway.

REFERENCES

- *BERG, L. S. 1940. Classification of Fishes both recent and fossil. *Trav. Inst. Zool. Acad. Sci. USSR*, 5 (2):
- CHACKO, P. I., ABRAHAM, J. G. and ANDAL, R., 1953. Report on a survey of the flora, fauna and fisheries of the Pulicat Lake, Madras, India (1951-52). *Contribution from Freshwater Fisheries Biological Station, Madras*, No. 8: 1-20.
- DAY, F., 1878. *Fishes of India: A natural history of the fishes of India, Burma and Ceylon*. William Dawson and Sons Ltd., London. Vols. 1 and 2: 496-501.
- GEORGE, K. C., 1958. On the occurrence of *Anchoviella beganensis* (Hardenberg) and *Anchoviella bataviensis* (Hardenberg) along the South-East and South-West Coasts of India. *Indian J. fish*, 5 (2): 348-356.
- JONES, S. and SUJANSINGANI, K. H., 1954. Fish and fisheries of the Chilka lake with statistics of fish catches for the year 1948-50—*Indian J. Fish.*, 1 (1-2): 261-270.
- KOUMANS, F. P., 1953. *The fishes of Indo-Australian Archipelago*, Leiden, 10, i-xiii, 1-423, 95 figs.
- MISRA, K. S., 1959. An aid to the identification of the common commercial fishes of India and Pakistan. *Rec. Indian Mus.* 57 (1-4): 1-320.
- MUNRO, I. S. R., 1955. *The Marine and Freshwater Fishes of Ceylon*, Canberra. i-xvi, 1-349, 56 plates, 19 figs.
- SMITH, J. L. B., 1949. *The sea fishes of South Africa*, Grahamtown, i-xii, 1-564, 107 plates, 1232 figs.

*not consulted in original.

THE COCCINELLIDAE (COLEOPTERA) OF THE ITALIAN
EXPEDITIONS TO THE KARAKORAM
AND HINDU KUSH

By

A. P. KAPUR

Zoological Survey of India, Calcutta

(With 2 Text-figures)

Through the courtesy of the late Prof. Edoardo Gridelli, Director, Museo Civico di Storia Naturale, Trieste, Italy, I have been able to examine a small but interesting collection of the Lady-beetles (Coccinellidae, Coleoptera) made by Prof. A. Marussi, leader of the Italian Expeditions to the Karakoram and Hindu Kush in 1954 and 1955, respectively. Very little is known of the coccinellid fauna of these areas. Altogether there are 15 examples belonging to four species, two of which are new to science and are being described in the present paper.

I am grateful to Dr. Renato Mezzena, the present Director of the above-mentioned Museum, for very kindly supplying me detailed information on the location of various collecting stations; the information supplied by him is given in square brackets at appropriate places in the text.

1. *Coccinella septempunctata* Linnaeus

1758. *Coccinella septempunctata* Linnaeus, *Systema Naturae* (Ed X): 365.

1932. *Coccinella septempunctata* Linnaeus: Korschefsky, *Coleopt. cat., Berl.*, 16 (120): 486.

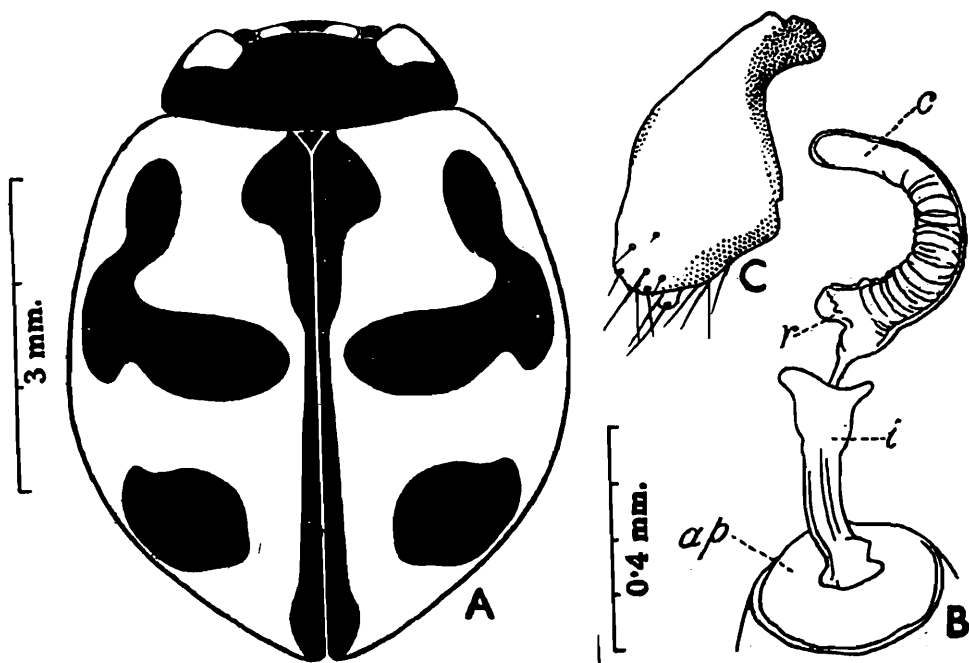
Material.—3 examples, Valle YARKHUM [Chitral], 2100-3600 m. [Hindu Kush; 72° - 74° E; 36° - 38° N].

This palaearctic species is very widely distributed and is distinguishable into a number of subspecies and varieties. The above-mentioned examples resemble the typical material of the species from Europe in respect of colour-pattern, but like some smaller members of the species, these examples are approximately 5.8 mm. long and 4.5 mm. broad.

2. *Coccinella marussii* sp. n.

(Text-fig. 1)

♀. Body subovate, moderately convex and smaller in size but otherwise similar to *Coccinella septempunctata* Linnaeus. Head black except for the dark grey eyes and a pair of pale testaceous, subquadrate spots on the frons each lying near the inner margin of the eye; canthus of the eye also testaceous. Pronotum black, with a pale testaceous subquadrate spot at each anterior angle, the spot weakly emarginate posteriorly. Scutellum



Text-fig. 1. *Coccinella marussii* sp. n. (A) Outline of the beetle, showing the pattern. (B) Spermatheca. (C) A genital plate of the female. *ap.* accessory plate; *c.* cornu; *i.* infundibulum; *r.* ramus.

black. Elytra (Text-fig. 1, A) reddish testaceous, with a large subrounded, black, scutellar spot which is gradually narrowed to a black sutural line that widens a little before the apex of the elytra; the other black spot in the basal half of the elytron is a compound one and appears to be composed of three confluent spots, *viz.*, a transverse discal spot, a submarginal spot, and a humeral spot with the connecting black areas fairly broad. The apical half of the elytron with a large, transverse-oval, black spot (1.3 mm. $\times$ 1.0 mm.) lying much closer to the lateral margin (though not touching it) than to the suture. Underside black except for the pale testaceous apices of the

pronotal epipleurae, the testaceous elytral epipleurae, and the whitish mesepimera.

Head with moderately impressed, small and fairly close punctures on the frons and a few greyish hair on the anterior margin of the clypeus. Pronotum with very fine, close and moderately impressed punctation. Scutellum small, triangular, with the sides as long as the base and with about eight very fine punctures. Elytra narrowly margined along the anterior half of the lateral margin, with the maximum width beyond the middle; punctation relatively sparse, coarse and less impressed than that on the pronotum. Underside with the prosternal carinae short, and with each abdominal line crossed by an oblique line. Female genitalia with the spermatheca semicircular, the cornu (*c*) slightly narrowed distally, the ramus (*r*) short, the infundibulum (*i*) broader at the distal than at the proximal end, and the accessory plate (*ap*) circular (Text-fig 1, B); the genital plates (ix sternite) elongate being 0.5 mm. long and 0.25 mm. broad, narrow and constricted near the base, broad distally, a well-defined papilla present at the apex of each genital plate (Text-fig. 1, C).

♂ unknown.

Length 5.4 mm.; breadth 4.0 mm.

Material.—*Holotype* : ♀, KARAKORAM, V Stak, (Kulan-kae); 3,100 m., [75° E., 35° 50' N.] August, 1954 (Prof. A. Marussi); in Museo Civico di Storia Naturale, Trieste, Italy. (The genitalia dissected and mounted in Canada Balsam between two cover-slips and attached to the same pin as the specimen.)

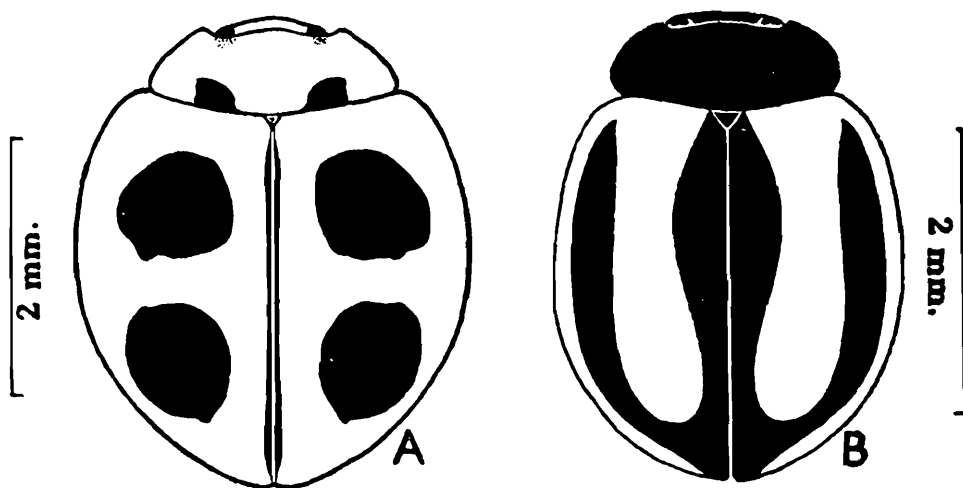
This species is easily distinguishable from all other known palaearctic species of *Coccinella* by its elytral pattern which is characterised by a common, black, sutural border and a compound, almost tricuspid, black spot in the basal half of the elytron. The female genitalia are also characteristic and indicate its affinities to *Coccinella septempunctata* L. and other related species of the group. However, in outline and detailed structure of the female genitalia, especially of the spermatheca, as described above, *C. marussii* is easily distinguishable from the other species.

3. *Verania allardi* (Mulsant)

(Text-fig. 2, A)

1866. *Lemnia allardi* Mulsant, *Mem. Acad. Lyon*, 17: 28.

1874. *Verania allardi* (Mulsant): Crotch, *Revision of the Coleopterous family Coccinellidae*: 177.
 1932. *Verania allardi* (Mulsant): Korschefsky, *Coleopt. Cat., Berl.*, 16 (120): 307.



Text-fig. 2. Outlines of the beetles, showing the patterns. (A) *Verania allardi* (Mulsant). (B) *Exochomus trijunctus* sp.n.

Material.—8 examples belonging to both sexes. CHITRAL, V Birir, 2,300 m., [In Brumboret's Valley; Hindu Kush.] August, 1955 (Prof. A. Marussi). (The genitalia of a few examples dissected and mounted between two cover-slips and attached to the same pin as the specimens.)

Originally described from "Northern India", the species is fairly widely distributed. In the Zoological Survey of India examples of the species from Chitral, Bihar, Manipur and Burma are also present. In the above-mentioned eight examples before me, variation in the size of the elytral spots has been observed although the relative position of spots remains constant. The example illustrated in the text-fig. 2, A, has large elytral spots, whereas in some other examples the spots are smaller. The elytral markings are very much reduced or almost absent in the examples from Manipur and Burma. Korschefsky (*loc. cit.*), in his catalogue lists *Verania malaccensis* Crotch (1874), from Gilol as its variety and gives wide distribution for the species, including a number of other countries from South-East Asia, but such a wide range of distribution for the species remains to be confirmed by comparative studies based on the material from different countries.

4. ***Exochomus trijunctus* sp. n.**

(Text-fig. 2, B)

♂, ♀. Body shortly oval, moderately convex, pubescent, mostly black except for the reddish-testaceous elytra which are ornamented with three black vittae that become confluent near the apices of elytra (Text-fig. 2, B). Each lateral stripe or vitta commences from the humeral callus and runs parallel to but at a little distance away from the lateral margin of the elytron except near the apex where all the vittae meet one another. The sutural vitta commences from the base of the elytra (on either side of the scutellum) and runs along the suture for its entire length, becoming gradually broad in the basal one-third of its length and narrowing again thereafter; the trijunction thus formed by the meeting of the vittae near the apex is quite broad. Underside black except for the reddish-testaceous elytral epipleura and the piceous tarsi.

Head with fine, rather shallow and moderately sparse punctation, and the greyish, short, sparse and subdepressed pubescence. Pronotum transverse, twice as broad as long; narrowly margined laterally and at the base; the anterior and basal angles rounded; punctation only relatively coarse and sparse when compared to that on the head; pubescence also slightly longer but otherwise similar to that on the head. Scutellum triangular, small, with only three or four fine punctures. Elytra with fine, close and relatively shallow punctation, and with short, subdepressed and greyish pubescence. Underside with the thoracic sternites finely and sparsely punctate, abdominal sternites, however, with relatively coarse, impressed and closer punctures; the sternites and legs clothed with greyish, rather long and sparse pubescence except for the elytral epipleurae where the pubescence is short.

Length 3.1 mm.; *breadth* 2.2 mm.

Material.—*Holotype*: ♂ KARAKORAM, V Stak, (Kulan-kae) 3,100 m. [75° E., 35° 50' N.], August, 1954. (Prof. A. Marussi); in Museo Civico di Storia Naturale, Trieste, Italy. (Male genitalia dissected and mounted in Canada Balsam between two cover-slips and attached to the same pin as the specimen). *Allotype*: ♀, same data as the holotype; deposited in the said Museum. (Genitalia dissected and mounted as above). *Paratype*: KARAKORAM, V Stak (Kuthia) 3,700-

3,900 m., August, 1954 (Prof. A. Marussi), in the Zoological Survey of India, Calcutta, India.

Exochomus trijunctus comes close to *Exochomus uropygialis* Mulsant and *Exochomus lituratus* Gorham, both of which occur in northern India and are characterised by the pubescent dorsal surface, black body and reddish testaceous elytra having black markings of different patterns. In *E. uropygialis* there is a small, black, common spot at the apex of elytra, while in *E. lituratus* each elytron is provided with a black sublateral vitta. However, both *E. uropygialis* and *E. lituratus* are larger species, being about 3.5 mm. to 4.2 mm. in length. Moreover, the elytral punctation in the latter two species is quite different, being coarser, more impressed and uneven than is the case in *E. trijunctus*. The genitalia in the three species also show differences in respect of the shape of the siphon and median lobe, but these need not be described here as these species can be easily distinguished from one another by the external characters stated earlier.

SUMMARY

Four species of Coccinellidae (Coleoptera) collected by the Italian Expeditions to the Karakoram and Hindu Kush under the leadership of Prof. A. Marussi, during 1954 and 1955, respectively, are recorded. Of these, *Coccinella marussii* Kapur and *Exochomus trijunctus* Kapur, both from Karakoram, are described as new species. The other two species are *Coccinella septempunctata* Linnaeus and *Verania allardi* (Mulsant), both of which are widely distributed.

ON TWO NEW SPECIES OF PELAGIC POLYCHAETES
FROM THE INDIAN OCEAN

By

G. PETER

*Indian Ocean Biological Centre, National Institute of
Oceanography, Ernakulum, Cochin*

(With 4 Text-figures)

INTRODUCTION

A study on the systematics and zoogeography of pelagic polychaetes of International Collections is in progress. Our knowledge of these worms in the Indian Ocean is very limited and is mainly based on the work of Fauvel (1953). The purpose of this paper is to describe two new species of pelagic polychaetes.

I am thankful to Dr. N. K. Panikkar, Director, National Institute of Oceanography for permitting me to publish this paper. I am also thankful to Dr. T. S. S. Rao and Dr. N. R. Menon for their valuable suggestions and to Dr. R. Philip Dales for help in identifying the species.

1. ***Lopadorhynchus panikkarii* sp. n.**

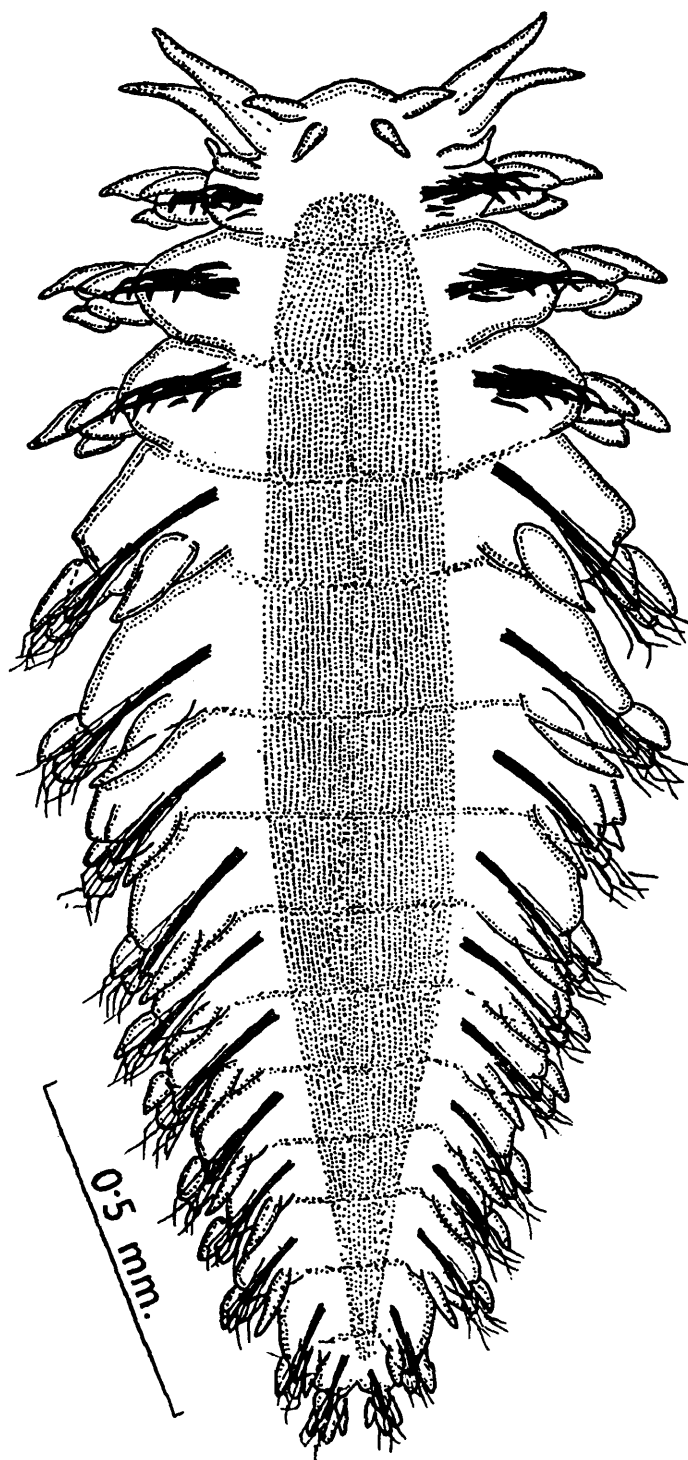
(Text-fig. 1, 2)

Material.—*Holotype* : Arabian Sea, Lat. 17°36' N. Long. 68°00' E., Stn. No. 12A of Anton Bruun, Cruise A. *Paratypes* : 1 ex., Lat. 16°37' N. 41°09' E., Stn. No. 73 of Meteor, Cruise I. 1 ex., Lat. 08°11' N. 50°57' E., Stn. No. 115 of Meteor, Cruise I. 2 exs., Lat. 16°19' N. 68°52' E., Stn. No. 205 of Meteor, Cruise I.

Measurements.—*Holotype* : Length 2.1 mm. for 14 segments ; width 0.5 mm. excluding parapodia and 1.0 mm. including parapodia and bristles.

Description.—Prostomium broad, bearing two pairs of frontal antennae : dorsal pair larger, appear to be anterolateral extensions of prostomium ; ventral pair smaller, located closer to the mouth. Eyes obscure. Three pairs of tentacular cirri,

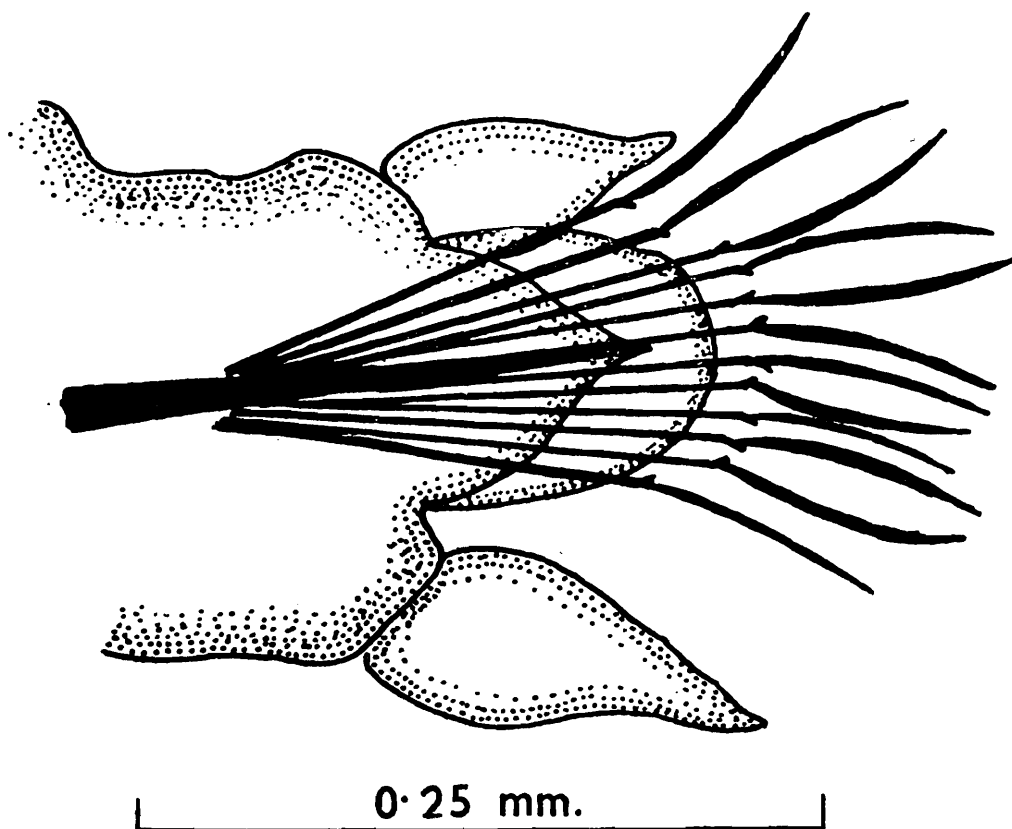
anterior two pairs long and of equal length, third pair very short (Text-fig. 1).



Text-fig. 1. *Lopadorhynchus panikkari* sp.n. Ventral view.

Parapodia uniramous, anterior three pairs modified, shorter and directed sideways. The parapodial lobes in these parapodia are bifid at the distal end. Dorsal cirri longer than ventral and both cirri longer than parapodial lobe and parapodial lamella absent.

All parapodia from fourth segment onwards directed obliquely to posterior side; parapodial lobe conical with rounded lamella; dorsal cirri smaller than ventral; cirri lanceolate. All parapodia provided with strong aciculum (Text-fig. 2).



Text-fig 2. *Lopadorhynchus panikkari* sp.n. 7th parapodium, magnified view.

Two types of chaetae : 1. Four to five simple heavy acicular chaetae with curved ends occur on three anterior pairs of modified parapodia only. 2. Long compound capillary chaetae with slightly flattened end pieces, occurring in bunch on the rest of parapodia. Compound capillary chaetae absent in the anterior modified parapodia and acicular chaetae not present on the rest of the parapodia.

Relationship and Differential Diagnosis.—The genus *Lopadorhynchus* was created by Grube in 1855. It is clear from his description that he never gave importance to the presence or absence of ventral cirri in the anterior two pairs of parapodia. Subsequently Bergstrom (1914) divided this genus into two subgenera based on the solitary character of the presence (*Prolopadorhynchus*) or absence (*Lopadorhynchus*) of ventral cirri in the anterior parapodia. Hartman (1959) raised them to

the generic level. But recent authors like Tebble (1960) disagree with this division.

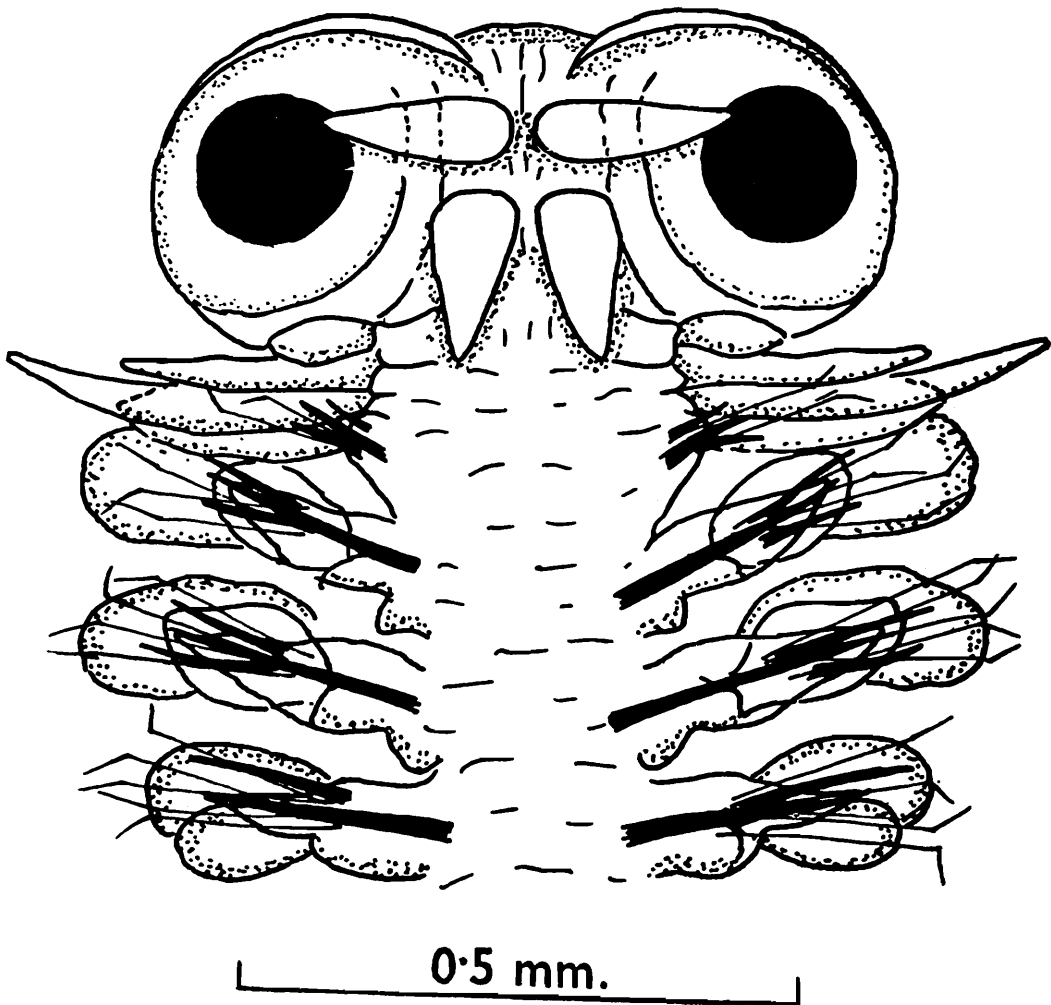
The present species differs from its allied species, *Lopadorhynchus nationalis* Reibisch mainly in the absence of simple acicular chaetae in the midbody region. The bifid nature of the parapodial trunk and the longer cirri on the anterior three pairs of parapodia are unique among the species assigned to *Lopadorhynchus*.

The species is named after Dr. N. K. Panikkar, Director of National Institute of Oceanography, India.

2. *Plotohelmis sumatransis* sp. n.

(Text-fig. 3, 4)

Material.—*Holotype* : Off the coast of Sumatra, Lat. 03°58' S. Long. 97°46' E ; 27.xii.1964 ; *Japanese Research Vessel "Oshromaru"* Coll.

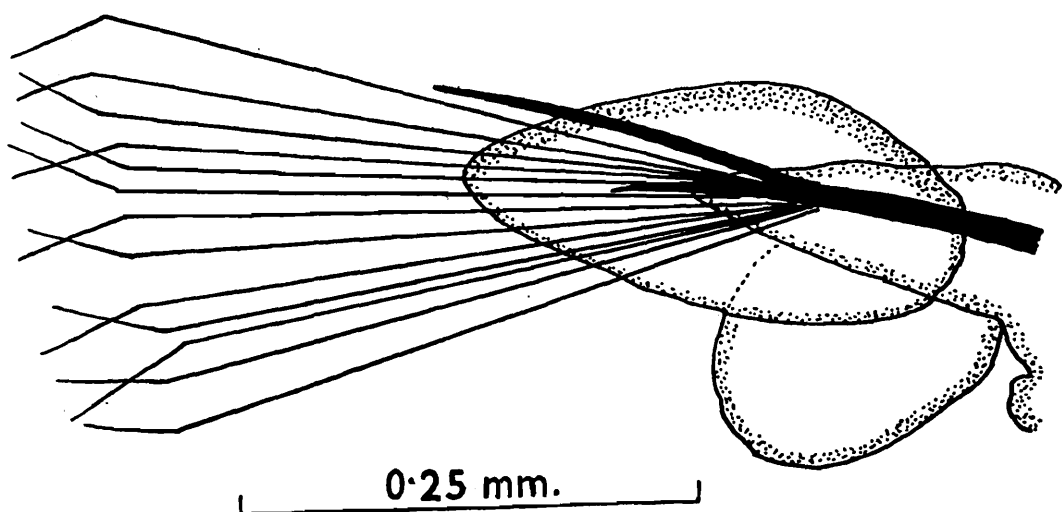


Text--fig. 3. *Plotohelmis sumatransis* sp. n. Anterior region, ventral view.

Measurements.—*Holotype* incomplete : length 2.7 mm. including a head fragment with 13 segments ; width 0.5 mm. excluding parapodia and 1.4 mm. including parapodia and bristles.

Description.—The presence of compound capillary chaetae and the reduction in number of the simple acicular chaetae in the anterior parapodia ; intermittantly arranged segmental glands provided with extensions on to the body surface.

Relationship and Differential Diagnosis.—The afore-mentioned characters distinguish *Plotohormis sumatransis* sp.n. from other members of the genus, viz., *P. tenuis*, *P. capitata*, and *P. alata*. In all these species the first few parapodia are totally devoid of compound capillaries and the acicular chaetae occur in fairly good numbers (10-11). The segmental glands in the existing species of *Plotohormis* occur on every segment starting from ninth, but in this new form they occur on segments six to ten. These glands, quite contrary to what is found in the other species, extend over the body surface, dorsally and ventrally. This glandular area is followed by a non-glandular region, thereby giving the body surface a striped appearance.



Text-fig. 4. *Plotohormis sumatransis* sp.n. Fifth parapodium.

Présence of only three pairs of tentacular cirri is an added difference of specific value shown by the material on hand. The fat frontal antennae is quite in contrast with the thin ones of other described species of this genus.

The genus *Plotohormis* was created by Chamberlin in 1919 and is characterised by the presence of both simple acicular chaetae and compound capillary chaetae, and the absence of a

cirriform appendage at the distal end of the parapodial trunk. The three existing species of *Plotohormis*, as Dales (1957) observes, closely resemble one another, the interspecific difference being confined to the variation in the relative length of the tentacular cirri. From this standpoint the difference noticed in *Plotohormis sumatransis* in characters like the disposition of compound capillaries, marked reduction in the number of simple acicular chaetae in the anterior parapodia are especially noteworthy. The species is named after the type locality which is off Sumatra.

REFERENCES

- BERGSTROM, E. 1914. Zur Systematik des Polychaeten Familie der Phyllodociden. *Zool. Bidrag. Uppsala*, **3**:
- CHAMBERLIN, 1919. "The Annelida Polychaeta".—*Mem. Mus. Comp. Zool.*, **48**:
- DALES, 1957. "Pelagic Polychaetes of the Pacific Ocean".—*Bull. Scripps Inst. Oceanogr. Univ. California*, **7** (2):
- FAUVEL, P. 1953. The Fauna of India Annelida Polychaeta. Allahabad, *The Indian Press Ltd.*, pp. 507.
- GRUBE, 1855. Beschreibungen neuer oder weniger bekannten Anneliden. *Arch. Naturg.*, **21**:
- HARTMAN, O. 1959. Catalogue of the Polychaetous Annelids of the world. *Allan Hancock Foundation Pubs. Occ. Pa.*, **23**:
- TEBBLE, N. 1960. The distribution of Pelagic Polychaetes in the S. Atlantic Ocean.—*Discovery Reports*, **30**:

SILUROID FISHES OF INDIA, BURMA AND CEYLON.
18. SYSTEMATIC POSITION OF THE GENUS *LAGUVIA*
HORA AND ITS RELATIONSHIPS

By

K. C. JAYARAM

*Zoological Survey of India, Calcutta**

(With 1 Text-figure)

INTRODUCTION

Hora (1921) established the genus *Laguvia* to accommodate *Pimelodus asperus* McClelland and two new species *L. ribeiroi* and *L. shawi*. The first species the type, was originally described by McClelland (1844) from Chusan, China and later its distribution was extended to Burma by Chaudhuri (1919). Günther (1864) and Bleeker (1873) referred it to *Hara* Blyth, whereas Chaudhuri (1919) described it under *Erethistes* Müller and Troschel.

Laguvia was characterised by Hora (1921) as comprising small fishes inhabiting "rapid running waters at the base of mountains" It was differentiated from *Erethistes* by its wide gill openings ; from *Glyptothorax* by possession of scapular processes, free bony tubercles on sides of body and in the absence of a well marked adhesive apparatus on thorax. Menon (1954) while revising the fishes of the genus *Glyptothorax* considered these differentiating characters of *Laguvia* as falling within the range of variation of *Glyptothorax* and accordingly synonymised it.

SYSTEMATIC POSITION

The apparent similarity exhibited by *Laguvia* to *Hara*, *Erethistes* and *Glyptothorax* is the main cause of confusion in determining its exact systematic position and relationships. *L. shawi* and *L. ribeiroi* are known by many examples and have been collected from different streams at the base of

*Present address: Southern Regional Station, Zoological Survey of India, Madras-600004.

Eastern Himalaya and also from the plains of North Bengal, Bihar and Uttar Pradesh. *L. asperus* is known only by its type and the subsequent record from Burma of two specimens by Chaudhuri (1919). These are all small sized fishes, very distinct and characteristic of the streams in which they live.

The chief characters of *Laguvia* are as below :—

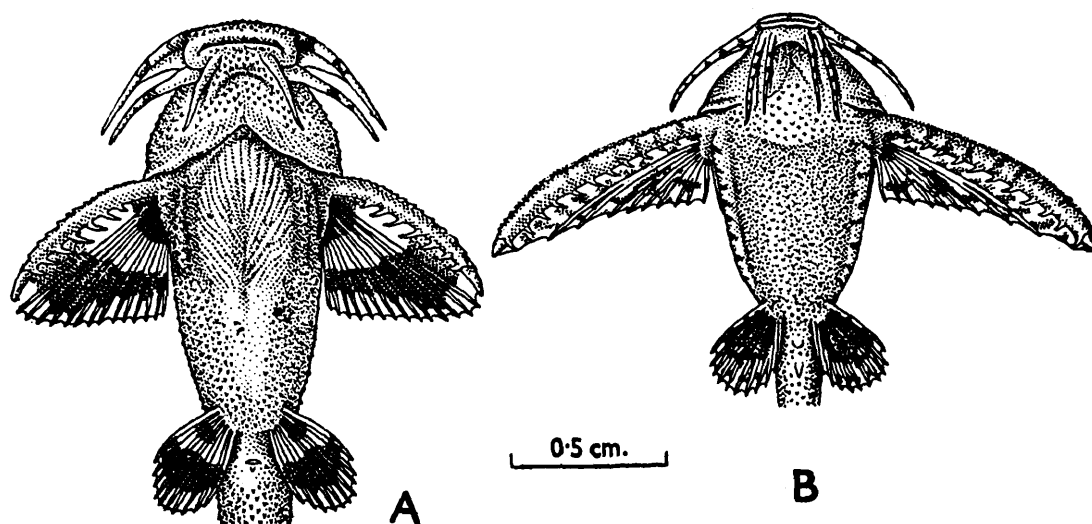
1. Thoracic adhesive apparatus faintly developed.
2. Barbels with annulated markings.
3. Mandibular barbels placed not in a transverse line but at different levels (see Text-fig. 1A).
4. Labial fold interrupted.
5. Caudal fin truncate, semicircular or emarginate, but not forked.
6. Pectoral spine serrated along inner edge with antrorse teeth, outer edge roughened or smooth.
7. Gill membranes wide, free from each other and narrowly united with isthmus.
8. Paired fins not plaited below.
9. Humeral processes along side of body on ventral surface slightly conspicuous and long.

Laguvia differs from *Glyptothorax* in the possession of long humeral processes, annulated barbels, position of mandibular barbels and the shape of the caudal fin. The first two characters may be shared by some species of *Glyptothorax* such as *G. tuberculatus* Prashad & Mukerji, but the position of the mandibular barbels and above all, the shape of the caudal fin have been found to be constant in *Laguvia*. No species of *Glyptothorax* has the caudal fin shaped as in *Laguvia*. The shape of the caudal fin has been utilised in classifying Bagrid genera (Jayaram, 1968) and is a valuable character showing no variations. Menon (1954) seems to have not observed these important differentiating characters of *Laguvia*.

The genus is more closely related to *Hara* than any other genera. However, it differs from *Hara* in having an interrupted labial fold, wider gill openings, arrangement of mandibular barbels, and in the presence of an adhesive apparatus on thorax, however faint or ill-developed it may be.

The nature of serrations of the pectoral spine at once distinguishes *Laguvia* from *Erethistes* in which the serrations are divergent along the outer edge. Besides this feature, the

position of mandibular barbels and the presence of an adhesive apparatus differentiates *Laguvia* from *Erethistes*.



Text-fig. 1A—Ventral view of *Laguvia ribeiroi* Hora ;
1B—Ventral view of *Hara hara* (Hamilton).

Thus, *Laguvia* is distinct with characteristic features of its own and as such should be considered as a separate genus. The four inter-related genera can be identified by the following key :—

1. Serrations on pectoral spine arranged in a divergent manner along outer edge. ... *Erethistes*
Serrations on pectoral spine arranged not in a divergent manner, but either retrorse or rough or smooth. ... 2
2. Caudal fin forked. ... *Glyptothorax*
Caudal fin not forked, but truncate, emarginate, or semicircular. ... 3
3. Mandibular barbels inserted along a transverse line on ventral surface. Labial fold continuous. ... *Hara*
Mandibular barbels inserted not in a transverse line, but at different levels. Labial fold not continuous. ... *Laguvia*

RELATIONSHIPS

Hora (1921) thought *Laguvia* as intermediate between *Erethistes* and *Glyptothorax*. Günther (1864), and Bleeker (1873) referred *Pimelodus asperus* McClelland aptly to *Hara*. *Laguvia* resembles *Hara* to a greater extent than the other two genera. The shape, size and other external features tend to

identify these fishes as belonging to *Hara* outwardly, but closer examination of the gill membranes, position of barbels and pectoral spine serrations reveal the true identity.

It would seem that *Laguvia* is a transition stage from *Hara* and *Erethistes*-like fishes leading to the specialised *Glyptothorax* group. *Glyptothorax* is better adapted for a life in swift streams than *Hara*, *Erethistes* and *Laguvia*. It is of interest to note here that these fishes are also obtained in still waters overgrown with thick vegetation. Hora (1950, p. 190) stated in regard to the habitat of *Erethistes* that it inhabits "sluggish deep waters overgrown with vegetation. In such habitats, their spider-like appearance and strongly pectinated spines presumably provide them with anchorage to the vegetation, among which they live fairly well protected from their enemies".

During a collection tour of North Bengal in 1970, the writer also similarly obtained examples of *Hara*, *Erethistes* and *Laguvia* from similar habitats. *Laguvia ribeiroi* was collected from the Dharla river, Mainaguri in Jalpaiguri district which at the time of visit was very sluggish with a depth of hardly 2 to 2.5 metres of water. The fish was collected by trap-net. Similarly *Erethistes montana* and *Hara hara* were collected from shallow sluggish rivers of the Teesta drainage system.

Glyptothorax on the other hand lives generally in swift streams with clear water and a rocky or stony bed.

Hora and Silas (1952) while discussing the evolution and distribution of Glyptosternoid fishes considered the following characters as less specialised.—

1. Pectoral and pelvic fins separated by a considerable distance.
2. Pectoral fins with fewer number of branched rays.
3. Paired fins not plaited on ventral surface.
4. Lips not continuously reflected round the mouth (*i.e.*) possession of an interrupted labial fold.
5. Absence of an adhesive apparatus on thorax.

Considering the above characters, *Laguvia*, *Erethistes* and *Hara* are much less specialised than *Glyptothorax*, and as such can be stated to be more primitive than *Glyptothorax*. The presence of a faintly developed adhesive apparatus on thorax in *Laguvia* would however place it above *Erethistes* and *Hara*. *Erethistes* appears to be the most primitive of the four and *Laguvia* the most specialised with *Hara* inbetween. *Laguvia*-

like ancestors may have given rise to the widely distributed *Glyptothorax*.

SUMMARY

Laguvia Hora was synonymised by Menon (1954) with *Glyptothorax* Blyth. The genus has been shown to be a less specialised form than *Glyptothorax* with close affinity to *Hara*, but possessing distinguishing features of its own. It is resurrected as a separate genus. Its close affinity to *Hara* is brought out and the probable phylogeny of these fishes is discussed.

ACKNOWLEDGEMENTS

I am thankful to the Director, Zoological Survey of India for facilities. The illustration was executed by Shri A. K. Mondal to whom my thanks are also due.

REFERENCES

- BLEEKER, P. 1873. Memoire sur la faune ichthyologique de Chine. *Ned. Tijdschr. Dierk.*, 4: 113-154.
- CHAUDHURI, B. L. 1919. Report on a small collection of fish from Putao (Hkamti Long) on the Northern Frontier of Burma. *Rec. Indian Mus.*, 16 (4): 271-287.
- GÜNTHER, A. 1964. Catalogue of the Physostomi containing the families Siluridae, Characinidae, Haplochromidae, Sternopygidae, Scopelidae, Stomiidae in the collection of the British Museum.—London, xxii+455 pp.
- HORA, S. L. 1921. On some new and rare species of fish from the Eastern Himalayas. *Rec. Indian Mus.*, 22 (5): 731-744.
- HORA, S. L. 1950. Siluroid fishes of India, Burma and Ceylon. XIII. Fishes of the genera *Erethistes* Müller & Troschel, *Hara* Blyth and of two new allied genera. *Rec. Indian Mus.*, 47: 183-202.
- HORA, S. L., & SILAS, E. G. 1952. Evolution and distribution of Glyptosternoid fishes of the family Sisoridae (Order Siluroidea). —*Proc. nat. Inst. Sci. India*, 18 (4): 309-322.
- JAYARAM, K. C. 1968. Contributions to the study of Bagrid fishes. (Siluroidea: Bagridae). 3. A systematic account of the Japanese, Chinese, Malayan and Indonesian genera.—*Treubia*, 27 (2-3): 287-386.
- MCCLELLAND, J. 1844. Description of a collection of fishes made at Chusan and Ningpo in China by G. R. Playfair.—*Calcutta J. nat. Hist.*, 4. (Not seen in original)
- MENON, M. A. S. 1954. Notes on fishes of the genus *Glyptothorax* Blyth.—*Rec. Indian Mus.*, 52 (1) [1953]: 27-54.

NOTES ON FISHES OF DOON VALLEY,
UTTAR PRADESH 1. DISTRIBUTIONAL AND
MORPHOLOGICAL STUDIES ON SOME
GLYPTOTHORACOID FISHES (SISORIDAE)

By

RAJ TILAK

Zoological Survey of India, Calcutta

and

A. HUSSAIN

Zoological Survey of India, Dehra Dun

(With 2 text-figs.)

INTRODUCTION

Considerable amount of interest has been shown in the study of fishes of Doon Valley for the last three decades (Hora and Mukerji, 1936 ; Lal and Chatterji, 1962 ; Lal, 1963 ; and Singh, 1964) but a thorough collection from the whole of the Doon Valley was never made. Recently parties from Zoological Survey of India have extensively surveyed the known waters of whole of Doon Valley and made a representative collection of fishes, which has recently been studied. The collection contains a large number of species not so far reported from the Doon Valley ; a detailed account of this will be published separately. In this paper interesting observations on the morphology and distribution of some glyptothoracoid fishes have been recorded.

OBSERVATIONS

The glyptothoracoid fishes differ from the glyptosternoid group of fishes mainly in the presence of an adhesive thoracic apparatus on the chest. No representative of glyptosternoid fishes has been as yet reported from Doon Valley, although *Euchiloglanis hodgarti* (Hora) exists in an adjoining area, *i.e.*, Kali River, District Nainital, U.P. (Menon and Sen, 1966). Of the glyptothoracoid fishes, only *G. pectinopterus* (McClelland) has thus far been known from Doon Valley (Hora & Mukerji,

1936, and Singh, 1964). The present study of the rich collection from this Valley shows that, in addition to *G. pectinopterus* (McCl.), five more sisorids of glyptothoracoid group, viz., *Pseudecheneis sulcatus* (McClelland), *Glyptothorax brevipinnis* Hora, *Glyptothorax gracilis* (Günther), *Glyptothorax cavia* (Hamilton) and *Glyptothorax horai* Shaw & Shebbeare, exist in that area. The material of all these five species has been studied in detail and the interesting points in their morphology and distribution are noted below.

Family SISORIDAE

Genus *Pseudecheneis* Blyth

(1) *Pseudecheneis sulcatus* (McClelland)

1842. *Gluptosternon sulcatus* McClelland, *Calcutta J. Nat. Hist.*, **2**: 587. (Type-locality: Khasi hills Assam.)

1923. *Pseudecheneis sulcatus*, Hora, *Rec. Indian Mus.*, **25**: 43.

Material.—(i) 1 ex., Aglar River, near its union with Jamuna River (near Mussoorie), 1.v.1966; (ii) 1 ex., Tons River, Dehra Dun, 1.viii.1965; (iii) 1 ex., Ichhari nala, 5 Kms. north of Koti, Dehra Dun, 6.vi.1967

Size.—23-150 mm. total length.

Remarks.—The material resembles the description of this species by McClelland (1842) and Day (1877) but differs in the ratio of the least height of the caudal peduncle with its length, which is 5.6 times in the adult and 7 times in the young examples against about 3 times as mentioned by Day (1877).

Distribution.—*P. sulcatus* is recorded so far from Khasi hills; Kameng Division, N.E.F.A.; Sikkim; Putao plains (Burma) and Catchin Cauri near Bhamo. The present record of this species from Doon Valley is interesting and extends the range of its distribution westwards along Himalaya.

Genus *Glyptothorax* Blyth

(2) *Glyptothorax cavia* (Hamilton)

1822. *Pimelodus cavia* Hamilton, *Fish. Ganges*: 188, 378. (Type-locality: Ramgarh District, North Bengal.)

1954. *Glyptothorax cavia*, Menon, *Rec. Indian Mus.*, **52**: 34.

Material.—(i) 1 ex., Tons River, Dehra Dun, 31.vii.1965, A. Hussain.

Size.—335 mm. total length.

Remarks.—The specimen agrees with the description of this species given by Hora and Menon (1948). So far the maximum size of this fish captured has been nearly 315 mm. The present specimen, measuring 335 mm. is the largest of this species so far captured. It could easily be enumerated as one among the food fishes of the area.

Distribution.—Myitkyina District, Burma (Sankha River); Jamuna River, N. Bengal; Darjeeling; Kosi River, Nepal; Sarda River, Tanakpur, Nainital, U.P. Its presence in Doon Valley extends its range of distribution further westwards along Himalaya.

(3) *Glyptothorax gracilis* (Günther)

1864. *Glyptosternum gracile* Günther, *Cat. Fish. Brit. Mus.*, 5: 186. (Type-locality: Nepal).

1954. *Glyptothorax gracile*, Menon, *Rec. Indian Mus.*, 52: 48.

Material.—(i) 1 ex., Tons River, Haripur, Dehra Dun, 31.vii.1965.

Size.—151 mm. total length.

Remarks.—Hora (1923) resurrected *G. gracilis* (Günther) on the basis of one specimen (120 mm. in length), collected by Dr. B. L. Chaudhuri from Ranjeet River, Manjhitar, Sikkim. We have examined the specimen and compared with it the present specimen from Tons River. There are two more specimens of this species from Kameng Frontier Division, N.E.F.A. in the collections of Zoological Survey of India. According to Hora (1923) the pectoral fins almost reach the base of the ventral but we find that in the specimen he examined (from Sikkim), they do miss the base of the ventrals by a small distance and in the specimen from Tons River as well as in those from N.E.F.A., the pectorals miss the ventrals by comparatively greater distance. Apart from this, the present specimen agrees with the description of the species given by Günther (1864). The species is characterised by the following:

- (1) The skin is granulated.
- (2) The thoracic adhesive apparatus is much longer than broad.
- (3) The under surface of the paired fins is devoid of plaits.

- (4) The pectoral fin is slightly longer than the head.
- (5) The ventrals extend beyond the anal opening and reach the origin of the anal fin.
- (6) The eyes are placed in the posterior half of the head.
- (7) The maxillary barbels are longer than the head.
- (8) The lower lobe of the caudal fin is longer than the upper.

Distribution.—N.E.F.A. ; Sikkim ; Nepal ; Dehra Dun, U.P. The report on the presence of this species in Dehra Dun (U.P.) extends its range of distribution further westwards along Himalaya.

(4) *Glyptothorax brevipinnis brevipinnis* Hora

1923. *Glyptothorax brevipinnis* Hora, *Rec. Indian Mus.*, **25**: 16.
(Type-locality: Unknown.)

1954. *Glyptothorax brevipinnis*, Menon, *Rec. Indian Mus.*, **52**: 37.

Material.—(i) 2 exs., Reh River, Dehra Dun ; (ii) 3 exs., Jamuna River, Dehra Dun.

Size.—45-113 mm. total length.

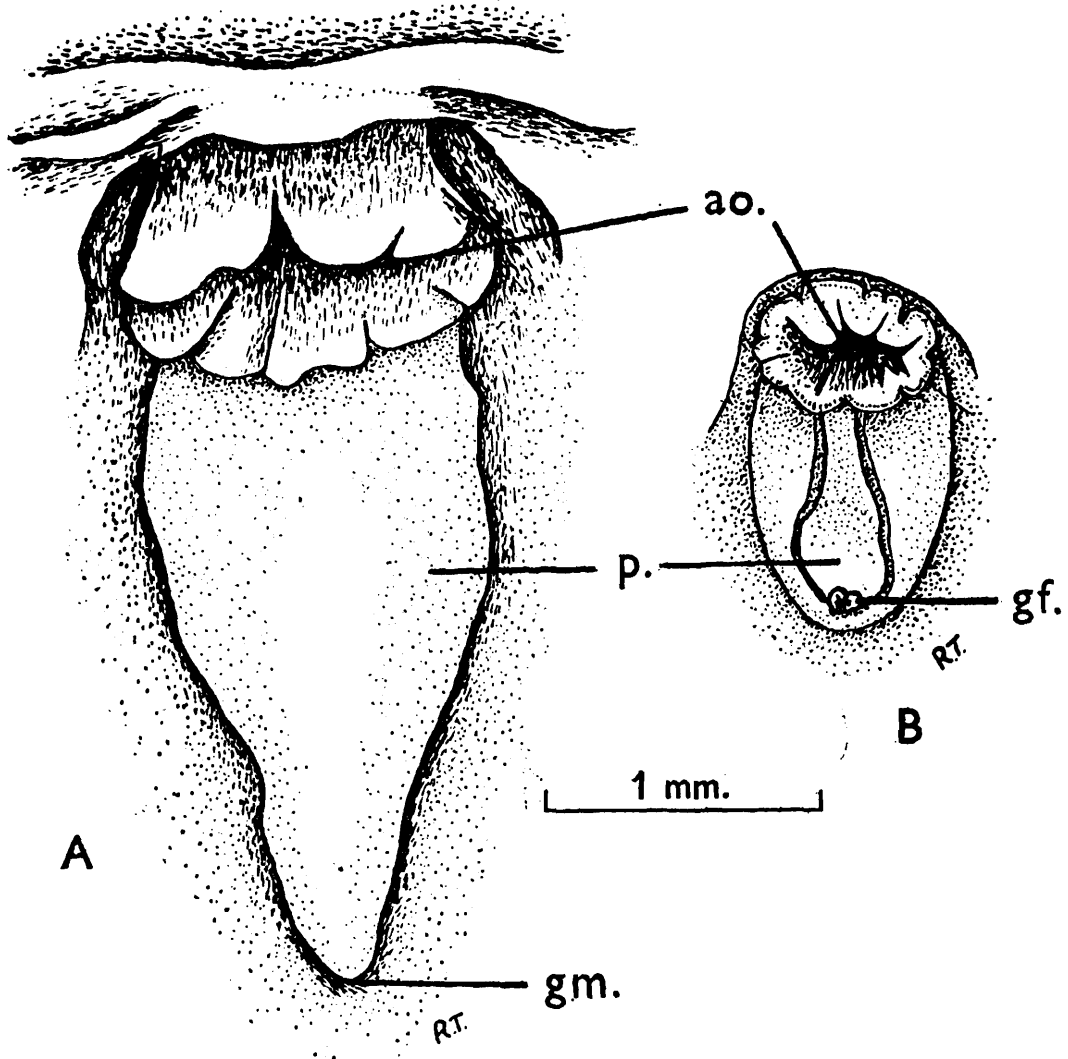
Remarks.—The material agrees with the description of this species by Hora (1923). Hora (1923) described this species on the basis of 4 examples, bearing no history. Due to long preservation, the colouration of the body of these specimens had faded away. Hora (1923) was, therefore, unable to describe the colouration of the species precisely. The present material is freshly preserved and hence it should be helpful to describe the colouration of this species.

Colouration.—The lateral and the dorsal sides of the body are dark chocolate brown. The under surface of the head and belly are light yellowish. There is a dark band at the base of the caudal. A light coloured streak runs between the bases of the rayed and the adipose dorsal fins and further between the latter and the upper lobe of the caudal fin. There is a light coloured transverse band at the base of the occipital process. The paired and the median fins, including the adipose fin, are dark coloured while their terminal portions are light coloured.

Sexual dimorphism.—Among Sisoridae, *Gagata sexualis* Tilak is the only species known to show a marked sexual dimorphism (Tilak, 1970) The present study shows that

Glyptothorax brevipinnis brevipinnis Hora also shows sexually dimorphic features which are described below :

(1) The least height of the caudal peduncle lies less than 2 times (1.68-1.87 times) in its length in the female examples and more than 2 times (2.06-2.5 times) in the male.

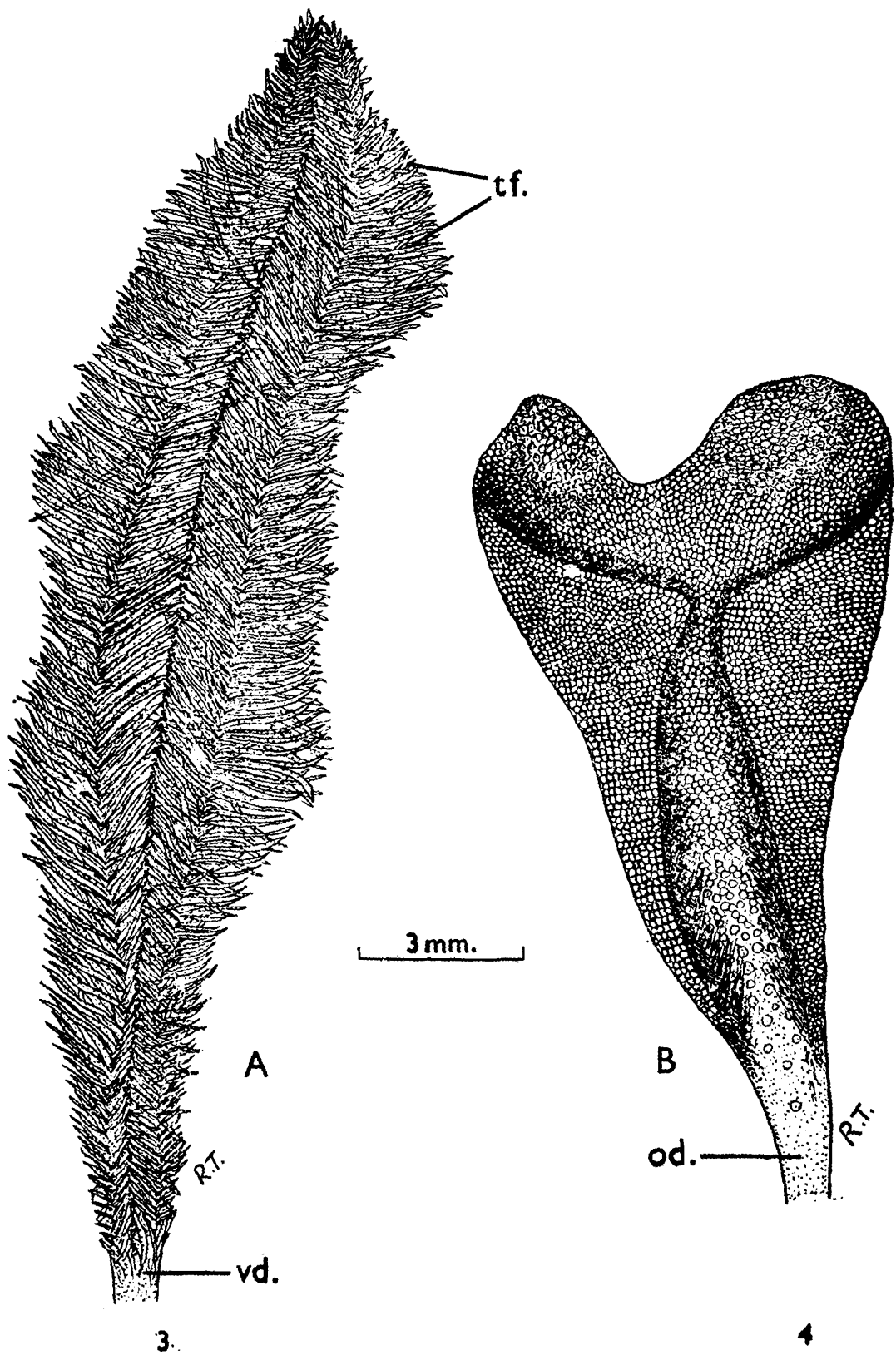


Text-fig. 1A. The external genital organs of male of *Glyptothorax brevipinnis brevipinnis* Hora.

B. The external genital organs of female of the same.

(2) Externally, the females are slightly heavier than the males and show a difference in their external genital organs. In the male, the genital papilla is elongated, wide and bulbous at the base and much narrow at the tip (Text-fig. 1A). In the female, the genital papilla is narrow at the proximal end and bulbous at the distal end (Text-fig. 1B). Moreover, it remains partly embedded in a fleshy envelope in the female and almost free in the male. The comparative length of the genital papilla is more in the male than in the female.

The shape and structure of the gonads differ greatly in the two sexes. In the male, the testes are paired and elongated. The two testes are fused together in the midline (Text-fig. 2A).



Text-fig. 2A. The male gonads of *G. brevipinnis brevipinnis* Hora.
B. The female gonads of the same.

Each testis consists of biserially arranged testicular follicles which profusely overlap with each other. Posteriorly, the testes form apparently a single vas deferens which is connected with the male genital papilla. In the female, the paired ovaries have fused completely to form a triangular ovarian sheet, the two outer edges of which are rolled downwards to envelope the alimentary canal. The anterior end of the ovary contains ova at different stages of maturity. Posteriorly, a single oviduct enters the female genital papilla (Text-fig. 2B).

Distribution.—Hora (1923) did not know the history of this species at the time of its description. Till recently, no material of this homeless species was collected. For the first time this species has been recorded here from the Doon Valley with a definite locality data.

(5) *Glyptothorax horai* Shaw and Shebbeare

1937. *Glyptothorax horai* Shaw and Shebbeare, *J. Bombay nat. Hist. Soc.*, **39**: 188. (Type-locality: Streams of Terai, North Bengal.)

1954. *Glyptothorax horai*, Menon, *Rec. Indian Mus.*, **52**: 37.

Material.—(i) 1 ex., Dehra Dun, 5.viii.1965, T. D. Soota.

Size.—122 mm. total length.

Remarks.—The thoracic adhesive apparatus of this fish is very characteristic; it extends from the ventral side of the lip to opposite the middle of the pectoral base in an acuminate arrow head shape. The shape and the structure of the adhesive thoracic apparatus of this species, based on the material from Patiala, has been described by Tilak and Tandon (1970) who studied the type as well as other material of this species in Zoological Survey of India and rectified some of the discrepancies in the description of this structure of the species by Shaw and Shebbeare (1937) and Menon (1954).

Distribution.—Terai, N. Bengal; Rihand River, near Dam, Mirzapur District, U.P.; Kosi River, Nepal; Patiala, East Panjab; Dehra Dun, U.P.

Tilak and Tandon (1970) while reporting on the presence of this species in Panjab, remarked that there is no record of the presence of this species in the intervening area between Kosi River and East Panjab and further opined that future surveys would find this species all along that area. The present report of this species from Doon Valley, the intervening

area between Kosi River (Nepal) and Patiala (E. Panjab), confirms the belief of Tilak and Tandon (1970).

SUMMARY

A study of glyptothoracoid fishes from Doon Valley shows that in addition to *Glyptothorax pectinopterus* (McClelland), five more species, viz., *Pseudecheneis sulcatus* (McClelland), *Glyptothorax cavia* (Ham.), *G. gracilis* (Günther), *G. brevipinnis brevipinnis* Hora and *G. horai* Shaw and Shebbeare occur in that area. Important points of their morphology have been recorded. All the five species have been recorded from the Valley for the first time and this extends their range of distribution further westwards along the Himalaya; it is important from zoogeographical point of view. *G. brevipinnis brevipinnis* Hora has been recorded for the first time with a definite locality from Dehra Dun. Sexually dimorphic characters of *G. brevipinnis brevipinnis* Hora have been figured and described.

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REFERENCES

- DAY, F. 1877. *The fishes of India: being a natural history of the fishes of India, Burma and Ceylon*. (Reprinted in 1958.) William Dawson & Co., London: 496-501.
- GÜNTHER, A. 1864. *Catalogue of the fishes in the British Museum*, 5: 186.
- HORA, S. L. 1923. Notes on fishes in the Indian Museum. V. On the composite genus *Glyptosternon* McClelland.—*Rec. Indian Mus.*, 25: 16.
- HORA, S. L. and MENON, M. A. S. 1948. Systematic position of three glyptosternoid fishes described by Hamilton.—*Rec. Indian Mus.*, 46: 55-61.

- HORA, S. L. and MUKERJI, D. D. 1936. Fish of the Eastern Doons, United Provinces.—*Rec. Indian Mus.*, **38**: 133-146.
- LAL, M. B. 1963. Distribution and migration of *Tor putitora*. *Cheetal*, **6**: 54.
- LAL, M. B. and CHATTERJEE, P. 1962. Survey of Eastern Doon fishes with certain notes on their biology.—*J. zool. Soc. India*, **14** (1 & 2): 230-243.
- McCLELLAND, J. 1842. On the fresh-water fishes collected by William Griffith Esq., F.L.S. Madras Medical Service, during his travels under the orders of the Supreme Government of India, from 1835-1842.—*Calcutta J. nat. Hist.*, **2**: 560-589.
- MENON, A. G. K. and SEN, T. 1966. Extension of the geographical range of *Euchiloglanis hodgarti* (Hora) with certain observations on the zoo-geography and evolution of glyptosternoid fishes of the family Sisoridae.—*Sci. & Cult.*, **32**: 211-212.
- MENON, M. A. S. 1954. On the fishes of the genus *Glyptothorax* Blyth.—*Rec. Indian Mus.*, **52**: 27-54.
- SHAW, G. E. and SHEBBEARE, E. O. 1937. The fishes of Northern Bengal.—*J. roy. Asiat. Soc. Beng., Sci.*, **3**: 1-317.
- SINGH, P. P. 1964. Fishes of the Doon Valley. *Ichthyologica*, **3** (1 & 2): 86-92.
- TILAK, R. 1970. A new sisorid catfish of the genus *Gagata* Bleeker from India.—*Zool. Medl. Leiden*, **44** (14): 207-215.
- TILAK, R. and TANDON, K. K. 1970. A new record of *Glyptothorax horai* Shaw and Shebbeare, and *Batasio tengana* (Ham.) from Patiala District, Punjab. *Res. Bull. (N.S.) Panjab Univ. Sci. Ser.*, **21** (3-4): 503-506.

KEY TO ABBREVIATIONS

od, oviduct; tf, testicular follicles; vd, vas defrens.
ao, anal opening; p, genital papilla; gf, female genital opening;
gm, male genital opening.