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SYSTEMATIC STATUS OF *SCIAENA BLEEKERI* DAY,
1876 (SCIAENIDAE : PISCES)

By

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I—INTRODUCTION

Day (1876) erected a new species of *Sciaena* viz., *bleekeri* on the basis of two specimens from Bombay. Jordan and Thompson (1911) treated this species as a synonym of *Sciaena argentatus* (Houttuyn, 1782) and the same course was followed by Fowler (1933), Matsubara (1937), Lin (1938), Munro (1955), and Chu, Lo and Wu (1963). This is evidently the basis for the frequent reference of *Argyrosomus argentatus* (Houttuyn) to India. On the basis of data now extant *Argyrosomus argentatus* is known to occur only in China, Formosa and Japan.

During a survey of the Orissa coast in December, 1966, ten specimens of *Argyrosomus argentatus* were collected. The specimens agree well with Houttuyn's (1782) original description and Fowler's (1933) description of the species. However, on comparison with Day's type of *Sciaena bleekeri* present in the Zoological Survey of India, it was clear that *Sciaena bleekeri* Day is a valid species and not conspecific with *Argyrosomus argentatus* (Houttuyn) as considered by earlier workers.

In support of the above contention of the identity of the two species, *Argyrosomus argentatus* (Houttuyn) and *Argyrosomus bleekeri* (Day), biometric data obtained from specimens of the former species collected from Orissa and the type material of the latter species are presented. Descriptions, synonyms and geographical distribution of the two species are also given. In the light of this data a brief discussion of how the two species have been confused through literature, has also been given. The present communication records *Argyrosomus argentatus* (Houttuyn) for the first time from Indian waters, indicating a wider distribution of the species in the Indo-Pacific.

II—NOTES ON THE SPECIES

***Argyrosomus bleekeri* (Day)**

1876. *Sciaena* (*Pseudosciaena*) *bleekeri* Day, *Fish. India* : 185, pl. 45, fig. 4 (Type-locality : Bombay).

1937. *Pseudosciaena indica* Tang, *Amoy. Mar. biol. Bull.*, 2 (2) : 64 (China).
 1937. *Nibea argentata* Matsubara (néc Houttuyn) : (partim) *J. Imp. Fish. Inst.*, 32 (2) : 44-52.
 1940. *Argyrosomus indicus* : Lin, *J. Hong Kong Fish. Res. Sta.*, 1 (2) : 252, fig. 5.
 1963. *Argyrosomus argentatus* : Chu, Lo and Wu, *Monograph Fishes China, Publ. Shanghai Fish. Inst.* : 62.

Material examined (One syntype).— No. 988, 1 ex., 151 mm., Bombay, ca. 1876, F. Day ; Original of pl. 45, fig. 4.

Description.— D X + I 27. A II 7. P 17. Scales in lateral series 60.

Gill rakers on first arch 5+9, longest raker slightly less than filament and half eye diameter.

Depth of body 26.5 ; length of head 31.1 ; diameter of eye 7.9 ; length of maxilla 12.5 ; length of lower jaw 14.6 ; length of 2nd anal spine 8.6 ; all in percentage of standard length. Diameter of eye 25.5 ; length of snout 25.5 ; interorbital width 19.1 ; length of maxilla 40.4 ; length of 2nd anal spine 27.6 ; in percentage of head length.

Gas-bladder.—Carrot-shaped, Otolithine type with 29 pairs of arborescent appendages.

The other salient characters of this species are given in Day (1876).

Distribution.— Coast of India, China and Japan.

Argyrosomus argentatus (Houttuyn)

1782. *Sparus argentatus* Houttuyn, *Verh. Holland Maatsch. Wet. Haarlem*, 20 : 319 (Type-loc. : Japan).
 1911. *Sciaena argentata* : Jordan and Thompson, *Proc. U. S. natn. Mus.*, 39 : 252.
 1933. *Johnius argentatus* : Fowler, *Bull. U. S. natn. Mus.*, 100, 12 : 394.
 1937. *Pseudosciaena argentatus* : Tang, *Amoy Mar. biol. Bull.*, 2 (2) : 65.
 1937. *Argyrosomus argentatus* : Lin, *Lingnan Sci. J.*, 17 (3) : 368.
 1937. *Nibea argentata* Matsubara : (partim), *J. Imp. Fish. Inst.*, 32 (2) : 44-52.
 1940. *Argyrosomus iharae* Lin, *néc.* (Jordan & Metz). *J. Hong Kong Fish. Res. Sta.*, 1 (2) : 253.

Material examined.—F 5783/2, 10 exs., 75-103 mm., Chandipur (Orissa), 6.xii. 1966, P. K. Talwar.

Description.—D X + I 26-29 ; deeply notched ; 4th spine longest. A II 7 ; second spine weak ; base $4\frac{1}{2}$ in dorsal base length ; origin under 11th-12th soft dorsal ray.

Scales in lateral series 49-52.

Gill rakers on first arch $6 + 14$; lanceolate, longest raker $\frac{1}{2}$ eye diameter, equals or slightly longer than filaments.

Depth of body 26.2-30.6 ; length of head 32.5-36.5 ; diameter of eye 8.8-11.2 ; length of maxilla 15.5-17.6 ; length of lower jaw 16.5-18.8 ; length of 2nd anal spine 8.7-10.7 ; all in percentage of standard length. Diameter of eye 24.2-32.2 ; length of snout 24.2-30.8 ; interorbital width 28.6-30.8 ; length of maxilla 45.7-50.0 ; length of 2nd anal spine 25.7-30.8 ; in percentage of head length.

Body oblong, compressed. Mouth terminal, oblique ; mandible slightly protruding. Maxilla reaches to hind edge of pupil.

Pores.—Four pores on snout ; three pairs of pores on mandibular symphysis, the anterior pair inconspicuous.

Scales.—Cycloid or weakly ctenoid on head and anterior half of body ; ctenoid on posterior half.

Teeth.—Villiform in narrow bands ; outer row of upper jaw enlarged, curved ; inner row of mandibles slightly enlarged.

Gas-bladder.—Carrot-shaped, Otolithine type with 22-23 pairs of arborescent diverticula.

Colour in alcohol.—Back brown, sides silvery. Spinous dorsal black, soft dorsal and caudal dusky ; soft dorsal with narrow white stripe. Other fins whitish. Opercle with dark blotch. Pectoral axil dusky.

Distribution.—East coast of India, China, Taiwan and Japan.

III—DISCUSSION

The original description of *Sciaena bleekeri* Day was derived from two specimens collected from Bombay. The larger syntype (Reg. No. 988) which Day figured has a dorsal fin formula $X + I 27$, a weak 2nd anal spine and an Otolithine type of gas-bladder. The smaller syntype (No. 968) has a dorsal fin formula $X + I 24$, a moderately strong 2nd anal spine and a simple gas-bladder with a pair of short simple appendages at the anterior end below the septum transversum. Day (1876) did not designate types, but nevertheless he appears to have attached more importance to those specimens which he figured on which his original descriptions were based. The authors are of the opinion that the figured syntype of *Sciaena bleekeri* Day should be designated as the lectotype. The smaller syntype is being studied to determine its status and generic affiliation.

Tang (1937) while treating the species under *Pseudosciaena* Bleeker proposed a substitute name *Pseudosciaena indica* for *Sciaena bleekeri* Day, 1876 since the specific name is preoccupied by *Pseudo-*

sciaena bleekeri (Steindachner, 1866). As we are not able to determine the specific identity from the original description and we are unable to examine the type, our conclusion is based on Fowler (1933) that *Pseudotolithus bleekeri* Steindachner, 1866 is closely related to *Corvina axillaris* Cuvier, 1830 and apparently belongs to the same species. But, should it be proved that Steindachner's (1866) use of the name *bleekeri* has priority, its proper disposition becomes a matter of importance. For the present it may be taken to be what it practically is ; representing an "unidentifiable" species.

Fowler (1933) was the first worker to give the gill raker count of *Argyrosomus argentatus* as 6 + 14-15. Matsubara (1937) who examined a series of specimens from China and Japan gave the gill raker count as 13-19, but mostly 14-18. Lin (1940) gave 5 + 10 for *A. indicus* (= *A. bleekeri*) and 7 + 12 for *A. iharae* (= *A. argentatus*). Munro (1955) obviously followed Fowler (*l.c.*) and gave 6 + 14-15 for *A. argentatus*. Chu *et al.* (1963), however, gave 5 + 10 for *A. argentatus*. The type of *Sciaena bleekeri* has a gill raker count 5 + 9 on the first gill arch. From this it is clear that *Argyrosomus bleekeri* (Day) is not conspecific with *Argyrosomus argentatus* (Houttuyn) and differs from the latter chiefly in the lesser number of gill rakers, 5 + 9-10 versus 6-7 + 14-15. This data clearly suggests that Matsubara's (1937) material represents a composite of both the species and Chu *et al.* (*l.c.*) were dealing with *A. bleekeri* (Day).

IV—ACKNOWLEDGEMENTS

The authors express their sincere thanks to Dr. A. P. Kapur, Director, Zoological Survey of India, Calcutta, for his sustained encouragement and interest during the course of this study and to Mrs. M. R. Mansukhani, Superintending Zoologist, Zoological Survey of India, for helpful comments on the manuscript.

V—SUMMARY

Sciaena bleekeri was first described by Day (1876) on the basis of two specimens from Bombay. Jordan and Thompson (1911) synonymised this species under *Sciaena argentatus* (Houttuyn) and the same course was followed by subsequent workers. This was evidently the basis for the frequent reference of *Argyrosomus argentatus* (Houttuyn) to India.

In the present paper it is shown that *Sciaena bleekeri* Day is a distinct species and not conspecific with *Argyrosomus argentatus* (Houttuyn). *A. argentatus* is recorded for the first time from Indian waters, indicating a wider distribution of the species in the Indo-Pacific.

VI—REFERENCES

- CHU, Y. T., LO, Y. L. & WU, H. L. 1963. *A study of the classification of the sciaenoid fishes of China, with description of new*

- genera and species*. Shanghai Fisheries Institute, China, : ii+100, 37 pls.
- DAY, F. 1875—1878. *The Fishes of India*, Williams and Norgate, London, 778 pp.
- FOWLER, H. W. 1933. Contributions to the biology of the Philippine Archipelago and the adjacent regions. *Bull. U. S. natn. Mus.*, **12**(100) : 1-465.
- HOUTTUYN, M. 1782. Beschrijving van eenige Japanisch Visschen en andere zeeschenpselen.—*Verh. Holl. Maatsch. Wet. Haarlem*, **20** : 319-22.
- JORDAN, D. S., & THOMPSON, W. F. 1911. A review of sciaenoid fishes of Japan.—*Proc. U. S. natn. Mus.*, **39** : 241-261.
- LIN, S. Y. 1938. Further notes on sciaenid fishes of China. *Lingnan Sci. J.*, **17**(3) : 367-381.
- LIN, S. Y. 1940. Croakers of the South China Sea. *J. Hong Kong Fish. Res. Sta.*, **1**(2) : 243-54.
- MATSUBARA, K. 1937. Sciaenoid fishes found in Japan and its adjacent waters.—*J. Imp. Fish. Inst.*, **32**(2) : 27-92.
- MUNRO, I. S. R. 1955. *The marine and fresh waterfishes of Ceylon*. : 349 pp., 56 pls.
- STEINDACHNER, F. 1866. Ichthyologische Mitteilungen.—*Verh. zool. bot. Ges. Wien.*, **16** : 761-796.
- *TANG, D. S. 1937. A study on sciaenoid fishes of China.—*Amoy Mar. biol. Bull.*, **2**(2) : 47-88.

BILATERAL ASYMMETRY IN PAIRED MERISTIC AND
MORPHOMETRIC CHARACTERS OF *LABEO DERO*
(HAMILTON) : CYPRINIDAE, CYPRINIFORMES

By

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(With 2 Tables)

I—INTRODUCTION

All vertebrates are known to be bilaterally symmetrical, although many cases of anomalous asymmetries are known among them. The extent of the occurrence of asymmetry increases as one descends down the vertebrate series from mammals to fishes. Fishes are, although, bilaterally symmetrical as far as their general body shape and major parts are concerned, yet an irregular form of asymmetry is well established in many of their important taxonomic characters. In the order Pleuronectiformes a normal dextral or sinistral asymmetry is established (Hubbs & Hubbs, 1944). Asymmetry in the gill raker count in Chars has been reported by Vladykov (1954) and a higher number of branchiostegal rays on the left side of Pacific Salmon has been observed by Jordan and Evermann (1896). Landrum (1966) analysed the differences between the number of the elements on the left and the right side structures of four paired meristic elements of three species of Salmon with a view to ascertain the extent of the asymmetry in them and to know whether data of one side of the fish could be used for the other without bias. In support of the study of the asymmetry in fishes, Landrum (1966) stated :

“As a consequence of these known asymmetries in fish, morphological characters from both sides of all species, ideally, should be examined for taxonomic and racial studies, or examination should be limited to one chosen side. If the latter alternative has been adopted, problems arise if the chosen side is mutilated or otherwise unobtainable. In racial studies on Pacific Salmon (Fukuhara *et al.*, 1962), data on various meristic characters were arbitrarily collected from the left side of all specimens. The racial study involved multivariate analysis of data from several meristic characters ; therefore occasional failures to obtain information from any one lost or damaged character prevented the specimen's use and reduced the usable sample size. As the reliability of the analysis was in part determined by the sizes of samples, unusable specimens were both a statistical and an economic loss.”

To the best of knowledge of the present authors, such a study has not so far been made for Indian fishes and hence the need for the present study which attempts to make an analysis of differences between the number of elements and measurements of different body parts in left and right side structures of five paired meristic and seven

morphometric characters of a freshwater cyprinid fish, *Labeo dero* (Hamilton). The object of the present analysis is to ascertain the extent and direction of asymmetry in these characters and to determine the usefulness of the information in taxonomic studies of the species.

II—MATERIAL AND TECHNIQUE

The data regarding the paired meristic and morphometric characters were obtained from 104 specimens, preserved as National Collection in the Zoological Survey of India, Calcutta. The material pertains to India, Nepal, and Burma. The characters examined are :

Meristic :—

1. Number of scales along the lateral line. 2. Number of scales in the lateral transverse series. 3. Number of branchiostegal rays. 4. Number of pectoral fin rays. 5. Number of pelvic fin rays.

Morphometric :—

1. Length of head. 2. Diameter of eye. 3. Length of snout. 4. Height of opercular flap. 5. Width of operculum. 6. Length of pectoral fin. 7. Length of pelvic fin.

The record of a particular character, which was either damaged on one or both sides, was not made.

III—EXPLANATION OF TERMS AND MEASUREMENTS

The different meristic and morphometric characters used in this study are briefly described below. The paired bony structures have been counted or measured both from the left and the right sides without dissecting them.

1. *Scales along the lateral line*.—All scales, which were penetrated by a lateral line tube, were counted. The count included the first scale starting from the angle of operculum to the last scale at the base of caudal fin. In some cases supernumerary scales were interpolated between two scales of the lateral line. Since such scales were unpenetrated, they were not counted.

2. *Scales in the lateral transverse series*.—All the scales from the origin of dorsal fin to the lateral line are included in this character. No count of scales has been taken below the lateral line.

3. *Number of branchiostegal rays*.—All bony branchiostegal rays, arising from the ceratohyal and the epihyal, were counted. Care was taken to avoid extra counts caused by abnormal lengthwise fission of a single ray.

4. *Pectoral and pelvic fin rays*.—All branched and unbranched rays, which extended upto the girdle, were counted.

5. *Length of head*.—The head length is measured from the tip of snout to the posterior edge of the bony operculum.

6. *Diameter of eye*.—The eye diameter is measured as the distance between the anterior and the posterior edges of the bony orbit,

7. *Length of snout*.—The length of snout is measured from the tip of the snout to the anterior edge of the bony orbit.

8. *Height of the opercular flap*.—The maximum height of the bony opercular flap was measured as the distance between the dorsal end of the operculum and the ventral edge of the opercular flap. The dorsal end of the bony operculum was determined by an incision made in the crease, that resulted from upward flexion of the opercular flap.

9. *Maximum width of operculum*.—The maximum width of the bony operculum was measured as the distance between the posterior end of bony operculum to its anterior margin. The anterior margin was determined by an incision made in the crease that resulted from anteriorward flexion of the operculum.

10. *Length of pectoral and pelvic fins*.—The maximum length of the pectoral and the pelvic fins has been taken as the length of the longest ray which was measured from its base (above the skin) to its tip.

All the measurements are shown in centimeter scale.

IV—STATISTICAL PROCEDURE

The observations of the left and the right sides of both male and female specimens have been tabulated for each of the characters studied. Under each observation, the value of left side has been subtracted from that of the right side ; the differences are positive when right side values are more than those of the left and negative in the reverse case.

The significance of mean difference of values between the left and right sides of the meristic and morphometric characters observed in each sample has been determined by using the formula for Students' 't' test, so as to ascertain whether there is any asymmetry in these characters and that the mean $\bar{x}$ value is significantly different from zero.

$$t = \frac{\bar{x} \sqrt{N}}{\sqrt{\frac{\sum x^2 - \frac{(\sum x)^2}{N}}{N-1}}}$$

OR

$$t = \frac{\bar{x} - \mu}{s/\sqrt{N}}$$

($\mu = \text{Zero}$)

where t = Students' 't' test

$\bar{x}$ = mean calculated by the formula $\sum x/N$

$\sum x$ = the summation of the difference of right minus left counts or measurements.

x = the value of right minus left counts or measurements in one specimen.

N = number of observations (It is different from 'n' which is $N-1$)

$\sum x^2$ = the sum of square of individual values

of x ($x_1^2 + x_2^2 + x_3^2 \dots x_n^2$).

N-1 = degrees of freedom

s = standard deviation and determined by

$$\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{N}}{N-1}$$

In order to ascertain the significance, the probability of happening either greater or lesser than zero (mean value) has been taken into account. Probability level was considered at 0.025 level (5 percent level of one-tailed table).

The probability value of 't' has been seen from the table given by Fisher and Yates (1953). The hypothesis tested was that the difference between the left and right side counts and measurements was zero.

V—RESULTS

An analysis of the differences in both meristic and morphometric characters between the right and left sides of the male and female specimens has been made and the results are presented below.

Bilateral variation in meristic characters (Table 1) :

Number of lateral line scales.—In this character the female exhibited a greater percentage of asymmetrical development with larger mean difference than the male. The percentage of specimens exhibiting asymmetry in lateral line scales and the direction of asymmetry varied among samples of each sex and among combined samples of both the sexes. As shown by right hand column (headed 'p'), the probability values for the observed mean differences are not significant. For males, the differences in left and right side counts averaged 36 percent and in females averaged 43 percent. Asymmetry between right and left side scale counts occurred in approximately 39 percent of the total of 89 specimens. The direction of asymmetry in male indicates that the right side develops approximately 0.07 scales more than the left side, and in female it indicates that the right side develops approximately 0.15 scales less than left side. In the total number of male and female examples the right side develops approximately 0.04 scales less than the left side. The difference in the variation of the counts in lateral lines of the right and left sides could be attributed to chance factors and hence cannot be attached any significance. This is proved by the value of 'p' which is greater than 0.05 in all the cases (Table 1). The overall mean difference between right and left side counts (0.044) is also insignificant.

Number of scales in lateral transverse series.—The comparison is made from the left and right side counts of 83 specimens. In this character the female exhibits a greater percentage of asymmetrical development with larger mean difference than male. In the male specimens asymmetrical development occurs in approximately 29 percent, in females approximately 38 percent and approximately 34 percent in the combined sample of both male and female specimens. The left side counts exceed those of right side in males approximately 16 %, in females approximately 29 % and in combined samples of males

and females approximately 23 %. The direction of asymmetry in males indicates that the right side develops approximately 0.08 scales less than the left side, in female it indicates that the right side develops approximately 0.2 scales less than left side and in combined sample of males and females the right side develops approximately 0.14 scales less than left side. The variation in the number of scales of the two sides, in the males and combined samples of males and females, is insignificant but in the female specimens it is statistically significant at 5 % level.

Number of branchiostegal rays.—The branchiostegal rays counts were collected from 103 specimens of this species. In this character the males exhibited a greater percentage of asymmetrical development with larger mean difference than the females. In the male specimens, asymmetrical development occurs in approximately 22 %, in females approximately 13 % and in the combined sample of male and female specimens approximately 18 %. The left side count exceeds right side count in approximately 18 % in males, approximately 11 % in females and in the combined sample of males and females asymmetry occurs in approximately 15 %. The direction of asymmetry in males indicates that the right side develops approximately 0.18 rays less than the left side, and in females it indicates that the right side develops approximately 0.09 rays less than the left side. In the combined sample of males and females the right side develops approximately 0.14 rays less than the left side. The mean difference is statistically insignificant at 5 % level for females but in males it is significant.

Number of pectoral fin rays.—The comparisons were made from the right and the left side counts of 103 specimens. In this character the female exhibited a greater percentage of asymmetrical development with larger mean difference than the male. In the male specimens, asymmetrical development occurs in approximately 40 %, in females approximately 49 % and in the combined sample of male and female specimens approximately 45 %. The left side counts exceed those of right side in approximately 16 % in males, 34 % in females and 25 % in combined sample of males and females. The direction of asymmetry in males indicates that the right side develops approximately 0.04 rays more than the left side and in females it indicates that the right side develops approximately 0.18 rays less than the left side. In the combined sample of male and female specimens the right side develops approximately 0.08 rays less than the left side. The mean difference observed is insignificant for this sample.

Number of pelvic fin rays.—A comparison has been made for right and left side counts of 103 specimens. In this character the females exhibited a greater percentage of asymmetrical development with larger mean difference than the males. In the male specimens asymmetrical development occurs in approximately 2 %, in females approximately 6 % and in the combined sample of males and females approximately 4 %. The left side counts exceed those of the right side in none of the male specimens, approximately 6 % in females and approximately 3 % in the total lot. The direction of asymmetry in male indicates that the right side develops approximately 0.02 rays more than the left side and in female it indicates that the right side develops approximately 0.06 rays less than the left side. In the

TABLE 1.—Bilateral variation in number of lateral line scales, scales in lateral transverse series, branchiostegal rays, pectoral fin rays and pelvic fin rays *Labeo dero* (Hamilton)

Characters	Sex	Number examined	% asymmetrical	% asymmetrical towards left	Σx	Σx^2	Mean of (R-L) $\bar{x}$	s	t	p
Lateral line scales	Male	42	35.7	16.7	3	21	0.071	± 0.712	0.648	>0.05
	Female	47	42.6	27.7	-7	29	-0.148	± 0.779	1.296	>0.05
	Total	89	39.3	22.5	-4	50	-0.044	± 0.752	0.551	>0.05
Scales in lateral transverse series	Male	38	28.9	15.8	-3	11	-0.078	± 0.538	0.776	>0.05
	Female	45	37.8	28.9	-9	19	-0.2	± 0.624	2.149	<0.05
	Total	83	33.7	22.9	-12	30	-0.144	± 0.586	1.311	>0.05
Branchiostegal rays	Male	50	22.0	18.0	-9	11	-0.180	± 0.437	2.905	<0.001
	Female	53	13.2	11.3	-5	6	-0.094	± 0.325	1.827	<0.10
	Total	103	17.5	14.5	-14	17	-0.135	± 0.384	3.565	<0.001
Pectoral fin rays	Male	50	40.0	16.0	2	26	0.04	± 0.726	0.388	>0.05
	Female	53	49.0	34.0	-10	76	-0.188	± 1.193	1.146	>0.05
	Total	103	44.7	25.2	-8	102	-0.077	± 0.996	0.784	>0.05
Pelvic fin rays	Male	50	2.0	0.0	1	1	0.02	± 0.141	0.996	>0.05
	Female	53	5.7	5.7	-3	3	-0.056	± 0.232	1.754	<0.10
	Total	103	3.9	2.9	-2	4	-0.019	± 0.194	0.989	>0.05

TABLE 2.—Bilateral variation in measurements of Length of head, diameter of eye, length of snout, height of opercular flap, width of operculum, pectoral fin length, and pelvic fin length of *Labeo dero* (Ham.)

Characters	Sex	Number Exa- mined	% asymme- trical	% asymme- trical towards left	Σx	Σx^2	Mean of (R — L) $\bar{x}$	s	t	p
Length of Head	Male	50	60.0	42.0	—10.5	19.25	—0.21	± 0.588	2.523	<0.02
	Female	54	53.7	22.2	0.5	11.25	0.009	± 0.46	0.143	>0.05
	Total	104	56.7	31.7	—10.0	30.5	—0.096	± 0.534	1.833	<0.10
Diameter of eye	Male	50	40.0	24.0	— 2.0	5.0	—0.04	± 0.316	0.904	>0.05
	Female	54	37.0	14.8	2.5	5.75	0.046	± 0.325	1.655	<0.10
	Total	104	38.5	19.2	0.5	10.75	0.103	± 0.322	3.229	<0.002
Length of snout	Male	50	52.0	28.0	1.5	19.0	0.03	± 0.621	0.339	>0.05
	Female	54	59.3	20.4	5.0	25.5	0.092	± 0.687	0.984	>0.05
	Total	104	55.8	24.0	6.5	44.5	0.062	± 0.654	0.966	>0.05
Height of opercular flap	Male	50	60.0	46.0	—10.5	12.75	—0.21	± 0.463	3.118	<0.002
	Female	54	46.3	37.0	— 5.0	12.5	—0.092	± 0.476	1.42	>0.05
	Total	104	52.9	41.3	—15.5	25.25	—0.149	± 0.475	3.197	<0.002

TABLE—2 (Contd.)

Characters	Sex	Number Exa- mined	% asymme- trical	% asymme- trical towards left	Σx	Σx^2	Mean of (R — L) $\bar{x}$	s	t	p
Width of Operculum	Male	50	52.0	32.0	— 4.0	11.0	—0.08	± 0.465	1.216	>0.05
	Female	54	35.2	12.5	3.0	5.5	0.055	± 1.0	0.404	>0.05
	Total	104	43.3	22.1	— 1.0	16.5	—0.009	± 0.4	0.227	>0.05
Length of pectoral fin	Male	46	45.7	11.1	8.5	13.75	0.184	± 0.519	2.4	<0.02
	Female	51	54.9	29.4	— 2.5	10.75	—0.04	± 0.458	0.622	>0.05
	Total	97	50.5	20.6	6.0	24.5	0.061	± 0.509	1.178	<0.10
Length of pelvic fin	Male	48	56.3	29.2	— 3.0	21.0	—0.062	± 0.664	0.643	>0.05
	Female	52	55.8	17.3	9.5	18.75	0.182	± 0.577	2.273	<0.05
	Total	100	56.0	23.0	6.5	39.75	0.06	± 0.63	0.952	>0.05

combined lot of male and female specimens the right side develops approximately 0.02 rays less than the left side. For this character asymmetry occurs approximately in 2—6% of the specimens—much less frequently than for the other four meristic characters examined. Variation in the number of rays from the opposite side resulted in very small mean difference. Although the left side count generally exceeds that of the right, the test for differences is not statistically significant.

Bilateral variation in morphometric characters (Table 2) : *Length of head*.—A comparison is made for the left and the right side measurements of altogether 104 specimens. In this character the males exhibit a greater percentage of asymmetrical development with larger mean difference than the females. In the male specimens, asymmetrical development occurs in approximately 60%, in females approximately 54% and in the combined sample of male and female specimens approximately 57%. The left side measurements exceed those of the right side in approximately 42% of males, in approximately 22% of females and in approximately 32% of the combined sample of male and female specimens. The direction of asymmetry in males indicates that the right side develops approximately 0.21 cms. less than the left side. In females the right side develops approximately 0.01 cms. more than the left side and in the total lot the right side develops approximately 0.01 cms. less than the left side. The mean difference observed is significant for male specimens and insignificant for females and for the combined lot.

Diameter of eye.—The right and left side measurements of eye diameter are taken for 104 specimens. The females exhibit a greater percentage of asymmetrical development with larger mean difference than males. In the male specimens, asymmetrical development occurs in approximately 40%, in females approximately 37% and approximately 39% in the total lot of male and female specimens. Left side measurements exceed in approximately 24% in males, approximately 15% in females and approximately 19% in the total of both. The direction of asymmetry in male specimens indicates that the right side develops approximately 0.04 cms. less than the left side, in female specimens right side develops approximately 0.05 cms. more than the left side and in combined sample the right side develops approximately 0.1 cm. more than the left side. However, the differences of the males and the females are not significant but the differences of the combined lot of males and females are significant.

Length of snout.—The left and right side measurements have been compared for 104 specimens. The male and the female groups similarly differ with no probable significant values occurring in either category. The female exhibited a greater percentage of asymmetrical development with larger mean difference than the male. In the male specimens, asymmetrical developments occur in approximately 52%, in female approximately 59% and in combined sample of both male and female specimens approximately 56%. The left side measurements of male exceed those of right side in approximately 28%, of females in approximately 20% and of combined sample in approximately 24%. The direction of asymmetrical development indicates that the right side of males develops approximately 0.03 cms. more

than the left side, of females approximately 0.09 cms. more than the left side and of both male and female examples approximately 0.06 cms. more than the left side.

Height of opercular flap.—A comparison is made from the left and the right side measurements of 104 examples. Male specimens exhibit a greater percentage of asymmetrical development with larger mean difference than the females. In the male specimens asymmetrical development occurs in approximately 60 %, in female specimens approximately 46 % and approximately in 53 % of the combined lot of male and female specimens. Left side measurements of males exceed in approximately 46 %, of females 37 % and of combined lot approximately 41 %. The direction of asymmetrical development indicates that the right side of the males develops approximately 0.21 cms. less than the left side, of females approximately 0.09 cms. less than the left side and of combined lot approximately 0.15 cms. less than the left side. Although the left side counts generally exceed the right in all the three, the difference is highly significant in males and in combined lot. In females the difference is not significant.

Width of operculum.—The left and right side measurements of the width of operculum has been compared for 104 specimens. Male and female groups varied similarly with no probable significant values occurring in either category. Males exhibit a greater percentage of asymmetrical development with larger mean difference than females. In the male specimens asymmetrical development occurs in approximately 52 %, in females approximately 35 % and in combined sample of both male and female specimens approximately 43 %. The left side measurements of males exceed in approximately 32 %, of females in approximately 13 % and in combined sample approximately 22 %. The direction of asymmetrical development indicates that right side of the males develops approximately 0.08 cms. less than the left side, in females approximately 0.06 cms. more than the left side, and in combined sample approximately 0.01 cm. less than the left side.

Length of pectoral fin.—The left and right pectoral fin measurements have been compared for 97 specimens. The female specimens exhibit a greater percentage of asymmetrical development with larger mean difference than the male specimens. In the male specimens asymmetrical development occurs in approximately 46 %, in females approximately 55 % and in combined sample approximately 51 %. The pectoral fin measurements of left side exceed those of right side in approximately 11 % of males, approximately 29 % of females and approximately 21 % of the combined sample. The direction of asymmetry in males indicates that the right side pectoral fin develops approximately 0.18 cms. more than that of the left side, in females the pectoral fin of right side develops approximately 0.04 cms. less than that of the left side and in the combined sample the right side fin develops approximately 0.06 cms. more than that of the left side fin. The mean difference observed is significant for male specimens and for female and combined sample of male and female specimens it is insignificant.

Length of pelvic fin.—A comparison has been made for the length of the pelvic fin of the two sides of 100 specimens. The male specimens exhibit a greater percentage of asymmetrical development with

greater mean difference than the females. In the pelvic fin length asymmetrical development occurs approximately 56% separately in the males, in the females and in the combined sample of both male and female specimens. The measurements of pelvic fin of right side exceed those of the left side of males in approximately 29%, of females in approximately 17% and in combined sample in approximately 23%. The direction of asymmetry indicates that the right side pelvic fin of male develops approximately 0.06 cms. less than the left side pelvic fin, of females approximately 0.18 cms. more than that of the left side and of combined sample approximately 0.06 cms. more than the left side pelvic fin. The mean difference observed is statistically insignificant for males and combined sample but it is significant in female specimens.

VI—CONCLUSIONS

No constant trend has been observed towards sexual dimorphism or effect of sampling location in respect to asymmetry of the studied characters. The meristic characters, such as the number of scales in the lateral line, the number of scales in the lateral transverse series, the number of pectoral fin rays and the number of pelvic fin rays in the females, show greater percentage of asymmetry than those of the males. In the number of branchiostegal rays, the males show greater percentage of asymmetry than the females. In the morphometric characters, such as the snout length and the pectoral fin length, the males show lesser percentage of asymmetry than females. In the length of head, the diameter of eye, the height of opercular flap and the width of the operculum, the males show greater percentage of asymmetry than the females. In the pelvic fin length both males and females show equal degree of asymmetry.

The results of the study show that *Labeo dero* (Ham.) (Pisces : Cyprinidae), which is essentially a bilaterally symmetrical animal, exhibits some asymmetry in respect to all the five meristic and seven morphometric characters studied here. In the present study no conclusive relationship has been found between the occurrence of asymmetry and the sex, but it is observed that the percentage of asymmetry in the meristic characters is more in females than the males. Out of five characters taken, four show more percentage of asymmetry in females than the males and in only one character (branchiostegal rays) males show greater percentage of asymmetry than females. For the morphometric characters in general the percentage of asymmetry is more in males than in females. Out of seven characters studied, four (head length, diameter of eye, height of opercular flap and width of operculum) show more percentage of asymmetry in males than in females. In two characters (length of snout and length of pectoral fin) the females show greater percentage of asymmetry than the males. In the length of pelvic fin both male and female specimens exhibit equal percentage of asymmetry.

In taxonomic and racial studies of *Labeo dero* (Ham), involving meristic and morphometric characters given above, the interchanging of counts and measurements of left and right sides, should be a signi-

ficant source of variation and a large number of such substitutions should affect results.

VII—ACKNOWLEDGEMENT

The authors are grateful to Dr. A. P. Kapur, Director, Zoological Survey of India, Calcutta, for kindly providing facilities to work and for continuous encouragement.

VIII—SUMMARY

104 specimens of *Labeo dero* (Hamilton) were examined to ascertain the extent and direction of asymmetry in five meristic and seven morphometric characters. The results obtained show that the fish which is essentially a bilaterally symmetrical animal, exhibits some asymmetry in respect to all the five meristic and seven morphometric characters. No conclusive relationship could be found between the occurrence of asymmetry and the sex, but females show more asymmetry than males, in meristic characters. For morphometric characters the percentage of asymmetry is more in males than in females. It is suggested that in taxonomic and racial studies the counts and measurements of left and right sides should be interchanged because as a result of the asymmetry of development of various parts of the body of the fish, it would affect the results.

IX—REFERENCES

- BAILEY, N. T. J. 1959. *Statistical methods in biology*.—London, E.C.I.
- FISHER, R. A. and YATES, F. 1953. *Statistical tables for biological, agricultural and medical research*. (4th Ed.).—Edinburgh.
- HUBBS, C. L. and HUBBS, L. C. 1944. Bilateral asymmetry and bilateral variation in fishes.—*Pap. Mich. Acad. Sci.*, 30 : 229-310, 1 pl.
- JORDAN, D. S. and EVERMANN, B. W. 1896. The fishes of North and Middle America.—*Bull. U. S. nat. Mus.*, 47, part 1 : 1-1240.
- LANDRUM, B. J. 1966. Bilateral asymmetry in paired meristic characters of pacific Salmon.—*Pacif. Sci.*, 20(2) : 193-202.
- VLADYKOV, V. D. 1954. Taxonomic characters of the eastern North American Chars (*Savelinus* and *Crystovomer*).—*J. Fish. Res. Bd. Can.*, 11(6) : 904-932.

ON THE PAGURID CRABS (CRUSTACEA-DECAPODA)
FROM ANDAMAN AND NICOBAR ISLANDS

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I—INTRODUCTION

The present paper is based on studies on collections of pagurid crabs made by various survey parties of the Zoological Survey of India, Calcutta, viz., Andaman Survey, 1952 by Dr. H. C. Ray ; Andaman and Nicobar Survey, 1959 by Dr. K. K. Tiwari, and Little Andaman Survey, 1961 by Dr. A. Daniel. The collections were made along the coastal regions of Andaman, Little Andaman and Car Nicobar Islands. The collections include 784 specimens in all representing 20 species belonging to two families viz., Paguridae and Coenobitidae. Eight species are of special interest from zoogeographical point of view, since they have been recorded for the first time from these islands.

Until the Zoological Survey of India took up intensive survey of Andaman and Nicobar group of islands, the intertidal pagurid fauna of these islands was not known completely except for the accounts of Heller (1865) and Alcock (1905).

Heller (1865) in his report on the Crustacea of the voyage of the Austrian ship 'Novara'—around the world, recorded no less than 14 species of pagurids from Nicobar Islands only. However the exact localities from the Nicobars are not mentioned and the recorded species are the following :—

1. <i>Paguristes ciliatus</i> (Heller)	10. <i>Pagurus punctulatus</i>
2. <i>Clibanarius longitarsis</i> (de Haan)	Olivier
3. <i>C. striolatus</i> Dana	(= <i>Dardanus megistos</i>
4. <i>C. humilis</i> Dana	(Herbst))
5. <i>C. corallinus</i>	11. <i>Coenobita clypeata</i>
(H. Milne-Edwards)	(Herbst)
6. <i>Calcinus tibicen</i> (Herbst)	12. <i>C. rugosa</i>
(= <i>Calcinus herbstii</i> de Man)	H. Milne-Edwards
7. <i>C. gaimardii</i> (H. Milne-Edwards)	13. <i>C. olivieri</i> Owen
8. <i>Diogenes miles</i> Dana	(identification doubtful)
(= <i>Diogenes merguiensis</i>	14. <i>C. violascens</i> Heller
de Man)	(= <i>Coenobita cavipes</i>
9. <i>Diogenes avarus</i> Heller	Stimpson)

Of the 14 species recorded, *Paguristes ciliatus* is a sublittoral form and the remaining 13 species are either intertidal or land forms. The identification of *Coenobita olivieri* is doubtful.

Alcock (1905) further recorded 14 more species and 5 new varieties or sub-species from this group of islands* and of these 'Investigator' only accounted for the collection of 13 species and the remaining 6 species were collected by either one or more of the following persons (A. Alcock, J. Anderson, J. Wood Mason, F. Stoliczka, R. D. Oldham, G. M. J. Giles, A. R. S. Anderson).

The species recorded are the following :—

1. <i>Pylocheles miersii</i> Alcock and Anderson 185 fms.	12. <i>Nematopagurus squamichelis</i> Alcock 185 fms.
2. <i>Parapylocheles scorio</i> Alcock 405 fms.	13. <i>Spiropagurus spiriger</i> var. <i>profundorum</i> Alcock 35 fms.
3. <i>Paguristes balanophilus</i> Alcock 53—60 fms.	14. <i>S. s.</i> var. <i>lophomeris</i> Alcock 20 fms.
4. <i>P. mundus</i> Alcock 112 fms.	15. <i>S. s.</i> var. <i>spinosicarpis</i> Alcock
5. <i>P. puniceus</i> Henderson 370—419 fms.	16. <i>Pagurus pergranulatus</i> (Henderson) 20 fms.
6. <i>Diogenes custos</i> (Fabricius)	17. <i>Pagurus zebra</i> var. (Alcock) 20 fms.
7. <i>Dardanus wood-masoni</i> (Alcock)	18. <i>Coenobita perlata</i> H. Milne-Edwards
8. <i>D. euopsis</i> (Dana)	19. <i>Birgus latro</i> (Linnaeus)
9. <i>D. deformis</i> (H. Milne-Edwards)	
10. <i>Aniculus strigatus</i> (Herbst)	
11. <i>Sympagurus bicristatus</i> var. <i>indicus</i> Alcock 405 fms.	

Of the 19 species further recorded, only 7 species are either intertidal or land forms and the remaining 12 species are collected below the intertidal mark ranging from 20 fms. to 419 fms. Thus leaving the doubtful *Coenobita olivieri*, altogether 32 species are recorded from the Andamans and Nicobars. Among them only 19 species are intertidal and this number is further increased to 27 by the present study.

II—SYSTEMATIC ACCOUNT

List of the species reported :

Family PAGURIDAE

1. <i>Clibanarius longitarsus</i> (de Haan)	† 2. <i>C. striolatus</i> Dana
*3. <i>C. olivaceus</i> Henderson	*4. <i>C. arethusa</i> de Man
† *5. <i>C. merguiensis</i> de Man	† 6. <i>C. humilis</i> Dana

* Species reported for the first time from the Andaman and Nicobar group of Islands.

† Species not reported so far from the mainland of India.

† 7. <i>C. corallinus</i> (H. M. Edwards)	8. <i>Calcinus herbstii</i> de Man
† *9. <i>C. latens</i> (Randall)	10. <i>C. gaimardii</i> (H. M. Edwards)
11. <i>Dardanus megistos</i> (Herbst)	*12. <i>D. vulnerans</i> (Thallwitz)
*13. <i>D. guttatus</i> (Olivier)	14. <i>D. deformis</i> (H. M. Edwards)
*15. <i>D. varipes</i> (Heller)	*16. <i>Aniculus aniculus</i> (Herbst)
Family COENOBITIDAE	
† 17. <i>Coenobita clypeata</i> Latreille	18. <i>C. rugosa</i> H. M. Edwards
† 19. <i>C. perlata</i> (H. M. Edwards)	20. <i>C. cavipes</i> Stimpson

Class CRUSTACEA
Order DECAPODA
Family PAGURIDAE

1. *Clibanarius longitarsus* (de Haan)

1849. *Pagurus longitarsus* de Haan, *Fauna Japon. Crust.* : 211.
1852. *Clibanarius longitarsis* : Dana, *U. S. Expl. Exped. Crust.*, pt. 1 : 464.
1950. *Clibanarius longitarsis* : Barnard, *Annals S. African Mus.*, 38 : 434.

Material.—22 exs., collected from the following localities : *North Andaman* : 1 ex., (12 mm.), Interview Island, 7.ii.59 (K. K. Tiwari) ; *Middle Andaman* : 2 exs., (9 mm. & 10.5 mm.), Long Island, 22.i.59 (K. K. Tiwari) ; *South Andaman* : 1 ex., (7 mm.), Bamboo flat, 13.ii.59 (K. K. Tiwari) ; *Port Blair* : 2 exs., (both 4.2 mm.), Aberdeen Jetty, 10.i.59 (K. K. Tiwari) ; 5 exs., (from 5 mm. to 13.2 mm.), Chatham Jetty, 10.ii.61 (A. Daniel) ; 4 exs., (4.5 mm. to 7 mm.), South Point Shore, 9.ii.61 (A. Daniel) ; *Little Andaman* : 2 exs., (8.5 mm. & 12.5 mm.), Tokoibuea, 12.ii.61 (A. Daniel) ; 1 ex., (14 mm.), Gaje, near Onge Bera, 25.ii.61 (A. Daniel) ; 1 ex., (7 mm.), Bumila Creek Shore, 28.ii.61 (A. Daniel) ; *Nicobar Island* : 1 ex., (23 mm.), Nan Cowry, 2.iv.59 (K. K. Tiwari).

Distribution.—Zanzibar and Madagascar to Liu Kiu Islands.

Remarks.—This species is reported from Chilka Lake, Madras, Porto Novo, Krusadai Island and Pamban on the east coast of India. Occurrence of this species from Nicobar Islands is made known by Heller (1865). Its record now from Andaman and Nicobar Islands after a lapse of 100 years is of considerable interest.

* Great Coco islands (Burma) are not taken into consideration under the Andaman and Nicobar group of islands.

2. *Clibanarius striolatus* Dana

1852. *Clibanarius striolatus* Dana, *U. S. Expl. Exp. Crust.*, pt. 1 : 463.
 1905. *C. striolatus* : Alcock, *Cat. Indian Decapod. Crust.*, pt. II(1) : 46.
 1950. *C. striolatus* : Barnard, *Annals S. African Mus.*, 38 : 434.

Material.—13 exs., (4 mm. to 9 mm.), Aberdeen Bay, Port Blair, 10 & 16.i.59, 2 & 8.iii.59 (K. K. Tiwari) ; 2 exs., (13 mm. both), Benyabai (near Ingoie), Little Andamans, 23.ii.61 (A. Daniel).

Distribution.—Gulf of Aden and Seychelles eastwards to Tahiti.

Remarks.—Availability of this species from Nicobar islands is made known by Heller (1865). However this species is not reported from the mainland of India.

3. *Clibanarius olivaceus* Henderson

1915. *Clibanarius olivaceus* Henderson, *Rec. Indian Mus.*, 11 : 26.
 1941. *C. olivaceus* : Gravely, *Bull. Madras Govt. Mus.*, (n.s.) *nat. hist.*, 5 (1) : 77.

Material.—3 exs., (5 mm. to 7.5 mm.), Aberdeen Bay, Port Blair, 16.i.59 & 18.iii.59 (K. K. Tiwari).

Distribution.—East coast of India.

Remarks.—This species is reported from Chilka Lake, Madras and Porto Novo on the east coast of India and it is now recorded for the first time from the Andaman Islands.

4. *Clibanarius arethusa* de Man

1888. *Clibanarius arethusa* de Man, *J. Linn. Soc. Zool.*, 22 : 252.
 1905. *C. arethusa* : Alcock, *Cat. Indian Decapod. Crust.*, pt. II (1) : 48.
 1935. *C. arethusa* : Reddi, *Curr. Sci.*, 3 : 562.

Material.—3 exs. (4.5 mm. to 7 mm.), South Point Shore, 9.iii.61 (A. Daniel) ; 4 exs., (5.5 mm. to 7 mm.), Chatham Jetty, Port Blair, 10.ii.61 (A. Daniel).

Distribution.—Bay of Bengal.

Remarks.—This species has been reported from Mergui (de Man 1888) Muttuwartu Par, Rameswaram and Madras (Henderson, 1893), Arakan coast and Mergui (Alcock, 1905), Pamban (Sundara Raj, 1927), Porto Novo (Reddi, 1935). Now, its record from the Andaman Islands for the first time, bridging the gap between Burmese coast and the Indian mainland, is of considerable interest from the zoogeographical point of view.

5. *Clibanarius merguiensis* de Man

1888. *Clibanarius aequabilis* var. *merguiensis* de Man, *J. Linn. Soc. Zool.* 22 : 247.

N.B. The measurements given in brackets are the carapace lengths measured dorsally length-wise in the middle line, from the tip of the rostrum to the cleft point.

1937. *C. aequabilis* var. *merguiensis* : Buitendizk, *Temminckia*, 2 : 265.
 1955. *C. merguiensis* : Fize & Serene, *Notes Inst. Oceanogr. Nhatrang*, 45 : 145.

Material.—86 specimens, from localities as listed under categories I, II & III, cited below.

Distribution.—Red Sea, Mauritius, Ceylonese coast, Burmese Coast, Malay Peninsula, South Vietnam and East Indies. Now they are recorded from the Andaman and Nicobars.

Remarks.—The specimens agree with the following distinctive characteristic features : viz. (1) the dactylus of the 3rd pair of thoracic legs is decidedly shorter than the propodus, and (2) the eye stalks are as long as the antennular peduncles. But all the specimens do not agree in their colour character and as such they have been divided into 3 categories as follows :

Category-I.—14 exs., are collected from the following localities. 1 ex., (4 mm.), Long Island (Middle Andaman), 22.i.59 (K. K. Tiwari); 9 exs., (4 mm. to 4.5 mm.), Aberdeen Bay (Port Blair), 10.i.59 and 2.iii.59 (K. K. Tiwari) ; 4 exs., (4 mm. to 5.8 mm.), Bumila Creek Shore (Little Andaman), 28.ii.61 (A. Daniel).

These 14 specimens have the dactylopodites of thoracic legs white in colour with a red streak on the upper margin. Out of four specimens collected from Bumila Creek Shore (Little Andaman), the white colour of the dactylopodites extends more or less upon the outer, inner and upper surfaces of the distal portions of propodites of both pairs of legs, in two specimens. In the other two specimens collected from the same locality, it extends as a white band along the length on the outer surface of propodi of 3rd pair of legs, but on the 2nd pair of legs as a white patch at the tip only. But in the remaining ten specimens collected from Long Island (Middle Andaman) and Aberdeen Bay (Port Blair), clear white bands can be seen lengthwise on the outer surfaces of propodi of both 2nd and 3rd pairs of legs.

Category-II.—18 exs., collected from the following localities. *Port Blair* : 1 ex., (6.5 mm.), South Point Shore, 9.iii.61 (A. Daniel) ; 4 exs., (4 mm. to 6.3 mm.), Chatham Jetty, 10.ii.61 (A. Daniel) ; 2 exs., (3.5 mm. & 4.5 mm.), Aberdeen Bay, 2.iii.59 (K. K. Tiwari). *Little Andaman* : 1 ex., (5 mm.), Ingoie Shore, 21.ii.61 (A. Daniel) ; 1 ex., (5.8 mm.), Nacbuge, 27.ii.61 (A. Daniel) ; 3 exs., (3.5 mm. to 5 mm.), Bumila Creek Shore, 28.ii.61 (A. Daniel) ; 4 exs., (4.5 to 7.5 mm.), Tular, 11 km, (7 miles) north of Gaja, 26.ii.61 (A. Daniel). *Nicobar* : 1 ex., (4.8 mm.), Nan Cowry Island, Nicobar, 2.iv.59 (K. K. Tiwari).

In these 18 specimens the anterior part of the body has light pink or white colour. Dactylus and propodus of both pairs of walking legs show uniform white colour having no band or patch on propodi.

Category-III.—54 exs., collected from the following localities : 1 ex., (5 mm.), from Interview Island (North Andaman), 7.ii.59

(K. K. Tiwari) ; 10 exs., (5 mm. to 7.3 mm.), Long Island (Middle Andaman), 20 & 22.i.59 (K. K. Tiwari) ; 26 exs., (3.5 mm. to 5.8 mm.), Aberdeen Bay, Port Blair, 16.i.59 & 2.iii.59 (K. K. Tiwari) ; 17 juveniles (below 3 mm.), Aberdeen Bay, Port Blair, 2.iii.59 (K. K. Tiwari).

The 35 specimens and 17 juveniles collected from Long Island (Middle Andaman) and Aberdeen Bay (Port Blair) have the anterior part of the body orange in colour. Ambulatory legs show grey colour except the dactyli which are white in colour. Red line is seen on the dorsal side of the dactylus. The grey colour of the ambulatory legs on the joints of merus, carpus and propodi is intense. The specimens have complete white band length-wise on the propodi of 3rd pair of legs and white patch at the tip of the propodi of 2nd pair of legs. However, a single specimen collected from Interview Island (North Andaman) has the propodi of ambulatory legs coloured deep brownish-black. A white streak is seen on the dorsal side of the propodus of 3rd left leg. Fingers of chelipeds and the anterior region of the palm show the same colour as that of the propodi. Remaining anterior part of the body and eye stalks have orange colour.

Even though the specimens are showing various types of colour patterns, they are not separated from *Clibanarius merguiensis* de Man, merely upon their colour differences.

Hitherto, this species was confined to Red Sea, Mauritius, Ceylonese, Burmese, Malayan, Indo-Chinese and East Indies waters. Now it is recorded, for the first time, from the Andaman, and Nicobar Islands. Its occurrence from these islands is, therefore, of special zoogeographical significance.

6. *Clibanarius humilis* Dana

1852. *Clibanarius humilis* Dana, *U. S. Expl. Exp. Crust.*, pt. 1 : 469.
 1905. *Clibanarius humilis* : Alcock, *Cat. Indian Decapod. Crust.*, pt. II (1) : 47.
 1953. *C. humilis* : Holthuis, *Atoll Res. Bull.*, 24 : 46.

Material :—6 exs., (4 mm. to 5 mm.), South Point Shore (Port Blair), 9.iii.61 (A. Daniel).

Distribution.—Laccadives, Maldives, Nicobars, East Indies, Fiji Islands, Tonga Islands, Cook Is., Tahiti, Tuamotu and Pacific Coral Islands.

Remarks.—This species though reported from Laccadives, Maldives and Nicobars by Alcock (1905) and now from Andamans has not so far been reported from the mainland of India.

7. *Clibanarius corallinus* (H. M. Edwards)

1848. *Pagurus corallinus* H. M. Edwards, *Ann. Sci. nat. Zool.*, (3) : 10 : 63.
 1905. *Clibanarius corallinus* : Alcock, *Cat. Indian Decapod. Crust.*, pt. II (1) : 48.
 1953. *C. corallinus* : Holthuis, *Atoll Res. Bull.*, 24 : 46.

Material.—2 exs., (15 mm. & 17 mm.), collected from Malacca village, Car Nicobar, 30.iii.59 (K. K. Tiwari).

Distribution.—From Andamans and Nicobars to Tahiti.

Remarks.—Alcock (1905) reported this species from Andamans and Nicobars but so far it has not been recorded from the mainland of India.

8. *Calcinus herbstii* de Man

1887. *Calcinus herbstii* de Man, *Archiv fur Naturges.*, 53 : 437.

1905. *C. herbstii* : Alcock, *Cat. Indian Decapod. Crust.*, pt. II (1) : 53.

1953(c). *C. herbstii* : Forest, *Bull. Mus. nat. Hist. Nat.*, (2), 25. no. 6 : 555.

Material.—23 exs., collected from the following localities.—*Middle Andaman*.—1 ex., (12 mm.), Long Island, 20.i.59 (K. K. Tiwari) ; *Port Blair*.—2 exs., (8.5 mm. both), Huddo, 6.iii.61 (A. Daniel) ; 8 exs., (5.5 mm. to 13 mm.), Chatham Jetty, 10.ii.61 (A. Daniel) ; *Little Andaman*.—4 exs., (7 mm. to 11 mm.), Tular, 26.ii.61 (A. Daniel), 2 exs., (16.5 mm. both), Ingoie Shore, 21.ii.61 (A. Daniel), 1 ex., (15.5 mm.), Laitora (near Tokoibuea), 14.ii.61 (A. Daniel), 1 ex., (15 mm.), Gaja (near Onge Bera), 25.ii.61 (A. Daniel) ; *Car Nicobar*.—2 exs., (8 mm. both), Malacca village, 30.iii.59 (K. K. Tiwari), 1 ex., (9.5 mm.), Sawai village, 31.iii.59 (K. K. Tiwari), 1 ex., (8.5 mm.), Mus village, 28.iii.59 (K. K. Tiwari).

Distribution.—Indo-Pacific region from East Africa to the Hawaii, Tahiti and Tuamotu Islands.

Remarks.—Alcock (1905) recorded this species earlier from Laccadives, Palk Strait and Andamans.

9. *Calcinus latens* (Randall)

1839. *Pagurus latens* Randall, *J. Acad. nat. Sci. Philad.* : 135.

1852. *Calcinus latens* : Dana, *U. S. Expl. Exp. Crust.*, pt. I : 459.

1953. *C. latens* : Holthuis, *Atoll Res. Bull.*, 24 : 44.

Material.—2 exs., (6 mm. & 8 mm.), collected from Aberdeen (Port Blair), 18.iii.59 (K. K. Tiwari), 1 ex., (6 mm.), Tular (near Gaja), Little Andaman, 26.ii.61 (A. Daniel).

Distribution.—From the Red Sea and east coast of Africa to the Hawaiian Islands and Tuamotu Archipelago.

Remarks.—This species has not so far been reported either from the mainland of India or from the Andaman Islands. Hence, its first occurrence from Andaman Islands, (Indian region) is of considerable interest specially with reference to the zoogeographical point of view.

10. *Calcinus gaimardii* (H. M. Edwards)

1848. *Pagurus gaimardii* H. M. Edwards, *Ann. Sci. nat. Zool.*, (3) 10 : 63.

1852. *Calcinus gaimardii* : Dana, *U. S. Expl. Exp. Crust.*, pt. 1 : 457.

1953. *C. gaimardii* : Holthuis, *Atoll Res. Bull.*, 24 : 42.

Material.—2 exs., (12 mm. & 17 mm.), Laitora 15, km. (9 miles) north of Tokoibuea, Little Andamans, 14.ii.61 (A. Daniel).

Distribution.—Islands of the Indo-Pacific region from Minicoy and Maldives to Tahiti,

Remarks.—This species was reported earlier from Nicobars by Heller (1865) and from Gulf of Manaar by Southwell (1906). It is recorded now for the first time from Little Andaman Islands.

11. *Dardanus megistos* (Herbst)

1804. *Cancer megistos* Herbst, *Krabben*, III, 4 : 23.
 1817. *Pagurus megistos* : Olivier, *Encycl. Meth.*, 8 : 639.
 1905. *P. punctulatus* : Alcock, *Cat. Indian Decapod. Crust.*, pt. II (1) : 81.
 1903. *Dardanus punctulatus* : Rathbun, *Proc. U. S. nat. Mus.*, 26 : 34.
 1953. *D. megistos* : Holthuis, *Atoll Res. Bull.*, 24 : 49.

Material.—8 exs., collected from the following localities. *Port Blair* : 1 ex., (19 mm.), Chatham Jetty, 10.ii.61 (A. Daniel), 1 ex., (24 mm.), below Cellular Jail, 10.iii.59 (K. K. Tiwari); *Little Andamans* : 2 exs., (12 mm. & 16.5 mm.), Nacbug, 27.ii.61 (A. Daniel), 2 exs., (15.5 mm. & 19.5 mm.), Benyabai (near Ingoie), 23.ii.61 (A. Daniel), 1 ex., (14 mm.), Laitora (near Tokoibuea), 14.ii.61 (A. Daniel), 1 ex., (25 mm.), Tokoibuea 12.ii.61 (A. Daniel).

Distribution.—Indo-Pacific region from the Red Sea and east coast of Africa to Australia and Hawaiian Islands.

Remarks.—Alcock (1905) reported this species from Laccadives and Andamans, Henderson (1893) from Tuticorin, Sundara Raj (1927) from Rameswaram Reef and A. R. Reddi (1935) from Porto Novo on the mainland of India.

12. *Dardanus vulnerans* (Thallwitz)

1890. *Pagurus vulnerans* Thallwitz, *Abh. U. Ber. K. Zool. etc. Mus. Dresden*, No. 3 : 33.
 1905. *P. vulnerans* : Alcock, *Cat. Indian Decapod. Crust.*, pt. II (1) : 83.
 1938. *P. vulnerans* : Yap-Chiongco, *Philippine J. Sci.*, 66 : 198.

Material.—1 ex., (21.5 mm), Cellular Jail (Port Blair) South Andaman, 10.iii.59 (K. K. Tiwari), 2 exs., (11 mm. & 12 mm.), Nacbug, Little Andaman, 27.ii.61 (A. Daniel).

Distribution.—Persian Gulf, Coromandel Coast, New Guinea, Philippines and Japan.

Remarks.—Alcock (1905) recorded this species from the Coromandel coast of India. It is recorded now for the first time from Andaman Islands.

13. *Dardanus guttatus* (Olivier)

1811. *Pagurus guttatus* Olivier, *Encycl. Meth.*, 8 : 640.
 1953. *Dardanus guttatus* : Holthuis, *Atoll Res. Bull.*, 24 : 48.

Material.—2 exs., (17 mm. & 31 mm.), Aberdeen, Port Blair, 16.iii.52 (H. C. Ray).

Distribution.—East coast of Africa to Hawaiian Islands.

Remarks.—This species is reported for the first time from Andaman Islands. However its availability on the mainland of India is not known with certainty as Kamalaveni (1950) identified a single

specimen from an unknown locality in the collection of the Zoological Survey of India.

14. *Dardanus deformis* H. M. Edwards

1836. *Pagurus deformis* H. M. Edwards, *Ann. Sci. nat. Zool.*, (2) 6 : 272.
1953. *Dardanus deformis* : Holthuis, *Atoll. Res. Bull.*, 24 : 47.

Material.—1 ex., (15.5 mm.), Nacbuge, Little Andaman, 27.ii.61 (A. Daniel).

Distribution.—From East coast of Africa to Tahiti.

Remarks.—Alcock (1905) reported this species from Andamans, Henderson (1893) from Tuticorin and Rameswaram on the mainland of India.

15. *Dardanus varipes* (Heller)

1861. *Pagurus varipes* Heller, *Verh. Zool. bot. Ges. Wien*, 11 : 22.
1938. *P. varipes* : Boone, *Bull. Vanderbilt Marine Mus.*, 7 : 266.

Material.—1 ex., (31 mm.), Aberdeen, Port Blair, 16.iii.52 (H. C. Ray).

Distribution.—Red Sea, Mozambique, Persian Gulf, S. India, Ceylon and Malay Archipelago.

Remarks.—Henderson (1893) gave an account of the availability of this species from Tuticorin on the mainland of India. Its occurrence now, made known for the first time from Andaman Islands is of special interest.

16. *Aniculus aniculus* (Herbst)

1791. *Cancer aniculus* Herbst, *Krabbenicius*, 2 : 37.
1793. *Pagurus aniculus* : Fabr., *Ent. Syst.*, 2 : 468.
1852. *Aniculus typicus* : Dana, *U. S. Expl. Exped. Crust.*, pt. 1 : 461.
1953. *A. aniculus* : Holthuis, *Atoll Res. Bull.*, 24 : 41.

Material.—1 ex., (27 mm.), Malacca village, Car Nicobar, 27.iii.59 (K. K. Tiwari).

Distribution.—Indo-Pacific Region from East coast of Africa to Japan, Paumotu Archipelago and New Zealand.

Remarks.—Henderson (1893) reported this species from Tuticorin on the south-east coast of India, Southwell (1906) from Lake Tampalakam and Trincomalee on the Ceylonese coast and it is now recorded for the first time from Andaman Islands.

Family : COENOBITIDAE

17. *Coenobita clypeata* Latreille

1826. *Coenobita clypeata* Latreille, *Fam. Nat. Règne Anim.* : 277.
1905. *C. clypeatus* : Alcock, *Cat. Indian Decapod. Crust.*, pt. II (1) : 142.
1943. *C. clypeata* : Thompson, *John Murray Exped.*, 1933-34, 7 : 425.

Material.—5 exs., collected from the following localities.—3 exs., (30 mm., 32 mm. & 39 mm.), Hut Bay; 1 ex., (27 mm.), Tailanda (near Kwate-tu-Kwage) Little Andaman, 18 & 19.ii.61 (A. Daniel), 1 ex., (23 mm.), Malaca, Car Nicobar, 23.iii.59 (K. K. Tiwari).

Distribution.—From Tropical West Africa, East Africa, Laccadives, Minicoy Islands and Burmese coast to Tahiti.

Remarks.—Occurrence of this species from Nicobar Islands is made known by Heller in 1865. This species however has not been reported from the mainland of India. Thus, its record now, from these islands after a lapse of 100 years is of special interest.

18. *Coenobita rugosa* H. M. Edwards

1837. *Coenobita rugosa* H. M. Edwards, *Hist. Nat. Crust.*, 2 : 241.

1905. *C. rugosus* : Alcock *Cat. Indian Decapod. Crust.*, pt. II (1) : 143,

1955. *C. rugosa* : Fize & Serene, *Notes Inst. Oceanogr. Nhatrang*, 45 : 12.

Material.—542 exs., collected from the following localities.—*North Andaman* : 3 exs., (9 mm. to 12.5 mm.), Port Cornwallis, 31.i.59 (K. K. Tiwari); *Middle Andaman* : 84 exs., (3 mm. to 15 mm.), Long Island, 20 & 22.i.59 (K. K. Tiwari); *South Andaman* : 1 ex., (15 mm.), Ross Island, 14.iii.59 (K. K. Tiwari); *Port Blair* : 4 exs., (10 mm. to 13 mm.), Aberdeen Jetty, 10.i.59 (K. K. Tiwari), 96 exs., (1.5 mm. to 17 mm.), Aberdeen Bay, 11 & 12.i.59 (K. K. Tiwari), 268 exs., (1.5 mm. to 19 mm.), Corbyn's Cove, 16.i.59 (K. K. Tiwari), 6 exs., (7.5 mm. to 13 mm.), Chatham Jetty, 10.ii.61 (A. Daniel), 1 ex., (9 mm.), Huddo, 6.iii.61 (A. Daniel), 1 ex., (7 mm.), South Point Shore, 9.iii.61 (A. Daniel); *Little Andaman* : 19 exs., (4.5 mm. to 29 mm.), Dugong Creek, 11.iii.59 (K. K. Tiwari), 1 ex., (13.5 mm.), Laitora, 14.ii.61 (A. Daniel), 9 exs., (7 mm. to 15 mm.), Bedeabdula, 16.ii.61 (A. Daniel), 1 ex., (18 mm.), Tokoibuea, 12.ii.61 (A. Daniel), 1 ex., (10.5 mm.), Hut Bay, 18.ii.61 (A. Daniel), 2 exs., (9 mm. & 13 mm.), Tailanda (near Kwate-tu-Kwage), 19.ii.61 (A. Daniel), 5 exs., (9 mm. to 17.5 mm.), Ingoie Shore, 21.ii.61 (A. Daniel), 10 exs., (8 mm. to 13.5 mm.), Tular, 26.ii.61 (A. Daniel), 5 exs., (11.5 mm. to 13 mm.), Gaje, 25.ii.61 (A. Daniel), 5 exs., (10 mm. to 14 mm.), Nacbuga, 27.ii.61 (A. Daniel); *Car Nicobar* : 6 exs., (8.5 mm. to 19 mm.), Malacca, 23.iii.59 (K. K. Tiwari), 2 exs., (7 mm. both), Passa bridge, 26.iii.59 (K. K. Tiwari), 8 exs., (4.5 mm. to 8 mm.), Mus village, 28.iii.59 (K. K. Tiwari), 3 exs., (7 mm. to 12. mm.), Sawaii village, 31.iii.59 & 5.iv.59 (K. K. Tiwari); *Nicobar* : 1 ex., (10 mm.), Nan Cowry Island, 2.iv.59 (K. K. Tiwari).

The biggest specimen measuring 29 mm. in the middle of carapace is collected from Dugong Creek (Little Andaman).

Distribution.—From the East coast of Africa, Red Sea and Indo-Pacific region to West Coast of America.

Remarks.—This is a common form found on the Andaman and Nicobar group of islands but not so on the mainland of India.

19. *Coenobita perlata* H. M. Edwards

1837. *Coenobita perlata* H. M. Edwards, *Hist. Nat. Crust.*, 2 : 242.

1905. *C. perlatus* : Alcock, *Cat. Indian Decapod. Crust.*, pt. II (1) : 145.
 1955. *C. perlata* : Fize & Serene, *Notes Inst. Oceanogr. Nhatrang*, 45 : 24.

Material.—7 exs., collected from the following localities.—*South Andaman* : 1 ex., (31.5 mm.), Corbyn's Cove 16.i.59 (K. K. Tiwari), —Port Blair, *Little Andaman* : 1 ex., (9 mm.), Bedeabdula (South of Tokoibuea), 16.ii.61 (A. Daniel), 1 ex., (36 mm.), Laitora (North of Tokoibuea), 14.ii.61 (A. Daniel) ; *Car Nicobar* : 4 exs., (5.5 mm. to 12.5 mm.), Sawaii village, 31.iii.59 & 5.iv.59 (K. K. Tiwari).

The biggest specimen measuring 36 mm. length on—wise in the middle line of the carapace is collected from Laitora (Little Andaman).

Distribution.—Red Sea, Seychelles, Mauritius through the Indo-Pacific to Samoa.

Remarks.—Though Alcock (1905) gave an account of the occurrence of this species from Laccadives, Andamans and Nicobars, it is not reported so far from the mainland of India.

20. *Coenobita cavipes* Stimpson

1859. *Coenobita cavipes* Stimpson, *Proc. Acad. nat. Sci. Philad.* : 245.
 1905. *C. cavipes* : Alcock, *Cat. Indian Decapod. Crust.*, pt. II(1) : 146.
 1955. *C. cavipes* : Fize & Serene, *Notes Inst. Oceanogr. Nhatrang*, 45 : 30.

Material.—44 specimens collected from the following localities.—*North Andaman*.—7 exs., (12 mm. to 28 mm.), Port Cornwallis, 1.ii.59 (K. K. Tiwari), 1 ex., (6.5 mm.), South Camp (Interview Island), 7.ii.59 (K. K. Tiwari) ; *Middle Andaman* : 18 exs., (6.5 mm. to 26 mm.), Long Island, 20, 22 & 25.i.59 (K. K. Tiwari) ; *South Andaman*. 1 ex., (5 mm.), Bamboo flat, 13.i.59 (K. K. Tiwari) ; *Port Blair* : 1 ex., (4.5 mm.), Chatham Jetty, 1 ex., (33.5 mm.), Corbyn's cove, 16.i.59 (K. K. Tiwari), 6 exs., (10.5 mm. to 27 mm.), South Point, 5 & 13.iii.59 (K. K. Tiwari), 1 ex., (5.5 mm.), Aberdeen Bay, 27.ii.59 (K. K. Tiwari), 2 exs., (7.5 mm. to 20 mm.), Aberdeen Jetty, 10.i.59 (K. K. Tiwari) ; *Little Andaman* : 1 ex. (37 mm.), Gaje (near Onge Bera) 25.ii.61 (A. Daniel) ; *Car Nicobar* : 3 exs., (9 mm. to 13 mm.), Malacca village, 23 & 30.iii.59 (K. K. Tiwari), 2 exs., (6.5 mm. to 9.5 mm.), Sawaii village, 5.iv.59 (K. K. Tiwari).

The biggest specimen measuring 37 mm. in the middle line of the carapace is collected from Gaje—Little Andaman.

Distribution.—From East Coast of Africa, East Coast of India, Andamans and Nicobars, Malaya and East Indies to Liu Kiu Islands.

Remarks.—This species like *Coenobita rugosa* Edw. is a common form found in Andaman and Nicobar group of Islands but not so common on the mainland of India.

III—SUMMARY

The present paper is based on studies on collections of pagurid crabs made by various survey parties of the Zoological Survey of India, viz. Andaman Survey, 1952 by Dr. H. C. Ray ; Andaman and Nicobar Survey, 1959 by Dr. K. K. Tiwari, and Little Andaman

Survey, 1961 by Dr. A. Daniel. The collections were made along the coastal regions of Andaman, the Little Andaman and the Car Nicobar Islands. The collections include 784 specimens in all, representing 20 species belonging to two families viz., Paguridae and Coenobitidae. Eight species are of special interest from the zoogeographical distribution of view, since they have been recorded for the first time from this group of Islands. History of the pagurid study of Andamans and Nicobars is discussed.

IV—REFERENCES

- ALCOCK, A. 1905. *Catalogue of the Indian Decapod Crustacea* in, the Collection of the Indian Museum, Part—II (Anomura), Fasciculus—1 (Pagurides) : i—xi and 1—197.
- HELLER, C. 1865. Reise der österreichischen Frigate Novara um die Erde. *Crustaceen*, : 82—92.
- HENDERSON, J. R. 1893. "A contribution to Indian Carcinology".—*Trans. Linn. Soc. (Zool)*, (2) 5 : 325-458.
- KAMALAVENI, S. 1950. On hermit-crabs (Family Paguridae) in the collection of the Indian Museum. *Rec. Indian Mus.*, 47 (1) : 77-85.
- DE MAN, J. G. 1888. Report on the Podophthalmous Crustacea of the Mergui Archipelago, collected for the Trustees of the Indian Museum Calcutta, by Dr. John Anderson, F.R.S., Superintendent of the Museum. *J. Linn. Soc. Zool.*, 22 : 225-255.
- REDDI, A. R. 1935. Notes on a collection of Paguridea from Porto Novo. *Curr. Sci.*, 3 : 561—562.
- SOUTHWELL, T. 1906. On the Anomura collected by Professor Herdman, at Ceylon, in 1902. In Herdman, W. A., *Report to the Government of Ceylon on the pearl oyster fisheries of the Gulf of Manaar*, pt. 5, No. 35 : 211-224.
- SUNDARA RAJ, B. 1927. The littoral fauna of Krusadai Island in the Gulf of Manaar. Decapoda—Paguridea. *Bull. Madras Govt. Mus.*, new ser., nat. hist. sect., 1 (1) : 129-134.

REACTIONS TO LIGHT IN WOODLICE (ISOPODA)

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I—INTRODUCTION

In spite of various inherent limitations due to their grade of organisation, woodlice are able to lead a terrestrial life as a result of modifications in their behaviour. Morphological features have not changed much since their marine ancestors (Pearse, 1916). Edney (1954) concludes that woodlice are not conspicuously adapted to terrestrial life. The negative response to light has been studied by few workers in the past. Some controlled experiments were carried out to elucidate the acclimatisation of woodlice to light and the influence of temperature on phototaxis.

II—EXPERIMENTS

(a) Reaction of Normal Woodlice to Light

Method.—Experiments were carried out with fresh animals in a choice-chamber apparatus which consisted of a glass container about 15 cm. in diameter and 7 cm. in height. The vessel was divided into two compartments by a piece of hardboard leaving a narrow space at the bottom through which the animals could just pass. The apparatus was covered above by a piece of black hardboard. Half of the apparatus was painted black on all sides so that no light from outside could affect that part. The floor was covered by two equal pieces of wet filter paper. A 40 watt bulb was fitted with a resistance box by which the intensity of illumination could be changed when required. The light was placed at a distance of 38 cm. from the unpainted side. A piece of cardboard 20 cm. x 25 cm. was fixed by a clasp in front of the light. A hole (5 cm. x 5 cm.) through which light could pass, was made on the upper part of the cardboard. A sheet of heat-proof glass was fitted across the hole. Thus one half of the chamber was illuminated whilst the other half was in darkness. The light intensity in the illuminated side of the arena was measured with an Avo light meter which gave a reading of 15 lumens per square foot. On the dark side 3 lumens per square foot were recorded.

Five adult males and five adult females of *Oniscus asellus* Linnaeus were placed in the choice-chamber. Females were marked with white paint so that they could easily be distinguished. The number of each sex in each half of the arena was recorded at intervals of fifteen minutes. These animals were then replaced by ten fresh animals and a further observation was made after fifteen minutes. The procedure was repeated until ten readings had been taken, so that the results of 100 animals were obtained. A similar series of experiments was carried with *Porcellio scaber* Latr. It was found that

26% of the position records of *O. asellus* and 29% of the position records of *P. scaber* were on the light side of the choice-chamber. No significant difference was noted between the behaviour of the two sexes in the intensity of their responses to light.

(b) Reaction to Light of Woodlice Acclimatised to Bright Light

A number of *O. asellus* and *P. scaber* were placed in a glass container 15 cm. in diameter and 7 cm. in height. A 60 watt bulb at distance of 60 cm. above was turned on for four days. The intensity of light on the floor of the container was 40 lumens per square foot (measured by an 'Avo' light meter). The reaction to light after acclimatisation to light was studied by the method described above for normal animals. At the beginning of the experiments, few animals were found to be photopositive but as soon as they had found the dark side, they aggregated there. Ten readings were recorded using ten animals at a time, over a period of fifteen minutes. This procedure was continued until the results of 1000 different animals had been obtained. These experiments showed that 72.8% of *P. scaber* and 57.4% of *O. asellus* were statistically ($P=0.05$) significant.

Hence it may be assumed that both *O. asellus* and *P. scaber* do not become acclimatised to bright light or if they do so, this conditioning does not persist for long.

The structure of eye of these animals have been studied in detail and findings will be published elsewhere (as it is beyond the scope of this paper). But it may be stated that pigment migration does not occur in the eye of these animals when exposed to bright light.

(c) Influence of Temperature on Phototaxis

The animals were placed in a large conical flask containing humus. The humidity of the air inside the flask was measured by cobalt thiocyanate paper (Solomon, 1957) and varied between 60% to 70%. The flask was closed with a piece of cotton wool. It was placed inside an incubator at a constant temperature of 30°C for 48 hours.

The reaction to light was now studied in exactly the same way as in the previous experiment. All conditions of the experiments were also exactly the same. The results of 1000 different animals showed that 49.6% of *O. asellus* and 52.1% of *P. scaber* remained on the dark side which was not significant statistically.

After exposure to a temperature of 30°C, therefore, no significant difference was obtained between the number of animals present in light or dark in each species. In other words, the woodlice became less photonegative at higher temperatures. This behaviour of *O. asellus* and *P. scaber* seems to be similar to that of *Armadillidium vulgare* (Latreille), according to Henke (1930).

Thus it is concluded that the reaction to light depends upon various factors and previous exposure to higher temperatures is one of them.

III—DISCUSSION

That woodlice are normally photonegative is corroborated in the present study. Fraenkel and Gunn (1940) have described the reactions of woodlice to light in different categories, such as, tropotaxis,

light compass reaction, unilateral blinding and circus movements, skototaxis etc. They also criticised the studies of workers.

Abbott (1918) found both *O. asellus* and *P. scaber* to be photonegative in general. He also noticed that some animals became photopositive after previous exposure to bright light. His observation was not based on strict experimental studies. However, Müller (1925) observed that *Cylisticus convexus* and *Trichoniscus pusillus* did not become photopositive after long exposure to light. The explanation of similar behaviour in *O. asellus* and *P. scaber* is due to the fact that *pigment migration does not occur in the eye* when exposed to bright light for prolonged period. This phenomenon has not been studied before.

Regarding the influence of temperature on phototaxis, Henke (1930) found that *Armadillidium vulgare* (Latreille) might be photopositive after previous exposure to higher temperature. The similar phenomenon with *O. asellus* and *P. scaber* has been observed in the present series of experiments.

IV—ACKNOWLEDGEMENTS

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V—SUMMARY

Oniscus asellus L. and *Porcellio scaber* Latr. are negatively phototactic animals. They do not become acclimatised to bright light and no pigment migration occurs in their compound eyes. They become less photonegative when they have previously been exposed to higher temperature.

VI—REFERENCES

- ABBOTT, C. H. 1918. Reactions of land isopods to light. *J. exp Zool.*, **27** : 193-246.
- EDNEY, E. B. 1954. Woodlice and the land habitat. *Biol. Rev.*, **29** : 185-219.
- FRAENKEL, G. E., and GUNN, D. L. 1940. *The orientation of animals*, Oxford.
- HENKE, K. 1930. Die Lichtorientierung und die Bedingungen der Lichtstimmung bei *Armadillidium cinereum* Zenker. *Z. Vergl. Physiol.*, **13** : 534-625.
- MÜLLER, A. 1925. Über Lichtreaktionen von Landasseln. *Zool. Vergl. Physiol.*, **3** : 113-44.
- PEARSE, A. S. 1916. An account of the crustacea collected by the Walker expedition to Santa Marta, Columbia. *Proc. U.S. nat. Mus.*, **49** : 531-36.
- SOLOMON, M. E. 1957. Estimation of humidity with cobalt thiocyanate papers and permanent colour standards. *Bull. ent. Res.*, **48** : 489-506.

FISHES OF THE GREAT NICOBAR EXPEDITION, 1966
WITH DESCRIPTION OF A NEW GOBIOID FISH
OF THE FAMILY KRAEMERIIDAE

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(With 1 Text-figure)

I—INTRODUCTION

It is well known that the Andaman and Nicobar group of islands is rich in its fish fauna (*vide* Day, 1870, 1878 ; Alcock, 1899 ; Annandale and Hora, 1925 ; Mukherji, 1935 ; Rao and Hora, 1938 ; Herre, 1939, 1941 ; Koumans, 1941 ; Jones, Silas and Dawson, 1960 ; Silas and Toor, 1961, 1962 ; Jones and Silas, 1962 ; Yazdani, 1963 ; Luther, 1966). The recent collection made by the Great Nicobar Expedition, 1966 is a very valuable addition to our knowledge of the fish fauna of these group of islands. It contains ninety three species belonging to sixty one genera and thirty five families, of which eleven species viz., *Gymnothorax boschi* (Blkr.), *Uropterygius macrocephalus* (Blkr.), *Ambassis buton* Popta, *Plesiops oxycephalus* Blkr., *Abudefduf cyaneus* (Q. & G.), *Abudefduf glaucus* (Cuv.) *Xanodon oktodon* (Blkr.), *Enchelyurus kraussi* (Klunz.), *Omobranchus zebra* (Blkr.), *Hypseleotris g  ntheri* (Blkr.), and *Ctenogobius grammogaster* Blkr., are recorded here for the first time from the Indian Seas,¹ while twelve species viz., *Pisodonophis cancrivorus* (Rich.), *Holocentrus lacteo-guttatus* Cuvier, *Mugil carinatus* Val., *Mugil cunnesius* Val., *Ephinephelus caeruleo-punctatus* (Bl.), *Leiognathus blochi* (Val.), *Secutor insidiator* (Bl.), *Abudefduf septemfasciatus* (Cuv.), *Butis gymnopomus* (Blkr.), *Bunaka gyrinoides* (Blkr.), *Quisquilius eugenius* Jordan & Evermann and *Periophthalmus variabilis* Eggert are new records for the Andaman and Nicobar group of Islands. A new species of a gobioid fish belonging to the genus *Kraemicus* Schultz, 1966 (family Kraemeriidae) is also described.

A systematic account giving details of the number of specimens of each species present in the collection, the size range in standard length, the date of collection, locality and their range of distribution are given in this paper. A brief description of those species which are either recorded for the first time from the Indian Seas or from the Andaman group of islands is also given.

¹ The limits of the Indian Seas are : on the west, the Gulf of Oman and then from Ras el Haad southwards along Long. 60  E.; on the south from Lat. 1  S., where it meets Long. 60  E, eastwards to the coast of Sumatra ; on the East, the coast of Burma. The Andaman Sea is included but the coastal and territorial waters of Pakistan, Burma and Ceylon are considered outside our area. (*vide* Misra, 1947.).

II—SYSTEMATIC ACCOUNT

Order 1. LAMNIFORMES

Family 1. CARCHARHINIDAE

1. *Carcharias melanopterus* Quoy & Gaimard

1824. *Carcharias melanopterus* Quoy & Gaimard, *Voy. Uranie, Zool. Poiss.* : 194, pl. 43, figs. 1-2.
 1878. *Carcharias melanopterus* : Day, *Fish. India* : 715, pl. 185, fig. 3.

1 ex., 520 mm., Great Nicobar Island, 1966.

Distribution.—Widely distributed in the tropical Pacific and Indian Oceans from South Africa to the Marquesas Islands, Japan and Australia.

Order 2. CLUPEIFORMES

Family 1. CLUPEIDAE

2. *Herklotsichthys punctatus* (Rüppell)

1837. *Clupea punctata* Rüppell, *Neue Wirbelth., Fische* : 78, pl. 21, fig. 2.
 1878. *Clupea klunzei* Day, *Fish. India* : 636, pl. 163, fig. 1.
 1965. *Herklotsichthys punctatus* : Whitehead, *Bull. Brit. Mus. nat. Hist. (Zool.)*, 12 (7) : 237.

1 ex., 35 mm., Campbell Bay, 12. iii. 1966.

Distribution.—East coast of Africa to Japan, Australia and Polynesia.

Family 2. ENGRAULIDAE

3. *Thrissina baelama* (Forskål)

1775. *Clupea baelama* Forskål, *Descript. animal.*, : 72.
 1878. *Engraulis baelama* : Day, *Fish. India* : 626, pl. 158, fig. 7.
 1940. *Thrissina baelama* : Herre, *Rec. Indian Mus.*, 42 : 1.

4 exs., 52-90 mm., Campbell Bay, 3, 12. iii. 1966.

Distribution.—Widely distributed from the Red Sea through India, East Indies to the Philippines, Guam and Samoa.

Order 3. CYPRINIFORMES

Family I. PLOTOSIDAE

4. *Plotosus anguillaris* (Bloch)

1797. *Platystacus anguillaris* Bloch, *Syst. Ichth.*, 11 : 49, pl. 373, figs. 1 & 2.
 1877. *Plotosus arab* Day, *Fish. India* : 483, pl. 112, fig. 4.
 1913. *Plotosus anguillaris* : Weber & Beaufort, *Fishes Indo-Australian Archipelago*, 2 : 229.

3 exs., 62—90 mm., Casurina Bay, 6. iv. 1966.

Distribution.—From the coast of Africa to Japan and the Society Islands.

Order 4. ANGUILLIFORMES

Family I. ANGUILLIDAE

5. *Anguilla bicolor* McClelland

1845. *Anguilla bicolor* McClelland, *Calcutta J. nat. Hist.*, 5 : 178, pl. 6, fig. 1.
 1878. *Anguilla bicolor* : Day, *Fish. India* : 660, pl. 167, fig. 3 and pl. 168, fig. 2.

1 ex., 49 mm., Log Point, Dogma river, 9. iv. 1966.

Distribution.—From India, Ceylon to the East Indies.

Family 2. MURAENIDAE

6. *Echidna nebulosa* (Ahl)

1789. *Muraena nebulosa* Ahl, *Dissert. de Muraena et Ophichths* : 5, pl. 1, fig. 2.
 1878. *Muraena nebulosa* : Day, *Fish. India* : 673, pl. 172, fig. 2.
 1916. *Echidna nebulosa* : Weber & Beaufort, *Fishes Indo-Australian Archipelago*, 3 : 348.

1 ex., 255 mm., between Cereberus and Conical Rock, 9.iii. 1966 ;
 1 ex., 290 mm., Galathea Bay, 28.iii. 1966 ; 1 ex., 260 mm., Great Nicobar Island, 1966.

Distribution.—From the Red Sea and east coast of Africa across the Indian and Pacific Oceans to China, Guam, Hawaii, and throughout Polynesia.

7. *Gymnothorax boschi* (Bleeker)

1853. *Muraena boschi* Bleeker, *Verh. Bat. Gen.*, 25 : 52.
 1955. *Gymnothorax boschi* : Munro, *Marine Freshwater Fishes Ceylon* : 62.

1 ex., 555 mm., Campbell Bay, 15.iii. 1966.

Body depth 13.5, head length 8.2 in total length. Head and trunk about equal to tail. Dorsal and anal moderately developed, the former beginning before gill opening. Dorsal three times as high as anal. Teeth in single series in both jaws. Intermaxillary with three mesial teeth and mandible with two inner symphysial canines. No vomerines but infrapharyngeals with two parallel double rows. Gill openings not much narrower than the eye diameter.

Distribution.—Ceylon, the East Indies and the Philippines. This is the first record of this species from Indian waters.

8. *Uropterygius macrocephalus* (Bleeker)

1865. *Gymnomuraena macrocephalus* Bleeker, *Ned. Tijdschr. Dierk.*, 2 : 54.
 1943. *Uropterygius macrocephalus* : Schultz, *Bull. U. S. natn. Mus.*, 180 : 27.

2 exs., 130-155 mm., Campbell Bay, 6.iii. 1966 ; 3 exs., 143-185 mm., Galathea Bay, 25.iii. 1966.

Depth of body 17.0-18.5, head length 6.2-8.0 in total length. Head and trunk somewhat longer than tail. Eye situated above middle of cleft of mouth, about 7.0 in length of head. Anterior nostrils in short tube, posterior nostrils with elevated rim. Gill openings about as wide as eye diameter. Anal and dorsal fins present only at tip of tail, both confluent with short caudal fin. Maxillary and mandibular teeth in two series; vomerine teeth uniserial. Colour pattern of finely mottled brown and markings not arranged in rows or bars, tail pale edged, nostrils white.

Distribution.—Marquesas Islands to Samoa. This is the first record of this species from Indian seas.

9. *Uropterygius marmoratus* (Lacépède)

1803. *Gymnomuraena marmorata* Lacépède, *Hist. nat. Poiss.*, 5 : 648.
 1878. *Gymnomuraena marmorata* : Day, *Fish. India* : 674, pl. 172, fig. 5.
 1962. *Uropterygius marmoratus* : Smith, *Ichthyol. Bull. Rhodes Univ.*, 23 : 247, pl. 53D.

1 ex., 385 mm., Campbell Bay, 11.iii. 1966.

Distribution.—Widely distributed in the tropical Indo-Pacific, from islands on the east coast of Africa to Central Pacific.

Family 3. OPHICHTHYIDAE

10. *Pisoodonophis cancrivorus* (Richardson)

1844. *Ophisurus cancrivorus* Richardson, *Voy. Erebus & Terror, Fishes* : 97.
 1916. *Pisoodonophis cancrivorus* : Weber & Beaufort, *Fishes Indo-Australian Archipelago*, 3 : 300.

1 ex., 150 mm., Galathea Bay, 25.iii. 1966.

Snout projects beyond mouth which reaches behind eye. Teeth in bands of several rows. Dorsal fin originates above middle of pectorals ; median fin low, ends before tip of tail. Tail about 1.5 times longer than rest of the body. Dorsal with a fine black margin.

Distribution.—Widespread, from Africa through India, Ceylon to Japan and Australia. This is the first record from the Andaman and Nicobar group of Islands.

Order 5. BELONIFORMES

Family 1. HEMIRHAMPHIDAE

11. *Hyporhamphus unifasciatus* (Ranzani)

1842. *Hemirhamphus unifasciatus* Ranzani, *Nov. Comm. Acad. Sci. Inst. Bonon.*, 5 : 326.
 1877. *Hemirhamphus unifasciatus* : Day, *Fish. India* : 514.
 1955. *Hyporhamphus unifasciatus* : Munro, *Marine Freshwater Fishes Ceylon* : 74.

1 ex., 210 mm., Great Nicobar Island, 1966.

Distribution.—Pantropical, from the east coast of Africa through the East Indies and the Philippines to the Galapagos Islands, Panama, and also the Atlantic coast of tropical America.

Order 6. SYNGNATHIFORMES

Family 1. SYNGNATHIDAE

12. *Syngnathus spicifer* Rüppell

1840. *Syngnathus spicifer* Rüppell, *Neue Wirbelth., Fische* : 143, pl. 33, fig. 4.
 1878. *Syngnathus spicifer* : Day, *Fish. India* : 678, pl. 174, fig. 1.

I ex., 135 mm., Shampen village, Dogma river, 10.iv. 1966.

Distribution.—From the Red Sea and east coast of Africa to China, Caroline Islands and the Bismarck Archipelago.

Order 7. CYPRINIDONTIFORMES

Family 1. CYPRINODONTIDAE

13. *Oryzias melastigma* (McClelland)

1839. *Aplocheilus melastigma* McClelland, *Asiatic Res.*, Calcutta, 19 : 301, 427, pl. 42, fig. 3.
 1878. *Haplochilus melastigma* : Day, *Fish. India* : 522, pl. 121, fig. 4.
 1939. *Oryzias melastigma* : Herre, *Rec. Indian Mus.*, 41 : 331.

50 exs., 33-43 mm., Casurina Bay, 7.iv. 1966 ; 1 ex., 36 mm., Shampen village, Dogma river, 10.iv. 1966 ; 1 ex., 43 mm., Great Nicobar Island, 1966.

Distribution.—From coasts of Ceylon and Peninsular India through Lower Bengal to Burma.

Order 8. BERYCIFORMES

Family 1. HOLOCENTRIDAE

14. *Holocentrus lacteo-guttatus* Cuvier

1829. *Holocentrum lacteo-guttatum* Cuvier, *Hist. nat. Poiss.*, 9 : 214.
 1953. *Holocentrus lacteo-guttatus* : Smith, *Sea Fishes Southern Africa* : 153, pl. 9, fig. 297.

2 exs., 107-131 mm., Casurina Bay, 2.iv. 1966.

D. XI, 13 ; A. IV, 9 ; Ll. 41-43 ; L tr. 3/8 ; Gill rakers 6+1+10.

Depth of body 2.7-2.8 ; head length 2.7 in standard length. Snout 4.6-5.0 ; eye diameter 2.6-2.8 ; interorbital width 2.8-3.0 ; in length of head. Lower jaw not projecting beyond upper ; interorbital area flat, spine at angle of preopercle projecting beyond margin of opercular flap. Colour in alcohol ground colour of cheeks, and opercles profusely sprinkled with minute brown dots. Back and upper sides light brown with faint yellow lengthwise lines and many minute brown dots. Caudal, pectoral and pelvic fins pale.

Distribution.—A central Indo-Pacific species, from the Red Sea through the East Indies and the Philippines to Hawaii and Tahiti. This is the first record of this species from the Andaman and Nicobar group of Islands.

Order 9. MUGILIFORMES

Family 1. MUGILIDAE

15. *Mugil carinatus* Valenciennes

1836. *Mugil carinatus* Valenciennes, *Hist. nat. Poiss.*, **11** : 148.
 1876. *Mugil carinatus* : Day, *Fish. India* : 349, pl. 74, fig. 2.
 1888. *Mugil klunzingeri* Day, *Fish. India, Suppl.*, : 800.
 1961. *Mugil carinatus* : Sarojini, *J. Bombay nat. Hist. Soc.*, **59** (2) : 548.

2 exs., 54-55 mm., Galathea Bay, 2.iii. 1966.

D. IV+1.8 ; A. III, 9 ; V. I, 5 ; P. 15 ; L I. 34-35.

Height of body 2.4-2.6 ; length of head 2.2-2.3 ; both in standard length. Eye diameter 3.7-4.0 in head length. Head length greater than height of body. Symphysial knob single. No elongated scale in axil of pectoral. End of maxilla visible when mouth is closed. Colour gray above, silvery below. Numerous black spots on pectorals which give a black appearance to its basal half. Similar spots on dorsal, caudal and anal also.

Distribution.—Red Sea and the west coast of India. This is the first record from the Andaman and Nicobar group of Islands.

16. *Mugil cunnesius* Valenciennes

1836. *Mugil cunnesius* Valenciennes, *Hist. nat. Poiss.*, : **11**, 114.
 1876. *Mugil speigleri* Day, *Fish. India* : 348, pl. 74, fig. 1.
 1876. *Mugil cunnesius* : Day, *Fish. India* : 349, pl. 74, fig. 3.
 1961. *Mugil cunnesius* : Sarojini, *J. Bombay nat. Hist. Soc.*, **59** (2) : 563.

4 exs., 62-82 mm., Jutalee river, 15.iv. 1966.

D. IV+1.8 ; A. III, 9 ; V. I.5 ; P. 15 ; L I. 32-34.

Height of body 3.0-3.6 ; length of head 3.1-3.6 ; both in standard length. Eye diameter 3.6 in head length. Head length less than height of body. Symphysial knob double. Lower jaw with single row of teeth, none on upper. Pectorals with elongate axillary scale ; dark spot at axil. Adipose lid present.

Distribution.—Red Sea, India, the East Indies, the Philippines and Queensland. This is the first record from the Andaman and Nicobar group of Islands.

17. *Mugil macrolepis* Smith

1849. *Mugil macrolepis* Smith, *Illust. S. Africa Zool., Pisces*, **4** : pl. 28, fig. 2.
 1876. *Mugil poicilus* Day, *Fish. India* : 351, pl. 75, fig. 4.
 1876. *Mugil borneensis* Day, *Fish. India* : 357, pl. 76, fig. 1.
 1961. *Mugil macrolepis* : Sarojini, *J. Bombay nat. Hist. Soc.*, **59** (2) : 551.

9 exs., 66-85 mm., Casurina Bay, 5.iv. 1966 ; 1 ex., 80 mm., Campbell Bay, 12.iii. 1966 ; 4 exs., 74-88 mm., Appial Bay, 8.iv. 1966 ; 3 exs., 85-98 mm., Shampen village, Dogma river, 10.iv. 1966.

Distribution.—From South Africa to China, Japan and the Society Islands.

18. **Mugil melinoptera** Valenciennes

1836. *Mugil melinopterus* Valenciennes, *Hist. nat. Poiss.*, **11** : 146.

2 exs., 60-100 mm., Casurina Bay, 5.iv. 1966 ; 1 ex., 70 mm., Shampen village, Dogma river ; 10.iv. 1966.

Distribution.—From the Andamans to Samoa.

19. **Mugil vaigiensis** Quoy & Gaimard

1825. *Mugil vaigiensis* Quoy & Gaimard, *Voy. Uranie, Zoologie* : 337, pl. 59, fig. 2.

1876. *Mugil vaigiensis* : Day, *Fish. India* : 359, pl. 73, fig. 4.

1961. *Mugil vaigiensis* : Sarojini, *J. Bombay nat. Hist. Soc.*, **59** (2) : 561.

1 ex., 58 mm., Campbell Bay, 3.iii. 1966.

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

Family 2. ATHERINIDAE

20. **Allanetta forskali** (Rüppell)

1835. *Atherina forskalii* Rüppell, *Neue Wirbelth., Fische* : 132.

1876. *Atherina forskalii* : Day, *Fish. India* : 345, pl. 71, fig. 4.

1953. *Allanetta forskali* : Schultz, *Bull. U. S. Nat. Mus.*, (202) **1** : 299.

1 ex., 95 mm., Campbell Bay, 2. iii. 1966.

Distribution.—From the Red Sea and the east coast of Africa to New Guinea.

21. **Pranesus duodecimalis** (Valenciennes)

1835. *Atherina duodecimalis* Valenciennes, *Hist. nat. Poiss.*, **10** : 458.

1876. *Atherina duodecimalis* : Day, *Fish. India* : 345.

1955. *Pranesus duodecimalis* : Munro, *Marine Freshwater Fishes Ceylon* : 95.

4 exs., 45-50 mm., Campbell Bay, 12.iii. 1966.

Distribution.—From Ceylon, the Andamans through the East Indies to the Aru Islands.

Order 10. PERCIFORMES

Family 1. AMBASSIDAE

22. **Ambassis buton** Popta

1918. *Ambassis buton* Popta, *Meded. Zool. Mus. Leiden* : 6.

2 exs., 68-77 mm., Polo-Balu, 18.iv. 1966 ; 3 exs., 32-36 mm., Great Nicobar Island, 1966.

D₁. VII, D₂. I. 9-10 ; A. III.9 ; L 1. 29-32 ; L tr. 2/1/8.

Depth of body 2.3-2.7 ; head length 2.3-2.7 ; in standard length. Eye diameter 2.9-3.0 ; interorbital distance 4.0-4.1 ; in length of head.

Maxillary reaches below anterior margin of pupil, its posterior end somewhat dilated, hind border emarginate. Chin prominent ; mouth oblique. Pointed teeth in several rows ; vomer, palatines and tongue with teeth. Preoperculum serrated in horizontal part. Dorsal separated from occiput by 14-15 scales. Caudal deeply forked. Lateral line continuous. Colour in alcohol yellowish brown ; sides of head, and lateral band on body and caudal silvery, accompanied by a bluish stripe. Membrane between second and third dorsal spine dusky, blackish distally.

Distribution.—This species has so far been reported only from Buton and New Guinea. The record of this species from the Great Nicobar Island is of interest.

23. *Ambassis commersonii* Cuvier

1828. *Ambassis commersonii* Cuvier, *Hist. nat. Poiss.*, 2 : 176, pl. 25.
 1875. *Ambassis commersonii* : Day, *Fish. India* : 52, pl. 15, fig. 3.
 1929. *Ambassis commersoni* : Weber & Beaufort, *Fishes Indo-Australian Archipelago*, 5 : 406.

1 ex., 145 mm., Polo-Balu, 18.iv. 1966.

Distribution.—From the Red Sea, east coast of Africa and eastwards to India, Thailand, the Philippines and Australia.

24. *Ambassis gymnocephalus* (Lacépède)

1802. *Lutjanus gymnocephalus* Lacépède, *Hist. nat. Poiss.*, 4 : 181, 216, pl. 23, fig. 3.
 1875. *Ambassis gymnocephalus* : Day, *Fish. India* : 54, pl. 15, fig. 6.

12 exs., 58-83 mm., Shampen village, Dogma river, 10.iv. 1966.

Distribution.—From the coasts of East Africa, India, Ceylon through the East Indies to the Philippines and China.

25. *Ambassis urotaenia* Bleeker

1852. *Ambassis urotaenia* Bleeker, *Nat. Tijdschr. Ned-Indie*, 3 : 257.
 1875. *Ambassis urotaenia* : Day, *Fish. India* : 55, pl. 15, fig. 8.

1 ex., 76 mm., Casurina Bay, 5.iv. 1966 ; 4 exs., 53-56 mm., Jutalee river, 15.iv. 1966.

Distribution.—Widespread, from South Africa to the Caroline Islands and Fiji.

Family 2. SERRANIDAE

26. *Epinephelus caeruleo-punctatus* (Bloch)

1790. *Holocentrus caeruleo-punctatus* Bloch, *Naturges. ausland. Fische*, 4 : 94, pl. 242, fig. 2.
 1875. *Serranus tumilabris* Day, *Fish. India* : 16, pl. 3, fig. 3.
 1875. *Serranus dermochirus* Day, *Fish. India* : 21.
 1931. *Epinephelus caeruleo-punctatus* : Weber & Beaufort, *Fishes Indo-Australian Archipelago*, 6 : 66.

1 ex., 55 mm., Galathea Bay, 21.iii. 1966 ; 1 ex., 76 mm., Pygmalion Point, 22.iii. 1966.

D. XI. 15-16 ; A. III,8 ; L1. 105-108 ; Predorsal scales 86-88 ; Gill rakers 9+17.

Height of body 3.5-3.7, head length 2.9 ; in total length. Interorbital space about half eye diameter. Maxillary reaches to below posterior border of eye. Head with cycloid scales, maxillary naked, body with ctenoid scales. Colour in alcohol-dark-brown, with smaller and larger chalky white spots. Maxillary groove edged with black.

Distribution.—East coast of Africa to the Philippines, Japan, Marshall and Fiji Islands. This is the first record from the Andaman and Nicobar group of Islands.

Family 3. PLESIOPIDAE

27. *Plesiops coeruleolineatus* Rüppell

1835. *Plesiops coeruleolineatus* Rüppell, *Neue Wirbelth., Fische* : 5, pl. 2, fig. 5.

1 ex., 24 mm., Pygmalion Point, 22.iii. 1966 ; 1 ex., 60 mm., Galathea Bay, 25.iii. 1966 ; 2 exs., 36-55 mm., Casurina Bay, 2.iv. 1966 ; 2 exs., 52-53 mm., Appial Bay, 14.iv. 1966.

Distribution.—From the Andamans through the East Indies, the Philippines, Japan, Australia to Fiji and Samoa Islands.

28. *Plesiops corallicola* Bleeker

1853. *Plesiops corallicola* Bleeker, *Nat. Tijdschr. Ned-Indie*, 4 : 280.

1875. *Plesiops nigricans* Day, *Fish. India* : 128, pl. 31, fig. 5.

1966. *Plesiops corallicola* : Schultz, *Bull. U. S. nat. Mus.*, (202) 3 : 163.

1 ex., 135 mm., Galathea Bay, 21.iii. 1966 ; 3 exs., 21-65 mm., Pygmalion Point, 22.iii. 1966 ; 2 exs., 120-138 mm., Galathea Bay, 25.iii. 1966 ; 1 ex., 94 mm., Casurina Bay, 6.iv. 1966 ; 1 ex., 109 mm., Great Nicobar Island, 1966.

Distribution.—Widespread, from the east coast of Africa to the Andamans, the Philippines, Australia, the Gilbert, Tonga and Samoan Islands.

29. *Plesiops oxycephalus* Bleeker

1855. *Plesiops oxycephalus* Bleeker, *Nat. Tijdschr. Ned-Indie*, 8 : 320.

1 ex., 126 mm., Galathea Bay, 25.iii. 1966

D. XII. 7 ; A. III,8 ; L-1. 25.

Head length 2.7 ; depth of body 3.2 ; snout to anal fin origin 1.4 ; length of pelvics 2.7 ; in standard length. Eye diameter 3.9 in head length ; rostro-frontal line straight. Jaws equal ; maxillary reaching slightly behind eye, about twice in head. Preoperculum rounded, with 7 oblique series of scales. Posterior lateral line beginning in front of a vertical through anal fin origin. Pectorals rounded,

equal post-orbital part of head. Lower rays of pectoral branched into silky filaments. Pelvics origin before origin of pectorals, first ray reaches anal. Caudal rounded. Colour in alcohol, brownish-violet, head dotted.

Distribution.—Batu and Ambon. This is the first record from Indian Seas.

Family 4. THERAPONIDAE

30. *Therapon jarbua* (Forskål)

1775. *Sciaena jarbua* Forskål, *Descript. animal.*, 12 : 50.
1875. *Therapon jarbua* : Day, *Fish. India* : 69, pl. 18, fig. 4.

3 exs., 19-87 mm., Great Nicobar Island, 1966.

Distribution.—Tropical Indo-Pacific, ranging from east coast of Africa to Japan, Australia and Polynesia.

Family 5. SILLAGINIDAE

31. *Sillago sihama* (Forskål)

1775. *Atherina sihama* Forskål, *Descript. animal.* : 13, 70.
1876. *Sillago sihama* : Day, *Fish. India* : 265, pl. 57, fig. 3.

1 ex., 170 mm., Great Nicobar Island, 1966.

Distribution.—Red Sea and east coast of Africa to Australia, Japan and Polynesia. Günther (1860) records this species from Nepal which obviously is an error.

Family 6. CARANGIDAE

32. *Caranx sexfasciatus* Quoy & Gaimard

1824. *Caranx sexfasciatus* Quoy & Gaimard, *Voy. de l'Uranie*, : 358, pl. 65, fig. 4.
1876. *Caranx hippos* Day, *Fish. India* : 216.

1 ex., 115 mm., Campbell Bay, 2.iii. 1966 ; 1 ex., 78 mm., Campbell Bay, 3.iii. 1966 ; 1 ex., 98 mm., Campbell Bay, 12.iii. 1966.

Distribution.—All through the warmer waters of the Indian and Pacific Oceans, from Africa to Hawaii.

Family 7. LIOGNATHIDAE

33. *Gazza minuta* (Bloch)

1797. *Scomber minutus* Bloch, *Syst. Ichth.* : 110, pl. 429, fig. 2.
1876. *Gazza minuta* : Day, *Fish. India* : 244, pl. 53, fig. 1.

1 ex., 64 mm., Shampen village, Dogma river, 10.iv. 1966.

Distribution.—Widespread in the Indo-West Pacific, ranging from the Red Sea and east coast of Africa to the Philippines, Taiwan, Queensland and Polynesia.

34. *Gerres oblongus* Cuvier

1830. *Gerres oblongus* Cuvier, *Hist. nat. Poiss.*, 6 : 479.
1875. *Gerres oblongus* : Day, *Fish. India* : 98, pl. 25, fig. 2.

1 ex., 72 mm., Shampen village, Dogma river, 10.iv. 1966.

Distribution.—From east coast of Africa to India, Ceylon, the East Indies, the Philippines and Samoa.

35. *Leiognathus blochi* (Valenciennes)

1835. *Equula blochii* Valenciennes, *Hist. nat. Poiss.*, 10 : 84.
1876. *Equula blochii* : Day, *Fish. India* : 241, pl. 52, fig. 5.
1931. *Leiognathus blochi* : Weber & Beaufort, *Fishes Indo-Australian Archipelago*, 6 : 328.

2 exs., 43-48 mm., Campbell Bay, 3.iii. 1966.

D. VIII. 16 ; A. III, 14.

Depth of body 2.0-2.1 ; head length 2.7.-2.9 ; both in standard length. Eye diameter 2.0 in length of head. Dorsal profile more arched than ventral profile. Mouth protractile, horizontal. Supraorbital edge serrated, a pair of small spines at its anterior-superior angle. Teeth minute, in single row in both jaws. Chest scaly ; head without scales. Colour in alcohol-silvery below and back brownish silvery.

Distribution.—India, Borneo and the Philippines. This is the first record of this species from the Andaman and Nicobar group of Islands.

36. *Leiognathus daura* (Cuvier)

1829. *Equula daura* Cuvier, *Regne Animal*, 2 : 22.
1876. *Equula daura* : Day, *Fish. India* : 240, pl. 52, fig. 4.
1931. *Leiognathus daura* : Weber & Beaufort, *Fishes Indo-Australian Archipelago*, 6 : 332.

2 exs., 53-55 mm., Campbell Bay, 12.iii. 1966.

Distribution.—From the coast of Arabia through the East Indies to Australia and the Philippines.

37. *Leiognathus dussumieri* (Valenciennes)

1835. *Equula dussumieri* Valenciennes, *Hist. nat. Poiss.*, 10 : 77, pl. 283.
1876. *Equula dussumieri* : Day, *Fish. India* : 239, pl. 52, fig. 3.
1931. *Leiognathus dussumieri* : Weber & Beaufort, *Fishes Indo-Australian Archipelago*, 6 : 326.

1 ex., 42 mm., Campbell Bay, 3.iii. 1966.

Distribution.—Widespread in the tropical Indo-Pacific, from Madagascar, India, Ceylon to Australia and Polynesia.

38. *Leiognathus equulus* (Forskål)

1775. *Scomber equula* Forskål, *Descript. animal.* : 75.
1876. *Equula edentula* : Day, *Fish. India* : 238, pl. 52, fig. 1.

1931. *Leiognathus equulus* : Weber & Beaufort, *Fishes Indo-Australian Archipelago*, 6 : 322.

1 ex., 55 mm., Campbell Bay, 12.iii. 1966 ; 1 ex., 81 mm., Casurina Bay, 5.iv. 1966 ; 2 exs., 62-66 mm., Jutalee river, 15.iv.66 ; 1 ex., 83 mm., Polu Balu, 18.iv, 1966.

Distribution.—Widespread in the tropical Indo-Pacific, from the east coast of Africa to the Philippines, Marshall Islands and Fiji.

39. *Pertica filamentosa* (Cuvier)

1829. *Gerres filamentosus* Cuvier, *Regne Animal*, (ed. 2), 2 : 188.
1875. *Gerres filamentosus* : Day, *Fish. India* : 98, pl. 25, fig. 3.
1955. *Pertica filamentosa* : Munro, *Marine Freshwater Fishes Ceylon* : 143, fig. 411.

1 ex., 83 mm., Casurina Bay, 4.iv.1966 ; 3 exs., 66-92 mm., Jutalee river, 15.iv.66.

Distribution.—From east coast of Africa to India, Ceylon, the East Indies, the Philippines, China, Japan, Australia and Melanesia.

40. *Secutor insidiator* (Bloch)

1787. *Zeus insidiator* Bloch, *Naturges. ausland. Fische*, 3 : 41, pl. 191, figs. 2 & 3.
1876. *Equula insidiatrix* : Day, *Fish. India* : 242, pl. 51 C; fig. 5.
1955. *Secutor insidiator* : Munro, *Marine Freshwater Fishes Ceylon* : 145, pl. 27, fig. 416.

1 ex., 26 mm., Campbell Bay, 12.iii.1966.

D. VIII.16 ; A. III,14.

Compressed, depth of body 2.3, length of head 3.0 ; in standard length. Mouth small, when fully protracted forms an upward directed tube. Ventral profile more convex than dorsal. Scales minute. Teeth minute, in two rows in both jaws. Colour in alcohol back brownish silvery, more silvery below, nine vertical bands on upper part of body.

Distribution.—Widespread, from the east coast of Africa to China, the Philippines and Polynesia. This is the first record from the Andaman and Nicobar group of Islands.

Family 8. MONODACTYLIDAE

41. *Monodactylus argenteus* (Linnaeus)

1758. *Chaetodon argenteus* Linnaeus, *Syst. Nat.*, (ed. 10) 1 : 272.
1876. *Psettus argenteus* : Day, *Fish. India* : 235, pl. 51 B, fig. 5.
1936. *Monodactylus argenteus* : Weber & Beaufort, *Fishes Indo-Australian Archipelago*, 7 : 207, fig. 54.

2 exs., 65-76 mm., Jutalee river, 15.iv.1966.

Distribution.—Indo-Pacific, from east coast of Africa through the East Indies to the Philippines, China and Samoa.

Family 9. TOXOTIDAE

42. *Toxotes jaculator* (Pallas)

1766.* *Sciaena jaculatrix* Pallas, *Phil. Trans. roy. Soc., London*, 56 : 186, pl. 8, fig. 6.

1875. *Toxotes jaculator* : Day, *Fish. India* : 117.

1 ex., 110 mm., Galathea Bay, 10.iii.1966.

Distribution.—From India to New Hebrides, Australia and the Philippines.

Family 10. POMACENTRIDAE

43. *Abudefduf bengalensis* (Bloch)

1787. *Chaetodon bengalensis* Bloch, *Naturges. ausland. Fische*, 3 : 110, pl. 213, fig. 2.

1877. *Glyphidodon bengalensis* Day, *Fish. India* : 387, pl. 83, fig. 3.

1940 . *Abudefduf bengalensis* : Weber & Beaufort, *Fishes Indo-Australian Archipelago*, 8 : 403.

1 ex., 13 mm., between Cereberus and Conical Rock, 9.iii.1966 ;

1 ex., 86 mm., Casurina Bay, 2.iv.1966.

Distribution.—Indo-Pacific, from the Red Sea and Madagascar to the Andaman Islands, the Philippines, China and Japan.

44. *Abudefduf biocellatus* (Quoy & Gaimard)

1825. *Glyphisodon biocellatus* Quoy & Gaimard, *Voy. Uranie, Zoologie* 2 : 389.

1877. *Glyphidodon antjerius* Day, *Fish. India* : 387, pl. 81, figs. 4 and 5.

1940. *Abudefduf biocellatus* : Weber & Beaufort, *Fishes Indo-Australian Archipelago*, 8 : 436.

2 exs., 33-52 mm., Galathea Bay, 25.iii.1966.

Distribution.—The Indo-Pacific, from the Red Sea and east coast of Africa to the Andaman Islands, Australia, the Marshall and Tuamotu Islands, and Japan.

45. *Abudefduf cyaneus* (Quoy & Gaimard)

1824. *Glyphisodon cyaneus* Quoy & Gaimard, *Voy. Uranie, Zoologie*, 2 : 392, pl. 64, fig. 3.

1940 *Abudefduf cyaneus* : Weber & Beaufort, *Fishes Indo-Australian Archipelago*, 8 : 432.

3 exs., 43-46 mm., Casurina Bay, 2.iv.1966.

D, XIII, 12 ; A, II. 11-12 ; P, 1.17 ; Upper L1. 15-16 ; Gill rakers 6+1+13.

Depth of body 2.2-2.3 ; head length 2.8-3.2 ; in standard length. Eye diameter 2.5-3.0 ; interorbital distance 3.7-4.0 ; in length of head. Preorbital and suborbital without scales, Two transverse rows of scales on preopercle. Scales on upper part of head reaching to between eyes. Opercle with single, flat spine. Teeth uniserial and

compressed. Membranes between dorsal spines deeply incised. Caudal deeply emarginate, almost truncate. Colour in alcohol brownish yellow, vent black.

Distribution.—The East Indies, the Philippines, Riu Kiu Islands, Marianas, New Hebrides and Samoa. This is the first record of this species west of the East Indies.

46. *Abudefduf glaucus* (Cuvier)

1830 *Glyphisodon glaucus* Cuvier, *Hist. Nat. Poiss.*, 5 : 475.

1960. *Abudefduf glaucus* : Smith, *Ichthyol. Bull. Rhodes. Univ.*, 19 : 336, pl. 29 F.

25 exs., 25-80 mm., Pygmalion Point, 22.iii.1966 ; 2 exs., 36-58 mm., Galathea Bay, 25.iii.1966.

D.XIII, 12 ; A. II, 11-12 ; P, 2.16 ; Upper lateral line 16-18 ; Gill rakers 7+1+12-13.

Depth of body 2.0-2.3 ; head length 2.7-3.4 ; in standard length. Eye diameter 2.4-3.0 ; interorbital width 3.0-3.7 ; in head length. Preopercle edge smooth. Teeth in two rows, inner row of smaller teeth. Scales of interorbital region extending to anterior margin of eye ; snout and area around nostrils naked ; orbital bones and both margins of preopercle naked. Opercular spines two, small and flat. Dorsal spines subequal after fourth ; soft dorsal and anal outlines angular ; caudal slightly forked, lobes rounded. Colour in alcohol uniform light yellowish, margin of anal and vent black.

Distribution.—Over the whole Western Indian Ocean, the East Indies, the Philippines to the Marshall and Marianas Islands. This is the first record from Indian Seas.

47. *Abudefduf modestus* (Schlegel)

1839-41. *Glyphidodon modestus* Schlegel, *Nat. Gesch. Ned. Zool.*, 2 : 23, pl. 6, fig. 2.

1877. *Glyphidodon modestus* : Day, *Fish. India* : 388, pl. 81, fig. 6.

1939. *Abudefduf modestus* : Herre, *Rec. Indian Mus.*, 61 : 341.

2 exs., 34-46 mm., Great Nicobar Island, 1966.

Distribution.—India to Japan and Samoa.

48. *Abudefduf septemfasciatus* (Cuvier)

1830. *Glyphisodon septemfasciatus* Cuvier, *Hist. nat. Poiss.*, 5 : 463.

1877. *Glyphidodon septemfasciatus* : Day, *Fish. India* : 386, pl. 81, fig. 7.

1940. *Abudefduf septemfasciatus* : Weber & Beaufort, *Fishes Indo-Australian Archipelago*, 8 : 401, fig. 49.

1 ex., 20 mm., between Cereberus and Conical Rock, 9.iii.1966 ; 4 exs., 43-63 mm., Galathea Bay, 21.iii.1966 ; 1 ex, 180 mm., Great Nicobar Island, 1966.

D.XIII. 13 ; A.II, 12 ; P.ii, 16 ; Upper L1. 21-22. Gill rakers 8+1+14.

Depth of body 1.7-1.9 ; head length 2.8-3.0 ; in standard length. Eye diameter 2.7-2.9 ; interorbital width 2.9-3.1 in head length. Teeth

uniseriate. Preorbital and suborbital entire, naked ; preopercle entire, margins not scaled. Scales on head only to narrowest part of interorbital. Opercle with broad, flat, triangular spine. Soft dorsal and anal fins angular. Colour in alcohol body with seven light greyish transverse vertical bars alternating with six blackish bars of about equal width. Pectorals pale, small black spot on pectoral base at its upper insertion. The specimen measuring 20 mm. with a black saddle across dorsal part of caudal peduncle, just behind dorsal fin.

Distribution.—Widespread, from the east coast of Africa to India, East Indies, the Philippines, China, Australia, Marshall, Society and Taumotu Islands. This is first record from the Andaman and Nicobar group of Islands.

Family 11. LABRIDAE

49. *Halichoeres centriquadrus* (Lacépède)

1802. *Labrus centriquadrus* Lacépède, *Hist. nat. Poiss.*, 34 : 437, 493.
1877. *PlatyGLOSSUS hortulanus* Day, *Fish. India* : 599, pl. 85, fig. 3.
1940. *Halichoeres centriquadrus* : Weber & Beaufort, *Fishes Indo-Australian Archipelago*, 8 : 189.

1 ex., 11 mm., between Cereberus and Conical Rock, 9.iii.1966.

Distribution.—Indo-Pacific, from east coast of Africa to Taiwan, Guam, Gilbert and Society Islands.

50. *Halichoeres marginatus* Rüppell

1835. *Halichoeres marginatus* Rüppell, *Neue Wirbelth., Fische* : 16.
1877. *PlatyGLOSSUS marginatus* : Day, *Fish. India* : 398, pl. 84, fig. 5.
1940. *Halichoeres marginatus* : Weber & Beaufort, *Fishes Indo-Australian Archipelago*, 8 : 197.

1 ex., 36 mm., Pygmalion Point, 23.iii.1966 ; 3 exs, 31-44 mm., Galathea Bay, 25.iii.1966.

Distribution.—From the Red Sea to the Philippines and Society Islands.

51. *Labroides dimidiatus* (Valenciennes)

1839. *Cossyphus dimidiatus* Valenciennes, *Hist. nat. Poiss.*, 13: 136, & 139.
1877. *Labroides dimidiatus* : Day, *Fish. India* : 393, pl. 87, fig. 1.

1 ex., 17 mm., Casurina Bay, 2. iv. 1966.

Distribution.—From the Red Sea, Mauritius to the Philippines, Hawaii and Samoa.

52. *Thalassoma purpureum* (Forskål)

1775. *Scarus purpureus* Forskål, *Descript. animal.*, : x, 27.
1877. *Julius purpurea* : Day, *Fish. India* : 404, pl. 86, fig. 3.
1960. *Thalassoma purpureum* Schultz, *Bull. U. S. natn. Mus.*, (202) 2 : 197, pl. 100D.

1 ex., 230 mm., Great Nicobar Island, 1966.

Distribution.—From the east coast of Africa, Red Sea through India to Hawaii and Panmotu Islands.

Family 12. SCARIDAE

53. *Xanothon oktodon* (Bleeker)

1861. *Pseudoscarus oktodon* Bleeker, *Versl. Akad. Amsterdam*, **12** : 235.

1956. *Xanothon oktodon* : Smith, *Ichthyol. Bull. Rhodes Univ.*, **1** : 7, pl. 41, fig. K.

1 ex., 400 mm., Great Nicobar Island, 1966.

D. IX,10 ; A. III,9 ; P. 2,12 ; Ll. 18+7 ; L tr. 2+6.

Two rows of scales on cheek, preopercle flange naked. Teeth brown red, single canine in each jaw. Nostrils minute, before eye. Interorbital width 2.5 in eye diameter. Caudal lobes slightly pointed. Colour in alcohol brown with lighter snout ; a dark blue band above upper lip continued to eye ; dorsal dark brown ; caudal brown with a vertical blue band.

Distribution.—East Africa, Seychelles, Madagascar, Zanzibar, Ceylon, the East Indies and the Philippines. This is the first record from India.

Family 13. BLENNIIDAE

54. *Enchelyurus flaviceps* Peters

1868. *Enchelyurus flaviceps* Peters, *Monatsber. Akad. Berlin* : 268.

1 ex., 38 mm., Galathea Bay, 21.iii.1966.

Distribution.—From the Andamans to the Hawaii and Society Islands.

55. *Enchelyurus kraussi* (Klunzinger)

1871. *Petroscirtes kraussi* Klunzinger, *Verh. Zool. bot. Ges. Wien*, **21** : 497.

1959. *Enchelyurus kraussi* : Smith, *Ichthyol. Bull. Rhodes Univ.*, **14** : 234.

1 ex., 33 mm., Galathea Bay, 21.iii.1966 ; 1 ex., 30 mm., Appial Bay, 14.iv.1966.

D. VIII,21 ; A. II,17-18 ; P. 13 ; V, 2.

Depth of body 4.8-5.0 ; head length 3.7-4.2 ; both in total length. Eye-diameter about 4.0 in head length. Mouth small, its corner scarcely reaching to below middle of eye. Gill openings to midpectoral base. About 30 upper and 40 lower teeth, lower canines larger. Origin of dorsal above hind border of preopercle. Dorsal higher behind, no notch. Anal rays subequal. Both vertical fins fully united with caudal, caudal rounded. Colour in alcohol brownish, underside somewhat lighter.

Distribution.—East coast of Africa, Seychelles, Red Sea and Malacca Straits. This is the first record from Indian Seas.

56. *Omobranchus zebra* (Bleeker)

1868. *Petroskirtes zebra* Bleeker, *Verl. Akad. Amrterdam*, 2 (2) : 279.
1951. *Petroscirtes (Omobranchus) zebra* : Chapman, *Fishes Indo-Australian Archipelago*, 9 : 376.

1 ex., 43 mm., Galathea Bay, 2.iii.1966.

D. XII,18 ; A. 20 ; P. 13.

Depth of body 8.8 ; head length 5.5. ; both in total length. Mouth terminal, reaching to below anterior part of eye. No tentacles on head. Gill openings small, above level of base of pectoral. Origin of dorsal above gill openings. Pelvics equal to post-orbital part of head. Caudal emarginate. No lateral line. Colour in alcohol head with five transverse vertical dark bands ; body and caudal with eight dark transverse bands. Dorsal and anal freckled with brown. A dark blotch behind eye.

Distribution.—Singapore, Sulu Islands and the Philippines. This is a new record for the Indian Seas.

Family 14. SALARIIDAE

57. *Atrosalarias fuscus* (Rüppell)

1835. *Salarias fuscus* Rüppell, *Neue Wirbelth, Fische* : 135, pl. 32, fig. 2.
1875. *Salarias fuscus* : Day, *Fish. India* : 33, pl. 70, fig. 2.
1888. *Salarias ruficaudus* Day, *Fish. India, Supplement* : 797.
1951. *Atrosalarias fuscus* : Chapman, *Fishes Indo-Australian Archipelago*, 9 : 255, fig. 44.

3 exs., 20-47 mm., Campbell Bay, 1.iii.66 ; 2 exs., 25-35 mm., between Cereberus and Conical Rock, 9.iii. 1966 ; 1 ex., 29 mm., Appial Bay, 14.iv.1966.

Distribution.—From the Red Sea, east coast of Africa through India to the Philippines, Pelew Island, Solomon Island, New Hebrides, Fiji and Tonga Islands.

58. *Entomacrodus epalzeocheilos* (Bleeker)

1859. *Salarias epalzeocheilos* Bleeker, *Nat. Tijdschr. Ned-Indie*, 19 : 343.
1876. *Salarias marmoratus* Day, *Fish. India* : 335.
1951. *Entomacrodus epalzeochilos* : Chapman, *Fishes Indo-Australian Archipelago*, 9 : 281.

1 ex., 55 mm., Campbell Bay, 1.iii.1966 ; 1 ex., 59 mm., Campbell Bay, 6.iii.1966.

Distribution.—India, the East Indies to Samoa.

59. *Istiblennius andamanensis* (Day)

1869. *Salarias andamanensis* Day, *Proc. zool. Soc. Lond.*, : 611.
1876. *Salarias andamanensis* : Day, *Fish. India* : 332.
1959. *Istiblennius andamanensis* : Smith, *Ichthyol. Bull. Rhodes Univ.*, 14 : 242, fig. 5.

1 ex., 44 mm., between Cereberus and Conical Rock, 9.iii.1966 ;
1 ex., 62 mm., Galathea Bay, 21.iii.1966 ; 10 exs., 24-67 mm.,
Pygmalion Point, 22.iii.1966.

Distribution.—East coast of Africa, Seychelles and the Andamans.

60. *Istiblennius bleekeri* (Chapman)

1876. *Salarias periophthalmus* Day, *Fish. India* : 333, pl. 69, fig. 5.
1951. *Salarias bleekeri* Chapman, *Fishes Indo-Australian Archipelago*,
9 : 338.

1 ex., 70 mm., Galathea Bay, 21.iii.1966.

Distribution.—The Andaman Islands, Sumatra and Huisman's Island.

61. *Istiblennius bilitonensis* (Bleeker)

1858. *Salarias bilitonensis* Bleeker, *Nat. Tijdschr. Ned-Indie*, 15 : 231.
1876. *Salarias bilitonensis* : Day, *Fish. India* : 334, pl. 71, fig. 1.

1 ex., 58 mm., between Cereberus and Conical Rock, 9.iii.1966.

Distribution.—From the Andamans to the East Indies.

62. *Istiblennius cyanostigma* (Bleeker)

1849. *Salarias cyanostigma* Bleeker, *Verh. Bat. Gen.*, 22 : 5, 7 & 18.
1876. *Salarias striolatus* Day, *Fish. India* : 333.
1960. *Istiblennius cyanostigma* : Schultz & Chapman, *Bull. U. S. natn. Mus.*, (202) 2 : 355, pl. 117 E.

3 exs., 40-46 mm., Pygmalion Point, 22.iii.1966.

Distribution.—The Andamans through the East Indies to the Marshall and Marianas Islands.

63. *Istiblennius dussumieri* (Valenciennes)

1836. *Salarias dussumieri* Valenciennes, *Hist. nat. Poiss.*, 11: 310.
1876. *Salarias dussumieri* : Day, *Fish. India* : 333, pl. 70, fig. 7.

1 ex., 36 mm., Appial's Bay, 14.iv.1966.

Distribution.—East coast of Africa, Seas of India to Queensland, the Marianas and Palmyra Islands.

64. *Istiblennius dayi* (Whitley)

1876. *Salarias alboguttatus* Day (*nec.* Kner), *Fish. India* : 334.
1929. *Salarias dayi* Whitley, *Rec. Austr. Mus.*, 17 : 136.

1 ex., 48 mm., Galathea Bay, 25.iii.1966.

Distribution.—The Andaman Islands.

65. *Istiblennius edentulus* (Bloch)

1801. *Blennius edentulus* Bloch, *Syst. Ichth.*, : 172.

1876. *Salarias quadricornis* Day, *Fish. India* : 331, pl. 70, fig. 4.
 1960. *Istiblennius edentulus* : Schultz & Chapman, *Bull. U. S. natn. Mus.*, (202) 2 : 353, pl. 118, A, B.

1 ex., 63 mm., Campbell Bay, 6.iii.1966 ; 1 ex., 70 mm., Galathea Bay, 25.iii.1966.

Distribution.—From the Red Sea to Madagascar, China, Hawaii, Australia and the Marquesas.

66. *Salarias fasciatus* (Bloch)

1786. *Blennius fasciatus* Bloch, *Naturges. ausland. Fische*, 2 : 110.
 1876. *Salarias fasciatus* : Day, *Fish. India* : 330.

1 ex., 51 mm., Galathea Bay, 25.iii.1966 ; 2 ex., 46-52 mm., Casurina Bay, 2.iv.1966 ; 1 ex., 58 mm., Galathea river, 1966.

Distribution.—From the Red Sea to the Samoa and Caroline Islands.

67. *Salarias fuscus* Rüppell

1835. *Salarias fuscus* Rüppell, *Neue Wirbelth., Fische* : 135, pl. 32, fig. 2.
 1876. *Salarias fuscus* : Day, *Fish. India* : 330, pl. 70, fig. 2.

3 exs., 20-47 mm., Campbell Bay, 1. iii.1966.

Distribution.—From the Red Sea through the Andaman and Nicobar Islands to the Philippines.

Family 15. CLINIDAE

68. *Tripterygion fasciatum* Weber

1913. *Tripterygion fasciatum* Weber, *Siboga Expeditn., Fische* : 548, fig. 118.

1 ex., 21 mm., between Cereberus and Conical Rock, 9.iii.1966 ;
 1 ex., 21 mm., Pygmalion Point, 23.iii.1966.

Distribution.—From the Andamans to the East Indies.

Family 16. ACANTHURIDAE

69. *Acanthurus lineatus* (Linnaeus)

1758. *Chaetodon lineatus* Linnaeus, *Syst. Nat.*, (ed. 10) : 274.
 1876. *Acanthurus lineatus* : Day, *Fish. India* : 203.

1 ex., 220 mm., Great Nicobar Island, 1966.

Distribution.—From Zanzibar to the Marquesas and Marshall Islands.

Family 17. ELEOTRIDAE

70. *Butis gymnopus* (Bleeker)

1853. *Eleotris gymnopus* Bleeker, *Nat. Tijdschr. Ned-Indie.*, 4 : 274.
 1856. *Butis gymnopus* : Bleeker, *Nat. Tijdschr. Ned-Indie.*, 12 : 215.

3 exs., 61-86 mm., Shampen village, Dogma river, 10.iv.66.

D₁. VI, D₂. 1,8 ; A. 1,8 ; P. 17 ; Ll. 30-31 ; L tr. 10 ; Predorsal scales $\pm$ 14.

Body elongate, height 5.0-5.3 ; head length 2.6-2.7 ; both in standard length. Eye 5.0-5.2 in head length ; interorbital width equals eye diameter. Lower jaw prominent ; maxillary extends to below anterior part of eye. Teeth small, in many rows, those of the outer and inner rows enlarged. Supraopercular groove distinct. Snout, interopercle and cheek naked. Head only scaled above behind eyes, opercle with ctenoid scales. No scales between eyes and orbital crest. Scales of breast and belly cycloid, of nape and laterally on body ctenoid. Caudal shorter than head. Colour in alcohol blackish, light behind.

Distribution.—India (Patani River) and Indo-Australian Archipelago. This is the first record from the Andaman and Nicobar group of Islands.

71. *Bunaka gyrinoides* (Bleeker)

1853. *Eleotris gyrinoides* Bleeker, *Nat. Tijdschr. Ned-Indie*, 4 : 272.

1876. *Eleotris canarensis* Day, *Fish. India* : 313, pl. 69, fig. 2.

1941. *Bunaka gyrinoides* : Koumans, *Mem. Indian Mus.*, 13 : 327.

18 exs., 23-74 mm., Shampen village, Dogma river, 10.iv.1966.

D₁. VI, D₂. 1.8 ; A. 1.8 ; P. 18-19 ; Ll. 58-61 ; L tr. 16-17 ; Predorsal scales $\pm$ 40.

Body anteriorly cylindrical, posteriorly compressed, height 5.1-6.0 ; head length 2.5-2.7 ; both in standard length. Eye diameter 5.0-5.2 in head length, interorbital width more than one eye diameter. Lower jaw little prominent ; maxillary extends to below posterior half of eye. Teeth equal, small. Supraocular groove distinct. Scales of body ctenoid ; cheek and opercle scaled, cycloid. Caudal obtusely rounded, shorter than head. Colour in alcohol dark brownish above, lighter below. Each scale with a dark spot. A dark longitudinal stripe from snout to eye.

Distribution.—India, Ceylon, Indo-Australian Archipelago, Admiralty Island and Pelew Island. This is the first record from the Andaman and Nicobar group of Islands.

72. *Bostrichthys sinensis* (Lacépède)

1801. *Bostrychus sinensis* Lacépède, *Hist. nat. Poiss.*, 5 : 183.

1876. *Bostrichthys sinensis* : Day, *Fish. India* : 309, pl. 65, fig. 4.

2 exs., 17-21 mm., between Cereberus and Conical Rock, 9.iii.1966 ; 2 exs., 16-20 mm., Galathea Bay, 21.iii.1966 ; 5 exs., 16-18 mm., Pygmalion Point, 22.iii.1966 ; 1 ex., 16 mm., Casurina Bay, 2.iv.1966.

Distribution.—From the Andamans through the East Indies to the Pacific.

73. *Eleotris andamensis* Herre

1939. *Eleotris andamensis* Herre, *Rec. Indian. Mus.*, 41 : 344.

1 ex., 29 mm., Shampen village, Dogma river, 1966.

Distribution.—The Andamans Islands.

74. *Eleotris fusca* (Schneider)

1801. *Poecilia fusca* Schneider, *Syst. Ichth* : 453.

1876. *Eleotris cavifrons* Day, *Fish. India* : 313, pl. 65, fig. 6.

1876. *Eleotris fusca* : Day, *Fish. India* : 313, pl. 65, fig. 7.

6 exs., 39-85 mm., Shampen village, Dogma river, 1966.

Distribution.—Red Sea and east coast of Africa to the Pacific.

75. *Hypseleotris güntheri* (Bleeker)

1875. *Asterropteryx güntheri* Bleeker, *Arch. neerl. Sc. ex. et. nat.*, 10 : 112.

1953. *Hypseleotris güntheri* : Koumans, *Fishes Indo-Australian Archipelago*, 10 : 326, fig. 80.

1 ex., 43 mm., Great Nicobar Island, 1966.

D₁. VI, D₂. I.9 ; A. I.9 ; P.14 ; L l. 28 ; L tr. 8 ; Predorsal scales 15. Body compressed, height 4.4, head length 3.3; both in standard length. Body profile straight. Eye diameter 3.6 in head length ; interorbital width slightly less than eye diameter. Snout pointed, shorter than eye, tip before middle of eye. Lower jaw prominent ; mouth narrow. Maxillary does not reach eye. Head totally scaled. except anteriorly on snout. Colour in alcohol yellowish. A black band from opercle to lower part of base of caudal fin, ending in a dark blotch. Rays of second dorsal and caudal fin spotted. Pectoral fin with dark spot at upper part of base. First dorsal fin with dark longitudinal band halfway.

Distribution.—This is the first record of the genus *Hypseleotris* Gill from Indian Seas. *H. güntheri* was known only from the East Indies to the Fiji Islands, Samoa and New Caledonia.

76. *Ophiocara aporos* (Bleeker)

1854. *Eleotris aporos* Bleeker, *Nat. Tijdschr. Ned-Indie*, 6 : 54.

1876. *Eleotris opiocephalus* Day, *Fish. India* : 312, pl. 62, fig. 2.

1888. *Eleotris tumifrons* Day, *Fish. India, Suppl.* : 795.

1953. *Ophiocara aporos* : Koumans, *Fishes Indo-Australian Archipelago*, 10 : 346, fig. 84.

8 exs., 59-125 mm., Shampen village, Dogma river, 10.iv.1966 ;
227 exs., 28-87 mm., freshwater pools, Great Nicobar Islands, 1966.

Distribution.—From Madagascar to India, through the East Indies to the Philippines, Kusaie, Fiji and Queensland.

Family 18. KRAEMERIIDAE

77. *Kraemicus smithi* sp. n.

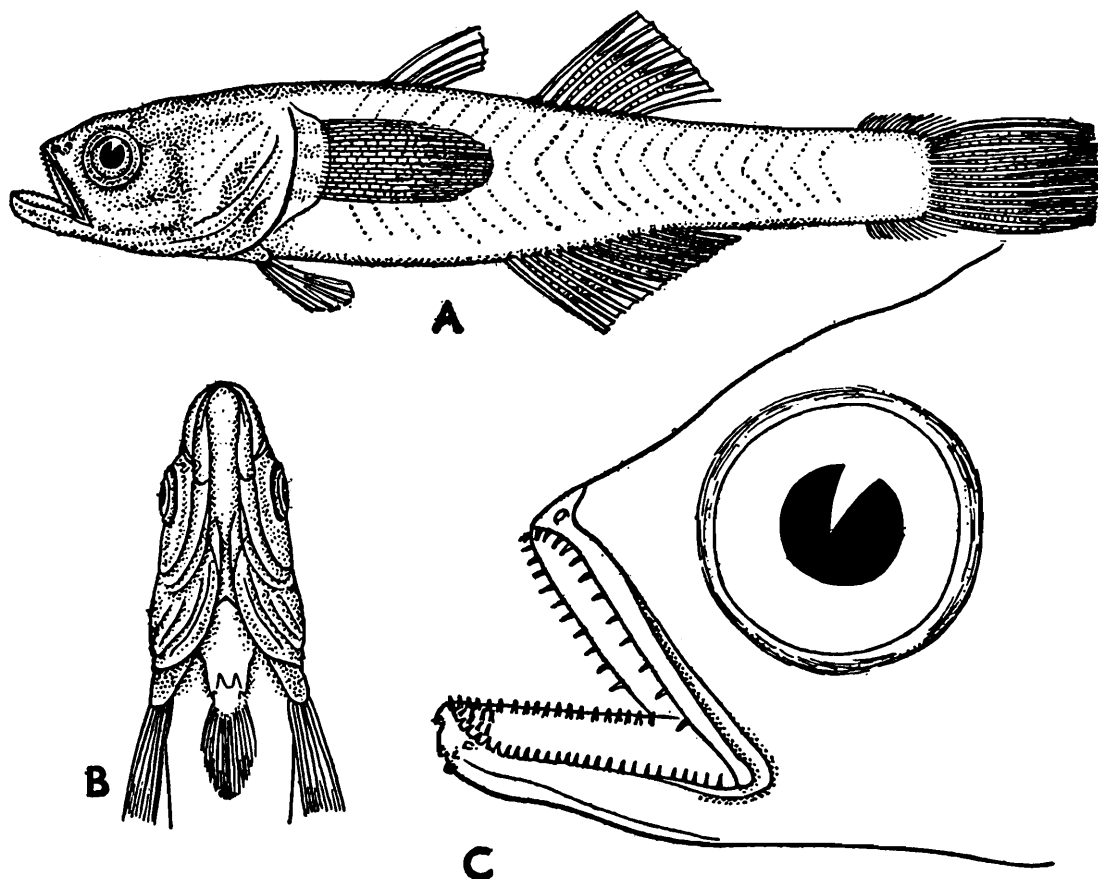
(Text-fig. 1 a, b & c)

Holotype.—26.0 mm., total length ; ♀ mature ; Shampen village, Dogma river, Great Nicobar Island ; 10.iv.1966 ; Coll. Dr. A. Daniel ; Zoological Survey of India Reg. No. 5522/2.

Paratypes.—14 examples, 11 ♂♂ and 3 ♀♀; mature; 13.5-20.0 mm., standard length; other details as for the holotype.
Reg. No. 5523/2.

Description.—D₁. V, D₂. I.7; A. I.12; P. 16; V. I. 4; C. 15.

Depth of body 5.0-6.1; head length 2.8-3.2; pectoral fin length 3.8-4.0; pelvic fin length 6.0-6.2, tip of snout to dorsal origin 2.2-2.5, all in standard length. Eye diameter 3.0-3.6; interorbital width 4.0-4.5; both in head length.



TEXT-FIG. 1. *Kraemerius smithi* sp. nov. X 6. A. Lateral view of holotype. B. Ventral view of head (diagrammatic). C. Lateral view of head showing teeth (diagrammatic).

Body elongate, naked, moderately compressed. The head relatively large, eyes large, lateral. Lower jaw notably projecting in front of snout, entering dorsal profile. Mouth moderate with single row of sharp minute teeth in upper jaw and two rows in lower jaw; no canines. Palatines and tongue edentate. Tongue bilobed, free. Maxillary oblique in position, vertical line through hind edge passing slightly in front of pupil; premaxillary not protractile. Gill rakers obsolete. Two pairs of nasal openings, one dorsally in front of eye, other next to upper lip. Anal fin origin slightly in front of base of second dorsal. Dorsal and anal rays divided, the last dorsal ray deeply forked. Pelvic insertion under base of pectorals; pelvics separate, fraenum distinct, not forming cup like disc. Caudal truncate, shorter than head. No lateral line. Air bladder present.

A stained and cleared specimen has revealed the following : Vertebrae 23 (7+16); 4 branchiostegal rays.

Colour in alcohol.—light brownish, pigment spots scattered on fins; eyes black.

This new species is named in honour of Prof. J.L.B. Smith, Department of Ichthyology, Rhodes University, Grahamston, who confirmed the identity of the species.

The new species may be distinguished from the other known species of *Kraemericus* Schultz, 1966 by the following key.

1. Dorsal V-15; body scaled....*K. chapmani* Schultz, 1966.

2. Dorsal V-1.7; body naked....*K. smithi* sp. n.

Ecology.—These gobioids were collected from a creek of the Dogma river from clear shallow water by disturbing the bottom mud. The area of collection is probably within the area of tidal influence.

Family 19. GOBIIDAE

78. *Acentrogobius reichei* (Bleeker)

1853. *Gobius reichei* Bleeker, *Nat. Tijdschr. Ned-Indie*, 5 : 509.

1876. *Gobius neilli* Day, *Fish. India* : 290, pl. 112, fig. 4.

1941. *Acentrogobius reichei* : Koumans, *Mem. Indian. Mus.*, 13 (pt. 3) : 232.

8 exs., 20-33 mm., between Cereberus and Conical Rock, 9.iii.1966; 5 exs., 23-45 mm., Pygmalion Point, 23.iii.1966; 1 ex, 31 mm., Great Nicobar Island, 1966.

Distribution.—South-east Africa, India to the Philippines.

79. *Bathygobius fuscus* (Rüppell)

1828. *Gobius fuscus* Rüppell, *Atl. Reise N. Afr. Fische* : 137.

1876. *Gobius elegans* Day, *Fish. India* : 293.

1876. *Gobius albo-punctatus*, Day, *Fish. India* : 294, pl. 63, fig. 7.

1941. *Bathygobius fuscus* : Koumans, *Mem. Indian. Mus.*, 13 : 267.

2 exs., 32-45 mm., between Cereberus and Conical Rock, 9.iii.1966; 1 ex, 45 mm., Galathea Bay, 21.iii.1966; 2 exs. 41-63 mm., Pygmalion Point, 23.iii.1966; 1 ex., 34 mm., Casurina Bay, 2.iv.1966; 2 exs., 35-48 mm., Great Nicobar Island, 1966.

Distribution.—From South Africa and Red Sea to Pacific America.

80. *Callogobius hasseltii* (Bleeker)

1851. *Eleotris hasseltii* Bleeker, *Nat. Tijdschr. Ned-Indie*, 1 : 253.

1941. *Callogobius hasseltii* : Koumans, *Mem. Indian Mus.*, 13 : 236.

10 exs., 28-30 mm., between Cereberus and Conical Rock, 9.iii.1966; 1 ex., 68 mm., Galathea River, 27.iii.1966; 1 ex., 63 mm., Casurina Bay, 2.iv.1966.

Distribution.—From India to the East Indies, Australia and Japan.

81. *Ctenogobius criniger* (Valenciennes)

1837. *Gobius criniger* Valenciennes, *Hist. nat. Poiss.*, **12** : 82.
 1876. *Gobius criniger* : Day, *Fish. India* : 288, pl. 62, fig. 2.
 1941. *Ctenogobius criniger* : Koumans, *Mem. Indian Mus.*, **13** : 265.

5 exs., 20-68 mm., Pygmalion Point, 22.iii.1966.

Distribution.—Widespread, from the east coast of Africa to the Philippines.

✕ 82. *Ctenogobius grammogaster* Bleeker

1875. *Ctenogobius grammogaster* Bleeker, *Arch. neerl. Sc. ex. et. nat.*, **10** : 124.

6 exs., 28-44 mm., Pygmalion Point, 22.iii.1966 ; 1 ex., 20 mm., Great Nicobar Island, 1966.

D₁. VI, D₂. I.11 ; A. I.9 ; P. 16 ; Ll. 29 ; L tr. 8.

Body elongate, height 4.1-4.5 ; head length 3.1-3.3 ; both in standard length. Body profile convex. Eye diameter 3.1 in length of head, interorbital width less than 1/3 eye-diameter. Mouth little oblique ; maxillary extends to below anterior part of pupil. Teeth in several rows. Nape naked ; breast with minute cycloid scales ; body scales ctenoid. Pectoral fin obtuse, slightly shorter than head. Ventrals pointed. Caudal obtuse, as long as head. Colour in alcohol greenish. A circular dusky band through eyes and the interorbital space. Eight transverse streaks along the sides of body. Caudal with transverse rows of dusky dots.

Distribution.—East Indies. This is the first record of this species from Indian waters.

83. *Pipidonia arenarius* (Snyder)

1908. *Heteroleotris arenarius* Snyder, *Proc. U. S. natn. Mus.*, **35** : 100.
 1941. *Pipidonia arenarius* : Koumans, *Mem. Indian Mus.*, **13** : 247.

1 ex., 23 mm., between Cereberus and Conical Rock, 9.iii.1966.

Distribution.—The Andamans, Thailand and Japan.

84. *Stigmatogobius römeri* (Weber)

1911. *Gobius römeri* Weber, *Abh. Senckenb. Naturf. Ges.*, **34** : 39, fig. 8.
 1953. *Stigmatogobius römeri* : Koumans, *Fishes Indo-Australian Archipelago*, **10** : 113, fig. 26.

1 ex., 30 mm., Shampen village, Dogma river, 1966.

Distribution.—The Andamans, the Philippines, Pelew Islands, Fiji and Australia.

85. *Quisquilius eugenius* Jordan & Evermann

1902. *Quisquilius eugenius* Jordan and Evermann, *Bull. U. S. Fish. Comm.*, **22** : 203.
 1941. *Quisquilius eugenius* : Koumans, *Men. Indian Mus.*, **13** : 248.

1 ex., 36 mm., Shampen village, Dogma river, 1966.

D₁. VI, D₂. I.10; A. I. 10. P. 18; L1.30; L tr. 10; Predorsal scales 15. Body elongate, compressed, height 4.6 in standard length. Head length 3.5 in standard length. Eye diameter 3.2 in head length. Maxillary extends to below posterior margin of pupil. Teeth in many rows, outer row enlarged. Gill openings continued forward below, isthmus narrow. Scales of body ctenoid, on nape ctenoid and on breast cycloid; head scaled above behind eyes. Caudal oblong, shorter than head. Ventrals united. Colour in alcohol yellowish, body with eight transverse bands on body.

Distribution.—India, Indo-Australian Archipelago and Hawaiian Islands. This is the first record from the Andaman and Nicobar group of Islands.

86. *Zonogobius semidoliatus* (Valenciennes)

1837. *Gobius semidoliatus* Valenciennes, *Hist. nat. Poiss.*, 12 : 67.

1876. *Gobius semidoliatus* : Day, *Fish. India* : 295, pl. 59, fig. 6.

1941. *Zonogobius semidoliatus* : Koumans, *Mem. Indian Mus.*, 13 : 250.

2 exs., 14-17 mm., between Cereberus and Conical Rock, 9.iii.1966; 1 ex., 27 mm., Pygmalion Point, 22.iii.1966; 1 ex., 23 mm., Galathea Bay, 25.iii.1966.

Distribution.—Widespread, Red Sea to the Pacific.

Family 20. PERIOPHTHALMIDAE

87. *Periophthalmus koelreuteri* (Pallas)

1770. *Gobius koelreuteri* Pallas, *Spicilegia Zool.*, 8 : 8, pl. 2, figs. 1-3.

1876. *Periophthalmus koelreuteri* : Day, *Fish. India* : 303, pl. 64, fig. 8.

2 exs., 70-125 mm., Alexandra river, 13.iv.1966.

Distribution.—Widespread, from East Africa to Samoa.

88. *Periophthalmus variabilis* Eggert

1935. *Periophthalmus variabilis* Eggert, *Zool. Jahrb. (Syst.)*, 66 : 63, pl. 3, fig. 13, and pl. 4, figs. 14 & 15.

1 ex., 52 mm., Campbell Bay, 3.iii.1966.

D₁. IX, D₂. I.12; A. I.12; P. 11; L1. 62; Predorsal scales 25.

Body elongate, anteriorly cylindrical, posteriorly compressed, height 7.4; length of head 5.2; both in total length. Teeth in upper jaw anteriorly two caninoid teeth; in lower jaw on each side two caninoid teeth. Ventrals not totally united; basal membrane absent. Caudal obtuse, about as long as head.

Distribution.—India, Thailand, Java and Sumatra. This is the first record from the Andaman and Nicobar group of Islands.

Family 21. PLATYCEPHALIDAE

89. *Platycephalus indicus* (Linnaeus)

1751. *Callionymus indicus* Linnaeus *Syst. Nat.* (ed. 10) : 250.

1876. *Platycephalus insidiator* Day, *Fish. India* : 276.
 1962. *Platycephalus indicus* : Beaufort & Briggs, *Fishes Indo-Australian Archipelago*, 11 : 131.

1 ex., 205 mm., Alexandra river, 13.iv.1966.

Distribution.—Widespread, east coast of Africa, Red Sea through the East Indies to New Guinea, Queensland and Japan.

Order 11. TETRADONTIFORMES

Family 1. TETRADONTIDAE

90. *Tetraodon fluviatilis* Hamilton

1822. *Tetraodon fluviatilis* Hamilton, *Fish. Ganges* : 16 & 362, pl. 30, fig. 1.
 1878. *Tetrodon fluviatilis* : Day, *Fish. India* : 707, pl. 183, fig. 1.
 1962. *Tetraodon fluviatilis* : Beaufort & Briggs, *Fishes Indo-Australian Archipelago*, 11 : 395.

1 ex., 47 mm., Galathea river, 27.iii.1966.

Distribution.—From India to the East Indies and the Philippines.

91. *Tetraodon immaculatus* Schneider

1801. *Tetraodon immaculatus* Schneider, *Syst. Ichth* : 507.
 1878. *Tetrodon immaculatus* : Day, *Fish. India* : 703, pl. 183, fig. 4.
 1962. *Tetraodon immaculatus* : Beaufort & Briggs, *Fishes Indo-Australian Archipelago*, 11 : 405.

1 ex., 114 mm., Great Nicobar Island, 14.iii.1966.

Distribution.—From the Red Sea and the east coast Africa to the Marshall Islands, Samoa and Australia.

92. *Tetraodon reticularis* Schneider

1801. *Tetrodon reticularis* Schneider, *Syst. Ichth.*, : 506.
 1878. *Tetrodon reticularis* : Day, *Fish. India* : 705, pl. 180, fig. 5.
 1962. *Tetraodon reticularis* : Beaufort & Briggs, *Fishes Indo-Australian Archipelago*, 11 : 401.

1 ex., 114 mm., Campbell Bay, 3.iii.1966.

Distribution.—India, East Indies, the Philippines, Fiji Islands and Australia.

Family 2. BALISTIDAE

93. *Balistapus undulatus* (Mungo Park)

1797. *Balistes undulatus* Mungo Park, *Trans. Linn. Soc. Lond.*, 3 : 37.
 1878. *Balistes undulatus* : Day, *Fish. India* : 691, pl. 177, fig. 4.
 1962. *Balistapus undulatus* : Beaufort & Briggs, *Fishes Indo-Australian Archipelago*, 11 : 297.

2 exs., 220 mm., Casurina Bay, 6.iv.1966.

Distribution.—From the Red Sea and east cost of Africa to Tahiti, and north to the Caroline Islands, China and Japan.

III—ACKNOWLEDGEMENT

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IV—SUMMARY

The fish collections of the Great Nicobar Expedition, 1966 contain 93 species belonging to 61 genera and 35 families of which eleven species are new records from the Indian Seas while twelve species are recorded for the first time from the Andaman and Nicobar group of Islands. A new species of the genus *Kraemicus* Schultz, belonging to the family Kraemeriidae, discovered in the collections, is described in this paper.

V—REFERENCES

- ALCOCK, A. W. 1899. *A descriptive catalogue of the Indian deep-sea fishes in the Indian Museum collected by the Royal Indian marine survey ship "Investigator"* Trustees of the Indian Museum, 200 pp.
- ANNANDALE, N. & HORA S. L. 1925. The freshwater fishes from the Andaman Islands. *Rec. Indian Mus*, 27 : 33-41.
- DAY, F. 1870. On the fishes of the Andaman Islands. *Proc. zool. Soc. Lond.*, : 677-705.
- DAY, F. 1878. *The Fishes of India*. Williams and Norgate, London. 778 pp.
- GÜNIHER, A. 1860. *Catalogue of the Acanthopterygian fishes in the collection of the British Museum*. London, 2 : xxii + 548
- HERRE, A. W. C. T. 1939. On a collection of littoral and freshwater fishes from the Andaman Islands. *Rec. Indian Mus.*, 41 : 327-372.
- HERRE, A. W. C. T. 1941. A list of the fishes known from the Andaman Islands. *Mem. Indian Mus.*, 13 (3) : 351-403.
- JONES, S., SILAS, E. G. & DAWSON, E. 1960. New records of Scombroid fishes from the Andaman-Nicobar Waters. *J. Mar. biol. Ass. India*, 2 (1) : 136-137.
- JONES, S. & SILAS, E. G. 1962. Mackerel from the Andaman Sea. *Sym. Scombroid Fishes. Mar. biol. Ass. India* (pt. 1) : 1-28 :
- KOUMANS, F. P. 1941. Gobioid fishes of India. *Mem. Indian Mus.*, 13 (3) : 205-329.
- LUTHER, G. 1966. On the occurrence of *Steinegeria rubescens* Jordan and Evermann (Bramidae : Pisces) in the Indian Ocean. *J. Mar. biol. Ass. India*, 8 (2) : 354-356.
- MISRA, K. S. 1947. A check list of the fishes of India Burma & Ceylon. Part 1. Elasmobranchii and Holocephali. *Rec. Indian Mus.*, 45 : 1-46.

- MUKERJI, D. D. 1935. Notes on some rare and interesting fishes from the Andaman Islands, with descriptions of two new freshwater gobies. *Rec. Indian Mus.*, **37** : 250-279.
- RAO, H. S. & HORA, S. L. 1938. On the ecology, bionomics and systematics of the blennid fishes of the genus *Andamia* Blyth. *Rec. Indian Mus.*, **40** : 377-401.
- SCHULTZ, L. P., HERALD, E. S., LACHNER, E. A., WELANDER, A. D., & WOODS, L. P. 1966. Fishes of the Marshall and Marianas Islands. *Bull. U. S. natn. Mus.*, 202 (3) : 1-165.
- SILAS, E. G. & TOOR, H. S. 1961. On some new records of pig-face brems (family Lethrinidae : Pisces) from the Andaman Sea. *J. Mar. biol. Ass. India*, **3** (1 & 2), : 208-214.
- SILAS, E. G. & TOOR, H. S. 1962. *Lethrinella conchyliatus* Smith (Lethrinidae : Pisces), a new record for Indian Seas. *J. Mar. biol. Ass. India*, **4** (1 & 2) : 243-245.
- YAZDANI, G. M. 1963. On a new record of a blennid fish, *Petrosirites rochi* M. Weber, from Andamans. *Curr. Sci.*, **32** (4) : 413.

DIPTERA FROM NEFA AND ASSAM FOOT HILLS.
PART 1. KAMENG FRONTIER DIVISION AND
ASSAM FOOT HILLS

By

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(With 1 Text-figure)

I—INTRODUCTION

The Zoological Survey of India in collaboration with the Defence Research and Development Organisation (Ministry of Defence, Government of India), Field Laboratory, Tezpur, carried out a faunistic survey of insects of medical and veterinary importance and other allied fauna of Kameng Frontier Division of NEFA and Assam Foot Hills during December 1965 to January 1966. It is the first in the series of joint surveys to cover the whole NEFA. The object of the survey is to study the insects and other allied fauna which are deleterious to the defence personnel stationed there. Side by side with these forms a general faunistic survey was also conducted. The present paper deals with the collections of Diptera made during this survey. The collections were made by Dr. S. K. Bhattacharyya and the senior author.

The whole terrain is rough, densely forested with narrow approaches and has mostly undifferentiated forest and hill soils. The population is sparsely represented at higher altitude than at foot hills. The highest point touched was Tse La which is at an altitude of 4740 metres. The timber line roughly reaches 4300 metres with a sparse vegetation above 4000 metres. Snow cover is seen above 4000 metres onwards. The forest is typically mountainous type full of pines in the Subansiri Frontier Division ; whereas Assam Foot Hills is covered by dense tropical forests. The average rainfall in this area varies from 300 to 400 cms. The temperature varies from 25° to -3°C.

The area covered is a most strategic one so far as the defence of our country is concerned. The Kameng Frontier Division includes Bhalukpung, Tenga Valley, Bomdila, Tse La and Tawang.

II—SYSTEMATIC ACCOUNT

Family TIPULIDAE

1. *Nephrotoma dorsopunctata* (Brunetti)

1911. *Pachyrhina dorsopunctata* Brunetti, *Rec. Indian Mus.*, 6 : 265.

1961. *Nephrotoma dorsopunctata* (Brunetti) : Alexander, *Rec. Indian Mus.*, 59 (1 & 2) : 23.

Material.—1 ex., Assam, Sonai Rupai Forest, 79 m., Missamari, 29. xi. 65.

Remarks.—Comparatively small, the fork of the upper branch of the fourth longitudinal vein forming a short petiole, which is an important difference from the type. Since there is only one example, it is retained for the time being in the same species.

This species is earlier reported from Mangaldai district, Assam-Bhutan Frontier ; Katihar, Bhogaon (Purnea district), Pusa, and Madhupur, Bihar ; base of Western Himalaya ; also from Ceylon.

2. *Antocha (Antocha) indica* Brunetti

1912. *Antocha indica* Brunetti, *Fauna Brit. India*, Diptera, Nematocera : 426–427, pl. 8, fig. 12.

1961. *Antocha (Antocha) indica* : Alexander, *Rec. Indian Mus.*, 59 (1 & 2) : 27

Material.—1 ex., NEFA, Kameng Division, Tenga River Side, 1524 m., 19. xii. 65.

Remarks.—Damaged.

Recorded previously from Mangaldai district, Assam-Bhutan Frontier ; Kurseong and Simla Hills.

Family BIBIONIDAE

3. *Bibio obscuripennis* Meijere

1904. *Bibio obscuripennis* Meijere, *Bijdr. Dierk.*, 17 : 86.

1912. *Bibio obscuripennis* : Brunetti, *Fauna Brit. India*, Diptera, Nematocera : 170.

Material.—(i) 4 exs., Kameng Division, Tawang Camp, 3200 m., 15.xii.65. (ii) 1 ex., Kameng Division, Rupa Camp, 3657 m., 20.xii.65.

Remarks.—The extreme anterior corners of the dorsum black, not red as described in the Fauna.

Recorded from Kurseong ; Natiyam, Simla district ; also from Nepal (Chitlong) and on the N. E. Burmese Frontier (Mount Tahepum).

4. *Bibio fuscitibia* Brunetti

1911. *Bibio fuscitibia* Brunetti, *Rec. Indian Mus.*, 4 : 279.

1912. *Bibio fuscitibia* : Brunetti, *Fauna Brit. India*, Diptera, Nematocera : 175.

Material.—3 exs., Kameng Division, Dukhampani, Bomdila, 2621 m., 5.xii.65.

Remarks.—Originally described from 2 specimens, one from Darjeeling and another from Phakia, Kumaon.

5. *Dilophus gratiosus* Bigot

1890. *Dilophus gratiosus* Bigot, *J. Asiat. Soc. Beng.*, 59 : 265.

1912. *Dilophus gratiosus* : Brunetti, *Fauna Brit. India*, Diptera, Nematocera : 178.

Material.—1 ex., Kameng Division, Tenga Valley, 1524 m., 21.xii.65.

Remarks.—Scutellar region rather dark instead of “bright brownish yellow.”

This has been reported from Kurseong, Darjeeling ; Amargarh, Bijnor district, Uttar Pradesh ; and also from Sadan, Upper Burma.

Family CULICIDAE

6. *Culex fatigans* Wiedemann

1828. *Culex (Culex) fatigans* Wiedemann, *Aussereurop. Zweifl. Ins.*, 1 : 10.

1934. *Culex (Culex) fatigans* : Barraud, *Fauna Brit. India*, Diptera, Culicidae, 5 : 420.

Material.—(i) 5 exs., Assam, Missamari, Officers' Mess, 79 m., 1. xii. 65. (ii) 1 ex., Rangapara fish market, 80 m., 1.xii.65.

Remarks.—Scales fallen in most of the specimens. All are females.

A domestic mosquito being common in tropics and sub-tropics of both new and old worlds. Occurs up to 1524 m., or more in the hills. It is concerned with the transmission of filariasis in man.

Family MYCETOPHILIDAE

7. *Sciara nigripennis* Brunetti

1912. *Sciara nigripennis* Brunetti, *Fauna Brit. India*, Diptera, Nematocera : 131.

Material.—33 exs., Kameng Division, Dukhampani, Bomdila, 2621 m., 5.xii.65.

Remarks.—Earlier reported from Kurseong, Darjeeling ; Manipur ; Bhimtal, Kumaon ; also from Pashoka, Sikkim ; and Palipola, Ceylon.

Family SIMULIIDAE

8. *Simulium indicum* Becher

1884. *Simulium indicum* Becher, *J. Asiat. Soc. Beng.*, 53 : 199.

1912. *Simulium indicum* : Brunetti, *Fauna Brit. India*, Diptera, Nematocera : 191.

Material.—(i) 17 exs., Kameng Division, Elephant Flat, Bhalukpung, 213.3 m., 23.xi.65. (ii) 1 ex., Kameng Division, Pinjuli Minor Camp, 213.3 m., 24.xii.65.

Remarks.—Recorded from the following places : Khasi Hills, Assam ; Manipur ; Kurseong, Darjeeling ; Simla, Western Himalayas ; and also from Sylhet, Bangladesh.

Family TABANIDAE

9. *Tabanus (Therioplectes) hirtus* Walker

1850. *Tabanus hirtus* Walker, *Ins. Saund.*, 1 : 52.

1911. *Tabanus (Therioplectes) hirtus* : Ricardo, *Rec. Indian Mus.*, 4 : 228.

Material.—1 ex., Kameng Division, Tawang Camp, 3200 m., 13.xii.65.

Remarks.—The frontal callus indistinct.

This species has earlier been reported from Simla Hills and Naini Tal, Himalaya.

Family EMPIDAE

10. *Elaphropeza variegata* Brunetti

1913. *Elaphropeza variegata* Brunetti, *Rec. Indian Mus.*, 9 : 42.

1920. *Elaphropeza variegata* : Brunetti, *Fauna Brit. India*, Diptera, 1 : 387.

Material.—(i) 8 exs., Assam, Sonai Rupai Forest, 79 m., 28.xi.65. (ii) 1 ex., Assam, Missamari, grassy fields, 79 m., 1.xii.65. (iii) 2 exs., Kameng Division, Charduar, 79 m., 1,27, & 28.xii.65. (iv) 263 exs., Assam, Jamugiri, Balipara, 79 m., 29.xii.65.

Remarks.—In 10 exs. colour of venter of abdomen varies from pale yellow to black. 267 exs. damaged. They differ from the typical forms in the stumpy abdomen and brownish tibiae.

Reported from Dibrugarh, Assam; Darjeeling; Dumdum, Calcutta; Paresnath, Bihar; Khurdah Road and Puri, Orissa.

Family SYRPHIDAE

11. *Paragus indicus* (Brunetti)

1908. *Pipizella indica* Brunetti, *Rec. Indian Mus.*, 2 : 52.

1923. *Paragus indicus* : Brunetti, *Fauna Brit. India*, Diptera, 3 : 33.

Material.—1 ex., Kameng Division, Charduar, 79 m., 28.xii.65.

Remarks.—Comparatively small and less hairy.

Reported from Darjeeling; Chapra, Bihar; Travancore, and Simla. Also recorded from Kathmandu, Nepal.

12. *Asarcina ericetorum* (Fabricius)

1781. *Syrphus ericetorum* Fabricius, *Spec. Ins.* 2 : 425.

1923. *Asarcina ericetorum* : Brunetti, *Fauna Brit. India*, Diptera, 3 : 63.

Material.—(i) 2 exs., Assam, Sonai Rupai Forest, 79 m., 2 & 29.xii.65.

Remarks.—This species shows much variation in abdominal colouration.

Brunetti (1923) mentions about its wide distribution in India and the East and of its occurrence all round the year.

13. *Asarcina aegrota* (Fabricius)

1805. *Eristalis aegrota* Fabricius, *Syst. Antl.* : 243.

1923. *Asarcina aegrota* : Brunetti, *Fauna Brit. India*, Diptera, 3 : 64.

Material.—1 ex., Assam, Sonai Rupai Forest, 79 m., 28.xi.65.

Remarks.—Reported to be a widely distributed species in India at almost all seasons of the year.

14. *Lasioticus seleniticus* (Meigen)

1822. *Syrphus seleniticus* Meigen, *Syst. Besch.*, 3 : 304.

1923. *Lasioticus seleniticus* : Brunetti, *Fauna Brit. India*, Diptera, 3 : 67.

Material.—(i) 2 exs., Kameng Division, Dukhampani, Bomdila, 2621 m., 5.xii.65 & 1 ex., 6.xii.65. (ii) 2 exs., Kameng Division, Tenga River Bed, 1524 m., 8.xii.65.

Remarks.—A common European species, previously recorded in Khasi Hills, Assam ; Simla and Dehra Dun.

15. *Syrphus serarius* Wiedemann

1830. *Syrphus serarius* Wiedemann, *Aussereurop. Zweifl. Ins.*, 2 : 128.

1923. *Syrphus serarius* : Brunetti, *Fauna Brit. India*, Diptera, 3 : 73.

Material.—(i) 1 ex., Assam, Sonai Rupai Forest, 79 m., 28.xi.65. (ii) 1 ex., Kameng Division, Pinjuli Minor Camp, 213.3 m., 24.xi.65.

Remarks.—This is a very widely distributed species. So far it has been recorded from Mangaldai, Assam-Bhutan border ; Khasi Hills and Shillong, Assam ; Darjeeling ; Chapra, Bihar ; Mussoorie, Kumaon and Almora, Uttar Pradesh ; and also from Soondrijal, Nepal ; Java and Japan.

16. *Syrphus balteatus* (De Geer)

1776. *Musca balteata* De Geer, *Mem. Insectes*, 6 : 116.

1923. *Syrphus balteatus* : Brunetti, *Fauna Brit. India*, Diptera, 3 : 82.

Material.—(i) 2 exs., Assam, Sonai Rupai Forest, Missamari, 79 m., 29.xi.65. (ii) 2 exs., Assam, Missamari, 79 m., 1.xii.65. (iii) 1 ex., Assam, Sonai Rupai Forest, 79 m., 2.xii.65. (iv) 2 exs., Kameng Division, Pinjuli Minor, 213.3 m., 24.xii.65. (v) 2 exs., Kameng Division, Charduar, 79 m., 28.xii.65.

Remarks.—In one example, the abdominal marking is indistinct. Its range of distribution includes all Europe, Madeira, Canaries, N. Africa and Asia to Japan.

17. *Syrphus corollae* (Fabricius)

1794. *Scaeva corollae* Fabricius, *Ent. Syst.*, 4 : 306.

1923. *Syrphus corollae* : Brunetti, *Fauna Brit. India*, Diptera, 3 : 85.

Material.—(i) 1 ex., Kameng Division, Dukhampani, Bomdila, 2621 m., 5.xii.65. (ii) 2 exs., Kameng Division, Tenga River Bed, 1524 m., 18.xii.65. (iii) 2 exs., Kameng Division, Rupa Camp, 3657 m., 20.xii.65.

Remarks.—In typical cases the hind tibiae two thirds black in both sexes, where as in the specimens at hand, it is wholly darker in males and orange in females.

Reported from a wide range of regions, Europe, Madeira and Canaries, N. Africa, and Asia to Japan. Brunetti (1923) doubtfully presumes its distribution in N. America also.

18. *Syrphus confrater* Wiedemann

1830. *Syrphus confrater* Wiedemann, *Aussereurop. Zweifl. Ins.*, 2 : 120.
1923. *Syrphus confrater* : Brunetti, *Fauna Brit. India*, Diptera, 3 : 92.

Material.—1 ex., Kameng Division, Pinjuli Minor Camp, 213.3 m., 24.xii.65.

Remarks.—The sides of the dorsum of thorax with dark pubescence instead of whitish.

Originally described from N. Guinea and is reported from India, Sumatra and China.

19. *Eristalis tenax* (Linnaeus)

1758. *Musca tenax* Linnaeus, *Syst. Nat.*, Ed. 10 : 591.
1923. *Eristalis tenax* : Brunetti, *Fauna Brit. India*, Diptera, 3 : 173.

Material.—(i) 1 ex., Kameng Division, Circuit House, Bomdila, 2621 m., 4.xii.65. (ii) 8 exs., Dukhampani, Bomdila, 2621 m., 5.xii.65. (iii) 4 exs., Tenga River Bed, 1524 m., 18.xii.65.

Remarks.—It is the most cosmopolitan of all the species of Syrphidae occurring in both the hills and plains. Recorded from India, Ceylon, Burma, Malay Peninsula and Japan.

20. *Eristalis taeniops* Wiedemann

1818. *Eristalis taeniops* Wiedemann, *Zool. Mag.*, 1 : 2.
1923. *Eristalis taeniops* : Brunetti, *Fauna Brit. India*, Diptera, 3 : 186.

Material.—1 ex., Pinjuli Minor Camp, 213.3 m., 24.xii.65.

Remarks.—In the second abdominal segment of male, the extension of the dark colour from the hind border joins the broad anterior border unlike that of typical case. In the third segment the dark colour of the anterior border extends to the lateral sides and not restricted to the middle as described in the Fauna.

Originally described from a male from Peshin and a female from Quetta. Recorded later from India the Canary Islands through Abyssinia to Khartorum, Rhodesia, the Transvaal and Natal. Also common around the shores of Mediterranean and recorded from Asia Minor and Arabia.

21. *Eristalis quinquestriatus* (Fabricius)

1805. *Syrphus quinquestriatus* Fabricius, *Ent. Syst.*, 4 : 289.
1923. *Eristalis quinquestriatus* : Brunetti, *Fauna Brit. India*, Diptera, 3 : 187.

Material.—1 ex., Assam, Addaborie Tea Estate, Balipara, 79 m., 10.xii.65.

Remarks.—Face black, not with yellowish grey to mentum as described in the Fauna. Abdomen dark, the second and third with their yellow stripes indistinct.

This is a widely distributed species, having been reported from Mangaldai, Assam-Bhutan Frontier ; Sukna, Darjeeling ; Madhupur, Bihar ; Cheria Islands, Chilka Lake, Orissa ; Bangalore ; Jabalpur ; Kousamie, Kumaon ; and from Katmandu, Nepal ; and Sibolga, Sumatra.

Family SEPSIDAE

22. *Sepsis indica* Wiedemann

1830. *Sepsis indica* Wiedemann, *Aussereurop. Zweifl. Ins.*, 2 : 467.

1909. *Sepsis indica* : Brunetti, *Rec. Indian Mus.*, 3 : 357.

Material.—1 ex., Assam, Sonai Rupai Forest, 79 m., 29.xi.65.

Remarks.—Mid and hind legs damaged. Thorax with a broad black stripe occupying the greater part of dorsum and of uniform width only with the rows of bristles, extending anteriorly from the dorsocentrals.

Recorded from Sadiya, Assam ; Rajmahal ; Calcutta ; Maddathorai and Pallode, South India ; and also from Rungpo, Sikkim.

23. *Sepsis rufa* Macquart

1850. *Sepsis rufa* Macquart, *Dipt. Exot. Supp.*, 4 : 269.

1909. *Sepsis rufa* : Brunetti, *Rec. Indian Mus.*, 3 : 359.

Material.—1 ex., Assam, Sonai Rupai Forest, 79 m., 29.xii.65.

Remarks.—Reported from Shillong ; Kurseong, Darjeeling ; Calcutta ; Pusa, Bihar ; Puri, Orissa ; Simla ; also from Tharbani, Nepal ; and Mandalay, Burma.

Family PIPUNCULIDAE

24. *Pipunculus biroï* Kertész

1903. *Pipunculus biroï* Kertész, *Ann. Hist. nat. Mus. Hung.*, 1 : 466.

1923. *Pipunculus biroï* : Brunetti, *Fauna Brit. India*, Diptera, 3 : 9.

Material.—(i) 1 ex., Kameng Division, Charduar Forest, 79 m., 29.xii.65. (ii) 1 ex., Assam, Jamugiri, 79 m., 29.xii.65.

Remarks.—1 ex. damaged.

Type described from Ceylon. Recorded further from Darjeeling, Port Canning and Calcutta, West Bengal ; U.P. ; Paresnath, Bhagalpur and Pusa, Bihar ; and also from Rangoon, Burma.

25. *Pipunculus major* Brunetti

1923. *Pipunculus major* Brunetti, *Fauna Brit. India*, Diptera, 3 : 10.

Material.—(i) 1 ex., Assam, Sonai Rupai Forest, 79 m., 28.xi.65. (ii) 1 ex., Kameng Division, Charduar Forest, 79 m., 27.xii.65. (iii) 1 ex., Assam, Tezpur, 26 LAA Mess, 79 m., 29.xi.65.

Remarks.—The specimen bearing the Register No. 4065/H6, has the fore and hind tarsi uniformly brown, instead of black apically. This is a new addition to ZSI collections. Originally described from Pusa, Bihar. There is no further record of this species till now.

Family TEPHRITIDAE

26. *Bactrocera caudata* (Fabricius)

1805. *Dacus caudata* Fabricius, *Syst. Antl.*, 16 : 276.

1913. *Bactrocera caudata* : Bezzi, *Mem. Indian Mus.*, 3 (3) : 97.

Material.—1 ex., Assam, Tezpur, 79 m., 1.i.66.

Remarks.—Originally described from Java. Reported later from Calcutta and Kurseong, West Bengal ; Shillong, Assam ; Dehra Dun and Bhowali, Uttar Pradesh ; also from Tenasserim, Burma ; and Formosa.

Family CHLOROPIDAE

27. *Anatrichus erinaceus* Loew

1860. *Anatrichus erinaceus* Loew, *Ofers. Vet. Akad. Forh.*, 13 : 97.

1910. *Anatrichus erinaceus* : Becker, *Ann. Hist. nat. Mus. Hung.*, 8 : 382.

Material.—8 exs., Assam, Jamugiri, Balipara, 79 m., 29.xii.65.

Remarks.—In Zoological Survey of India Collections this species is represented from the following places ; Calcutta ; Puri and Chilka Lake, Orissa ; Port Blair ; and Mandalay, Burma.

Family MUSCIDAE

28. *Musca (Musca) domestica vicina* Macquart

1851. *Musca vicina* Macquart, *Mem. Soc. Sc. Agric. Lille*, : 226.

1965. *Musca (Musca) domestica vicina* : Emden, *Fauna India*, Diptera, 7 (1) : 55.

Material.—(i) 8 exs., Kameng Division, Dukhampani, Bomdila, 2621 m., 5.xii.65. and 12 exs., 6.xii.65. (ii) 1 ex., Kameng Division, Tenga River Bed, 1524 m., 19.xii.65. (iii) 1 ex., Kameng Division, Rupa Camp, 3657 m., 20.xii.65. (iv) 1 ex., Kameng Division, Charduar, 79 m., 28.xii.65.

Remarks.—Its distribution is world-wide in tropical and sub-tropical belt. Very common in the whole Oriental Region : Baluchistan and Kashmir to Ceylon and Burma and eastward to the Fiji Islands.

29. *Musca (Musca) domestica nebulo* Fabricius

1784. *Musca nebulo* Fabricius, *Ent. Syst.*, 4 : 321.

1965. *Musca (Musca) domestica nebulo* : Emden, *Fauna India*, Diptera, 7 (1) : 55.

Material.—(i) 1 ex., Kameng Division, Missamari, Officers' Mess, 79 m., 1.xii.65. (ii) 1 ex., Kameng Division, Dukhampani, Bomdila, 2625 m., 6.xii.65. (iii) 1 ex., Kameng Division, Tenga River Bed, 1524 m., 18.xii.65.

Remarks.—Common in India and Ceylon. Recorded also from Egypt, Yemen, Palestine and Malaya.

30. *Musca (Byomyia) ventrosa* Wiedemann

1830. *Musca ventrosa* Wiedemann, *Aussereurop. Zweifl. Ins.* 2 : 256.
1965. *Musca (Byomyia) ventrosa* : Emden, *Fauna India*, Diptera, 7 (1) : 60.

Material.—(i) 1 ex., Assam, Sonai Rupai Forest, 79 m., 29.xi.65. (ii) 2 exs., Kameng Division, Dukhampani, Bomdila, 2621m., 6.xii.65.

Remarks.—Widely distributed in the Ethiopian and Oriental Regions : from West and East Africa, India, Ceylon, Burma, Malaya to Formosa. Also reported from Celebes and N. Queensland.

31. *Musca (Byomyia) sorbens* Wiedemann

1830. *Musca sorbens* Wiedemann, *Aussereurop. Zweifl. Ins.*, 2 : 418.
1965. *Musca (Byomyia) sorbens* : Emden, *Fauna India*, Diptera, 7 (1) : 61.

Material.—(i) 1 ex., Assam, Sonai Rupai Forest, 79 m., 30.xi.65. (ii) 6 exs., Kameng Division, Charduar, 79 m., 28.xii.65. (iii) 2 exs., Assam, Tezpur, 79 m., 31.xii.65 & 1.i.66.

Remarks.—Distributed throughout the Ethiopian, Oriental and Australian Regions.

32. *Musca (Byomyia) pattoni* Austen

1910. *Musca pattoni* Austen, *Ann. Mag. nat. Hist.*, (8) 5 : 114.
1965. *Musca (Byomyia) pattoni* : Emden, *Fauna India*, Diptera, 7 (1) : 64.

Material.—1 ex., Kameng Division, Jamugiri, Balipara, 79 m., 29.xii.65.

Remarks.—Facets of eyes on dorsal side, a little enlarged. Reported from Assam, Uttar Pradesh to S. India and Ceylon.

33. *Musca (Philaematomyia) crassirostris* Stein

1903. *Musca crassirostris* Stein, *Mitt. Zool. Mus. Berlin*, 2 : 99.
1965. *Musca (Philaematomyia) crassirostris* : Emden, *Fauna India*, Diptera, 7 (1) : 71.

Material.—26 exs., Assam, Sonai Rupai Forest, 79 m., 30.xi.65, 30.xi.65 & 2.xii.65.

Remarks.—This is a very widely distributed species having been earlier reported from Eastern Mediterranean, Socotra, Sudan, Belgian Congo, S. Rhodesia and Transvaal and the whole of the Oriental Region. In India it is reported from Pusa, Bihar ; Gauhati, Assam and Coimbatore, Tamil Nadu.

34. *Musca (Eumusca) lusoria* Wiedemann

1824. *Musca lusoria* Wiedemann, *Analecta ent.* : 47.

1965. *Musca (Eumusca) lusoria* : Emden, *Fauna India*, Diptera, 7 (1) : 79.

Material.—1 ex., Assam, Sonai Rupai Forest, Missamari, 79 m., 30.xi.65.

Remarks.—Recorded from the Eastern part of Ethiopian Region. In Oriental Region from Central and North India ; Ceylon and Burma.

35. *Musca (Viviparomusca) bakeri illingworthi* Patton

1923. *Musca illingworthi* Patton, *Phillip. J. Sci.*, 23 : 323.

1965. *Musca (Viviparomusca) bakeri illingworthi* : Emden, *Fauna India*, Diptera, 7 (1) : 84.

Material.—1 ex., Kameng Division, Charduar, 79 m., 27.xii.65.

Remarks.—New to ZSI collections.

Reported from Western China, Malaya and Indonesia (upto Lombok and Celebes).

36. *Musca (Viviparomusca) gibsoni* Patton & Cragg

1913. *Musca gibsoni* Patton & Cragg, *Ind. J. med. Res.*, 1 : 14.

1965. *Musca (Viviparomusca) gibsoni* : Emden, *Fauna India*, Diptera, 7 (1) : 86.

Material.—(i) 8 exs., Assam, Sonai Rupai Forest, 79 m., 30.xi.65, 2.xii.65. (ii) 1 ex., Assam, Jamugiri, Balipara, 79 m., 29.xii.65.

Remarks.—Recorded from Assam ; Darjeeling ; Calcutta ; Nilgiri Hills and Palni Hills, S. India ; and also from Ceylon, Burma, Malaya and Formosa.

37. *Dasyphora cyanicolor kempi* Emden

1965. *Dasyphora cyanicolor kempi* Emden, *Fauna India*, Diptera, 7 (1) : 144.

Material.—9 exs., Kameng Division, Tawang Camp, 3200 m., 13.xii.65.

Remarks.—New to ZSI collections, though reported in *Fauna* as represented in ZSI collections, the species is not traceable.

Recorded from Gulmarg, Kashmir ; Simla Hills, Himachal Pradesh ; Darjeeling, W. Bengal ; and from several localities in Assam.

38. *Stomoxys calcitrans* (Linnaeus)

1758. *Conops calcitrans* Linnaeus, *Syst. Nat.* (ed. 10) : 604.

1965. *Stomoxys calcitrans* : Emden, *Fauna India*, Diptera, 7 (1) : 160.

Material.—3 exs., Assam, Sonai Rupai Forest, 79 m., 29.xii.65 & 30.xi.65.

Remarks.—Its distribution is world-wide including all parts of the Oriental Region.

39. *Lyperosia* (*Lyperosia*) *exigua* (de Meijere)

1903. *Haematobia exigua* de Meijere, *Meded. proefst. Oost.-Java*, (3), No. 44 : 17.
 1965. *Lyperosia* (*Lyperosia*) *exigua* : Emden, *Fauna India*, Diptera, 7 (1) : 176.

Material.—(i) 37 exs., Assam, Sonai Rupai Forest, 79 m., 30.xi.65, & 2.xii.65. (ii) 16 exs., Assam, Jamugiri, 79 m., 29.xii.65.

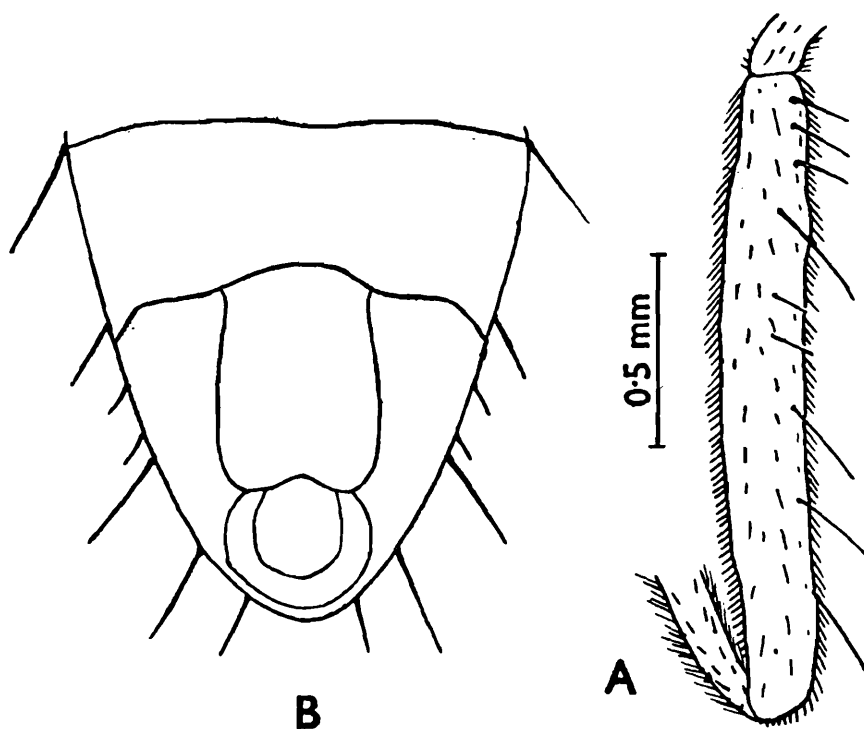
Remarks.—Widely distributed in Australian and Oriental Regions.

40. *Limnophora* (*Limnophora*) *conica* Stein

1915. *Limnophora conica* Stein, *Suppl. ent.*, : 30, 38.
 1965. *Limnophora* (*Limnophora*) *conica* : Emden, *Fauna India*, Diptera, 7 (1) : 602.

Material.—2 exs., Assam, Sonai Rupai Forest, 79 m., 28.xi.65.

Remarks.—This species is characterised by an oblique row of a bristles (Text-fig. 1A) on the hind femur and the fourth ventrite being well exposed with a broad incision (Text-fig. 1B). New to India and ZSI collections. Known to occur in Formosa, Java, Malaya, N. E. Burma and Thailand.



TEXT-FIG. 1. *Limnophora* (*Limnophora*) *conica* Stein. A. The hind femur showing the oblique row of bristles. B. Ventral view of hind end of male abdomen.

Family CALLIPHORIDAE

41. *Chrysomya megacephala* (Fabricius)

1784. *Musca megacephala* Fabricius, *Syst. Ent.*, 4 : 317.

1940. *Chrysomya megacephala* : Senior-White, Aubertin & Smart, *Fauna Brit. India*, Diptera, 6 : 138.

Material.—2 exs., Assam, Missamari, Officers' Mess, 79 m., 1.xii.65.

Remarks.—Very common in Oriental and Australian Regions.

42. *Chrysomya rufifacies* (Macquart)

1842. *Lucilia rufifacies* Macquart, *Mem. Soc. Roy. Sci. Arts Lille* Annee :-303.

1940. *Chrysomya rufifacies* (Macquart) : Senior-White, Aubertin and Smart, *Fauna Brit. India*, Diptera, 6 : 141.

Material.—1 ex., Assam, Sonai Rupai Forest, 79 m., 28.xi.65.

Remarks.—Very common all over the Oriental and Australian Regions.

III—ACKNOWLEDGEMENTS

The authors express their deep gratitude to Dr. A. P. Kapur, Director, Zoological Survey of India, Calcutta, for permitting to work out the material and going through the manuscript. Thanks are also due to Shri K. S. Pradhan, Superintending Zoologist, Zoological Survey of India, Calcutta, for the help he has rendered during the course of the preparation of this paper.

IV—SUMMARY

The present paper deals with 551 examples of Diptera from NEFA and Assam Foot Hills. It comprises 42 species belonging to 14 families. Of these, 3 species of Muscidae, i.e., *Musca (Viviparomusca) bakeri illingworthi* Patton, *Dasyphora cyanicolor kempfi* Emden and *Limnophora (Limnophora) conica* Stein, are new to ZSI collections, the last one being also new to India.

V—REFERENCE

BRUNETTI, E. 1923. *The Fauna of British India, including Ceylon and Burma. Diptera, Pipunculidae, Syrphidae, Conopidae and Oesiridae*. 3. xi + 424 pp., 85 figs., 6 pls.—London (Taylor & Francis).

NOTES ON A COLLECTION OF ENDOMYCHIDAE
(INSECTA : COLEOPTERA) FROM NEFA WITH
DESCRIPTION OF A NEW SPECIES

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(With 1 Text-figure)

I—INTRODUCTION

During the course of a general faunistic survey of the NEFA region, conducted by the Zoological Survey of India, our colleagues Dr. K. C. Jayaram and Shri S. Biswas, made a small collection of this interesting family. It consists of five species belonging to four genera. One of these species is considered to represent a hitherto unknown species and is described below. Systematic notes are given for the remaining species.

We are thankful to Dr. A. P. Kapur, Director, Zoological Survey of India, for facilities to work on these collections.

II—SYSTEMATIC ACCOUNT

Family ENDOMYCHIDAE

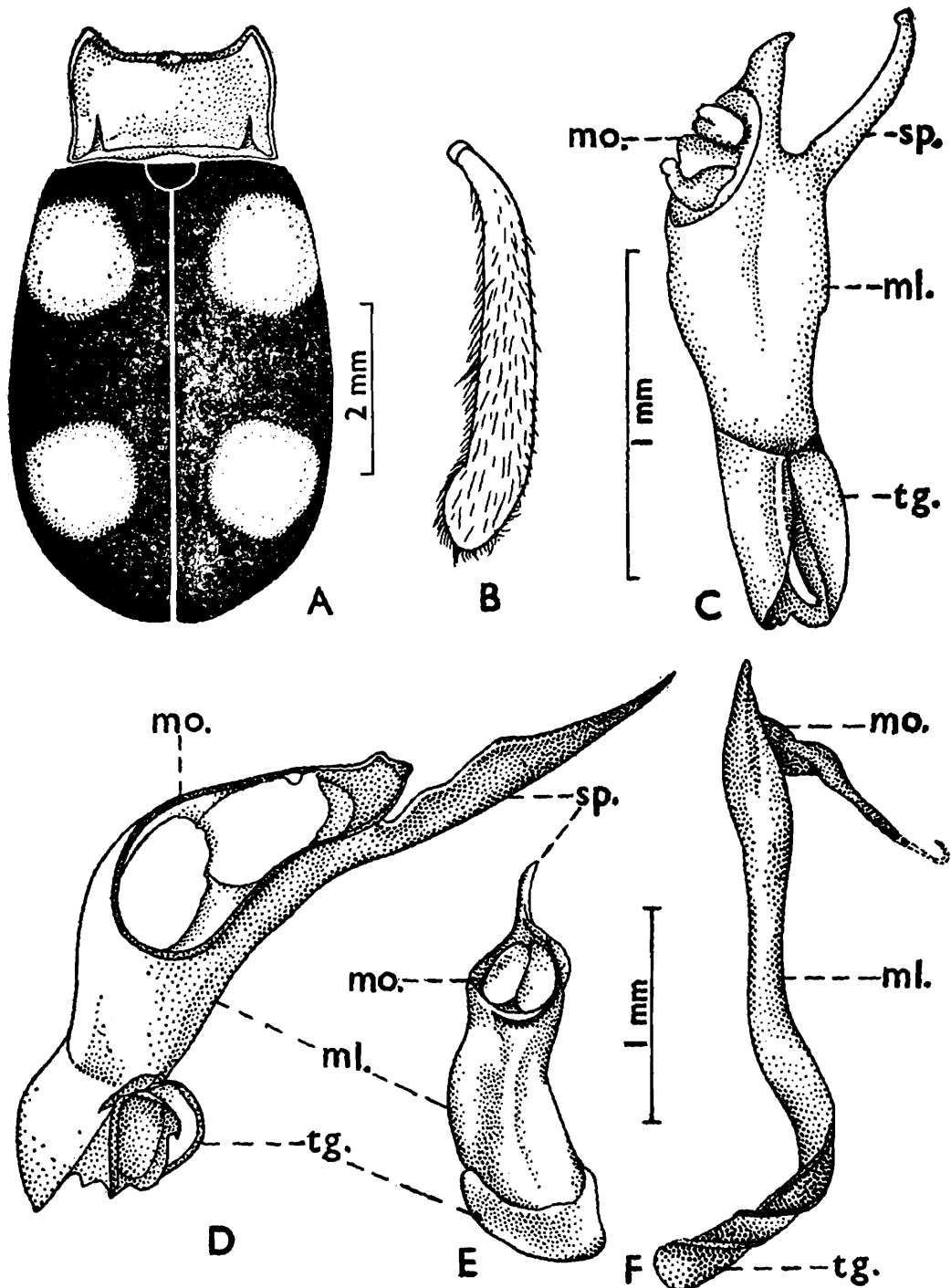
1. *Eumorphus quadriguttatus* (Illiger)-
(Text-fig. 1 D)

1800. *Erotylus quadriguttatus* Illiger, in Wiedemann's, *Archiv. F. Zool.*,
1 (2), : 124.
1925. *Eumorphus quadriguttatus* : Arrow, *Fauna of British India, Coleo-
ptera, Clavicornia* : 305.

Material examined.—INDIA : N.E.F.A. Kameng Frontier Division:
10 exs., Rupa, 1676 m,—iii.1961; 3 exs., Bitselling Vill., 915 m, 14.iii.
1961; 3 exs., Duplako Bank, 1676 m., 1.iv. 1961; 2 exs., Amatulla,
233 m., 9.iii.1961; 2 exs., Dirong Dzong road, 6 km. west to Rahung,
2134 m., 9.iv:1961 (All K.C.J. Coll.).

Remarks.—In certain minor characters of variable nature, the above examples differ from the description of the species given by Arrow (1925) who has stated that each elytron has two large, pale yellow, nearly round or slightly transverse spots, about equal in diameter to the interval between each horizontal pair. The interval in the present specimens is about 1.5 times of the diameter of the spot. In the case of pronotum, the channel along the middle of posterior

half is not distinct. In males, the hairy pad is confined to the median part of the last two or three abdominal sternites. The other specimens in Zoological Survey of India, from the same region, also agree with the present observations.



TEXT-FIG. 1. A. Dorsal view of the pronotum and elytra of *Engonius kamengensis* sp. n. (Holotype). B. Middle tibia of male of *Engonius kamengensis* (Paratype). C. Lateral view of aedeagus of *Engonius kamengensis* (Paratype). D. Lateral view of aedeagus of *Eumorphus quadriguttatus* (Illiger). E. Dorsal view of aedeagus of *Ancylopus melanocephalus* (Olivier). F. Lateral view of aedeagus of *Eucteanus cruciger* Gorham. ml.—median lobe (penis), mo.—median orifice, sp.—spine, tg.—tegmen.

All the above examples conform to the var. *pulchripes* Gerst., in the character of femora being bright coral-red except in the basal half. Arrow (*l.c.*) has observed a series of specimens from S. India (Sidapur, Coorg) comprising about equal numbers of typical form and those belonging to var. *pulchripes* and he has also seen a collection from Sikkim representing both these forms, but throughout the Malayan region the red-legged form is evidently rare, if not absent, and in Ceylon that variety alone is found. It shows that a separate name is not justified because both forms are available in the same geographical area.

The male genitalia (Text-fig. 1 D) are figured here for the first time. On the ventral face projects a large, narrow rather irregularly shaped spine, the median orifice is closed by the protruding internal sac and the tegmen, at the base, is ill defined.

2. *Engonius kamengensis* sp. n. (Text-fig. 1 A-C)

Material.—Holotype : ♂ INDIA : N.E.F.A. Kameng Frontier Division, Bokhar, 27.v.1961. Paratype : 1 ♀, 1 ♀ Chug, Kameng Frontier Division (All K.C.J. Coll.).

Description.—Body black, moderately large, rather narrow, strongly convex and clothed with very minute grey pubescence. Length : 7.0—7.6 mm. (7.6 mm. Holotype). 3.6 mm. Breadth : 3.1—3.6 mm. Holotype).

Head.—Black, longer than wide ; punctation moderately strong, rather irregular, on the vertex separated by about its own diameter.

Pronotum.—Less strongly punctate than the head, punctation almost similar and as close as on the head but closer to the sides ; transverse, about twice as broad as long ; sides narrowly but distinctly margined ; anterior angles sub-acute and blunt ; posterior angles acute, a little prominent but blunt ; each side with a small median, submarginal tubercle ; with a median transverse groove along the base, extending upwards sublaterally upto the $\frac{1}{4}$ of pronotal length ; without a median groove.

Scutellum.—Semicircular, punctation very close, rather coarse.

Elytra.—Black, each elytron with two transverse orange patches, the anterior one just behind the shoulder reaching the outer but not the inner margin, slightly obliquely placed and the posterior one not reaching either margin and more rounded in shape than the anterior one ; punctation larger and denser than on the head and pronotum, more or less regular, on the disc coalescent but not confluent.

Ventral side.—Almost black including legs, with ferruginous tinge here and there ; finely pubescent ; prosternal process narrow, sides almost parallel, apex a little rounded, but without any distinct knob ; metasternum minutely and sparingly punctate ; abdominal sternites moderately punctate, punctures progressively denser/closer and more regular from the 1st to the apical sternite, apical abdominal sternite slightly notched at the apex.

Male.—Anterior tibiae, bearing an oblique tooth on the inner edge just after the middle and the middle tibiae (Text-fig. B) only a little bent at the base and slightly incurved at the apex but almost straight in the middle portion and without any teeth.

Male genitalia.—(Paratype—Text-fig.C) Penis (median lobe) an irregularly shaped strongly chitinated tube with two spines projecting from the apex, smaller one nearer the median orifice (mo) and the other larger and more slender in shape; the median orifice being closed by the folding over of a part of the protruding internal sac; the tegmen consisting of a single undefined piece and the basal internal sac armature not distinct.

Relationship.—This species comes nearer to *Engonius pubescens* Arrow, in the upper surface being pubescent and in the absence of median groove on the pronotum but it differs from it in (i) more or less rounded shape of the elytral orange patches as against the irregular shape of these patches (ii) punctation on pronotum not so close (iii) basal groove on the pronotum not angulate in the middle (iv) prosternal process not knobbed at the apex versus knobbed at the apex, (v) metasternum impunctate versus finely punctate (vi) third segment of antenna not as long as the fourth and fifth segments together versus third segment of antenna as long as the fourth and fifth segments together, (vii) the middle tibiae in male not bearing any angular internal flange a little beyond the base versus an angular internal flange present a little beyond the base.

3. *Engonius signifer* Gorham

1875. *Engonius signifer* Gorham, *Trans. ent. Soc.* : 311.

1925. *Engonius signifer* : Arrow, *Fauna of British India, Coleoptera, Clavicornia* : 316.

Material examined.—INDIA : N.E.F.A, Kameng Frontier Division : 1 ex., Rupa, 1676 m. 1.vi.1961; 1 ex., Dengza village, 1234 m., 15.iii.1961 (All K.C.J. Coll.)

Remarks.—It is known in India from Assam, Manipur and Punjab and from Burma. Both the above examples are female.

4. *Ancylopus melanocephalus* (Olivier)

(Text-fig. 1 E)

1808. *Endomychus melanocephalus* Olivier, *Entomologie*, 6 : 1073.

1925. *Ancylopus melanocephalus* : Arrow, *Fauna of British India, Coleoptera, Clavicornia* : 334.

Material examined.—INDIA : N.E.F.A. Kameng Frontier Div.: 43 exs., Rupa, 1676 m., 2.iv.1961; 6 exs., Dirong Rd., Jungla, 2134 m., 24. iv. 1961; 3 exs., Dirong Dzong, 1600 m., 11.iv. 1961; 8 exs., Milan Kang, 1981 m., 20.iv.1961; 4 exs., Milan Kang, 2134 m., 18.iv.1961; 3 exs., Naphra, 1829 m., 25.iv 1961; 11 exs., Sanglichu, 1676 m., 12.iv.1961; 18 exs., Rahung Vill., 1829 m., 8.iv. 1961; 1 ex., Dengzi, 1234 m., 29. v. 1961; 1 ex., Nukmadong, 2469 m., 21.iv.1961.

Remarks.—In a large collection of 98 examples there is hardly any variation worth mentioning. Both the sexes are almost equally represented (45♂ & 53♀). The male genitalia are figured (Text-fig. E) for the first time. The penis (median lobe) is a small, curved slightly twisted highly chitinated plate with a single tubular pointed spine on the ventral side exceeding the dorsal side; median orifice (mo.) opening is on the dorsal side and is covered with folding over of the protruding internal sac; armature of the internal sac not distinct and the tegmen is undefined.

5. *Eucteanus cruciger* Gorham (Text-fig. 1 F)

1897. *Eucteanus cruciger* Gorham, *Proc. zool. Soc. Lond.*, : 460.

1925. *Eucteanus cruciger* : Arrow, *Fauna of British India, Coleoptera, Clavicornia* : 353.

Material examined.—INDIA : N.E.F.A. : Kameng Frontier Div. 2 exs., Kalaktang, Shergaon, 2010 m., 31.viii.1961; 1 ex., Dirong Dzong, Milankhang Valley, 2135 m., 7.viii.1961; 1 ex., Dirong Dzong Chug Vill., 2135 m., 13.viii. 1961; 1 ex., Bomdila town, 2620 m., 16.iv. 1961. (All S. B. Coll.).

Remarks.—It is previously known in India from Manipur only. The width of the interval between the elytral patches is rather variable in the specimens before us, it is distinctly less than half the diameter of one of the patches. The male genitalia (Text-fig. F) are figured and described here for the first time. The penis (media nlobe) is a long, narrow, strongly chitinated, doubly twisted plate, almost forming a right angle at the base; the ventral spine is directed upwards and then backwards, sharply and abruptly reduced to a sharp point.

III—SUMMARY

This paper deals with five species of Endomychidae from N.E.F.A., India. Of these, one species viz., *Engonius kamengensis* is described as a new species. Systematic notes, including descriptions of male genitalia are given for all the species.

IV—REFERENCES

ARROW G. J. 1925. *The Fauna of British India, Coleoptera, Clavicornia*. 416 pp., 76 figs, 1 pl., London.

AN ECOLOGICAL STUDY ON COLLEMBOLA OF
WEST BENGAL (INDIA)

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(With 2 Text-figures and 5 Tables)

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I—INTRODUCTION

Ecological study of the subterranean Collembola is a comparatively young discipline. In view of the probable role of the subterranean micro-and mesofauna in the economy of soil, the possible long-term effects of agricultural practices, and the desirability of controlling soil pests, an ecological study of the soil fauna especially the Collembola, has become a matter of urgent practical importance. In the present era this particular discourse has evoked a considerable revival of interest among the pedobiologists. Symptomatic of this revival is the persistent pouring of literature, concerned with the autecological or the synecological studies of the soil Collembola, from the different parts of the world especially Europe, U.S.A. and Latin America. In India, however, this aspect of soil zoology has not received due attention despite the abundance of springtails in Indian soils, and so far there have come out only two noteworthy publications (Choudhuri and Roy, 1966 and 1967) that offer some useful information as to the ecological behaviour of Indian Collembola. It is this paucity of knowledge in regard to the bionomics of Indian Collembola and further because of the large confusion that still centres round the probable effects of the various edaphic factors in limiting the populations of Collembola the present authors undertook an extensive investigation by taking numerous samples from the different plots of the ten districts of West Bengal having equable and different soil conditions. The chief purpose of this investigation is to evaluate the quantitative and the qualitative composition of collembolan fauna, their seasonal variations and distributional patterns

in relation to different soil factors namely moisture, organic carbon, nitrate, phosphate, calcium carbonate, hydrogen ion concentration (pH), particle size and soil cover (vegetation) and finally to compare the results of this study with those of the existing works in this line.

II—SAMPLING, EXTRACTION AND ANALYSIS OF SOIL FACTORS

Soil samples were collected by a modified soil auger (Dhillon, 1964) and were extracted by an apparatus originally devised by Macfadyen (1953) and subsequently modified by Dhillon (1964 a). Polyvinyl lactophenol was employed as a mounting-clearing medium in the preparation of slides. To determine the water content the soil was dried in an oven at 105°C. The loss in weight (expressed in percentage) represented the moisture derived from hygroscopic and some of the capillary water. The pH was determined from soil suspension by an electric pH meter and organic carbon by rapid titration method of Walkley and Black (1934). Particle size was measured by using an ocular micrometer taking 1000 particles at random from each sample. Calcium carbonate was determined by rapid titration method as described by Piper (1942); nitrate and phosphate contents were estimated colorimetrically by Phenol—disulphonic acid method and Molybdenum blue test as described by Dowdeswell (1959).

III—HABITATS STUDIED

348 samples (108 from Nadia, 60 from 24-Parganas, 24 from Calcutta, 24 from Howrah, 24 from Midnapore, 24 from Hooghly, 24 from Bankura, 24 from Burdwan, 24 from Jalpaiguri and 12 from Darjeeling) were collected generally from a depth ranging from 0—15 cm., from 30 plots of which 28 were sampled once in a month of a year while the remaining 2 plots at Darjeeling were sampled six times each over a period of two years. Most of the plots were uncultivated, well vegetated and in the Gangetic plain, being subjected to tropical climates with high humidity and fairly high temperature and containing mainly alluvium and in places laterite and red soils as in Bankura and Darjeeling districts. The mechanical characteristics of soil of different plots are given in table 1. The plots were found to be covered with grass and weeds belonging to the families of Amarantaceae, Compositae, Verbenaceae, Euphorbiaceae, Vitaceae, Polygonaceae and Commelinaceae in Nadia district; Verbenaceae, Euphorbiaceae, Compositae, Polygonaceae, Convolvulaceae and Gramineae in 24 Parganas district; Euphorbiaceae, Polygonaceae, Caesalpinnaceae and Compositae in Calcutta; Amarantaceae, Vitaceae, Polygonaceae, Euphorbiaceae, Scitamineae and Malvaceae in Howrah district; Amarantaceae, Rubiaceae, Nyctaginaceae, Euphorbiaceae, Vitaceae and Verbenaceae in Hooghly district; Euphorbiaceae, Compositae and Gramineae in Burdwan district; Convolvulaceae, Papaveraceae, Euphorbiaceae, Mimosae and Palmae in Bankura district; Lythraceae, Convolvulaceae and Euphorbiaceae in Jalpaiguri district; Compositae, Malvaceae and some gymnosperms in Darjeeling district.

TABLE 1.—Mechanical analysis of sampling plots

Plot	District	Coarse sand (%)	Fine sand (%)	Silt (%)	Clay (%)
Kalyani A	Nadia	1.32	66.63	16.00	13.50
Kalyani B		2.60	64.07	21.20	11.50
Kalyani C		0.30	62.44	31.80	3.75
Majherchar		2.64	22.02	53.00	20.00
Chandmari		1.10	35.83	38.50	21.80
Chasarhati		0.18	62.77	16.50	20.35
Haringhata		0.45	50.93	24.50	19.80
Mohanpur A		3.24	33.79	37.00	21.50
Mohanpur B		0.37	50.76	29.50	12.50
Kanchrapara A	24-Parganas	1.75	34.25	29.18	33.22
Kanchrapara B		2.35	35.15	30.16	31.44
Halisahar		2.68	57.36	24.24	11.82
Khardaha		0.78	46.32	19.89	30.61
Budge Budge		3.37	66.73	14.00	12.50
Beliaghata A	Calcutta	0.48	35.62	38.79	22.81
Beliaghata B		3.24	34.89	37.21	21.46
Bantul A	Howrah	1.28	46.92	29.74	24.86
Bantul B		0.98	43.12	28.16	27.24
Arambag A	Hooghly	5.38	38.36	32.24	20.22
Arambag B		4.36	32.44	28.67	32.73
Pahalanpur A	Burdwan	1.45	52.90	23.25	17.70
Pahalanpur B		1.60	51.20	23.45	19.15
Bankura A	Bankura	0.90	59.31	19.63	10.27
Bankura B		7.25	61.21	16.47	11.64
Garhbeta A	Midnapore	3.39	32.68	30.12	28.51
Garhbeta B		3.87	36.83	30.40	24.30
Carron A	Jalpaiguri	16.40	46.31	10.22	26.13
Carron B		17.21	43.90	12.64	24.36
Darjeeling A	Darjeeling	6.54	50.92	20.18	19.26
Darjeeling B		5.98	52.66	21.32	18.14

IV—COMPOSITION OF COLLEMBOLAN FAUNA

The spectrum of Collembola as found in this study is not very large. The total collembolan fauna obtained belonged to 25 genera (Table 2) of the families Entomobryidae, Onychiuridae, Hypogastruridae, Neanuridae, Poduridae, Isotomidae and Sminthuridae, the specific identity of which are given in table 3. The number of genera also varied being maximum in Nadia (14) and minimum in Burdwan (4). Moreover some forms differed in abundance in the plots of the same district or of the different districts. The most widely distributed genera were *Lepidocyrtus*, *Proisotoma*, *Cyphoderus*, *Lobella* and *Isotomurus* being found respectively in 7, 9, 7, 6 and 4 districts. None of the 25 genera was universal in occurrence. The

TABLE 2.—Collembola encountered in different months in West Bengal

Collembolan form	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jly.	Aug.	Sept.	Oct.	Nov.	Dec.	% of total Collembola
<i>Lepidocyrtus</i> sp.	265	328	339	314	359	585	985	908	622	349	283	367	26.13
<i>Cyphoderus</i> sp.	239	263	199	246	263	387	599	650	420	222	266	175	18.14
<i>Proisotoma</i> sp.	303	205	282	267	227	315	578	448	376	490	375	352	19.83
<i>Xenylla</i> sp.	4	18	6	16	4	18	9	14	16	7	16	8	0.61
<i>Lobella</i> sp.	45	47	51	52	58	53	61	65	72	59	46	52	3.09
<i>Seira</i> sp.	53	66	28	42	39	40	49	32	36	28	41	35	2.26
<i>Friesea</i> sp.	8	4	5	12	16	20	24	40	8	8	8	—	0.70
<i>Pseudosinella</i> sp.	179	48	67	35	73	119	127	73	98	49	79	84	4.99
<i>Sinella</i> sp.	14	40	9	49	59	—	34	32	4	27	9	12	1.33
<i>Entomobrya</i> sp.	2	11	2	8	2	10	12	3	2	13	2	—	0.25
<i>Hypogastrura</i> sp.	64	76	56	80	104	144	132	80	96	116	84	52	8.00
<i>Isotomiella</i> sp.	—	—	—	12	32	8	8	—	—	16	—	20	0.42
<i>Isotoma</i> sp.	—	8	—	8	8	—	—	—	20	20	16	—	0.36
<i>Sminthurinus</i> sp.	57	92	21	64	34	16	67	66	22	31	38	36	2.51
<i>Sphaeridia</i> sp.	44	45	38	23	27	21	67	56	50	37	8	19	2.00
<i>Arrhopalites</i> sp.	—	11	—	17	22	—	15	24	—	9	—	—	0.45
<i>Onychiurus</i> sp.	—	6	—	19	24	8	25	8	—	8	8	8	0.52
<i>Alloscopus</i> sp.	8	12	8	8	20	4	4	4	8	4	4	—	0.38
<i>Dicranocentrus</i> sp.	48	67	51	82	96	80	42	56	48	48	69	56	3.42
<i>Isotomurus</i> sp.	90	134	36	80	86	62	82	122	47	72	32	31	4.03
<i>Callyntrura</i> sp.	27	47	4	27	22	16	46	33	16	32	7	14	1.32
<i>Pseudachorutes</i> sp.	—	—	—	12	—	—	—	—	20	—	—	—	0.14
<i>Salina</i> sp.	18	17	21	20	23	12	32	17	40	14	22	19	1.17
<i>Protanura</i> sp.	20	7	9	5	8	7	10	15	11	7	23	26	0.68
<i>Neanura</i> sp.	—	10	—	16	10	—	5	14	—	—	—	—	0.24

plots of Jalpaiguri and Darjeeling supported the fauna distinct from that of the other plots. The species *Alloscopus tetracantha* found in Jalpaiguri and *Arrhopalites caecus*, *Onychiurus himalayensis* and *Neanura intermedia* found in Darjeeling were not recorded elsewhere. The important genera like *Lepidocyrtus*, *Proisotoma*, *Cyphoderus*, *Seira*, *Callyntrura*, *Onychiurus*, *Sminthurinus*, etc. were represented by more than one species. The order of dominance of the widely distributed genera could be expressed as *Lepidocyrtus* > *Proisotoma* > *Cyphoderus* > *Isotomurus* > *Lobella* (Table 2). The mean number of Collembola per plot is figured in the text—figure 1.

TABLE 3.—Species of Collembola encountered in West Bengal

Suborder : ARTHROPLEONA

Family : ENTOMOBRYIDAE

*Lepidocyrtus suborientalis**L. heterolepis**L. cyaneus**Lepidocyrtus* sp.*Cyphoderus javanus**C. assimilis**Cyphoderus* sp.*Sinella montana**Sinella* sp.*Seira boneti**S. indica**Salina indica**Entomobrya* sp.*Callyntrura* sp.*C. cingulata**Dicranocentrus indicus**Alloscopus tetracantha*

Family : ISOTOMIDAE

*Proisotoma thermophila**P. minuta**Proisotoma* sp.*Isotomurus ciliatus**Isotomiella minor**Isotoma* sp.

Suborder : SYMPHYPLEONA

Family : SMINTHURIDAE

*Sminthurinus bimaculatus**S. alpinus**Sminthurinus* sp.*Arrhopalites caecus**Sphaeridia brevipila*

Family : OONYCHIURIDAE

*Onychiurus indicus**O. himalayensis*

Family : NEANURIDAE

*Neanura intermedia**Protanura carpentari*

Family : HYPOGASTRURIDAE

Xenylla sp.*Pseudachorutes* sp.*Lobella* sp.*Hypogastrura* sp.

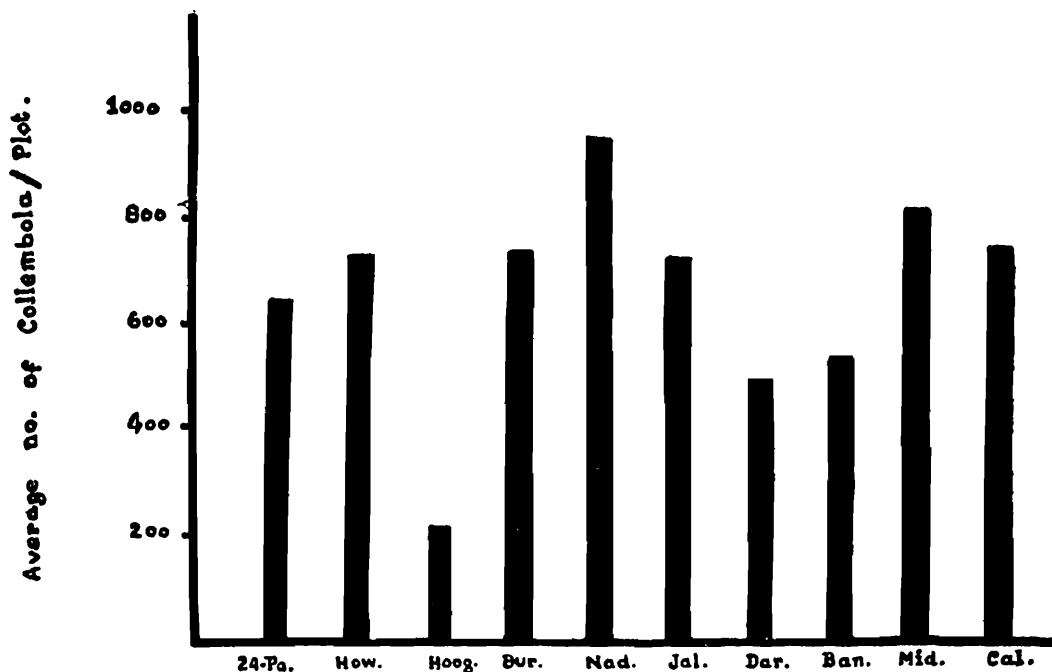
Family : PODURIDAE

Friesea sp.

V—SEASONAL VARIATION OF COLLEMBOLAN FAUNA

The seasonal variation patterns were different in different forms. The general form of the population curve was determined by *Lepidocyrtus*, *Proisotoma* and *Cyphoderus* which were the overwhelmingly dominant genera and members of which attained their peak in July-August (Table 2). The populations of *Hypogastrura*, *Lobella*, *Sphae-*

ridia and *Salina* also attained similar maxima. But the individuals of *Pseudosinella*, *Isotomurus*, *Sminthurinus* and *Callyntrura* exhibited two peaks, one being in the winter months and the other in monsoon months. *Sinella* and *Dicranocentrus* showed an annual cycle of another sort having the peak population in May. The population of Collembola, when considered district-wise showed their maxima in



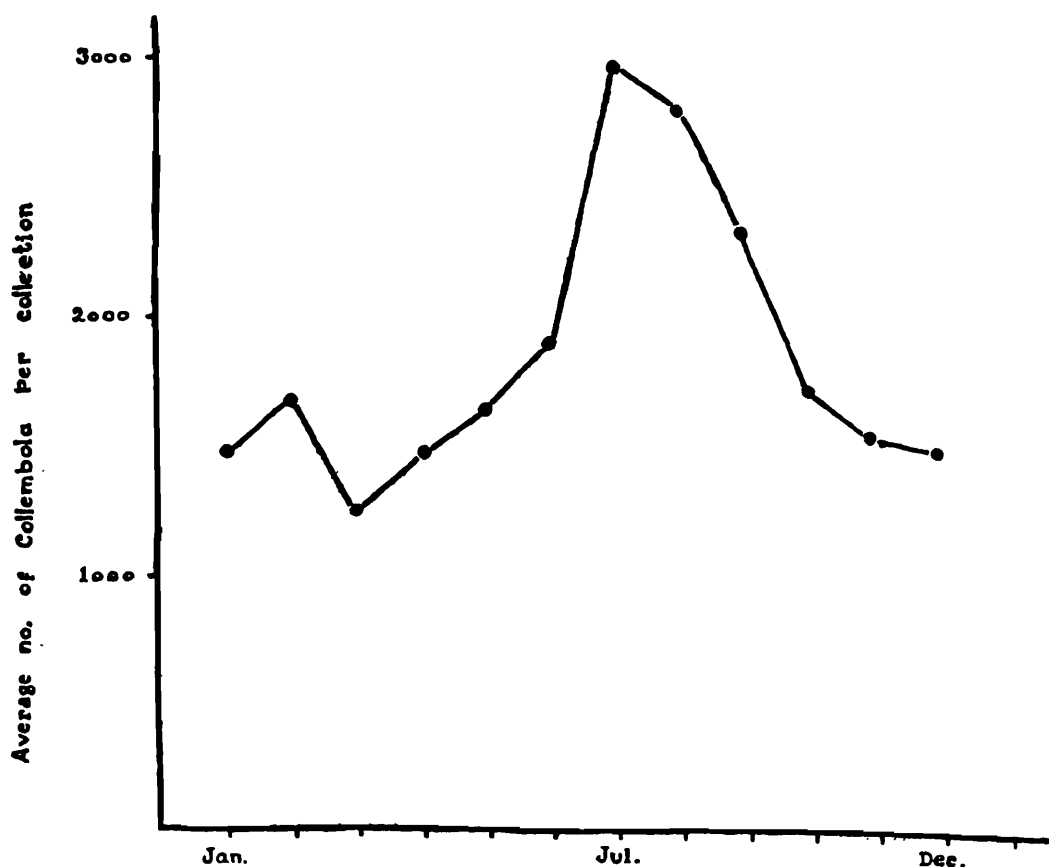
TEXT-FIG. 1.—Mean number of Collembola per plot in different districts of West Bengal.

July-September (in Nadia, 24-Parganas and Howrah), in June-August (in Calcutta, Bankura and Midnapore), in November-January (in Burdwan), in January-February (in Jalpaiguri) and in April-May (in Darjeeling); and minima in February-April (in Nadia and Hooghly), in May (in 24 Parganas), in March (in Calcutta) in February and April (in Burdwan), in March-April (in Bankura), in April-May and December (in Midnapore and Jalpaiguri), and in October (in Darjeeling). The total Collembola of Hooghly district was more or less at the same level throughout the year with, of course, a slight increase during the period June to August. The occurrence of two minimal periods in the same year as found in Burdwan, Midnapore and Jalpaiguri was perhaps due to the exhibition of two peak periods by some forms. The total number of Collembola of West Bengal was at the lowest level in March and in the monsoon months, July-August, it attained the peak (Text-fig. 2).

VI—CORRELATION OF SOIL FACTORS AND COLLEMBOLAN POPULATION

Calculation of the mean values of soil factors and mean number of Collembola in different months (not recorded here) clearly revealed that in most of the cases the population rose to peak when the important soil factors like moisture, organic carbon or organic matter, nitrate and phosphate became concentrated. The values of pH of

most of the samples were between 6 and 7. The moisture content showed wide range of variation from 2.9% (Bankura district) to 14.7% (Nadia District). The organic carbon content varied from 0.11% (24 Parganas district) to 3.24% (Darjeeling district). The calcium carbonate content ranged between 1.3% (Darjeeling district) to 8% (Bankura district) and the nitrate content varied from 0.32 ppm (Hooghly district) to 4.4 ppm (24 Parganas district). The phosphate content of all the samples were less than 1 ppm ranging from 0.08 ppm (24-Parganas district) to 0.98 ppm (Calcutta). The mean particle size also showed variations along with the mechanical composition and in many cases the variation in the same plot was noted. It varied from 0.022 mm (24 Parganas district) to 0.127 mm (Midnapore district).



TEXT-FIG. 2.—Fluctuation of total collembolan population in the sampling plots of West Bengal.

In order to find out as to whether there was a significant correlation between the soil factors and the monthly collembolan population, correlation coefficient values (r) were worked out (table 4.) The water content, organic carbon and particle size, in most of the cases, and the nitrate as well as the phosphate in a few cases were significantly correlated. The calcium carbonate also in a few cases showed correlation with the collembolan population but that was weakly positive or weakly negative.

TABLE 4.—Correlation coefficient (r) for soil factors and Collembolan population

Factors correlated	Nadia	24-Parganas	Calcutta	Howrah	Hooghly	Burdwan	Bankura	Midnapore	Jalpaiguri	Darjeeling
Collembola : Water content	+0.663	+0.877	+0.563	+0.865	+0.549	—0.157	—0.891	+0.485	+0.064	—0.018
Collembola : Organic carbon	+0.975	—0.839	+0.816	+0.806	+0.375	+0.078	+0.291	+0.945	+0.798	+0.440
Collembola : Nitrate	+0.613	+0.180	+0.416	+0.100	+0.720	—0.198	+0.441	+0.845	+0.500	+0.052
Collembola : Phosphate	+0.438	—0.602	+0.332	+0.185	+0.699	—0.248	—0.472	+0.838	+0.881	+0.061
Collembola : Calcium carbonate	+0.539	+0.317	+0.347	+0.323	—0.147	+0.258	—0.189	—0.348	—0.325	—0.209
Collembola : Particle size	+0.811	+0.213	+0.239	—0.113	+0.359	+0.114	+0.419	+0.312	+0.862	+0.146
Water content : Organic carbon	+0.790	+0.753	+0.572	+0.902	+0.360	+0.584	—0.011	+0.292	+0.193	+0.478
Water content : Nitrate	+0.528	—0.512	+0.552	+0.197	+0.620	—0.412	—0.223	+0.710	—0.267	+0.498
Water content : Phosphate	+0.572	+0.713	+0.102	—0.016	+0.686	+0.414	—0.263	+0.580	+0.460	—0.592
Organic carbon : Nitrate	+0.312	—0.509	+0.796	+0.151	+0.342	—0.171	+0.152	+0.081	+0.011	—0.009
Organic carbon : Phosphate	+0.112	+0.158	+0.041	—0.015	+0.568	—0.075	+0.431	+0.238	+0.038	+0.093
Nitrate : Phosphate	+0.013	—0.317	+0.293	—0.085	+0.830	—0.428	—0.301	+0.622	+0.686	—0.174
Organic carbon : Particle size	+0.512	+0.139	+0.232	+0.019	—0.096	+0.131	—0.145	+0.689	+0.487	—0.231
Calcium carbonate : Particle size	+0.492	—0.224	—0.119	+0.432	+0.412	+0.096	+0.141	+0.449	+0.662	+0.124

VII—VERTICAL DISTRIBUTION

It is well known that in the undisturbed plots of temperate regions the majority of the individuals are generally concentrated in the upper layers of the soil as reported by Murphy (1953), Poole (1957), Dhillon and Gibson (1962) and Davis (1963). The similar pattern of distribution of tropical Collembola has also been on record (Choudhuri and Roy 1967). The vertical distribution was studied by dividing the samples in 3 subsamples in 3 depth ranges viz., upper (0–5 cm.), middle (5–10 cm.) and lower (10–15 cm.). In table 5 are listed the total number of different forms extracted in 3 subsamples from all the sampling plots. The fauna, as a whole, and most of the species in all areas were found to be greater in concentration in the upper or middle subsample than the lower one.

VIII—DISCUSSION

Since the composition of the collembolan fauna was found to vary from one plot to another it would be worthwhile to see which of these plots or habitats were the most distinct and the degree of similarity among them. The distinctiveness in the faunal make up in Jalpaiguri and Darjeeling could be attributed to the existence of an ecological set up different from that of the plain region of West Bengal. High altitude, low temperature, different types of vegetation, high amount of rainfall, low pH, etc. were the characteristic features in the ecology of both districts of Jalpaiguri and Darjeeling. The maximum number of genera (14) of Collembola were recorded from the district of Nadia and in this respect next in position was Calcutta which supported 10 different genera. These two areas had the following advantages from the point of view of the soil fauna : (i) plots remained uncultivated and undisturbed for a long period permitting the development and prevalence of a more or less stable climatic conditions and a mature community of animals as well as plants, (ii) relatively greater abundance of plant remains and high organic content and thus affording possibly stable food supply. These conditions, being favourable, led to the establishment of a greater average number of Collembola in the plots of those districts (Text-fig. 1).

It has already been mentioned that the plots under review were mostly well vegetated and macroflora of an area obviously has some effects on the nature of the soil and humus. The thickness of humus layer or the total content of organic carbon depend greatly on the intensity of vegetation and the macroflora are supposed to exert some indirect influence on the populations of soil Collembola through its effect on soil cavity size, humus formation and soil moisture (Strickland, 1947, Bellinger, 1954, Knight, 1961, Davis, 1963). But how far the species composition of a population is dependant upon the plant community is difficult to ascertain. However, like the previous workers it can well be assumed that the vegetation is just one of the components of the ecological complex that limit the populations of Collembola.

The collembolan populations vary both in quantity and in quality

from plot to plot. These variations might be due to the local differences in the composition of the substrate, but there also seems to be a tendency towards hyperdisposition or clumping of organisms in the homogeneous environment. The differences exhibited by the fauna in all the cases may not be real ; but some, at least, seem so clear-cut that they must represent real differences in the fauna. Some of the cases may be considered in greater detail as examples.

The genus *Lepidocyrtus* was represented mainly by four species viz. *L. medius*, *L. suborientalis*, *L. heterolepis* and *L. cyaneus* being concentrated in most cases in the upper (0-5 cm.) or middle sub-samples. Their wide distribution and numerical dominance suggest that they are capable of existing in varying ecological niches. Their total absence from the himalayan and sub-himalayan West Bengal is interesting and is perhaps an indication of their lack of adaptability to high altitude climate. Again the reports of *L. cyaneus* by Bellinger (1954), Sheals (1957), Dhillon and Gibson (1962) and Davis (1963) from the different parts of the world suggest the cosmopolitan nature of the genus.

The genus *Proisotoma* was represented by mainly two forms *P. thermophila* and *P. minuta*. Its distribution in the Gangetic plain as well as in the sub-himalayan West Bengal signifies its widespread nature and also its capability to withstand diverse ecological conditions.

Cyphoderus, the third important genus of this investigation, was represented mainly by two species, *C. javanus* and *C. assimilis*, being steadily adapted to the gangetic alluvium as well as to the red and lateritic soil. Their maximum occurrence in the upper substratum makes one to consider them as humus or litter forms and their absence from the plots of Darjeeling and Jalpaiguri districts signifies their nature of distribution being restricted to the plain region. Moreover, the presence of *C. assimilis* and *C. javanus* in both Nadia and Midnapore having different soil conditions further justifies their not too narrow range of distribution in the plains at least.

Among other forms the numerically important genera were *Pseudosinella*, *Hypogastrura*, *Isotomurus* and *Lobella*. Both *Pseudosinella* and *Hypogastrura* were significantly present in Nadia being numerically higher than in the other districts suggesting their non-randomised distribution. *Isotomurus ciliatus* was not quantitatively so significant in any particular district. The species of *Lobella* were numerically lesser than the previous forms but being present in 6 districts in the Gangetic plain exhibited their wide range of distribution in West Bengal. This particular finding is consistent with the works of Yosii (1959 and 1966) who has reported many of these forms from the different localities of Eastern Asia.

The Collembola extracted only from himalayan and sub-himalayan part of West Bengal were *Alloscopus tetracantha*, *Arrhopalites caecus*, *Neanura intermedia* and *Onychiurus himalayensis*. The last two species have already been reported as high altitude forms by Imms

(1912) and by Choudhuri (1958). The species *Arrhopalites caecus* was also extracted from agricultural soils of England by Dhillon and Gibson (1962). In view of this the absence of *Alloscopus tetracantha* and *Arrhopalites caecus* in the plains of West Bengal is really difficult to explain. The members of Symphypleona like *Sphaeridia brevipila* and *Sminthurinus bimaculatus* were present in greater numbers in the plots of Jalpaiguri district. Similarly *Sinella montana* was numerically dominant in Darjeeling district. Among other strictly localised forms were *Protanura carpentari* and *Sminthurinus alpinus* extracted only from the plots of Howrah district, *Isotoma* sp., *Onychiurus indicus* from 24 Parganas, *Seira indica* from Midnapore, *Pseudachorutes* sp. and *Isotomiella minor* from Nadia. The last named species, though insignificant here, was reported from different ecological niches by Haarlov (1960), Poole (1961) and Milne (1962). The other important forms were *Seira boneti* present in 3 districts and *Diacranocentrus indicus*, *Xenylla* sp., *Friesea* sp. and *Entomobrya* sp. all of which were present only in two districts.

The existing literature on the seasonal fluctuation of population indicate maximum populations between late autumn and early spring and fall to a minimum during summer months (Ford, 1935, 1937, 1938, Glassgow, 1939, Weis-Fogh, 1948, Macfadyen, 1952, Sheals, 1957, Haarlov, 1960, Milne, 1962, Davis, 1963, Rapoport & Najt, 1966 and Rapoport & de Izarra, 1966). But the results obtained in the present investigation, especially with regard to dominant species are different from those of the previous workers. The dominant species begin to increase in number from April-May reaching their respective maxima in July-August after which they again decline (Table 2). The occurrence of single population peak may be due to the existence of a single generation per year while the record of two peaks may be attributed to the existence of more than one generation.

The causes of monsoon maxima in the dominant forms may further be attributed to the direct influence of soil moisture due to increased rainfall. In warmer months on the other hand, low rainfall combined with a high evaporation rate may result in desiccation which if sufficient to bring about a decrease in humidity, is bound to reduce the numbers because of the high mortality of the delicate and susceptible forms. Fluctuation in number may depend on factors like availability of food, presence or absence of predators, and inter-and intra-specific relations. The plots in different districts under this investigation were ecologically different and consequently the pattern of fluctuation in regard to the total population and also the specific population was found to be different.

The fluctuation pattern as exhibited here, though unusual, is not a unique one. Absence of winter maxima was reported by several workers (Vander Drift, 1951, Bellinger, 1954, Stöckli, 1957, Poole, 1961, Dhillon and Gibson, 1962). The observations so far made in this line undoubtedly suggest that in Collembola regular seasonal occurrence is rare and especially so in soil forms. Whatever are the existing tendencies towards regularity these are readily masked by environment. Consequently the pattern of population fluctuation

varies not only from species to species but from year to year and geographically.

In the present study the vertical distribution was variable in the plots sampled. During the summer months there was a tendency of migration of the surface forms into deeper layers to avoid drought or desiccation as already reported by Strickland (1947). According to Glasgow (1939) different genera and even different species of the same genus inhabiting the same soil may show marked difference in distribution. This was also observed in the present investigation. The greater was the concentration in *Lepidocyrtus*, *Cyphoderus*, *Proisotoma*, *Lobella*, *Dicranocentrus*, *Isotomurus* and *Callyntrura* in the topmost subsample ; in *Salina*, *Hypogastrura*, *Pseudachorutes*, *Pseudosinella* in the middle and in *Onychiurus* and *Xenylla* in the lower subsample (Table 5). This distribution was more or less similar to that described by Volz (quoted by Bellinger, 1954) who studied the vertical distribution of collembola in forest soils of Europe.

TABLE 5.—Vertical distribution of Collembola

Collembolan forms	Total number in upper layer (0-5 cm.)	Total number in middle layer (5-10 cm.)	Total number in lower layer (10-15 cm.)
<i>Lepidocyrtus</i> sp.	3319	1658	348
<i>Cyphoderus</i> sp.	2278	1339	437
<i>Proisotoma</i> sp.	1998	1287	405
<i>Xenylla</i> sp.	32	45	55
<i>Lobella</i> sp.	231	203	199
<i>Seira</i> sp.	145	159	177
<i>Friesea</i> sp.	90	53	84
<i>Pseudosinella</i> sp.	202	416	82
<i>Sinella</i> sp.	201	155	44
<i>Onychiurus</i> sp.	17	21	47
<i>Alloscopus</i> sp.	24	56	8
<i>Dicranocentrus</i> sp.	395	169	55
<i>Isotomurus</i> sp.	451	301	195
<i>Callyntrura</i> sp.	153	54	14
<i>Pseudachorutes</i> sp.	0	31	6
<i>Salina</i> sp.	73	201	89
<i>Protanura</i> sp.	88	49	16
<i>Neanura</i> sp.	42	11	7
<i>Entomobrya</i> sp.	15	32	15
<i>Hypogastrura</i> sp.	320	462	23
<i>Isotomiella</i> sp.	129	21	7
<i>Isotoma</i> sp.	12	24	0
<i>Sminthurinus</i> sp.	227	234	107
<i>Sphaeridia</i> sp.	154	136	127
<i>Arrhopalites</i> sp.	62	31	14

The probable reasons for concentration of collembolan forms in the upper layers of the soil have already been discussed by the present authors (1967). It is also worth mentioning that, with the reduction in the percentage porosity, the gaseous exchange is hindered

and organisms living in the deeper layers must be able to tolerate higher tension of carbon dioxide and lower tensions of oxygen than individuals living near the surface (Dhillon and Gibson, 1962). The degree of parallelism between the porosity and the vertical distribution of fauna (Dhillon and Gibson, 1962) further supports the importance of porosity as a limiting factor in the colonisation of soil Collembola. Not only does the total porosity decrease with depth, but so also does the average diameter of the pore spaces and, as Weis-Fogh (1948), Haarlov (1955) and Stöckli (1957) have pointed out, this diminution must, for purely mechanical reasons, limit the larger species to the upper layers. Although the fundamental vertical zoning of species in the soil can be tentatively accounted for in terms of size, nutritional preferences and carbon dioxide tolerance, it is really difficult to explain the temporary changes in distribution which are superimposed upon the basic pattern. Movements of the fauna into the deeper layers may be ascribed to such causes as (1) drying or flooding of the upper layers of the soil, (2) prevalence of unfavourably high or low surface temperatures and (3) responses to alterations in the carbon dioxide content of the interstitial air (Kühnelt, 1950). Baver (1956) has stated that the carbon dioxide content of the soil air is subject to significant variations, even at considerable depths. Moreover it undergoes seasonal changes in relation to temperature and moisture content of the soil. More recently Rapoport and de Lzarra (1966) suggest that the availability of larger number of collembolles in deeper layer might be due to their occurrence in rhizosphere along the thinnest rootlets or in the hollows of root channels formed by decayed roots.

A critical study of the soil factors revealed that in most of the sampling areas the population was maximum in July when the moisture, and organic carbon content were fairly high, the carbonate, nitrate and phosphate contents were moderate and soil reactions were nearly neutral. But the samples of Jalpaiguri, Darjeeling and Burdwan, where the maximum population was obtained in February, April and May, respectively, had lower concentration of moisture than those with the minimum population at these places.

The values of pH of most of the samples under this study were between 6 and 7. According to Buckman and Brady (1960) this intermediate pH range perhaps presents the most satisfactory biological regime. Here nutrient conditions are favourable without being extreme and availability of certain salts are maximum. Besides, the values of pH were well within the tolerance range of most or rather all of the species. This is indicated by the steady occurrence of the forms like *Seira boneti* and *Isotomurus ciliatius* in Jalpaiguri and Darjeeling (having pH value 5.9) and also in Calcutta and Bankura (having higher pH value). Moreover, workers like Agrell (1941), Bellinger (1954), Dhillon and Gibson (1962), Davis (1963) did not observe any correlation of pH with collembolan populations. As the values of pH in most cases were near the neutral point and also because these values were well within the tolerance range of most of the forms, the correlation coefficient values (r) of pH and collembolan

population need not be calculated. Well representation of the same species in two different soil pH (5.9 at Darjeeling and 7.3 at Calcutta) is really interesting and contradicts the views of Gisin (1943, 1955). It is quite clear from the present study that pH has very little or no direct effect on collembolan population, but it may do so by indirectly influencing soil reaction. Nitrification and nitrogen fixation by the micro-organism take place vigorously in soils only at pH values well above 5.5. Moreover, mobility of calcium and magnesium and satisfactory availability of phosphorus is restricted to a pH range of approximately 6 to 7. Vegetation is also sometimes related to the pH value of soil.

In most of the samples of the present study moisture content showed significant positive correlation with the collembolan population since the monsoon months mostly witnessed maximum population and upward fluctuation. But the occurrence of same species in different moisture levels of the different areas may indicate that the role of moisture is more pronounced in seasonal fluctuation than in species composition as emphasized by Davis (1963). Actually the position as to the role of moisture on collembolan fauna is still confusing. Some investigators like Hammer (1953), Stebayev (1962), Dhillon and Gibson (1962) have found that certain forms are negatively correlated to soil moisture. Again workers like Agrell (1941), Knight (1961), Poole (1961) and Christiansen *et al.* (1961) have found a positive correlation, while Macfadyen (1952) and Marcuzzi (1962) found no correlation at all. The increased populations with increased moisture content may be due to the existence of forms having "preferences" to moisture condition. Besides this, the capacity of collembolans to withstand the condition of drought or desiccation as some time prevails in nature varies from species to species (Choudhuri, 1963) and therefore may be considered to be one of the reasons for population fluctuation. Moisture content also exerts large influence on soil fauna through diverse effects on plants and soil conditions (1) by acting as the solvent which together with the dissolved nutrients makes up the soil solution, (2) by maintaining hydrogen ion concentration of the soil and (3) also by taking part in the process of nitrification. In view of this it may be assumed that the moisture, the availability of which depends on rainfall, temperature, percolation, evaporation etc., exerts profound influence, direct or indirect on soil microfauna.

The data presented here clearly indicate that high organic carbon content has a significant bearing on the probability of a larger population of Collembola. It is well established that carbon forms the most important constituent part of the total organic matter which generally contains 55-50% carbon. Therefore increased percentage of organic carbon in any soil obviously leads to the greater organic matter content. Increased population of Collembola with increased organic matter content has also been reported by workers like Haarlov (1960), Christiansen *et al.* (1961), Holler-land (1962) Chernova (1963), Davis (1963), Choudhuri and Roy (1966). The soil organic matter may exert direct or indirect influence on the collembolan population

through its effect on vegetation and soil conditions by (1) modifying the physical and chemical properties of soil ; (2) determining the nature of microbial population and its activities through supplies of organic and inorganic nutrients essential for (3) buffering soil reaction ; (4) influencing moisture holding capacity, soil temperature, oxidation-reduction potential of soil, (5) absorbing certain toxic materials injurious to plant growth and (6) in supplying certain catalytic agents and various trace elements essential for plant growth (Russell 1954 and 1957). Above all, the occurrence of larger number of collembolans in the litter and humus layers also substantiate the affinity of the collemboles to organic matter content.

Availability of organic carbon again depends on many factors. In general under comparable conditions, the nitrogen and organic carbon increase as the effective moisture becomes greater. For this reason a tendency of increase in the percentage of organic carbon was observed in many plots with the onset of monsoon months. Significant correlation existing between soil moisture and organic carbon content, as has been observed, also supports this view. Texture of the soil also seems to influence the percentage of organic carbon present. A sandy soil, for example, usually carries less organic matter and nitrogen than that of a finer texture. This is probably due to the lower moisture content and to the ready oxidation that occurs in the lighter soil. Carbonate content of soil and its vegetative covers, are other factors that may affect the accumulation of soil organic carbon.

It is well known that most of the collembolans are either saprophagous or phytophagous. They generally feed on algae, fungi, lichens, decayed and undecayed leaves, bacteria and fungal spore, the abundance of which is related to the quantity of organic matter. Therefore it appears very probable that the total concentration of potential food, as measured by the percentage of organic matter, is of profound importance in the distribution of soil Collembola (Haarlov, 1960 ; Christiansen *et al*, 1961).

On analysis it has been observed that calcium carbonate has significant correlation with collembolan population only in few cases and that too is either weakly positive or negative. This possibly indicates that direct relationship between carbonate content and population distribution is insignificant or absent. Moreover the occurrence of same species (*Sinella montana*) in the district of Darjeeling and Nadia having widely different carbonate level further supports the above contention. The concentration of calcium carbonate in most of the cases did undergo little change with the change of season and thus appeared to make little contribution towards the seasonal variation of collembolan population except that it might exert its influence indirectly through vegetation and physico-chemical characteristics of soil (Russel, 1954, 1957).

The concentration of nitrate was found to increase in most cases with the onset of monsoon months when the collembolan population

also became comparatively numerous suggesting thereby that nitrate is one of the factors that contributes to the seasonal fluctuation, but how far this contention is true is still to be established. On analysing the correlation coefficient values of nitrate and collembolan population it was observed that in few cases nitrate has significant correlation with the population density. On the other hand collembolan forms were not found to be specific to any concentration of nitrate since *Lepidocyrtus* sp., *Proisotoma* sp. etc. were abundant in the sampling plots of Nadia and Hooghly districts with different concentration of nitrates. The nitrate content of samples taken from Hooghly district was considerably low and there the population of *Collembola* was also significantly low. Nitrate is one of the most essential macronutrients used by plants to keep their successful existence and it is usually formed from the organic nitrogenous compounds by decomposition—ammonification and nitrification brought about through the activities of some bacteria. The latter are extremely sensitive to their environment conditioned by aeration, temperature, moisture, pH, calcium carbonate, carbon-nitrogen ratio, etc. The optimum moisture-suitable for nitrification is generally attained in the monsoon months in the tropics for which nitrate content of the soil samples under this study increased to some extent at that period.

Nitrate in the soil with its variations in concentration sometimes brings about changes in the microclimate which may be favourable or unfavourable to the microfauna. It also influences greatly the macroenvironment by helping exuberant growth of vegetation. Therefore the nitrate content of the soil is capable of establishing a balanced soil climate, which, in its turn, is expected to support a larger fauna.

In some plots phosphate content showed significant correlation with the collembolan population which was compatible with findings of Wakerley (1963). In many cases of this investigation phosphate content was also weakly or negatively correlated which signifies that the relation of soil phosphate and collembolan population was not regular. The occurrence of same species *Proistoma thermophila* in the plots of Halisahar and Beliaghata, having different phosphate levels, makes the role of the phosphate content in species composition of a plot dubious. Both organic and inorganic forms of phosphates are present in the soil. Organic compounds of phosphorus form a constituent part of humus complex of the soil. Rock and other insoluble phosphates are the inorganic forms present in the native rocks from which the soil is derived. With possible exception of nitrate, no other compound has been as critical in the growth of plants in the fields as phosphate. A lack of this element is really serious since it may preclude the access of other nutrients to the plants. Introduction of a number of phosphate fertilizers in agricultural farming further speaks for its tremendous importance as a plant growth promoter. In view of this the influence of phosphate, direct or indirect, may not be overruled despite the lack of strong positive correlation between it and the collembolan population as found here.

In many plots the average particle size showed some positive correlation with the collembolan population being consistent with the findings of Christiansen *et al.* (1961) who obtained maximum population in the particle size ranging from 0.09 to 0.119 mm., while in many other cases the relation was weak or negative. Actually the role of size of particles in limiting the collembolan population is not well studied as in most cases the authors like Kühnelt (1950), Bellinger (1954), Haarlov (1960), Davis (1963) have studied the pore volume and pore space. But it is also well recognised that the amount of this space is determined largely by the arrangements of the particles. If they tend to lie close together, as in sands or compact subsoils, the total porosity is low. If they are arranged in porous aggregates, as is often seen in the case of medium textured soils rich in organic matter, the pore space per unit volume will be high (Buckman and Brady, 1960).

Pore volume and pore space which are secondarily related to particle size are again influenced by the concentration of the cementing agent *viz.* calcium carbonate and organic carbon. In this investigation two plots (one at Howrah and the other at Midnapore district) with varying average particle size supported the species *Cyphoderus javanus* in good number thus indicating that the distribution of the species is not restricted to any particular range of particle size.

There is a general agreement that available pore space decreases with depth which might be due to some compact sub-soil particles or due to decrease in organic matter content and a subsequent lowering of granulation. Decrease of pore space with depth thus leads to a decrease in population density (Haarlov, 1955). So from the relation of particle size and pore space and also from the data of the previous workers it can be assumed that soil particles provided with good amount of organic carbon will lead to the establishment of greater pore space and ultimately support a denser population by making more living space available.

Choudhuri (1961) reports that apart from the size restrictions there are also very important adsorptive and abrasive factors to be considered in relation to the mean diameter and particle size of the soil. These factors are only valid if the humidity of the soil falls below saturation level and the soil becomes deficient in organic food matter.

Several factors like rigidity, plasticity, moisture holding capacity, drainage etc., are also related to the size of the particles and thus may exert some influence on soil microfauna.

In view of the findings of the present investigations and also taking into consideration the comprehensive review work of Christiansen (1964) it can be assumed that the changes exhibited by the collembolan fauna might be more due to cumulative influence of small variations in a number of factors constituting a 'factorial complex' than the overriding effect of large changes in a component of that

complex. Moreover the interrelationships among the factors analysed in this study are intricate, complex and inextricably intertwined. So the complexity of the soil as an environment makes it virtually impossible in field studies to take into consideration. Other important variables which might conceivably influence the nature, size or distribution of the subterranean forms. Further progress in unravelling these relationships is unlikely to be made until the behaviour of individual species in relation to single environmental factor is fully studied under controlled conditions in the laboratory.

IX—SUMMARY

Recorded in this paper are the results of an evaluation as to the quantitative as well as the qualitative composition of the collembolan fauna of West Bengal, India, their seasonal variations and distributional patterns, both horizontal and vertical, in relation to various soil factors namely moisture, organic carbon, nitrate, phosphate, calcium carbonate, hydrogen ion concentration, particle size and soil cover (vegetation). The results are based on 348 soil samples collected from 30 different uncultivated plots of West Bengal. The spectrum of *Collembola* as found in this study is not very large and the collembolan fauna extracted belong to 25 genera of the families Entomobryidae, Onychiuridae, Hypogastruridae, Neanuridae, Poduridae, Isotomidae and Sminthuridae; of which the dominant genera are *Lepidocyrtus*, *Proisotoma*, *Cyphoderus*, *Lobella* and *Isotomurus*. The general form of the population curve seems to be determined by the aforesaid first three genera, members of which attained their peak in July-August. The occurrence of winter maxima is also obtained in some cases. The calculation of the mean values of soil factors and mean number of *Collembola* reveals that in most of the cases the population rises to peak when the important soil factors like moisture, organic carbon, nitrate and phosphate become relatively more concentrated. The particle size is also found to be significantly correlated with the population at least in some cases. The reasons for fluctuation of population are also discussed in terms of edaphic factors. The majority of the individuals has been found to be aggregated in the upper layers of soil and this is consistent with the findings of the other workers in this field. From the experimental results obtained in this study, it can be assumed that the changes exhibited by the collembolan fauna might be more due to cumulative influences of small variations in a number of factors constituting a factorial complex than the overriding effect of large changes in a component of that complex.

X—REFERENCES

- AGRELL, I. 1941. Zur Ökologie der Collembolan. Untersuchungen in Schwedischen Lappland. *Opusc. ent.*, Suppl., 3 : 1-236.
BAVER, L. D. 1956. *Soil Physics*, New York.
BAWEJA, K. D. 1939. Studies of the soil fauna with special reference to the recolonisation of sterilised soil. *J. Anim. Ecol.*, 8 : 120-161.

- BELLINGER, P. F. 1954. Studies of soil fauna with special reference to Collembola. *Conn. Agric. Expt. Sta. Bull.*, 583 : 67.
- BUCKMAN, O. H. and BRADY, C. N. 1960. *The nature and properties of soil*. The Macmillan Company.
- CHERNOVA, N. V. 1963. Population dynamics of Collembola (Insecta) in compost made from fallen leaves. *Zool. Zh.*, 42(a) : 1370-1382.
- CHOUDHURI, D. K. 1958. Some new species of *Onychiurus* Gervais (Collembola : Onychiuridae) from Nepal and Uganda. *Proc. ent. Soc. Lond.*, (B) 27 : 147-154.
- CHOUDHURI, D. K. 1961. Effect of soil structure on Collembola. *Sci. & Cult.*, 27 : 494-495.
- CHOUDHURI, D. K. and ROY, S. 1966. Role of edaphic factors on the distribution of subterranean collembolan fauna of West Bengal. Part I. Monograpias, *Progresos En Biologia del suelo Actas Del Primer Coloquio Latin Americano de Biologia del Suelo* : 391-403.
- CHOUDHURI, D. K. and ROY, S. 1967. Qualitative composition of the collembolan fauna of some uncultivated fields in Nadia district (West Bengal) with a correlation between monthly population and individual soil factor. *Rev. d' ecol. et. biol. du sol.*, 4(3) : 507-515.
- CHRISTIANSEN, K. 1964. Bionomics of Collembola. *Ann. Rev. Entomol.*, 9 : 147-178.
- CHRISTENSEN, K., WILLSON, M. and TECKLIN, J. 1961. The Collembola of Hunter Cave, with a preliminary study of micro arthropod ecology of Hunter Cave. *Bull. Natl. Speleological Soc.*, 23 : 59-69.
- DAVIS, B. N. K. 1963. A study of microarthropod communities in mineral soils near Corby, Northants. *J. Anim. Ecol.*, 32 : 49-71.
- DHILLON, B. S. 1964 Estimations of soil arthropod population I. Development of sampling tool. Proceedings of All India Entomological Research Workers' Conference and Plant Protection Seminar. I.C.A.R., New Delhi.
- DHILLON, B. S. 1964. Estimations of soil arthropod population II. Extraction apparatus. Proceedings of All India Entomological Research Workers' Conference and Plant Protection Seminar, I.C.A.R., New Delhi.
- DHILLON, B. S. and GIBSON, N.H.E., 1962. A study of the Acarina and Collembola of agricultural soils. *Pedobiologia.*, 1 : 189-209.
- DOWDESWELL, W. H. 1959. *Practical Animal Ecology*. Methuen & Co., London.
- FORD, J. 1935 The animal population of meadow near Oxford. *J. Anim. Ecol.*, 4 : 195-207.
- GISIN, H. 1943. Ökologie und Lebensgemeinschaften der Collembolen in Schewizerischen Exkursionsgebiet Basels. *Rev. suisse Zool.*, 50 : 131-224.
- GISIN, H. 1955. Recherches sur la relation entre la faune endogee de Collembolen et les qualites agrologiques de sols Viticoles. *Rev. suisse Zool.*, 62 : 601-648.

- HAARLOV, N. 1955. Vertical distribution of mites and Collembola in relation to soil structure : in *Soil Zoology*. Ed. Kevan, D. K. McE. Butterworth, London.
- HAARLOV, N. 1960. Microarthropods from Danish soils, ecology and phenology. *Oikos*, Suppl., 3 : 1-176.
- HAMMER, M. 1953. Investigations of the microfauna of Northern Canada. II Collembola. *Acta Artica*, 6 : 1-108.
- HOLLER-LAND, G. 1962. The dependance of soil inhabiting Collembola on fertilisation and other local factors under conditions prevailing at Dikopthof. *Mongr. Angew.*, 18 : 80-120.
- IMMS, A. D. 1912. On some Collembola from India, Burma and Ceylon. *Proc. zool. Soc. London* : 80-124.
- KNIGHT, C. 1961. The Tomocerinae in old field stands of North Carolina. *Ecology*, 42 : 140-149.
- KÜHNELT, W. 1950. *Bodenbiologie mit besonderer Berücksichtigung der Tierwelt*. Vienna. Harold.
- MACFADYEN, A. 1952. The small arthropods of a Molinia fen at Cothill. *J. Anim. Ecol.*, 21 : 87-117.
- MACFADYEN, A. 1953. Notes on methods for the extraction of small soil arthropods. *J. Anim. Ecol.*, 22 : 65-77.
- MARCUZZI, G. 1962. Contributes to the knowledge of soil fauna of South-Eastern Alps. *Intern. Congr. entomol.*, Wien, 1960-Verhandl, 3 : 154-158.
- MILNE, S. 1962. Phenology of a natural population of soil Collembola. *Pedobiologia*, 2 : 41-52.
- MURPHY, P. W. 1953. The biology of the forest soils with special reference to mesofauna or meiofauna. *J. Soil Sci.*, 4 : 155-193.
- PIPER, C. S. 1942. Soil and plant analysis. *Mongr. Waite Agric. Res. Inst., Univ. Adelaide*, South Australia.
- POOLE, T. B. 1961. An ecological study of the Collembola in a coniferous forest soil. *Pedobiologia*, 1 : 113-137.
- RAPOPORT, E. H. and Najt, J. 1966. Ecologia de los microarthropods en suelos Gley and Solonchak de Bahia Blanca, Argentina. Monografias, Progresos En Biología del Suelo, Actas Del Primer Coloquio Latin Americano de Biología del Suelo : 521-546.
- RAPOPORT, E. H. and de IZARRA, D. C. 1966. On the rhizosphere of some Argentine plants and its relation to soil microfauna. Monografias, Progresos En Biología del Suelo, Actas Del Primer Coloquio Latin Americano de Biología del Suelo : 609-614.
- RUSSELL, E. J. 1954. *Soil conditions and plant growth*. Longmans.
- RUSSELL, E. J. 1957. *The world of soils*. Collins.
- SHEALS, J. G. 1957. The Collembola and Acarina of uncultivated soil. *J. Anim. Ecol.*, 26 : 125-134.
- STÖCKLI, A. 1957. Die Metazoenfauna von Wiesen und Ackerboden aus der Umgebung von Zurich. *Landw. Jb. Schweiz.*, 6 : 571-595.
- STRICKLAND, A. H. 1947. The soil fauna of two contrasted plots of lands in Trinidad, British West Indies. *J. Anim. Ecol.*, 16 : 1-10.

- VAN DER DRIFT, J. 1951. Analysis of the animal community of beech forest floor. *Tijdschr. Ent.*, **94** : 1-168.
- WAKERLEY, S. B. 1963. Effect of lime and phosphate on soil Collembola. *Ann. appl. Biol.*, **5**(1) : 171-172.
- WALKLEY, A. and Black, I. A. 1934. An examination of the Degtjareff method for determining soil organic matter, and a proposed modification of the chromic acid titration method. *Soil Sci.*, **37** : 29-38.
- WEIS-FOGH, T. 1948. Ecological investigation of mites and collembolans in the soil. *Nat. Jutland.*, **1** : 135-270.
- YOSHII, R. 1959. Studies on the collembolan fauna of Malaya and Singapore. Contributions from the Biological Laboratory Kyoto University. No. **10** : 1-65.
- YOSHII, R. 1966. On some Collembola of Afghanistan, India and Ceylon, collected by Kuphe Expedition 1960. Kyoto University Scientific expedition to the Karakoram and Hindukush 1955. **8** : 333-405.

DIPTERA FROM N.E.F.A.* AND ASSAM FOOT HILLS
PART II, KAMENG FRONTIER DIVISION, SUBANSIRI
FRONTIER DIVISION, NORTH LAKHIMPUR
AND ASSAM FOOT HILLS

By

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(With 1 Text-figure)

I—INTRODUCTION

This part deals with the Diptera collections made by A. N. T. Joseph and party during the second N. E. F. A. Survey (April-May, 1966), which surveyed Kameng Frontier Division, Subansiri Frontier Division, North Lakhimpur and Assam Foot Hills. Kameng Frontier Division was resurveyed because it had not been possible to carry out a detailed survey during the previous one, *i. e.*, December 1965 to January 1966, owing to the extreme winter, whereas Assam Foot Hills was taken up again to explore the summer fauna.

II—SYSTEMATIC ACCOUNT

Family TIPULIDAE

1. *Tipula* (*Vestiplex*) *subtinctoria* Brunetti

1912. *Tipula subtinctoria* Brunetti, *Fauna Brit. India*, Diptera, Nematocera, : 326.
1961. *Tipula* (*Vestiplex*) *subtinctoria* Brunetti : Alexander, *Rec. Indian Mus.*, 59 (1 & 2) : 23.

Material.—1 ex., N. E. F. A, Subansiri Division, Ziro, 1585 m., 14. v. 1966.

Remarks.—Brunetti (*l. c.*) based his description from a single male from Kurseong, Darjeeling District.

2. *Tipula* (*Indotipula*) *flavescens* Brunetti

1923. *Tipula flavescens* Brunetti, *Fauna Brit. India*, Diptera, Nematocera, : 334.
1961. *Tipula* (*Indotipula*) *flavescens* Brunetti : Alexander, *Rec. Indian Mus.*, 59 (1 & 2) : 23

Material.—1 ex., N. E. F. A, Subansiri Division, Chukru, 1128 m., 22. v. 1966.

* Since named as Arunachal Pradesh

Remarks.—Brunetti (*l. c.*) described the species from a single female from Hakgalla, Ceylon.

3. *Nephrotoma concolorithorax* (Brunetti)

1912. *Pachyrhina concolorithorax* Brunetti, *Fauna Brit. India*, Diptera, Nematocera, : 346.

1961. *Nephrotoma concolorithorax* (Brunetti) : Alexander, *Rec. Indian Mus.*, 59 (1 & 2) : 21.

Material.—1 ex., N. E. F. A, Subansiri Division, Kimin, 198 m., 9. v. 1966.

Remarks.—Damaged; legs missing. Described from a male from Khasi Hills, Assam; and one female from Sylhet, Bangladesh.

4. *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 (1 & 2) : 21.

Material.—(i) 1 ex., N. E. F. A, Kameng Division, Dunn Bridge, 1524 m., 1. v. 1966 ; (ii) 1 ex., N. E. F. A, Subansiri Division, Hapoli, 1585 m., 15. v. 1966.

Remarks.—Reported from Mussoorie ; Kurseong; Darjeeling; also from Sikkim. Brunetti (1912) considers it as the commonest species to be found in the hilly parts of North India.

5. *Pachyrhina javensis* (Doleschall)

1856. *Tipula javensis* Doleschall (nec *T. javana* Wied.), *Nat. Tijds. Ned. Ind.*, 10 : 406.

1912. *Pachyrhina javensis* (Doleschall) : Brunetti, *Fauna Brit. India*, Diptera, Nematocera, : 348.

Material.—1 ex., N. E. F. A, Kameng Division, Tipi, 213 m., 6. v. 1966.

Remarks.—Brunetti (*l. c.*) redescribed the species from the collections taken at the base of the hills in the Naini Tal District. Also reported from Java; Sumatra; Ceylon.

6. *Antocha (Antocha) indica* Brunetti

1912. *Antocha indica* Brunetti, *Fauna Brit. India*, Diptera, Nematocera, : 426.

1961. *Antocha (Antocha) indica* Brunetti : Alexander, *Rec. Indian Mus.*, 59 (1 & 2) : 27.

Material.—1 ex., N. E. F. A., Kameng Division, Dunn Bridge, 1524 m., 21. iv. 1966.

Remarks.—Described from Phagu and Theog, Simla Hills; Kurseong, Darjeeling District; Mangaldai District, Assam-Bhutan border.

7. *Teucholabis fenestrata* Osten Sacken

1887. *Teucholabis fenestrata* Osten Sacken, *Beitr. Ent. Zeit.*, **31** : 198.
 1912. *Teucholabis fenestrata* Osten Sacken : Brunetti, *Fauna Brit. India*,
 Diptera, Nematocera, : 429.

Material.—2 exs., N. E. F. A., Subansiri Division, Pamir, 16. v. 1966.

Remarks.—Recorded from Nainital; Khasi Hills, Assam; also from Peradeniya, Ceylon.

8. *Symplecta punctipennis* (Meigen)

1818. *Limnophila punctipennis* Meigen, *Syst. Besch.*, **1** : 117, pl. 5, figs. 2, 3, 7.
 1912. *Symplecta punctipennis* (Meigen) : Brunetti, *Fauna Brit. India*, Diptera,
 Nematocera, : 486.

Material.—1 ex., N. E. F. A., Kameng Division, Dunn Bridge, 1524 m., 22. iv. 1966.

Remarks.—Brunetti (*l. c.*) redescribed the species from specimens collected from Matiana, Simla District; Darjeeling. It occurs throughout Europe.

9. *Pseudolimnophila* (*Pseudolimnophila*) *fusca* (Brunetti)

1918. *Limnophila fusca* Brunetti, *Rec. Indian Mus.*, **15** : 326.
 1961. *Pseudolimnophila* (*Pseudolimnophila*) *fusca* (Brunetti) : Alexander,
Rec. Indian Mus., **59** (1 & 2) : 28.

Material.—7 exs., N. E. F. A., Kameng Division, Shaitan Bridge, 1524 m., 23. iv. 1966.

Remarks.—Brunetti (*l. c.*) described the species from Sureil, Darjeeling District.

10. *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.—5 exs., N. E. F. A., Subansiri Division, Hapoli, 1585 m., 15. v. 1966.

Remarks.—Reported from Simla ; Naini Tal ; Kurseong ; also from Nepal.

Family BIBIONIDAE

11. *Penthetria japonica* Wiedemann

1830. *Penthetria japonica* Wiedemann, *Aussereurop. Zweifl. Ins.*, **2** : 618.
 1967. *Penthetria japonica* Wiedemann : Hardy, *Pacific Insects*, **9** (3) : 522.

Material.—(i) 49 exs., N. E. F. A., Kameng Division, Bomdila, 2621 m., 22. iv. 1966 ; (ii) 1 ex., N. E. F. A., Kameng Division, Tawang, 3200 m., 28. iv. 1966.

Remarks.—Reported from Japan; China; India ; Formosa.

12. *Dilophus graciosus* Bigot

1890. *Dilophus graciosus* Bigot, *J. Asiat. Soc. Beng.*, **59** : 265.
 1912. *Dilophus graciosus* Bigot : Brunetti, *Fauna Brit. India*, Diptera, Nematocera, : 178.
 1967. *Dilophus graciosus* Bigot : Hardy, *Pacific Insects*, **9** (3) : 526.

Material.—9 exs., N. E. F. A., Kameng Division, Tse La, 3657 m., 25. iv. 1966.

Remarks.—In males no white hairs below head. Thorax with a broad ferrugineous line; scutellar region rather dark; stems of halteres black. Abdomen generally black.

Recorded from Amangarh, Bijnor District; Kumaon District; Darjeeling District (several localities); also from Sadon, Upper Burma.

13. *Bibio fuscitibia* Brunetti

1911. *Bibio fuscitibia* Brunetti, *Rec. Indian Mus.*, **4** : 279.
 1912. *Bibio fuscitibia* Brunetti : Brunetti, *Fauna Brit. India*, Diptera, Nematocera : 175.
 1967. *Bibio fuscitibia* Brunetti : Hardy, *Pacific Insects*, **9** (3) : 532.

Material.—2 exs., N. E. F. A., Kameng Division, Tse La, 3657 m., 25. iv. 1966.

Remarks.—Reported from Phakia, Kumaon; Tonglu, Darjeeling.

Family SIMULIIDAE

14. *Simulium indicum* Becher

1844. *Simulium indicum* Becher, *J. Asiat. Soc. Beng.* **53** : 191.
 1912. *Simulium indicum* Becher : Brunetti, *Fauna Brit. India*, Diptera, Nematocera, : 191.

Material.—(i) 12 exs., N. E. F. A. Kameng Division, Tipi, 213 m., 3. v. 1966 ; (ii) 9 exs., N. E. F. A., Subansiri Division, Chukru, 1128 m., 22. v. 1966.

Remarks.—Recorded from Simla; Tons Valley, N. W. Himalaya; Kurseong and Darjeeling, Darjeeling District; Khasi Hills, Assam; also from Sylhet, E. Pakistan.

Family STRATIOMYIDAE

15. *Ptilocera fastuosa* Gerstaecker

1857. *Ptilocera fastuosa* Gerstaecker, *Linn. Ent.*, **11** : 332.
 1920. *Ptilocera fastuosa* Gerstaecker : Brunetti, *Fauna Brit. India*, Diptera, Brachycera, **1** : 34.

Material.—(i) 1 ex., N. E. F. A., Kameng Division, Tipi, 213 m., 6. v. 1966 ; (ii) 3 exs., N. E. F. A., Subansiri Division, Dejoo, 183 m., 10. v. 1966 ; (iii) 1 ex., N. E. F. A., Subansiri Division, Tamen, 457 m., 20. v. 1966.

Remarks.—Reported from India; Ceylon; Burma.

16. *Eudmeta marginata* (Fabricius)

1805. *Hermetia marginata* Fabricius, *Syst. Antl.*, : 63.
 1920. *Eudmeta marginata* (Fabricius) : Brunetti, *Fauna Brit. India*, Diptera, Brachycera, 1 : 42.

Material.—4 exs., Kameng Division, Tipi, 213 m., 6. v. 1966.

Remarks.—Pleura apple green in colour. Tips of scutellum green. Brunetti (*l.c.*) omitted to mention the presence of two narrow tubercles extending from the anterior extremities of scutellum towards the mesonotum.

Recorded in India from Darjeeling. Also known to occur from Burma; Java; Borneo; Sumatra.

17. *Negritomyia maculipennis* (Macquart)

1849. *Ephippium maculipenne* Macquart, *Dipt. Exot. Suppl.*, 4 : 54.
 1920. *Negritomyia maculipennis* (Macquart) : Brunetti, *Fauna Brit. India*, Diptera, Brachycera, 1 : 47.

Material.—(i) 1 ex., N.E.F.A., Subansiri Division, Dejoo, 183 m., 10. v. 1966; (ii) 1 ex., N.E.F.A., Subansiri Division, Tamen, 457 m., 18.v. 1966.

Remarks.—Palpi brownish. The indistinct whitish mark above each antenna absent. Facial region above the antennal base with two small patches of white hairs. Clubs of halteres snow-white.

Previously reported from Coorg, S. India; also from Kandy, Ceylon.

18. *Ptecticus aurifer* (Walker)

1854. *Sargus aurifer* Walker, *List. Dipt. Brit. Mus.*, 5 : 96.
 1920. *Ptecticus aurifer* (Walker) : Brunetti, *Fauna Brit. India*, Diptera, Brachycera, 1 : 78.

Material.—1 ex., N. E. F. A., Subansiri Division, Pamir, 564 m., 17. v. 1966.

Remarks.—Hind tarsi brownish. Reported from India; Sikkim; Borneo.

19. *Rosapha bicolor* (Bigot)

1879. *Calochaetis bicolor* Bigot, *Ann. Soc. Ent. France* : 189.
 1907. *Rosapha bicolor* (Bigot) : Brunetti, *Rec. Indian Mus.*, 1 : 93.

Material.—1 ex., N. E. F. A., Subansiri Division, Tamen, 457 m., 18. v. 1966.

Remarks.—Known to occur in Tura, Garo Hills and Sadiya, Assam; Kohima, Nagaland; Karkurghat, Nilgiri Hills.

Family TABANIDAE

20. *Tabanus nephodes* Bigot

1892. *Tabanus nephodes* Bigot, *Mem. Soc. Zool. France*, 5 : 656.
 1911. *Tabanus nephodes* Bigot : Ricardo, *Rec. Indian Mus.*, 4 : 145.

Material.—3 exs., N. E. F. A., Kameng Division, Tipi, 213 m., 6. v. 1966.

Remarks.—One specimen (ZSI Reg. No. 4201/H6) with a broad black lateral stripe on either side of thorax.

Previously recorded from Sibsagar, Assam; Naga Hills, Nagaland.

21. *Tabanus auriflamma* Walker

1848, *Tabanus auriflamma* Walker, *List Dipt. Brit. Mus.*, 1 : 155.

1911. *Tabanus auriflamma* Walker : Ricardo, *Rec. Indian Mus.*, 4 : 148.

Material.—1 ex., N. E. F. A., Subansiri Division, Kimin, 198 m., 11. v. 1966.

Remarks.—Reported from Sibsagar and Cachar, Assam; Naga Hills, Nagaland; also from Sylhet, Bangladesh.

22. *Tabanus albimediis* Walker

1850. *Tabanus albimediis* Walker, *Dipt. Saund.*, : 48.

1911. *Tabanus albimediis* Walker : Ricardo, *Rec. Indian Mus.*, 4 : 156.

Material.—2 exs., Assam, Sonai Rupai Forest, 79 m., 28. v. 1966.

Remarks.—Palpi with black hairs. The fore legs comparatively darker.

National Zoological Collections contain specimens from Kashmir; Punjab; Orissa; Bihar; W. Bengal. Also known to occur in Nepal; Ceylon.

23. *Tabanus monotaeniatus* (Bigot)

1892. *Atylotus monotaeniatus* Bigot, *Mem. Soc. Zool. France*, 5 : 655.

1911. *Tabanus monotaeniatus* (Bigot) : Ricardo, *Rec. Indian Mus.*, 4 : 159.

Material.—(i) 1 ex., N. E. F. A., Kameng Division, Denling Forest, 229 m., 5. v. 1966; (ii) 2 exs., N. E. F. A., Subansiri Division, Kimin, 198 m., 11. v. 1966; (iii) 1 ex., Assam, Sonai Rupai Forest, 79 m., 28. v. 1966.

Remarks.—Specimens comparatively darker. Reported from several localities of Assam.

24. *Tabanus jucundus* Walker

1848. *Tabanus jucundus* Walker, *List. Dipt.*, 1 : 187.

1911. *Tabanus jucundus* Walker : Ricardo, *Rec. Indian Mus.*, 4 : 164.

Material.—2 exs., Assam, Sonai Rupai Forest, 79 m., 28 v. 1966.

Remarks.—Reported from Uttar Pradesh; Punjab; Western Ghats. Also recorded from Ceylon; Hongkong.

25. *Tabanus sanguineus* Walker

1850. *Tabanus sanguineus* Walker, *Dipt. Saund.*, 1 : 54.

1911. *Tabanus sanguineus* Walker : Ricardo, *Rec. Indian Mus.*, 4 : 194.

Material.—2 exs., Assam, Sonai Rupai Forest, 79 m., 28.v,1966,

Remarks.—Palpi with abundant black hairs. In one specimen with the ZSI Registration No. 4093/H6, the grey haired tomentose hind border interrupted on either side of the triangle.

Reported from Pusa, Bihar; Khasi Hills, Assam, also from Hongkong; Burma; Malaya; Java; Sumatra.

26. *Haematopota assamensis* Ricardo

1911. *Haematopota assamensis* Ricardo, *Rec. Indian Mus.*, 4 : 343.

Material.—(i) 1 ex., N. E. F. A., Kameng Division, Denling Forest, 229 m., 5.v.1966 ; (ii) 1 ex., N. E. F. A., Subansiri Division, Kimin, 198 m., 11.v.1966.

Remarks.—Recorded from Nangpoh and Shillong, Assam.

27. *Chrysops dispar* (Fabricius)

1798. *Tabanus dispar* Fabricius, *Ent. Syst. Suppl.* : 567.

1911. *Chrysops dispar* (Fabricius) : Ricardo, *Rec. Indian Mus.*, 4 : 380.

Material.—(i) 3 exs., N.E.F.A., Subansiri Division, Kimin, 198 m., 9.v.1966 ; (ii) 1 ex., N.E.F.A., Subansiri Division, Dejoo, 183 m., 10.v.1966 ; (iii) 1 ex., Assam, Sonai Rupai Forest, 79 m., 28.v.1966 ;

Remarks.—Widely distributed in India. Also reported from Ceylon; Nepal; Singapore; Rangoon; Hongkong; Java; Sumatra; Thailand ; Taiwan.

28. *Chrysops designata* Ricardo

1911. *Chrysops designata* Ricardo, *Rec. Indian Mus.*, 4 : 383.

Material.—(i) 1 ex., N. E. F. A., Kameng Division, Tipi, 213 m., 3.v.1966 ; (ii) 2 exs., N. E. F. A., Subansiri Division, Kimin, 198 m., 9.v.1966 ; (iii) 1 ex., N. E. F. A., Subansiri Division, Kimin, 198 m., 11.v.1966 ; (iv) 1 ex., N. E. F. A., Subansiri Division, Ziro, 1585 m., 13.v.1966.

Remarks.—In the second abdominal tergum of male, the black colour not forming a complete hind margin and so the yellow triangle touches the hind border. The females differ in that, the black colour begins a little away from the anterior margin of the second tergum, at the same time they agree with the named general National Collections.

Reported from Jaulasal, Naini Tal District. The National Zoological Collections also contain specimens from Kashmir.

29. *Chrysops flavocincta* Ricardo

1902. *Chrysops flavocincta* Ricardo, *Ann. Mag. nat. Hist.*, (7) 9 : 380.

1911. *Chrysops flavocincta* Ricardo : Ricardo, *Rec. Indian Mus.*, 4 : 395.

Material.—1 ex., Assam, North Lakhimpur, 91 m., 26.v.1966.

Remarks.—Abundant on the western side of Western Ghats. Reported from Khasi Hills; Sarawak; Trincomalee.

Family BOMBYLIIDAE

30. *Hyperalonia tantalus* (Fabricius)

1794. *Anthrax tantalus* Fabricius, *Ent. Syst.*, 4 : 260.

1920. *Hyperalonia tantalus* (Fabricius) : Brunetti, *Fauna Brit. India*, Diptera, *Brachycera*, 1 : 181.

Material.—2 exs., N. E. F. A., Kameng Division, Tipi, 213 m., 3.v.1966.

Remarks.—Reported from India; Nepal; Sumatra; Java; Borneo; Celebes, China; Japan.

31. *Hyperalonia oenomaus* Rondani

1875. *Hyperalonia oenomaus* Rondani, *Ann. Mus. Gen.*, 7 : 453.

1920. *Hyperalonia oenomaus* Rondani : Brunetti, *Fauna Brit. India*, Diptera, *Brachycera*, 1 : 185.

Material.—1 ex., N. E. F. A., Kameng Division, Tipi, 213 m., 3.v.1966 and 1 ex., 6.v.1966.

Remarks.—Reported from Peshoke Spur, Darjeeling District; Sadiya, Assam; also from Rungpo, Sikkim; Mergui, Burma; Philippines.

32. *Argyramoeba distigma* (Wiedemann)

1828. *Anthrax distigma* Wiedemann, *Aussereurop. Zweifl. Ins.*, 1 : 309.

1920. *Argyramoeba distigma* (Wiedemann) : Brunetti, *Fauna Brit. India*, Diptera, *Brachycera*, 1 : 218.

Material.—1 ex., N. E. F. A., Subansiri Division, Tamen, 305 m., 19.v.1966.

Remarks.—Wings with a well marked fuscous spot well separated from the anterior dark band of the wing.

Widely distributed in India.

33. *Anthrax paniscus* (Rossi)

1790. *Bibio paniscus* Rossi, *Fauna Etrus.*, 2 : 256.

1920. *Anthrax paniscus* (Rossi) : Brunetti, *Fauna Brit. India*, Diptera, *Brachycera*, 1 : 248.

Material.—1 ex., N. E. F. A., Kameng Division, Dunn Bridge, 524 m., 1.v.1966.

Remarks.—Reported from Simla; Naini Tal.

Family ASILIDAE

34. *Michotamia aurata* (Fabricius)

1794. *Asilus aurata* Fabricius, *Ent. Syst.*, 4 : 387.

1960. *Michotamia aurata* (Fabricius) : Ratan Lal, *Catalogue Indian Insects*, part 29, Asilidae, Diptera : 9.

Material.—1 ex., N. E. F. A., Subansiri Division, Dejoo, 183 m., 10.v.1966.

Remarks.—Recorded from Darjeeling; Madras; also from Celebes.

35. *Merodontina robusta* Rao & Parui

1969. *Merodontina robusta* Rao & Parui, *Zool. Anz.*, **182** : 110.

Material.—1 ex., N. E. F. A., Subansiri Division, Pinjuli, 244 m., 4.v.1966.

Remarks.—Hind tibia dorsally with 5 bristles, all black in colour. Originally described from Denzi, Kameng Division, N. E. F. A.,

36. *Philodicus femoralis* Ricardo

1921. *Philodicus femoralis* Ricardo, *Ann. Mag. nat. Hist.*, (9) **8** : 190.

1960. *Philodicus femoralis* Ricardo : Ratan Lal, *Catalogue Indian Insects*, part 29, Asilidae, Diptera, : 35.

Material.—5 exs., Assam, Charduar, 79 m., 29.v.1966.

Remarks.—New to Z. S. I. collections. Known to occur in Pusa and Chapra, Bihar; Sadiya, Assam; also in Burma.

Family CONOPIDAE

37. *Physocephala calopus* (Bigot)

1887. *Conops calopus* Bigot, *Ann. Soc. Ent. France*, (6) **7** : 133.

1923. *Physocephala calopus* (Bigot) : Brunetti, *Fauna Brit. India*, Diptera, **3** : 364.

Material.—(i) 1 ex., N. E. F. A., Subansiri Division, Tamen, 457 m., 20.5.1966; (ii) 1 ex., N. E. F. A., Subansiri Division, Tamen, 305 m., 19.v.1966.

Remarks.—Originally described from Pondicherry. Distributed in Almora, Kumoan District; Deesa, Gujarat; Abu, Rajasthan ; several localities of Darjeeling District; also in Quetta, W. Pakistan.

Family SYRPHIDAE

38. *Paragus serratus* (Fabricius)

1805. *Mulio serratus* Fabricius, *Syst. Antliat.*, : 186.

1923. *Paragus serratus* (Fabricius) : Brunetti, *Fauna Brit. India*, Diptera, **3** : 31.

Material.—(i) 5 exs., N. E. F. A., Subansiri Division, Kimin, 198 m., 11.v.1966. (ii) 1 ex., Assam, Tezpur, 79 m., 30.v.1966.

Remarks.—This species exhibits much variation in the abdominal colouration.

Widely distributed in India; also commonly occurring in Africa.

39. *Paragus indicus* (Brunetti)

1908. *Pipizella indica* Brunetti, *Rec. Indian Mus.*, **2** : 52.

1923. *Paragus indicus* (Brunetti) : Brunetti, *Fauna Brit. India*, Diptera, **3** : 33.

Material.—2 exs., N. E. F. A., Kameng Division, Dunn Bridge, 1524 m., 21.iv. 1966.

Remarks.—Originally described from Simla District; and Kathmandu, Nepal. Reported from Simla; Mussoorie; Allahabad; Darjeeling; Chapra; Pusa; Tenmalai, S. India.

40. *Melanostoma orientale* (Wiedemann)

1824. *Syrphus orientalis* Wiedemann, *Analec. Ent.*, : 36.

1923. *Melanostoma orientale* (Wiedemann) : Brunetti, *Fauna Brit. India*, Diptera, 3 : 48.

Material.—(i) 1 ex., N. E. F. A., Kameng Division, Bomdila, 2621 m., 22.iv.1966; (ii) 11 exs., N. E. F. A., Subansiri Division, Ziro, 1585 m., 13.v.1966; (iii) 2 exs., Subansiri Division, Ziro, 1585 m., 14.v.1966; (iv) 9 exs., Subansiri Division, Hapoli, 1585 m., 15.v.1966; (v) 3 exs., Subansiri Division, Chukru, 1128 m., 22.v.1966; (vi) 2 exs., Subansiri Division, Godak, 915 m., 23.v.1966.

Remarks.—The extension of black and orange yellow spots of abdominal terga varying; in some examples the orange yellow almost hidden below the black colour, others with the mediolongitudinal black mark absent in third, fourth and rarely in second.

Widely distributed species of the genus in the East.

41. *Melanostoma univittatum* (Wiedemann)

1824. *Syrphus univittatus* Wiedemann, *Analec. Entom.*, : 36.

1923. *Melanostoma univittatum* (Wiedemann) : Brunetti, *Fauna Brit. India*, Diptera, 3 : 50.

Material.—(i) 1 ex., N. E. F. A., Kameng Division, Tipi, 213 m., 3.v.1966; (ii) 3 exs., N. E. F. A., Kameng Division, Pinjuli, 244 m., 4.v.1966; (iii) 1 ex., N. E. F. A., Subansiri Division, Chukru, 1128 m., 22.v.1966.

Remarks.—Recorded from Darjeeling; Chapra and Pusa, Bihar; Sadiya, Dibrugarh and Shillong, Assam; Coorg, Nedungadu and Coromander, S. India; also from Ceylon; Lower Burma; Sumatra; Queensland.

42. *Asarcina ericetorum* (Fabricius)

1781. *Syrphus ericetorum* Fabricius, *Spec. Ins.*, 2 : 425.

1923. *Asarcina ericetorum* (Fabricius) : Brunetti, *Fauna Brit. India*, Diptera, 3 : 63.

Material.—(i) 1 ex., N. E. F. A., Subansiri Division, Dejoo, 183 m., 10.v.1966; (ii) 13 exs., Subansiri Division, Kimin, 198 m., 11.v.1966; (iii) 3 exs., N. E. F. A., Subansiri Division, Tamen, 457 m., 18.v.1966.

Remarks.—The orange-yellow abdomen masked with fuscous in varying degrees and hence only a few show typical colouration. In one male specimen, with the ZSI Registration No. 4204/H6, the semicircular spot on the upper side of the antennal prominence brownish.

Widely distributed in India and the East in both hills and plains throughout the greater part of the year.

43. *Asarcina aegrota* (Fabricius)

1805. *Eristalis aegrota* Fabricius, *Syst. Antl.*, : 243.
 1923. *Asarcina aegrota* (Fabricius) : Brunetti, *Fauna Brit. India*, Diptera, 3 : 64.

Material.—(i) 1 ex., N. E. F. A., Kameng Division, Tipi, 213 m., 3.v.1966 and 3 exs., 6.v.1966; (ii) 1 ex., N. E. F. A., Kameng Division, Pinjuli, 244 m., 4.v.1966; (iii) 2 exs., N. E. F. A., Kameng Division, Denling Forest, 229 m., 5. v.1966; (iv) 4 exs., N. E. F. A., Subansiri Division, Kimin, 198 m., 11.v.1966; (v) 1 ex., N.E.F.A., Subansiri Division, Ziro, 1585 m., 14.v.1966; (vi) 1 ex., N. E. F. A., Subansiri Division, Pamir, 564 m., 17.v.1966; (vii) 8 exs., N.E.F.A., Subansiri Division, Tamen, 457 m., 18. v.1966 and 2 exs., 20.v.1966; (viii) 4 exs., Assam, Sonai Rupai Forest, 79 m., 28.v.1966.

Remarks.—Widely distributed in India and the East.

44. *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) 3 exs., N. E. F. A., Kameng Division, Tipi, 213m., 3.v.1966 and 2 exs., 6.v.1966; (ii) 4 exs., N. E. F. A., Kameng Division, Pinjuli, 244 m., 4.v.1966; (iii) 2 exs., N. E. F. A., Subansiri Division, Kimin, 198 m., 9.v.1966; (iv) 4 exs., N. E. F. A., Subansiri Division, Dejoo, 183 m., 10.v.1966; (v) 20 exs., N.E.F.A., Subansiri Division, Kimin, 198 m., 11.v.1966; (vi) 6 exs., N. E. F. A., Subansiri Division, Ziro, 1585 m., 13.v.1966; (vii) 5 exs., N. E. F. A., Subansiri Division, Ziro, 1585 m., 14.v.1966; (viii) 5 exs., N.E.F.A., Subansiri Division, Hapoli, 1585 m., 15. v. 1966; (ix) 1 ex., N.E.F.A., Subansiri Division, Pamir, 564 m., 17.v.1966; (x) 6 exs., N.E.F.A., Subansiri Division, Tamen, 457 m., 18.v.1966 and 5 exs., 20.v.1966; (xi) 2 exs., N.E.F.A., Subansiri Division, Tamen, 305 m., 19.v.1966; (xii) 1 ex., N. E. F. A., Subansiri Division, Chukru, 1128 m., 22.v.1966.

Remarks.—Extremely common throughout the East in Hills and plains; also known to occur in Europe; Maderia; Canaries; N.Africa; Asia to Japan.

45. *Syrphus corollae* (Fabricius)

1794. *Scaeva corollea* Fabricius, *Ent. Syst.*, 4 : 306.
 1923. *Syrphus corollae* (Fabricius) : Brunetti, *Fauna Brit. India*, Diptera, 3 : 85.

Material.—(i) 1 ex., N. E. F. A., Kameng Division, Dunn Bridge, 1524 m., 21.iv.1966; (ii) 1 ex., N. E. F. A., Subansiri Division, Hapoli, 1585 m., 5.v.1966.

Remarks.—In the specimen bearing Z. S. I. Registration No. 4206/H6, the hind femur without black marking.

The range of distribution includes all Europe; Madeira and Canaries; N. Africa; Asia to Japan.

46. *Ischiodon scutellaris* (Fabricius)

1805. *Scaeva scutellaris* Fabricius, *Syst. Antl.*, : 252.
1923. *Ischiodon scutellaris* (Fabricius) : Brunetti, *Fauna Brit. India*, Diptera, 3 : 97.

Material.—(i) 1 ex., N. E. F. A., Kameng Division, Dunn Bridge, 1524 m., 1.v.1966; (ii) 1 ex., N. E. F. A., Kameng Division, Tipi, 213 m., 6.v.1966; (iii) 1 ex., Subansiri Division, Tamen, 457 m., 20.v.1966; (iv) 1 ex., N. E. F. A., Subansiri Division, Tamen, 305 m., 18.v.1966 and 1 ex., 19.v.1966.

Remarks.—In the specimen with the ZSI Registration No. 4202/H6, the hind margin of abdomen predominately black.

Very common in India, especially in Assam; widely distributed in the East; common in North Africa.

47. *Miogramma javana* (Wiedemann)

1824. *Syrphus javanus* Wiedemann, *Anal. Ent.*, : 34.
1923. *Sphaerophoria javana* (Wiedemann) : Brunetti, *Fauna Brit. India*, Diptera, 3 : 100.
1945. *Miogramma javana* (Wiedemann), Frey, *Notul. ent.*, 25 : 165.

Material.—(i) 2 exs., N. E. F. A., Subansiri Division, Kimin, 198 m., 11.v.1966; (ii) 1 ex., N. E. F. A., Subansiri Division, Ziro, 1585 m., 13.v.1966; (iii) 1 ex., Subansiri Division, Pamir, 564 m., 17.v.1966; (iv) 3 exs., N. E. F. A., Subansiri Division, Tamen, 457 m., 18.v.1966.

Remarks.—Distributed in Tura, Assam; Coorg, South India; also in Ceylon; Java; Sumatra; New Guinea.

48. *Sphaerophoria nigratarsis* Brunetti

1915. *Sphaerophoria* "Form 3 *nigratarsis*", Brunetti, *Rec. Indian Mus.*, 11 : 216.
1923. *Sphaerophoria indiana* Bigot : Brunetti, *Fauna Brit. India*, Diptera, 3 : 102.
1967. *Sphaerophoria nigratarsis* Brunetti : Joseph, *Oriental Insects*, 1 (3 & 4) : 244.

Material.—(i) 3 exs., N. E. F. A., Kameng Division, Dunn Bridge, 1524 m., 21.v.1966; (ii) 3 exs., Kameng Division, Pinjuli, 244 m., 4.v.1966; (iii) 3 exs., N. E. F. A., Subansiri Division, Ziro, 1585 m., 13.v.1966.

Remarks.—Brunetti erected this as a form in 1915, which he himself later on synonymised with *Sphaerophoria indiana* Bigot. Joseph (*l.c.*) in his recent paper raised this to species and type designated.

So far known to occur from Simla; Kurseong.

49. *Baccha dispar* Walker

1860. *Baccha dispar* Walker, *Proc. Linn. Soc. London*, 4 : 121.
1923. *Baccha dispar* Walker : Brunetti, *Fauna Brit. India*, Diptera, 3 : 115.

Material.—1 ex., N. E. F. A., Subansiri Division, Kimin, 198 m., 11.v.1966.

Remarks.—Much more darker than those described in Fauna ; the yellowish spots on the third and fourth abdominal segments rather indistinct.

Reported from Nilgiris, South India; also from Celebes,.

50. *Baccha amphithoe* Walker

1849. *Baccha amphithoe* Walker, *List Diptera Brit. Mus.*, 3 : 549.

1923. *Baccha amphithoe* Walker : Brunetti, *Fauna Brit. India*, Diptera, 3 : 126.

Material.—(i) 1 ex., N. E. F. A., Subansiri Division, Dejoo, 183 m., 10.v.1966; (ii) 1 ex., N. E. F. A., Subansiri Division; Kimin, 198 m., 11.v.1966.

Remarks.—Recorded from Cherrapunji, Assam; Sibpur and Calcutta, Bengal; also from Sikkim; Ceylon.

51. *Eristalis tenax* (Linnaeus)

1758. *Musca tenax* Linnaeus, *Syst. Nat. Ed.* 10 : 591.

1923. *Eristalis tenax* (Linnaeus) : Brunetti, *Fauna Brit. India*, Diptera, 3 : 173.

Material.—(i) 4 exs., N. E. F. A., Kameng Division, Dunn Bridge, 1524 m., 1.v.1966; (ii) 2 exs., N. E. F. A., Kameng Division, Bomdila, 2621 m., 22.iv.1966; (iii) 2 exs., N. E. F. A., Kameng Division, Shaitan Bridge, 1524 m., 23.iv.1966; (iv) 3 exs., N. E. F. A., Kameng Division, Tawang, 3200 m., 27.iv.1966 and 1 ex., 28. iv. 1966; (v) 6 exs., N. E. F. A., Subansiri Division, Ziro, 1585 m., 13.v.1966; (vi) 20 exs., N. E. F. A., Subansiri Division, Ziro, 1585 m., 14.v.1966; (vii) 21 exs., N. E. F. A., Subansiri Division, Hapoli, 1585 m., 15.v.1966; (viii) 1 ex., N. E. F. A., Subansiri Division, Tamen, 457 m., 18.v.1966 and 1 ex., 20. v.1966; (ix) 1 ex., N. E. F. A., Subansiri Division, Tamen, 305 m., 19.v.1966.

Remarks.—In the variety *campestris* mentioned by Brunetti (*l.c.*), the basal half of the hind femora is pale. In fact this portion exhibits such colour variations from black to pale that it is difficult to establish the variety definitely. So here no attempt has been made to separate out the variety. The specimen bearing the ZSI Registration No. 4203/H6 differs as follows : basal half of the hind tibia distinct yellow; wing and face blacker; and scutellum brownish yellow covered with matching hairs. The genitalic study confirms the species.

The most cosmopolitan species of the family occurring in the East. India; Ceylon; Burma; the Malay Peninsula and eastwards to Japan.

52. *Eristalis arvorum* (Fabricius)

1787. *Syrphus arvorum* Fabricius, *Mant. Ins.*, : 335.

1923. *Eristalis arvorum* (Fabricius) : Brunetti, *Fauna Brit. India*, Diptera, 3 : 181,

Material.—(i) 12 exs., N.E.F.A., Kameng Division, Tipi, 213 m., 3.v.1966 ; (ii) 2 exs., N. E. F. A., Kameng Division, Tipi, 213 m., 6.v.1966 ; (iii) 6 exs., N. E. F. A., Subansiri Division, Pamir, 564 m., 17.v.1966.

Remarks.—Common all over India; also occurring almost all parts of the Orient.

53. *Eristalis himalayensis* Brunetti

1880. *Eristalis ursinus* Bigot (*nec* Jaennicke), *Ann. Soc. Ent. France*, (5) 10 : 215.

1923. *Eristalis himalayensis* Brunetti : Brunetti, *Fauna Brit. India*, Diptera, 3 : 168.

Material.—(i) 1 ex., N. E. F. A., Kameng Division, Tse La, 3657 m., 25.iv.1966 ; (ii) 1 ex., N. E. F. A., Kameng Division, Tawang, 320 m., 28.iv.1966.

Remarks.—Thorax without greyish band along the transverse suture or at the anterior margin.

Originally described by Bigot from India. It is of common occurrence along Himalaya at about 1500 m. and upwards during the summer.

54. *Eristalis quinquelineatus* (Fabricius)

1781. *Syrphus quinquelineatus* Fabricius, *Spec. Ins.*, 2 : 425.

1830. *Eristalis quinquelineatus* (Fabricius) : Wiedemann, *Aussereurop. Zweifl. Ins.*, 2 : 185.

Material.—(i) 2 exs., N. E. F. A., Kameng Division, Dunn Bridge, 1524 m., 21.iv.1966 ; (ii) 1 ex., N.E.F.A., Subansiri Division, Pamir, 564 m., 12.v.1966 ; (iii) 1 ex., N.E.F.A., Subansiri Division, Tamen, 457 m., 20.v.1966.

Remarks.—Reported from Kasauli, Theog and Phagu, Simla District; Naini Tal and Bijnor, Uttar Pradesh; Kurseong, Darjeeling district ; Mysore, Ootacamund and Yercaud, South India.

55. *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., N. E. F. A., Subansiri Division, Tamen, 305 m., 19.v.1966.

Remarks.—Very common throughout the East.

56. *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.—(i) 1 ex., N. E. F. A., Subansiri Division, Dejoo, 183 m., 10.v.1966 ; (ii) 2 exs., N. E. F. A., Subansiri Division, Chukru, 22.v.1966.

Remarks.—In these three females, the extension of orange brown and black colour of abdomen variable. In the second tergum of the specimens bearing ZSI Registration Nos. 4107/H6 and 4108/H6, the lateral black marks small and not united with the broad mediolongitudinal mark. The specimen registered under 4112/H6, with a broad mediolongitudinal black stripe with which unite the wide lateral marks in 2nd, 3rd and 4th tergites.

Reported from Simla and Rampore Chaka, Uttar Pradesh; Khasi Hills, Assam; North Bengal; Nilgiris, Yercaud and Salem, South India ; also from Ceylon.

Family SEPSIDAE

57. *Sepsis indica* Wiedemann

1830. *Sepsis indica* Wiedemann, *Aussereurop. Zweifl. Ins.*, 2 : 467.

1909. *Sepsis indica* Wiedemann : Brunetti, *Rec. Indian Mus.*, 3 : 357.

Material.—1 ex., N. E. F. A., Subansiri Division, Godak, 975 m., 23. v. 1966.

Remarks.—Recorded from Calcutta; Rajmahal, Bihar ; Sadiya, Assam; Maddathorai and Pallode, South India ; also from Sikkim.

58. *Sepsis rufa* Macquart

1850. *Sepsis rufa* Macquart, *Dipt. Exot. Suppl.*, 4 : 269.

1909. *Sepsis rufa* Macquart : Brunetti, *Rec. Indian Mus.*, 3 : 359.

Material.—2 exs., N. E. F. A., Subansiri Division, Godak, 975 m., 23.v.1966.

Remarks.—Reported from Simla; Kurseong, Darjeeling and Calcutta, W. Bengal; Shillong, Assam; Puri, Orissa; also from Rangoon.

Family TEPHRITIDAE

59. *Dacus (Strumeta) cucurbitae* Coquillett

1899. *Dacus cucurbitae* Coquillett, *Ent. News*, : 129.

1913. *Bactrocera cucurbitae* (Coquillett) : Bezzi, *Mem. Indian Mus.*, 3 : 96.

1960. *Dacus (Strumeta) cucurbitae* Coquillett : Narayanan and Batra, *Fruitflies and their control*, : 26.

Material.—1 ex., Sta. No. 7, N. E. F. A., Kameng Division, Tipi, 213 m., 6.v.1966.

Remarks.—This species attacks a large variety of cucurbits, other vegetables and occasionally fruits.

Widely distributed in India; also recorded from Nepal; Pakistan; Ceylon ; Burma ; Thailand ; Federated Malay States ; Java ; China ; Taiwan ; Philippines ; Hawaiian Islands ; Australia ; East Africa.

60. *Ptilona nigriventris* Bezzi

1913. *Ptilona nigriventris* Bezzi, *Mem. Indian Mus.*, 3 : 110.

Material.—1 ex., N. E. F. A., Subansiri Division, 198 m., 9.v.1966.

Remarks.—Reported from Khasi Hills, Assam; also from Sylhet, Bangladesh

61. *Tephrostola acrostacta* (Wiedemann)

1824. *Trypeta acrostacta* Wiedemann, *Anal. Entom.*, 54 : 119.

1913. *Tephrostola acrostacta* (Wiedemann) : Bezzi, *Mem. Indian Mus.*, 3 : 153.

Material.—1 ex., N. E. F. A., Subansiri Division, Tamen, 305 m., 18.v.1966.

Remarks.—Reported from Calcutta; Ranchi, Bihar; Puri, Orissa; also from Sikkim; Bangladesh ; Burma.

Family MUSCIDAE

62. *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.—1 ex., N. E. F. A., Kameng Division, Dahung, 1524 m., 23.iv.1966.

Remarks.—Found in the houses throughout the year and popularly known as the housefly.

Distribution world-wide.

63. *Musca (Musca) domestica vicina* Macquart

1851. *Musca vicina* Macquart, *Mem. Soc. Sc. Agric. Arts Lille* : 226.

1965. *Musca (Musca) domestica vicina* Macquart : Emden, *Fauna India*, Diptera, 7 (1) : 55.

Material.—(i) 4 exs., N. E. F. A., Kameng Division, Dunn Bridge, 1524 m., 1.v.1966; (ii) 6 exs., N. E. F. A., Kameng Division, Dahung, 1524 m., 23.iv.1966.

Remarks.—World-wide in tropical and subtropical belt. Very common in the whole of Oriental region.

64. *Musca (Byomyia) sorbens* Wiedemann

1830. *Musca sorbens* Wiedemann, *Aussereurop. Zweifl. Ins.*, 2 : 418.

1965. *Musca (Byomyia) sorbens* Wiedemann : Emden, *Fauna India*, 7 (1) : 61.

Material.—1 ex., Assam, Tezpur, 79 m., 30.v.1966.

Remarks.—Distributed throughout the Ethiopian, Oriental and Australian regions.

65. *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., N. E. F. A., Subansiri Division, Kimin, 198 m., 9.v.1966; (ii) 1 ex., N. E. F. A., Subansiri Division, Dejoo, 183 m., 10.v.1966.

Remarks.—Reported to be a blood-sucking species attacking the legs and abdomen of cattle, horses and donkeys and is said to bite man occasionally.

Distributed in the whole of Oriental region; also in mediterranean; Socotra Sudan; Belgian Congo; S. Rhodesia; Transvaal.

66. *Musca (Viviparomusca) bezzii* Patton and Cragg

1913. *Musca bezzii* Patton and Cragg, *Ind. J. med. Res.*, 1 : 19.

1965. *Musca (Viviparomusca) bezzii*, Patton and Cragg : Emden, *Fauna India*, Diptera, 7 (1) : 83.

Material.—1 ex., Assam, Sonai Rupai Forest, 79 m., 28.v.1966.

Remarks.—Haematophagous in habit and found on and around animals.

Widely distributed at altitudes of 500 m. and above.

67. *Orthellia fletcheri* Emden

1965. *Orthellia fletcheri* Emden, *Fauna India*, Diptera, 7 (1) : 122.

Material.—(i) 1 ex., N. E. F. A., Subansiri Division, Ziro, 1585 m., 13.v.1966; (ii) 2 exs., N. E. F. A., Subansiri Division, Ziro, 1585 m., 14.v.1966.

Remarks.—Emden (*l.c.*) erected the species on females. The male (ZSI Registration No. 4181/H6) is caught for the first time. It differs from the females in that the ocellars are not strongly developed and the eyes contiguous with strongly enlarged inner facets.

Recorded from Siliguri, Kurseong and Darjeeling, W. Bengal; Shillong, Assam; Kodaikanal, Madras; also from Ceylon; Burmae.

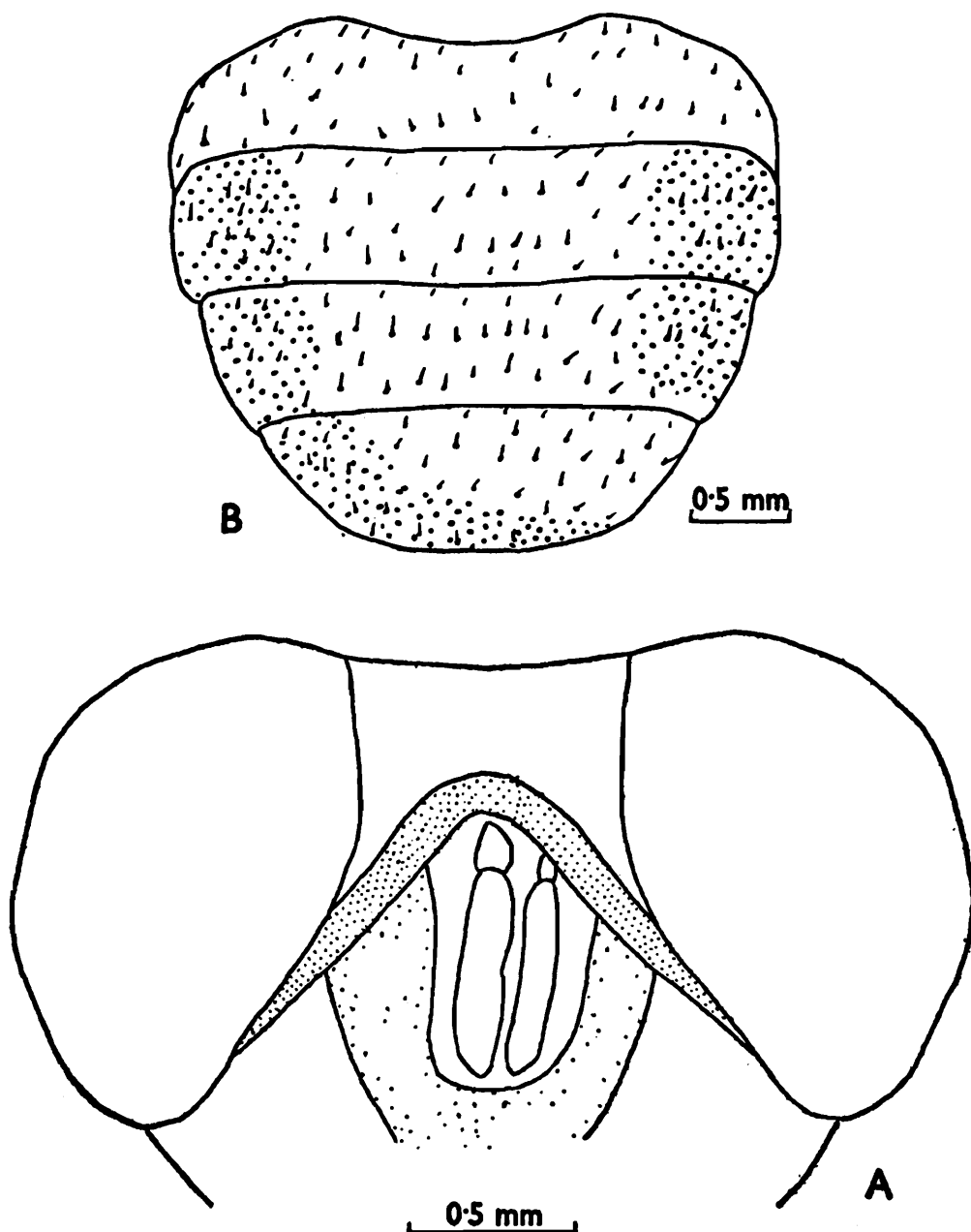
68. *Orthellia coerulea* (Wiedemann)

1819. *Musca coerulea* Wiedemann, *Zool. Mag.*, 3 : 23.

1965. *Orthellia coerulea* (Wiedemann) : Emden, *Fauna India*, 7 (1) : 124.

Material.—(i) 2 exs., N. E. F. A., Kameng Division, Dunn Bridge, 1524 m., 21.iv.1966 and 1 ex., 1.v.1966; (ii) 60 exs., N. E. F. A., Subansiri Division, Ziro, 1585m., 13.v.1966; (iii) 10 exs., N. E. F. A., Subansiri Division, Ziro, 1585m., 14.v.1966; (iv) 18 exs., N. E. F. A.,

Subansiri Division, Pamir, 564 m., 18.v. 1966; (v) 2 exs., N. E. F. A., Subansiri Division, Tamen, 457 m., 18. v. 1966; and 2 exs., 20.v.1966; (vi) 4 exs., N. E. F. A., Subansiri Division, Tamen, 305 m., 18.v. 1966; and 9 exs., 19.v. 1966 (vii) 3 exs., N. E. F. A., Subansiri Division, Chukru, 1128 m., 22.v.1966.



TEXT-FIG. 1A. *Orthellia coerulea* (Wiedemann), face from above of the unique specimen wherein the antennae rest in a deep facial socket ; B. *Chlororhinia temenensis* sp. n., dorsal view of abdomen.

Remarks.—This species exhibits much intraspecific variations and some of the noteworthy features are as follows : In typical males the inner facets of compound eyes are strongly enlarged. The present collection contains male specimens wherein the facets are uniformly smaller in size, intermediate forms with slightly larger inner facets and finally typical forms with strongly enlarged facets.

Thus a complete evolutionary series can be traced starting from the uniformly smaller to the strongly enlarged facets of compound eyes.

In preserved specimens normally the antennae can be seen clearly in side-view, but in an unique female specimen bearing ZSI Registration No. 4193/H6, the clypeus forms a deep socket (text-fig. 1A) within which rests the antennae. In lateral view only the arista are seen.

In a female specimen with ZSI Registration No. 4192/H6, there is a conical projection of lunula along with the base of antenna at its lower side. In the specimen registered under the No. 4191/H6, on one side with three conspicuous *prst dc*, the opposite side being normal.

Reported from India; Ceylon; Sikkim; Nepal; Burma; Malaya; Thailand/China; Taiwan; Japan; Indonesia to Australia; Solomon Islands.

69. *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., N.E.F.A., Subansiri Division, Dejoo, 183 m., 10.v.1966; (ii) 1 ex., N. E. F. A., Subansiri Division, Tamen, 457 m., 20.v.1966; (iii) 1 ex., Assam, Tezpur, 79 m., 30.v.1966.

Remarks.—Reported from India; Ceylon; Burma; Malaya; also seen from Thailand; Laos; Sumatra; Java; Lombok; Flores; Taiwan.

70. *Orthellia lauta* (Wiedemann)

1830. *Musca lauta* Wiedemann, *Aussereurop. Zweifl. Ins.*, 2 : 410.

1965. *Orthellia lauta* (Wiedemann) : Emden, *Fauna India*, Diptera, 7 (1) : 128.

Material.—(i) 1 ex., N. E. F. A., Subansiri Division, Tamen, 457 m., 20.v. 1966; (ii) 6 exs., Assam, Tezpur, 79 m., 30.v.1966.

Distributed widely in India; also recorded from Ceylon; W. Pakistan; Nepal; Burma; Malaya; Thailand; Laos; Sumatra; Borneo; Java; Lombok; Flores; Australia.

71. *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., N. E. F. A., Subansiri Division, Ziro, 1585 m., 13.v.1966; (ii) 1 ex., N. E. F. A., Subansiri Division, Godak, 975 m., 23.v.1966.

Remarks.—Reported from India; Sikkim; Nepal; W. Burma; Ceylon; Lombok; Taiwan.

72. *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., N.E.F.A., Subansiri Division, Kimin, 198 m., 9.v.1966 ; (ii) 1 ex., N. E. F. A., Subansiri Division, Dejoo, 183 m., 10.v.1966.

Remarks.—Distributed in India; Ceylon; W. Pakistan; Sikkim; Nepal; Upper Burma; China; Sumatra; E. Java.

73. *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., N. E. F. A., Subansiri Division, Kimin, 198 m., 9.v.1966 ; (ii) 1 ex., N. E. F. A., Subansiri Division, Kimin, 198 m., 11.v.1966.

Remarks.—Recorded from India; Ceylon; Nepal; Burma; Malaya; Thailand; Laos; Sumatra; Java; Lombok; Taiwan.

74. *Stomoxys calcitrans* (Linnaeus)

1758. *Conops calcitrans* Linnaeus, *Syst., nat.* ed. 10 : 604.
 1965. *Stomoxys calcitrans* (Linnaeus) : Emden, *Fauna India*, Diptera, 7 (1) : 160.

Material.—(i) 1 ex., N. E. F. A., Subansiri Division, Dejoo, 183 m., 10.v.1966; (ii) 1 ex., N. E. F. A., Subansiri Division, Godak, 975 m., 23.v.1966.

Remarks.—Distribution world-wide, including all parts of Oriental region.

Family CALLIPHORIDAE**75. *Lucilia fumicosta* Malloch**

1926. *Lucilia (Luciliella) fumicosta* Malloch, *Ann. Mag. nat. Hist.*, (9) 17 : 507.
 1940. *Lucilia fumicosta* Malloch : Senior-White, Aubertin and Smart, *Fauna Brit. India*, Diptera, 6 : 48.

Material.—(i) 3 exs., N. E. F. A., Kameng Division, Dunn Bridge, 1524 m., 21.iv.1966; and 1 ex., 1.v.1966. (ii) 1 ex., N.E.F.A., Kameng Division, Tipi, 213 m., 3.v.1966.

Remarks.—Two pairs of posterior acrostichals present. All the specimens with the middle tibia with two anterodorsal bristles. Small hairs outside the frons continued to parafacialia in one specimen.

This species is a new to India and ZSI Collections. Originally described from Mt. Maquiling, Los Banos, Philippine Islands.

76. *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) 17 exs., N. E. F. A., Kameng Division, Tipi. 213 m., 3.v.1966 ; (ii) 9 ex., Assam, Sonai Rupai Forest, 79 m., 28.v.1966; (iii) 1 ex., Assam, Charduar, 79 m., 29.v.1966.

Remarks.—Very common in Oriental and Australian Regions.

77. *Chrysomya bezziana* Villeneuve

1914. *Chrysomya bezziana* Villeneuve, *Rev. Zool. Afr.*, 3 : 430.

1940. *Chrysomya bezziana* Villeneuve : Senior-White, Aubertin and Smart, *Fauna Brit. India*, Diptera, 6 : 140.

Material —(i) 1 ex., N. E. F. A., Kameng Division, Dunn Bridge, 1524 m., 21.iv.1966 ; (ii) 5 exs., N. E. F. A., Kameng Division, Tipi, 213 m., 3.v.1966.

Remarks.—A fly producing myiasis both in man and animals.

Recorded from India; also from Ceylon; Tong-king; Philippine Islands; Ethiopian region.

78. *Strongyloneura delectans* (Walker)

1860. *Isomyia delectans* Walker, *Proc. Linn. Soc. Lond.*, 4 : 134.

1940. *Strongyloneura delectans* (Walker) : Senior-White, Aubertin and Smart, *Fauna Brit. India*, Diptera : 6 : 159.

Material.—1 ex., N. E. F. A., Subansiri Division, Dejoo, 183 m., 10.v.1966.

Remarks.—Acrostichals 2 : 2. Abdomen without red or cupreous reflections. Anterior region of first visible abdominal segment not black.

Reported from Mussoorie, Himalayan Foot Hills; also from Celebes; Laos; Philippine Islands.

79. *Cosmina bicolor* (Walker)

1857. *Idia bicolor* Walker, *Proc. Linn. Soc.*, 1 : 23, 77.

1940. *Cosmina bicolor* (Walker) : Senior-White, Aubertin and Smart, *Fauna British India*, Diptera, 6 : 173.

Material.—(i) 6 exs., N. E. F. A., Subansiri Division, Dejoo, 183 m., 10.v.1966; (ii) 2 exs., N. E. F. A., Subansiri Division, Kimin, 198 m., 11.v.1966.

Remarks.—Palpi black throughout, only two stripes on the thorax conspicuous.

Reported from Indo-Gangetic plains, Assam, Coorg and Nilgiris, India; also from Ceylon; Burma; Malaya; Borneo; Java; Thailand.

80. *Cosmina biplumosa* (Senior-White)

1924. *Stomorhina biplumosa* Senior-White, *Spol. Zevl.*, 13 : 110.
 1940. *Cosmina biplumosa* (Senior-White) : Senior-White, Aubertin and Smart, *Fauna Brit. India*, Diptera, 6 : 175.

Material.—1 ex., N. E. F. A., Subansiri Division, Dejoo, 183 m., 10.v.1966.

Remarks.—A good deal of white pile on vertex wanting. Pleura with yellowish pile in addition to the black hairs.

It is reported for the first time from India and is new to ZSI collections. Earlier reported from Thailand; Malaya.

81. *Cosmina simplex* (Walker)

1857. *Idia simplex* Walker, *Trans. Ent. Soc. Lond.* n.s., 4 : 212.
 1940. *Stomorhina simplex* (Walker) : Senior-White, Aubertin and Smart, *Fauna Brit. India*, Diptera, 6 : 202.
 1952. *Cosmina simplex* (Walker) : Peris, *An. Estac. exp. Aula Dei*, 2 : 132.

Material.—(i) 4 exs., N. E. F. A., Kameng Division, Tipi, 213 m., 6.v.1966; (ii) 1 ex., N. E. F. A., Kameng Division, Pinjuli, 244 m., 4.v.1966; (iii) 1 ex., Subansiri Division, Kimin, 198 m., 11.v. 1966.

Remarks.—Apical region of the wing well marked with fuscous [colour.

Recorded from Kerala; Assam Bhutan Border; also from Sumatra; Borneo.

82. *Stomorhina discolor* (Fabricius)

1794. *Musca discolor* Fabricius, *Ent. Syst.*, 4 : 320.
 1940. *Stomorhina discolor* (Fabricius) : Senior-White, Aubertin and Smart, *Fauna Brit. India*, Diptera, 6 : 192.

Material.—(i) 1 ex., N. E. F. A., Kameng Division, Tipi, 213 m., 3.v.1966 and 1 ex., 6.v.1966; (ii) 1 ex., N. E. F. A., Subansiri Division, Kimin, 198 m., 11.v.1966; (iii) 93 exs., N. E. F. A., Subansiri Division, Tamen, 457 m., 18.5.1966.

Remarks.—Distributed in India; also in W. Pakistan; Ceylon; Malaya, Java; Philippine Islands; Hong Kong; N. Australia; New Caledonia; Fiji.

83. *Chlororhinia exempta* (Walker)

1857. *Idia exempta* Walker, *Journ. Linn. Soc. Lond.*, 1 : 128.
 1940. *Chlororhinia exempta* (Walker) : Senior-White, Aubertin and Smart, *Fauna Brit. India*, Diptera, 6 : 206.

Material.—7 exs., N. E. F. A., Subansiri Division, Tamen, 457 m., 18.v.1966.

Remarks.—Smaller in size than the type. Black setiferous dots on the thorax and abdomen less conspicuous.

84. *Chlororhinia tamenensis* sp.n.

♂ ♀ *Head* sub-holoptic in male; frons shining black with one and three fourths as broad as one of the parafrontalia in female; parafacialia shining black; antennae bright ochraceous. *Thorax* bright metallic green covered with black setiferous spots, with rufous suffusions on dorsal and lateral regions; prescutellar acrostichals 2; postsutural dorsocentrals 2; rest of the bristles inconspicuous; pleural hairs tawny with pale hairs at the posterior margin of mesopleura. *Abdomen* oval; dark blue at the discal region, the rest metallic green with reddish suffusions at the lateral and apical regions; covered all over with black setiferous spots (text-fig. 1B). *Wings* hyaline, basally slightly infuscated; apical cell petiolate in line with vein III (wings in paratype (♀) damaged). *Legs* with brownish femora, except the metallic front pair tibiae and tarsi ochraceous.

Remarks.—*Chlororhinia tamenensis* sp. n. resembles closely *Chlororhinia exempta* (Walker) but differs from it as well as from *Chlororhinia fuscohirta* Malloch, the only other known Indian species, in that the female frons is one and three fourths as broad as one of the parafrontalia. Further, thorax and abdomen in both the sexes with rufous suffusions all over, the latter being pitchy dark at the discal region.

Length ♂ 5.5 mm., of wings 3.5 - 4 mm.

♀ 6.5 mm., of wing 4.5 mm.

Holotype : ♂ in Z. S. I. Collections (Reg. No. 4198/H6);

Paratypes : ♂ (Reg. No. 4199/H6), ♀ (Reg. No. 4200/H6), both in Z. S. I. Collections.

All the types collected from N. E. F. A., Subansiri Division, Tamen by A. N. T. Joseph on 18.v.1966.

Family SARCOPHAGIDAE

85. *Sarcophaga haematodes* Meigen

1826. *Sarcophaga haematodes* Meigen, *Syst. Besch.*, 5 : 29.

1940. *Sarcophaga haematodes* Meigen : Senior-White, Aubertin and Smart, *Fauna Brit. India*, Diptera, 6 : 225.

Material.—1 ex., N. E. F. A., Kameng Division, Dunn Bridge, 1524 m., 22.iv.1966. and 1 ex., 2.v.1966.

Remarks.—Hind tibia with two anterodorsal and two dorsal bristles.

A palaearctic species entering the Oriental region. So far known to occur in India in Kashmir and eastwards up to Darjeeling along the Himalaya. The present record of the species shows that its distribution further extends eastwards upto N. E. F. A.

86. *Sarcophaga albiceps* Meigen

1826. *Sarcophaga albiceps* Meigen, *Syst. Besch.*, 5 : 22.

1940. *Sarcophaga albiceps* Meigen : Senior-White, Aubertin and Smart, *Fauna Brit. India*, Diptera, 6 : 242.

Material.—(i) 1 ex., N. E. F. A., Kameng Division Tipi, 213 m., 3.v.1966; (ii) 1 ex., N. E. F. A., Subansiri, Division, Pamir, 564 m., 17.v.1966; (iii) 2 exs., N. E. A. F. Subansiri Division, Chukru, 1128m., 22.v.1966.

Remarks.—Posterior dorsocentrals 6, anteriormost very weak. Senior-White *et al.* (*l.c.*) mention the presence of only 4 posterior dorsocentrals. The named collections in Z. S. I., however, with 6 posterior dorsocentrals.

Distributed in Oriental Region throughout; Europe; Palestine; North China; New Guinea, Australian region.

87. *Sarcophaga orientaloides* Senior-White

1924. *Sarcophaga orientaloides* Senior-White, *Rec. Indian Mus.*, 26 : 244.
1940. *Sarcophaga orientaloides* Senior-White : Senior-White, Aubertin and Smart, *Fauna Brit. India*, Diptera, 6 : 251.

Material.—3 exs., Kameng Division, Tipi, 213 m., 3.v.1966.

Remarks.—Hind and mid-tibiae well fringed.

Distributed in Dehradun, Uttar Pradesh; Chapra, Bihar; Barkuda Islands, Orissa; Assam, several localities; Madras; several localities; Bombay; also from Ceylon, Burma; Thailand; Malaya.

88. *Sarcophaga brevicornis* Ho

1934. *Sarcophaga brevicornis* Ho, *Bull. Fan. inst. Biol.*, 5 : 23.
1940. *Sarcophaga brevicornis* Ho : Senior-White, Aubertin and Smart, *Fauna Brit. India*, Diptera, 6 : 262.

Material.—1 ex., N. E. F. A., Kameng Division, Tipi, 213m., 3.v.1966.

Remarks.—Recorded from Madras ; also from China; Hainan Island; Federated Malay States.

89. *Sarcophaga kempi* Senior-White

1924. *Sarcophaga kempi* Senior-White, *Rec. Indian Mus.*, 26 : 247.
1940. *Sarcophaga kempi* Senior-White : Senior-White, Aubertin and Smart, *Fauna Brit. India*, Diptera, 6 : 264.

Material.—2 exs., N. E. F. A., Kameng Division, Tipi, 213 m., 3.v.1966.

Remarks.—Recorded from Pusa, Bihar; Calcutta; also from Burma; Ceylon; China.

90. *Sarcophaga dux* Thomson

1868. *Sarcophaga dux* Thomson, *Dipt. Eugen. Reise*, 540.
1940. *Sarcophaga dux* Thomson : Senior-White, Aubertin and Smart, *Fauna Brit. India*, Diptera, 6 : 266.

Material.—(i) 1 ex., Kameng Division, Dunn Bridge, 1524 m., 21. iv.1966; (ii) 1 ex., N. E. F. A., Subansiri Division, Tamen, 305 m., 18.v.1966.

Remarks.—Widely distributed in all parts of the globe.

91. *Sarcophaga haemorrhoidalis* (Fallen)

1816. *Musca haemorrhoidalis* Fallen, *Vet.-Akut. Handl.*, : 237.

1940. *Sarcophaga haemorrhoidalis* (Fallen) : Senior-White, Aubertin and Smart, *Fauna Brit. India*, Diptera, 6 : 276.

Material.—(i) 2 exs., N. E. F. A., Kameng Division, Dunn Bridge, 1524 m., 1.v.1966; (ii) 1 ex., Subansiri Division, Ziro, 1585 m., 14.v.1966.

Remarks.—In India so far known to occur from Himalaya from Kulu to Darjeeling. The present record from NEFA, shows its presence further east along the Himalaya. Widely distributed in Palaearctic region; also recorded from Ethiopian region.

III—ACKNOWLEDGEMENTS

We are indebted to Dr. A. P. Kapur, Director, Zoological Survey of India, Calcutta, for the permission to study the material and for the valuable help extended to us during the course of this work. Our thanks are also due to Sri. K. S. Pradhan, Superintending Zoologist, Zoological Survey of India, Calcutta, for his constant interest in this work. We owe greatly also to our colleague, Sri. P. Parui, for his help in identifying the tipulids.

IV—SUMMARY

The paper deals with 91 species of Diptera, of which one *i. e.*, *Chlororhinia tamenensis* (Calliphoridae) is new. The male of *Orthellia fletcheri* Emden (Muscidae), is described for the first time; its differences with the female are pointed out. *Lucilia fumicosta* Malloch and *Cosmina biplumosa* (Senior-White) both belonging to the family Calliphoridae, are new Indian records. The total number of examples studied is 758.

V—REFERENCES

- BRUNETTI, E. 1912. The Fauna of British India, including Ceylon and Burma. Diptera, Nematocera (excluding Chironomidae and Culicidae).xxviii+581 pp., 44 figs., 8 pls. London.
- BRUNETTI, E. 1915. Notes on Oriental Syrphidae; with descriptions of new species. Part II. *Rec. Indian Mus.*, 11 : 201-256.
- BRUNETTI, E. 1918. Revision of the Oriental Tipulidae with descriptions of new species. Part II. *Rec. Indian Mus.*, 15 : 255-340.
- BRUNETTI, E. 1920. The Fauna of British India, including Ceylon and Burma. Diptera, Brachycera, 1. ix+401 pp., 40 figs., 4 pls. London.

- BRUNETTI, E. 1923. The Fauna of British India, including Ceylon and Burma. Diptera, Pipunculidae, Syrphidae, Conopidae and Oestridae, 3. xi+424 pp., 85 figs., 6 pls. London.
- EMDEN F. I. VAN, 1965. The Fauna of India and the adjacent countries. Diptera, Muscidae, 7 (1). xiv+647 pp., 156 figs., 2 pls. Calcutta.
- JOSEPH, A. N. T. 1967. On the 'Forms' of *Sphaerophoria* St. Fargeau and Serville (Diptera : Syrphidae) described by Brunetti from India. *Oriental Insects*, 1 (3-4) : 243-248.
- SENIOR WHITE, R., AUBERTIN, D. AND SMART, J. 1940. The Fauna of India, including the remainder of the Oriental Region. Diptera, Calliphoridae, 6, xiii+288 pp., 152 figs., 1 map., London.

NOTES ON A COLLECTION OF DERMAPTERA
FROM N.E.F.A*, INDIA

By

G. K. SRIVASTAVA

Zoological Survey of India, Calcutta
(with 3 Text-figures)

I—INTRODUCTION

The present paper is based on a small but interesting collection of Dermaptera made by Dr. K. C. Jayaramakrishnan and Shri S. Biswas from Kameng Frontier Division, N. E. F. A., India in the year 1961. It comprises twenty species (including five represented by nymphs which could be identified up to generic level only). Two new species viz., *Aborolabis kalaktangensis* and *Forficula jayarami* are described, and two species, namely, *Paralabis montshadskii* Bey-Bienko and *Cordax politus* Burr are the first records from India. Some of the species represented in the collection show Palaearctic affinities.

I am thankful to, Dr. A. P. Kapur, Director, for providing necessary facilities and to Shri K. S. Pradhan, Superintending Zoologist, Zoological Survey of India, Calcutta for very kindly going through the manuscript.

The following species are represented in the collection examined.

Superfamily PYGIDICRANOIDEA

Family PYGIDICRANIDAE

Subfamily *Pygidicraninae*

1. *Cranopygia* sp.

Subfamily *Echinosomatinae*

2. *Echinosoma sumatranum* (Haan)

Subfamily *Diplatyinae*

3. *Diplatys* sp.

Superfamily LABIOIDEA

Family CARCINOPNORIDAE

Subfamily *Carcinophorinae*

4. *Aborolabis pervicina* (Burr)
5. *Aborolabis kalaktangensis* sp. n.
6. *Paralabis montshadskii* Bey-Bienko

* since named as Arunachal Pradesh

Family LABIIDAE

Subfamily *Labiinae*

- 7.
- Homotages feae*
- (Bormans)

Superfamily FORFICULOIDEA

Family LABIDURIDAE

Subfamily *Labidurinae*

8. *Nala* sp.
 9. *Forcipula decolyi* (Bormans)
 10. *Forcipula* sp.

Family FORFICULIDAE

Subfamily *Anechurinae*

11. *Allodahlia scabriuscula* (Serville)
 12. *Allodahlia macropyga* (Westwood)
 13. *Anechura* sp.

Subfamily FORFICULINAE

14. *Forficula schlagintweiti* (Burr)
 15. *Forficula beelzebub* (Burr)
 16. *Forficula acris* Burr
 17. *Forficula greeni* (Burr)
 18. *Forficula jayarami* sp. n.

Subfamily OPISTHOCOSMIINAE

19. *Cordax forcipatus* (Haan)
 20. *Cordax politus* Burr

II—KEY TO THE GENERA REPRESENTED IN THE COLLECTION
 EXAMINED FROM N.E.F.A.

- 1(16). Second tarsal segment small, not lobed or dilated
 2(5). Femora crenate
 3(4). Size large, antennal segments 4-6 broader than long, nymphal
 cerci not segmented *Cranopygia* Burr
 4(3). Size small, antennal segments 4-6 longer than broad, nymphal
 cerci segmented *Diplatys* Serville
 5(2). Femora not carinate
 6(7). Pronotum transverse, provided with thick hairs, metasternum
 sinuate posteriorly ... *Echinosoma* Serville
 7(6). Pronotum not transverse, without thick hairs, metasternum truncate
 posteriorly
 8(15). Posterior margin of ultimate tergite deflexed and fused with the
 pygidium
 9(12). Manubrium longer than penultimate sternite, dilated at apex
 10(11). Parameres armed with a triangular tooth at base
 Aborolabis Srivastava
 11(10). Parameres without any tooth at base *Paralabis*
 Burr
 12(9). Manubrium shorter than penultimate sternite, not dilated at apex
 13(12). Sides of abdomen with spines *Forcipula* Bolivar
 14(13). Sides of abdomen without spines *Nala* Zacher
 15(8). Posterior margin of ultimate tergite not fused with pygidium
 *Homotages* Burr
 16(1). Second tarsal segment lobed and/or dilated

- 17(20). Meso-and meta-sternal plates broad and strongly transverse
 18(19). Elytra keeled at costal margin . *Allodahlia* Verhoeff
 19(18). Elytra devoid of any keel *Anechura* Scudder
 20(17). Meso- and meta-sternal plates narrow and weakly transverse
 21(22). Abdomen somewhat depressed, forceps of male depressed and dilated at base . . . *Forficula* L.
 22(21). Abdomen convex, forceps of male not depressed or dilated at base, long and cylindrical *Cordax* Burr

III—SYSTEMATIC ACCOUNT

Superfamily PYGIDICRANOIDEA

Family PYGIDICRANIDAE

Subfamily *Pygidicraninae*

1. *Cranopygia* sp.

Material.—(i) 1 ex. (nymph), Foot Hills below stones, on Bil-siri river bank, 27. ii. 61 ; (ii) 1 ex. (nymph), Milankang river Valley, 19. v. 61 ; and (iii) 2 exs. (nymphs), Norgum river bank, below Dengzi village, 15.iii.61 (*K. C. Jayaramakrishnan* coll.).

Subfamily *Echinosomatinae*

2. *Echinosoma sumatranum* (Haan)

1842. *Forficula (Echinosoma) sumatranum* Haan, *Verh. nat. Gesch. Nederl. Overzee. Bezitt.* : 241.
 1863. *Echinosoma sumatranum* : Dohrn, *Stett. ent. Zeit.*, 24 : 65.
 1863. *Echinosoma westermanni* Dohrn, *Stett. ent. Zeit.*, 24 : 65.
 1910. *Echinosoma sumatranum* : Burr, *Fauna Brit. India, Dermaptera* : 70.

Material.—(i) 1 ♀, Sangtichu, 12.iv.61 ; and (ii) 1 ex. (nymph), Rahung village, 8.iv.61 (*K. C. Jayaramakrishnan* coll.).

Distribution.—This species occurs throughout the Oriental Region.

Subfamily *Diplatyinae*

3. *Diplatys* sp.

Material.—(i) 1 ex. (nymph), Norgum river bank, below Dengzi village, 15.iii.61 ; (ii) 1 ex. (nymph), Milankang, 19.iv.61 ; and (iii) 3 exs. (nymphs), Milankang river Valley, 19.iv.61 (*K. C. Jayaramakrishnan* coll.).

Remarks.—Only one specimen is with segmented cerci, the first segment being much longer than the rest. In the other specimens the cerci are broken.

Superfamily LABIOIDEA

Family CARCINOPHORIDAE

Subfamily *Carcinophorinae*

4. *Aborolabis pervicina* (Burr)

1913. *Anisolabis pervicina* Burr, *Rec. Indian Mus.*, 8 (2) : 137,

1915. *Paralabis pervicina* : Burr, *J. R. micr. Soc.*, 1915 : 540.
 1969. *Aborolabis pervicina* : *Ent. Rec.*, 81, : 246.

Material.—(i) 6♂♂, 8♀♀ Dirong Dzong, 10.iv.61 ; (ii) 2♂♂, 4♀♀, Dikongko river bank, four miles north of Rupa, 14.iv.61 ; (iii) 7♂♂, 5♀♀, Chug village, 14.iv.61 ; (iv) 1♂, Milankang river bank, two miles north, 18.iv.61 ; (v) 3♀♀, Milankang Valley, 19.iv.61 ; (vi) 1♂, 2♀♀, Shergaon, 29.iii.61 ; (vii) 3♀♀, Sangtichu, 12.iv.61 ; (viii) 6♂♂, 3♀♀, 2 exs. (nymphs) Kalaktang, 17.iii.61 ; and (ix) 1♀, Rahung village, 8.i.v.61 (*K. C. Jayaramakrishnan* coll.).

Description.—The description of the species given by Burr (1913) being inadequate, it is described below in detail.

Male.—Head triangular, shining black, convex, sutures faint. Antennae with 19-segments, black, fifth segment shorter than the third but longer than the fourth, with yellowish pubescence. Pronotum black, nearly square, median suture not well marked, prozona slightly tumid and metazona flat, posterior angles gently rounded, posterior margin truncate. Elytra and wings absent in the material examined. Sternal plates brownish, prosternum slightly wider at posterior end and meso- and meta-sternum broad ; mesosternum rounded and metasternum truncate posteriorly. Legs brownish, femora and tibiae slender, banded with black ; tarsi with yellowish brown shining pubescence on underside, first segment slightly shorter in length than the second and third combined. Abdomen black, shiny, punctulate, depressed in the middle, sides of segments 6 to 9 acute, regulose and carinate, pubescence sparse, on underside only ; last dorsal segment transverse, less punctulate with a median depression, sides with carina and a depression, striolate above the roots of forceps. Penultimate ventral segment (Text-fig. 1 A) somewhat rounded with posterior margin truncate, manubrium long, dilated at apex and a little more than double the length of ninth sternite. Forceps (Text-fig. 1 B) with branches remote, asymmetrical, trigonal and dilated at base, the upper ridge absent in apical half, tapering, and terminating to a blunt point, bent inwards, right branch is curved more strongly than the left, inner margins serrated in basal one third. Genitalia figured by Burr (1915) and Srivastava (1969).

Female.—Closely resembling the male in colour and most characters. Pronotum slightly broader posteriorly, punctulation of the body obscure, sides of abdominal segments blunt and not carinate ; last dorsal segment transverse, but narrowing posteriorly. Penultimate ventral segment obtusely rounded posteriorly, punctulation obscure and not covering the last sternite completely.

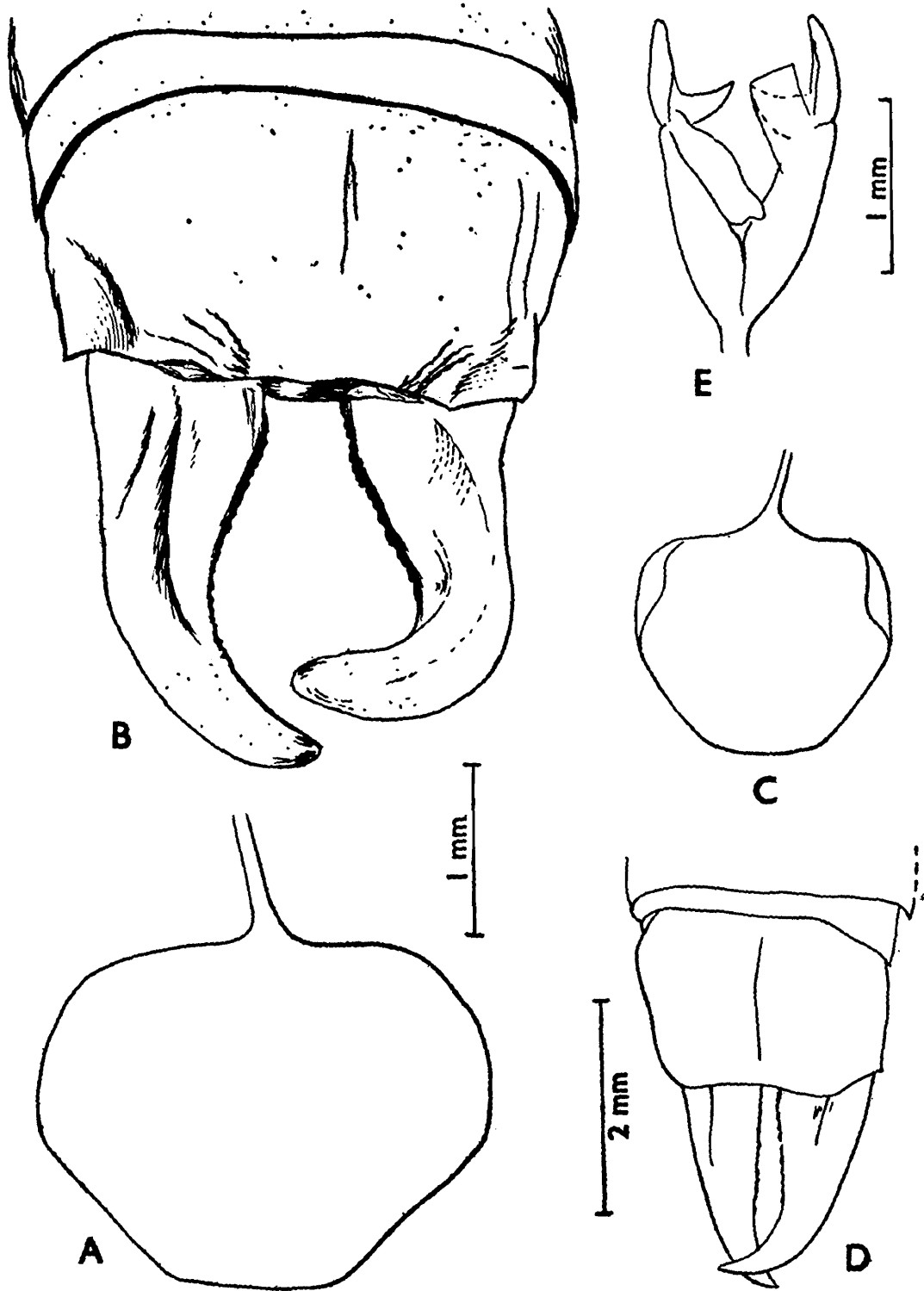
Measurements.—

	Length of body (without forceps)	Length of forceps
Male.	13 - 16 mm.	2 - 3 mm.
Female.	7 - 18 mm.	2 - 3.5 mm.

Remarks.—The colour varies from shining black to blackish brown, abdomen from finely punctulate to heavily punctate and in

some cases the forceps less asymmetrical. In one specimen from Kalaktang the posterior angles of pronotum are markedly rounded.

Distribution.—Originally described from NEFA (Abor Region, now Siang Div.), Assam in India and Bhutan, it has since not been recorded from elsewhere.



TEXT-FIG. 1. *Aborolabis pervicina* (Burr) : ♂, A. Penultimate sternite. B. Last tergite and forceps. *Aborolabis kalaktangensis* sp. n. : ♂, C. Penultimate sternite. D. Last tergite and forceps. and E. Genitalia (Figs. A & B and C & D same scale).

5. *Aborolabis kalaktangensis* sp. n.

Male.—General colour brownish, with traces of black on abdomen only. Head triangular, posterior margin gently sinuate, frons tumid, sutures faint, eyes small and black. Antennae 17-segmented, second segment yellowish and the rest brownish-yellow, clad with hairs. Pronotum almost quadrate, median suture well marked, anterior and posterior margin truncate, hind angles gently rounded, prozona tumid, metazona somewhat flat. Elytra and wings absent. Legs brownish yellow, femora proximally dark brown, clad with brownish yellow hairs; tibiae and tarsi with row of thick yellow hairs on under-side. Abdomen cylindrical, sides parallel, exceedingly finely punctulate, sides of segments 6 to 9 acute, ecarinate and without striations. Last tergite quadrate, median impression not faint, oblique striae at the bases of forceps. Penultimate ventral segment (Text-fig. 1C) somewhat oval, with posterior margin gently rounded, manubrium long, slightly more than double the length of penultimate sternite and dilated at apex. Forceps (Text-fig. 1D) with branches subcontiguous, trigonal at base, upper ridge present in basal one-third only, afterwards depressed, tapering and curved, right branch crossing over the left. Genitalia as seen in text-fig. 1E.

Female.—Agrees with male in most characters except that the sides of abdominal segments rounded; penultimate sternite triangular, with posterior margin obtusely rounded and forceps almost straight.

Measurements.—

	Length of body (Without forceps)	Length of forceps
Holotype : ♂	.13.30 mm.	1.72 mm.
Paratypes : ♀ ♀	.12.21 - 7.42 mm.	1.33-1.72 mm.

Material.—*Holotype*, ♂, Kalaktang village, 17.iii.61 (K. C. Jayaramakrishnan coll.); genitalia dissected and mounted between coverslips and attached to the specimen; *Paratypes* : 2 ♀ ♀, with same data as the holotype, and 3 ♀ ♀, from Dirong Dzong, 10-11. iii.61 (K. C. Jayaramakrishnan coll.), in the Zoological Survey of India, Calcutta.

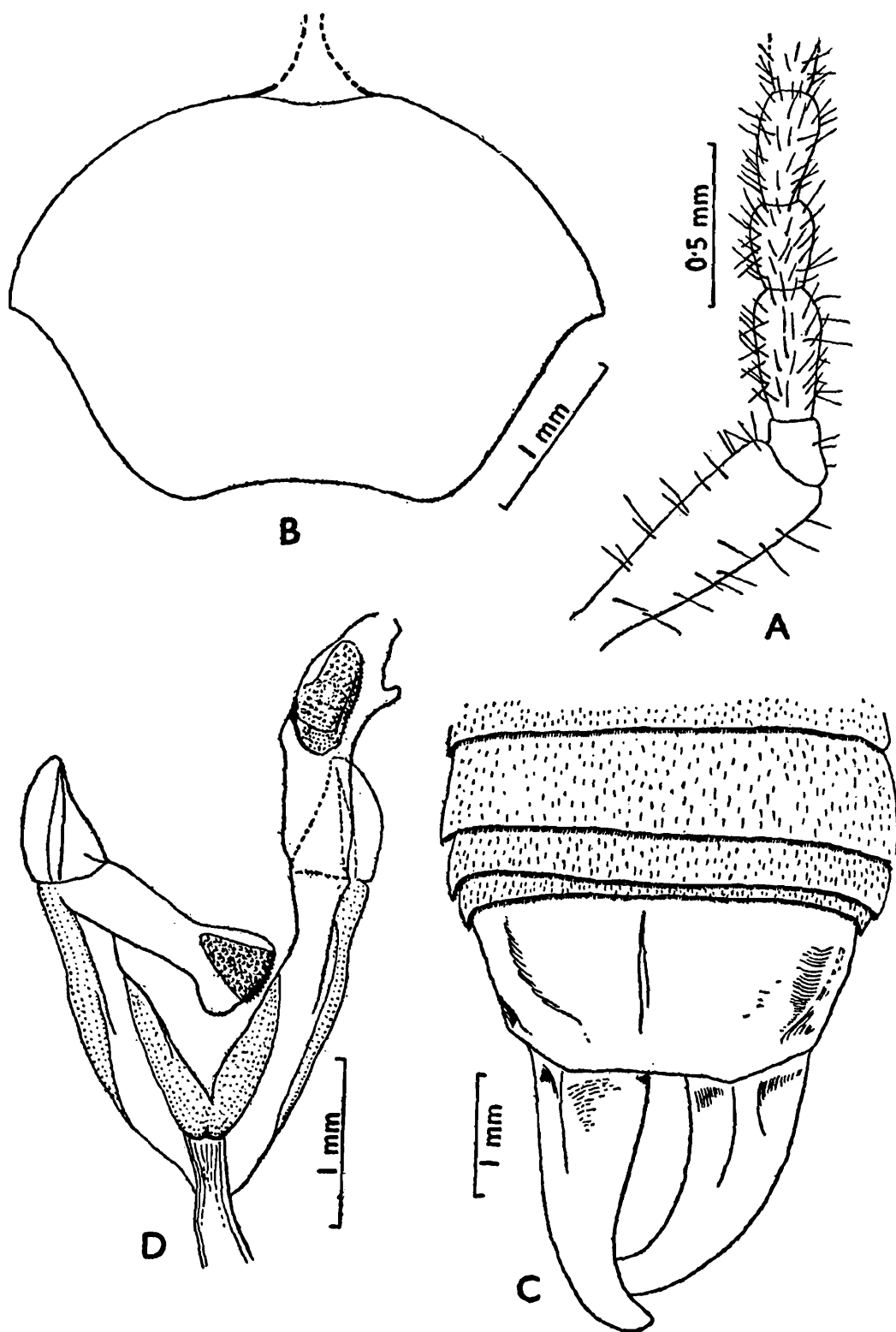
Affinities.—This species comes very close to *Aborolabis pervicina* (Burr) but differs from it in general colouration, especially femora which are not banded; abdomen almost cylindrical, parallel sided, exceedingly finely punctulate, sides of sixth to ninth abdominal segments ecarinate; last tergite quadrate, and forceps subcontiguous and weakly asymmetrical.

6. *Paralabis montshadskii* Bey-Bienko

1959. *Anisolabis* (*Paralabis*) *montshadskii* Bey-Bienko, *Ent. Obozr.*, 38, No. 3, (English translation) : 540.

Material.—(i) 1 ♂, Rahung, 9.iv.61; and (ii) 1 ♂, 2 ♀ ♀, Chug village, 15.iv.61 (K. C. Jayaramakrishnan coll.).

Distribution.—This species was hitherto known only from China, Yunnan (Bey-Bienko, 1959), is now recorded from India.



TEXT-FIG. 2. *Paralabis montshadskii* Bey-Bienko : ♂, A. First five antennal segments. B. Penultimate sternite. C. Last tergite and forceps, and D. Genitalia.

Remarks.—It agrees well with Bey-Bienko's (1959) description except for the following minor differences :

Size slightly larger (male, length of body 13.96—14.63 mm., length of forceps 2.46-2.47 ; female, length of the body 10.35-13.01 mm., length of forceps 1.90-2.37 mm.), total absence of tubercles on third

and fourth abdominal segments, subcontiguous forceps, and genitalia with praeputial sacs well armed with denticulate pads.

Family LABIIDAE

Subfamily Labiinae

7. *Homotages feae* (Bormans)

1888. *Anechura feae* Bormans, *Ann. Mus. Civ. Gen.*, (2) 6 : 445.
 1909. *Homotages feae* : Burr, *Deutsch. Ent. Zeitschr.* : 327.
 1910. *Homotages feae* : Burr, *Fauna Brit. India, Dermaptera* : 156.
 1916. *Homotages feae* : Burr, *J. R. micr. Soc.*, 1915 : 5.
 1961. *Homotages feae* : Bharadwaj and Bhatnagar, *Zool. Anz.*, 167 (7-8) : 285.

Material.—(i) 1 ♀, 1 ex. (nymph), Chug village, 15.iv.61 ; (ii) 1 ♀, Milankang river valley, 19.iv.61 ; and (iii) 1 ex. (nymph), Bomdila, 7.iv.61 (K. C. Jayaramakrishnan coll.).

Distribution.—India : West Bengal (Darjeeling), Uttar Pradesh (Naini Tal). It has also been recorded from Burma and Nepal.

Superfamily FORFICULOIDEA

Family LABIDURIDAE

Subfamily Labidurinae

8. *Nala* sp.

Material.—2 exs. (nymphs), Sangtichu, 12.vi.61 (K. C. Jayaramakrishnan coll.).

9. *Forcipula decolvi* (Bormans)

1900. *Forcipula decolvi* Bormans, *Ann. Mus. Civ. Gen.*, (2) 20 : 444.
 1910. *Forcipula decolvi* : Burr, *Fauna Brit. India Dermaptera* : 91.
 1923. *Forcipula decolvi* : Hebard, *Mem. Dept. Agric. India*, 7, No. 11 : 211.

Material.—(1) 1 ♂, 1 ex. (nymph), Chug village, 14.iv.61 ; and (ii) 2 ♀♀ Foot Hills, below stones on Bilsiri river bank, 27.xi.61 (K. C. Jayaramakrishnan coll.).

Distribution.—India : Assam (Sibsagar), West Bengal (Kurseong) and Madras (Anamalaies).

It has also been recorded from Nepal, Sikkim, China and New Guinea.

Remarks.—The specimens before me agree with the description of Burr (1910) in most characters except that the head is black and clothed with yellowish hairs. Antennae brownish yellow except for the third segment which is lighter in colour; tibiae brownish at base. Penultimate sternite and the genitalia as seen in the Text-figs. 3, A. and B.

10. *Forcipula* sp.

Material.—(i) 1 ex. (nymph), Milankang river bank, two miles north, 18.iv.61 ; (ii) 1 ex. (nymph), Amatulla village, 9.iii.61 ; (iii)

1 ex. (nymph), Bilsiri river, 27.ii.61 and (iv) 1 ex. (nymph), Norgum river, bank, below Dengzi village, 15.iii.61 (K. C. Jayaramakrishnan coll.).

Family FORFICULIDAE

Subfamily Anechurinae

11. *Allodahlia scabriuscula* (Serville)

1839. *Forficula scabriuscula* Serville, *Histoire Naturelle des Insectes Orthopteres* : 38.
 1842. *Forficula brachynota* Haan, *Verh. Natur. Gesch. Nederl. Overzee, Bezitt* : 243.
 1888. *Anechura scabriuscula* : Bormans, *Ann. Mus. Civ. Gen.*, (2) 6 : 444.
 1902. *Allodahlia scabriuscula* : Verhoeff, *Zool. Anz.*, No. 665 : 194.
 1910. *Allodahlia scabriuscula* : Burr, *Fauna Brit. India. Dermaptera* : 150.

Material.—(i). 10♂♂, 5♀♀, Pangabari Chu, three miles south-west of Kalaktang, 20.iii.61 ; and (ii) 1♂, Domko, 27.iii.61 (K. C. Jayaramakrishnan coll.).

Distribution.—India : Assam and West Bengal. It has also been recorded from Sikkim, Bhutan, Burma, China, Sumatra, Java and Borneo.

12. *Allodahlia macropyga* (Westwood)

1839. *Forficula macropyga* Westwood, in : Royle, *Ill. Bot. Nat. Hist. Himalyan Mts.*, 1 (2) : 53.
 1910. *Allodahlia macropyga* : Burr, *Fauna Brit. India, Dermaptera* : 151.
 1923. *Allodahlia macropyga* : Hebard, *Mem. Dept. Agric. India*, 7, No. 11 : 223.
 1947. *Allodahlia macropyga* : Hincks, *Ark. Zool.*, 39 A, No. 1 : 26.
 1961. *Allodahlia macropyga* : Bharadwaj & Bhatnagar, *Zool. Anz.*, 167 (7-8) : 228.

Material.—(i) 1♂, Kalaktang, Sangloom, 11.ix.61 (S. Biswas coll.); and (ii) 1♀, Siggon, 6.v.61 (K. C. Jayaramakrishnan coll.)

Distribution.—India : Bhutan, Sikkim, Assam; West Bengal, Himachal Pradesh, Panjab and Uttar Pradesh.

It has also been recorded from Burma, China and Tibet.

Affinities.—This species comes close to *Allodahlia scabriuscula* (Serville) but can be easily differentiated by the punctate elytra and the pygidium having a well developed median spine.

13. *Anechura* sp.

Material.—(i) 5 exs. (nymphs), Moshing, 25.iii.61 ; (ii) 5 exs. (nymphs), Dirong Dzong, 10-14.iv.61 ; (iii) 3 exs. (nymphs) Chug village, 14.iv.61 ; (iv) 3 exs. (nymphs), Rupa, 1-3.v.61 ; (v) 3 exs. (nymphs), Udalguri, 2.iii.61 ; (vi) 2 exs. (nymphs), Sangtichu, 12.iv.61 ; (vii) 2 exs. (nymphs), Milankang river bank, two miles north, 18.iv.61 ; (viii) 3 exs. (nymphs), Milankang river valley, 19.iv.61 ; (ix) 7 exs. (nymphs), Bomdila, 7.iv.61 ; (x) 1 ex. (nymph), Bomdila Pass, 7.iv.61 ; (xi) 4 exs. (nymphs), Rahung village 7.iv.61 ; (xii) 1 ex. (nymph), Norgum river bank below Dengzi village, 15.iii.61 ; (xiii).

1 ex. (nymph), Amatulla, 9.iii.61 and (xiv) 1 ex. (nymph), Shergaon, 29.iii.61 (K. C. Jayaramakrishnan coll.).

Remarks.—These nymphs are at various stages of development. Their colour varies from brown to black, and the pronotum and sternal plates are transverse.

Subfamily FORFICULINAE

14. *Forficula schlagintweiti* (Burr)

1904. *Anechura schlagintweiti* Burr, *Trans. ent. Soc. Lond* : 314.
 1910. *Forficula schlagintweiti* : Burr, *Fauna Brit. India, Dermaptera* : 165.
 1911. *Forficula beebei* Burr, *J. Asiat. Soc. Beng. (N. S.)*, 7, No. 11 : 795.
 1923. *Forficula schlagintweiti*: Hebard, *Mem. Dept. Agric. India*, 7, No 11 : 225.
 1947. *Forficula schlagintweiti* : Hincks, *Ark. Zool.*, 39 A, No. 1 : 32.

Material.—2♂♂, 1♀, Bomdila Town, 15-16.iv.61 (K. C. Jayaramakrishnan coll.).

Distribution.—India : West Bengal, Punjab and Kashmir ; Sikkim, Bhutan.

It has also been recorded from Burma, China, Tibet and Nepal.

Remarks.—The two males before me represent the typical phase of the species and agree well with Burr's (1910) description, except for the fifth antennal segment being slightly longer than the third and the abdomen exceedingly finely punctulate.

Affinities.—This species comes very close to *Forficula lebongae* Hebard, described from Sikkim, but can be easily differentiated by its larger size, transverse pronotum and more flattened forceps.

15. *Forficula beelzebub* (Burr)

1900. *Chelisoches beelzebub* Burr, *Ann. Soc. Ent. Belgique*, 64 : 51.
 1910. *Forficula beelzebub* : Burr, *Fauna Brit. India, Dermaptera* : 167.
 1923. *Forficula beelzebub* : Hebard, *Mem. Dept. Agric. India*, 7, No. 11 : 227.

Material.—8♂♂, Sangtichu river bank near Sangti village, 12.iv.61 ; (ii) 8♂♂, 1♀, Sangtichu, 12.iv.61 ; (iii) 1♂, 2♀♀, Udalguri, 2.iii.61 ; (iv) 1♂, Kalaktang village from jungle town, 16.iii.61 ; (v) 2♀♀, Chug village, 14.iv.61 ; (vi) 1♂, 1♀, Dirong Dzong, 13.iv.61 ; and (vii) 1♀ Shergaon, 19.iii.61 (K. C. Jayaramakrishnan coll.).

Distribution.—India : West Bengal (Kurseong, Darjeeling) and Uttar Pradesh.

It has also been recorded from Nepal and China.

16. *Forficula acris* (Burr)

1905. *Forficula acer* Burr, *J. Asiat. Soc. Beng. (N. S.)*, 1 : 30.
 1905. *Forficula celer* Burr, *J. Asiat. Soc. Beng. (N. S.)*, 1 : 31.
 1910. *Forficula aceris* (Sic) : Burr, *Fauna Brit. India, Dermaptera* : 168.
 1923. *Forficula acris* : Hebard, *Mem. Dept. Agric. India*, 7, No. 11 : 228.
 1947. *Forficula acris* : Hincks, *Ark. Zool.*, 39 A, No. 1 : 31.
 1959. *Forficula acris* : Bey-Bienko, *Ent. Obozr. (English translation)*, 38, No. 3 : 554.
 1961. *Forficula acris* : Bharadwaj and Bhatnagar, *Zool. Anz.*, 167 (7-8) : 286.

Material.—1 ♂, Sangtichu river bank, near Sangti village, 12.iv.61 (K. C. Jayaramakrishnan coll.).

Distribution.—Originally described from Sikkim (Mung Phu), this species has since been reported in India from Assam, Himachal Pradesh (Kulu), Panjab and Uttar Pradesh (Kumaon region). Recently, it has also been reported from Burma and China.

Affinities.—This species is closely allied to *Forficula beelzebub* (Burr). Burr (1913a) regards *F. acris* and *F. beelzebub* as the same species, and states that from a long series it is impossible to say where *F. acris* ends and *F. beelzebub* begins. Hebard (1923) has reported these two as distinct species. Hincks (1947), however, owing to a single male specimen before him of *F. acris*, could not draw any final conclusion.

After having examined a long series of specimens of *F. beelzebub* and a single male of *F. acris*, I find that these two are distinct species as there are no intermediate forms.

17. *Forficula greeni* (Burr)

1901. *Chelisoches pulchellus* Burr (nec Gerst.), *J. Bombay nat. Hist. Soc.* : 327 (partim).

1907. *Forficula greeni* Burr, *Trans. ent. Soc. Lond.* : 111.

1910. *Forficula greeni* : Burr, *Fauna Brit. India Dermaptera* : 170.

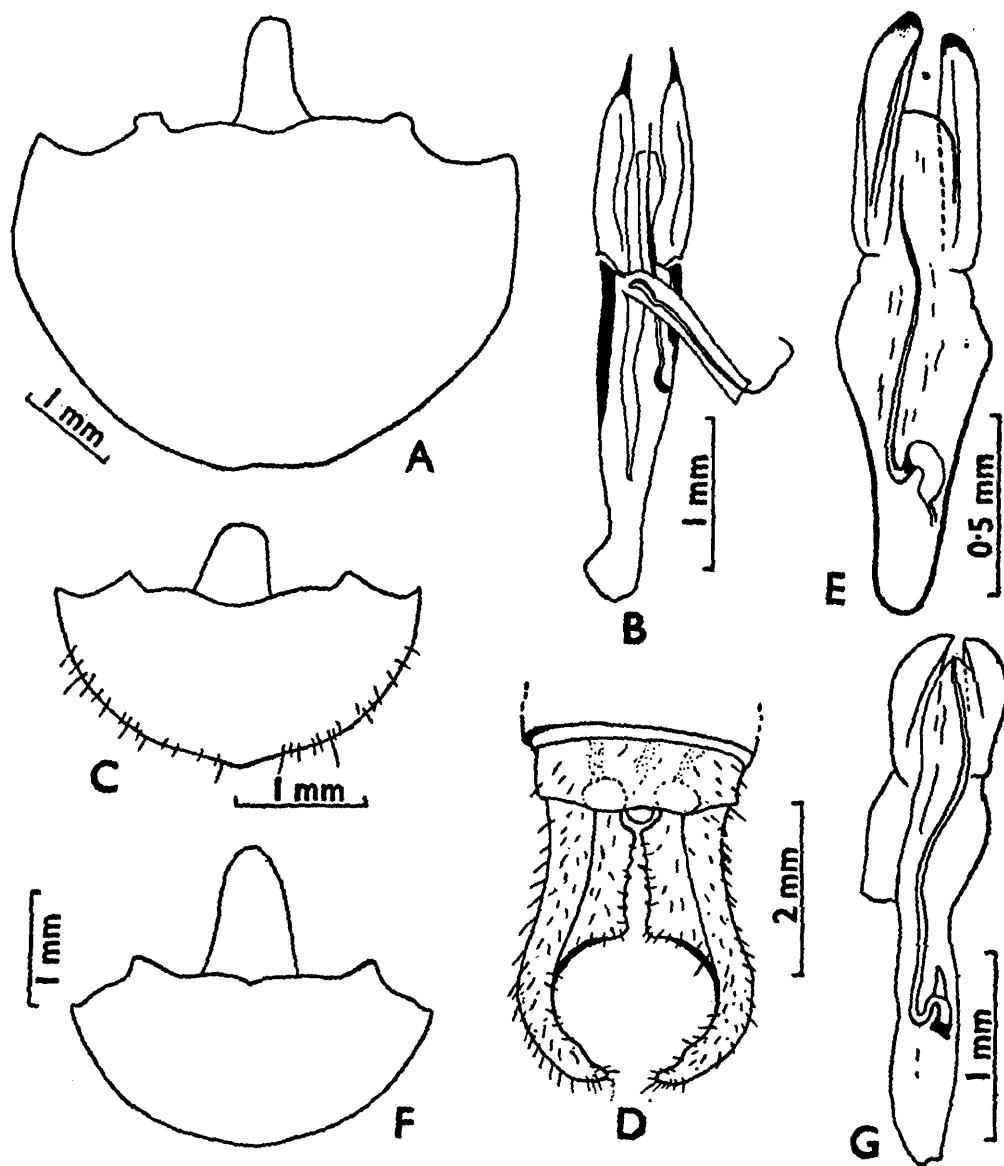
Material.—(i) 1 ♀, Udalguri, 2.iii.61 ; and (ii) 1 ♀, Rahung village, 7.iv.61 (K. C. Jayaramakrishnan coll.).

Distribution.—This species was recorded from Ceylon, but it has since been known to occur in India. It has been recorded from West Bengal (Calcutta) and Madras (Palni Hills and Shembaganur).

18. *Forficula jayarami* sp. n.

Male.—Head brownish red, with patches of black on frons, surface with micro-reticulations, triangular, posterior margin sinuate, median suture well marked, transverse suture faint, frons and occiput tumid, eyes small. Antennae 12-(?) segmented, clad with hairs, third segment almost equal to fourth. Pronotum black but brownish yellow on sides, as broad as head, weakly transverse, anterior margin truncate, sides straight and gently raised, posterior margin rounded but gently obtuse in the middle. Elytra brownish yellow, with micro-reticulations, abbreviated, rectangular, longer than the pronotum, with posterior margin truncate, lateral folds well marked. Wings much reduced, completely concealed by elytra. Legs dirty yellowish. Abdomen reddish black, not much depressed, dilated in the middle, distinctly punctate with micro-reticulations, lateral tubercles on third and fourth tergites weakly developed, sides of segments 6 to 9 rugosely punctate, with transverse, feebly granular, orange stripes at the posterior margin. Last tergite black, transverse, almost smooth, only at places longitudinal stripes of minute punctures, with

a pair of tubercles at the posterior margin. Penultimate sternite (Text-fig.3C) transverse, rounded posteriorly but very gently obtuse in the middle, punctate in the basal half. Pygidium obtusely rounded. Forceps (Text-fig.3D) dilated from base to half of its length, with a distinct longitudinal convexity diverging from base to apex, inner margin of dilated portion crenulate, subcontiguous at base then diverging gently and again slightly converging apically; then strongly bowed to a compressed point, enclosing somewhat an oval space, surface sparsely punctate, with light yellow hairs. Genitalia as seen in text-fig.3E.



TEXT-FIG. 3. *Forcipula decolyi* (Bormans) : ♂, A. Penultimate sternite B. Genitalia; *Forficula jayarami* sp. n. : ♂, C. Penultimate sternite. D. Last tergite and forceps. E. Genitalia. *Cordax forcipatus* (Haan) : ♂, F. Penultimate sternite and G. Genitalia.

Female.—Agrees with male in most characters except that the sides of abdominal segments not rugose and without any transverse granular stripes at the posterior margin. Last tergite without

tubercles and sloping posteriorly. Penultimate sternite with posterior margin rounded, not obtuse in the middle. Forceps contiguous and straight.

Measurements.—

Length of the body (Without forceps)		Length of the forceps
Holotype : ♂	10.81 mm.	3.35 mm.
Paratypes : ♀♀	8.86-9.20 mm.	2.32-2.40 mm.

Material.—*Holotype*, ♂ Domko, 8.vi.61 (*K. C. Jayaramakrishnan* coll.) ; genitalia and right elytra mounted between cover slips, penultimate sternite mounted on a card and all the three pinned with the specimen. *Paratypes*, 2 ♀♀ Dirong Dzong, Chug valley, 28.vii.61 and 10.viii.61 (*S. Biswas* coll.), all in the Zoological Survey of India, Calcutta.

Affinities.—This species resembles closely with *Forficula lesnei* Finot described from the Western Europe, but differs from it in being larger in size, and in the structure and punctuation of abdominal tergites, the forceps with inner margin of dilated portion not quite straight and with distinct longitudinal convexity, penultimate ventral segment with posterior margin rounded but gently obtuse in the middle and also in the details of the structure of genitalia, especially the virga forming an angle at the entrance of reniform vesicle.

Subfamily OPISTHOCOSMIINAE

19. *Cordax forcipatus* (Haan)

1842. *Forficula forcipata* Haan, *Verh. Natur. Gesch. Nederl. Overzee.*, *Bezitt.* : 242.
 1900. *Opisthocosmia forcipata* : Bormans, *Forficulidae*, in *Das "Tierreich"* : 95.
 1904. *Opisthocosmia erroris* Burr, *Trans. ent. Soc. Lond.* : 308.
 1911. *Cordax forcipatus* : Burr, *J. Asiat. Soc. Beng.* (N. S.), 7, No. 11 : 797.

Material.—1 ♂, Kalaktang, Sangloom, 11.ix.61 (*S. Biswas* coll.).

Distribution.—India : NEFA (Upper Rotung), West Bengal (Kurseong). It has also been recorded from New Guinea, Siam, Java, Sumatra and Borneo.

20. *Cordax politus* Burr

1911. *Cordax politus* Burr, *J. Asiat. Soc. Beng.* (N. S.), 7, No. 11 : 798.
 1947. *Cordax politus* : Hincks, *Ark. Zool.*, 39 A, No. 1 : 41.

Material.—1 ♀, Milankang river valley, 19.iv.61 (*K. C. Jayaramakrishnan* coll.).

Distribution.—This species was hitherto known only from Burma. This is the first record from India.

IV—SUMMARY

The material of Dermaptera collected from Kameng Frontier Division, N.E.F.A. in 1961, which has been examined by me, contains

fifteen species (excluding the species which have been identified upto generic level only). All the species reported in the present paper have been recorded for the first time from this region. Two new species are described, these being *Aborolabis kalaktangensis* and *Forficula jayarami*. Two other species viz., *Paralabis montshadskii* Bey-Bienko and *Cordax politus* Burr constitute the first record from India.

V—REFERENCES

- BEY-BIENKO, G. J. 1959. Results of the Chinese-Soviet Zoological-Botanical expeditions of 1955-1957 to South West China.—*Ent. Obozr.* (English translation), **38**, No. 3 : 529-563.
- BURR, M. 1910. *The Fauna of British India, including Ceylon and Burma, Dermaptera*, : 217, 10 pls.—London (Taylor and Francis).
- BURR, M. 1913. Zoological results of the Abor Expedition, 1911-12. x, Dermaptera. *Rec. Indian Mus.*, **8** (2) : 135-147.
- BURR, M. 1913a. Indian Dermaptera collected by Dr. A. D. Imms. *J. Asiat. Soc. Beng.* (N. S.), **9**, No. 5 : 183-187.
- BURR, M. 1915. On the male genital armature of the Dermaptera. Part II : Psalidae *J. R. micr. Soc.*, **1915.**, 521-546.
- HEBARD, M. 1923. Studies in Indian Dermaptera. *Mem. Dept. Agric. India*, **7**, No. 11 : 195-242, pls. 19-21.
- HINCKS, W.D. 1947. Entomological results from the Swedish expedition 1934 to Burma and British India.—*Ark. Zool.*, **39** A, No. 1 : 1-43.
- SRIVASTAVA, G. K. 1969. On a new genus of Dermaptera from India. *Ent. Rec.*, **81** : 246-248.

NOTES ON COLLECTION OF HISPINAE AND CASSIDINAE
(COLEOPTERA : CHRYSOMELIDAE) FROM N. E. INDIA

By

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(With 1 Text-figure and 1 Table)

I—INTRODUCTION

This report is based on the collection of Chrysomelidae, sub-families Hispinae and Cassidinae, (also considered of family rank by various authors) which have been collected by the various survey parties from the Zoological Survey of India in the Sikkim and NEFA regions.

These surveys were conducted by my colleagues as under :—

Dr. A. G. K. Menon	(Sikkim, 1959) A. G. K. M.
Dr. K. C. Jayaramakrishnan	(NEFA, 1961) K. C. J.
Shri S. Biswas	(NEFA, 1961) S. B.
Shri G. Ramakrishna	(Sikkim, 1962) G. R.
Dr. S. K. Bhattacharyya and Dr. A. N. T. Joseph	(NEFA, 1965) S.K.B. & A.N.T.J.

This collection comprises 18 species of which one species, is new and is described below. One species viz. *Hispellinus minor* (Maulik), which was earlier known from Sumatra and Ceylon, is now being recorded from India for the first time. Besides, there are seven species which form new records from Sikkim.

II—LIST OF SPECIES

Subfamily *Hispinae*

1. <i>Anisodera guerini</i> Baly	12. <i>C. occursans</i> Spaeth
2. <i>Dactylispa peregrina</i> Maulik	13. <i>Sindia sedecimaculata</i>
3. <i>D. atkinsoni</i> (Gestro)	(Boheman)
4. <i>D. manii</i> sp. n.	14. <i>Basiprinota maculipennis</i>
5. <i>Gonophora pulchella</i> Gestro	<i>maculipennis</i> (Boheman)
6. <i>Anisoderopsis excavata</i> (Baly)	15. <i>B. (B.) decemmaculata</i>
7. <i>Hispellinus minor</i> (Maulik)	(Boheman)

Subfamily *Cassidinae*

8. <i>Aspidomorpha miliaris</i> (Fabricius)	16. <i>B. (B.) impustulata</i>
9. <i>A. sanctae-crucis</i> (Fabricius)	(Boheman)
10. <i>A. indica</i> Boheman	17. <i>Laccoptera quadrimaculata</i>
11. <i>Cassida icterica</i> Boheman	(Thunberg)
	18. <i>Epistictina viridimaculata</i>
	(Boheman)

III—SYSTEMATIC ACCOUNT

Order COLEOPTERA

Family CHRYSOMELIDAE

Subfamily HISPINAE

1. *Anisodera guerini* Baly

1858. *Anisodera guerini* Baly, *Catalogue Hispinae* : 168.

1919. *Anisodera guerini* : Maulik, *Fauna British India, Chrysomelidae (Hispinae, Cassidinae)* : 35.

Material.—1 ex., Kameng Div., Anakaling, 25.v.1961 (K.C.J.)

Remarks.—This species was reported by Maulik (*l.c.*) from S. India, Maharashtra, N. Bengal, Assam, Sikkim, Burma and Java. All the abdominal sternites are not thickly and coarsely punctate as implied by Maulik (*l. c.*). The 1st and 2nd (visible) abdominal sternites are very sparsely punctate, the 3rd and 4th sternites are moderately punctate while only the last abdominal sternite is thickly and coarsely punctate.

Distribution.—India, Sikkim, Burma, Indonesia (Java).

2. *Dactylispa peregrina* Maulik

1919. *Dactylispa peregrina* Maulik, *Fauna British India, Chrysomelidae (Hispinae, Cassidinae)* : 185.

Material.—2 exs., Kameng Div., Rupa, 3.v.1961 (K.C.J.), 2 exs., Kameng Div., Domko, 10.v.1961 (K.C.J.) ; 3 exs., Sikkim, 22.v.1962 (G.R.) ; 1 ex., Sikkim, Singlik, 9.v.1962 (G.R.) ; 1 ex., Sikkim, Keiozing, 19.v.1962 (G.R.)

Remarks.—As reported by Maulik (*l.c.*), this species occurs in the hills of N.E. India (Punjab, Uttar Pradesh, Assam, W. Bengal) and Burma. It comes close to *D. brevispinosa* Chapuis, which is also known from hills of Punjab and Assam. Sufficient number of examples belonging to the latter species are not available for detailed examination.

Distribution.—India and Burma.

3. *Dactylispa atkinsoni* (Gestro)

1897. *Hispa atkinsoni* Gestro, *Ann. Mus. Civ. Genova*, 38 : 132 (Sikkim : Mungphu)

1919. *Dactylispa atkinsoni* : Maulik, *Fauna British India, Chrysomelidae (Hispinae, Cassidinae)* : 205.

Material.—1 ex., Sikkim, 22.v.1962 (G.R.).

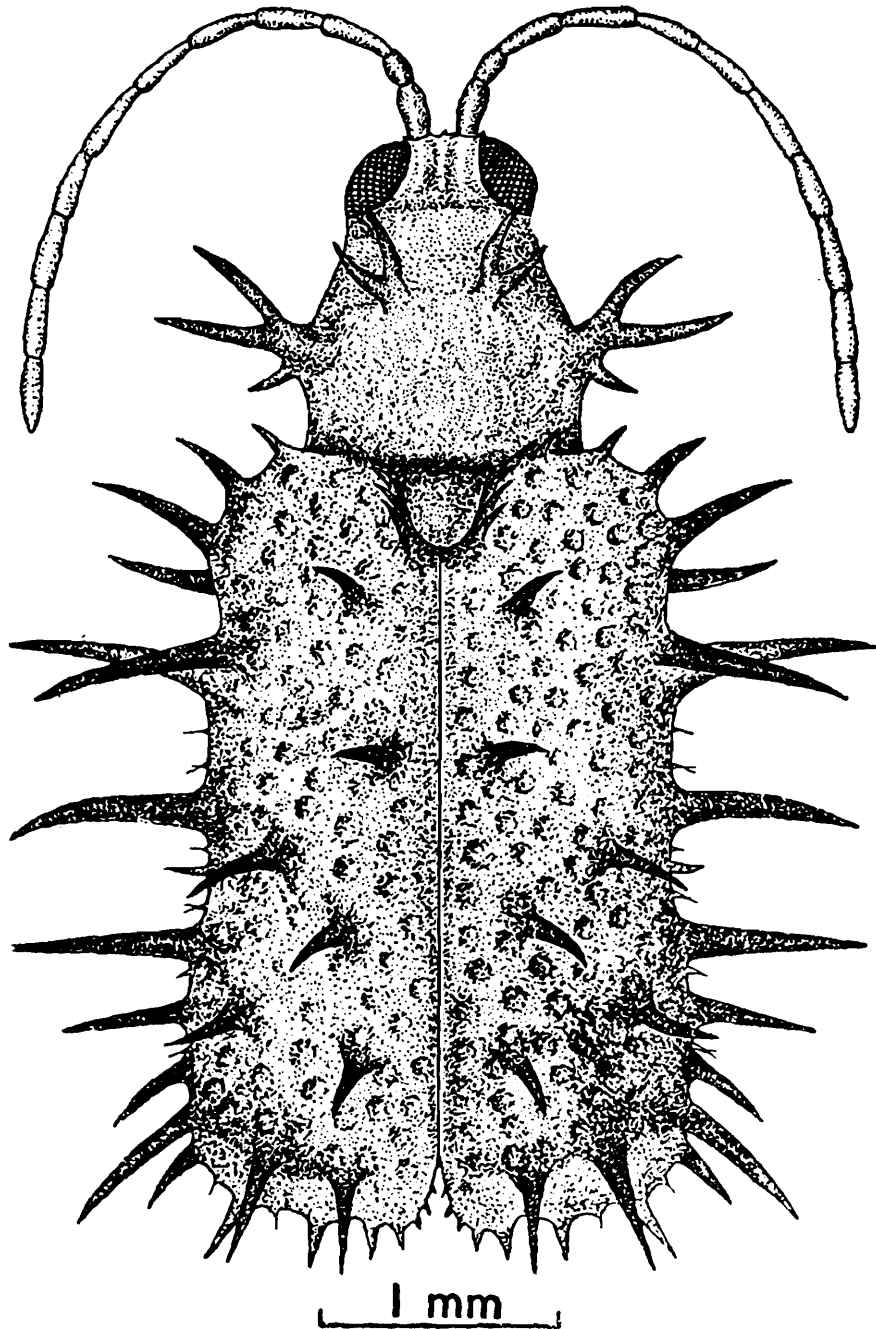
Remarks.—This species has been reported from Punjab, Uttar Pradesh : Kumaon : Bhimtal, W. Bengal : Darjeeling. It is now being reported from Sikkim for the first time.

Distribution.—India,

4. *Dactylispa manii* sp.n.

(Text-fig. 1)

Body elongate. Antennae, head, elytra, legs and most of the ventral side yellowish-brown ; disc of pronotum and elytral spines black.

TEXT-FIG. 1.—Dorsal view of *Dactylispa manii* sp. n.

Head.—Yellowish-brown, interocular space and antennae of the same colour ; antennae moderate-sized, hairy, apical five segments gradually thickened ; interocular space slightly depressed somewhat rough ; collar and vertex smooth and shining ; a row of white hairs along the inner margin of the eyes.

Pronotum.—Black colour reduced to two patches on the disc, reddish brown anteriorly and posteriorly ; the surface coarsely punctate and moderately pubescent, with a narrow median longitudinal glabrous line ; anterior border with two pairs of spines not very close to each other, each pair with a small stalk, front spine a little longer than posterior one ; the three lateral spines having a common stalk, the first two being almost equal and parting at a higher level than the third, the latter being much smaller and emanating almost from base of the stalk ; all spines reddish brown.

Scutellum.—Reddish brown, surface with very fine tubercles giving it a rough appearance, five minute spines on each side of scutellar ridge.

Elytra.—Reddish brown ; sides not broadly expanded anteriorly or posteriorly ; surface more or less punctate-striate, punctures large and quite close to each other, with fine hairs arising out of punctures ; each elytron with ten black spines disposed as under.—(i) 4 small spines arranged in an irregular sub-sutural row (ii) 3 spines arranged in an irregular sublateral row, the anterior most spine being much longer than other two (iii) 3 spines arranged in a sub-apical transverse row ; besides discal spines, the lateral margin, from the humeral to the sutural angle having 15 spines (4-5 on apical margin, being yellowish brown and others black).

Length—4.5 mm ; Breadth 3.5 mm.

Holotype : INDIA : NEFA : Kameng Div. : Amatulla River bank, 2 km. south of Ama town, 8.iii. 1961 (K.C.J.) in Z.S.I. Colln.

Remarks.—In Maulik's (1919), key to species known from India, it comes close to *D. tissa* Maulik, from which it differs in (i) the sculpture of pronotum (ii) ventral side reddish brown vs. black (iii) colouration of antennal segments (iv) scutellum reddish brown pitch-black (v) in number of spines from humeral angle to sutural angle. In Gressitt and Kimoto's key (1963), this species also comes close to *D. mauliki* Gressitt in the elytra having fine hairs arising from punctures and each elytron having 10 black spines but differs from it in having the 10 spines on each elytron not so large and pronotum not entirely black. It also differs from *D. filiola* Weise, in which the lateral spine 3 (i.e. most posterior) of pronotum arises from base of the trunk of anterior two spines but this spine in the present species is shorter than other two spines as against as long as spine 1.

5. *Gonophora pulchella* Gestro

1888. *Gonophora pulchella* Gestro, *Ann. Mus. Civ. Genova*, (6) 26 : 176 (Burma : Smegeo-Myo Bhomo Tenasserim).

1919. *Gonophora pulchella* : Maulik, *Fauna British India, Chrysomelidae : Hispinae, Cassidinae* : 146.

1963. *Gonophora pulchella* : Gressitt et Kimoto, *Pac. Ins. Mon.*, 1 B : 911.

Material.—Sikkim : 1 ex. Rhenock, 3.v.1962 (G. R.)

Remarks.—The above example is slightly longer (6.0 mm) than the measurements given by Maulik (*l.c.*) viz. 5.5 mm. It is previously reported in India from W. Bengal, Assam, Manipur. It is now being recorded from Sikkim for the first time.

Distribution.—India, Burma, Indo-China, Hainan Island.

6. *Anisoderopsis excavata* (Baly)

1858. *Anisodera excavata* Baly, *Catalogue Hispinae* : 105.

1919. *Anisoderopsis excavata* : Maulik, *Fauna British India, Chrysomelidae (Hispinae, Cassidinae)* : 37.

Material.—Sikkim : 2 exs., Rishikhodo, 994 m., 7. v .1959 (A.G.K.M.)

Remarks.—This species is earlier reported from India : W. Bengal : Darjeeling, Assam, Cachar, Burma and Tonkin. It is now being recorded from Sikkim for the first time.

While the longitudinal rows of punctures on elytra are ten, their relative disposition and confluence appear to be variable. In addition there are a few scattered punctures present particularly on the sides.

Distribution.—India, Burma, Vietnam (Tonkin).

7. *Hispellinus minor* (Maulik)

1919. *Monochirus minor* Maulik, *Fauna British India, Chrysomelidae (Hispinae, Cassidinae)* : 155 (Ceylon : Trincomalee ; Sumatra : Nahat).

Material.—NEFA : 1 ex., Kameng Div., 28 xii.1965 (S.K.B. and A.N.T.J.)

Remarks.—This species is known from Sumatra and Ceylon. The present record from N. E. India fills the gap in its distribution and is of zoogeographical importance. It is being recorded from India for the first time.

Distribution.—India, Ceylon and Sumatra.

Subfamily Cassidinae

8. *Aspidomorpha miliaris* (Fabricius)

1775. *Cassida miliaris* Fabricius, *Syst. Ent.*, Flensburgei et Lipsiae : 91 (St. Helenae).

1919. *Aspidomorpha miliaris* : Maulik, *Fauna British India, Chrysomelidae (Hispinae, Cassidinae)* : 334.

1963. *Aspidomorpha miliaris* : Gressitt et Kimoto, *Pac. Ins. Mon.*, 1 B, : 952.

Material.—Assam : 1 ex., Tezpur, 1.i.1966 (S.K.B. & A.N.T.J.).

Remarks.—This species is very widely distributed in the Oriental region. In India also it is very common. Colour variation etc. have been adequately discussed by Maulik (*l.c.*) and Gressitt et Kimoto (*l.c.*).

Distribution.—India, Burma, S. China (Yunnan, Hong Kong), Hainan I., Vietnam, Malaya, Indonesia, Celebes, Philippines, New Guinea.

9. *Aspidomorpha sanctae-crucis* (Fabricius)

1794. *Cassida St. crucis* Fabricius, *Ent. Syst.*, Hafniae, 4 : 446.
 1919. *Aspidomorpha sanctae-crucis* : Maulik, *Fauna British India, Chrysomelidae (Hispinæ, Cassidinae)* : 329.
 1963. *Aspidomorpha sanctae-crucis* : Gressitt et Kimoto, *Pac. Ins. Mon.*, 1 B : 953.

Material.—Assam : 1 ex., Missamari, 28. xi. 1965 (S.K.B. & A.N.T.J.).

Remarks.—This species is widely distributed in India from south to the base of Himalaya in the north. It generally occurs in abundance and shows considerable variation in size.

Distribution.—India, Ceylon, Burma, S. China, Hainan, Vietnam, Thailand, Malaya, Sunda-Islands.

10. *Aspidomorpha indica* Boheman

1854. *Aspidomorpha indica* Boheman, *Monograph Cassidinae*, 2 : 318.
 1919. *Aspidomorpha indica* : Maulik, *Fauna British India, Chrysomelidae (Hispinæ, Cassidinae)* : 327.
 1963. *Aspidomorpha indica* : Gressitt et Kimoto, *Pac. Ins. Mon.*, 1 B : 952.

Material.—Sikkim : 1 ex., Thomhyak, 31. v. 1959 (A.G.K.M.) ; NEFA : 1 ex., Kalaktang, Sangloom, 2288 m, 11.ix.1961 (S. B.).

Remarks.—Maulik (*l.c.*) recorded this species from India : Madras : Samalkot, Godavari Dist. and Sikkim : Darjeeling (now in W. Bengal). There is no other record of this species from India since then and it is now being recorded from Sikkim and NEFA for the first time.

Distribution.—India.

11. *Cassida icterica* Boheman

1854. *Cassida icterica* Boheman, *Monograph Cassidinae*, 2 : 400 (Almora).
 1919. *Cassida icterica* : Maulik, *Fauna British India, Chrysomelidae (Hispinæ, Cassidinae)* : 380.

Material.—Sikkim : 1 ex., 19.iii.1959 (A.G.K.M.).

Remarks.—So far this species is known only from its type-locality viz., Uttar Pradesh : Almora. It is now being recorded from Sikkim for the first time.

Distribution.—India.

12. *Cassida occursans* Spaeth

1914. *Cassida occursans* Spaeth, *Deut. Ent. Zeits.* : 560 (Sikkim : Mungphu. Assam ; Boroma)
 1919. *Cassida occursans* : Maulik, *Fauna British India, Chrysomelidae (Hispinæ, Cassidinae)* : 395.

Material.—NEFA : Kameng Div. : 2 exs. Dengri, 15.v.1961 ; 1 ex., Ankaling, 26. v. 1961 ; 1 ex., Ankaling, 25.v.1961 (K.C.J.).

Remarks.—Maulik (*l.c.*) p. 395, has stated “Body more or less oblong, twice as long as broad.....” This cannot be true since the measurements given by him on p.396 are “Length 7.5 mm ; breadth 5.4 mm.” The present examples measure 7.0-7.2 mm in length and 5.4-5.5 mm. in breadth. In the collections of the Zoological Survey of India there are examples from Abor expedition and Burma ; these examples are a little dark reddish brown, slightly larger in size and with deeper punctures on the elytra, than in the above examples.

Distribution.—India and Burma.

13. *Sindia sedecimmaculata* (Boheman)

1856. *Cassida sedecimmaculata* Boheman, *Catalogue Col. Ins. Brit. Mus.*, 9 : 119 (Sikkim : Mungphu).
 1919. *Sindia sedecimmaculata* : Maulik, *Fauna British India, Chrysomelidae (Hispinae, Cassidinae)* : 343-344.
 1963. *Sindia sedecimmaculata* : Gressitt *et* Kimoto, *Pac. Ins. Mon.*, 1 B : 954-955.

Material.—NEFA : Kameng Div., 1 ex., Dengzi, 15.v.1961 ; 2 exs., same locality, 25.v.1961 (K.C.J.).

Remarks.—In India this species is known only from its type-locality viz. Sikkim : Mungphu. It is now being recorded from NEFA region for the first time. Since its description in 1856 by Boheman, it has been reported from S.W. China (Kweichow) by Chen, 1935.

Distribution.—India and China.

14. *Basiprionota* (s. str.) *maculipennis* (Boheman)

1850. *Prioptera maculipennis* Boheman, *Monograph Cassidinae*, 1 : 50.
 1919. *Prioptera maculipennis* : Maulik, *Fauna British India, Chrysomelidae (Hispinae, Cassidinae)* : 313.

Material.—Assam : 1 ex., Lushai hills, Nausel, 1219 m., 16.ix.1960 (F. Schmid) ; NEFA : 1 ex., Kameng Div. : Diefam hill, 21.v.1961 (K.C.J.).

Remarks.—In India this species is reported by Maulik (*l.c.*) from Nepal : Dekhut, Assam : Mangaldai Dist. and Bhutan frontier. This species is widely distributed from India to Hainan. Gressitt (1938) considers Hainan's specimens to belong to the subspecies *reducta* Gressitt. Thus the specimens from India belong to the nominotypical subspecies.

Distribution.—Nepal and India.

15. *Basiprionota* (s. str.) *decemmaculata* (Boheman)

1850. *Prioptera decemmaculata* Boheman, *Monograph Cassidinae*, 1 : 60.
 1919. *Prioptera decemmaculata* : Maulik, *Fauna British India, Chrysomelidae (Hispinae, Cassidinae)* : 314-316.

Material.—Sikkim : 1 ex., Makaibari, 30 iv.1962 (S. Ali) ; NEFA : Kameng Div., 1 ex., 10.iii.1961 ; 1 ex., Ankaling, 24.v.1961 ; 1 ex., same locality, 25.v.1961 (K.C.J.).

Remarks.—This species is recorded by Maulik (*l.c.*) from Sikkim : Mungphu ; Assam and Burma.

Distribution.—India and Burma.

16. *Basiprionota* (s. str.) *impustulata* (Boheman)

1850. *Prioptera impustulata* Boheman, *Monograph Cassidinae*, 1 : 46.

1919. *Prioptera impustulata* : Maulik, *Fauna British India, Chrysomelidae (Hispinæ & Cassidinae)* : 316.

Material.—Sikkim : 1 ex., Toong, 31.vii. 1959 (A.G.K.M.).

Remarks.—Maulik (*l.c.*) records this species from Assam only. In the collection of the Zoological Survey of India, there is one example labelled : Calc. Nov. 18 (which means Calcutta, November 1918) and has been identified by Maulik. In the example under report, the head is black and not yellowish brown as per description given by Maulik. This factor, however, I believe to be within the range of individual variation. This is the first record of this species from Sikkim. It is also slightly larger in size (11.0 X 9.5 mm) as against 10.5 X 9.0 mm, the measurements given by Maulik (*l.c.*).

17. *Lacoptera quadrimaculata* (Thunberg)

1789. *Cassida quadrimaculata* Thunberg, *Nov. Ins. Spec.*, 5 : 86 (China).

1919. *Lacoptera quadrimaculata* : Maulik, *Fauna British India, Chrysomelidae (Hispinæ : Cassidinae)* : 347.

1963. *Lacoptera quadrimaculata* : Gressitt et Kimoto, *Pac. Ins. Mono.*, 1 B : 956.

Material.—Sikkim : 1 ex., Chufun fun, 24.vii.1959 ; 1 ex., Gangtok, 16.viii.1959 (A.G.K.M.).

Remarks.—This species is very widely distributed both in India and the Oriental region.

Distribution.—India, Burma, Andaman Islands, S. China, Taiwan, Indo-China, East Indies.

18. *Epistictina viridimaculata* (Boheman)

1850. *Epistictia viridimaculata* Boheman, *Monograph Cassidinae*, 1 : 15 (Nepal).

1919. *Epistictia viridimaculata* : Maulik, *Fauna British India, Chrysomelidae (Hispinæ, Cassidinae)* : 320.

1963. *Epistictina viridimaculata* : Gressitt et Kimoto, *Pac. Ins. Mon.*, 1 B : 945.

Material.—Sikkim : 1 ex., Lingjok, 20.v.1962 (G.R.).

Remarks.—This species is known in India from Punjab and Assam. It is now being recorded from Sikkim for the first time.

Distribution.—Nepal, India, Burma, S. W. China, Vietnam, Thailand, Malacca.

TABLE 1.—Showing distribution of species in the Oriental Region.

	Ceylonese sub-region	Indian sub-region	Indo-Chinese sub-region	Indo-Malay sub-region	
Subfamily HISPINAE					
<i>Anisodera guerini</i>		—	—	—	
<i>Dactylispa peregrina</i>			—		
<i>D. atkinsoni</i>			—		
<i>D. manii</i>			—		
<i>Gonophora pulchella</i>			—	—	
<i>Anisoderopsis excavata</i>			—		
<i>Hispellinus minor</i>	—	—	—	—	
Subfamily CASSIDINAE					
<i>Aspidomorpha miliaris</i>	—		—	—	Widely distributed.
<i>A. santae-crucis</i>	—	—	—	—	Widely distributed.
<i>A. indica</i>	—	—	—		
<i>Cassida icterica</i>			—		
<i>Cassida occursans</i>			—		
<i>Sindia sedecimaculata</i>			—		
<i>Basiprionota</i> (B.)					
<i>maculipennis maculipennis</i>			—		
<i>B. (B.) decempunctata</i>			—		
<i>B. (B.) impustulata</i>		—	—		
<i>Laccoptera</i>					Widely distributed.
<i>quadrimaculata</i>	—	—	—	—	
<i>Epistictina</i>					
<i>viridimaculata</i>	—	—	—	—	
	6	7	18	(4 + 3 = 7)	

IV—SUMMARY

This is a report on a collection of Hispinae and Cassidinae (Chrysomelidae) made during the faunistic survey of Sikkim and NEFA by the Zoological Survey of India between 1959-1965. Of the 18 species, one is described as new viz. *Dactylispa manii* and 7 species are being recorded from Sikkim for the first time.

Out of 18 species, 3 species are widely distributed and 11 species are endemic to N.E. India including Burma.

V—REFERENCES

- CHEN, S. H. 1935. Schwedisch-chinische wissenschaftliche expedition nach du nordwestlichen Provinzen Chinas.—*Ark. zool.*, **27** A, no. 5 : 13 pp.
- GRESSITT, J. L. 1938. Some tortoise beetles from Hainan Island. (Coleoptera : Chrysomelidae : Cassidinae).—*Lignan Sci. J.*, **17** : 185-193.

GRESSITT, J. L. and KIMOTO, S. 1963. The Chrysomelidae (Coleopt.) of China and Korea, Part 2. *Pac. Ins. Mon.*, 1 B : 301-1026.

MAULIK, S. 1919. The Fauna of British India, including Ceylon and Burma. Coleoptera. Chrysomelidae (Hispinæ and Cassidinae). xii+440 pp.—London (Taylor & Francis).

FOSSIL FAUNA OF RAJASTHAN (INDIA)

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(With 1 Text-figure and 2 tables)

I—INTRODUCTION

Impey (1956) was the earliest worker to deal with the animal fossils from Rajasthan. Towards the end of last century Blanford (1877), and Oldham (1886) recorded a few forms while dealing with the geology of Jaisalmer area. It is observed that this subject received greater attention of workers since 1946. Thereafter a number of workers have contributed to the study of animal fossils from this part of India. An attempt has been made below to give a systematic list of fossil forms known from this state, their geographical distribution along with the author who reported them from each locality. A reference to table II will give an idea about the geological distribution of the species.

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II—GEOLOGY OF RAJASTHAN

The study of fossil animals is always correlated with the location, both geographical and stratigraphical. It is the latter which gives actual knowledge about the palaeoecology and palaeogeography of the area and also the relative time of existence of a species vis-à-vis other species.

The geology of Rajasthan has, since the later half of the last century, been studied by different workers like Blanford (1877), Coulson (1933), Fermor (1930), Gupta (1934), Gupta and Mukherji (1938), Heron (1917, 1924, 1932, 1935 & 1936), Oldham (1886), La Touche (1902), etc.

The existing knowledge on geology of Rajasthan has been well summarised by Ghosh (1952). Table I (based on Ghosh) shows the various geological formations which are found in this state. It will be seen that the eastern part (excepting Dholpur) and the Aravallis are devoid of fossils whereas, the western part consisting of Barmer, Bikaner, Jaisalmer and Jodhpur districts, is full of fossiliferous sites which are given in Table II. These fossiliferous formations belong to Cretaceous, Jurassic and Eocene periods. Map 1 shows the distribution of fossil-bearing formations and the known fossiliferous sites in these areas.

TABLE 1

Showing Geological formations in Rajasthan

(Broken lines indicate unconformity)

Era (Age in Million years).	Systems	Formations.
Quaternary	Recent	Recent : Sand, alluvium, Kankar,
	Pleistocene	Older alluvium
1		-----
	Pliocene Miocene Oligocene }	Not reported in Rajasthan
Tertiary. or Kainozoic (Birth of Himalaya; Final wreck of Gondwana land)	Eocene	Nummulitic limestone, Fuller's earth and subbentonite of Western Rajasthan, and lignite in Bikaner and Jodhpur.
60		-----
120	Cretaceous	----- Barmer sandstone Abur formation -----
Secondary or Mesozoic		
145	Jurassic	----- Parihar formation Bedesar formation Jaisalmer limestones Lathi formation -----
	Triassic	Not reported in Rajasthan
170		-----
	Permian ? Carboniferous-	----- Bap boulder beds Bhadaura formation near Bap in Jodhpur -----
240		
Palaeozoic	Devonian Silurian Ordovician }	Absent in Rajasthan
	Cambrian	Upper Vindhya :—East and West of Aravallis. Lower Vindhya :—Limestone and shale ; and Malani series

----- 500 -----	
Algonkian or Proterozoic	----- . . .
-----610—725-----Precambrian	Cuddapah (Kadapa) Delhi System : Alwar series Ajabgarh series (from Delhi Idar, Ajmer, Udaipur state).
(Major elevation of Aravallies & birth of Gondwana land)	
-----1000-----	
Archaean or	----- Raialo series :-- Makrana, Rajnagar, -----
Azoic	Bhagwanpura marbles. ----- Aravalli system (=Dharwarian system) ----- Banded Gneissic complex and Bundel- khand granite (seen on both to the east and west of the Aravallis).
-----1500-----	

Based on Ghosh (1952) and Liubimova, Guha & Mohan (1960).

III—SYSTEMATIC LIST OF FOSSIL FAUNA

Authors recording various species from different localities are cited by numbers in the list of references.

Phylum PROTOZOA
Class SARCODINA
Order FORAMINIFERA

Family ACERVULINIDAE

1. Genus *Gypsina* Carter,

(1) *Gypsina* sp.—Kolayat (45, 48) Bandah (27).

Family ALVEOLINELLIDAE

2. Genus *Alveolina* d'Orbigny

(2) *Alveolina elliptica* var. *flosculina* Silvestri.—Bandah (27)

(2a) *Alveolina oblonga* d'Orbigny.—Jaisalmer (5).

Subgenus *Flosculina* Stache

(3) *Alveolina (Flosculina)* sp.—Kolayat (44, 45, 48, 51); Marh (47).

Family AMPHISTEGINIDAE

3. Genus *Eoconuloides* Cole & Bermudez

(4) *Eoconuloides* sp.—Kolayat (48).

4. Genus **Asterigerina** d'Orbigny

- (5)
- Asterigerina indica*
- Jacob & Sastri, 1950.—Marh (24)

Family ASTORRHIZIDAE

5. Genus **Bathysiphon** M. Sars

- (6)
- Bathysiphon*
- sp.—Nagurda (1).

Family BULIMINIDAE

6. Genus **Bulimina** d'Orbigny

- (7)
- Bulimina*
- sp.—Marh (24).

7. Genus **Turrilina** Andreae

- (8)
- Turrilina*
- sp.—Nagurda (1)

8. Genus **Virgulina** d'Orbigny

- (9)
- Virgulina*
- sp.—Marh (24)

Family CHAPMANIIDAE

9. Genus **Dictyoconoides** Nuttall

- (10)
- Dictyoconoides cooki*
- (Carter).—Bandah formation (27, 35) Jaisalmer (5) ; Kolayat (44, 45, 48, 51).

- (11)
- Dictyoconoides*
- sp.—Marh (47).

Family CYCLOCYPEIDAE

10. Genus **Discocyclina** Gumbel

- (12)
- Discocyclina dispansa*
- (Sowerby 1837).
-
- Bandah formation (27, 35).

- (12a)
- Discocyclina sowerbyi*
- Nuttall.—Bandah (27)

- (13)
- Discocyclina*
- sp. (sellate forms) Kolayat (44) ; Bandah (27).
-
- Subgenus
- Discocyclina**
- Gumbel, 1870.

- (14)
- Discocyclina*
- (
- Discocyclina*
-) sp.—Kolayat (48) ; Marh (47).

Subgenus **Actinocyclina** Gumbel

- (15)
- Discocyclina*
- (
- Actinocyclina*
-) sp.—Kolayat (44, 45, 48).

11. Genus **Pseudophragmina** Douville
Subgenus **Proporocyclina** Vaughan & Còle

- (16) *Pseudophragmina* (*Proporocyclina*) spp.
(=*Discocyclina* (*Proporocyclina*) sp.—Kolayat (44, 45, 48).

Family HETEROCHELICIDAE

12. Genus **Bolivina** d'Orbigny

- (17) *Bolivina* sp.—Rohli (43, 42) ; Utarlai (42)

Family MILIOLIDAE

13. Genus **Quinqueloculina** d'Orbigny

- (18) *Quinqueloculina* sp.—Marh (24)

Family NODOSARIDAE

14. Genus **Astacolus** Montfort

- (19) *Astacolus aphrastus* var. *minuta* Subbotina, Datta & Srivastava 1960.—Jaisalmer (53).

- (20) *Astacolus centrogyrata* var. *definita* Subbotina & Datta, 1960.—Kuldhar (54).

15. Genus **Citharina** d'Orbigny

- (20a) *Citharina submulticostata* Subbotina & Datta, 1960.—Kuldhar (53).

15a. Genus **Citharinella** Marie

- (21) *Citharinella foliaformis* Subbotina & Datta, 1960. Marie Kuldhar (53).

16. Genus **Dentalina** d'Orbigny

- (22) *Dentalina* sp.—Marh (24).

17. Genus **Lagena** Walker & Jacob

- (23) *Lagena* sp.a.—Marh (24).

- (24) *Lagena* sp.b.—Marh (24).

- (25) *Lagena* sp.—Nagurda (1) ; Rohli and Utarlai (42).

18. Genus **Lenticulina** Lamarck

- (26) *Lenticulina dilectaformis* Subbotina & Srivastava, 1960.—Kuldhar (54).

- (27) *Lenticulina munsteri* (Roemer).—Kuldhar (53).

19. Genus **Pseudoglandulina** Cushman

- (28)
- Pseudoglandulina*
- sp.—Marh (24).

20. Genus **Vaginulinopsis** Silvestri

- (29)
- Vaginulinopsis cryptospira*
- (Paalzow).—Jaisalmer (53).

- (30)
- Vaginulinopsis*
- cf.
- eritheles*
- Loeblich & Tappan, 1950.—Jaisalmer (53).

Family NONIONIDA E

21. Genus **Nonion** Montfort

- (31)
- Nonion scapha*
- var.
- indica*
- Jacob & Sastri, 1950.—Marh (24).

22. Genus **Nonionella** Cushman

- (32) ?
- Nonionella*
- sp.—Marh (24).

Family NUMMULITIDAE

23. Genus **Assilina** d'Orbigny

- (33)
- Assilina daviesi*
- de Cizancourt, 1938.—Kolayat (45); Bandah (27).

- (34)
- Assilina granulosa*
- (d'Archiac, 1847).—Khewansar (50); Jaisalmer (5, 34); Kolayat (45); Kuiala (35); Palana (34, 51, 58).

- (35)
- Assilina leymerie*
- d'Archiac & Haime, 1853.—Khewansar (50); Kolayat (45); Marh (24); Palana (51).

- (36)
- Assilina*
- cf.
- spinosa*
- Davies, 1937.—Khewansar (50).

- (37)
- Assilina spinosa*
- Davies, 1937.—Kuiala (35); Bandah (27).

- (38)
- Assilina subumbilicata*
- de Cizancourt, 1938.—Khewansar (50); Kolayat (55).

- (39)
- Assilina umbilicata*
- (Rutten, 1915).—Kolayat (45).

- (40)
- Assilina*
- sp.—Khewansar (50).

24. Genus **Eoassilina** Singh

- (41)
- Eoassilina elliptica*
- Singh, 1957.—Palana (51).

25. Genus **Heterostegina** d'Orbigny

- (42)
- Heterostegina*
- sp.—Kolayat (44, 48).

26. Genus **Nummulites** Lamarck

- (43)
- Nummulites asymmetrica*
- Singh, 1957.—Kolayat (51).

- (44)
- Nummulites atacicus*
- Leymerie, 1846.—Bandah (27, 35); Jaisalmer (5); Khewansar (50); Marh (24, 45); Palana (34, 58).

- (45) *Nummulites beaumonti* d'Archiac & Haime, 1853.—Kuchri (3).
- (46) *Nummulites irregularis* Deshayes, 1838.—Kuiala (35).
- (47) *Nummulites leymeriei* d'Archiac Haime, 1853.—Kuchri (3).
- (48) *Numulites maculatus* Nuttal, 1926.—Kolayat (45, 49, 51).
- (49) *Nummulites* cf. *maculatus* Nuttal, 1926.—Kolayat (44).
- (50) *Nummulites ramondi* DeFrance.—Kuchri (3).
- (51) *Nummulites spira* (de Roissy, 1853).—Kuchri (3).
- (52) *Nummulites stamineus* Nuttal, 1926.—Kolayat (44, 49, 51). Bandah (27).
- (53) *Nummulites* sp.—Khewansar (50) ; Kishangarh and Boa (6); Kolayat (44) ; Marh (47) ; Bandah (27).

27. Genus **Operculina** d'Orbigny

- (54) *Operculina* sp.—Kolayat (45) ; Palana (51) ; Bandah (21)

28. Genus **Operculinoides** Hanzawa

- (55) *Operculinoides* sp.—Kuiala (35).

Family ORBITOIDIDAE

29. Genus **Eulinderina** Barker & Grimsdale

- (56) *Eulinderina* sp.—Marh (45).

Family ORBULUNIDAE

30. Genus **Globigerina** d'Orbigny

- (57) *Globigerina* cf. *pseudobulloides* Plumer, 1926.—Marh (24).
- (58) *Glogigerina triloculinoides* Plumer, 1926.—Marh (24).
- (59) *Globigerina* sp.—Marh (24) ; Nagurda (1).

Family POLYMORPHINIDAE

31. Genus **Guttulina** d'Orbigny

- (60) *Guttulina* sp.—Marh (24).

Family ANOMALINIDAE

32. Genus **Cibicides** Montfort

- (61) *Cibicides* cf. *beaumontiana* (d'Orbigny).—Marh (24).
- (62) *Cibicides praecursorius* (Schwager, 1838).—Marh (24).
- (63) *Cibicides praecursorius* var. *madhensis* Jacob & Sastri, 1950. Marh (24).
- (64) *Cibicides* sp.—Nagurda (1) ; Rohli (42, 43) ; Utarlai (42).

Family GLOBOROTALIIDAE

33. Genus **Cycloloculina** Heron-Allen & Earland

(65) *Cycloloculina* sp.—Marh (24).

34. Genus **Discorbis** Lamarck

(66) *Discorbis globularis* (d'Orbigny, 1826).—Marh (24).

(67) *Discorbis* sp.—Rohli (42, 43); Siasar (28); Utarlai (42).

35. Genus **Globorotalia** Cushman

(68) *Globorotalia* sp.—Rohli (42, 43); Utarlai (42).

36. Genus **Gyroidina** d'Orbigny

(69) *Gyroidina* sp.—Rohli (42, 43); Utarlai (42).

37. Genus **Linderina** Schlumberger

(70) *Linderina bikanerensis* Singh, 1953a.—Marh (47); Kolayat (49, 51); Bandah (35).

(71) *Linderina* aff. *brugesi* Schlumberger, 1893.—Kolayat.

(72) *Linderina kirtharensis* Singh, 1953a.—Bandah (35); Kolayat (51); Marh (47).

(73) *Linderina kolayatensis* Singh, 1953a.—Bandah (35); Kolayat (51); Marh (47).

(74) *Linderina rajasthanensis* Singh, 1953a.—Bandah (35); Kolayat (49, 51); Marh (47).

(75) *Linderina* sp.—Kolayat (44, 45).

38. Genus **Lockhartia** Davies

(76) *Lockhartia tipperi* (Davies).—Kolayat (45).

(77) *Lockhartia* sp.—Khewansar (50).

39. Genus **Planorbulina** d'Orbigny

(78) *Planorbulina* sp.—Kolayat (44).

40. Genus **Pulvinulina** Parker & Jones

(79) *Pulvinulina* sp.—Khari (28).

41. Genus **Pulvinulinella** Cushman

(80) *Pulvinulinella* sp.—Marh (24).

42. Genus **Rotalia** Lamarck

(81) *Rotalia crookshankiana* Jacob & Sastri, 1950.—Marh (24).

- (82) *Rotalia subgranulosa* Jacob & Sastri, 1950.—Marh (24).
 (83) *Rotalia* sp.—Khari (28) ; Nagurda (1) ; Rohli (42, 43) ;
 Utarlai (42).

Family PLANORBULINIDAE

43. Genus **Eoannularia** Cole & Bermudez

- (84) *Eoannularia* sp.—Kolayat (48).

Family SPIRILLINIDAE

44. Genus **Coscinoconus** Leupold

- (85) *Coscinoconus* cf. *elongatus* Leupold, 1935.—Jaisalmer (53).

45. Genus **Spirillina** Ehrenberg

- (86) *Spirillina tenuicostata* Subbotina, Datta & Srivastava,
 1960. Jaisalmer (53).

46. Genus **Trocholina** Paalzow

- (87) *Trocholina transversarii* Paalzow, 1932.—Jaisalmer (53).

Family SORITIDAE

47. Genus **Orbitolites** Lamarck

- (88) *Orbitolites complanatus* Lamarck, 1801.—Kuiala (35) ;
 Khewansar (50).

Family TINOPORIDAE

48. Genus **Calcarina** d'Orbigny

- (89) *Calcarina* sp.—Kolayat (48).

Family TROCHAMMINIDAE

49. Genus **Ammobaculites** Cushman

- (90) *Ammobaculites* sp.—Gunga (59) ; Kapurdi and Nagurda
 (1) ; Rohli (42, 43) ; Utarlai (42).

50. Genus **Haplophragmoides** Cushman

- (91) *Haplophragmoides* sp.—(=*Haplophragmies*).— Damodera
 (37) ; Rohli and Utarlai (42).

51. Genus **Trochammina** Parker & Jones

- (92) *Trochammina* sp.—Damodera (37) ; Nagurda (1).

Phylum PORIFERA

- (93) Unidentified sponge spicules.—Jaisalmer (53).

Phylum COELENTERATA
Class ANTHOZOA

- (94) Unidentified corals.—Kuldhar (29) ; Lodorwa (32).

Phylum BRYOZOA
Order CRYPTOSOMATA

Family FENESTELLIDAE

52. Genus **Polypora** McCoy

- (95)
- Polypora ampla*
- Lonsd.—Bap (41).

- (96) Unidentified Bryozoa.—Jaisalmer (53).

Phylum ANNELIDA
Class POLYCHAETA

Family NEREIDAE

53. Genus **Nereites** Linnaeus

- (97)
- Nereites*
- sp.—Jaisalmer (16).

Phylum ARTHROPODA
Class CRUSTACEA
Order OSTRACODA

Family BAIRDIIDAE

54. Genus **Bairdia** McCoy

- (98)
- Bairdia*
- sp.—Jamsar (25) ; Marh (24).

Family CYPRIDAE

55. Genus **Cypris** Muller

- (99)
- Cypris*
- sp.—Jamsar (25).

56. Genus **Potamocypris** Brady

- (100)
- Potamocypris*
- sp.—Jamsar (25).

Family CYTHERELLOIDAE

57. Genus **Cytherella** Jones

- (101)
- Cytherella obscura*
- Iubimova & Mohan, 1960.—Amar Sagar (29).

Family CYTHERIDAE

58. Genus **Bythocythere** Sars

- (102)
- Bythocythere*
- sp. juv.—Kuldhar (29).

59. Genus **Cythereis** Jones

- (103)
- Cythereis*
- sp.—Marh (24) ; Nagurda (1).

60. Genus **Cytheropteron** Sars

- (104)
- Cytheropteron*
- sp.—Marh (24).

61. Genus **Paijanborchella** Kingma

- (105)
- Paijanborchella*
- sp.—Kuiala formation (35).

62. Genus **Progonocythere** Sylvester—Bradley

- (106) *Progonocythere grumosa* Lubimova & Mohan, 1960.—Kuldhar (29).
 (107) *Progonocythere implicata* Lubimova & Mohan, 1960.—Kuldhar (29).
 (108) *Progonocythere laeviscula* Lubimova & Mohan, 1960.—Kuldhar (29).
 (109) *Progonocythere prolata* Lubimova & Mohan, 1960.—Kuldhar (29).
 (110) *Progonocythere* aff. *obscura* Lubimova & Mohan, 1960.—Kuldhar (29).
 (111) *Progonocythere* sp.—juv.—Kuldhar (29).
 (112) *Progonocythere* sp.—indet.—Kuldhar (29).

63. Genus **Xestolebris** Sars

- (113) *Xestolebris* sp.—Kuiala formation (35).
 (114) Unidentified Ostracoda.—Jaisalmer (53) ; Damodera (37).

Order DECAPODA

Suborder **MACRURA**Family **PENAEIDAE**64. Genus **Penaeus** Fabricius

- (115) *Penaeus barmerensis* Tiwari, 1963.—Kapurdi (56).
 (116) *Penaeus glaessneri* Tiwari, 1963.—Kapurdi (56).
 (117) *Penaeus kapurdi* Prasad, 1961.—Kapurdi (36).
 (118) *Penaeus* sp.—Kapurdi (55).

65. Genus **Metapenaeus** Wood-Mason and Alcock

(119) *Metapenaeus* sp.—Kapurdi (55).

Suborder **ANOMURA**

Family **GONEPLACIDAE**

66. Genus **Goniocypoda** Woodward

(120) *Goniocypoda rajasthanica* Glaessner & Rao, 1960.—Kapurdi (13, 55).

(121) Unidentified crabs (possibly of Potamonidae or Ocypodidae or Grapsidae).—Kapurdi (2, 26).

(122) Unidentified Caridean.—Kapurdi (13).

Phylum **ECHIWODERMATA**

Class **ASTEROIDEA**

(123) Unidentified Asteroid.—Ramgarh (17).

Class **ECHINOIDEA**

Order **CIDAROIDA**

Family **CIDARIDAE**

67. Genus **Cidaris** Leske

(124) *Cidaris* sp.—Jaisalmer. (22).

Family **HEMICIDARIDAE**

68. Genus **Hemicidaris** Linnaeus

(125) *Hemicidaris jaisalmerensis* Sahni & Bhatnagar, 1955.—Jaisalmer (39, 40).

(126) *Hemicidaris* sp.—Jaisalmer (3).

Order **CASSIDULOIDA**

Family **CLYPEIDAE**

69. Genus **Pygurus** Agassiz

(127) *Pygurus* sp.—Jaisalmer (3).

Family **HEMIASTERIDAE**

70. Genus **Ditremaster** Munier-Chalmas

(128) *Ditremaster* sp.—Marh (59).

71. Genus **Hemiaster** Desor

- (129)
- Hemiaster*
- sp.—N.W. of Boa (6).

Family **BRISSIDAE**72. Genus **Macropneustes** Linnaeus

- (130)
- Macropneustes*
- sp.—Boa (6).

73. Genus **Metalia** Gray

- (131)
- Metalia sowerbyi*
- d'Archiac.—Marh (10, 34).

- (132) Unidentified Echinoids.—Kapurdi (1, 11, 55).

- (133) Unidentified spines.—Jaisalmer (53).

- (134) Dwarf echinoids.—Khewansar (50).

Class **CRINOIDEA**

- (135) Unidentified crinoid stems.—Bap (41).

Class **HOLOTHUROIDEA**

- (136) Unidentified spines.—Jaisalmer (53).

Phylum **MOLLUSCA**
Class **GASTROPODA**Family **BELLEROPHONTIDAE**74. Genus **Bellerophon** Montfort

- (137)
- Bellerophon*
- sp.—Bap (41).

Family **CERITHIIDAE**75. Genus **Potamides** Brongniart

- (138)
- Potamides*
- sp.—Jamsar (12).

Family **CONIDE**76. Genus **Conus** L.

- (139)
- Conus*
- sp.—Boa (6).

Family **CONULARIIDAE**77. Genus **Conularia** Sowerby

- (140)
- Conularia*
- cf.
- laevigata*
- Waagen, 1891.—Bap (41).

Family LYMNAEIDAE

78. Genus **Planorbis** Guttard.

(141) *Planorbis* sp.—Dholpur (34)

Family MELANIIDAE

79. Genus **Melania** Lamarck

(142) *Melania tuberculata* var.—Dholpur (34).

Family NATICIDAE

80. Genus **Natica** Lamarck

(143) *Natica* sp.—Jaisalmer (3).

Family NERINAEIDAE

81. Genus **Nerinaea** Defrance

(144) *Nerinaea* sp.—Jaisalmer (22).

Family NERINEIDAE

82. Genus **Nerinea** Defrance

(145) *Nerinea* sp.—Jaisalmer (3)

Family STROMBIDAE

83. Genus **Rostellaria** Lamarck

(146) *Rostellaria* sp.—Boa (6).

84. Genus **Tibia** Roeding

(147) *Tibia* sp.—Kapurdi (1).

Family SUCCINEIDAE

84a. Genus **Succinea** Draparnaud

(147a) *Succinea* sp.—Dholpur (34).

Family VIVIPARIDAE

85. Genus **Vivipara** Lamarck

(148) *Vivipara bengalensis* Lamarck.—Siasar (25).

(149) *Vivipara* sp.—Dholpur (34.)

Family VOLUTIDAE

86. Genus **Voluta** Linnaeus

(150) *Voluta* sp.—Boa (6).

87. Genus **Volutilithes** Swains

(151) *Volutilithes* cf. *cithara* Lamarck.—Marh (59).

Family EUOMPHALIDAE

88. Genus **Straparollus** Montfort

(152) *Straparollus* sp.—Bhadaura (30).

Family BELLEROPHONTIDAE

89. Genus **Bucanopsis** Ulrich

(153) *Bucanopsis warthi* Waagen.—Bap (41)

90. Unplaced Genus **Cruziana** d'Orbigny

(154) *Cruziana furcifera* d'Orbigny, 1842.—Osia (33, 58).

(155) Unidentified Gastropoda.—Dangri (37) ; Jaisalmer (22) ; Kapurdi (1) ; Shawal (3).

Class LAMELLIBRANCHIA

Family ANOMIIDAE

91. Genus **Anomia** Linnaeus

(156) *Anomia* sp.—Jaisalmer (3).

Family ARCIDAE

92. Genus **Arca** Linnaeus

(157) *Arca* sp.—Boa (6) ; Kuchri (3) ; Rohli (42, 43) ; Utarlai (42).

93. Genus **Glycimeris** da Costa

(158) *Glycimeris* sp.—Marh (59).

Family AVICULIDAE

94. Genus **Pinna** Linnaeus

(159) *Pinna* sp.—Jaisalmer (3).

Family CARDITIDAE

95. Genus **Cardium** Linnaeus

(160) *Cardium* sp.—Barmer (28) ; Boa (6).

96. Genus **Discors** Deshayes

(161) *Discors* sp.—Rohli (1).

Family CARDITIDAE

97. Genus **Venericardia** Lamarck

(162) *Venericardia mutabilis* (d'Archiac & Haime).—Marh (59).

(163) *Venevicardia* cf. *sindensis* (d'Archiac & Haime).—Marh (59).

(164) *Venericardia* cf. *subcomplanata* (d'Archiac & Haime).—Marh (59).

(165) *Venericardia* sp.—Nagurda (1).

(166) *Venericardia* cf. *semi-inflata* type.—Rohli (42, 43) ; Utarlai and Nagurda (42).

Family CHAMIDAE

98. Genus **Chama** Bruguiere

(167) *Chama* sp.—Boa (6).

Family CORBULIDAE

99. Genus **Palaeocorbula** Reed

(168) *Palaeocorbula* sp.—Bap (41).

100. Genus **Corbula** Bruguiere

(169) ? *Corbula* (*Bicorbula*) *subexarata* d'Archiac.—Marh (59).

(170) *Corbula lyrata* Sowerby.—Jaisalmer (3, 32, 33).

(171) *Corbula pectinata* Sowerby.—Jaisalmer (3, 32, 33).

(172) *Corbula* sp.—Barmer & Nagurda (1) ; Rohli (42, 43) ; Utarlai (42).

Family CYRENIDAE

101. Genus **Corbicula** Müllhf

(173) *Corbicula* aff. *occidens* Bens.—Dholpur (34).

Family LUCINIDAE

102. Genus **Lucina** Bruguiere

(174) *Lucina metableata* Cossm.—Nagurda (1).

(175) *Lucina* sp.—Rohli (42, 43) ; Utarlai (42).

Family MYTILIDAE

103. Genus **Modiola** Lamarck(176) *Modiola* sp.—Jaisalmer (3).

Family NUCULANIDAE

104. Genus **Nuculana** Link(177) *Nuculana* cf. *thompsoni* Reed, 1937.—Bap (41).(178) *Nuculana prashadi* Tiwari, 1966.—Kapurdi (57).(179) *Nuculana* (*Sacella*) sp.—Barmer (1).(180) *Nuculana* sp.—Rohli (42, 43) ; Utarlai (42).(181) ? *Nuculana* sp.—Marh (59).

Family NUCULIDAE

105. Genus **Nucula** Lamarck(182) *Nucula cuneiformis* Sowerby.—Jaisalmer (32, 33).

Family OSTREIDAE

106. Genus **Liostrea** Douville(183) *Liostrea* (*Catinula*) *alimena* (d'Orbigny, 1850).— 2 km. SW. of Kuldhar (22).(185) *Liostrea* (*Catinula*) *sandalina* (Goldfuss, 1833).— 6 km. NW. of Jaisalmer (22).107. Genus **Ostrea** Linnaeus(186) *Ostrea* aff. *angulata* Sowerby.—Boa (6).(187) *Ostrea multicostata* Deshayes.—Palana (58).(188) *Ostrea* (*Liostrea*, sp.—Marh (59).(189) *Ostrea* (*Lopha*) *marshi* Sowerby.—1 km. SW. of Kuldhar (22).(190) *Ostrea* sp.—NE. of Boa (6) ; Kuchri (3).

Family PECTINIDAE

108. Genus **Aviculopecten** M'coy(191) *Aviculopecten* sp.—Bap (41).109. Genus **Pecten** Müller(192) *Pecten lens* Sowerby.—Jaisalmer (3, 32, 33).(193) *Pecten* (*Camptonectes*) *indicus* Cox, 1952.—1 km. SW. of Kuldhar (22).

- (194) *Pecten* (*Camptonectes*) sp.—6 km. NW. of Jaisalmer (22).
 (195) *Pecten* sp.—Marh (59).

110. Genus **Spondylopecten** Roeder

- (196) *Spondylopecten* cf. *rogeri* Agarwal.—2 km. SW of Kuldhar (22).

Family **PHOLADOMYIDAE**

111. Genus **Homomya** Agassiz

- (197) *Homomya* (2 spp.).—Jaisalmer (3)

112. Genus **Mactromya** Agassiz

- (198) *Mactromya* sp.—Jaisalmer (3).

113. Genus **Pholadomya** Sowerby

- (199) *Pholadomya granosa* Sowerby.—Jaisalmer (3, 32, 33).
 (200) *Pholadomya* sp.—Jaisalmer (22).

Family **TRIGONIDAE**

114. Genus **Trigonia** Bruguiere, 1789

- (201) *Trigonia costata* Parkinson.—Jaisalmer (3, 32, 33).
 (202) *Trigonia* cf. *nitida* Kitchin, 1903.—Jaisalmer (22).

Family **UNIONIDAE**

115. Genus **Unio** Retzius

- (203) *Unio* aff. *corrugatus* Mull.—Dholpur (34).
 (204) *Unio* sp.—Barmer (28).

Family **VENERIDAE**

116. Genus **Clementia** Gray

- (205) *Clementia* aff. *papyracea* Gray.—Boa (6).

117.. Genus **Dosinia** Scop.

- (206) *Dosinia* sp.—Boa (6).

118. Genus **Pitar** Romer

- (207) *Pitar* sp.—Nagurda (1).

119. Genus **Tapes** Megerle

- (208) *Tapes* sp.—Boa (6).

Family EDMONDIDAE

120. Genus **Astartila** Dana

(209) *Astartila* sp.—Bap (41).

Family PLEUROTOMARIIDAE

121. Genus **Peruvispira** Chronic

(210) *Peruvispira* cf. *umariensis* (Reed, 1928).—Bap (41).

Unplaced LAMELLIBRANCHIA

122. Genus **Astartella** Hall & Whitney

(211) *Astartella* sp.—Bap (41).

123. Genus **Nucleana**

(212) *Nucleana* sp.—Nagurda (1).

(213) Unidentified Lamellibranch shells.—Jaisalmer (22, 53) ; 1 km.SW of Kuldhar (22) ; Kuchri (3).

Class CEPHALOPODA¹

Family AMMONITIDAE

124. Genus **Ammonites** Bruguiere

Subgenus **Stephanoceras** Waagen

(214) *Ammonites* (*Stephanoceras*) *fissus* Sowerby.—Jaisalmer (3, 32, 33, 52).

(215) *Ammonites opis* Sowerby.—Kuchri (3, 23).

(216) *Ammonites* sp.—Damodera (6) ; Loderwa (32).

Family BELEMNOPSIDAE (=Belemnitidae)

125. Genus **Belemnites** Breyn.

Subgenus **Belemnopsis** Bayle]

(217) *Belemnites* (*Belemnopsis*) cf. *orientalis* Waagen.—2 Km. SW of Kuldhar (22).

(218) *Belemnites* (*Belemnopsis*) sp.—1.6 km. W of Bhadesar (40) ; 1 km. and 2 km.SW of Kuldhar (22).

(219) *Belemnites* sp.—Lodorwa (32) ; Kuchri (23).

126. Genus **Hibolites** Mayer

(220) *Hibolites* sp.—2.5 km.SW of Bhadesar (22).

Family BERRAISELLIDAE

127. Genus **Hoplitides** vonKoenen

- (221)
- Hoplitides laevisculus*
- Vonkoenen, 1902.—Abur (33, 52).

Family BONARELLIDAE

128. Genus **Sindeites** Spath

- (222)
- Sindeites sindensis*
- Spath.—Jaisalmer (32, 33, 52).

Family DESHAYESITIDAE

129. Genus **Deshayesites** Kazanskii

- (223)
- Deshayesites*
- ?
- aburensis*
- Spath.—Abur (33, 52).

- (224)
- Deshayesites bodei*
- (v. Koenen.).—10 km. SW of Sann (37).

Family EUCYCLOCERATIDAE

130. Genus **Idiocycloceras** Spath

- (225)
- Idiocycloceras singulare*
- Spath.—Jaisalmer (32,33, 52).

Family MAYAITIDAE

131. Genus **Dhosaites** Spath

- (226)
- Dhosaites*
- aff.
- otoitoides*
- Spath.—2 km. SW. of Kuldhar (22).

132. Genus **Epimayaaites** Spath

- (227)
- Epimayaaites*
- cf.
- excentricus*
- Spath.—2 km. SW. of Kuldhar (22).

- (228)
- Epimayaaites*
- sp.—2 km. SW of Kuldhar (22).

133. Genus **Mayaites** Spath

- (229) ?
- Mayaites*
- sp.—1 km. and 2 km. S. of Kuldhar (22).

Family OPPELIDAE

134. Genus **Campylites** Rollier

- (230) ?
- Compylites*
- sp.—Jaisalmer (33, 52).

Family PARACENOCERATIDAE

135. Genus **Paracenoceras** Spath

- (231)
- Paracenoceras*
- (
- Nautilus*
-)
- kumagunensis*
- Waagen.—Jaisalmer (3, 32, 33).

Family PERISPHINCTIDAE

136. Genus **Aulacosphinctes** Uhlig

(232) *Aulacosphinctes occultefurcatus* Waagen.—2.5 km. SW of Bhadesar (22).

(233) *Aulacosphinctes* sp.—2.5 km. SW. of Bhadesar (22).

137. Genus **Choffatia** Siemiradzki

(234) ? *Choffatia* sp.—2 Km. SW. of Kuldhar (22).

138. Genus **Grossouvria** Siemiradzki

(235) *Grossouvria steinmanni* (Parona and Bonarelli).—Jaisalmer (32, 33, 52).

139. Genus **Indosphinctes** Spath

(236) *Indosphinctes* sp.—1 km. SW. of Kuldhar (22).

140. Genus **Kinkeliniceras** Buckman

(237) *Kinkeliniceras* sp.—1 km. & 2 km. SW. of Kuldhar (22).

141. Genus **Obtusicoelites** Buckman

(238) *Obtusicoelites* cf. *nandi* Spath.—1 km. SW. of Kuldhar (22).

(239) *Obtusicoelites* sp.—Jaisalmer (32, 33, 52).

142. Genus **Pachysphinctes** Dietrich

(240) *Pachysphinctes* aff. *bathyplocus* Waagen.—3.5 km. NW. of Lodorwa (33, 52).

143. Genus **Perisphinctes** Waagen

(241) *Perisphinctes* sp.—2.5 km. SW. of Bhadesar (22) ; 1.6 km. W of Bhadesar (40) ; Damodera (6).

144. Genus **Properisphinctes** Waagen

(242) *Properisphinctes* aff. *bernesis* P de Loriol.—Jaisalmer (32, 33, 52).

145. Genus **Prososphinctes** Schindewolf

(243) *Prososphinctes* sp.—Jaisalmer (33, 52)

146. Genus **Torquatisphinctes** Spath

(244) *Torquatisphinctes* sp. ? of *jelskii* group.—Jaisalmer (33).

147. Genus **Virgatosphinctes** Uhlig

- (245) *Virgatosphinctes communis* Spath.—2.5km. SW of Bhadesar (22).
 (246) *Virgatosphinctes densiplicatus* Waagen.—2.5 km. SW of Bhadesar (22).
 (247) *Virgatosphinctes densiplicatus* var. *rotunda* Spath.—2.5 km. SW of Bhadesar (22).
 (248) *Virgatosphinctes* aff. *oppeli* Spath—Lodorwa (33, 52).
 (249) *Virgatosphinctes* sp.—2.5 km. SW of Bhadesar (22) ; 3.5 km. NW of Lodorwa (33, 52).

Family STEPHANOCERATIDAE

148. Genus **Hoplites** Neumayr

- (250) *Hoplites macconnelli* Whiteaves.—Abur (33, 52).

Family REINECKIDAE

149. Genus **Reineckia** Bayle

- (251) *Reineckia* cf. *reissi* Steinmann.—Jaisalmer (32, 33, 52).
 (252) *Reineckia* sp.—1 km. and 2 km. SW of Kuldhar (22).

150. Genus **Reineckeites** Buckmann

- (253) *Reineckeites* cf. *waageni* (Till).—1 Km. SW of Kuldhar (22).
 (254) Unidentified Cephalopoda.—1 Km. SW of Kuldhar (22) ; Badhaura (30) ; Bap (41).

Class SCAPHOPODA

Family DENTALIIDAE

151. Genus **Dentalium** Linnaeus

- (255) *Dentalium* sp.—Marh (59).

Phylum BRACHIOPODA
 Class INARTICULATA
 Order ATREMATA

Family LINGULIDAE

152. Genus **Lingula** Bruguiere

- (256) *Lingula* sp.—Bap (41).

Family PRODUCTIDAE

153. Genus **Linoproductus** Chao

- (257) *Linoproductus* sp.—Bap (41).

154. Genus **Productus** Sowerby(258) *Productus* sp.—Badhaura (30).

Class ARTICULATA
Order PALAEOTREMATA
Family RHYNCHONELLIDAE

155. Genus **Rhynchonella** Fischer

- (259) *Rhynchonella* (*Cryptorhynchia*) *pulcherrima* Kitchin.—
6 km. NW of Jaisalmer (22).
(260) *Rhynchonella* (*Cryptorhynchia*) *pulcherarima* var. *jhuraensis*
Agrawal.—6 km. NW of Jaisalmer (22).
(261) *Rhynchonella* (*Kutchyrhynchia*) *kutchensis* Kitchin.— 6
km. NW of Jaisalmer (22).
(262) *Rhynchonella* cf. *recticardinalis* Kitchin.—1 km. SW of
Kuldhar (22).
(263) *Rhynchonella* cf. *rugosa* Kitchin.—1 km. SW of Kuldhar
(22).
(264) *Rhynchonella* sp.—Jaisalmer (3) ; 2 km. SW of Kuldhar
(22).

Family SPIRIFERIDAE

156. Genus **Spirifer** Sowerby

- (265) *Spirifer* cf. *nagmargensis* Bion, 1928.—Bap (41).
(266) *Spirifer* cf. *narsarhensis* Reed.—Bap (41).
(267) *Spirifer* sp.—Badhaura (30).

Family SUESSIDAE

157. Genus **Spiriferina** d'Orbigny(268) *Spiriferina* sp.—Badhaura (30).

Family TEREBRATULIDAE

158. Genus **Jaisalmeria** Sahni & Bhatnagar

- (269) *Jaisalmeria depressa* Sahni & Bhatnagar, 1955.—Bhadesar (39, 40).
(270) *Jaisalmeria inflata* (Kitchin).—Bhadesar (39, 40).
(271) *Jaisalmeria kitchini* (Stefanini).—Bhadesar (39, 40).
(272) *Jaisalmeria ovalis* Sahni & Bhatnagar, 1955.—Bhadesar (39, 40).
(273) *Jaisalmeria ovalis* var. *cuneata* Sahni & Bhatnagar, 1955.—Bhadesar (39, 40).
(274) *Jaisalmeria taylori* Sahni & Bhatnagar, 1955.—Bhadesar (39, 40).

159. Genus **Kutchithyris** Buckmann

- (275) *Kutchithyris jaisalmerensis* Sahni & Bhatnagar, 1955.—Bhadesar (39, 40).
 (276) *Kutchithyris jaisalmerensis* var. *ganesha* Sahni & Bhatnagar.—1955 Bhadesar (39, 40).

160. Genus **Terebratula** Bruguiere

- (277) *Terebratula biplicata* Sowerby.—Jaisalmer (3, 32, 33).
 (278) *Terebratula dhosaensis* Kitchin.—1 km. SW of Kuldhar (22).
 (279) *Terebratula intermedia* Sowerby.—Jaisalmer (3, 32, 33).
 (280) *Terebratula jooraensis* Kitchin.—6 km. NW of Jaisalmer (22) ; 1 km. and 2 km. SW of Kuldhar (22).
 (281) *Terebratula* cf. *pyroidea* Kitchin.—6 km. NW of Jaisalmer (22).

161. Genus **Waldheimia** King
Subgenus **Zeilleria** Bayle

- (282) *Waldheimia* (? *Zeilleria*) sp.—2.5 km. SW of Bhadesar (22).

Family STROPHOMENIDAE

162. Genus **Derbyia** Waagan

- (283) *Derbyia* sp.—Bhadhaura (30) ; Bap (41).

163. Genus **Streptorhynchus** King

- (284) *Streptorhynchus* sp.—Bap (41).

Family TEREBRATULIDAE

164. Genus **Dielasma** King

- (285) *Dielasma* cf. *dadanense* Heed.—Bap (41).
 (286) Unidentified Brachiopoda.—Kotah (11).

Phylum CHORDATA
Class PISCES
Order EUSELACHIIFamily CARCHARIIDAE
(=ODONTASPIDAE)165. Genus **Odontaspis** Agassiz

- (287) *Odontaspis macrata striata* (Winkler).—Gunga (60).

Order ISOSPONDYLI

Family CLUPEIDAE

- (288) Clupeoid Fish.—Kapurdi (2, 13).
 (289) Unidentified fish.—Kapurdi (26).
 (290) Unidentified fish vertebra.—Gunga (60).

Unplaced fossil
 166. Genus **Lingular**

- (291) *Lingular* sp.—Badhaura (30).

IV.—FAUNA FROM DIFFERENT GEOLOGICAL PERIODS

Ghosh (1952) has mentioned the occurrence from Kotah, of certain doubtful forms which may be treated either as primitive brachiopods or the algae. Nature of these specimens has been discussed by many authors and summarized by Misra (1957) who on the basis of his observations of this material treats them as of inorganic origin. In view of the findings of Misra (1957) the existence of animal life in Lower Vindhya becomes doubtful. The Upper Vindhya are so far known to be devoid of animal life. A definite proof of the existence of life in Rajasthan has been given by Shah (1963) since Permian time from Bap. A list of Permian fauna is given in section I of appendix I. Section II of the same appendix deals with the list of fauna from Bhadaura assigned to Permo-Carboniferous by Misra *et al.* (1961), who treat Bap Boulders and yellow 'bouldery' sand stones of Badhaura Formation as contemporaneous.

During Mesozoic maximum fauna is known from Jurassics of Jaisalmer area. A list of Jurassic fauna is given in appendix II. The Cretaceous are exposed near Abur and a few cephalopods are known from that locality.

The tertiaries are represented in Rajasthan by Eocene deposits in Barmer, Jaisalmer and Bikaner. These deposits have yielded a good number of Foraminifera in addition to Ostracoda, Decapod Crustacea, Echinoderms, molluscs and a few fish remains. A list of Eocene fauna is given in Appendix III.

The fauna from Recent deposits including the alluvium etc. have been, due to small number of fossils known from them, given in appendix IV.

V.—SUMMARY

Geology of fossil bearing formations in Rajasthan is briefly given. A list and map of fossiliferous localities in the State is given. 291 species, belonging to 166 genera of different groups of animals are listed systematically. Animal fossils known from different geological periods are listed separately. An index of fossils known from Rajasthan (India) is provided.

VI.—REFERENCES

1. BAROOAH, S. K. 1946. The occurrence of the Laki series in Jodhpur State. *Curr. Sci.*, **15** (11) : 317.
2. BAROOAH, S. K. 1950. Fossil fish and crabs in the fullers earth bed at Kapurdi, Jodhpur, Rajasthan. *Curr. Sci.*, **19** (5) : 165.
3. BLANFORD, W. T. 1877. Geological notes on the Great Indian Desert between Sind and Rajputana. *Rec. geol. Surv. India*, **10** : 10-21.
4. CARTER, H. J. 1862. On contributions to the Geology of western India, including Sind and Baloochistan. *J. Roy. Asiatic Soc. Bombay*, Br. **6** (21) : 161-206.
5. CHATTERJI, A. K. 1960. On the occurrence of Kirthar in Jaisalmer, Rajasthan. *Proc. 47th Indian Sci. Congr.*, pt. 3 : 279.
6. CHATTERJI, P. C. (Unpublished) Personal communication.
7. COULSON, A. L. 1933. The geology of Sirohi State, Rajputana. *Mem. geol. Surv. India*, **63** : 148-149.
8. FERMOR, L. L. 1930. On the age of Aravalli Range. *Rec. geol. Surv. India*, **62** (4) : 391-409.
9. FERMOR, L. L. 1931. General Report of the Geological survey of India for the year 1930. *Rec. geol. Surv. India*, **65** (1) : 1-60.
10. GEE, E. R. 1931 (See Fermor, L. L. 1931).
11. GHOSH, P. K. 1952. Western Rajputana.—Its tectonics and minerals including evaporities. *Bull. nation. Inst. Sci., India*, No. 1 : 101-130.
12. GHOSH, P. K. DUTTA, K. K. TAPLOO and R. K. 1944. (See Ghosh, P. K. 1952).
13. GLAESSNER, M. F. and Rao, R. 1960. A new species of crab from the early tertiary of Fuller's Earth deposits of Kapurdi, Rajasthan i.e. India. *Rec. geol. Surv. India*, **86** (4) : 675-682.
14. GUPTA, B. C. 1934. Geology of central Mewar. *Mem. geol. Surv. India*, **65** (2), : 107-169+i-xv.
15. GUPTA, B. C. and MUKHERJI, P. N. 1938. Geology of Gujarat & S. Rajputana. *Rec. geol. Surv. India*, **73** : 164-205.
16. GUPTA, P.D., SRIVASTAVA M.L. and AGRAWAL, V.C. 1966. Occurrence of *Nereites*, A fossil Polychaet (Annelida) in Rajasthan. *Sci.*, **35** (24), : 624.
17. GUPTA, P. D., GRAWAL, V. C. and SRIVASTAVA, M. L. 1967. Fossil Asteroid (Echinodermata) from Ramgarh, Rajasthan (India). *Labdev J. Sci. & Tech. India*, **5** (1) : 71.
18. HERON, A. M. 1917. Geology of north-eastern Rajputana and adjacent districts. *Mem. geol. Surv. India*, **45** (1) : 1-128-+i-xviii.
19. HERON, A. M. 1922. The geology of Western Jaipur. *Rec. Geol. Surv. India*, **54** (4) : 345-397.
20. HERON, A. M. 1935. Synopsis of pre-Vindhyan geology of Rajputana. *Trans. nation. Inst. Sci. India*, **1** (2) : 17-33.
21. HERON, A. M. 1936. Geology of south-eastern Mewar, Rajputana. *Mem. geol. Surv. India*, **68** (1) : 1-120+i-xx.
22. HOFFMAN, K. 1963. Appendix : Palaeontological determination of fossils. (See Richter-Bernburg, G. and W. Schott, 1963).

23. IMPEY, 1862. Discovery of Ammoniferous Limestone near Jeyselmer in the Great Desert. & C. (See Carter, 1862).
24. JACOB, K. and SASTRI, V.V. 1950. Some new Microforaminifera from the Fuller's earth Bikaner, Rajputana. *Sci. & Cult.*, **16** : 80-82.
25. JACOB, K., SASTRY M. V. A. and SASTRI, V. V. 1952. A note on the microfossils of the impure gypsum from the Jamsar mine, Bikaner, and on the possible origin of the gypsum. *Bull. nation. Inst. Sci. India.*, No. 1 : 68-69.
26. KAUL, K. N. 1951. A fossil Nariel from Rajputana Desert. *Agriculture & Anim. Husb.*, **2** (3) : 9-11, pl. 1.
27. KHOSLA, S. C. 1967. A note on the stratigraphy and microfauna of the Kirthar beds of the Jaisalmer area. *Curr. Sci.*, **36** (24) : 670-671.
28. LA TOUCHE, T. H. D. 1902. The geology of Western Rajputana. *Mem. geol. Surv. India*, **35** (1) : 1-116.
29. LUBIMOVA, P. C., GUHA D. K. and MOHAN, M. 1960. Ostracoda of Jurassic and tertiary deposits from Kutch and Rajasthan (Jaisalmer), India. *Bull. Geol. Min. Met. Soc. India*, No. 22 : 1-60.
30. MISRA, J. S., SRIVASTAVA, B. P. and JAIN, S. K. 1961. Discovery of Marine Permocarboniferous in the W. Rajasthan. *Curr. Sci.*, **30** (7) : 262-263.
31. MISRA, R. C. 1957. *Fermoria*, the Enigma of Indian Palaeontology. *J. Pal. Soc. India*, **2** : 54-57, 2 pls.
32. OLDHAM, R. D. 1886. Preliminary note on the geology of northern Jaisalmer. *Rec. geol. Surv. India*, **19** (3) : 157-160.
33. PASCOE, E. H. 1959. *A manual of the Geology of India and Burma*, Vol. 2 : 486-1344.+1 map.
34. PASCOE, E. H. 1963. *A manual of the Geology of India and Burma*, Vol. 3 : xxiv+1345-2130+1 map.
35. PODDAR, M. C. 1963. Geology and oil possibilities of the Tertiary Rocks in Western India. *Proc. 2nd Symp. on Dev. of Petr. Res. of Asia and Far East. Mineral Resources Dev. Ser.*, New York, No. 18, **1** : 226-230.
36. PRASAD, K. N. 1961. Decapoda crustacea from the Fuller Earth's deposits of Kapurdi (Rajasthan). *Indian Minerals*, **15** : 435.
37. RICHTER-BERNBURG, G. and SCHOTT, W. 1963. Jurassic and Cretaceous at the western border of the Gondwana shield in India, and the stratigraphy and oil possibilities. *Proc. 2nd. Symp. Dev. Petr. Res. of Asia and the Far East. Mineral Resources Div. Ser.* New York., No. 18, **1** : 230-236.
38. SASTRI, G. G. K. 1962. Origin of the Desert Gypsum in Rajasthan. *Rec. geol. Surv. India*, **87** (4) : 781-786.
39. SAHNI, M. R. and BHATNAGAR, N. C. 1955, Recent Research in the Palaeontological Division Geological Survey of India. *Curr. Sci.*, **24** (6) : 187.
40. SAHNI, M. R. and BHATNAGAR, N. C. 1958.—New Fossils from the Jurassic rocks of Jaisalmer. *Rec. geol. Surv. India*, **87** (2) : 418-437.
41. SHAH, S. C. 1963. Marine Permian fauna from Bap Boudier bed, Rajasthan. *Indian Minerals.*, **17** (2) : 195-197.

42. SIDDIQUIE, H. N. and BAHL, D. P. 1965. Geology of the Bentonite deposits of Barmer District, Rajasthan. *Mem. geol. Surv. India*, (1962) **96** : 1-96.
43. SIDDIQUITE, H. N. and IQBALUDDIN, 1963. On the occurrence of Palaeocene and Eocene bed in the Barmer District, Rajasthan. *Curr. Sci.*, **32** : 575.
44. SINGH, S. N. 1951a. Kirthar Foraminifera from Rajasthan. *Curr. Sci.*, **20** (9) : 230.
45. SINGH, S. N. 1951b. Kirthar Foraminifera from Rajasthan. *Proc. nat. Acad. Sci., B*, **22** (1) :
46. SINGH, S. N. 1952. On the extension of Kirthar sea to Rajasthan. *Proc. nat. Acad. Sci. India, B*, **22** (1) : 7-10.
47. SINGH, S. N. 1953a. Species of the genus *Linderina* from the Kirthars of Kolayat, Bikaner, Rajasthan, India. *Proc. nat. Acad. Sci. India, B*, **23** (1-3), : 21-28.
48. SINGH, S. N. 1953.b. Geology of area WSW. of Marh village near Kolayat, Bikaner, Rajasthan. *Proc. nat. Acad. Sci., India, B*, **23** (1-3) : 13-20.
49. SINGH, S. N. 1953.c. Foraminiferal genera and species from the Kirthars near Kolayat (Bikaner) Rajasthan. *Proc. 40th Indian. Sci. Congr.*, Pt. 3 : 25-26.
50. SINGH, S. N. 1955. On the Laki formation near Khewansar (Rajasthan). *Proc. 42 nd Ind. Sci. Congr.*, Pt. 3 : 182.
51. SINGH, S. N. 1957. Two aberrant types of Nummulitidae from the Eocene of Rajasthan, India. *J. Paleont. Soc. India*, **2** : 208-212.
52. SPATH, L. F. 1933. Revision of the Jurassic Cephalopod Fauna of Kochh (Cutch). *Pal. Ind. A new Ser.*, **9**, Men. 2, Pt. 6 : 659-949.
53. SUBBOTINA, N. N. DUTTA, A. K. and SRIVASTAVA, B. N. 1960. Foraminifera from the upper Jurassic deposits of Rajasthan (Jaisalmer) and Kutch, India. *Bull. Geol. Min. Met. Soc. India*, No. 23 : 1-48.
54. SUBBOTINA, N. N. and SRIVASTAVA, B. N. 1960.—See SUBBOTINA, DATTA and SRIVASTAVA, 1960.
55. TIWARI, K. K. 1962. Occurrence of fossil Penaeid prawn in the Fuller's Earth deposits of Kapurdi (Barmer district, Rajasthan). *Sci. & Cult.*, **28** : 244-245.
56. TIWARI, K. K. 1963. Lower Tertiary Penaeid shrimps from Kapurdi (Barmer District, Rajasthan, India). *Crustaceana*, **5** (3): 205-212. Pls. 2 and 3.
57. TIWARI, K. K. 1966. A new species of *Nuculana* Link (Mollusca Bivalvia) from Lower Eocene Fullers Earth deposits of Kapurdi, Rajasthan (Western India). *Ann. Mag. nat. Hist.* (13) **9** : 161-165.
58. VREDENBERG, E. W. 1907. Preliminary note on the Geological age of the coal at Palana in Bikaner, Rajasthan. *Rec. geol. Surv. India*, **36** (4) : 314-315.
59. WEST, W. D. 1949. General Report of the Geological Survey India for the year 1948. *Rec. geol. Surv. India*, **82** (1) : of 1-253.
60. WHITE, E. I. 1952. Sharks tooth from a boring near Gunga, Jodhpur State. (See Ghosh, P. K. 1952).

VII.—APPENDICES

APPENDIX I

(1) List of Permian Fauna from Rajasthan

BRYOZOA : *Polypora ampla*.

CRINOIDEA : Unidentified crinoid stem.

GASTROPODA : *Bellerophon* sp., *Bucanopsis warthi*, *Conularia* cf. *laevigata*.LAMELLIBRANCHIA : *Astartella* sp., *Astartila* sp., *Aviculopecten* sp., *Nuculana* cf. *thompsoni*, *Palaeocorbula* sp.

CEPHALOPODA : Unidentified cephalopoda.

BRACHIOPODA : *Derbyia* sp., *Dielasma* cf. *dadanense*, *Lingula* sp., *Linoproductus* sp., *Spirifer* cf. *nagmargensis*, *Spirifer* cf. *narsarhensis*, *Streptorhynchus* sp.

(2) List of Permo-Carboniferous Fauna from Rajasthan

GASTROPODA : *Straparollus* sp.BRACHIOPODA : *Derbyia* sp., *Productus* sp., *Spirifer* sp., *Spiriferina* sp.UNPLACED FORMS : *Lingular* sp.

CEPHALOPODA : Unidentified forms.

APPENDIX II

List of Jurassic Fauna from Rajasthan

FORAMINIFERA : *Astacolus aphrastus* var. *minuta* ; *Astacolus centrogyrata* var. *definita*, *Citharina submulticostata*, *Citharinella foliaformis*, *Coscinoconus* cf. *elongatus*, *Haplophragmoides* sp., *Lenticulina dilectaformis*, *L. munsteri*, *Nummulites beaumonti*, *N. leymeriei*, *N. ramondi*, *N. spira*, *Spirillina tenuicostata*, *Trochammina* sp., *Trocholina transversarii*, *Vaginulinopsis cryptospira*, *V* cf. *eritheles*.

PORIFERA : Unidentified sponge spicules.

COELENTERATA : Unidentified corals.

BRYOZOA : Unidentified Bryozoa.

ANNELIDA, (Polychaeta) : *Nereites* sp.OSTRACODA : *Bythocythere* sp. juv., *Cytherella obscura*, *Progonocythere grumosa*, *P. implicata*, *P. laevisculus*, *P. prolata*, *P. aff. obscura*, *Progonocythere* sp. juv., *Progonocythere* sp. indet.ECHINOIDA : *Cidaris* sp., *Hemicidaris jaisalmerensis*, *Hemicidaris* sp., *Pygurus* sp., unidentified spines.

HOLOTHUROIDEA : Unidentified spines.

GASTROPODA : *Natica* sp., *Nerinaea* sp., *Nerinea* sp., and other unidentified gastropoda.LAMELLIBRANCHIA : *Anomia* sp., *Arca* sp., *Corbula lyrata*, *C. pectinata*, *Homomya* sp., *Liostrea* (*Catinula*) *alimena*, *L. (C.) sandalina*, *Mactromya* sp., *Modiola* sp., *Nucula cuneiformis*, *Ostrea* (*Lopha*) *marshi*, *Ostrea* sp., *Pectan lens*, *P. (Camptonectes) indicus*, *P. (Camptenectis)* sp., *Pholadomya granosa*, *Pho-*

ladomya sp., *Pinna* sp., *Spondylopecten* cf. *rogeri*, *Trigonia costata*, *T* cf. *nitida*, and other unidentified forms.

CEPHALOPODA : *Ammonites* (*Stephanoceras*) *fissus*, *A. opis*, *Ammonites* sp., *Aulacosphinctes occultefurcatus*, *Aulacosphinctes* sp., *Belemnites* (*Belemnopsis*) *orientalis*, *B.* (*Belemnopsis*) sp., *Belemnites* sp., ? *Campylites* sp., ? *Choffatia* sp., *Dhosaites* aff. *otoitoides*, *Epimayautes* cf. *excentricus*, *Epimayautes* sp., *Grossouvria steinmanni*, *Hibolites* sp., *Idiocycloceras singulare*, *Indosphinctes* sp., *Kinkeliniceras* sp., ? *Mayautes* sp., *Obtusicostrites* cf. *nandi*, *Obtusicostrites* sp., *Paracenoceras* (*Nautilus*) *kumagunensis*, *Pachysphinctes* aff. *bathyplocus*, *Perisphinctes* sp., *Properisphinctes* aff. *bernensis*, *Prososphinctes* sp., *Reineckia* cf. *reissi*, *Reineckia* sp., *Reineckites* cf. *waageni*, *Sindeites sindensis*, *Torquatisphinctes* sp., cf. *jelskii* group, *Virgatosphinctes communis*, *V. densiplicatus*, *V. densiplicatus* var. *rotunda*, *V.* aff. *oppeli*, *Virgatosphinctes* sp. and other unidentified cephalopod.

BRACHIOPODA : *Jaisalmeria depressa*, *J. inflata*, *J. kitchini*, *J. ovalis*, var. *cuneata*, *J. taylori*, *Kutchithyris jaisalmerensis*, *K. jaisalmerensis* var. *ganesha*, *Rhynchonella* (*Cryptorhynchia*) *pulcherrima*, *R.* (*C.*) *pulcherrima* var. *jhuraensis*, *R.* (*Kutchyrhynchia*) *Kutchensis*, *R.* cf. *recticardinalis*, *R.* cf. *rugosa*, *Rhynchonella* sp., *Terrbratula biplicata*, *T* cf. *dhosaensis*, *T. intermedia*, *T. Jooraensis*, *T* cf. *phroidea*, *Waldheimia* (? *Zeilleria*) sp.

APPENDIX III

List of Eocene Fauna from Rajasthan

FORAMINIFERA : *Alveolina elliptica* var. *flosculina*, *A. oblonga*, *Alveolina* (*Flosculina*) sp., *Ammobaculites* sp., *Assilina daviesi*, *A. granulosa*, *A. leymeriei*, *A.* cf. *spinosa*, *A. subumblicata*, *A. umblicata*, *Assilina* sp., *Asterigerina indica*, *Bathysiphon* sp., *Bolivina* sp., *Bulimina* sp., *Calcarina* sp., *Cibicides* aff. *beaumontiana*, *C. praecursorius*, *C. p.* var. *madhensis*, *Cibicides* sp., *Cycloloculina* sp., *Dentalina* sp., *Dictyoconoides cooki*, *Dictyoconoides*, sp., *Discocyclina* sp. (sellate forms), *D. dispansa*, *D. sowerbyi*, *D.* (*Discocyclina*) sp., *D.* (*Actinocyclina*) sp., *D.* (*Proporocyclina*) sp., *Discorbis globularis*, *Discorbis* sp., *Eoannularia* sp., *Eoassilina elliptica*, *Eoconuloides* sp., *Eulinderina* sp., *Globigerina triloculinoides*, *G.* cf. *pseudobulloid*, *Globigerina* sp., *Globorotalia* sp., *Guttulina* sp., *Gypsina* sp., *Gyrodina* sp., *Heterostegina* sp., *Lagena* sp., *a.*, *Lagena* sp. *b.*, *Lagena* sp., *Linderina bikanerensis*, *L.* off. *brugesi*, *L. kirtharensis*, *L. kolayatensis*, *L. rajasthanensis*, *Linderina* sp., *Lockhartia tipperi*, *Lockhartia* sp., *Nonion scapha* var. *indica*, *Nonionella* sp., *Nummulites asymmetrica*, *N. atacicus*, *N. irregularis*, *N. maculatus*, *N.* cf. *maculatus*, *N. stamineus*, *Nummulites* sp., *Operculina* sp., *Operculinoides* sp., *Orbitolites complanatus*, *Planorbulina* sp., *Pseudoglandulina* sp., *Pseudophragmina* (*Proporocyclina*) sp., *Pulvinulinella* sp., *Quenqueloculina* sp.,

- Rotalia crookshankiana*, *R. subgranulosa*, *Rotalia* sp., *Trochamina* sp., *Turrilina* sp., *Virgulina* sp.
- OSTRACODA : *Bairdia* sp., *Cypris* sp., *Cythereis* sp., *Cytheropteron* sp., *Paijanborchella* sp., *Potamocypris* sp., *Xestolebris* sp., Unidentified ostracoda.
- CRUSTACEA (Decapoda) : *Penaeus barmerensis*, *P. glaessneri*, *P. kapurdi*, *Penaeus* sp., *Metapenaeus* sp., *Goniocypoda rajasthanica*, unidentified crabs, unidentified Caridan.
- ASTEROIDEA : Unidentified asteroid.
- ECHINOIDEA : *Ditremaster* sp., *Macropneustes* sp., *Metalia sowerbyi*, dwarf echinoids and other unidentified echinoids.
- GASTROPODA : *Conus* sp., *Potamides* sp., *Rostellaria* sp., *Tibia* sp., *Voluta* sp., *Volutilithes* cf. *cithara*, and other unidentified gastropoda.
- LAMELLIBRANCHIA : *Arca* sp., *Cardium* sp., *Chama* sp., *Clementia* aff. *papyracea*, *Corbula* (*Bicorbula*) *subexarata*, *Corbula* sp., *Discors* sp., *Dosinia* sp., *Glycimeris* sp., *Lucina metableata*, *Lucina* sp., *Nucleana* sp., *Nuculana* (*Sacella*) sp., *Nuculana* sp., *Ostrea angulata*, *O. multicostata*, *O. (Liostrea)* sp., *Pecten* sp., *Pitar* sp., *Tapes* sp., *Unio* sp., *Venericardia mutabilis*, *V. cf. sindensis*, *V. cf. subcomplanata*, *Venericardia* sp., *Venericardia* of sem-inflata type.
- SCAPHOPODA : *Dentalium* sp.
- PISCES : *Odontaspis macrata striata*, clupeid fish, and unidentified fish vertebra.

APPENDIX IV

List of Sub-Recent or Recent and Gangetic Alluvial Fauna from Rajasthan

- FORAMINIFERA : *Discorbis globularis*, *Discorbis* sp., *Pulvinulina* sp., *Rotalia* sp.,
- GASTROPODA : *Melania tuberculata* var., *Planorbis* sp., *Vivipara bengalensis*, *Vivipara* sp., *Succinea* sp.
- LAMELLIBRANCHIA : *Corbicula* aff. *occidens*, *Unio* cf. *corrugatus*.

List of Abbreviations used

A., Asteroidea ; Br. Brachiopoda ; Bz., Bryozoa ; Cp., Cephalopoda ; Cl., Coelenterata ; Cr. Crinoidea ; Cd., Crustacea (Decapoda) ; E., Echinoidea ; Fm., Foraminifera ; G., Gastropoda ; H. Holothuroidea ; Lm., Lamellibranchia ; O., Ostracoda ; Pc., Pisces ; Pf., Proifera ; Pl., Polychaeta ; Sp., Scaphopoda.

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TABLE II—Showing the fossiliferous sites in Rajasthan

Locality	District	Longitude & Latitude.	Age of the formation (given by the author in parentheses)
1. Abur	Jaisalmer	70°37' : 27°11'	Cretaceous, Lower Aptian (Pascoe, 1959).
2. Amar Sagar	Jaisalmer	70°55' : 26°49'	Jurassic : Jaisalmer formation.
3. Badhaura (Bhadaura)	Jodhpur	71°17' : 27°18'	Palaeozoic : Badhaura formation (Permocarboniferous) (Misra et al, 1961).
4. Bandah	Jaisalmer	70°17' : 27°12'	Upper Eocene : Bandah formation of Kirthaeage (Poddar, 1963).
5. Bap	Jodhpur	72°21' : 27°22'	Palaeozoic : Permian : Bap Boulder beds (Shah, 1963).
6. Barmer	Barmer	71°24' : 25°45'	Lower Tertiary (LaTouche, 1902).
7. Bhadesar, (Badhesar or Bedesir)	Jaisalmer	70°45' : 27°05'	Jurassic : Bhadesar formation (Hoffman, 1963).
8. Boa	Jaisalmer	70°52' : 27°17'	Lower Tertiary (Chatterji, P. C.)
9. Damodera	Jaisalmer	70°43' : 26°53'	Jurassic : Upper Baisakhi (Richter--Bernburg & Schott, 1963).
10. Dangri	Jaisalmer	71°20' : 26°30'	Possibly Jurassic-Possible, Lathiformation (Richter-Bernburg & Schott, 1963).
11. Dholpur	Dholpur	77°50' : 26°40'	Gangetic Alluvium (Pascoe, 1963).
12. Gunga	Jodhpur	71°10' : 26°10'	Lower Eocene (Ghosh, 1952).
13. Jaisalmer (Town)	Jaisalmer	70°55' : 26°55'	Jurassic : Jaisalmer formation (Hoffman, 1963).
14. Jamsar	Bikaner	73°20' : 28°15'	Late Tertiary or later (Recent) (Jacob, Sastry & Sastri, 1952).
15. Kapurdi	Barmer	71°20' : 25°50'	Upper Paleocene or Lower Eocene (Glaessner & Rao, 1960) Laki series (Barooah, 1950).
16. Khari	Bikaner	73°35' : 28°20'	Recent (La Touche, 1902).

TABLE II—(Contd.)

17.	Khewansar ¹	Jaisalmer	70°54' : 27°15'	Eocene : Lakistage (Singh, 1955).
18.	Kishangarh	Jaisalmer	70°33' : 27°53'	Eocene (Chatterji, P. C.)
19.	Kolayat	Bikaner	72°55' : 27°50'	Middle Eocene : Middle Kirthar (Singh, 1957).
20.	Kotah	Kotah	75°50' : 25°10'	Palaeozoic Lower Vindhya (Ghosh, 1952, Pg. 105).
21.	Kuchri	Jaisalmer	70°33' : 27°05'	Jurassic (Blanford, 1877).
22.	Kuldhar	Jaisalmer	70°45' : 26°50'	Jurassic : Jaisalmer formation (Subbotina, Datta & Srivastava, 1960).
23.	Khuiala (Kuiala)	Jaisalmer	70°26' : 27°08'	Eocene : Khuijala formation of Lakseries (Poddar, 1963).
24.	Lodorwa	Jaisalmer	70°48' : 26°59'	Jurassic : Baisakhi (Subbotina, Datta & Srivastava, 1960).
25.	Marh	Bikaner	72°56' : 27°51'	Eocene : Laki formation (Jacob and Sastri, 1950).
26.	Nagurda	Barmer	71°24' : 26°09'	Eocene : Laki series (Barooah, 1946).
27.	Osia	Jodhpur	71°20' : 26°05'	Trans Arawalli (Pascoe, 1959).
28.	Palana	Bikaner	73°15' : 26°50'	Lower Eocene : Laki formation (Vredenberg, 1907).
29.	Ramgarh	Jaisalmer	70°30' : 27°20'	Eocene (Blanford, 1877).
30.	Rohli	Barmer	71°20' : 25°55'	Eocene : Upper Paleocene to Lower Eocene (Siddique & Iqbaluddin, 1963).
31.	Sann ²	Jaisalmer	70°30' : 26°37'	Cretaceous : Abur stage (Richter-Bernburg & Schott, 1963).
32.	Shawal	Jaisalmer	71°14' : 26°59'	Jurassic Laki formation (Blanford, 1877).
33.	Siasar	Bikaner	72°34' : 28°35'	Sub Recent (Jacob, Sastry & Sastri, 1952).
34.	Utarlai	Barmer	71°25' : 25°45'	Upper Paleocene or Lower Eocene (Siddiqui & Bahl, 1965).

1, 2. These places could not be found on topo-sheets. Co-ordinates are given for Khewalsir or Khinsar, and Sam respectively.

STUDIES ON THE CRUSTACEAN FAUNA OF MYSORE
COAST 1. DECAPODA : BRACHYURA

By

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I—INTRODUCTION

The crabs dealt with in the present paper were collected during a recent faunistic survey of the Mysore coast under the leadership of the senior author. Altogether twenty two species are identified and included. The crustacean fauna of the coastal belt from north of Mangalore to south of Karwar has not been properly surveyed and one of the main purposes of the recent faunistic survey was to uncover the different crustacean species that are met with along this coast. The brachyuran crabs are dealt with in the present communication. Other groups will follow in subsequent papers.

We are grateful to Dr. A. P. Kapur, Director, Zoological Survey of India for his kind encouragement and to the members of the survey party for their cooperation in the collection of the present material.

II—ECOLOGICAL NOTES

The area surveyed included the south and north Kanara districts of the Mysore state. The entire coastal tract from Mangalore ($74^{\circ} 50' \text{ E}$, $12^{\circ} 52' \text{ N}$) to Karwar ($74^{\circ} 05' \text{ E}$, $14^{\circ} 50' \text{ N}$) was covered during the survey. Sandy expanses are met with only in the southern coastal parts while the northern coastal stretch is mountainous and rocky. In many places lofty extensions of the Western Ghats almost merge with the sea. Coast line is zig-zag, sandy enclosures being met with between hilly projections into the sea. However, many of the rocky areas are devoid of any vegetation. They are granite masses constantly washed by the sea, with least amount of hiding places. The result is that the shore fauna in these areas is rather poor.

Crabs described in this paper were all collected either from sandy tracts or from among crevices among the granite rocks.

III—SYSTEMATIC ACCOUNT

Family DORIPPIDAE

1. *Dorippe facchino* Herbst

1783. *Dorippe facchino* Herbst, *Krabben*, 1 (2) : 190.

Material—2♂, 1♀., Mangalore beach, 24. xii. '66.

Distribution.—East coast from the mouth of Hooghly to Madras, also widely reported from many parts of the world.

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Family LEUCOSIDAE

2. *Philyra scabriscula* (Fabr.)

1798. *Leucosia scabriscula* Fabricius, *Ent. Syst. Suppl.* : 349.

Material.—50 ♂, 126 ♀, Karwar ; 2 ♂, 5 ♀, Kumta, 16.i.67 and 10.i.67 respectively.

Distribution.—Madras, Travancore, Karachi, Tavoy, Mekran coast, Persian Gulf, Red Sea, Zanzibar, Mergui archipelago, Nicobar and Indonesia.

Family CALAPPIDAE

3. *Matuta lunaris* (Forskål)

1775. *Matuta victor* Forskål, *Deser. Anim.*, No. 44, : 91.

Material.—2 ♂, 2 ♀, Kumta ; 2 ♂, 5 ♀, Karwar ; 5 ♂, 3 ♀, Bhatkal ; 4 ♂, 6 ♀, Mangalore 11.i.67, 16.i.67, 4.i.67 and 18.xii.66 respectively.

Distribution.—Indian coasts, Andamans, Red Sea, Zanzibar, Madagascar. Also from Ganges delta, Arakan, Madras, Ceylon, Malabar coast, Karachi, Penang, Tavoy from the Indo-Pacific.

4. *Matuta banksii* Alcock

1896. *Matuta banksii* Alcock, *J. Asiat. Soc. Beng.*, 67 (2) : 158.

Material.—4 ♀, Mangalore, 17.xii.66.

Distribution.—Andaman-Nicobars, Mergui, Sundarbans & Ganges delta, Madras, Mahanadí delta, Bombay, Karachi, Durban Bay, Mozambique, Mauritius.

Family MAIIDAE

5. *Doclea gracilipes* Stimp

1857. *Doclea gracilipes* Stimp, *Proc. Acad. nat. Sci. Philad.* : 216.

Material.—1 ♂, 6 ♀, Malpe beach, Udipi on 26.xii.66.

Distribution.—Sandheads, R. Hooghly, Andamans, Hong Kong, Nergui Is., and localities in the Indo-Pacific.

Family PORTUNIDAE

6. *Portunus pelagicus* (Linnaeus)

1766. *Cancer pelagicus* Linn., *Mus. Lud. Ulr.* : 434.

Material.—1 ♂, 1 ♀, Karwar ; 2 ♀, Sirur ; 2 ♂, 2 ♀, Coondapore ; 3 ♀, Malpe, Udipi 16.i.67, 4.i.67, 29.xii.66 and 26.xii.66.

Distribution.—This is a widely distributed species having been recorded from Indian coasts, east Africa, Japan, Philippines, Australia, Tahiti, Mediterranean.

7. *Portunus sanguinolentus* (Herbst)

1796. *Cancer sanguinolentus* Herbst, *Krabben* 1 (2) : 161.

Material.—9 ♂, 3 ♀, Coondapore ; 10 ♂, 4 ♀, Mangalore beach on 29.xii.66 and 24.xii.66 respectively.

Distribution.—Very common in Indian coasts, Andaman-Nicobar Is., East coast of S. Africa, Australia and Hawaii Is. Holthuis (1956)* says that this Indo-Pacific species has migrated to the Mediterranean through the Suez Canal.

8. *Scylla serrata* (Forskål)

1775. *Cancer serratus* Forskål, *Descr. Anim.* : 90.

Material.—1 ♀, Mangalore ; 2 ♂, 1 ♀, Kumta beach on 18.xii.66 and 13.i.67 respectively.

Distribution.—The whole of Indo-Pacific region including east Africa, Red Sea, Japan, Tahiti, New Zealand and Australia, Philippines, Viet-Nam.

9. *Charybdis riverandersoni* Alcock

1899. *Charybdis riverandersoni* Alcock, *J. Asiat. Soc. Beng.*, 68 (2) : 53.

Material.—1 ♂, Kumta ; 3 ♂, 7 ♀, Karwar on 10.i.67 and 16.i.67 respectively.

Known distribution includes Indian coasts and Japan.

10. *Charybdis affinis* Dana

1852. *Charybdis affinis* Dana, *Proc. Acad. nat. Sci. Philad.* : 85.

Material.—2 ♂, Suratkal (Mangalore) on 22.xii.66.

Distribution.—It has been recorded from Mergui, Akyab, Orissa coast and from coasts of Burma and Andaman group of Is.

Family XANTHIDAE

11. *Menippe rumphii* (Fabr.)

1798. *Cancer rumphii* Fabr., *Ent. Syst. Suppl.* : 336.

Material.—1 ♀, Sirur ; 5 ♂, 7 ♀, Dharieswar ; 1 ♀, Karwar on 4.i.67, 10.i.67 and 16.i.67 respectively.

Distribution.—Indian coasts, Penang, Tavoy, Mergui Is., Persian Gulf, Ceylon, Laccadives, Karachi.

* *Bull. zool. Nomencl.*, 12 : 107-119.

12. *Eriphia leavimanus* Guerin

1844. *Eriphia leavimanus* Guerin, *Icon. R. A. Crust.* (pl. 3, fig. 1).

Material.—1 ♂, from Murudeswar (Bhatkal) on 6.i.67.

Distribution.—Aracan coast, Laccadives, Mergui, Indian coasts, Ceylon, Andaman, East Africa and Australia.

13. *Pilumnopus indica* (de Man)

1887. *Heteropanope indica* de Man, *J. Linn. Soc.*, 22 : 53.

Material.—4 ♂, 4 ♀, Murudeswar on 6.i.67.

Distribution.—Mergui Is., Japan, Karachi, Bombay.

14. *Ozius tuberculosus* M. Edwards

1834. *Ozius tuberculosus* M. Edw. *Historia nat. Crust.* Roma, 1 : 405.

Material.—1 ♀, Bhatkal beach on 4.i.67.

Distribution.—Mergui Is., Nicobar, New Caledonia, Mauritius, and now the Mysore coast.

Remarks.—Alcock (*loc. cit.*) (1898) obtained two specimens which are present in the Zoological Survey of India from the Nicobar Is. and Mergui Is. The present record seems to be the first from the Indian coast.

There is considerable difference in the size of the three specimens we examined, and this is presented below:

Locality	Length	Breadth
Nicobar	5.8 mm.	7.9 mm. (female)
Mergui	3.9 mm.	5.7 mm. (female)
Bhatkal	2.7 mm.	3.9 mm. (female)

Brief description of the present specimen is as follows:

Carapace studded with small pearly granules. Front cut into four equidistant teeth. Anterolateral border, exclusive of orbital angle, cut into five teeth. Branchial region of the carapace crossed transversely by two furrows, which have a common starting point at the fourth tooth. Dark brown to red colour in spirit; fingers and dactyli of legs dark brown.

15. *Ozius rugulosus* Stimpson

1858. *Ozius rugulosus* Stimpson, *Proc. Acad. nat. Sci. Philad.* : 34.

Material.—1 ♂, Mangalore; 2 ♀, Dharieswar (Kumta) on 18.xii.66 and 10.i.67.

Distribution.—Wide distribution in tropical regions of the Indo-Pacific from Japan to India, Red Sea, East coast of Africa, Andamans and Arakan.

16. *Epixanthus frontalis* (Milne Edwards)

1834. *Ozius frontalis* M. Edwards, *Historia. Nat. Crust.* 1 : 406.

Material.—1 ♂, Sirur, 1 ♀, Murudeswar on 4.i.67 and 6.i.67.

Distribution.—East and west coasts of India, Ceylon, Andaman Nicobars, Mauritius, Mergui, Akyab, Orissa coast and Makran coast.

17. *Xantho (Leptodius) exaratus* (Milne-Edwards)

1834. *Chlorodius exaratus* M. Edwards, *Historia Nat. Crust.* Roma or Varsoviae, 1 : 402.

Material.—1 ♂, 1 ♀, Murudeswar ; 3 ♂, Dharieswar 6.i.67 and 10.i.67 respectively.

Distribution.—East and west coasts of India, Persian Gulf, Ceylon, Red Sea, Seychelles Is., Polynesia, Australia, Hawaii, Penang, Akyab, Andamans, Bombay, Ceylon and Karachi.

Family OCYPODIDAE**18. *Uca annulipes* (Laterielle & Edw.)**

1852. *Gelasimus annulipes* M. Edward, *Ann. Sci. Nat. Paris Zool.*, 18 (3) : 149.

Material.—25 ♂, 1 ♀, from Malpe (Udipi), on 26.xii.66.

Distribution.—Indian coasts, Red Sea, East Africa, Australia, West coast of America.

19. *Ocypoda ceratophthalma* (Pallas)

1772. *Cancer ceratophthalmus* Pallas, *Spel. Zool.*, 9 : 83.

Material.—2 ♂, from Sirur (Bhatkal) beach, 4.i.67.

Distribution.—This widely distributed Indo-Pacific species is recorded from several localities from Indian coasts.

Family GRAPSIDAE**20. *Grapsus grapsus* (Linn.)**

1766. *Cancer grapsus* Linn., *Syst. Nat.* : 1048.

Material.—1 ♂, 2 ♀, Kumta ; 6 ♂, 25 ♀, Coondapore ; 1 ♂, 1 ♀, Suratkal ; 3 ♂, Hosabetu ; 4 ♂, 3 ♀, Penambur, 13.i.67, 30.xii.66, 22.xii.66, 21.xii.66 and 19.xii.66 respectively.

Distribution.—Widely recorded from coasts of India and Ceylon.

21. *Metapograpsus messor* (Forskål)

1775. *Cancer messor* Forskål, *Descrive. Anim. in Itin Orient.* : 88.

Material.—4 ♂, 4 ♀, Coondapore, on 30.xii.66.

Distribution.—Widely distributed in the Indo-Pacific from Hawaii to Red Sea and east African coasts including India.

22. *Plagusia depressa* (Herbst) var. *squamosa* (Herbst)

1796. *Cancer depressus* Herbst, *Krabben* & C. I (ii) : 117.

Material.—2 ♀, Karwar beach on 16.i.67.

Distribution.—Arabian Sea, Bay of Bengal and Indo-Pacific.

IV—SUMMARY

Twenty two species of crabs belonging to eight families and eighteen genera obtained from the Mysore coast during a recent faunistic survey of the area are listed with distributional accounts. *Ozius tuberculosus* M. Edwards is a new record from Indian coasts. This was formerly recorded from the oceanic islands of Mauritius and Nicobars in the western and eastern ends of the Indian Ocean.

V—REFERENCES

- ALCOCK, A. 1898. Materials for a carcinological fauna of India. No. 3. The *Brachyura Cyclometopa*. Pt. 1. The family Xanthidae. *J. Asiat. Soc. Bengal*, 67 (2) : 67-233.
- HOLTHUIS, L. B. 1956. Proposed addition to the "Official list of generic names in Zoology" of the names of twentyfive genera of Macrura Reptantia (Class Crustacea, Order Decapoda), including proposals for the use of the plenary powers (a) to validate the spelling "Cherax" as the valid original spelling for the generic name published as "Cherax" and "Cheraps" by Erichson in 1846 (b) to suppress the specific name "Goudotti" Guerin-Meneville, 1839 as published in the combination "Astacoides Goudatti" and (c) to validate the emendation to *Palinurus* of the generic name "Pallimurus" Weber, 1795. *Bull. zool. Nomencl.*, 12 (4) : 107-119.

SOME LAND MOLLUSCS OF KASHMIR, INDIA

By

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(With 2 Text-figures and 1 Plate)

I—INTRODUCTION

The present paper is a taxonomic study of some land molluscs of Kashmir, based primarily on material collected during two faunistic surveys of Jammu and Kashmir Valley during the years 1954 and 1955 by the Zoological Survey of India. Opportunity was also taken to re-examine the identified collections of land molluscs preserved in the Zoological Survey of India, including the types of Nevill and incorporate the results in the present study. An account of the fresh-water and amphibious molluscs of Kashmir Valley is given by the authors in an earlier paper. (Rajagopal and Subba Rao, 1968).

References dealing exclusively with molluscan fauna of Kashmir are few and scattered. The earliest work appears to be a short paper by Woodward (1856) in which he reported two species of *Ena* Turton (= *Bulimus* Scopoli). Theobald (1878) recorded, besides other molluscs, 14 genera and 27 species of land shells from Kashmir and adjacent areas. Nevill (1878 b) while reporting on the collections made by the second Yarkand Mission, dealt with 3 genera and 10 species, and Godwin-Austen (1899) listed 12 genera and 19 species of land molluscs from this area. Blanford and Godwin-Austen (1908) in the *Fauna of British India*, have listed 6 genera and 9 species, all belonging to family Zonitidae, from Kashmir, and Gude (1914) accounted for 11 genera and 22 species, spread in six families, while dealing with non-operculate land molluscs in the *Fauna of British India*.

II—ABBREVIATIONS USED

coll. — Collector ; ex(s). — example(s) ; Reg. No. — Registered Number ; Sta. — Station ; ZSI. — Zoological Survey of India.

III—CONSOLIDATED LIST OF LAND MOLLUSCS KNOWN FROM KASHMIR AND ITS VICINITY

Class	GASTROPODA
Order	STYLOMMATOPHORA
Family	VERTIGINIDAE

1. *Orcula himalayana* (Benson)
2. *Pupoides coenopictus* Hutton

3. *Pupilla muscorum* Linnaeus
4. *Pupilla muscorum* var. *asiatica* Möllendorf
5. *Pupilla eurina* Benson
6. *Gastrocopta huttoniana* (Benson)

Family VALLONIIDAE

- *7. *Vallonia pulchella* (Müller)
8. *Vallonia costata* (Müller)
- *9. *Vallonia ladacensis* (Nevill)

Family ENIDAE

10. *Ena arcuata* (Küster)
- *11. *Ena candelaris* (Pfeiffer)
12. *Ena coelebs* (Pfeiffer)
13. *Ena domina* (Benson)
- *14. *Ena mainwaringiana* (Nevill)
15. *Ena pretiosa* (Reeve)
16. *Ena sindica* (Reeve)
17. *Ena smithei* (Benson)
- *18. *Ena stoliczkanus* (Nevill)
- *19. *Ena rufistrigata* (Reeve)
- *20. *Ena rufistrigata* var. *gracilis* (Hanley & Theobald)
21. *Cerastus segregatus* (Reeve)

Family CLAUSILIIDAE

22. *Clausilia waageni* Stoliczka

Family FERUSSACIDAE

23. *Glessula hügelii* Pfeiffer

Family ZONITIDAE

24. *Oxychilus lucida* Draparnaud
25. *Oxychilus fulva* Draparnaud

Family VITRINIDAE

26. *Vitrina pellucida* (Müller)

Family ARIONIDAE

- *27. *Anadenus altivagus* (Theobald)
28. *Anadenus jerdoni* Godwin-Austen

Family ARIOPHANTIDAE

29. *Bensonia angelica* Pfeiffer
30. *Bensonia monticola* (Hutton)

- *31. *Euaustenia cassida* (Hutton)
- *32. *Euaustenia monticola* Pfeiffer
- *33. *Euaustenia theobaldi* (Godwin-Austen)
- 34. *Kaliella barrackporensis* Pfeiffer
- *35. *Khasiella hyba* (Benson)
- 36. *Macrochlamys glauca* Benson
- 37. *Macrochlamys (Rhadella) kashmirensis* Benson
- 38. *Macrochlamys (Microcystis ?) sonamurgensis* (Nevill)
- 39. *Macrochlamys patane* Benson
- 40. *Parvatella austeniana* (Nevill)
- 41. *Parvatella altivaga* Godwin-Austen
- 42. *Parvatella flemingi* Pfeiffer
- *43. *Syama splendens* (Hutton)
- 44. *Syama ? theobaldi* Godwin-Austen

Family FRUTICICOLIDAE

- 45. *Aegista huttoni* (Pfeiffer)
(= *Plectotropis huttoni* (Pfeiffer))
- 46. *Cathaica matainensis* Nevill
- 47. *Cathaica phaeozoma* von Martens

Family HELICIDAE

- 48. *Trichia hispida* (Linnaeus)

IV—KEY TO THE IDENTIFICATION OF THE LAND MOLLUSCS OF KASHMIR UPTO FAMILIES (BASED ON SHELL CHARACTERS ONLY).

1. Shell external ..	2
Shell internal i.e. enclosed by mantle	Arionidae.
2. Shell minute not larger than 4 mm. in major diameter and 2 mm. in height, widely umbilicate	Valloniidae.
Shell always larger and never widely umbilicate but may be perforate	3
3. Shell fusiform-cylindrical, spire turreted ..	Enidae.
Shell heliciform, spire depressed or conoidly turbinata	Ariophantidae.

V—SYSTEMATIC ACCOUNT

Class GASTROPODA
Order STYLOMMATOPHORA

Family VALLONIIDAE

Genus *Vallonia* Risso, 1826

Type-species : *Vallonia rosalia* Risso, 1826. (= *Helix pulchella* Müller, 1774). by monotypy.

*Species studied by us.

1826. *Vallonia* Risso, *Hist. nat. Europe merid.*, 4 : 101.
 1893. *Vallonia* : Sterki, *Proc. Acad. nat. Sci. Philad.* : 234-246.

Sterki (1893) gave an excellent account of this genus, which is represented in the collection by two species.

1. *Vallonia pulchella* (Müller, 1774)

1774. *Helix pulchella* Müller, *Verm. Terr. Fluv. Hist.*, 2 : 30 (sp. no. 232), (Type-locality : not mentioned).
 1893. *Vallonia pulchella* : Sterki, *Proc. Acad. nat. Sci. Philad.*, Philadelphia : 246-251.
 1894. *Vallonia pulchella* : Pilsbry, *Man. Conch.*, 9 : 283.
 1914. *Vallonia pulchella* : Gude, *Fauna Brit. India, Mollusca* II (Trochomorphidae—Janellidae), London, : 223.
 1935. *Vallonia pulchella* : Mozley, *Trans. Roy Soc. Edin.*, Edinburgh, 58 (3), No. 24 : 645.

Material.—Coll. *A. S. Rajagopalaiengar* : 1 ex., Sta. 44-Stagnant water in the lowest terraced tank in Shalimar Garden, 31.vii. 1955 (washed material).

Distribution.—Throughout Nearctic and Palaearctic regions and in Asia as far south as Kashmir, in the latter ; Bermuda, Northern Africa ; Azores ; Madeira etc. It has been introduced (probably with plants) into Australia, Mauritius etc.

Remarks.—The single dry shell (which was evidently washed into the tank whence it was collected) representing this species in the collection, agrees well with the description given by Sterki (1893). The shell is finely and regularly striated ; umbilicus is broad and deep. The outerlip is considerably thickened. Whorls : $3\frac{3}{4}$.

Measurements (in mm.)

Major diameter	2.8
Minor „	2.0
Height	1.7

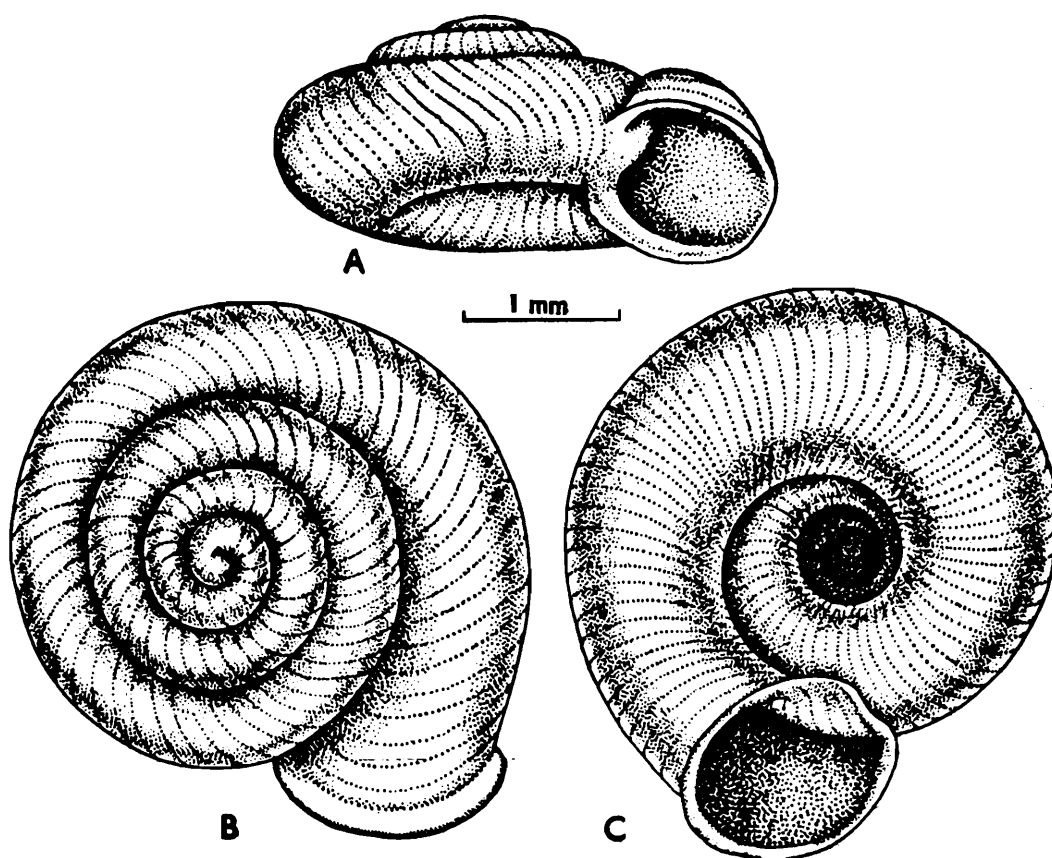
2. *Vallonia ladacensis* (Nevill, 1878)

(Text-figs. 1, 2)

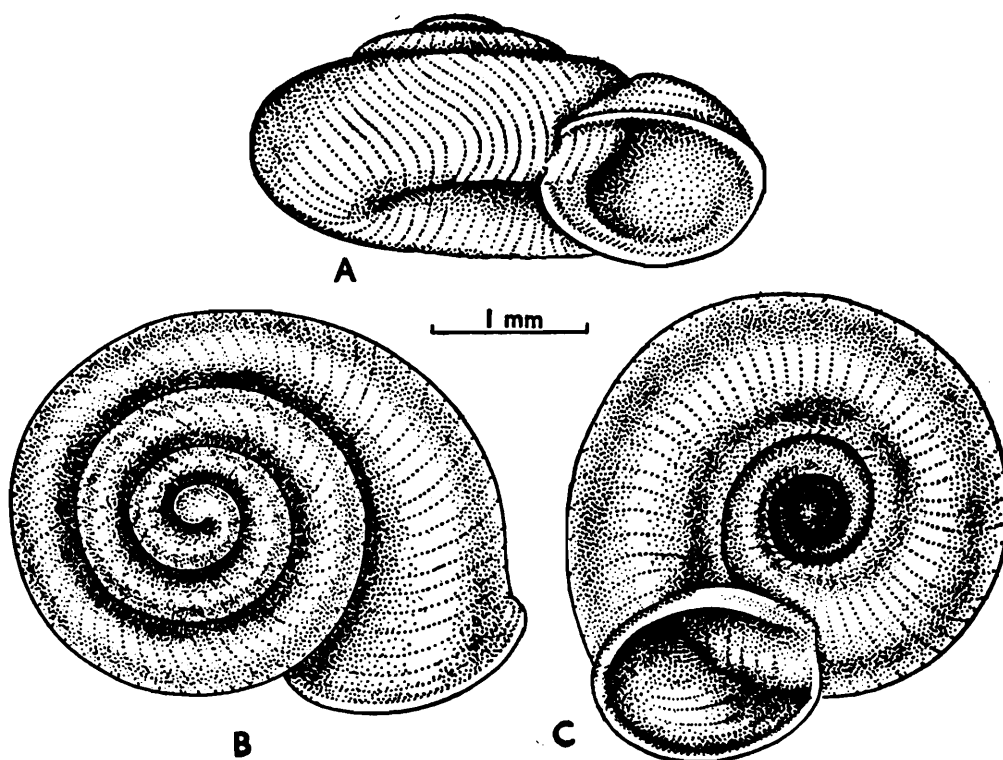
1878. • *Helix (Vallonia) ladacensis* Nevill, *Sci. Res. Sec. Yarkand Mission, Mollusca*, London : 4 (Type-locality : Mataian in the Dras Valley, Ladakh).
 1882. *Helix (Vallonia) ladacensis* : von Martens, *Mem. Acad. Sci. St. Petersburg*, (7) 30 (11) : 3.
 1893. *Vallonia ladacensis* : Sterki, *Proc. Acad. nat. Sci. Philad.*, Philadelphia, p. 275.
 1914. *Vallonia ladacensis* : Gude, *Fauna Brit. India, Mollusca*, II (Trochomorphidae—Janellidae), London, p. 226.

Material.—No. of examples studied : 17 : Lot A : Coll. ? : (i) 2 exs., Kashmir ; (ii) 9 exs., Leh (Ladak) ; Lot B : Coll. *A. S. Rajagopalaiengar* : (iii) 6 exs., Sta. 12 - underneath stones on the bank of the Lidar river, Pahalgam, 2. vii. 1955.

Distribution.—India : Kashmir ; Ladakh : Mataian, Dras Valley, Leh ; Punjab : Spiti ; Western Tibet ; Turkestan : Tian-Shan Mountains.



TEXT-FIG. 1. *Vallonia ladacensis* (Nevill) (Lectotype).
 A. Front view. B. Dorsal view. C. Ventral view.



TEXT-FIG. 2. *Vallonia ladacensis* (Nevill) (A specimen from Pahalgam).
 A. Front view. B. Dorsal view. C. Ventral view.

Remarks.—The original material of Nevill, on which this species was described, is available in the Zoological Survey of India. It contains three specimens labelled as "Type". Nevill (1878 b), however, had not formally designated any type, hence we have taken the opportunity to select one shell from the original material and designate it as "Lectotype", bearing Reg. No. M 18328/3, Zoological Survey of India (Text-fig. 1 A, B and C).

We have compared our specimens with the type material, and find that it is conspecific with the latter. However, in the shells under study the number of whorls are $4\frac{1}{2}$ i.e., one less than in the lectotype. The spire is slightly more suppressed and the outer lip slightly more transversely expanded. These minor variations may be due to the shells having not attained full development. The ribs are closely set and fine as in the "Type". Also, the umbilicus is prominently wide open, through which the whorls can be traced up to the apex.

Measurements (in mm.)

	Lectotype	Kashmir specimens	
		Largest	Smallest
Major diameter	4.0	3.5	2.4
Minor ,,	3.25	2.8	2.0
Height	2.0	1.6	1.1

Family ENIDAE

Genus *Ena* (Leach) Turton, 1831

Type-species : *Bulimus montanus* Draparnaud

- *1786. *Bulimus* Scopoli, *Deliciae Florae. et. Faunae Insubricae*, 1 : 67 (Preoccupied by *Bulimus* Scopoli, 1777 for a genus under family Amnicolidae).
- *1831. *Ena* (Leach MS) : Turton, *Man. Shells Brit. Islands* : 81 (in syn.)
- *1831. *Bulimina* : Ehrenberg, *Symb. Phys. Anim. Evert.*, ser. I. Mollusca, decas prima, signature d. fourth page (non *Bulimina* D'Orbigny, 1826) (Preoccupied by *Bulimina*, a genus of Foraminifera).
- 1839. *Buliminus* : Beck, *Index Mollusc.*, : 68 (as a subgenus of *Bulimus*).
- *1840. *Ena* Turton, *Man. Land & Freshwater Shells*, Ed. 2 : 182.

The name *Ena* Turton, is the available valid name for the genus, others (synonymy vide supra) being preoccupied.

This genus is represented by four species and a variety in the collection.

3. *Ena candelaris* (Pfeiffer, 1846)

- 1846. *Bulimus candelaris* Pfeiffer, *Proc. zool. Soc. Lond.* : 40 (Type-locality : not mentioned).
- 1849. *Bulimus candelaris* : Reeve, *Conch. Icon.*, 5, sp. 408.
- 1855. *Bulimulus candelaris* : Adams, *Gen. Rec. Moll.*, 2 : 159.
- 1878. *Buliminus (Petraeus) candelaris* var. Nevill, *Sci. Res. Second Yarkand Mission*, Mollusca, London : 20.

* Not seen in original

1914. *Ena candelaris* : Gude, *Fauna Brit. India Mollusca* II (Trochomorphidae-Janellidae), London : 243-244.

Material.—No. of examples studied : 464 : Lot A : Coll. ? (i) 30 exs. (16 sinistral + 14 dextral), Tinali and Kashmir (Mixed collection) ; Lot B : Coll. *S. L. Hora* : (ii) 12 exs., Sta. 4-Shankaracharya Hill*, 28.iv.1954. Lot C : Coll. *A. S. Rajagopalaiengar* : (iii) 120 exs., Sta. 4-Below stones, Shankaracharya Hill, Srinagar, 20.vi.1955 ; (iv) 88 exs., Sta. 4a—on the grass, Shankaracharya Hill, Srinagar ; 20-21.vi.1955 ; (v) 105 exs., Sta. 4a—on the grass, Shankaracharya Hill, Srinagar, 21.vi.1955 ; (vi) 24 exs.,—on plants at Bareen, near Srinagar, 24.vi.1955 ; (vii) 115 exs., Sta. 9—Bed of a dried-up streamlet, Bareen, near Srinagar, 26.vi.1955.

(All the examples under Lots B and C are sinistral).

Distribution.—North-west India : Fort Lockhart ; Kashmir : Srinagar, Shankaracharya Hill ; Jhelum Valley above Kokala ; Pakistan : Tinali ; Tibet.

Remarks.—The large collection of this “candle-like” form before us is of uniform nature, without much noticeable individual variation. The whorls are 9 and “rudely finely striated” excepting for the two apical whorls. The shells are “dead-white” and the margin of aperture ivory white. They represent various stages of growth. Juvenile forms are of conical shape, body whorl prominently keeled and with the margin of the aperture not expanded.

Nevill (1878b) records both dextral and sinistral forms together from Tinali and observes “the dextral form appears to have been found more abundant than the sinistral”, whereas Theobald (1878) reporting the species from Murree and various places in Kashmir comments that “sinistral shells are most numerous but dextral ones also occur not rarely” Nevill (1878a) in his “Hand list” cites 3 examples (all sinistral) from “Takt-i-Soliman” Further, he (1878b) quotes Lydekker having noticed the two forms not usually found absolutely together. Our study also reveals that Lots B and C (above) contain only sinistral shells. It is likely that these specimens are drawn from homogeneous population (s) occurring in the area and in which only the sinistral character appears to prevail.

The live snails were found sticking to blades of grass, leaves etc. of plants and aestivating during spells of dry weather in June. With the onset of rainy or humid condition they were observed to come out and actively crawl about.

4. *Ena stoliczkana* (Nevill, 1878)

1878. *Bulimus (Petraeus) stoliczkanus* Nevill, *Sci. Res. Second Yarkand Mission*, Mollusca, London : 19. (Type-locality : Sonamarg, Kashmir).

Material.—No. of examples studied : 12. Lot A. Coll. ? (i) 2 exs., Sonamarg ; Lot B. Coll. *K. K. Tiwari* : (ii) 10 exs., crawling on stones, Banihal, 15.vii.1955.

Distribution.—India : Kashmir.

*Also known as “Takht-e-Suleman”.

Remarks.—The specimens of Lot A (i) above, which are from identified collections of Zoological Survey of India are quite large in size. They agree with Nevill's (1878b) fig. 27.

The specimens of Lot B (ii) above are of much smaller size and they are strikingly similar to Nevill's figs. 25 and 26.

The umbilicus is narrowly rimate and partially covered by the reflected columella. Whorls are 7. In the two juveniles present in the collection they are $5\frac{1}{2}$.

5. *Ena mainwaringiana* (Nevill, 1878)

- 1878. *Bulimus mainwaringianus* Nevill, *Sci. Res. Second Yarkand Mission*, Mollusca, London : 19. (Type-locality : Murree, West Punjab).
- 1881. *Napaeus mainwaringianus*: Theobald, *J. Asiat. Soc. Beng.*, 50 (2) : 47-48.
- 1902. *Bulimus* (*Subzebrinus*) *mainwaringianus* : Kobelt, *Conch-Cab.*, 1 (13) (Buliminidae) : 937.
- 1914. *Ena mainwaringiana* : Gude, *Fauna Brit. India, Mollusca II* (Trochomorphidae-Janellidae), London : 251.

Material.—No. of examples studied : 298. Lot A. Coll. ? : (i) 8 exs., Jhelum ; (ii) 1 ex., ZSI., Reg. No. M 6951/1, Gilgit, 5000 ft.; Lot B. Coll. K. K. Tiwari : (iii) 33 exs., on the slopes of Shankaracharya Hill, Srinagar, below stones, 5.vi.1955 ; (iv) 1 ex., Below stone, Chakua nullah, Batote, 30.vii.1955 ; Lot C. Coll. A. S. Rajagopalaiengar : (v) 100 exs., Sta. 4—Shankaracharya Hill, Srinagar, below stones, 20.vi.1955 ; (vi) 142 exs., Sta. 4—Shankaracharya Hill, Srinagar, below stones, 21.vi.1955 ; (vii) 5 exs., Sta. 9—Near Bareen village towards the mountain on the East, 26.vi.1955 ; (viii) 7 exs., Sta. 45—Underneath shrubby bushes in the slope behind the Telephone Exchange, Gulmarg, 1.viii.1955 ; (ix) 2 exs., Sta. 50—Beneath shrubby bushes in the slope opposite Tourist Bureau, Gulmarg, 3.viii.1955.

Distribution.—India : Kashmir ; Jhelum Valley ; Pakistan : Murree, Pakli Valley (Tandiani Hills) ; Lundi Kotal.

Remarks.—We have carefully examined Nevill's "Type" (Holotype-ZSI. Reg. No. M 18327/3) of this species, with which we have compared the collection under study and find that the latter agrees very well with it. The collection contains shells which are larger in size than the "Type" or any other shell in the entire hypodigm studied by Nevill (1878b).

The epidermis is of light horny brown, except for the 8 exs. in Lot A above, but without the "variegated opaque white markings." In a large number of shells the epidermis has peeled off exposing the white shell surface beneath. The mature shells are with 7 whorls while the juveniles are with 6. The columella is broadly reflected, straight and slightly subangulate. The umbilicus is rimate and partially occluded by the columella. The outer lip is not so much thickened as in the "Type"

In the Lot C (v) and (vi) above are present 5 and 2 large-sized shells respectively, which agree with Gude's fig. 92 on p. 252.

The largest shell measures 17×8 mm.

6. *Ena rufistrigata* (Reeve, 1849)

1849. *Buliminus rufistrigatus* Reeve, *Conch. Icon.*, London, 5, sp. no. 570, pl. 78, fig. 570 (Type-locality : Base of the lower range of the Himalaya, between the rivers Jumna and Sutlej).
 1878. *Buliminus (Petraeus) rufistrigatus* : Nevill, *Sci. Res. Second Yarkand Mission*, Mollusca, London : 20.

Distribution.—India : Base of the lower range of the Himalayas between Jumna and Sutlej ; Jhelum Valley ; Outer hills from Jumna to the Indus (Kashmir) ; Ludi Kotal.

Remarks.—Gude (1914) has given a good synonymy and discussed at some length its affinities with the *eremita*, *sindicus*, *salsicola* and *spelaeus*.

A single good specimen from the second Yarkand Expedition material examined by Nevill is represented in the collection of Zoological Survey of India.

7. *Ena rufistrigata* (Reeve) var. *gracilis* (Hanley & Theobald, 1870)

1870. *Bulimus rufistrigatus* var. *gracilis* Hanley and Theobald, *Conch. Indica* : 10. (Type-locality : Between the rivers Jumna and Sutlej. Punjab).

Distribution.—India : Kashmir ; Kakerhati.

Remarks.—This variety is represented by 2 exs. in the Zoological Survey of India from the Second Yarkand Expedition collection studied by Nevill (1878b). We have carefully examined them and find that they are more slender than the typical form. Of the two shells one is mature and has 7 whorls and the other is juvenile with only 5 whorls.

Family ARIONIDAE

Genus *Anadenus* Heynemann, 1863

Type-species : *Anadenus giganteus* Heynemann

1863. *Anadenus* Heynemann, *Malak. Blätt.*, 10 : 138.

Godwin-Austen (1882) and Tryon (1885) have given the generic diagnosis of these slugs. Pilsbry (1898) has also traced the phylogeny of this genus *vis-a-vis* other genera of Arionidae.

This genus is represented in the collection by a single species.

8. *Anadenus altivagus* (Theobald, 1862).

(Pl. 1, Figs. 1-3)

1862. *Limax altivagus* Theobald, *J. Asiat. Soc. Beng.*, 21 : 489 (Type-locality : Cissutlej Hills near Fagu, Narkanda, Saraon, etc., Alt. 1828 to 2743 M.).
 1882. *Anadenus altivagus* : Godwin-Austen, *Land and Freshwater Moll. India*, London, pt. 2 : 49.
 1914. *Anadenus altivagus* : Gude, *Fauna Brit. India, Mollusca II* (Trochomorphidae-Janellidae), London : 470.

Material.—No. of examples studied : 21. Lot A : Coll. ? : (i) 1 ex., ZSI, Reg. no. M 14782/2, Gulmarg, Kashmir ; Lot B : Coll. *S. L. Hora* (ii) 1 ex., Sta., 44—On the way from Pahalgam to Biasarn (alt. 2438 m.), 15.vi.1954 ; Lot C : Coll. *A. S. Rajagopalaiengar* (iii) 3 exs., Sta. 50—Below shady plants in the slope opposite Tourist Bungalow, Gulmarg, 3.viii.1955 ; (iv) 16 exs., Sta. 51—Under shady plants, pieces of log etc., near Khilanmarg (alt. 3352 m.), 3.viii.1955.

Distribution.—India : Kashmir ; Himachal Pradesh : Simla, Kufri, Dalhousie ; Uttar Pradesh : Nainital ; Pakistan : Tandiani, Changligali near Murree ; Nepal.

Remarks.—While Godwin-Austen (1882) and Tryon (1885) consider *A. giganteus* Heynemann, as synonymous with *A. altivagus* (Theobald), Nevill (1878b) and Gude (1914) have treated the two species as distinct. Gude (1914), however, on the basis of a pencil remark by Godwin-Austen in a copy of the Land and Freshwater Mollusca of India at the British Natural History Museum, infers that Godwin-Austen has modified his earlier view and admitted *giganteus* as a distinct form.

According to Godwin-Austen (1882) the slugs were found to be in full activity and development during rains in June and July. Our observations also point to the same, for, the active life of these slugs seem to culminate into full sexual activity in August. Many slugs were seen in copulation by one of the authors (Rajagopal) in Khilanmarg (alt. 3352 M.) on 3rd August, 1955. The copulating pairs separated at the slightest disturbance. By careful handling one pair was successfully preserved with the respective external genitalia in a well extended condition (Lot B (iii) above. See Pl. 1, figs. 2 & 3).

In the Lot B (iii) above is a specimen, which during coitus acted as a functional male, with the penis preserved in a well-extended condition (Plate 1, fig. 2). The basal part of the penis is broad and swollen, while the distal part is narrow, short and pointed. The penis appears as if mounted on a platform. Below this platform is what Godwin-Austen refers to as the "reversed portion", in which embedded on all sides except the posterior are several rows of calcareous plates with spiny margins. Posteriorly, embedded in this portion is a large calcareous shield with undulating rows of longitudinal comb-like projections below and with sharp curving margin pointed at one end, above.

In the same lot is another specimen which was a functional female during coitus (Plate 1, fig 3). In this also similar calcareous structures as described for the male are present at corresponding places in the "reversed portion". Only the penis with its platform is not visible. In its place a much contracted genital orifice can be seen.

The slugs in life are dark greenish brown, the tentacles and head region being much darker. The animals secrete slime very profusely.

The slugs seem to prefer cool, shady and humid places as most of them were collected underneath shady plants, below pieces of decaying wood etc.

No good figure of this slug is available in literature. Therefore, a photograph of the best specimen present in the collection is reproduced here (See Pl. 1, fig. 1).

This is a new record of its occurrence in Kashmir.

Family ARIOPHANTIDAE

Genus *Syama* Godwin-Austen, 1908.

Type-species : *Macrochlamys prona* Nevill.

1908. *Syama* Godwin-Austen, *Fauna Brit. India Mollusca*, (Testacellidae and Zonitidae), London, : 152 (As a subgenus of *Euaustenia* Cockerell).
1931. *Syama* : Thiele, *Handbuch Syst. Weichtierk.*, Jena, 1 : 620.

This genus is represented in the collection by a single species.

9. *Syama splendens* (Hutton, 1838)

1838. *Nanina splendens* Hutton, *J. Asiat. Soc. Beng.*, Calcutta, 7 (1) : 215 (Type-locality : Mahasu, near Simla).
1878. *Nanina* (*Bensonina*) *splendens* : Nevill, *Sci. Res. Second Yarkand Mission*, Mollusca, London : 18.
1908. *Euaustenia* (*Syama*) *splendens* : Blanford and Godwin-Austen, *Fauna Brit. India, Mollusca* (Testacellidae and Zonitidae), London : 153.

Material.—No. of examples studied : 55. Lot A : Coll. ? (i) 10 exs., Rampur, Kashmir, 11.iv.1916 ; Lot B : Coll. *Baini Prashad* (ii) 1 ex., Sta. 7-Thajwas Margs near Sonamarg, Kashmir, (alt. 2743 m.), 17-23.vi.1921. Lot C : Coll. *S. L. Hora* (iii) 1 ex., Sta. 55—On way from Tangmarg (alt. 2194 M.) to Khilanmarg (alt. 3352 m.), 22.vi.1954. Lot D : Coll. *K. K. Tiwari* (iv) 1 ex.,—Batakut, 5 km south of Rest House, below stones, (alt. ca 2438 M.), 17.vi.1955 ; Lot E : Coll. *A. S. Rajagopalaiengar* (v) 4 exs., Sta. 4—Below stones in Shankaracharya Hill, Srinagar, 21.vi.1955 ; (vi) 1 ex., Sta. 18—Among dead leaves underneath a bush at the base of Pissu Ghat, 6.vii.1955 ; (vii) 2 exs., Sta. 22—Stagnant pool by the side of the canal of Lidar River, Pahalgam, on way to Chandanwari, 8.vii.1955 ; (viii) 3 exs., Sta. 45—Underneath shrubby bushes in the slope behind the Telephone Exchange, Gulmarg, 1.viii.1955 ; (ix) 28 exs., Sta. 49—Underneath stones in a cool place off the 3rd km from Tangmarg to Gulmarg, 3.viii.1955 ; (x) 3 exs., Sta. 50—Beneath shrubby bushes in the slope opposite Tourist Bureau, Gulmarg, 3.viii.1955 ; (xi) 2 exs., Sta. 51—Under a rotting log of wood near Khilanmarg, 3.viii.1955.

Distribution.—India ; Western Himalayas, near Mussoorie and Simla ; Kashmir ; Pakistan : Tinali.

Remarks.—The full grown large-sized shells are fairly stout and light horny brown or yellow in colour. The smaller ones are thin, fragile and when fresh glossy and deeply pink or light reddish.

Genus *Khasiella* Godwin-Austen, 1899.

Type-species : *Helix vidua* Hanley and Theobald.

1899. *Khasiella* Godwin-Austen, *Land and Freshwater Moll. India*, London, 2 : 129.
 1908. *Khasiella* : Blanford and Godwin-Austen, *Fauna Brit. India, Mollusca* (Testacellidae and Zonitidae), London : 157.

Godwin-Austen (1899) proposed the name *Khasiella* to include the snails which were anatomically different from *Euplecta* Semper. He originally proposed the name as a subgenus of *Euplecta* but later (1908) raised it to a genus.

This is represented in the collection by a single species.

10. *Khasiella hyba* (Benson, 1861)

1861. *Helix hyba* Benson, *Ann. Mag. nat. Hist.*, London, (3) 7 : 83 (Type-locality : Dahinkund, Sub-Himalaya, not far from Sutlej).
 1870. *Helix hyba* : Hanley and Theobald, *Conch. Indica*, pt. 2, pl. 30, figs. 2 & 3.
 1908. *Khasiella hyba* : Blanford and Godwin-Austen, *Fauna Brit. India, Mollusca*, London : 162.

Material.—No. of examples studied : 7. Lot. Coll. A. S. Rajagopalaiengar (i) 1 ex., Sta. 9—In a hole on the top of the mountain, east of Bareen village, 26.vi.1955 ; (ii) 2 exs., Sta. 45—Underneath shrubby bushes in the slope behind the Telephone Exchange, Gul marg, 1.viii.1955 ; (iii) 4 exs., Sta. 49—Underneath a cool place off the 3rd km. from Tangmarg to Gulmarg, 3.viii.1955.

Distribution.—India : Kashmir : Hill behind Aijas, east of Wular Lake ; Western Himalayas : Dahinkund, Bari Doab ; Himachal Pradesh : Dalhousie and Chamba.

Remarks.—In the collection studied there are three adult shells which are in perfect agreement with the figure given by Hanley and Theobald (1870) and the description and figure of Blanford and Godwin-Austen (1908).

The four young shells found in the collection differ from the adults in being more depressedly conoid than trochiform with tumid ventral side. All the shells are sharply carinated.

Genus *Euaustenia* Cockerell, 1898.

Type-species : *Austenia scutella* Benson.

1891. *Euausteniae* Cockerell, *Ann. Mag. nat. Hist.*, (6) 7 : (as a section of *Austenia*).
 1898. *Euaustenia* Cockerell : *Nautilus*, 12 : 10 (name emended).
 1908. *Euaustenia* : Blanford and Godwin-Austen, *Fauna Brit. India, Mollusca* (Testacellidae and Zonitidae), London : 148.

While Cockerell (1898) proposed *Euaustenia* as a section of *Austenia* Nevill, Blanford and Godwin-Austen (1908) raised it to a generic level, but Thiele (1931) again made it a section of *Macrochlamys* Gray. We follow Blanford and Godwin-Austen in treating it as a genus.

This is represented in the collection by three species.

11. *Euaustenia monticola* (Pfeiffer, 1848)

1848. *Vitrina monticola* Pfeiffer, *Proc. zool. Soc. Lond.*, 16 : 107 (Type-locality : not specified).
1859. *Vitrina scutella* Benson, *Ann. Mag. nat. Hist.*, (3) 3 : 188 (in part).
1878. *Helicarion monticola* : Nevill, *Sci. Res. Second Yarkand Mission*, Mollusca, London : 15.
1888. *Austenia scutella* : Godwin-Austen, *Land and Freshwater Moll. India*, London, 1 : 232.
1908. *Euaustenia monticola* : Blanford and Godwin-Austen, *Fauna Brit. India. Mollusca* (Testacellidae and Zonitidae), London : 149.

Blanford and Godwin-Austen (loc. cit.) have given a comprehensive synonymy of this species.

Material.—No. of examples studied : 45. Lot. A : Coll. A. S. Rajagopalaiengar (i) 2 exs., Sta. 9—In a burrow up the mountain, east of Bareen near Srinagar, 26.vi.1955 ; (ii) 2 exs., Sta. 12—Eastern bank of Lidar river, Pahalgam, 2.vii.1955 ; (iii) 1 ex., Sta. 13—Underneath stone, on the way from Pahalgam to Chandanwari, 3.vii.1955 ; (iv) 9 exs., Sta. 20—Underneath stones, on the way from Pahalgam to Chandanwari, 7.vii.1955 ; (v) 7 exs., Sta. 21—Underneath moist stones near a canal of Lidar river on road from Chandanwari to Pahalgam, 7.vii.1955 ; (vi) 1 ex., Sta. 30—A swampy area by the roadside about $\frac{1}{4}$ km. from Thajiwara near Acchabal, crawling on weeds, 15.vii.1955 ; (vii) 1 ex., Sta. 49—Underneath stones in a cool place off 3rd km. from Tangmarg to Gulmarg, 3.viii.1955 ; (viii) 1 ex., Sta. 50—Beneath shrubby bushes in the slope opposite Tourist Bureau, Gulmarg, 3.viii.1955 ; Lot. B : Coll. K. K. Tiwari (ix) 1 ex., Paddy fields, Banihal, 15.vii.1955 ; (x) 15 exs., Below stones, Banihal alt. ca. 1632 ms., 18.vii.1955 ; (xi) 2 exs., Banihal, Crawling on the stones by the side of the road, 20.vii.1955 ; Lot. C : Coll. K. S. Pradhan (xii) 3 exs., Sta. 43—Shit Garhi, collected from below stones on moist ground about 4 km. N. W. of P. W. D. Rest House, Sonamarg, 30.vii.1955.

Distribution.—India : Northwest Himalayas to Nainital ; Pakistan : Murree.

Remarks.—Pfeiffer (1848) while describing the species from specimens out of the Cuming's collection states their localities as : "from Bengal, Landour, Himalaya, Almorah", without specifying the type-locality of his species.

Godwin-Austen (1888) says "considerable confusion exists with regard to *monticola*, *cassida* and *scutella*, and the localities in which they were originally collected" An idea of the extent of this confusion can be had by referring to Nevill (1878 b), Godwin-Austen (1888), and Blanford and Godwin-Austen (1908). Godwin-Austen (1888), while discussing the probable distinctness of identity of the two specimens *i.e.* the one from Kashmir (Nasmana) and the other from Khasi Hills (Teria Ghat) studied by Benson, asserts "I can state there is no form at all approaching it (*Austenia scutella* Benson) at Teria Ghat in Khasi Hills, nor have I seen anything like it either from Darjiling or Assam" We also think he is right in this.

The collection consists of shells which are fragile and of various sizes. There are some with the animal intact. All the shells are depressed with very flattened spire and subpapillate apex. Colour of shell is dirty green to olivaceous green. Live animals vary in colour. Some were observed with body tinged yellowish and the mantle and mid portion orange yellow. Others were dark bluish.

Measurements (in mm.)
Largest shell

Major diameter	25
Minimum „	20
Height „	10

12. *Euaustenia cassida* (Hutton, 1838)

1838. *Vitrina cassida* Hutton, *J. Asiat. Soc. Beng.*, 7 : 214 (Type-locality : Simla).
 1878. *Helicarion stoliczkanus* Nevill, *Sci. Res. Second Yarkand Mission*, Mollusca, London : 15.
 1908. *Euaustenia cassida* : Blanford and Godwin-Austen, *Fauna Brit. India*, Mollusca, (Testacellidae and Zonitidae), London : 150.

Material.—No. of examples studied : 13. Lot. A : Coll. S. L. Hora (i) 5 exs., Sta. 2—Kashmir entrance of the Banihal Tunnel, (alt. ca 2712 km.), 24.v. 1954 ; (ii) 1 ex., Sta. 18—Acchabal Hatchery, 31.v.1954 ; (iii) 3 exs., Sta. 34b—A stream below Acchabal Hatchery spring, 13.vi.1954 ; Lot B : Coll. A. S. Rajagopalaiengar (iv) 1 ex., Sta. 34—Sticking to the side wall of a spring, Acchabal Hatchery, 17.vii.1955 ; Lot C : Coll. K. K. Tiwari (v) 1 ex., Below stone, Chakua nullah, Batote, 30.vii.1955 ; (vi) 2 exs., Found crawling on stones at Batote, 2.viii.1955.

Distribution.—India : Western Himalayas to Kumaon.

Remarks.—The collection studied contains shells which are more tumid than the previous species. The spire is convex, shell pale yellow. As Nevill (1878b) observes this species is found in company with the preceding one.

13. *Euaustenia theobaldi* (Godwin-Austen, 1888)

1888. *Austenia theobaldi* Godwin-Austen, *Land and Freshwater Moll. India*, London, 1 (vi) : 236. (Type-locality: Bichlari, Chinab Valley).
 1908. *Euaustenia theobaldi* : Blanford and Godwin-Austen, *Fauna Brit. India*, Mollusca (Testacellidae and Zonitidae), London : 152.

Material.—No. of examples studied : 5. Lot. Coll. A. S. Rajagopalaiengar (i) 2 exs., Sta. 45—Underneath shrubby bushes in the slope behind the Telephone Exchange, Gulmarg, 1.viii.1955 ; (ii) 3 exs. Sta. 50—In the shrubby bushes opposite Tourist Bureau, Gulmarg, 3.viii.1955.

Distribution.—India : Chenab Valley, above the Bichlari River in Kashmir ; Dharmsala in the Kangra Valley.

Remarks.—The shells are dirty green, thin, horny, globose, with convex whorls. The aperture is nearly circular. The examples are with the animal intact. In life, they were pale reddish, the upper mantle portion covering the shell and the posterior half of the body being brighter red. Anterior half of the rim of the foot and the head region are finely granulated and dark. The tentacles are four and the darkest.

VI—ACKNOWLEDGEMENT

We are thankful to Dr. A. P. Kapur, Director, Zoological Survey of India for the facilities and to Dr. K. K. Tiwari, Zoological Survey of India, for going through the manuscript and offering valuable suggestions and criticisms.

VII—SUMMARY

The paper gives a systematic account of land molluscs of Jammu and Kashmir dealing with 13 species spread over four families, of which one species is a new record for Kashmir.

A "Lectotype" from Nevill's "Type" material of *Vallonia ladacensis* is selected and figured.

The justification for the use of the generic name *Ena* Turton is given and the confusion regarding the use of other generic names clarified (*vide* Synonymy).

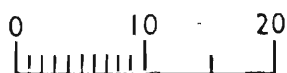
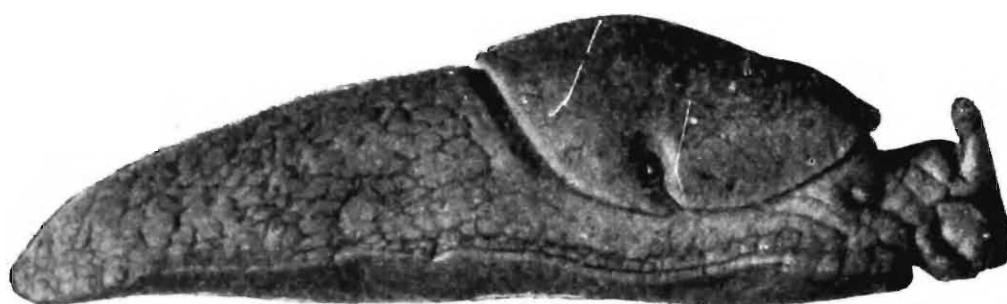
An attempt has been made to specify the exact identity of *Euaustenia monticola* (Pfeiffer) and to explain the confusion arising out of Benson's identification of collection from two widely different localities.

A consolidated list of land molluscs known so far from Kashmir and its vicinity is also included.

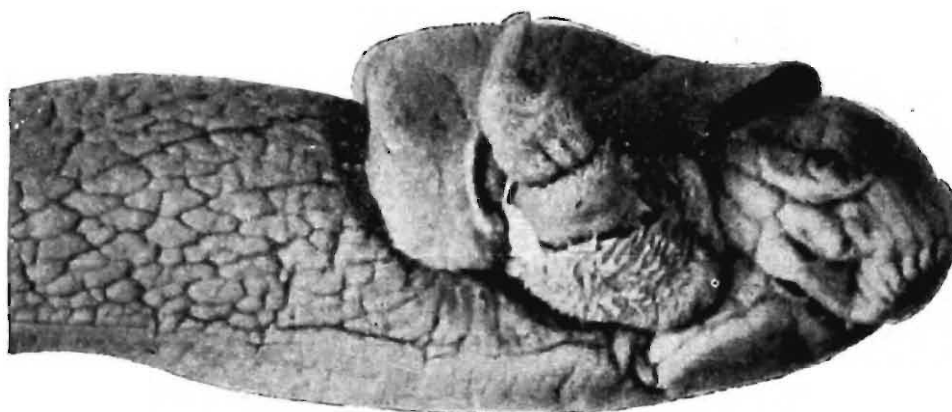
VIII—REFERENCES

- BLANFORD, W. T. & GODWIN-AUSTEN, H. H. 1908. *Fauna Brit. India, Mollusca*. (Testacellidae and Zonitidae), XV + 311 pp. London (Taylor & Francis).
- COCKERELL, T. D. A. 1898. Note on *Mariaella dussumieri*. *Nautilus*, 12 : 9-10.
- GODWIN-AUSTEN, H. H. 1882. *Land and Freshwater Mollusca of India*, London, pt 2 : 19-65.
- GODWIN-AUSTEN, H. H. 1888. *Land and Freshwater Mollusca of India*, London, pt. 6 : 207-257.
- GODWIN-AUSTEN, H. H. 1899. Address of the President. Appendix A. List of shells from Kashmir territory, north of the Pir Panjal and Kajrag ranges, including Yarkand. Appendix B. List of shells from Kashmir territory, south of the Pir Panjal and Kajrag ranges, including the Murree Hill and Hazara. *Proc. malac. Soc. Lond.*, 3 : 259-262.
- GUDE, G. K. 1914. *Fauna of British India, Mollusca, II Trochomorphidae Janellidae*, xii+520 pp.—London (Taylor & Francis).
- HANLEY, S. and THEOBALD, W. 1876, *Conchologia Indica*, London, pt. 2 : 11-18,

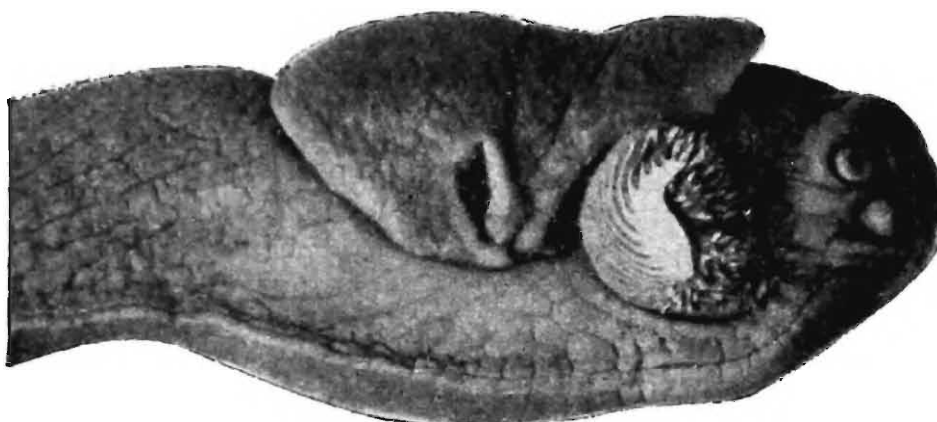
- NEVILL, G. 1878a. *Handlist of Mollusca in the Indian Museum, Calcutta. Pt. I Gastropoda, Pulmonata and Prosobranchia-Neurobranchia*, Calcutta, xv + 338 pp.
- NEVILL, G. 1878b. Mollusca II—Mollusca from Kashmir and neighbourhood of Mari (Murree) in the Punjab. *Sci. Res. Second Yarkand Mission*, Mollusca, London, : 14-21.
- PEIFFER, L. 1848. Descriptions of twenty three new species of *Vitrina* from the collection of H. Cuming Esq. *Proc. zool. Soc. Lond.*, 16 : 104-109.
- PILSBRY, H. A. 1898. Phylogeny of the genera of Arionidae. *Proc. malac. Soc. Lond.*, 3 : 94-104.
- RAJAGOPAL, A. S. and SUBBA RAO, N. V. 1968. Aquatic and amphibious molluscs of the Kashmir valley, India. *Proc. Symposium on Mollusca*, Part I, Marine Biological Association of India, Mandapam Camp : 94-120.
- STERKI, V. 1893. Observations of *Vallonia*. *Proc. Acad. nat. Sci. Philad.*, : 234-279.
- THEOBALD, W. 1878. Notes on the land and freshwater shells of Kashmir, more particularly of the Jhelum valley below Srinagar and the hills north of Jamu. *J. Asiat. Soc. Beng.*, 47 (2) : 141-149.
- THIELE, J. 1931. *Handbuch der Syst. Weichtierkunde*, Jena, 1, vi + 778 pp.—Jena (Verlag von Gustav Fischer).
- TRYON, G. W. 1885. *Man. Conch.*, (2) 1 : 364 pp. + 60 pls.—Philadelphia (Published by the author)
- WOODWARD, S. P. 1856, On the land and freshwater shells of Kashmir and Tibet, collected by Dr. T. Thomson. *Proc. zool. Soc. Lond.*, pt. 24 : 185-187.



1



2



3

PLATE 1. *Anadenus altivagus* (Theobald) from Khilanmarg, Kashmir.

Fig. 1. View of the slug from its right-side.

Fig. 2. The functional male slug with the "reversed portion" and the well-extended penis.

Fig. 3. The functional female slug with the genital orifice and the "reversed portion."

A CATALOGUE OF INDIAN FOSSIL AMPHIBIA

By

R. K. GHOSE

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(With 1 Text-figure)

I—INTRODUCTION

According to Romer (1953¹), about 260 genera of fossil Amphibia are so far known in the world. Of these, only 13 genera, comprising 17 species, have been reported from India, and most of them from the Gondwanas. Yet, no catalogue of the Indian fossil Amphibia is available. Some information on the fossil species together with references to published literature have been given by La Touche (1917-1926²), and since then a number of workers have contributed to the subject. But all these data are scattered through the literature. An attempt has, therefore, been made here to present a catalogue of Indian fossil Amphibia, together with a bibliography on the subject.

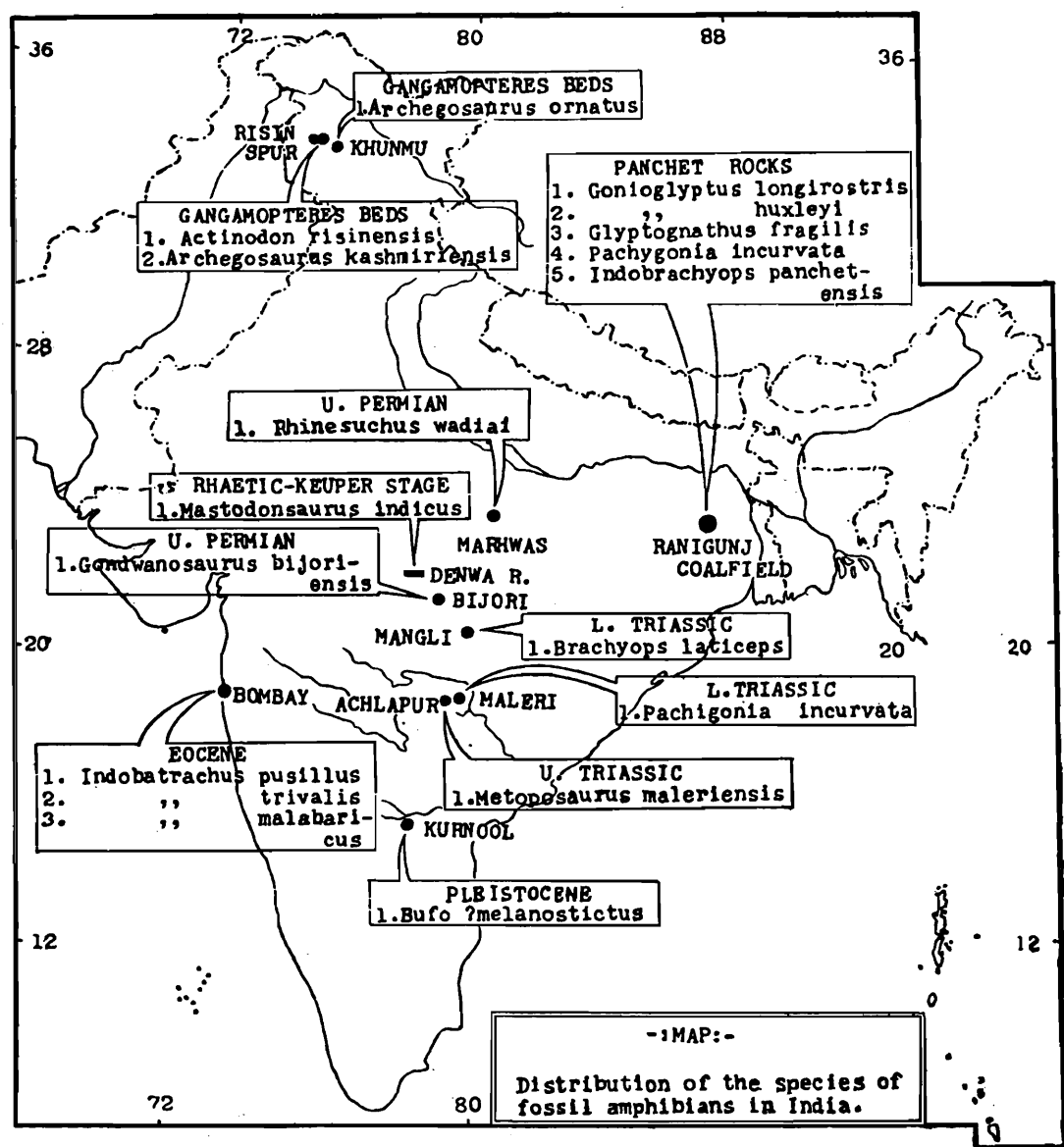
In this paper, all the known Indian fossil amphibian genera and species, and some unidentified material of the group known so far from the literature cited in the bibliography are given, together with distribution of the different species, their localities and geological horizons. Also, the distribution of the different species, their localities and geological horizons have been shown in text-figure 1 (p. 214).

The classification adopted here is after Romer (*op. cit.*).

The bibliography contains 60 references. With the exceptions of one or two, only those papers are included which have Indian fossil amphibians as the main interest. An index to these references indicating genera and species mentioned there, general references, geological horizons and states has also been appended. The original reference of each species has been indicated by a number in parenthesis after the specific name, which refers to the serial number of entry in the bibliography.

¹ Romer, A. S. 1953. *Vertebrate Paleontology*. Chicago (Uni. Chicago Press).

² La Touche, T. H. D. 1917-1926. *A bibliography of Indian geology, and Physical geography*, 4 parts. Calcutta (Govt. India).



R. K. Ghosh—A Catalogue of Indian Fossil Amphibia.

TEXT-FIG. 1.—Map showing the distribution of the different species of Amphibia so far known from India.

II—LIST OF FOSSIL AMPHIBIANS

Species	Geological Horizon	Locality
Superorder LABYRINTHODONTIA		
Order RACHITOMI		
Suborder <i>ERYOPSOIDEA</i>		
Family ARCHEGOSAURIDAE		
Genus <i>Archegosaurus</i> Goldfuss		
1. <i>Archegosaurus kashmiriensis</i> Tewari (48)	Upper Carboniferous (Lower Gondwana)	Gangamopteris beds, Risin Spur near Srinagar, Kashmir.
2. <i>Archegosaurus ornatus</i> S. Woodward (58)	Lower Permian (Lower Gondwana)	Gangamopteris beds, Kunmu, Kashmir.
3. <i>Archegosaurus</i> sp (58)	Lower Permian (Lower Gondwana)	do
4. <i>Archegosaurus</i> ? sp (27)	Upper Permian (Lower Gondwana)	Bijori, Madhya Pradesh.
Family ERYOPSIDAE		
Genus <i>Actinodon</i> Gandry		
5. <i>Actinodon risinensis</i> Wadia and Swinton (55)	Permo-Carboniferous (Lower Gondwana)	Gangamopteris beds, near Risin hamlet, c. 2½ Km. E. N. E. of Zewan, Vihi District, Kashmir. 34°4' x 74°56'

II—LIST OF FOSSIL AMPHIBIANS—*Contd.*

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Species	Geological Horizon	Locality
Suborder <i>NEORHACHITOMI</i>		
Family RHINESUCHIDAE		
Genus <i>Rhinesuchus</i>		
6. <i>Rhinesuchus wadai</i> Tripathi (50)	Late Permian (Lower Gondwana, Raniganj Stage)	Marhwas, Sidhi District, Madhya Pradesh.
Genus <i>Gondwanosaurus</i> Lydekker (28)		
7. <i>Gondwanosaurus bijoriensis</i> Lydekker (28)	Upper Permian (Lower Gondwana)	Bijori, Madhya Pradesh.
Family CAPITOSAURIDAE		
Genus <i>Mastodonsaurus</i> Jaeger		
8. <i>Mastodonsaurus indicus</i> Lydekker (32)	Triassic-Jurassic (Middle Gondwana, Rhaetic-Keuper stage)	Denwa River, Satpura District, Madhya Pradesh.
9. <i>Mastodonsaurus</i> sp (21)	Permo-Triassic	Raniganj Coalfield, Bengal.
Family TREMATOSAURIDAE		
Genus <i>Gonioglyptus</i> Huxley (21)		
10. <i>Gonioglyptus longirostris</i> Huxley (21)	Lower Triassic (Middle Gondwana)	Panchet Rocks, Raniganj Coalfield, Bengal.
11. <i>Gonioglyptus hexleyi</i> Lydekker (25)	do	do
12. <i>Gonioglyptus</i> ? sp (25)	do	do

II—LIST OF FOSSIL AMPHIBIANS—*Contd.*

Species	Geological Horizon	Locality
13. <i>Gonioglyptus</i> sp (17) Genus <i>Glyptognathus</i> Lydekker (25)	Lower Triassic	Prionolobus beds, Salt Range, Punjab.
14. <i>Glyptognathus fragilis</i> Lydekker (25) Family METOPOSAURIDAE Genus <i>Metoposaurus</i>	Lower Triassic (Middle Gondwana)	Panchet Rocks, Raniganj Coalfield, Bengal.
15. <i>Metoposaurus maleriensis</i> Roy-Chowdhuri (45)	Upper Triassic (Middle Gondwana, Maleri formation)	Achlapur, Pranhita Godavari Valley, Andhra Pradesh.
16. <i>Metoposaurus</i> sp (18) Family BRACHYOPIDAE Genus <i>Brachyops</i> Owen (37)	do	Maleri, Andhra Pradesh.
17. <i>Brachyops laticeps</i> Owen (37)	Lower Triassic (Middle Gondwana)	Near Mangli, c. 80 km. south of Nagpur and c. 56 km. N. W. of Chanda, Maharashtra.
18. ? <i>Brachyops</i> sp (41) Genus <i>Indobrachyops</i> Huene & Sahni (19)	Permo-Triassic	Raniganj Coalfield, Bengal.
19. <i>Indobrachyops panchetensis</i> Huene & Sahni (19)	Lower Trias (Upper Panchets)	Panchet Rocks, Raniganj Coalfield, Bengal.

II—LIST OF FOSSIL AMPHIBIANS—*Contd.*

Species	Geological Horizon	Locality
Genus <i>Pachygonia</i> Huxley		
20. <i>Pachygonia incurvata</i> Huxley (21)	Lower Triassic (Middle Gondwana)	Panchet Rocks, Raniganj Coalfield near Raniganj, Bengal
21. do (29)	Lower Triassic (Middle Gondwana)	Maleri, Andhra Pradesh.
22. <i>Pachygonia ? incurvata</i> Huxley (25)	Lower Triassic-Upper Jurassic (Gondwana, Kota- Maleri Group)	do
Superorder SALIENTIA		
Order ANURA		
Suborder PROCOELA		
Genus <i>Bufo</i> Laurenti		
23. <i>Bufo</i> cf. <i>melanostictus</i> Schneider (30)	Pleistocene (Cave deposits)	Kurnool, Andhra Pradesh.
24. <i>Bufo</i> sp (12)	Post-Pleistocene	Billa-Surgam, Andhra Pradesh.
Genus <i>Indobatrachus</i> Noble (33)		
25. <i>Indobatrachus pusillus</i> (Owen) (36)	Eocene	Bombay, Maharashtra.
26. <i>Indobatrachus trivalis</i> Chiplonker (7)	Lower Eocene	Worli Hill, Bombay, Maharashtra.
27. <i>Indobatrachus malabaricus</i> Verma (54)	Eocene (Intertrappean beds)	Malabar Hill, Bombay, Maharashtra.

II—LIST OF FOSSIL AMPHIBIANS—*Contd.*

Speices	Geological Horizon	Locality
Suborder <i>DIPLASIOCOELA</i>		
Family RANIDAE		
Genus <i>Rana</i> Linnaeus		
28. <i>Rana</i> sp (12)	Post Pleistocene	Billa-Surgam, Andhra Pradesh.
Some undetermined Labyrinthodont remains :		
(a) Right lateral thoracic plate and vertebrae (11)	Lower Triassic (Middle Gondwana)	Panchet Rocks, Raniganj Coalfield, Bengal.
(b) Greater part of the right ramous of mandible (24)	do	do
(c) Skull of Labyrinthodont (52)	do	do
(d) Lower jaw (symphysis) (25)	do	do
(e) Humerus (52)	do	do
(f) Disarticulated bones (52)	do	do
(g) Limb bones (43)	do	do
(h) Maxilla (29)	Upper Triassic (Middle Gondwana, Denwa Group).	Dinwa River, Satpura, Madhya Pradesh.
(i) Fragment of mandible (43)	Upper Triassic-Middle Jurassic (Gondwana, Kota- Maleri Group).	Andhra Pradesh.
(j) Vertebrae (25).	Upper Triassic (Middle Gondwana, Maleri Group).	do

III—BIBLIOGRAPHY

(References marked with an asterisk are not seen in original)

1. AIYENGER, N. K. N. and VENKATARAM, M. S. 1940. Classification of the Gondwana system based on vertebrate faunal evidence. *Rec. geol. Surv. India*, **75** (Professional paper No.7) : 1-14.
2. BLANFORD, W. T. 1876. Note on the geological age of certain groups comprised in the Gondwana series of India and on the evidence they afford of distinct zoological and botanical terrestrial regions in ancient epochs. *Rec. geol. Surv. India*, **9** : 79-85.
3. BLANFORD, W. T. 1878. The Palaeontological relations of the Gondwana system : a reply to Dr. Feistmantel. *Rec. geol. Surv. India*, **11** (1) : 104-150.
4. BLANFORD, W. T. 1885. Homotaxis, as illustrated from Indian formations. *Rec. geol. Surv. India*, **18** (1) : 32-57.
5. BROOM, R. 1915. On the Triassic Stegocephalians *Brachyops*, *Bothriceps* and *Lydekkeriana* gen. nov. *Proc. zool. Soc. Lond.*, 1915 : 363-368.
6. COTTER, G. de P. 1918. A revised classification of the Gondwana system. *Rec. geol. Surv. India*, **48** (1) [1917] : 23-33.
7. CHIPLONKER, G. W. 1940. A new species of fossil frog from the intertrappean beds of Worli Hill, Bombay. *J. Bombay nat. Hist. Soc.*, **41** (4) : 799-804.
8. DAS GUPTA, H. C. 1928. Palaeontological notes on the Panchet beds at Deoli, near Asansol. *J. Asiat. Soc. Beng.*, **22** [1927] : 215-217.
9. DAS GUPTA, H. C. 1929. Batrachian and reptilian remains found in the Panchet beds at Deoli, Bengal. *J. Asiat. Soc. Beng.*, **24** (4) : 473-479.
10. EFREMOV, J. A. 1960. The Gondwana system of India and the Vertebrate life history in the late Palaeozoic. *J. palaeont. Soc. India*, **2** (1957) : 24-28.
11. FEISTMANTEL, O. 1877. Note on *Estheria* in the Gondwana formation. *Rec. geol. Surv. India*, **10** (1) : 26-30.
12. FOOTE, R. B. 1884. Mr. H. B. Foote's work at the Billa Surgam Caves. *Rec. geol. Surv. India*, **17** (4) : 200-208.
13. FOOTE, R. B. 1885. Notes on the result of Mr. H. B. Foote's further excavations in the Billa Surgam Caves. *Rec. geol. Surv. India*, **18** (4) : 227-235.
14. FOX, C. S. 1931. The Gondwana System and related formations. *Mem. geol. Surv. India*, **58** : 1-241.
15. GEE, E. R. 1930. New fossil localities within the Panchet series of the Raniganj Coal field. *Rec. geol. Surv. India*, **63** (2) : 205-207.
16. HISLOP, REV. S. 1861. On the age of the fossiliferous thin-bedded sand stone and coal of the province of Nagpur, India. *Quart. J. geol. Soc. Lond.*, **17** (1) : 346-354.

- *17. HUENE, F. von. 1920. *Gonioglyptus* ein altriassischer stegocephale aus Indian. *Acta. zool.*, **1** : 451-459.
- 18. HUENE, F. von. 1940. The tetrapod fauna of the Upper Triassic Maleri beds. *Mem. geol. Surv. India, Palaeont. indica*. N. S., **32** (1) : 1—42.
- *19. HUENE, F. von. and SAHNI, M. R. 1958. *Indobrachyops panche-tensis* gen et. sp. nov. from the Upper Panchets (Lower Trias) of Raniganj Coalfield. *Monogr. Palaeont. Soc. India*, No. 2 : 1-14.
- 20. HUXLEY, T. H. 1861. Observations on some reptilian remains from North Western Bengal. *Quart. J. geol. Soc.*, **17** (1) : 362.
 Abstract : 1. Huxley, T. H. 1862. Reptilian-Reste aus dem NW. Bengalen. *Neu. Jahrb. F. Min.*, 1862 : 633.
 *2. *Geologist*, **4** : 209.
 *3. *Phil. Mag.*, Ser. 4, **21** : 537.
- 21. HUXLEY, T. H. 1865. Vertebrate fossils from the Panchet rocks, Raniganj, Bengal. *Mem. geol. Surv. India, Palaeont. indica*, Ser. 4, **1** (1) : 2-24.
- 22. LYDEKKER, R. 1877. Notices of new and other vertebrata from Indian Tertiary and Secondary rocks. *Rec. geol. Surv. India*, **10** : 30-43.
- 23. LYDEKKER, R. 1879. Indian Pre-Tertiary Vertebrata.—Reptilia and Batrachia (Amphibia). *Mem. geol. Surv. India, Palaeont. indica*, Ser. 4, **1** (3) : 1-36.
- 24. LYDEKKER, R. 1881. Note on some Gondwana vertebrates. *Rec. geol. Surv. India*, **14** (2) : 174-178.
 Abstract : *1. *Neu. Jahrb. f. Min.*, 1879 : 977-981.
- 25. LYDEKKER, R. 1882. On some Gondwana Labyrinthodonts. *Rec. geol. Surv. India*, **15** (1) : 24-28.
- 26. LYDEKKER, R. 1883a. Synopsis of the fossil Vertebrata of India. *Rec. geol. Surv. India*, **16** (2) : 61-93.
- 27. LYDEKKER, R. 1883b. Notes on the Bijori Labyrinthodont. *Rec. geol. Surv. India*, **16** (2) : 93-94.
- 28. LYDEKKER, R. 1885a. The labyrinthodont from the Bijori Group. *Mem. geol. Surv. India, Palaeont. indica*, Ser. 4, **1** (4), : 1-16.
 Abstract : *1. *Ann. Mag. nat. Hist.* 1888, ser. 5, **16** : 72-73.
 *2. *Neu. Jahrb. f. Min.*, 1886, **2** : 292-293.
 *3. *Geol. Mag.*, Dec. 3, **2** : 370-371.
- 29. LYDEKKER, R. 1885b. The Reptilia and Amphibia of Maleri and Denwa groups. *Mem. geol. Surv. India, Palaeont. indica*, Ser. 4, **1** (5) : 1-38.
 Abstract : *1. *Ann. Mag. nat. Hist.*, (5) **17** : 532-534.
- 30. LYDEKKER, R. 1886. Indian Tertiary and post Tertiary Vertebrata. The Fauna of the Karnul Caves. *Mem. geol. Surv. India, Palaeont. indica*, Ser. 10, **4** (2) : 23-58.

31. LYDEKKER, R. 1887. The fossil Vertebrata of India. *Rec. geol. Surv. India*, **20** (2) : 51-79.
32. LYDEKKER, R. 1890. *Catalogue of the fossil Reptilia and Amphibia*. Brit. Mus. Nat. Hist., Part 4, xxiii+295+8 pp., illus. London (Trustees Brit. Mus.)
33. NOBLE, G. K. 1930. The fossil frogs of the Inter-trappean beds of Bombay. *Amer. Mus. Novit.*, **401** : 1-13.
34. OLDHAM, T. 1871. Sketch of the geology of the Central Provinces. *Rec. geol. Surv. India*, **4** (3) : 69-81.
35. OLDHAM, R. D. 1859. Fossil fish-teeth of genus *Ceratodus* from Maledi, south of Nagpur, *Mem. geol. Surv. India, Palaeont. indica*, **1** (3) : 295-309.
36. OWEN R. 1847. On the Batracholites indicative of a small species of frog (*Rana pussila*, OW.). Addendum to the communication from G. T. Clark, Esq., Bombay. *Quart. geol. soc.*, **3** (1) : 224-225.

Abstract : 1. Owen, R. 1849. Über einen Batracholithen, *Rana pusilla* OW. *Neue. Jahrb. F. Min.*, 1849 : 244.

*2. *Bibl. Univ.*, Ser. 4, **6** : 67-68.

37. OWEN, R. 1854. Description of the cranium of a Labyrinthodont Reptile (*Brachyops laticeps*) from Mangali, Central India. *Quart. J. geol. Soc.*, **10** (1) : 473-474 ; **11** (1) : 37-39.

Abstract : *1. *Neu. Jahrb. f. Min.*, 1855 : 254.

38. RANDHAWA, M. S. 1952. Life in the Carboniferous period. The coal age. The age of Amphibia and Hycopods. *J. Sci. Industr. Res.*, (A), **11** (10) : 452-462.
39. RIBEIRO, J. 1921. The geology of Worli Hills. *J. Bombay nat. Hist. Soc.*, **27** (4) : 582-595.
40. ROBINSON, P. L. 1958. Some new vertebrate fossils from the Panchet series of West Bengal. *Nature*, **182**, No. 4651 : 1722-1723.
41. ROY, B. C. 1961. General report of the Geological Survey of India for the year 1955. *Rec. geol. Surv. India*, **89** (1) : 1-340.
42. ROY, B. C. 1962a. General report of the Geological Survey of India for the year 1956. *Rec. geol. Surv. India*, **91** (1) : 1-269.
43. ROY, B. C. 1962b. General report of the Geological Survey of India for the year 1957. *Rec. geol. Surv. India*, **92** (1) : 1-185.
44. ROY, B. C. 1962c. General report of the Geological Survey of India for the year 1958. *Rec. geol. Surv. India*, **93** (1) : 1-119.
45. ROY Chaudhuri, T. 1965. A new metoposaurid Amphibian from the Upper Triassic Maleri formation of Central India. *Phil. Trans. Roy. Soc. Lond.*, Ser. B, **250**, No. 761 : 1-52.
46. STOLICZKA, F. 1869. Osteological notes an *Oxyglossus pusillus* (*Rana pusilla*, owen), from the Tertiary frog-beds in the Island of Bombay. *Mem. geol. Surv. India, Palaeont indica*. **6** : 387-394.

47. SWINTON, W. E. 1962. *Fossil Amphibians and Reptiles*. 3rd. ed. 117 pp., illus. London (Trustees Brit. Mus.).
48. TEWARI, A. P. 1960. Note on a new species of *Archegosaurus* from the lower Gondwanas by Risin Spur (Kashmir). *Curr. Sci.*, **29** : 144-145.
49. TEWARI, A. P. 1962. A new species of *Archegosaurus* from the Lower Gondwana of Kashmir. *Rec. geol. Surv. India*, **89** : 427-434.
50. TRIPATHI, C. 1962. *Rhinesuchus wadai* sp. nov., a new labyrinthodont from Vindya Pradesh. *Rec. geol. Surv. India*, **89** (2) : 399-406.
51. TRIPATHI, C. and Puri, S. N. 1962. On the remains of *Lystrosaurus* from the Panchets of the Raniganj Coal-field. *Rec. geol. Surv. India*, **89** (2) : 407-426.
52. TRIPATHI, C. and Satsangi, P. P. 1963. *Lystrosaurus* fauna of the Panchet series of the Raniganj Coalfield. *Mem. geol. Surv. India, Palaeont. indica*, N. s., **37** : 1-53.
53. *TRIPATHI, C. and Satsangi, P. P. (in press). Fossil Labyrinthodonts from the Panchet Series of the Raniganj Coalfield. *Mem. geol. Surv. India, Palaeont. indica*, N. s., **38**.
54. VERMA, K.K. 1965. Note on a new specis of fossil frog from the Inter-trappean bed of Malabar Hill, Bombay. *Curr. Sci.*, **34** (6) : 182-183.
55. WADIA, D. N. and Swinton, W. E. 1929. *Actinodon risinensis*, n. sp., in the lower Gondwanas of Vihi district, Kashmir. *Rec. geol. Surv. India.*, **61** (1) [1928] : 141-145.
56. WAAGEN, W. 1878. On the geographical distribution of fossil organisms in India. *Rec. geol. Surv. India*, **11** (4) : 267-301.
57. WAAGEN, W. 1888. The "Carboniferous glacial period" translated by R. Bruce Foote. *Rec. geol. Surv. India*, **21** (3) : 89-130.
58. WOODWARD, A. S. 1905. Fishes and Labyrinthodonts (*in* Permo-Carboniferous plants and vertebrates from Kashmir, by A. C. Seward and A. S. Woodward, 13 pp. pls. 8-10) *Mem. geol. Surv. India, Palaeont. indica*, N. s., **2** (2), : 10-13.

Abstract : *1. *Geol. Mag.*, Dec. 5, **3** : 272-273.

*2. *Nature*, **72** : 539.

*3. *Geol. Centralbl.*, **9** : 731.

*4. *Neu. Jahrb. f. Min.*, 1910, **2** : 484.

59. WYNNE, A. B. 1866. On the geology of the Island of Bombay. *Mem. geol. Surv. India, Palaeont. indica*. **5** : 173-225.
60. WYNNE, A. B. 1869. On the occurrence of frog-beds at a locality hitherto concealed, but exposed now by reclamation works in Bombay Island, December, 1867. *Mem. geol. Surv. India, Palaeont. indica*. **6** : 385-386.

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VI—SUMMARY

All the known Indian fossil amphibian species together with some unidentified material as reported in literature have been listed. Under the bibliography 60 references, mainly dealing with Indian fossil amphibians, are given.

SYSTEMATIC STATUS AND IDENTITY OF *OTOLITHUS*
VOGLERI BLEEKER, 1853 (PISCES : SCIAENIDAE)

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(With 1 Text-figure)

INTRODUCTION

During a study on the sciaenid fishes of the Hooghly estuary (north-east coast of India), several specimens referable to *Otolithus vogleri* Bleeker, 1853 and *Corvina sina* Cuvier, 1830 were collected. A study of the pertinent literature, however, indicates that considerable confusion exists about the status and identity of the former species.

Bleeker (1853) described *Otolithus vogleri* for the first time from Sumatra. This species was subsequently reported from other parts of the Indo-west Pacific (Day, 1876 ; Seale, 1910 ; Zugmayer, 1913 ; Fowler, 1931 ; Hardenberg, 1931) and the Western Indian Ocean (Norman, 1922 ; Barnard, 1927). Day (1876) described and figured both *Sciaena vogleri* (Bleeker) and *Sciaena sina* (Cuvier) from Indian waters. Barnard (1927) gave a description of *Otolithus vogleri* Bleeker from Delagoa Bay (South Africa) and then commented that "From Day's (*Fish. Ind.*, p. 186) descriptions of the two species it is difficult to find any specific differences, though the figure of *sina* shows a rather more prominent or inflated snout" but refrained from combining the two species. Fowler (1933) while describing *Johnius sina* (Cuvier) relegated *Otolithus vogleri* Bleeker to the synonymy of this species and this synonymisation was followed by subsequent workers (Weber & de Beaufort, 1936 ; Herre, 1953 ; Smith, 1953). Matsubara (1937) erroneously treated *Corvina sina* Cuvier, 1830 as a synonym of *Nibea argentata* (Houttuyn, 1782) ; the species has, however, been shown to be even generically distinct (*vide* Chu, Lo & Wu, 1963).

A study of the available material (including Days' (1876) figured examples) of both *vogleri* Bleeker and *sina* Cuvier, however, indicates that both these species are congeneric but specifically distinct. We are in agreement with Chu, Lo & Wu (1963) in their treatment of *sina* Cuvier under the genus *Wak* Lin, 1938. Dutt & Thankam (1968) erroneously treated *sina* Cuvier under *Nibea* Jordan & Thompson though this species has a hammer-shaped otolithine gas-bladder. Descriptions of both these species are given below to facilitate comparison.

SYSTEMATIC ACCOUNT

a. *Wak vogleri* (Bleeker, 1853)

1853. *Otolithus vogleri* Bleeker, *Nat. Tijdschr. Nederland Indie*, 4 : 253, (type loc : Sumatra).
 1860. *Sciaena vogleri* : Günther, *Cat. Fish. Brit. Mus.*, 2 : 294.
 1876. *Sciaena vogleri* : Day, *Fish. India* : 186, pl. 45, fig. 1.
 1877. *Otolithes vogleri* : Bleeker, *Atl. Ichth.*, 9 : pl. 386, fig. 4.
 1908. *Sciaena parva* Gilchrist & Thompson, *Ann. S. African Mus.*, 6 : 183 (South Head Tugela River).
 1922. *Sciaena marleyi* Norman, *Ann. Mag. nat. Hist.*, (9) 9 : 319, (Natal).
 1927. *Sciaena vogleri* : Barnard, *Ann. S. African Mus.*, 21 : 571.
 1933. *Johnius sina* Fowler (nec. Cuvier) (partim), *Bull. U. S. natn. Mus.*, 100, 12 : 388.
 1936. *Pseudosciaena sina* : Weber & de Beaufort, *Fishes Indo-Australian Archipelago*, 7 : 513.
 1948. *Sciaena sina* : Pillay, *J. Bombay nat. Hist. Soc.*, 48 (1) : 53.
 1953. *Johnius sina* : Smith, *Sea fishes of Southern Africa* : 226.
 1955. *Johnius sina* : Munro (partim), *Marine and Freshwater Fishes Ceylon* : 155.
 1959. *Pseudosciaena sina* : Misra (partim). *Rec. Indian Mus.*, 57 : 268.
 1961. *Pseudosciaena sina* : Khalaf, *Marine and Freshwater Fishes Iraq* : 96.
 1963. *Wak sina* : Chu, Lo & Wu, *Fish. China* : 32, fig. 17.
 1968. *Nibea sina* : Dutt & Thankam (partim), *J. Bombay nat. Hist. Soc.*, 65 (2) : 341.

D X.1+26 - 29 ; A 11+7 ; P 17-19 ; L.l. 46-51 ; L.tr. 5-6/11-13 ; G.R. 5-6+10-12.

Depth of body 30.1-33.7, length of head 31.4-34.4, eye diameter 8.8-11.3, length of snout 8.7-11.7, interorbital width 7.4-9.0, post-orbital distance 15.3-17.8, length of lower jaw 10.2-12.7, length of maxilla 13.9-15.5, length of pectoral fin 22.3-25.8, length of pelvic fin 19.7-22.6, base of second dorsal fin 36.0-41.7, base of anal fin 8.7-11.7, length of second anal spine 9.2-12.8, depth of caudal peduncle 9.6-12.3 ; all in percentage of standard length.

Body oblong, not much compressed. Bones of head normal. Snout bluntly pointed, rostral flap slightly lobed. Mouth terminal, oblique ; maxilla extends to the middle of eye. Preopercle crenulate. Pores—snout with three pores on top and a large median pore at the free edge of skin. Five pores on mandibular symphysis, the median pore with two distinct pits ('False five-pored' form). Teeth—villiform, outer row of upper and inner row of lower jaw enlarged, not as canines. Scales—on head cycloid, on body ctenoid ; base of soft dorsal scaly. Fins—dorsal spines moderate, 3rd and 4th longest. Anal originates opposite 11th-12th dorsal ray ; second anal spine moderate, half as long as first ray. Caudal wedge-shaped.

Gas-bladder.—Hammer-shaped otolithine form with 15 pairs of arborescent diverticula. Sonific muscles present in males only. Colour in alcohol—greyish or brownish above, silvery below. Spinous dorsal blackish, soft dorsal and caudal grey. A blackish spot present on pectoral axil. Opercle with a diffuse blotch.

Distribution.—South Africa, Iraq, India, Ceylon, the East Indies and China.

Material Examined.—

990. 1ex., 210 mm. SL. ; Bombay ; Dr. F. Day (Original of pl. 44, fig. 2).

F 6146/2. 4exs, 70-104 mm. S. L. ; Hooghly ; Dr. Bhusari.

F 6147/2. 1ex., 113 mm. S. L. ; Diamond Harbour ; 16.i.69 ; A. Joglekar.

F 6148/2. 4exs, 89-136 mm S. L. ; Port Canning ; March '69 ; A. Joglekar.

F 6149/2. 4exs, 91-97 mm. S. L. ; Diamond Harbour ; March '69 ; A. Joglekar.

b. *Wak sina* (Cuvier, 1830)

1830. *Corvina sina* Cuvier, *Hist. nat. Poiss.*, 5 : 122, (type loc : Pondicherry, Malabar, Japan).

1860. *Sciaena sina* : Günther, *Cat. Fish. Brit. Mus.*, 2 : 292.

1865. *Sciaena sina* : Day (nec. Day, 1876), *Fish. Malabar* : 52.

1925. *Johnius sina* : Fowler, *Proc. : Acad. natn. Sci. Philad.* : 247.

1933. *Johnius sina* : Fowler (*partim*), *Bull. U. S. natn. Mus.*, 100, 12 : 388.

1955. *Johnius sina* : Munro (*partim*), *Marine and Freshwater Fishes Ceylon* : 155.

1959. *Pseudosciaena sina* : Misra (*partim*), *Rec. Indian Mus.*, 57 : 268.

1968. *Nibea sina* : Dutt & Thankam (*partim*), *J. Bombay. nat. Hist. Soc.*, 62 (2) : 241.

D X .1+28-30 ; A 11+7 ; P 15-17 ; L. l. 48-50 ; L tr. 5-6/9-11 ; G.R. 7-8+16-18.

Depth of body 29.0-32.8, length of head 29.4-32.0, diameter of eye 8.8-10.7, length of snout 7.0-8.3, interorbital width 8.0-9.3, postorbital distance 14.9-16.6, length of lower jaw 10.7-12.9, length of maxilla 14.5-16.4, length of pectoral fin 21.0-24.3, length of pelvic fin 18.2-22.3, base of second dorsal fin 37.6-43.9, base of anal fin 9.6-11.4, length of second anal spine 10.2-12.7, depth of caudal peduncle 7.5-10.4, all in percentages of standard length.

Body oblong, well compressed posteriorly. Bones of head cavernous. Snout blunt, rounded, rostral flap slightly lobed. Mouth terminal, oblique ; maxilla extends to posterior end of pupil. Preopercle denticulate. Pores—no pores on snout ; three pairs on mandibular symphysis, anterior pair most inconspicuous. Teeth-villiform, outer row of upper jaw and inner row of lower jaw enlarged but not as canines. Scales—on head cycloid, on body ctenoid. Fins—dorsal spines weak, 4th longest. Anal originates opposite 13th to 15th dorsal ray ; second anal spine moderate, more than 1/2 length of first ray. Caudal wedge—shaped.

Gas-bladder.—Hammer-shaped otolithine form with 12 pairs of arborescent diverticula. Sonific muscles present in males, absent in females.

Colour in alcohol.—Greyish on back and sides, silvery below. Spinous dorsal dusky, other fins except pelvics grey. Opercle with a diffuse blotch.

Distribution.—South Africa, India, Ceylon, the Philippines and Japan.

Material examined.—

F 6140/2. 2 exs, 93-96 mm. S. L. ; Port Canning ; 10.iii.69 ; *A. Joglekar*.

F 6141/2. 10 exs, 105-113 mm. S. L. ; Diamond Harbour ; 17.iii.69 ; *A. Joglekar*.

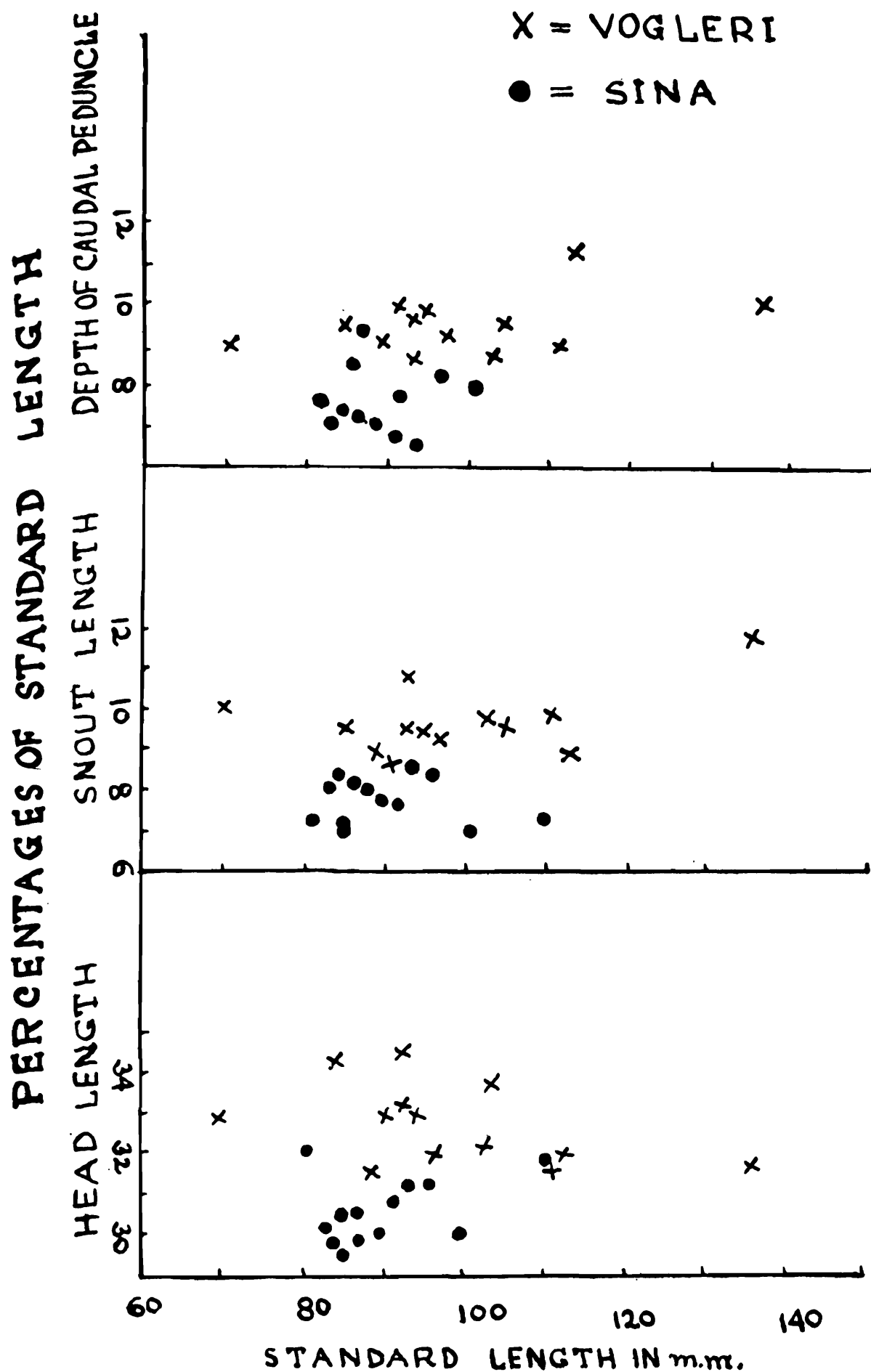
F 6142/2. 1 ex, 110 mm. S. L. ; Sunderbans ; *B. S. Bhimachar*.

DISCUSSION

As stated earlier, Day (1876) described and figured both *Sciaena sina* (Cuvier) and *Sciaena vogleri* (Bleeker). Both these species were considered identical by Fowler (1933), Weber & de Beaufort (1936), Munro (1955), Misra (1959) and Chu *et al.* (1963). Fortunately, Day's (1876) figured examples corresponding to pl. 44, fig. 2 and pl. 45, fig. 1 of both the species are available in the Zoological Survey of India, for study.

Day's *sina* (Reg. No. 972) may easily be distinguished from his *vogleri* (Reg. No. 990) in having a prominent snout and a ventral mouth (vs. terminal). The sharpest distinction, however, apparently lies in the lesser number of gill-rakers (4+8 vs. 6+12). Day's *vogleri* agrees well with the original description (Bleeker, 1853) and figure (Bleeker, 1877) of the species. It is, however, doubtful whether Day's (l.c.) description of *sina* applies to the true *sina*. Day's figured example of *sina* has five conspicuous mandibular pores and its snout margin is deeply lobed. Besides these, there are several other points of differences between his description and Cuvier's (1830) original description of the species. The identity of Day's *sina* is being studied.

The specimens of *sina* and *vogleri* from the Hooghly estuary agree well with Cuvier's (1830) and Bleeker's (1853) descriptions of the two species respectively. *Wak vogleri* (Bleeker) may be distinguished from *Wak sina* (Cuvier) by the following characters : pores on snout (present vs. absent) ; number of mandibular pores (5 vs. 6) ; nature of head bones (normal vs. cavernous) and lesser number of gill rakers (5-6+10-12 vs. 7-8+16-18). The percentage of several body measurements plotted against standard length (text-fig. I) also indicate notable differences between the two species. We, therefore, conclude that *Wak vogleri* (Bleeker) is specifically distinct from *Wak sina* (Cuvier). The gill-raker counts given by Fowler (1933), Munro (1955), Misra (1959) and Dutt & Thankam (1968) clearly indicate that they were dealing with a composite sample of both these species,



TEXT-FIG. 1.—Percentages of body measurements on Standard length in *Wak vogleri* (Bleeker) and *Wak sina* (Cuvier).

ACKNOWLEDGEMENTS

The authors are grateful to Dr. A. P. Kapur, Director, Zoological Survey of India for encouragement and to Dr. A. G. K. Menon, Superintending Zoologist, Zoological Survey of India, Calcutta for his sustained help and for going through the manuscript critically.

SUMMARY

Considerable confusion exists about the status and identity of *Otolithes vogleri* Bleeker, 1853 originally described from the East Indies. Fowler (1933) relegated this species to the synonymy of *Corvina sina* Cuvier, 1830 and this synonymisation was followed by subsequent workers (Weber & de Beaufort, 1936 ; Herre, 1953 ; Smith, 1953).

A study of the material collected from the Hooghly estuary, Day's (1876) figured specimens of *vogleri* and *sina* and the pertinent literature, however, indicates that both these species are congeneric but specifically distinct. The generic relationship, synonymy and descriptions of both these species are given in this paper.

REFERENCES

- BARNARD, K. H. 1927. A monograph of the marine fishes of South Africa. *Ann. S. African Mus.*, **21** (pt. 1) : 1-1065.
- BLEEKER, P. 1853. *Nat. Tijdschr Nederland Indie*, **4** : 243-302.,
———, 1877. *Atlas Ichthyologique des Indes Orientales Néerlandaises*, **9**, pl. 386, fig. 4.
- CHU, Y. T., Y. L. LO & H. L. WU. 1963. *A study of the classification of sciaenoid fishes of China, with description of new genera and species*. Shanghai Fisheries Institute, i-ii, 1-100, 37 pls.
- CUVIER, G. 1830. In Cuvier & Valenciennes, *Histoire naturelle des Poissons*. **5** : 499 pp.
- DAY, F. 1875-1878. *The Fishes of India*. Williams & Norgate, London. 778 pp.
- DUTT, S & THANKAM, V. 1968. The Sciaenidae of the coastal waters of Visakhapatnam. *J. Bombay nat. Hist. Soc.*, **65** (2) : 335-347.
- FOWLER, H. W. 1931. A small collection of fishes from Singapore. *Proc. Acad. natn. Sci., Philad.*, **83** : 446.
———, 1933. Contributions to the biology of the Philippine Archipelago and adjacent regions. *Bull. U. S. natn. Mus.*, **12** (100) : 1-465
- HARDENBERG, J. D. F. 1931. The fish fauna of Rokan mouth. : *Treubia*, **13** (1), : 87-168.
- HERRE, A. W. 1953. *Check List of Philippine fishes*. Fish & Wild life Service, Washington Res. Rep. **20** : 475-476.
- MATSUBARA, K. 1937. Sciaenoid fishes found in Japan and its adjacent waters. *J. imp. Fish. Inst.*, **32** (2) : 27-92.
- MISRA, K. S. 1959. An aid to the identification of the common commercial fishes of India and Pakistan. *Rec. Indian, Mus.*, **57** (1-4) : 1-318.

- MUNRO, I. S. R. 1955. *The marine and freshwater fishes of Ceylon*. Canberra. 349 pp, 56 pls.
- NORMAN, J. R. 1922. Three new fishes from Zululand and Natal collected by Mr. Bell-Marley with additions to fish fauna of Natal. *Ann. Mag. nat. Hist.*, 9 (9) : 318-321.
- SEALE, A. 1910. Fishes of Borneo, with descriptions of four new species. *Philippine J. Sci.*, 5 : 263-288.
- SMITH, J. L. B. 1953. *The sea fishes of Southern Africa*. Grahams-town. 564 pp, 103 pls.
- WEBER, M. & L. F. DE BEAUFORT. 1936. *The Fishes of the Indo-Australian Archipelago*. Leiden. 7 : XV+607 pp.
- ZUGMAYER, E. 1913. Die Fische Von Baluchistan. Mit cinseitendeu Bemerkugen uber die fauna des landes. *Abh. bayer. Akad. Wiss*, 26 (pt. 6) : 1-35.

COMPARISON OF THE POPULATIONS OF THE GIZZARD
SHAD, *ANODONTOSTOMA CHACUNDA* (HAMILTON)
(PISCES : CLUPEIDAE) FROM GODAVARI
AND HOOGHLY ESTUARIES

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(With 4 Text-figures and 5 Tables)

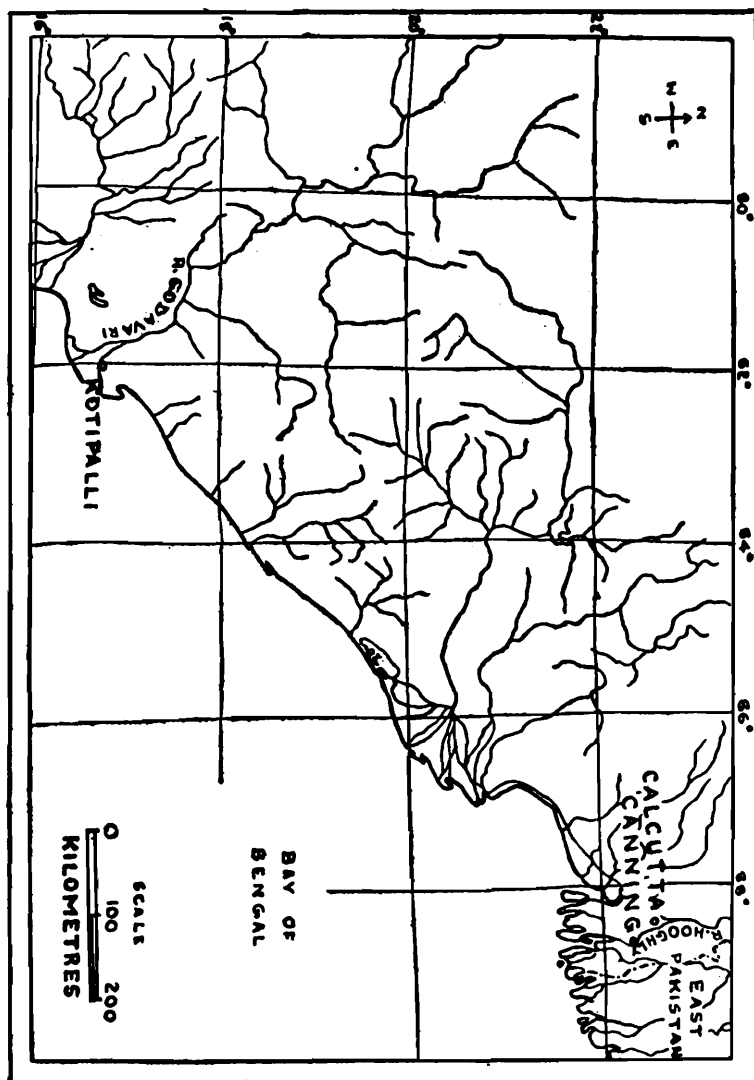
INTRODUCTION

Many clupeid and engraulid fishes which constitute the marine component of estuarine fauna are found to breed in the river mouth regions and ascend the rivers, in so far as the salinity is favourable for their survival, for feeding purposes (Babu Rao, 1964, 1965). Thus they complete their life cycles in their respective estuaries without making any large scale migrations in the sea. This has resulted in the establishment of local populations of these species in the particular environment in which they abound. Fishery biologists have distinguished the intraspecific populations by subjecting the biometric data (body measurements and meristic counts) to statistical analysis. In India, the different populations of *Hilsa ilisha* (Ham.) (Clupeidae) occurring in the various rivers and lakes were statistically shown to differ from one another in their body proportions and meristic counts (Pillay, 1952, 1957). Similarly the Godavari estuarine population of *Stolephorus commersonii* Lacépède (Engraulidae) is found to be significantly different from the Waltair coastal population in some of the morphometric and meristic characters (Babu Rao, 1965 b) and the two populations of *Setipinna godavariensis* Babu Rao (Engraulidae) from Godavari and Hooghly estuaries, situated at different latitudes and longitudes were also similarly shown to be distinct from one another (Babu Rao and Joglekar, 1968). It appears that the two estuaries have their distinct populations of species of fishes. Samples of *Anodontostoma chacunda* (Hamilton) (Clupeidae) collected from both the estuaries have been compared in morphometric and meristic characters to see whether they are drawn from the same stock or they belong to distinct populations.

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MATERIAL AND METHODS

Two samples of *Anodontostoma chacunda*, one in March, 1960 and the second in May, 1960 from the fishermen's catches near Kotipalli (latitude between 16° and 17° and longitude 82°) at Godavari estuary and one sample in November, 1966 from the fishermen's catches near Canning (latitude between 22° and 23° and longitude between 88° and 89°) at Hooghly estuary (Text-fig. 1) were obtained.



TEXT-FIG. 1.—Northeast coast of India showing Godavari and Hooghly estuaries.

The body measurements were taken in preserved condition. In all cases counts of rays were taken consistently only for the left pectoral fin.

Comparison of countable characters was done by applying the chi-square test (Bailey, 1959). Regression analysis, followed by 't' test (Goulden, 1939) was applied to compare the two populations in the body proportions.

OBSERVATIONS

Counts of pectoral fin rays, dorsal fin rays, anal fin rays, pre-ventral scutes and postventral scutes were taken for about 100 specimens from each locality (Table I). The following body measurements were taken for 70 specimens from each locality : total length, standard length, head length, body depth and eye diameter. The ranges of the body measurements are presented in Table II.

TABLE I.—Frequency distribution of the meristic characters of *Anodontostoma chacunda* from Godavari and Hooghly estuaries.

(A) *Pectoral fin rays*

Locality	14	15	16	17	n
Godavari	5	45	43	7	100
Hooghly	3	63	34		100

(B) *Dorsal fin rays*

Locality	16	17	18	19	20	21	22	n
Godavari			21	51	11	1		84
Hooghly	2	7	22	30	34	4	1	100

(C) *Anal fin rays*

Locality	16	17	18	19	20	21	22	23	n
Godavari			1	11	35	32	7	1	87
Hooghly	1	5	8	9	26	32	19		100

(D) *Preventral scutes*

Locality	16	17	18	n
Godavari	12	86	2	100
Hooghly	9	72	19	100

(E) *Postventral scutes*

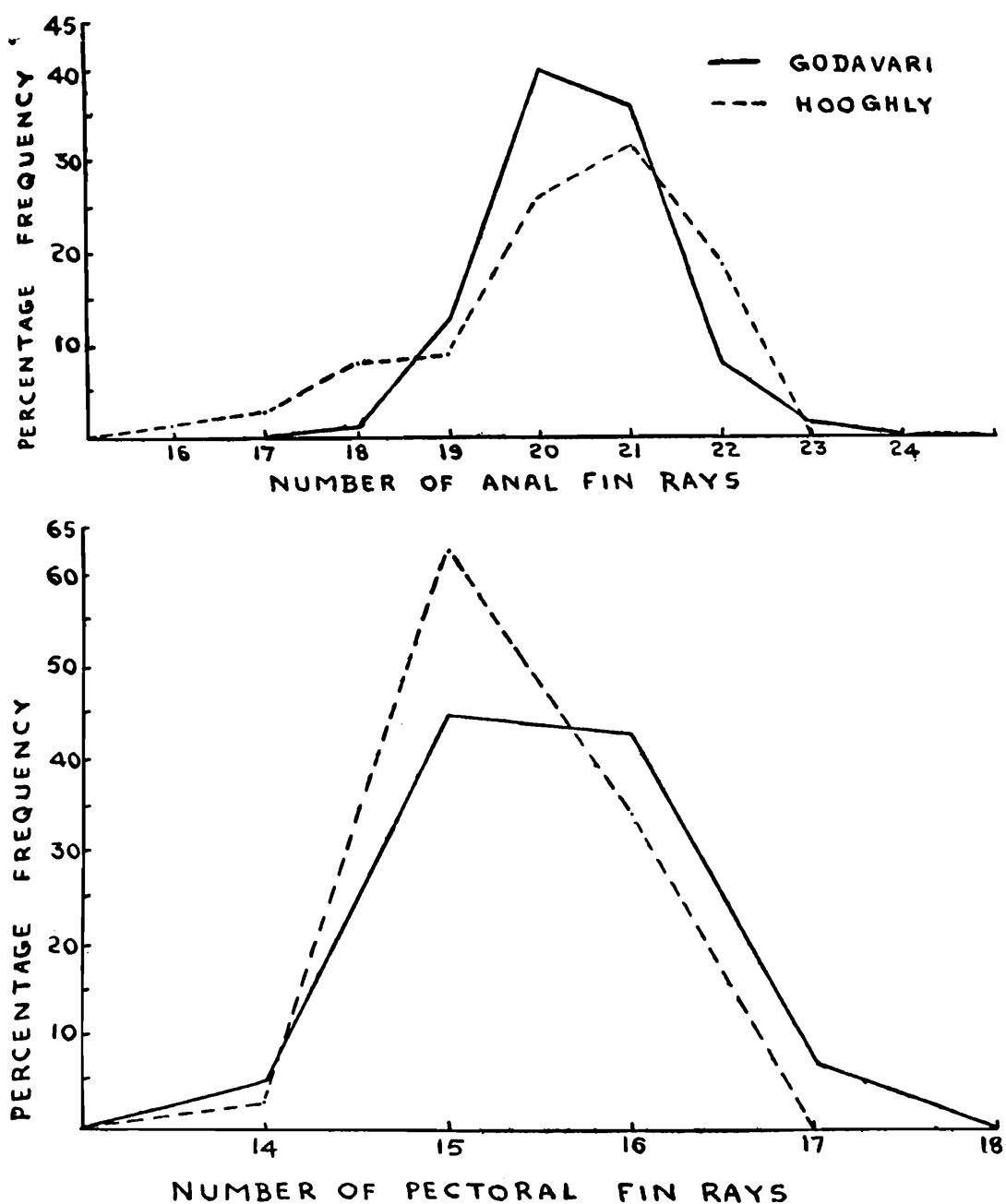
Locality	9	10	11	12	13	14	n
Godavari	1	6	60	33			100
Hooghly		19	62	14	3	2	100

TABLE II.—Ranges of the body measurements of *A. chacunda* from the two localities.

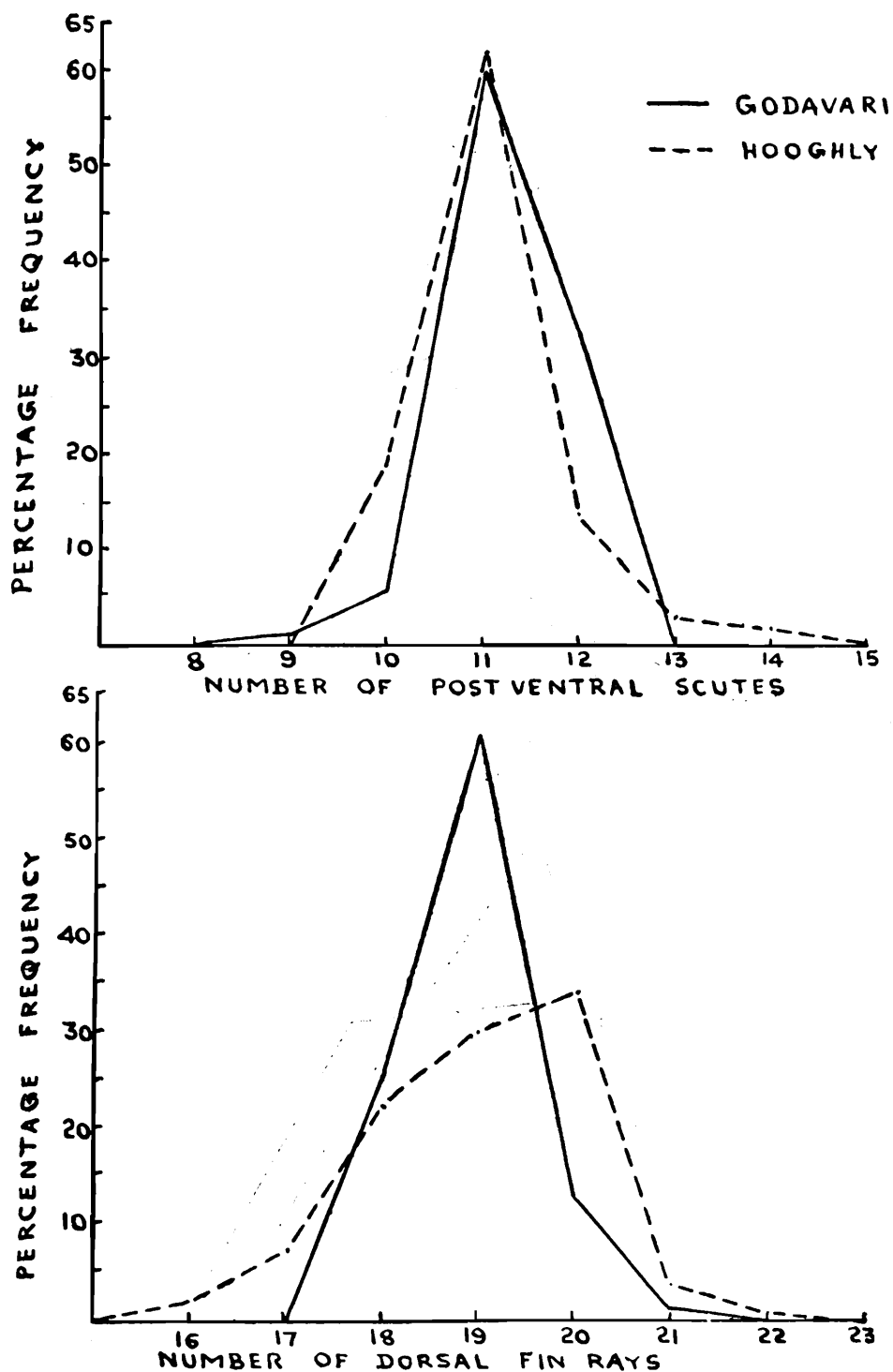
Body measurement	Godavari N—70	Hooghly N—70
1. Standard length	3.60 — 8.15 CM.	3.20 — 5.55 CM.
2. Head length	1.10 — 2.40 CM.	0.95 — 1.65 CM.
3. Depth of the body	1.25 — 3.35 CM.	1.00 — 2.40 CM.
4. Eye diameter	0.32 — 0.70 CM.	0.40 — 0.65 CM.

An application of chi-square test (Table III) for the frequencies of the meristic characters of the two localities, has shown that the two populations differ significantly from one another in the number of pectoral fin rays, dorsal fin rays, anal fin rays, and postventral scutes (Text-figs. 2 & 3). Regression coefficients and standard error of regression coefficients were obtained in the two populations for

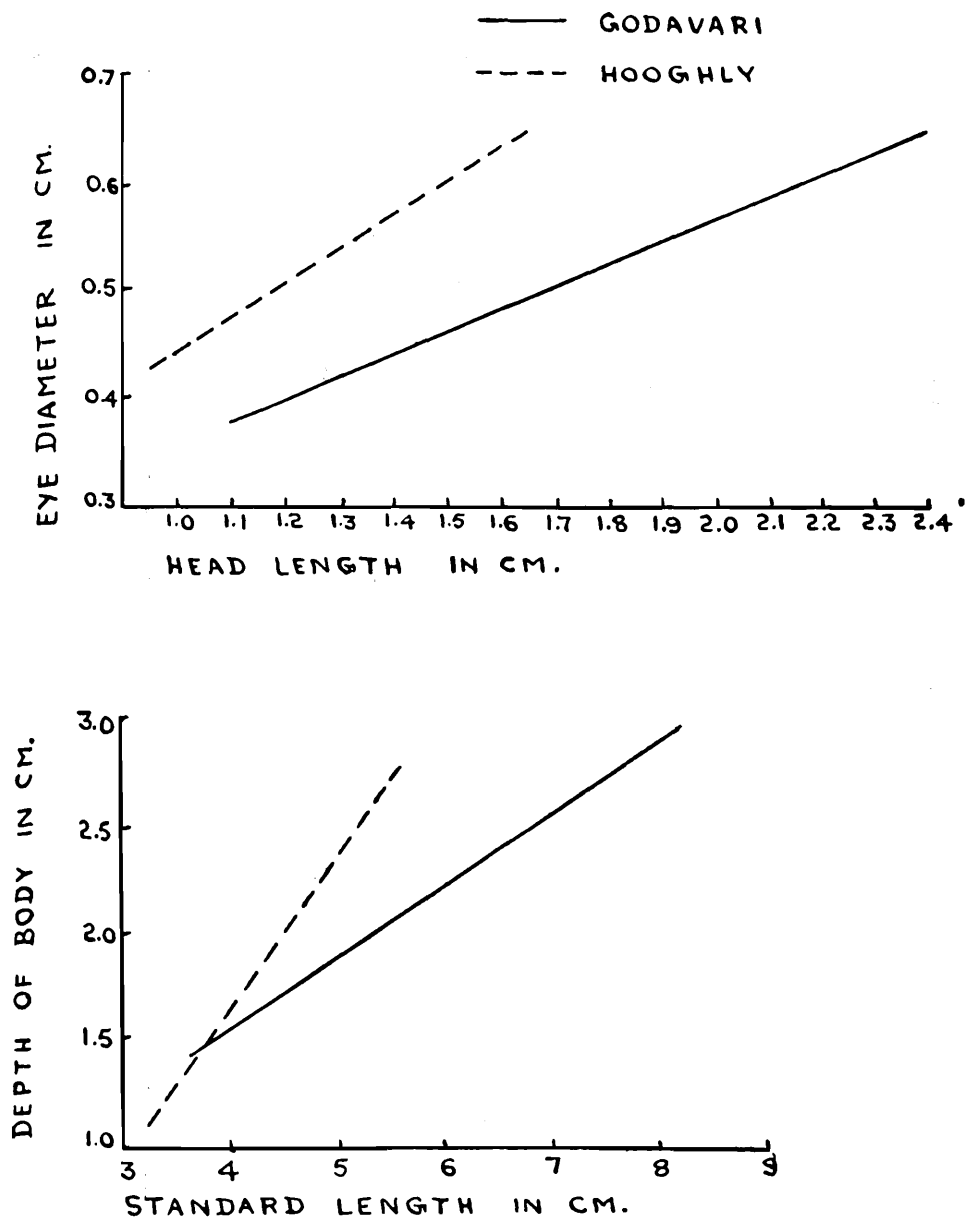
head length in relation to standard length, body depth in relation to standard length and eye diameter in relation to head length. When the difference in the regression coefficients is tested by means of 't' test (Table IV) it was found that the two populations differ significantly in body depth in relation to standard length and eye diameter in relation to head length (Text-fig. 4).



TEXT-FIG. 2.—Percentage frequency polygons of anal fin rays (upper graph) and pectoral fin rays (lower graph) of *A. chacunda* from Godavari (solid line) and Hooghly (broken lines) estuaries.



TEXT-FIG. 3.—Percentage frequency polygons of postventral scutes (upper graph) and dorsal fin rays (lower graph) of *A. chacunda* from Godavari (solid line) and Hooghly (broken line) estuaries.



TEXT-FIG. 4.—Regression lines of eye diameter on head length (upper graph) and depth of body on standard length (lower graph) in the *A. chacunda* populations from Godavari (Straight line) and Hooghly (broken line) estuaries.

TABLE III.—*Chi-square test applied to the meristic data of the samples from the two estuaries*

S. No.	Character	Obs. X^2	d.f.	P.	Significance	Remarks
1.	Pectoral fin rays	4.617	1	<0.05	Significant	Classes 14 and 15 and 16 and 17 are bracketed. 2×2 contingency table formula with Yate's correction is applied.
2.	Dorsal fin rays	20.424	2	<0.01	Significant	Classes 16 to 18 and 20 to 22 are bracketed.
3.	Anal fin rays	8.443	3	<0.05	Significant	Classes 16 to 19 and 22 and 23 are bracketed.
4.	Preventral Scutes	0.2123	1	>0.50	Not Significant	Classes 17 and 18 are bracketed. 2×2 contingency table formula with Yates' correction is applied.
5.	Postventral Scutes	9.234	2	<0.01	Significant	Classes 9 and 10 and 12 to 14 are bracketed.

TABLE IV.—Regression analysis of morphometric data of *A. chacunda* from Godavari and Hooghly estuaries .

Regression between	Godavari			Hooghly			Standard error of difference S ₁₋₂	t	P
	No. of Specimens	Regression Coefficient	Standard error of regression coefficient	No. of Specimens	Regression Coefficient	Standard error of regression coefficient			
	n ₁	b ₁	S ₁	n ₂	b ₂	S ₂			
1) Standard length and Head Length	70	0.20516	0.01875	70	0.22821	0.20240	0.20320	0.113	>0.50*
2) Standard length and Body depth	70	0.33993	0.03519	70	0.49915	0.02614	0.04382	3.364	<0.01**
3) Head length and Eye diameter	70	0.26969	0.00571	70	0.31825	0.02274	0.02345	2.071	<0.05**

* Not Significant ; ** Significant.

CONCLUSIONS

From the above biometric analysis it is clear that Godavari estuary population of *Anodontostoma chacunda* has a significantly higher number of pectoral fin rays and post-ventral scutes and significantly lower number of anal fin rays and dorsal fin rays than the Hooghly estuary population. The rate of growth of body depth in relation to standard length and the rate of growth of eye diameter in relation to head length are significantly higher in Hooghly estuary population than the Godavari estuary population. Out of the eight morphometric and meristic characters tested, the two populations are found to differ significantly from one another in six characters (Table V).

TABLE V.—Characters of *Anodontostoma chacunda* in which the two populations from Godavari and Hooghly estuaries are tested for homogeneity.

Sl. No.	Character	Significance
1.	Pectoral fin rays	Significant
2.	Dorsal fin rays	Significant
3.	Anal fin rays	Significant
4.	Preventral scutes	Not significant
5.	Postventral scutes	Significant
6.	Head length in standard length	Not significant
7.	Body depth in standard length	Significant
8.	Eye diameter in head length	Significant

It may be concluded that the two populations are drawn from different stocks. These and earlier studies (Babu Rao and Joglekar, *loc. cit.*) contribute to the view that each estuary has its own type of population of fishes, though belonging to the same species.

ACKNOWLEDGEMENTS

The data on the Godavari estuary population were collected by one of us (MBR) when he was in the Zoology Department, Andhra University, as an I. C. A. R. employee. He is thankful to Dr. S. Dutt, Zoology Department, Andhra University, for his guidance, to Prof. P. N. Ganapati, Head of the Zoology Department, Andhra University, for his interest and encouragement and to the I. C. A. R. for financial grant. Both the authors are thankful to Drs. A. P. Kapur and B. S. Chauhan, Zoological Survey of India, for their interest and encouragement in the preparation of the paper.

SUMMARY

Populations of the gizzard shad, *Anodontostoma chacunda*, which forms a moderate fishery in two of the east coast estuaries situated in different latitude and longitudes, viz., Godavari and Hooghly, were compared by subjecting the biometric data to statistical analysis. The two populations are found to differ significantly in six of the eight morphometric and meristic characters, indicating that the two populations are drawn from different stocks of the same species.

REFERENCES

- BABU RAO, M. 1964. Some observations on the biology of *Hilsa kanagurta* (Bleeker) (Fam : Clupeidae).—*Ichthyologica*, Srinagar, 3, pp. 63-76.
- BABU RAO, M. 1965. Biological studies on the gizzard shad, *Anodontostoma chacunda* Hamilton (Fam : Clupeidae).—*J. Mar. biol. Ass. India*, Mandapam Camp, 7 (1), pp. 89-101.
- BABU RAO, M. 1965b. Biometric studies on *Anchoviella commersonii* (Lacépède) (Engraulidae : Pisces) from Andhra coast. *J. Mar. biol. Ass. India*, Mandapam Camp, 7 (2), pp. 369-376.
- BABU RAO, M. AND A. JOGLEKAR 1968.—Comparative studies on *Setipinna godavariensis* Rao (Pisces : Engraulidae) from Godavari and Hooghly estuaries. *J. Mar. biol. Ass. India*, Mandapam Camp, 9 (1), pp. 38-60,
- BAILEY, N. T. J. 1959. *Statistical Methods in Biology*.—The English University Press Ltd., London, pp. 1-282.
- GOULDEN, C. H. 1939. *Methods of Statistical Analysis*.—John Wiley & Sons Inc., New York, pp. vi+277.
- PILLAY, T. V. R. 1952. A preliminary biometric study of certain populations of Hilsa, *Hilsa ilisha* (Ham.).—*Proc. Indo-Pac. Fish. Coun.*, Sec. II, S2/8, pp. 1-14.
- PILLAY, T. V. R. 1957. A morphometric study of the population of Hilsa, *Hilsa ilisha* (Hamilton) on the River Hooghly and of the Chilka Lake.—*Indian J. Fish.*, New Delhi, 4 (2), pp. 344-386.

PAGURID CRABS (DECAPODA, ANOMURA)
FROM WALT AIR COAST

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(with 6 Text-figures)

I—INTRODUCTION

While the systematics of Anomura has been extensively studied in different parts of the world, comparatively very little work has been done on the Indian anomurans after Alcock's (1905) publication on Indian decapod Crustacea. Henderson (1915) described six hermit crabs from the Chilka lake. The pagurids from Krusadai island were described by Sundara Raj (1927). Gravely (1941), while studying the fauna of Madras coast, mentioned the occurrence of eight species of hermit crabs. The pagurid crabs collected after 1905 and deposited in the Indian Museum were described by Kamalaveni (1951). San-kolli (1961) described a new species of *Pagurus* from Ratnagiri.

The present work was undertaken with a view to make a systematic study of anomuran fauna of Waltair coast. During the course of the study twenty three species belonging to five genera of the family Paguridae were recorded. Out of these, one species of the genus *Pagurus* happens to be new to science. The material for the present study was collected from Lawson's Bay, Waltair and Visakhapatnam harbour.

II—SYSTEMATIC ACCOUNT

Family PAGURIDAE

Subfamily DIOGENINAE

Paguropsis Henderson

1888. *Paguropsis* Henderson, *Challenger*, Anomura : 98.
1899. *Chlaenopagurus* Alcock, *J. Asiat. Soc. Beng.* : 113.
1905. *Paguropsis* : Alcock, *Cat. Ind. Mus. Crust.* : 27.

Carapace moderately elongate, rostrum prominent. The abdomen is flexed, not spirally coiled. Eyestalks stout, ophthalmic scales separated, spiniform. Antennal acicle large, flagellum long, nonsetose. Chelipeds equal, finger tips corneous, opening horizontally. The 2nd and 3rd pair of walking legs long and short, 4th pair have chelae.

Paired abdominal appendages are present on the 1st two abdominal segments of the male and 1st abdominal segment in the case of female.

Paguropsis typica Henderson

(Text-fig. I, Fig. 1. A, B, C)

1888. *Paguropsis typicus* Henderson, *Challenger*, Anomura : 99.
 1899. *Chlaenopagurus andersoni* Alcock, *J. Asiat. Soc. Beng.* : 115.
 1905. *Paguropsis typica* : Alcock, *Cat. Ind. Mus. Crust* : 28.

Diagnosis.—Rostrum projects beyond the eyes, 3rd pair of legs chelate paired, abdominal appendages present.

Description.—The cervical groove is deep-cut and the carapace included within is well calcified. Rostrum projects well between the eyestalks. Eyes are large and reniform. Chelipeds massive, quite equal, covered with long, stiff, golden yellow bristles. 3rd pair of legs and in a chela. In males, the first two abdominal segments have paired appendages whereas in females only the first segment has paired appendages.

Material.—About 10 specimens were collected from Lawson's Bay, Waltair.

Measurements.—6.2 mm. carapace length.

Distribution.—Philippines, Cape Comorin and Gulf of Martaban.

Remarks.—This species is collected for the first time from Waltair coast.

Clibanarius Dana

1852. *Clibanarius* Dana, *U. S. Expl. Expd. Crust.* : 461.
 1905. *Clibanarius* : Alcock, *Cat. Ind. Mus. Crust.* : 40.
 1953. *Clibanarius* : Forest, *Bull. Mus. Hist. Nat. Paris*, : 437.

Carapace elongate, rostrum distinct but short. Abdomen well developed, spirally coiled. Eyestalks long and slender. Antennal acicle short; antennal flagellum long, nonsetose. Chelipeds subequal, fingers open and close horizontally. Tip corneous and spooned. Fourth pair of legs subcheliform, 5th pair cheliform, both have on the surface, near the tip a patch of imbricating corneous granules.

Key to the species of Clibanarius

1. The dactylus of the 3rd pair of thoracic legs is longer than propodus.

- A. Eyestalks much shorter than the antennular peduncles ; a strong spine at the inner end of the lower inner border of the merus of the chelipeds.

C. infraspinatus

- B. Eyestalks as long as the antennular peduncle.

- (1) Eyestalks much longer than the anterior border of the carapace, the eyes occupying about one eleventh of their lengths

C. padavensis

- (2) Eyestalks a little longer than the anterior border of the carapace *C. longitarsus*
- (3) Eyestalks distinctly longer than the anterior border of the carapace, the eyes occupy about one tenth of the length of the eyestalk *C. olivaceous*
- (4) Eyestalks equal in length to the anterior border of the carapace, the eyes occupying about one eighth of their length. *C. striolatus*
- II. The dactylus of the 3rd pair of thoracic legs is decidedly shorter than the propodus, which on the left side has its outer surface remarkably flattened and the upper border of that surface very sharply defined. Carapace not abnormally elongate; chelipeds not remarkably setose. Eyestalks as long as the anterior border of the carapace or as the antennular peduncle *C. humilis*
- III. The dactylus of 3rd pair of thoracic legs is exactly of the same length as the propodus *C. eurysternus*

***Clibanarius infraspinatus* Hilgendorf**

(Text-fig. I. Fig. 2, A, B, C)

1869. *Clibanarius infraspinatus* Hilgendorf, *V. D. Decken's Reisen Ost Afr.* : 97.
 1905. *Clibanarius infraspinatus* : Alcock, *Cat. Ind. Mus. Crust.*, : 44.

Diagnosis.—A strong blunt spine at inferior border of merus of each cheliped; distinct longitudinal striations on the legs and ocular peduncles.

Description.—Carapace with scattered tufts of long yellow bristles. Rostrum small, hardly reaching the base of the ophthalmic scales; eyestalks long and slender. Ophthalmic scales with the free edges spinose and setose, approximated. Antennal acicle setose and spinose, overlapping the base of the terminal joint of the peduncle; flagellum longer than the carapace. Chelipeds equal and similar, longer than the carapace. There is a very strong spine at the inner end of the lower inner border of the merus. The 2nd and 3rd pair of legs just reach beyond the chelipeds. The outer surface of the propodus of 3rd left leg somewhat flattened, besides being of a lighter colour and very distinctly striped in a longitudinal direction on eyestalks and on legs.

Material.—About 60 specimens were collected from Visakhapatnam harbour.

Measurements.—9.5 mm. carapace length.

Distribution.—Singapore, Mergui, Sydney, Red Sea, Philippines and Bay of Bengal.

***Clibanarius padavensis* de Man**

(Text-fig. I. Fig. 4, A, B, C)

1883. *Clibanarius padavensis* de Man, *J. Linn. Soc.* : 242.
 1905. *Clibanarius padavensis* : Alcock, *Cat Ind. Mus. Crust.*, : 44.

Diagnosis.—Rostrum prominent, eyestalks $1/6$ th longer than anterior border of carapace, chelipeds equal and similar, the dactylus of the third pair of legs about one and $2/7$ times longer than propodus.

Description.—Fine silky setae are present on the sides of the carapace and on the antennal peduncles and legs. Rostrum rather prominent, reaching to a little beyond the base of the ophthalmic scales and beyond the antennal angles of the carapace. Ophthalmic scales approximated, their edges spinose. Antennal acicle setose, very indistinctly serrulate, flagellum nearly twice as long as the carapace. Chelipeds equal and similar, merus with 1 or 2 spinules at the far end of the outer lower border. Inner border of carpus indistinctly and of propodus more distinctly serrulate, the carpus having a distinct spine at the far end of the inner border : Outer surface of the fingers studded dark with tipped spinules. The fingers when closed are separated at the base by gap. The 2nd and 3rd legs exceed the chelipeds on the left side by more than a dactylus and on the right side by more than a dactylus and a half.

Material.—About 80 specimens were collected from Visakhapatnam harbour.

Measurements.—Length of carapace : 9.0 mm.

Distribution.—Port Canning, Mergui, Akyab, Singapore and Madras coast.

Remarks.—The species is recorded for the first time from Waltair coast.

***Clibanarius longitarsus* (De Haan)**

(Text-fig. I. Fig. 3, A, B, C)

1850. *Pagurus longitarsus* De Haan, *Faun. Jap. Crust.*, : 211.

1902. *Clibanarius longitarsus* : de Man, *Decapod und Stomatop.*, : 741.

1950. *Clibanarius longitarsus* : Barnard, *Ann. S. Afr. Mus.*, : 434.

Diagnosis.—Eyes a little longer than anterior border of carapace; chelipeds subequal, tarsus longer than the preceding segment covered with number of tufts of hairs. Propodus of left cheliped and propodus of 3rd pair of walking legs somewhat flattened on the external surface.

Description.—The portion of the carapace anterior to the cervical groove is little longer than broad, slightly convex, covered with yellow bristles on the sides; rostrum pointed, triangular, ocular peduncle a little longer than the anterior margin of carapace, almost equal to the antennular peduncle; ophthalmic scales small, pointed with two small teeth at the free end; antennal scale small, with long hairs, hardly reaches the middle of the last segment of the peduncle. Chelipeds subequal, the right a little longer, merus covered with a number of small patches in the anterior region; outer border armed with two small spines.

Material.—Nearly 15 specimens were collected from Visakhapatnam harbour.

Measurements.—Carapace length : 5.5 mm.

Distribution.—Japan, Singapore, Ternate, Indian Ocean, China, Africa, Pondichery and Chilka lake.

Remarks.—This species is recorded for the first time from Waltair coast.

***Clibanarius olivaceus* Henderson**

(Text-fig. II. Fig. 2, A, B, C)

1915. *Clibanarius olivaceus* Henderson, *Rec. Indian. Mus.*, : 287.

Diagnosis.—Rostrum moderately prominent, eyestalks distinctly longer than the anterior border of carapace; chelipeds subequal and similar. The dactylus of 3rd leg is about $\frac{1}{4}$ longer than propodus.

Description.—Carapace with tufts of setae on the sides and behind the cervical groove. Rostrum moderately prominent reaching a little beyond antennal angles of the carapace. Ophthalmic scales with the outer edge setose and faintly spinose. Antennal acicle setose and slightly spinose, the proximal spinule being most prominent, scarcely reaching the terminal joint of the peduncle. Chelipeds subequal and similar; merus with the upper margin obscurely serrulate and 2 spinules at the distal end of the outer lower margin; hand only slightly roughened and comparatively free of setae; fingers rougher and more setose than the palm. The length of the hand, including the fingers, is about twice its breadth. The 2nd and 3rd legs exceed the chelipeds on both sides by the length of the dactyli and nearly half the propodi. A spinule is present at the lower distal end of the merus and another at the upper distal end of the carpus in both pairs of legs. The dactylus of the 3rd leg is about $\frac{1}{4}$ th longer than the corresponding propodus; the dactylus of the 2nd leg while stouter is still distinctly longer than its propodus.

Material.—About 85 specimens were collected from Visakhapatnam harbour.

Measurements.—Carapace length : 7.0 mm.

Distribution.—Chilka lake and Madras coast.

Remarks.—This species is recorded for the first time from Waltair coast.

***Clibanarius striolatus* Dana**

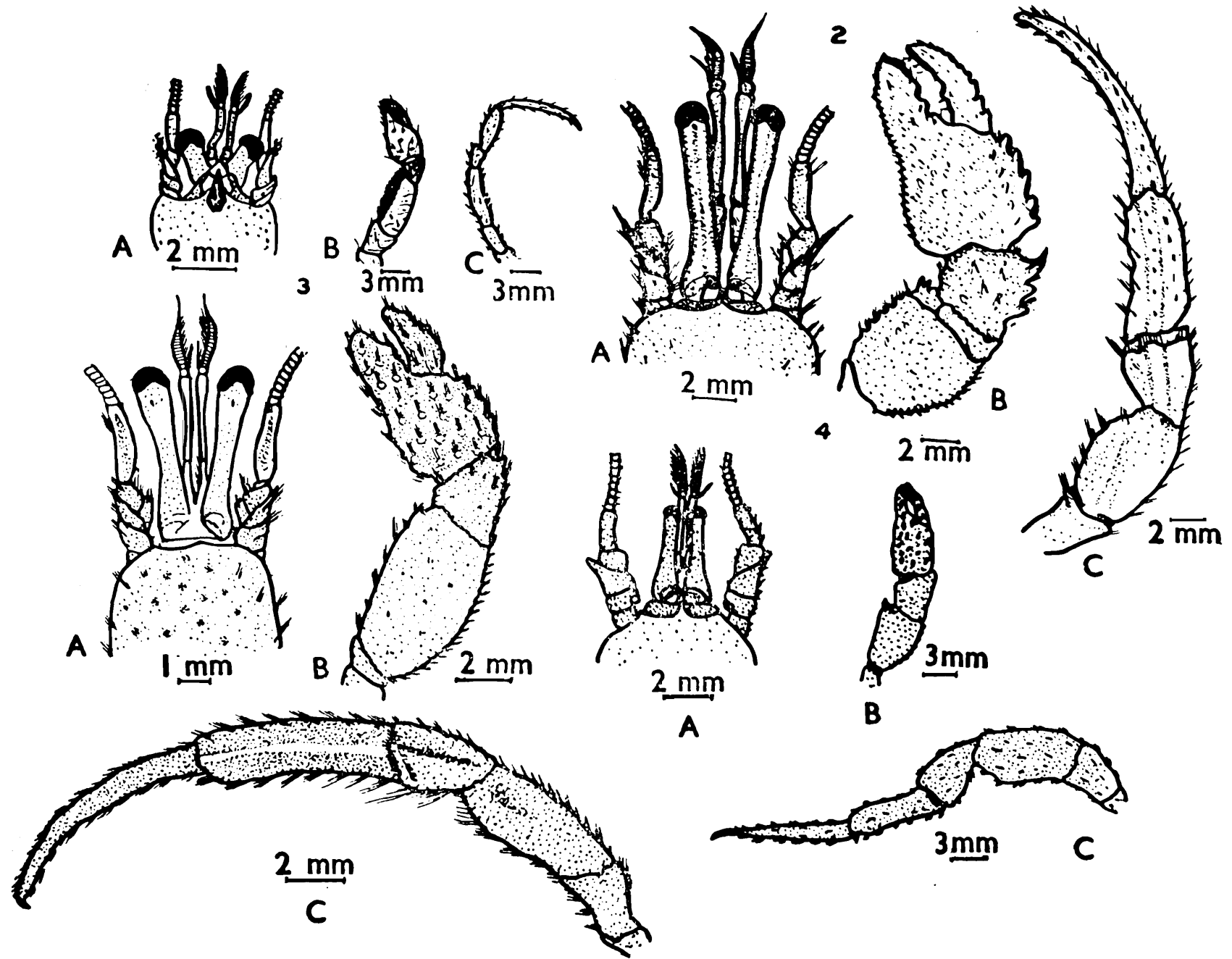
(Text-fig. II. Fig. 1, A, B, C)

1852. *Clibanarius striolatus* Dana, *U. S. Expl. Expd. Crust.*, : 463.

1905. *Clibanarius striolatus* : Alcock, *Cat. Ind. Mus. Crust.*, : 46.

1953. *Clibanarius striolatus* : Forest, *Bull. Mus. Hist. Nat.*, : 448.

Diagnosis.—Rostrum small, does not reach to the base of the ophthalmic scales. Eyestalks as long as the anterior border of carapace; hands short and stout. Propodus of 3rd left leg has the



Text-fig. I— Fig. 1. *Paguropsis typica* Henderson. Fig. 2. *Clibanarius infraspinus* Hilgendorf.
 Fig. 3. *Clibanarius longitarsus* (De Haan). Fig. 4. *Clibanarius padavensis* de Man. A.
 anterior portion of the animal; B. cheliped, C. walking leg.

upper border of its outer surface well defined; dactylus of this pair of legs is a little shorter.

Description.—Anterior region of the carapace quadrangular. Fine silky setae present on the sides of the carapace, antennal peduncles and legs. Rostrum little shorter and does not reach to the base of the ophthalmic scales. Eyestalks shorter and stouter, being only as long as the anterior border of the carapace; eyes larger, occupying from $1/7$ to $1/8$ of the length of the eyestalk. Ophthalmic scales approximated, their edges spinose. Antennal acicle setose very indistinctly serrulate, usually not overlapping the base. Chelipeds equal, similar, shorter and stouter. Usually the hands and the wrists are rougher and more setose. The 2nd and 3rd legs exceed the chelipeds on the left side by more than a dactylus and on the right side by more than a dactylus and a half. The propodus of the 3rd left leg has the upper border of its outer surface fairly well defined and the dactylus of this pair of legs is a little shorter than in *C. padavensis*.

Material.—About 70 specimens were collected from Visakhapatnam harbour.

Measurements.—Carapace length : 5.0 mm.

Distribution.—Fiji islands, Persian Gulf, Mergui, Tahiti, Trincomalee, Seychelles and Gulf of Aden.

Remarks.—This species is recorded for the first time from Indian coast.

Clibanarius humilis (Dana)

(Text-fig. II. Fig. 3, A, B, C)

1851. *Pagurus humilis* Dana, : 271.

1852. *Clibanarius humilis* : Dana, *U. S. Expl. Expd. Crust.*, : 469.

1907. "*Clibanarius aequibilis* : Dana", *Nobili.*, : 367.

1915. "*Clibanarius aequibilis*, var. *merguiensis* de Man" : *Bouvier.*, . 29.

1957. *Clibanarius humilis* : Forest, *Proc. 8th Pacif. Sci. Congr.*, : 1057

Diagnosis.—Eyestalks a little longer than anterior border of carapace. Chelipeds unequal, the right being larger than left.

Description.—Carapace a little longer than broad; rostrum short, exceeds the antennal angles. Eyestalks a little longer than antennal peduncles. Antennal peduncles as long or longer than the ocular peduncles. Chelipeds unequal, the right being larger than the left; the left reaches only to the propodus of right. Carpus covered with small tubercles, propodus with sharp pointed teeth near the internal margin and also on the fingers. The propodus of the third right walking leg with a keel on the lateral margin.

Material.—Only 5 specimens were collected from Visakhapatnam harbour.

Measurements.—Carapace length : 6.00 mm.

Distribution.—Tuamotu, Hikueru, Tahiti and Pakume.

Remarks.—This species is recorded for the first time from Indian coast.

Clibanarius eurysternus Hilgendorf

(Text-fig. II. Fig. 4, A, B, C)

1878. *Pagurus (Clibanarius) eurysternus* Hilgendorf, *Monts. Akad. wiss.*, : 822.
 1888. *Clibanarius eurysternus* : de Man, *Decapod und Stomatop.*, : 447.
 1938. *Clibanarius eurysternus* : Yap-Chiongco, *Philipp. J. Sci.*, : 189.

Diagnosis.—Cephalothorax and basal segments of chelipeds and legs depressed; carapace striated with colour markings, outer surface of legs similarly striated, chelipeds similar and equal, dactylus of legs flattened remarkably from below.

Description.—Carapace compressed; six longitudinal reddish brown stripes on dorsal surface of the carapace. Rostrum exceeding antennal angles of carapace, eyestalks with alternating reddish brown and yellowish white, longitudinal stripes. Ophthalmic scales approximated, broadly triangular and spinose at free edges. Antennal acicle stout, setose, spinose on top, distinctly overlapping base of last segment of peduncle. Chelipeds and legs striped similar to eyestalks. Chelipeds similar and equal, slightly stouter than legs, equal to or slightly longer than carapace. Merus unarmed except for two spines and a tubercle on distal outer lower margin; carpus with a strong spine on distal inner border; hands and fingers on dorsal surface studded with corneous-tipped spines with a cluster of yellowish bristles arising from base of each. Fingers closed, meet only at tips. Legs much longer than chelipeds, right legs longer than left, carpus of legs with sharply pointed corneous-tipped spine on inner dorsal distal border; few spines of similar nature are also present on distal inner margin of carpus of left leg. Propodus and dactylus of 3rd leg equal in length, both compressed from below.

Material.—About 60 specimens were collected from Visakhapatnam harbour.

Measurements.—Carapace length : 7.0 mm.

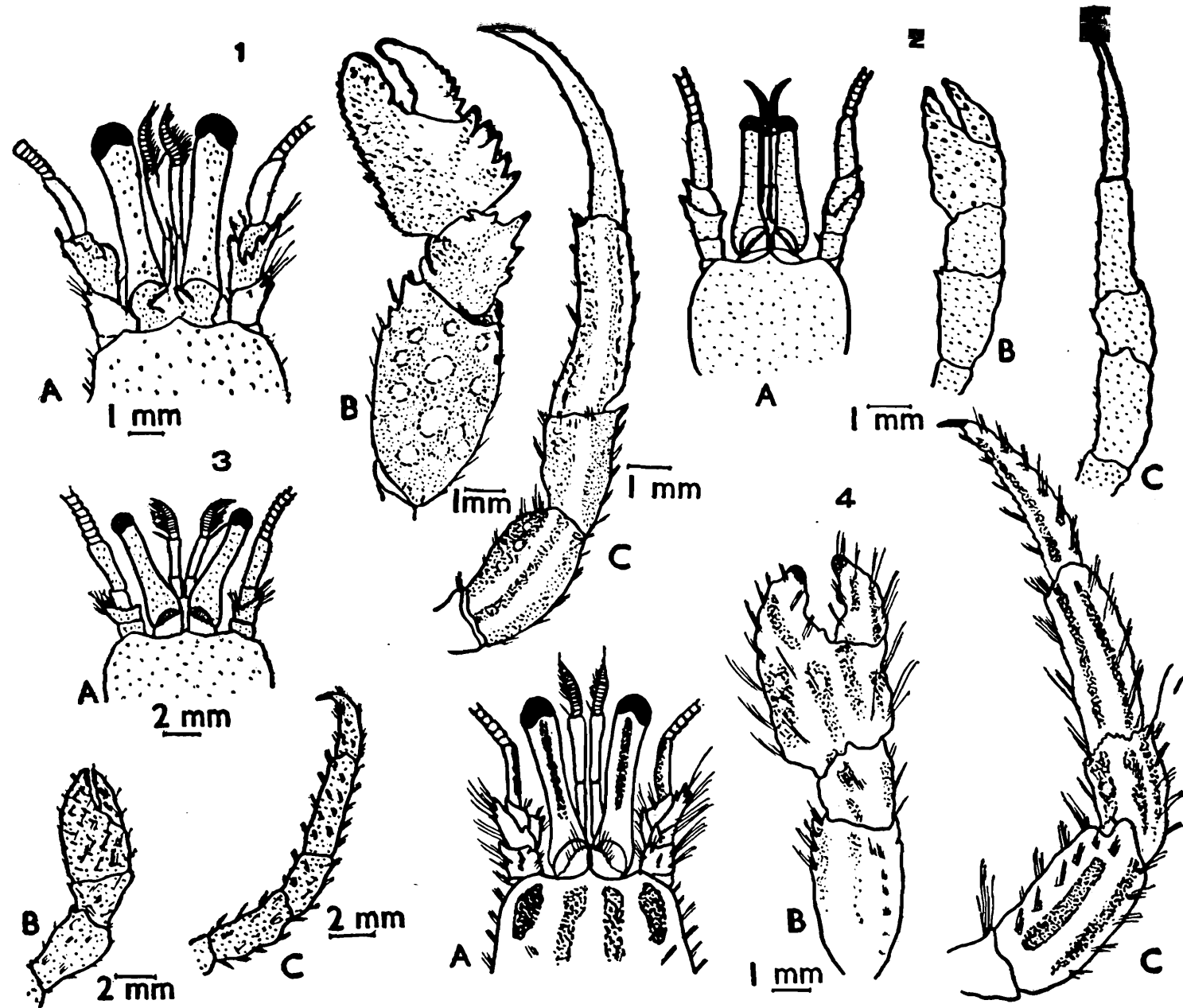
Distribution.—Mozambique, Malay Archipelago, Malayasia and Philippines.

Remarks.—This species is recorded for the first time from Indian coast.

Diogenes Dana

1852. *Diogenes* Dana, *U. S. Expl. Expd. Crust.*, : 438.
 1893. *Diogenes*: Stebbing, *Hist. Crust.*, : 160.
 1905. *Diogenes* : Alcock, *Cat. Ind. Mus. Crust.*, : 59.

Carapace usually elongate, broadened posteriorly, well calcified in front of the cervical groove; rostrum replaced by a movable rostriform process of the ophthalmic somite. Eyestalks moderately slender; ophthalmic scales large, separated by rostrum. Antennal acicle well formed; flagellum more or less setose. The chelipeds are



Text-fig. II— Fig. 1. *Clibanarius striolatus* Dana. Fig. 2. *Clibanarius olivaceus* Henderson.
 Fig. 3. *Clibanarius humilis* (Dana). Fig. 4. *Clibanarius eurysternus* Hilgendorf.
 A. anterior portion of the animal; B. cheliped; C. walking leg.

dissimilar and unequal, the left being greatly the larger, the fingers open and close in an obliquely vertical direction, the finger tips acuminate and calcareous. The 4th pair of legs are subchelate and the 5th pair chelate.

Key to the species of the genus Diogenes

- I. The rostrum is a narrow lamina, with the free edge spinose distally.
 - A. The carapace is longer than broad ; left hand when fully extended not inclined inwards.
 - (i) Antennal acicle bifurcate, the inner branch reaches about half way along the penultimate joint of the peduncle.
 - (a) The outer (longer) branch of the antennal acicle just or barely reaches the base of the terminal joint of the peduncle ; outer surface of the left hand beset with claw-shaped spines. *D. diogenes*
 - (b) The outer branch of the acicle reaches well beyond the base of the last joint of the peduncle ; outer surface of left hand closely and finely granulose. *D. custos*
 - (ii) Antennal acicle obscurely bifurcate, the outer branch does not reach the base of the terminal joint of the peduncle ; outer surface of left hand closely and finely granulose.
 - (a) Left hand nearly oval, the palm higher than long. *D. affinis*
 - (b) Left palm as long as high, the lower part of its outer surface flattened. *D. planimanus*
 - (c) Left hand oblong, the palm longer than high. *D. violaceous*
 - (d) Left hand with longitudinal rows of tubercles *D. waltairensis*
 - B. The carapace broader than long ; left hand, even when fully extended, strongly inclined inwards. *D. miles*
- II. The rostrum is a slender non-serrated spinule ; eyestalks not so long as the anterior border of the carapace or as the antennal peduncle ; fixed finger of left cheliped deflexed.
 - (a) The eyestalks reach nearly to the middle third of the terminal joint of the antennular peduncle ; wrist and hand of left cheliped of adult more remarkably elongate. *D. avarus*
 - (b) The eyestalks hardly reach the base of the terminal joint of the antennular peduncle.
 - (i) A simple obliquely-longitudinal crest on the outer surface of the left palm *D. costatus*
 - (ii) Two obliquely-longitudinal crests on the outer surface of the left palm. *D. bicristimanus*

Diogenes diogenes (Herbst)

(Text-fig. IV. Fig. 4, A, B, C)

1791. *Cancer diogenes* Herbst, *Krabben*, : 17.
 1893. *Diogenes diogenes* : Henderson, *Trans. Linn. Soc. Zool.*, : 412.
 1905. *Diogenes diogenes* : Alcock, *Cat. Ind. Mus. Crust.*, : 62.

Diagnosis.—Rostrum much longer than ophthalmic scales, its anterior half spinose; antennal acicle is bifurcate, the opposed edges of the forks being spinulose, the outer fork just or barely reaches the base of the terminal joint. Left cheliped nearly twice as long as the carapace.

Description.—Rostrum much longer than ophthalmic scales, its anterior half spinose. Ophthalmic scales spinulose. The antennal peduncle reaches to about middle of the terminal joint of the antennular peduncle. The antennal acicle is bifurcate. The chelipeds and legs are copiously and elegantly spinose, the fingers of the smaller cheliped and the dactyli of 2nd and 3rd legs being thickly plumed.

Material.—About 20 specimens were collected from Lawson's Bay, Waltair.

Measurements.—Carapace length : 5.0 mm.

Distribution.—Due to the confusion of this species the distribution is uncertain.

***Diogenes custos* (Fabricius)**

(Text-fig. III. Fig. 2, A, B, C)

1798. *Pagurus custos* Fabricius, *Ent. Syst. Suppl.*, : 412.

1893. *Diogenes custos* : Henderson, *Trans. Linn. Soc. Zool.*, : 414.

1905. *Diogenes custos* : Alcock, *Cat. Ind. Mus. Crust.*, : 64.

Diagnosis.—Eystalks short, less than $\frac{2}{3}$ the length of the anterior border of carapace, rostrum is longer in relation to eystalks; antennular and antennal peduncles are of equal length.

Description.—The eystalks are short, being less than $\frac{2}{3}$ the length of the anterior border of the carapace; hence the rostrum is longer in relation to the eystalks, being nearly half its length. The antennular and antennal peduncles are of equal length. The upper border of the hand, the dactylus of the cheliped and the anterior border of the four terminal joints of the 2nd and 3rd legs are spinose or spinulose.

Material.—About 10 specimens were collected from Lawson's Bay, Waltair.

Measurements.—Carapace length : 6.00 mm.

Distribution.—South east coast of Australia, Mergui, Andamans and Bay of Bengal.

***Diogenes affinis* Henderson**

(Text-fig. III. Fig. 3, A, B, C)

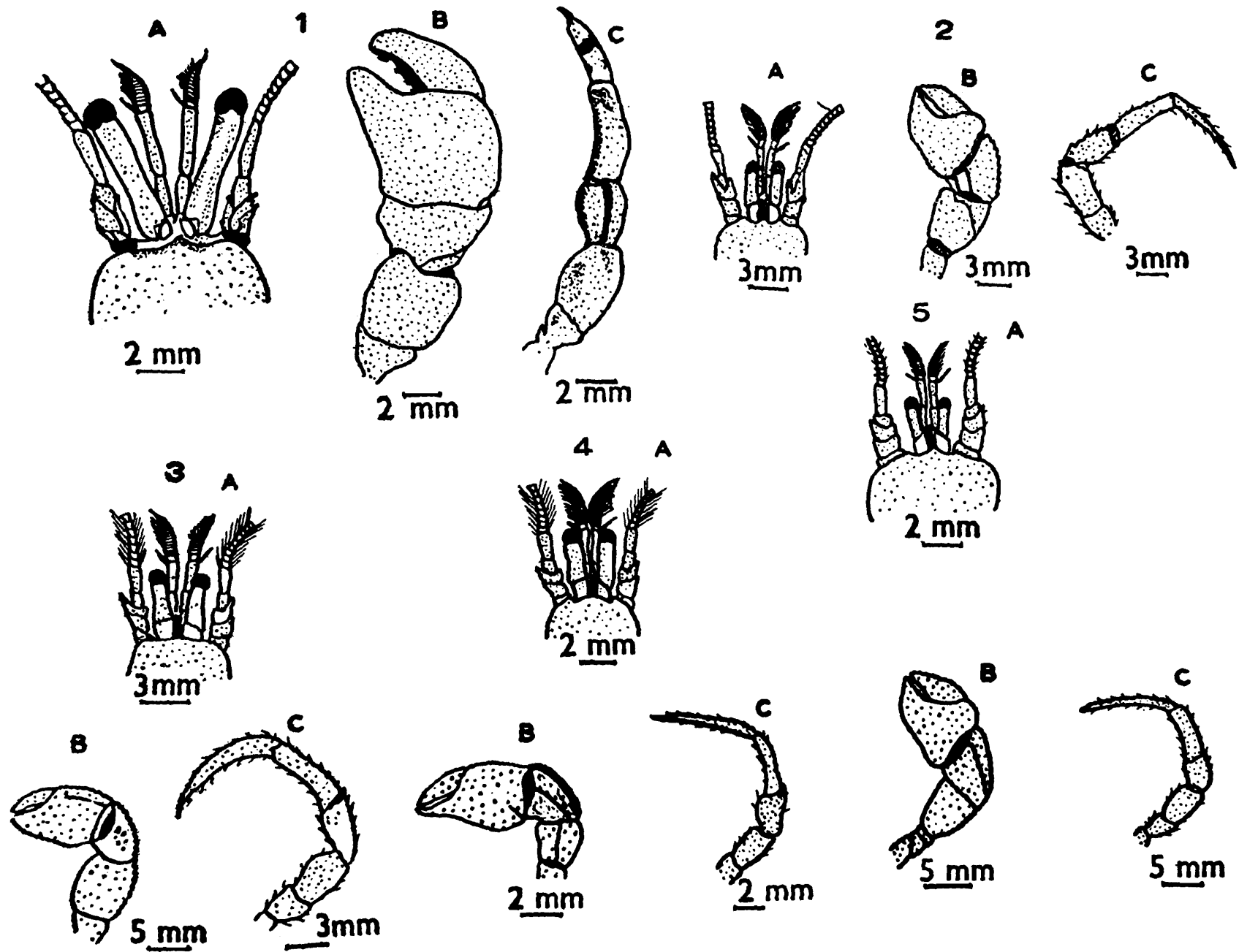
1893. *Diogenes affinis* Henderson, *Trans. Linn. Soc. Zool.*, : 415.

1852. *Diogenes custos* Dana, *U. S. Expl. Expd. Crust.*, : 439.

1905. *Diogenes custos* var. *affinis* : Alcock, *Cat. Ind. Mus. Crust.*, : 65.

Diagnosis.—Rostrum short, little longer than ophthalmic scales.

Description.—The rostrum is shorter, being a little longer than the ophthalmic scales. Antennal flagellum thickly setose to the tip.



Text-fig. III— Fig. 1. *Calcinus herbstii* (de Man). Fig. 2. *Diogenes custos* (Fabricius). Fig. 3. *Diogenes affinis* Henderson. Fig. 4. *Diogenes planimanus* Henderson. Fig. 5. *Diogenes violaceous* Henderson. A. anterior portion of the animal; B. cheliped; C. walking leg.

In the left cheliped the hand is shorter and broader, the dactylus does not make up $\frac{2}{3}$ the total length of the hand and the lower edge of the fixed finger is spinuous. The anterior surface of the propodus and dactylus of the 2nd and 3rd legs is granulose, not spinulose.

Material.—About 15 specimens were collected from Lawson's Bay, Waltair.

Measurements.—Carapace length : 5.5 mm.

Distribution.—Bay of Bengal.

***Diogenes planimanus* Henderson**

(Text-fig. III, Fig. 4, A, B, C)

1893. *Diogenes planimanus* Henderson, *Trans. Linn. Soc. Zool.*, : 416.
1905. *Diogenes custos* var. *planimanus* : Alcock, *Cat. Ind. Mus. Crust.*, : 66.

Diagnosis.—Rostrum short, narrow, inner branch of antennal acicle obsolete and the outer branch falls far short of the base of the terminal joint of peduncle, flagellum more setose. The fixed finger of the left hand is straight.

Description.—The inner branch of the antennal acicle is obsolete and the outer branch falls far short of the base of the terminal joint of the peduncle. The rostrum is short, not much exceeding the ophthalmic scales but is remarkably narrower. On the outer surface of the carpus of the left cheliped there is an irregular row of enlarged granules parallel with the inner border. The palm of the hand is as long as high and the lower portion of its outer (granular) surface forms a flat facet bounded posteriorly by a short ridge running parallel with the carpal articulation; the granules on this ridge and at the junction with the lower border of the palm are enlarged. The left hand when fully extended has a slight inclination inwards.

Material.—About 15 specimens were collected from Lawson's Bay, Waltair.

Measurements.—Carapace length : 6.0 mm.

Distribution.—Malaya Peninsula and Bay of Bengal.

***Diogenes violaceus* Henderson**

(Text-fig. III. Fig. 5, A, B, C)

1893. *Diogenes violaceus* Henderson, *Trans. Linn. Soc. Zool.*, : 416.
1905. *Diogenes custos* var. *violaceus* : Alcock, *Cat. Ind. Mus. Crust.*, : 66.

Diagnosis.—Rostral scale is long, inner fork of the antennal acicle nearly obsolete and the outer fork falls far short of the base of the terminal joint of the peduncle. Left hand is narrow, fixed finger of the same has a straight lower margin.

Description.—The inner fork of the antennal acicle is nearly obsolete, and the outer fork falls far short of the base of terminal joint of the peduncle. The antennal flagellum is less coarsely setose. The

palm of the left hand is longer than broad, so that the dactylus, though long, does not make up $\frac{2}{3}$ the total length of the hand and the hand as a whole is oblong instead of nearly oval.

Material.—10 specimens were collected from Lawson's Bay.

Measurements.—Carapace length : 6.0 mm.

Distribution.—Bay of Bengal.

***Diogenes waltirensis* Kamalaveni**

(Text-fig. IV. Fig. 1, A, B, C)

1951. *Diogenes custos* var. *waltirensis* Kamalaveni, *Rec. Indian Mus.*, : 78.

Diagnosis.—Rostrum prominent extending upto the base of the eyestalks. Eyestalks a little more than half the length of the anterior border of carapace. Ophthalmic scales well developed and margins serrated. Left cheliped twice as long as the right.

Description.—Carapace is almost as long as broad, posterior margins rounded. The rostrum is prominent extending upto the base of the eyestalks and is slightly longer than the ophthalmic scales. Eyestalks are long and slender. Ophthalmic scales are well developed and their margins are finely serrated. The antennal peduncles are hairy and the basal segment bears a stout spine on its outer anterior margin. Chelipeds dissimilar and unequal, the left being twice as long as the right. The left cheliped is slightly shorter and stouter than the legs and less hairy than the right cheliped. The movable finger of the left cheliped is studded with rounded tubercles which form longitudinal rows on the upper margin. The 2nd and 3rd pair of legs are similar being longer than the left cheliped by about half their dactylus and the 2nd pair slightly exceeds the 3rd pair.

Material.—Only 5 specimens were collected from Lawson's Bay, Waltair.

Measurements.—Carapace length : 10.0 mm.

Distribution.—Waltair coast.

***Diogenes miles* (Herbst.)**

(Text-fig. V. Fig. 1, A, B, C)

1791. *Cancer miles* Herbst, *Krabben.*, : 19.

1893. *Diogenes miles* : Henderson, *Trans. Linn. Soc. Zool.*, : 413.

1905. *Diogenes miles* : Alcock, *Cat. Ind. Mus. Crust.*, : 67.

Diagnosis.—Carapace broader than long and very flat. Rostrum longer than ophthalmic scales, its edge spinulose. Eyestalks $\frac{3}{5}$ the length of anterior border of carapace. Antennal acicle hardly bifurcate, flagellum thickly setose almost to the tip. Left cheliped vastly larger than the right with the hand much inclined inwards.

Description.—Cephalothorax broad and very flat. Carapace broader than long. Rostral appendage longer than ophthalmic scales, its edge spinulose. Left cheliped vastly larger than the right, with the wrist much inclined outwards and the hand inwards, the fingers have the outer surface granulose and the opposed edges setose in tufts. The 2nd and 3rd legs of both sides exceed the left cheliped by nearly half their dactylus.

Material.—About 20 specimens were collected from Lawson's Bay, Waltair.

Measurements.—Carapace length : 5.0 mm.

Distribution.—Bay of Bengal.

***Diogenes avarus* Heller**

(Text-fig. V, Fig. 5, A, B, C)

1865. *Diogenes avarus* Heller, *Novara Crust.*, : 83.

1887. *Diogenes avarus* : Walker, *J. Linn. Soc. Zool.*, : 113.

Diagnosis.—Rostrum a slender spine, not so long as the ophthalmic scales; eyestalks stout, not $\frac{2}{3}$ the length of the anterior border carapace; left cheliped vastly longer than the right.

Description.—Carapace moderately elongate, its antero-lateral border finely serrulate. Rostrum a slender spine, not so long as the ophthalmic scales. Eyestalks stout. The antennules are slightly longer than antennal peduncles. The antennal acicle is a simple spine. The left cheliped is vastly longer than the right and in the adult male is nearly $2\frac{1}{2}$ times the length of the carapace. The carpus is longer than the merus and a little longer than the palm of the hand; its inner edge is very well defined and serate. The right cheliped is setose, especially as to the fingers. The 3rd right leg, which is a little longer than the 2nd, hardly reaches the base of the dactylus of the left cheliped.

Material.—About 50 specimens were collected from Lawson's Bay, Waltair.

Measurements.—Carapace length : 4.0 mm.

Distribution.—East Africa, Persian Gulf, Singapore, Torres Strait, Philippines, Madras coast and Krusadai island.

Remarks.—This species is recorded for the first time from Waltair coast.

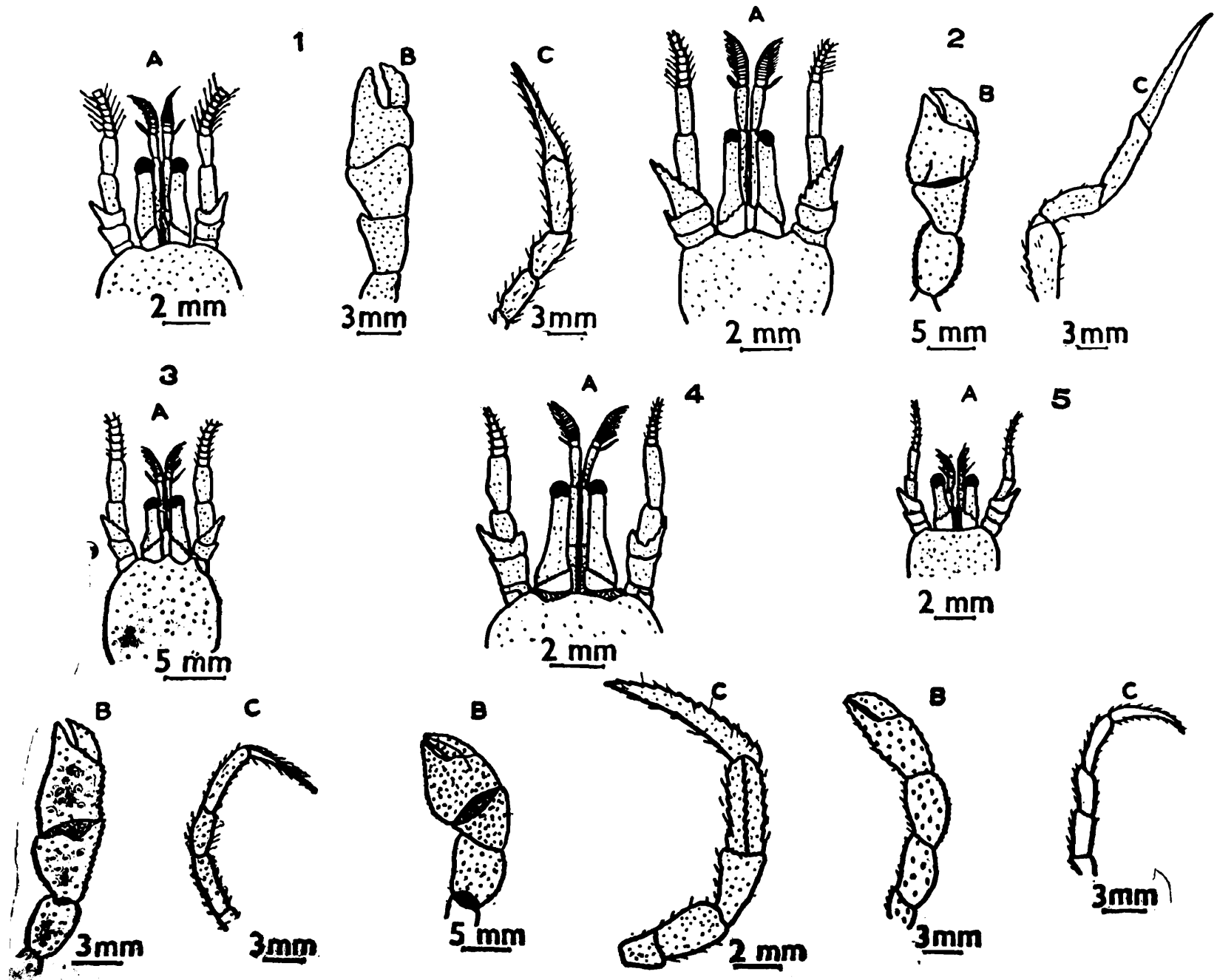
***Diogenes costatus* Henderson**

(Text-fig. IV. Fig. 2, A, B, C)

1893. *Diogenes costatus* Henderson, *Trans. Linn. Soc. Zool.*, : 418.

1905. *Diogenes costatus* : Alcock, *Cat. Ind. Mus. Crust.*, : 70.

Diagnosis.—Rostrum a slender spine; eyestalks about $\frac{4}{5}$ the length of the antero-lateral border of carapace. Antennal flagellum



Text-fig. IV— Fig. 1. *Diogenes waltirensis* Kamalaveni. Fig. 2. *Diogenes costatus* Henderson.
 Fig. 3. *Diogenes bicristimanus* Alcock. Fig. 4. *Diogenes diogenes* (Herbst).
 Fig. 5. *Diogenes avarus* Heller. A. anterior portion of the animal; B. chelipeds;

thickly setose upto the tip, antennal acicle a simple spine; left cheliped vastly larger than the right.

Description.—Carapace moderately elongate; rostrum a slender spine, shorter than ophthalmic scales. Eyestalks about $\frac{4}{5}$ the length of the antero-lateral border of the carapace. Eyes small. Antennal acicle a simple spine, strongly spinose along the inner edge. Left cheliped vastly larger than the right; merus a little shorter than the carpus; fixed finger deflexed. The right cheliped hardly reaches the base of the left hand; it is granular, spinose and especially on the hand setose. The 2nd and 3rd legs do not quite reach the end of the larger cheliped. The anterior edge of the carpus and propodus is spinulose and setose, the spinules of the carpus being the most distinct; the dactyli are longer than the propodi and are plumose.

Material.—About 30 specimens were collected from Lawson's Bay, Waltair.

Measurements.—Carapace length : 5.0 mm.

Distribution.—Indian peninsula.

Remarks.—This species is recorded for the first time from Waltair coast.

***Diogenes bicristimanus* Alcock**

(Text-fig. IV. Fig. 3, A, B, C)

1905. *Diogenes bicristimanus* Alcock, *Cat. Ind. Mus. Crust.*, : 72.

Diagnosis.—Carapace narrower and more elongate, antennal acicle does not reach the base of the terminal joint of the peduncle; flagellum carries only a few setae.

Description.—The carapace is narrower and more elongate. The antennal acicle falls a good deal short of the base of the terminal joint of the peduncle. The antennal flagellum is considerably longer than the carapace and carries only a few setae. In the left cheliped the merus is little longer than the carpus and has the upper border ill defined and the lower border not serrulate; the anterior border of the carpus is not spinose and the whole outer surface of the hand is granulose. A broad longitudinal ridge runs without a break along the middle of the outer surface of the palm and is continued downwards to the tip of the deflexed fixed finger. There is a second obliquely longitudinal ridge which does not quite reach the dactylus. In the 2nd and 3rd legs the only joint whose anterior border is distinctly spinulose is the carpus.

Material.—This is the most common species occurring in large numbers throughout the year at Lawson's Bay Waltair.

Measurements.—Length of carapace : 6.0 mm.

Distribution.—South Arabian coast, South African coast, Indus delta and Bay of Bengal.

Calcinus Dana

1852. *Calcinus* Dana, *U. S. Expl. Expd.*, : 456.
 1905. *Calcinus* : Alcock, *Cat. Ind. Mus. Crust.*, : 51.
 1950. *Calcinus* : Barnard, *Ann. South. Afr. Mus.*, : 436.

Carapace elongate, broadened posteriorly, its anterior part calcified. Rostrum small but very distinct. Eyestalks long and slender. Antennal acicle well formed; flagellum nonsetose. Chelipeds unequal and dissimilar, the left being vastly the larger; the fingers move on obliquely vertical plane. Finger tips calcareous and much spooned. The 4th pair of legs subchelate, 5th pair chelate.

Calcinus herbstii de Man

(Text-fig. III. Fig. 1, A,B,C)

1836. *Pagurus tibicen* H. Milne-Edwards, *Ann. Sci. Nat. Zool.*, : 278.
 1852. *Calcinus tibicen* : Dana, *U. S. Expl. Expd. Crust.*, : 457.
 1888. *Calcinus herbstii* de Man, *Arch. fur Naturg.*, : 437.
 1905. *Calcinus herbstii* : Alcock, *Cat. Ind. Mus. Crust.*, : 53.

Diagnosis.—Eyestalks stout, slightly curved. Both chelipeds smooth and unarmed; left more massive than right. The 2nd and 3rd legs considerably shorter than larger cheliped; the dactyli are much shorter than the propodi.

Description.—Eyestalks stoutish, slightly curved. Ophthalmic scales acute. Antennal acicle stout. Both chelipeds are smooth and unarmed, with the edges of all the joints entire. There is an oblique groove across the near end of the outer surface of the carpus of the left cheliped. The 2nd and 3rd legs of both sides are considerably shorter than the larger cheliped; their joints are smooth and unarmed, except for a spinule at the far end of the anterior border of the carpus; the dactyli are much shorter than the propodi.

Material.—About 10 specimens were collected from Lawson's Bay.

Measurements.—Carapace length : 5.0 mm.

Distribution.—Cocos islands, Andamans, Palk Strait, Laccadives, Mauritius, East Africa and Sandwich islands.

Remarks.—This species is recorded for the first time from Bay of Bengal.

PAGURINAE**Pagurus* (Brandt)**

1851. *Eupagurus* Brandt. *Middendorff's Reise in Sibiriens, Zool.*, : 105.
 1905. *Eupagurus* : Alcock, *Cat. Ind. Mus. Crust.*, : 122.
 1961. *Pagurus* : Sankolli, *J. zool. Soc. India.*, : 136.

* Genus *Pagurus* was previously known as *Eupagurus*; according to the rules of nomenclature and decisions of the International Commission on Zoological Nomenclature, the correct generic name is *Pagurus*.

Carapace elongate, broadened posteriorly. Rostrum either distinct or obsolescent. Abdomen well developed, spirally coiled. Eystalks either stout or slender, ophthalmic scales usually distinct. Antennal acicle long, flagellum long, more or less setose. External maxillipeds widely separated at base. The chelipeds are usually dissimilar and unequal, the right being much the larger, very rarely are they subequal; the fingers move in a more or less horizontal plane and the finger tips are calcareous, rarely corneous. The 4th pair of legs are subcheliform, the 5th pair are imperfectly cheliform, the fingers being very short and blunt; in both pairs the usual subterminating pavement of imbricating granules are found.

Key to the species of the genus Pagurus

- I. Eystalks as long as or longer than the anterior border of the carapace. Rostrum obsolescent. The upper border of the right palm overhangs the base of dactylus as a lobe. *P. pergranulatus*
- II. Eystalks distinctly shorter than anterior border of carapace.
 - A. Rostrum acute, long and prominent. *P. anceps*
 - B. Rostrum not so prominent as the antennal angles of carapace.
 - (1) Chelipeds and legs sparsely hairy. *P. indicus*
 - (2) Chelipeds densely hairy with a pinhole sized foramen in the under surface of the carpus of one or both chelipeds. *P. carpofoforaminatus*

***Pagurus pergranulatus* (Henderson)**

(Text-fig. V. Fig. 2, A,B,C)

1896. *Eupagurus pergranulatus* Henderson, *J. Asiat. Soc. Beng.*, : 520.

Diagnosis.—Rostrum obsolescent, eystalks longer than the anterior border of carapace; upper border of the right palm overhanging the base of the dactylus as a lobe.

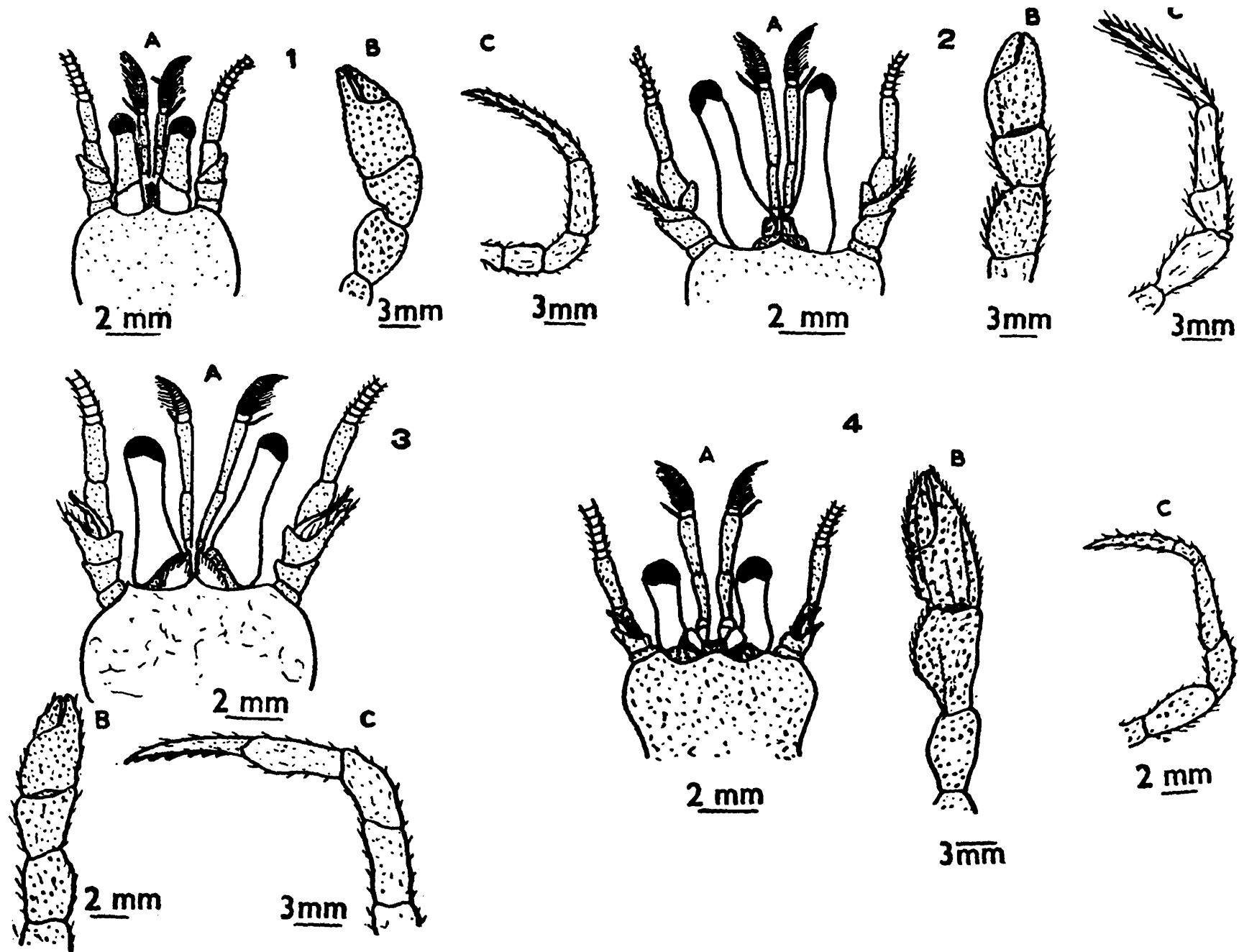
Description.—Carapace a little longer than broad. Rostrum obsolescent. Eystalks longer than the anterior border of the carapace. Ophthalmic scales narrow, foliaceous. Antennal peduncle reaches to the middle of the terminal joint of the antennular peduncle. Antennal acicle curved, smooth. Chelipeds unequal, the right being much the larger, the upper border of the right palm overhangs the base of the dactylus as a lobe. The 2nd and 3rd legs longer than the right cheliped by the dactylus.

Material.—About 50 specimens were collected from Lawson's Bay, Waltair.

Measurements.—Carapace length : 7.0 mm.

Distribution.—Andamans and north east coast of Ceylon.

Remarks.—This species is recorded for the first time from Bay of Bengal.



Text-fig. V— Fig. 1. *Diogenes miles* (Herbst). Fig. 2. *Pagurus pergranulatus* (Henderson). Fig. 3. *Pagurus anceps* Forest. Fig. 4. *Pagurus carpofoeraminatus* (Alcock). A. anterior portion of the animal; B. cheliped; C. walking leg.

***Pagurus anceps* Forest**

(Text-fig. V. Fig. 3, A,B,C)

1954. *Pagurus anceps* Forest, *Bull. Mus. Hist. Nat. Paris.*, 26.

Diagnosis.—Carapace a little longer than broad, rostrum long, acute, prominent. Ocular peduncles $5/7$ th the length of the anterior border of carapace. Right cheliped presents an important sexual dimorphism. Propodus and dactylus of walking legs subequal.

Description.—Carapace a little longer than broad, rostrum long, acuminate, denticles on the frontal margin not striking, ocular peduncles cylindrical, three times longer than broad, $5/7$ the length of the anterior border of carapace. Ocular scales broad, round, a small spine at the point of its attachment to the carapace. Last segment of the antennule exceeds the cornea in length. Antennal peduncle a little longer than ocular peduncle. Among the males, the propodus of the right cheliped is equal to the carapace in length, asymmetrical, internal border of the fixed finger oblique in relation to the longitudinal axis of the hand. Anterior region of the finger curved. Among the females the hand is scarcely longer than the anterior region of carapace. Propodus of the left cheliped $4/5$ th of the carapace in length. Chelipeds very finely granulated among adult males. In the females the granules have a tendency to grow into spiniform processes on the margins of the hand. Propodus and dactylus of walking legs subequal, a small corneous spinule is present on the ventral distal border of propodus; dactylus long, with 5-6 corneous spinules. The left 4th pleopod in the case of female and 3rd left pleopod in the case of male are biramous.

Material.—About 10 specimens were collected from Lawson's Bay, Waltair.

Measurements.—Carapace length : 6.0 mm.

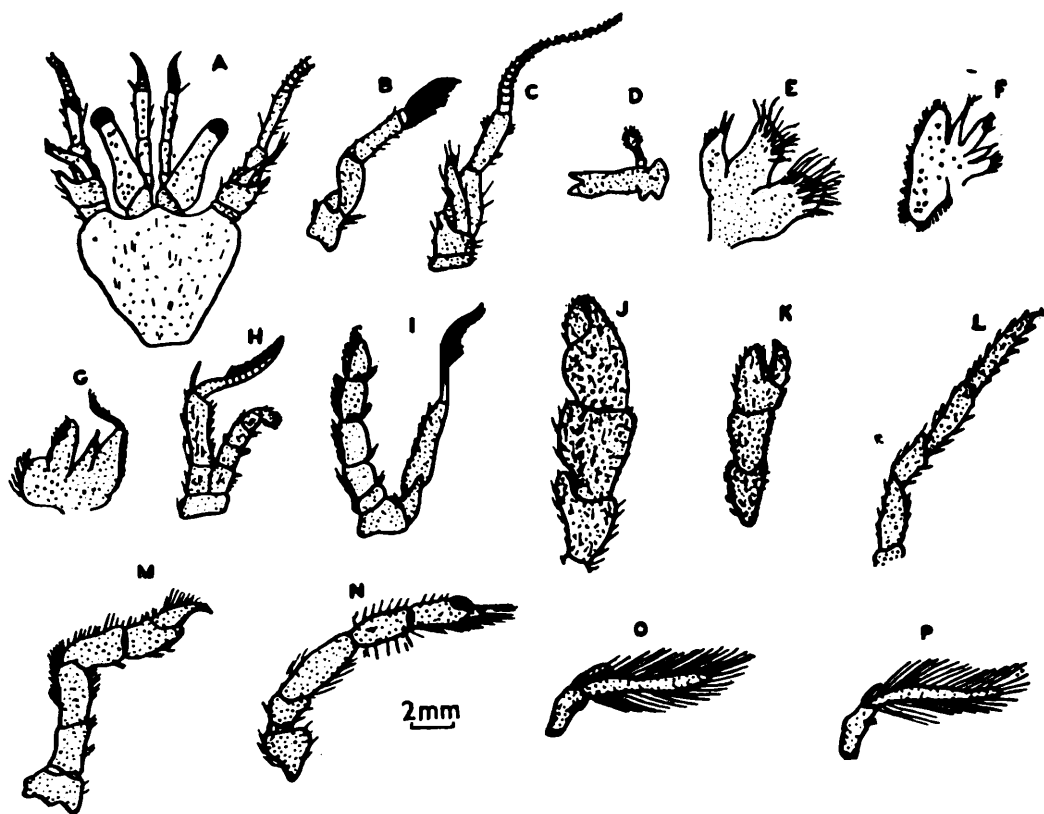
Distribution.—Cocos-Keeling islands.

Remarks.—This species is recorded for the first time from Indian coast.

***Pagurus indicus* sp. nov.**

(Text-fig. VI, A-P)

Diagnosis.—Carapace shield shaped, rostrum rounded, does not reach the antennal angles of carapace, frontal margins concave, finely serrated; ophthalmic scales leaf-shaped with hairs on margins, ocular peduncles shorter than anterior border of carapace, antennal acicle long, exceeds the proximal point of terminal segment; right cheliped longer and stouter than left, inner surface of merus of right cheliped with a rounded keel; outer and inner margin of carpus smooth, distal margin serrate, keel on the inner lateral surface denticulate, 6 prominent teeth arranged in a longitudinal row on the carpus; palm longer than broad, with a serrated longitudinal crest on the outer surface of palm. Cutting edges of fingers with 3 big and 3 small teeth.

TEXT-FIG VI. *Pagurus indicus*. sp. nov.

A. entire animal ; B. antennule ; C. antenna ; D. mandible ; E. 1st maxilla ; F. 2nd maxilla ; G. 1st maxilliped ; H. 2nd maxilliped ; I. 3rd maxilliped ; J. right cheliped ; K. left cheliped ; L. 2nd pereiopod ; M. 4th pereiopod ; N. 5th pereiopod ; O & P. pleopods.

Description.—The anterior hard portion of the abdomen shield-shaped, as long as broad, with 3 tufts of hairs on the gastric region ; rostrum rounded, does not reach the antennal angles of carapace, frontal margins on either side of rostrum concave and finely serrated, ophthalmic scales leaf-shaped, ocular peduncles shorter than anterior border of carapace, antennular peduncles more or less equal in length to antennal peduncle. Second segment of antennal peduncle longer than broad, acicle simple, exceeds the proximal end of the terminal segment of the peduncle ; chelipeds unequal, the right being longer and stouter than the left; upper inner and outer lateral surfaces of the right merus are quite smooth, the lower distal portion of the inner lateral surface forms a keel ; the carpus is longer and broader than merus, outer and inner margins smooth ; distal margin finely serrulate, the lower inner lateral surface forms a distal keel which is denticulate, 6 large teeth arranged in a longitudinal row on the mid-dorsal surface ; palm longer than broad, with a serrated longitudinal crest on the outer margin, the cutting edge of the fingers with 3 big and 3 small teeth, no keel on the merus and carpus and no longitudinal row of teeth on carpus and no crest on the palm are present on the left cheliped. The two chelipeds are covered with fine granules and sparsely setose. Pereiopods of both the sides surpass the tip of the right cheliped, the merus is longer than carpus, the propodus is covered on the anterior side with tufts of long hairs, dactylus smaller

than propodus, bears 6 spine like teeth on the posterior margin which increase in size distally, the tip is black and slightly falciform.

Material.—About 20 specimens were collected from Lawson's Bay, Waltair.

Measurements.—Carapace length : 6.0 mm.

Colour.—With red longitudinal bands on the chelipeds and legs which disappear in preserved specimens.

Remarks.—This species resembles *Pagurus kulkarnii* Sankolli in many respects. But it differs from it in the following aspects : (1) Frontal margin on either side of the rostrum concave and finely serrated, (2) no spines at the distal end of the antennal acicle and second segment of the antenna, (3) inner and outer margins of both merus and carpus smooth, (4) keel of the carpus denticulate, longitudinal row of 6 teeth on the carpus, (5) a longitudinal serrated crest on the outer margin of palm, (6) cutting edges of fingers with 3 small and 3 big teeth, (7) dactylus of walking legs with 6 spine-like teeth and (8) chelipeds and legs with red longitudinal bands in living condition.

***Pagurus carpofoaminatus* (Alcock)**

(Text-fig. V. Fig. 4, A,B,C)

1905. *Eupagurus carpofoaminatus* Alcock, *Cat. Ind. Mus. Crust.*, : 130.

Diagnosis.—Rostrum broad, rounded, eyestalks about $\frac{3}{4}$ the length of the anterior border of carapace ; antennal peduncle reaches to the middle of the terminal joint of the antennular peduncle. Right cheliped slender, larger than the left ; a pin-hole sized pit near the middle of the under surface of the carpus of cheliped.

Description.—Rostrum broad, rounded, not nearly so prominent as the well pronounced antennal angles of the carapace. Eyestalks about $\frac{3}{4}$ the length of the anterior border of the carapace. Ophthalmic scales narrow, foliaceous. The antennal peduncle reaches to the middle of the terminal joint of the antennular peduncle ; antennal acicle curved. Chelipeds tomentose, but not so as to conceal surface sculpture. Right cheliped rather stender but much larger than the left, about $2\frac{1}{2}$ times the length of the carapace. Near pre middle of the under surface of the carpus in the adult is a deep pin hole sized pit. The 2nd and 3rd legs, which are nude, considerably exceed the large cheliped.

Material.—Only 5 specimens were collected from Lawson's Bay Waltair.

Measurements.—Carapace length : 8.0 mm.

Distribution.—Bay of Bengal, Malabar coast and Ceylon.

III—ACKNOWLEDGEMENTS

We wish to express our sincere thanks to Prof. P. N. Ganapati and Prof. S. Mehdi Ali for kindly providing facilities to carry out the investigation. Thanks are also due to Dr. J. Forest, Paris for verifying

the pagurid collections and confirming the new species of *Pagurus* and to Dr. K. K. Tiwari for supplying the literature.

IV—SUMMARY

A detailed study of the anomuran fauna of Lawson's Bay, Waltair and Visakhapatnam harbour was made. During the course of the investigation, twenty three species belonging to the family Paguridae were recorded. Out of these, one species of *Pagurus*, *P. indicus* happens to be new to science. Besides, *Clibanarius striolatus*, *C. humilis*, *C. eurysternus* and *Pagurus anceps* are recorded for the first time from Indian coast.

V—REFERENCES

- ALCOCK, A. W., 1905. *Catalogue of the Indian decapod Crustacea in the collection of the Indian Museum. Pts. 1-3. Part 2. Anomura.* Trustees of Indian Mus, Calcutta, 197 pp.
- GRAVELY, F. H., 1941. Shells and other animal remains found on the Madras beach. 1. Groups other than snails. *Bull. Madras Govt. Mus. n.s. Nat. Hist.*, 5 : 75.
- HENDERSON, J. R., 1915. Crustacea decapod fauna of the Chilka lake. *Mem. Indian Mus.*, 5 : 190-325.
- KAMALAVENI, S., 1951. On hermit crabs (Paguridae) in the collection of Indian Museum. *Rec. Indian Mus.*, 47 : 77-85.
- SANKOLLI, K. N., 1961. On a new species of hermit crab, *Pagurus kulkarnii*, (Anomura, Paguridae). *J. zool. Soc. India*, 13 : 136-142.
- SUNDARA RAJ, B., 1927. The littoral fauna of Krusadai Island id Gulf of Mannar, Decapoda, Paguridea. *Bull. Madras Govt. Mus. n.s. Nat. Hist. Sec.* 1 : 129-134.

STUDIES ON SOME AMPHIBIAN TREMATODES FROM
WEST BENGAL AND MAHARASHTRA (PART-II)

By

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I—INTRODUCTION

In our earlier paper (1970) we have exhaustively dealt with amphibian trematodes from Uttar Pradesh and West Bengal. This paper is a continuation of the previous paper and includes a list of trematode parasites from West Bengal and Maharashtra. The detail descriptions of the species have not been included here as most of the species have been adequately dealt with by other workers and in our previous paper. However, the variations observed in the present material are briefly discussed wherever considered necessary. The paper also includes the distribution of the various species in India and elsewhere.

The parasites reported herewith were collected during our survey from certain parts of West Bengal and Ramtek, District Nagpur, Maharashtra. The collections from Ramtek were made by the senior author and those from West Bengal by the junior author.

Our thanks are due to the Director, Zoological Survey of India for providing laboratory facilities.

II—SYSTEMATIC ACCOUNT

Family : 1. LECITHODENDRIIDAE Odhner, 1910

Subfamily : 1. PLEUROGENETINAE Looss, 1899.

1. *Pleurogenoides gastroporus* (Lühe, 1901).

1901. *Pleurogenes gastroporus* Lühe, Zentbl. Bak. ParasitKde. Abt., 30 (4) : 166.

Material.—4 exs. (i) 1 ex. from intestine of *Rana tigrina*, Ramtek, 13. xi. 68 ; (iii) 3 exs. from intestine of *Rana cyanophlyctis*, Ramtek 11. xii. 68.

Distributions.—Sitapur, Bareilly, Allahabad, Varanasi (U.P.), Nagpur, Ramtek (Maharashtra), Dacca (Bangladesh).

Remarks.—This species is reported from different parts of U.P. Simha (1958) recorded this species from a reptilian host *Chamaeleon zeylanicus* from Hyderabad. This species or any other species of the genus *Pleurogenoides* has not yet been reported from West Bengal.

Sub family : 2. GANEONIAE Yamaguti, 1958.

2. **Ganeo tigrinum** Mehra and Negi, 1928.

1928. *Ganeo tigrinum* Mehra and Negi, *Allahabad Univ. Stud.*, 4 : 63.

Material.—13 exs. (i) 9 exs. from intestine of *Rana tigrina*, Ramtek, 13.xii.68 ; 24.xii.68 ; (ii) 4 exs. from intestine of *Rana cyanophlyctis*, Ramtek, 11.xii.68.

Distributions.—Allahabad, Varanasi, Bareilly, Almora, Bhimtal (U.P.), Jaisalmer (Rajasthan), Srinagar, Shalimar (Jammu and Kashmir), Hyderabad (A.P.), Nagpur, Ramtek (Maharashtra), Dacca (Bangladesh).

Remarks : The present lot shows some interesting variations in the position of the testes and ovary in relation to ventral sucker, caecal length in relation to vitelline follicles and the extension of vitellaria. These variations will be discussed in a separate paper. This species has also been recorded from *Chamaeleon zeylanicus* from Hyderabad by Simha (1958). This species has not yet been reported from West Bengal.

Family : 2. PARAMPHISTOMIDAE Fiscoeder, 1901.

Sub family : 3. DIPLODISCINAE Cohn, 1904.

3. **Diplodiscus amphichrus** Tubangui, 1933

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

Material.—12 exs. (i) 4 exs. from rectum of *Rana tigrina*, Howrah, 10.viii.67 ; (ii) 6 exs. from rectum of *Rana tigrina*, Ramtek, 6.x.68 ; and (iii) 2 exs. from rectum of *Rana tigrina*, Ramtek, 13.xii.68.

Distribution.—Sitapur, Almora, Bhimtal, Lucknow, Bareilly (U.P.), Bombay, Ramtek (Maharashtra), Srinagar, Shalimar, Punch, Bimna, Harwan, Hundawara, Shupyan (Jammu and Kashmir), Guntur (A.P.) Howrah (West Bengal), Philippines, Manchuria, Korea, Japan.

Remarks.—This species is widely distributed in India and elsewhere.

Family : 3. PLAGIORCHIIDAE Ward, 1917.

Sub family : 4. PLAGIORCHIINAE Pratt, 1902.

4. **Tremiorchis ranarum** Mehra and Negi, 1925

1925. *Tremiorchis ranarum* Mehra and Negi, *Proc. 12th. Indian Sci. Cong., Abs.*, pt. 3 : 147.

1926. *Tremiorchis ranarum* : Mehra and Negi, *Parasit.*, 18 (2) : 168.

Material.—10 exs. (i) 2 exs. from intestine of *Rana cyanophlyctis*, Ramtek, 11.xii.68 ; (ii) 8 exs. from intestine of *Rana tigrina*, Ramtek., 11.xii.68 ; 13.xii.68.

Distribution.—Sitapur, Lucknow (U.P.), Karnal (Haryana), Calcutta (West Bengal), Jabalpur, Ramtek (Maharashtra).

Remarks.—Some of the specimens in the present lot show variation in the beginning of the vitellaria. In some specimens they start from the middle level or slightly anterior of ventral sucker while in others they start from two different levels, thus, they are asymmetrical.

Family : 4. LECITHODENDRIIDAE Odhner, 1910.

Sub family : 5. PROSTOCINAE Yamaguti, 1958.

5. *Mehraorchis ranarum* Srivastava, 1934.

1934. *Mehraorchis ranarum* Srivastava, *Bull. Acad. Sci. U. P. Allahabad*, 3 (4) : 239.

Material.—6 exs. (i) 2 exs. from intestine of *Rana tigrina*, Ramtek, 11.xii.68 ; (ii) 4 exs. from liver of *Rana tigrina*, Ramtek, 12.xii.68.

Distribution.—Sitapur, Lucknow (U.P.), Hoshiarpur (Punjab), Udaipur (Rajasthan), Hyderabad (A.P.), Birati (West Bengal), Nagpur, Ramtek (Maharashtra), Dacca (Bangladesh).

Remarks.—Ovary variously placed in relation to ventral sucker. Uterus may or may not extend to post caecal ends.

Family : 5. HEMIURIDAE Lühe, 1901.

Sub family : 6. HALIPEGINAE Ejsmont, 1931.

6. *Halipegus mehransis* Srivastava, 1933.

1933. *Halipegus mehransis* Srivastava, *Bull. Acad. Sci. U. P. Allahabad*, 3 (1) : 42.

Material.—2 exs. from intestine of *Rana cyanophlyctis*, Ramtek, 11.xii.68.

Distribution : Sitapur, Bareilly (U.P.), Hyderabad (A.P.), Nagpur, Ramtek (Maharashtra), Burma, Ceylon.

Family : 6. PLAGIORCHIIDAE Ward, 1917.

Sub family : 7. HAEMATOLECHINAE Teixeira de Freitas *et* Lent, 1939. nom. emend. Yamaguti, 1958.

7. *Haematolechus almorai* (Pande, 1937).

1937. *Pneumonaeces almorai* Pande, *Proc. Indian Acad. Sci*, 6 : 114.

Material.—3 exs. from lungs of *Rana cyanophlyctis*, Ramtek, 11.xii.68.

Distribution.—Almora (U.P.), Srinagar (Jammu and Kashmir), Ramtek (Maharashtra).

Remarks.—This species has been recorded so far only from high altitude and this is the first record of the species from the plains.

Family : 7. BRACHICOELIDAE Johnston, 1912.

Sub family : 8. MESOCOELINAE Dollfus, 1929.

8. *Mesocoelium sociale* (Lühe, 1901).

1901. *Distoma sociale* Lühe, Zentrbl. Bakt. ParasitKde., Abt. 1, : 30
(4) : 171

Material : 348 exs. (i) 103 exs. from intestine of *Bufo melanostictus*, Burdwan, 13.vi.68 (ii) 245 exs. from intestine and rectum of *B. melanostictus*, Burdwan, 26.vii.68.

Distribution.—Calcutta, Burdwan (West Bengal), Rangoon (Burma), East Indies, Paraguay, Philippines.

Remarks.—Uterine coils in some of the specimens with eggs ascend up to the mouth giving a false impression about the genital pore. Position of testis and ovary also varies in relation to ventral sucker.

Family MICROPHALLIDAE Travassos, 1920

Subfamily MICROPHALLIDAE Ward, 1901

9. *Megalotriotrema dicaecus* (Mukherjee and Ghosh, 1967)

1967. *Microphallus dicaecus* Mukherjee and Ghosh, Zool. Anz., 178 (5/6) : 342.

1970. *Bengaliniella dicaecus* : Deblock, Mukherjee and Ghosh Ann. Parasitol. hum. comp., 45 (2) : 203.

1970. *Megalotriotrema dicaecus* : Deblock., Mukherjee and Ghosh, Ann. Parasitol. hum. comp., 45 (2) : 2211.

Material.—15 exs. (i) 2 exs. from liver of *Rana tigrina*, Sujapur, 9.viii.67 (ii) 1 ex. from rectum of *R. tigrina*, Sujapur, 9. viii. 67 and (iii) 12 exs. from intestine of *R. tigrina* Sujapur, 19.vi.68.

Distribution.—Sujapur (West Bengal).

Remarks.—After its first record, this species has subsequently been recovered from different locations in addition to its normal habitat in the intestine. There does not seem to be any appreciable difference in its size or topography of various organs.

III—REFERENCES

- MUKHERJEE, R. P. and GHOSH, R. K. 1970. Studies on some amphibian trematodes from Uttar Pradesh and West Bengal. *Indian J. Helminth*, 22 (1) : 67-78.
- SIMHA, S. S. 1958. Studies on the trematode parasites of reptiles found in Hyderabad State. *Z. ParasitKde.*, 18 : 161-218.
- YAMAGUTI, S. 1958. *Systema Helminthum*, Vol. 1 (1 & 2) New York.

ON A COLLECTION OF FISHES FROM SIKKIM

By

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I—INTRODUCTION

Sikkim is a small state, lying between latitude 27°5' and 28°9' N and longitude 86°59' and 88°56' E. This mountainous area lies wedged in between Tibet on the north, Bhutan on the east, Nepal on the west and the Indian state of West Bengal on the south. The only source of fish in this small state are rivers, namely the Lachen, the Lachung, the Zemu, the Talung, the Great Ranjeet, the Rangoli and the Rangpo; the Teesta river, which originates from Lhamo lake and enters West Bengal, gathers water from many of them. The importance of the knowledge of the fish fauna of this state would be fully realized by those engaged on the comparative studies of the ichthyo-faunae of the different regions along the Himalaya as well as by those, working on the Indo-central Asiatic faunae.

As early as 1845, McClelland described two species of the genus *Puntius* viz. *Puntius spinulosus* (McClelland) (= *Barbus spinulosus* McClelland) and *Puntius clavatus* (McClelland) (= *Barbus clavatus* McClelland) and one anabantid, *Ctenops nobilis* McClelland of his new genus *Ctenops* McClelland. All the three species were recorded from rivers at the foot of Sikkim mountains on the northern frontiers of Bengal. Günther (1868) mentioned the distribution of *Tor mosal* (Hamilton) (= *Barbus hexastichus* McClelland), *Danio aequipinnatus* (McClelland) (= *Danio lineolatus* (Blyth)) and *Noemacheilus rupecula* (McClelland) in that state. Day (1878) made a mention of these species and also showed the distribution of *Labeo dyocheilus* (McClelland) in Sikkim. Hora (1923) resurrected Günther's species from Nepal, *Glyptothorax gracilis*, on the basis of one specimen from Ranjeet River, Sikkim and in 1935 described two new loaches viz. *Noemacheilus devdevi* Hora and *N. inglisi* Hora from Sikkim. Later, Hora and Silas (1951, 52) recorded *Glyptothorax maculatum* (Ragan) from Sikkim. Menon (1954) attributed the distribution of *Glyptothorax striatus* (McClelland) and *Glyptothorax gracilis* (Günther) to the same place. Menon (1964) showed that *Garra lamta* Hamilton exists in this state. Apart from these short notices, there is no consolidated account of the fishes of Sikkim so far, in literature. By the study of the collection of fishes from Sikkim in the Zoological Survey of India, the present author finds that an equal number of more species with definite material could be added to the fish fauna of Sikkim, already known. In the present paper, therefore, a list of the fishes of Sikkim has been prepared

with the help of the collections lying in Zoological Survey of India and also including those mentioned in the literature. This paper should act as a basis for any future work on the fishes of Sikkim.

II—SYSTEMATIC LIST

A list of 26 species of fishes of Sikkim, based either on the material existing in Zoological Survey of India or on the reports in the literature, is given here. It is expected that some more species might be existing in that area and may come to light through future surveys.

Order SILURIFORMES

Family SISORIDAE

1. *Glyptothorax striatus* (McClelland)
2. *Glyptothorax gracilis* (Günther)
3. *Glyptosternum maculatum* (Regan)
4. *Pseudecheneis sulcatus* (McClelland)
5. *Euchiloglanis hodgarti* (Hora)

Order CYPRINIFORMES

Family CYPRINIDAE

6. *Schizothorax plagiostomus* Heckel
7. *Schizothorax richardsonii* (Gray)
8. *Puntius spinulosus* (McClelland)
9. *Puntius clavatus* (McClelland)
10. *Acrossocheilus hexagonolepis* (McClelland)
11. *Tor mosal* (Hamilton)
12. *Labeo dyocheilus* (McClelland)
13. *Garra lamta* Hamilton
14. *Garra annandalei* Hora
15. *Garra gotyla gotyla* (Gray)
16. *Barilius bendelisis* (Hamilton)
17. *Barilius vagra* Hamilton
18. *Barilius barna* Hamilton
19. *Barilius* sp.
20. *Danio aequipinnatus* (McClelland)
21. *Brachydanio rerio* (Hamilton)

Family COBITIDAE

22. *Noemacheilus devdevi* Hora
23. *Noemacheilus deTerrai* Hora
24. *Noemacheilus inglisi* Hora
25. *Noemacheilus repecula* (McClelland)

Order PERCIFORMES

Suborder ANABANTOIDEI

Family ANABANTIDAE

26. *Ctenops nobilis* McClelland

III—SYSTEMATIC NOTES

Order SILURIFORMES Greenwood *et al.*, 1966.

Family SISORIDAE Gill, 1872.

Genus *Glyptothorax* Blyth, 1860.

1. *Glyptothorax striatus* (McClelland)

1842. *Glyptosternon striatus* McClelland, *Calcutta J. nat. Hist.*, 2 : 587, pl. 6, figs. 1,2 (Type-locality : Khasi hills).

1954. *Glyptothorax striatus* : Menon, *Rec. Indian Mus.*, 52 : 53.

Material.—1 ex., below Gangtok, Sikkim, Coll. *F. M. Bailey*.

Remarks.—The skin is granulated. The supraoccipital spine does not reach the basal bone of the dorsal fin. The head and anterior part of the body are depressed. The dorsal fin is higher than the body. The paired fins are strongly plaited.

Distribution.—Sikkim, Assam.

2. *Glyptothorax gracilis* (Günther)

1864. *Glyptosternon gracile* Günther, *Cat. Fish. Brit. Mus.*, 5 : 186 (Type-locality : Nepal).

1954. *Glyptothorax gracile* : Menon, *Rec. Indian Mus.*, 52 : 48.

Material.—1. ex. from Ranjeet river, Manjhitar, Sikkim, Coll. *B. L. Chaudhuri*, 1913.

Remarks.—The skin is granulated. The supraoccipital spine touches the basal bone of the dorsal fin. The adhesive thoracic apparatus is longer than broad.

Distribution.—Sikkim, Nepal.

Genus *Glyptosternum* McClelland, 1842

3. *Glyptosternum maculatum* (Regan)

1905. *Parexostoma maculatum* Regan, *Ann. Mag. nat. Hist.*, (7) 15 : 183 (Type-locality : Lhasa, Tibet).

1951. *Glyptosternum maculatum* : Hora & Silas, *Rec. Indian Mus.*, 49 : 10.

Material.—1 ex. (damaged), Sikkim, Coll. *Lord Carmichael*.

Remarks.—The jaws have bands of conical teeth. The gill openings extend to ventral surface of the body. The pectoral fin has 11 rays. The rayed and adipose dorsal fins are separated from each other. The least height of the caudal peduncle is equal to half of its length. The head and body are greatly depressed.

Distribution.—Sikkim, Tibet.

Genus *Pseudecheneis* Blyth, 1860.4. *Pseudecheneis sulcatus* (McClelland)

1842. *Glyptosternon sulcatus* McClelland, *Calcutta J. nat. Hist.*, 2 : 587, pl. 6 (Type-locality : Khasi hills).

1877. *Pseudecheneis sulcatus* : Day, *Fish. India*, : 500, pl. 116, fig. 1.

Material.—1 ex., juvenile. Kholā river, near Gangtok, Indo-Swiss Sikkim Expedition, 1959.

Remarks.—In this specimen, the length of the head is 6.6 times in the total length (*Vs.* 7.5 times) and there are 15 transverse folds in the thoracic apparatus on the chest instead of 14. The gill openings are small and do not extend to the lower surface of the head. The gill membranes are attached to broad isthmus.

Distribution.—Sikkim, Assam, Darjeeling.

Genus *Euchiloglanis* Regan, 19075. *Euchiloglanis hodgarti* (Hora)

1923. *Glyptosternum hodgarti* Hora, *Rec. Indian Mus.*, 25 : 38. (Type-locality : Nepal, Pharping and Abor hills).

1951. *Euchiloglanis hodgarti* : Hora & Silas, *Rec. Indian Mus.*, 49 : 17.

Material.—2 exs., Somdong, 4.8 Kms. down of Chakung, W. Sikkim, 3. iii. 1959, Coll. A. G. K. Menon.

Remarks.—According to Hora and Silas (1951) the number of the branched rays in the pectoral fin is a very important character in separating the glyptosternoid genera as well as the species of the genus *Euchiloglanis* Regan. According to them *E. hodgarti* (Hora) has 16—17 branched rays in the pectoral fin and is different from *E. davidi* (Sauvage) and *E. myzostoma* Norman, which have 13—15 branched rays in the pectoral.

There are two specimens, from Somdong, 4.8 Kms. down of Chakung, Sikkim, which resemble *E. hodgarti* (Hora) in many characters but significantly differ in having 15 branched rays in the pectoral fin (*Vs.* 16—17 in *E. hodgarti* (Hora)). In addition to this, there are a few other points of difference in the measurements of the body. The measurements of the body of the two specimens are given below as reference for future workers.

D 1/6, P 1/15, V 1/5, A 4/5, C 3/2

Measurements in millimeters

Total length	116	71
Standard length	103	63
Length of head	23	14
Height of head at occiput	10	6
Width of head at base of pectoral	19	13
Body depth	13	9
Length of snout	10	6
Interorbital width	6	4
Length of caudal peduncle	9	5
Least height of caudal peduncle	7	4

Distance from snout tip to commencement of dorsal	31	20
Distance from snout tip to ventral base	36	22
Distance from snout tip to anal base	85	50
Distance from snout tip to anal opening	82	48.5
Distance from base of ventral to commencement of anal	49	30
Distance from anal opening to commencement of anal	3	1.5
Longest ray of dorsal fin	13	7
Length of pectoral fin	27	12
Length of pelvic fin	17	13
Length of caudal fin	13	8
Length of base of adipose dorsal fin	4	2
Gape of mouth	10	6

Distribution.—Sikkim, Nepal, Darjeeling, and Assam.

Order CYPRINIFORMES Berg, 1940

Suborder CYPRINOIDEI Berg, 1940

Family CYPRINIDAE (Bon, 1837) Gill, 1861.

Genus *Schizothorax* Heckel

6. *Schizothorax plagiostomus* Heckel

1838. *Schizothorax plagiostomus* Heckel, *Fische aus Caschmir* : 16, pl. 1
(Type-locality : Kashmir).
1959. *Schizothorax plagiostomus* : Misra, *Rec. Indian Mus.*, 57 : 166.

Material.—(i) 2 young exs., Rongni Chu, Tardhong, 13.xii. 1952, Coll. Unknown. (ii) 1 young ex. 16. xii. 1952, Coll. Unknown, Sikkim.

Remarks.—In this material the body is cylindrical with a covering of minute scales. There is a suctorial disc on the ventral side of the lower jaw. Along either side of the anal opening, there is a row of enlarged tile-like scales. There are some dark spots on dorsal side of the body.

Distribution.—Jammu, Kashmir, Uttar Pradesh, Assam, Eastern Himalaya, Sikkim, Bhutan, Nepal, Afghanistan.

7. *Schizothorax richardsonii* (Gray)

1832. *Cyprinus richardsonii* Gray, *Illust. Indian Zool.*, Hardwicke, pl. 94, fig. 2, (Type-locality : not mentioned).
1877. *Oreinus richardsonii* : Day, *Fish. India*, : 530, pl. 125, fig. 4.

Material.—9 young exs., Ranjeet river, Manjhitar, June, 1913, Coll. B. L. Chaudhuri.

Remarks.—The scales in the lateral line are less than 100. The scales of the anal sheath are equal to 2/3rd of eye diameter and the latter is less than 2 times in the interorbital width.

Distribution.—Uttar Pradesh, Eastern Himalaya, Nepal, Bhutan, Sikkim.

Genus *Acrossocheilus* Oshima, 1919

8. *Acrossocheilus hexagonolepis* (McClelland)

1839. *Barbus hexagonolepis* McClelland, *Indian Cyprinidae* : 270, 313, pl. 41, fig. 3 (Type-locality : Upper Assam).

1959. *Acrossocheilus hexagonolepis* : Misra, *Rec. Indian Mus.*, **57** : 148.

Material.—(i) 2 young exs., Rongni Chu, Tardong, North of Martin, 13. xii. 1952, Coll. Unknown; (ii) 24 young exs., Martin river, Martin, 16. xii. 1952, Coll. Unknown; (iii) 1 ex., Rani Khola, Rani pool, 15. viii. 1959, Coll. A. G. K. Menon ; and (iv) 1 ex., Rishi Khola, Rishi, 15. iv. 1959, Coll. A. G. K. Menon.

Remarks.—The species is distinguishable by the presence of a group of horny tubercles on cheeks and the lower lip is separated from the jaw which has a horny covering. In the young examples, there is a dark spot at the base of the caudal fin while the same is absent in the adults.

Distribution.—Throughout Eastern Himalaya, Assam, Burma, and further east, Sikkim, Nepal, Pakistan.

Genus *Tor* Gray, 1834.

9. *Tor mosal* (Hamilton)

1822. *Cyprinus mosal* Hamilton, *Fish. Ganges* : 306, 388 (Type-locality : Kosi river).

1940. *Barbus (Tor) mosal* : Hora, *J. Bombay nat. Hist. Soc.*, **41** : 784-94.

Material.—(i) 2 exs. from unspecified locality in Sikkim, Oct., 1928, Coll. Unknown. (ii) 49 exs. (young), Rongpo Chu, Rongpo, 8.xii.1952, Coll. Unknown.

Remarks.—In these specimens (measuring 205—256 mm.) the fin rays are D 4/9, V 1/8, A 3/5. There are 23 scales along the lateral line. The length of head is slightly smaller than the depth of the body. There are 4 barbels. The dorsal spine is bony and smooth. Eye diameter is nearly 5 times in length of head. Hora (1940) recorded, in Burmese specimens, that the eye is 3.3-4.2 times in head length. This may be due to difference in size of the fish.

In the young examples, the snout is smooth and there is a black spot at the base of the caudal.

Distribution.—Throughout Himalaya, Sikkim, Bhutan.

Genus *Garra* Hamilton, 1822

10. *Garra lamta* Hamilton

1822. *Cyprinus (Garra) lamta* Hamilton (in part), *Fish. Ganges*, : 344, 393 (Type-locality : Tinau river, tributary of Rapti river, at Butwal (Nepal), 33.6 Kms. North of Nautanwa in Gorakhpur, U. P.).

1964. *Garra lamta* : Menon, *Mem. Indian Mus.*, **14** (4) : 208.

Material.—(i) 1 ex., Chatra, Sikkim (ii) 18 exs., Ranjeet river, Manjhitar, (iii) 1 ex., Rongni Chu, Martin.

Remarks.— There are two pairs of barbels and 34 scales along the lateral line. The distance of the vent from base of anal fin is 4.5—5.0 times in that between anterior origin of the pelvics and the anal fin.

Distribution.—Darjeeling Himalaya, Eastern Nepal, Sikkim.

11. *Garra annandalei* Hora

1921. *Garra annandalei* Hora, *Rec. Indian Mus.*, 22 : 657 (Type-locality : Mahananda river, below Darjeeling).
 1964. *Garra annandalei* : Menon, *Mem. Indian Mus.*, 14 (4) : 217.

Material.—(i) 1 ex., Hi, west of Pachrek, 3.iv. 1959, Coll. A. G. K. Menon, (ii) 12 exs., Rishi Khola, Rishi, 15. xii. 1959, Coll. A. G. K. Menon.

Remarks.—It resembles *Garra lamta* Hamilton but differs only in having the tip of the snout being marked off by a deep transverse groove and that the distance of the vent from the base of anal fin is nearly 3 times in that between anterior origin of pelvic and anal fins.

Distribution.—Darjeeling Himalaya, Nepal, Sikkim.

12. *Garra gotyla gotyla* (Gray)

1832. *Cyprinus gotyla* Gray, *Illust. Indian Zool. Hardwicke*, 1, pl. 88, figs. 3,3a (Type-locality : Northern India).
 1964. *Garra gotyla gotyla* : Menon, *Mem. Indian Mus.*, 14 (4) : 233.

Material.—(i) 5 young exs., Rishi Khola, Rishi, 12.iv. 1959, Coll. A. G. K. Menon ; (ii) 1 young ex., Dikchi khola, 14. viii. 1959. Coll. A. G. K. Menon ; and (iii) 2 exs., Khola river, Gangtok, 1959, Coll. A. G. K. Menon.

Remarks.—There is a mild probosis with a single projection, without lateral lobes on the snout. The height of the body is slightly more than 5 times in the standard length.

Distribution.—Assam, Chota Nagpur plateau, Vindhya Mountains, Upper Burma, Pakistan, Sikkim.

Genus *Barilius* Hamilton, 182213. *Barilius bendelisis* (Hamilton)

1807. *Cyprinus bendelisis* Hamilton, *Journey Mysore*, 3 : 345. pl. 32, (Type-locality : rivers of mysore).
 1822. *Cyprinus (Barilius) bendelisis* : Hamilton, *Fish. Ganges*, : 270, 385.
 1959. *Barilius bendelisis* : Misra, *Rec. Indian Mus.*, 57 : 141.

Material.—1 ex., Martin river, 16. xii. 1952, Coll. Unknown.

Distribution.—Throughout India, Sikkim, Pakistan, Ceylon.

14. *Barilius vagra* Hamilton

1822. *Cyprinus (Barilius) vagra* Hamilton, *Fish Ganges* : 269, 385 (Type-locality : Ganges at Patna).
 1878. *Barilius vagra* : Day, *Fish. India* : 589, pl. 148, fig. 3.

Material.—3 exs., Ranjeet river, Manjhitar, June, 1913, Coll. B. L. Chaudhuri.

Remarks.—There are four barbels and 12-13 dark bands descending from the back to the lateral line. Hora (1937) stated that

Barilius modestus Day was simply a colour variant of *B. vagra* Hamilton, on the assumption that the specimens of the latter species, from Nepal in his collection, bore no colour bands. A specimen in the present collection, too, lacks colour bands completely. This species is distinguished from *B. modestus* Day, on characters other than the colour bands. The absence of the colour bands could be attributed to the particular ecological conditions.

Distribution.—Assam, Bengal, Bihar, Punjab, Jammu, Himachal Pradesh, Uttar Pradesh, Sikkim, Nepal, Pakistan, Ceylon.

15. *Barilius barna* Hamilton

1822. *Cyprinus (Barilius) barna* Hamilton, *Fish. Ganges*, : 268. 384, (Type-locality : Yamuna and Brahmaputra rivers).
1878. *Barilius barna* : Day, *Fish, India*, : 592, pl. 147, figs. 1, 2.

Material.—2 exs., unspecified locality of Sikkim, Coll. Unknown.

Distribution.—Assam, Bengal, Bihar, Orissa, Sikkim, Pakistan.

16. *Barilius* sp.

Material.—1 ex., Ranjeet river, Manjhitar, June, 1913, Coll. B. L. Chaudhuri.

Remarks.—There is one specimen of the genus *Barilius* which resembles *B. bonarensis* Chaudhuri (from Garhwal, U. P.) in a few characters but differs in another few. Since there is only one specimen, I give here only its description and leave it to be compared in future, if more specimens from the same locality are procured.

D. 2/7, P. 1/13, V. 1/8, A. 3/11, C. 19

Head 4.4 in standard length, 5.5 in total length. Depth of body 5.1 in standard length, 6.5 in total length. Eye diameter 3.3 in head length; equal to inter-orbital width. Snout smaller than diameter of eye. Two pairs of barbels; mandibular pair extremely small, maxillary ones nearly 1/3rd head length. Pectoral fin smaller than head, does not reach pelvics; the latter reach anal opening. Dorsal origin midway between eye and base of caudal fin. Caudal deeply forked. 45 scales along lateral line, 20 rows ahead of dorsal fin.

Measurements in millimeters

Total length	74.0
Standard length	58.0
Head length	13.3
Depth of body	11.4
Diameter of eye	4.0
Snout length	3.1
Interorbital width	4.0
Maxillary barbels	4.4
Pectoral fin	11.2
Length of caudal peduncle	13.0
Least height of caudal peduncle	5.5

Genus **Danio** Hamilton, 182217. **Danio aequipinnatus** (McClelland)

1839. *Perilampus aequipinnatus* McClelland, *Indian Cyprinidae*, : 395, pl. 60, fig. 1 (Type-locality : Assam)
 1878. *Danio aequipinnatus* : Day, *Fish. India.*, : 596, pl. 110, fig. 5.

Material.—34 exs., Ranjeet river, Manjhitar, June, 1913, Coll. B. L. Chaudhuri.

Distribution.—Assam, Bengal, Darjeeling, Sikkim, Penninsular India, Bangla Desh, Burma, Ceylon.

Genus **Brachydanio** Weber & Beaufort, 191618. **Brachydanio rerio** (Hamilton)

1822. *Cyprinus rerio* Hamilton, *Fish Ganges*, : 323, 390 (Type-locality : Kosi river).
 1878. *Danio rerio* : Day, *Fish. India* : 597, pl. 111, fig. 4.

Material.—4 exs., Rorathong, near Pakyang, 28.1.1941, Coll. S. L. Hora.

Distribution.—Bengal, Bihar, Uttar Pradesh, Peninsular India, Sikkim.

Genus **Noemacheilus** van Hasselt, 182319. **Noemacheilus devdevi** Hora

1935. *Noemacheilus devdevi* Hora, *Rec. Indian Mus.*, 37 : 54. (Type-locality : Eastern Himalaya, small streams below Darjeeling and in Sikkim).

Material.—(i) 5 exs., Rongni Chu, Tardong, 13. xii. 1952, Coll. Unknown. (ii) 1 ex., Martin river, Martin, 16. xii. 1952, Coll. Unknown.

Distribution.—Eastern Himalaya, Sikkim.

20. **Noemacheilus deTerrai** Hora

1936. *Noemacheilus deTerrai* Hora, *Mem. Conn. Acad. Arts. & Science*, 10 : 311 (Type-locality : North India, Yale North India Expedition, 1932).

Material.—2 exs., Ranjeet river, Manjhitar, June, 1913, Coll. B. L. Chaudhuri.

Remarks.—The species is characterised by the presence of elongated dorsal fin and the elongated caudal peduncle. The shape of the caudal fin is characteristic of the species.

Distribution.—Northern India, Sikkim.

IV—ACKNOWLEDGEMENTS

The author is grateful to Dr. A. P. Kapur, Director, Zoological Survey of India, Calcutta for his continuous encouragement and to Dr. A. G. K. Menon, Superintending Zoologist, for his interest in the work.

V—SUMMARY

The collection of fishes from Sikkim, lying in Zoological Survey of India, Calcutta, has been studied. A list of 26 species of fishes, known so far from this state, is prepared, and interesting characters of the material are recorded.

VI—REFERENCES

- DAY, F. 1875-78. *The fishes of India*. William Dawson and Sons. Ltd., London (Reproduced and printed by Photolitho offset).
- GÜNTHER, A. 1868. *Catalogue of fishes in the British Museum*, London.
- HORA, S. L. 1923. Notes on the fishes in the Indian Museum. V. on the composite genus—*Glyptosternon* McClelland.—*Rec. Indian Mus.*, Calcutta, **25** : 25.
- HORA, S. L. 1935. Notes on the fishes in the Indian Museum. XXIV. Loaches of the genus *Noemacheilus* from Eastern Himalayas with the description of a new species from Burma and Thailand.—*Rec. Indian Mus.*, Calcutta, **37** : 54, 58.
- HORA, S. L. 1937. Notes on fishes in the Indian Museum. XXIX. On a collection of fish from Nepal.—*Rec. Indian Mus.*, Calcutta, **39** : 44.
- HORA, S. L. 1940. Game fishes of India. X. The Mahseers or the large scaled barbels of India. 3. The Mosal Mahseer, *Barbus* (*Tor*) *mosal* (Hamilton).—*J. Bombay nat. Hist. Soc.*, Bombay, **41** : 784-794.
- HORA, S. L. and SILAS, E. G. 1951. Notes on fishes in the Indian Museum. XLVII. Revision of the Glyptosternoid fishes of the family Sisoridae. with description of new genera and species.—*Rec. Indian Mus.*, Calcutta, **49** : 5-29, 2 text-figs., 1 pl.
- HORA, S. L. and SILAS, E. G. 1952. Evolution and distribution of glyptosternoid fishes of the family Sisoridae (Order : Siluroidea).—*Proc. nat. Inst. Sci. India*, New Delhi, **18** (4) : 309-322.
- MCCLELLAND, J. 1845. Description of four species of fishes from the river at the foot of Boutan mountains.—*Calcutta J. nat. Hist.*, Calcutta, **5** : 280, 281.
- MENON, A. G. K. 1964. Monograph of the cyprinoid fishes of the genus *Garra* Hamilton.—*Mem. Indian Mus.*, Calcutta, **14** (4) : 236.
- MENON, M. A. S. 1954. Notes on fishes of the genus *Glyptothorax* Blyth.—*Rec. Indian Mus.*, Calcutta, **52** : 48, 53.

THE HELMINTH FAUNA OF ANDAMAN AND
NICOBAR. NEMATODA

By

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and

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Zoological Survey of India, Calcutta

(With 3 Text-figures and 2 Tables)

I—INTRODUCTION

Very little is known about the helminth fauna of the Andaman and Nicobar Islands. While trematodes and nematodes have been casually reported by Sewell (1922) and Bhalerao (1935), cestodes and acanthocephalans have remained practically untouched. The helminth fauna of these islands is of special interest due to the fact that the fauna of this area seems to occupy an overlapping area of two different zones viz., Indian and Malayan.

During 1969 (February-April) the Zoological Survey of India conducted a general faunistic survey of these islands. The nematode material, comprising eight species obtained in the course of this survey, forms the subject of this paper. Some interesting variations and new host and locality records have been brought to light.

The paper also includes a summary of the results of the helminthological studies carried out since Sewell (1922) and Bhalerao (1935).

We are thankful to Dr. A. P. Kapur, Director, Zoological Survey of India, Calcutta, and Dr. B. S. Chauhan, Deputy Director, Zoological Survey of India, for their kind encouragement in the completion of this paper.

II—DESCRIPTION

***Meteterakis andamanensis* Soota and Chaturvedi, 1970.**

(Text-fig. 1)

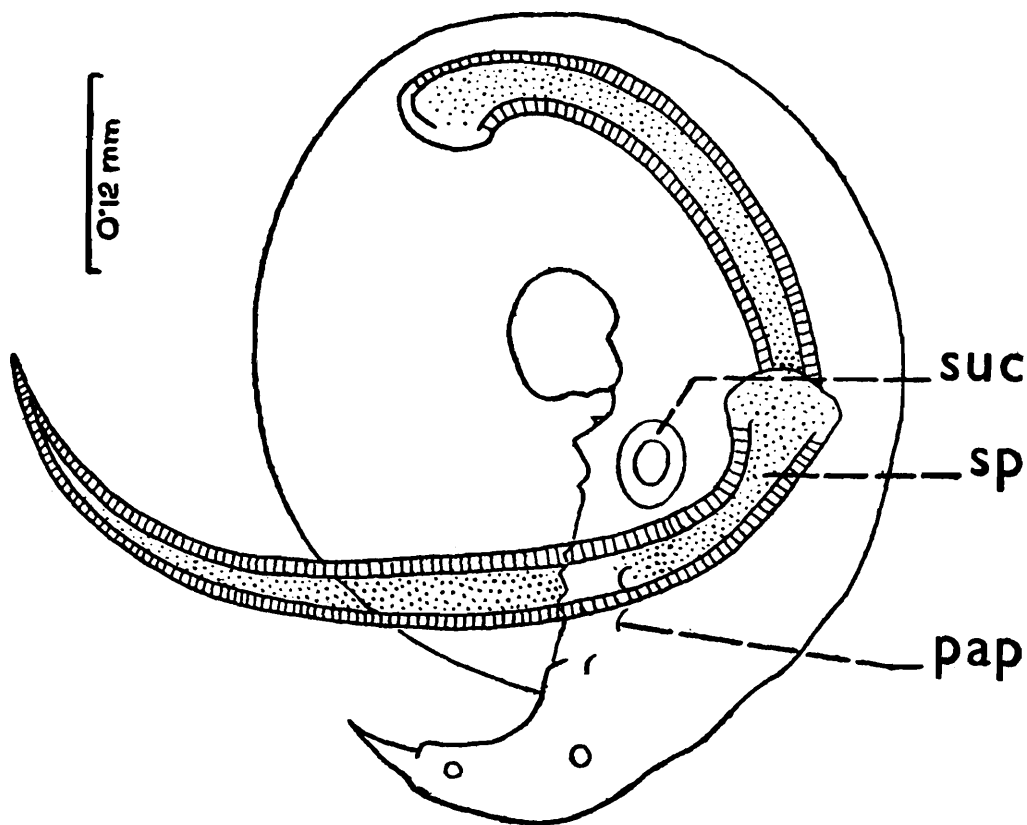
1970. *Meteterakis andamanensis* Soota and Chaturvedi, *Proc. Indian Sci. Congr.*, 450.

Material examined—Holotype—♂, Z.S.I. Reg. No. w 6902/1, host—*Bufo* sp., location—rectum, locality—Maya Bundar (Middle Andaman), collector—T. D. Soota, 27. iii. 1969. Paratypes—Several ♂♂ and ♀♀, Z.S.I. Reg. No. w 6903/1. Other details as for holotype.

All measurements are in millimeters

Description.—Male : Body 3.85-5.0 long, 0.22-0.3 wide ; oesophagus 0.66-0.88 long ; bulb 0.11-0.14 x 0.14-0.16 ; tail 0.16-0.19 long ; sucker 0.055-0.066 long and 0.066-0.077 away from cloaca ; spicules two, equal, non-alate and well-chitinised, 0.4-0.5 long ; papillae, presuctorial one pair, suctorial three pairs, postsuctorial or adanal three pairs, and caudal three pairs and distributed over the tail, sub-ventral papillae not clearly discernible due to the tail region being very closely spiralled.

Female : Body 4.12-5.5 long, 0.22-0.3 wide ; oesophagus 0.55-0.66 long ; bulb 0.11-0.12 x 0.15-0.16 ; vulva 1.6-1.8 away from anterior end ; tail 0.28-0.3 long ; eggs 0.044 x 0.044 in diameter.



TEXT-FIG. 1. *Meteterakis andamanensis* soota & chaturvedi Posterior end of Male.

Remarks.—The present species comes close to *M. govindi* Karve, 1930, and *M. japonica* (Wilkie, 1930) Inglis, 1957, but differs from the first species in various body measurements, in having bigger sucker, lesser number of papillae and their arrangement and in such bigger and chitinised spicules.

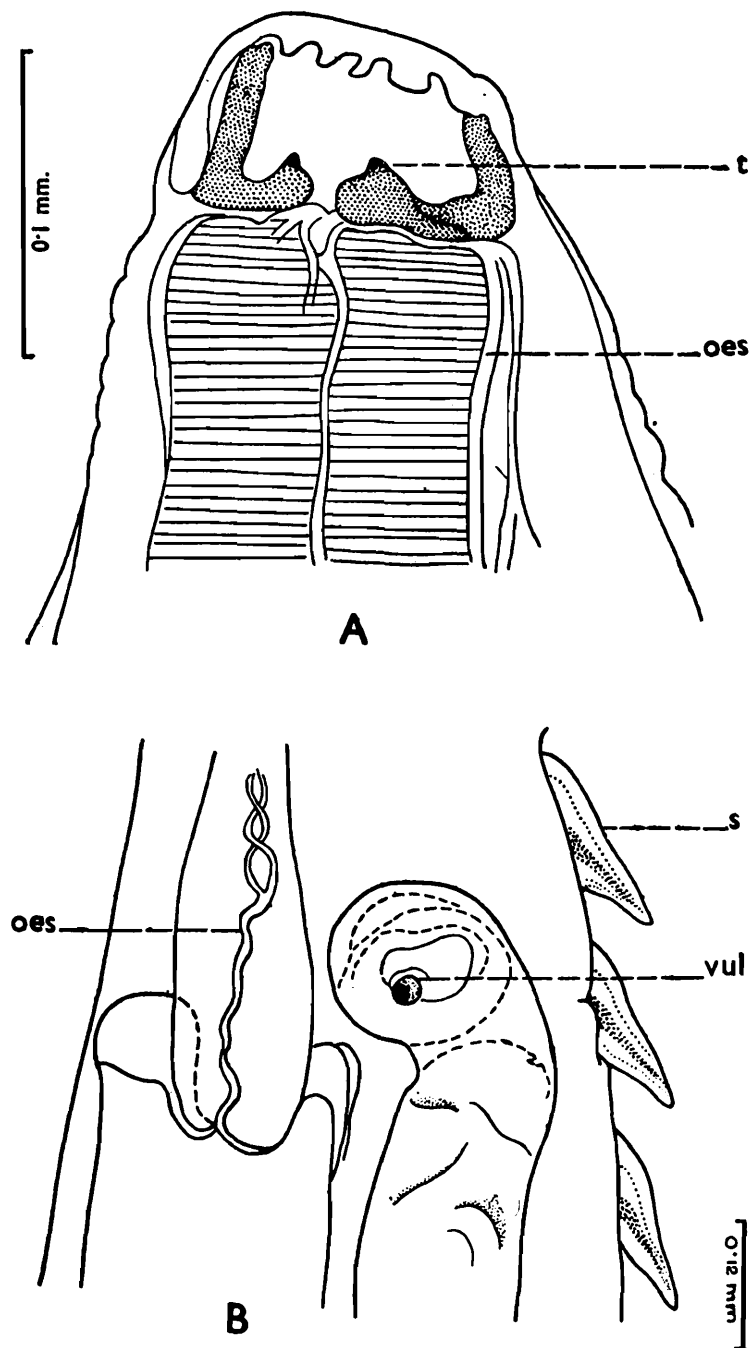
It differs from the second species in various body measurements, in possessing smaller spicules, and in the number and arrangement of papillae.

***Rictularia nicobarensis* Soota and Chaturvedi, 1970.**

(Text-figs. 2, a & b ; and 3, a-c)

1970. *Rictularia nicobarensis* Soota and Chaturvedi, *Proc. Indian Sci. Congr.*, 450

Material examined.—Holotype—♀, Z. S. I. Reg. No. w 6904/1, host—*Rattus rattus*, location—intestine, locality—Car Nicobar, collector—T. D. Soota, 12.iii.1969. Paratype—♀, Z. S. I. Reg. No. w 6905/1. Other details as in holotype.

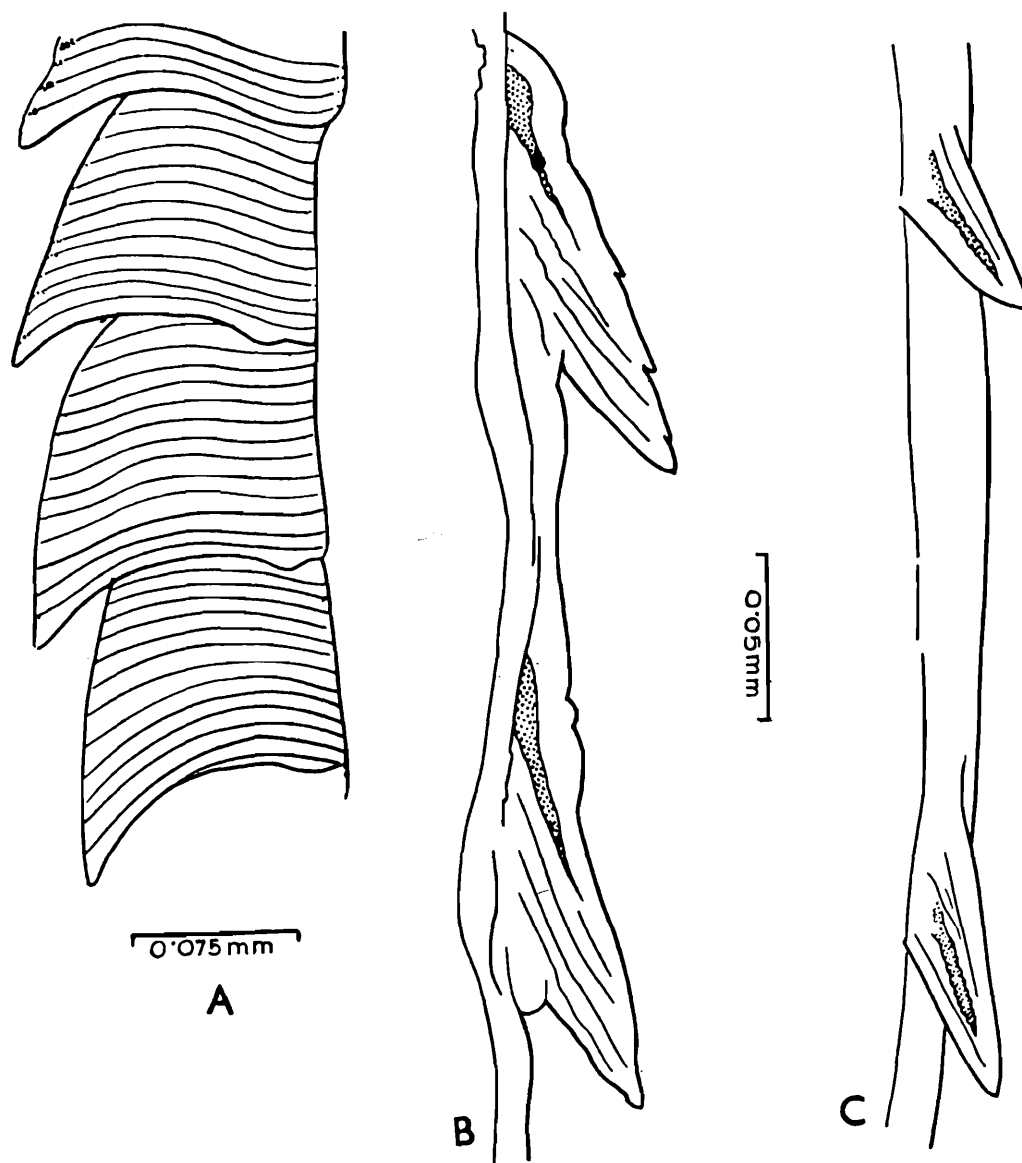


TEXT-FIG. 2. *Rictularia nicobarensis* Soota & Chaturvedi

(a) Anterior region (b) Body region showing vulva.

Description.—Female : Body 27.5-29.2 long, 0.82-0.88 wide ; buccal capsule 0.066-0.077 long and 0.099 wide ; wall of capsule, dorsal 0.044 and ventral 0.066 long ; oesophagus 3.85-4.0 long ; vulva 3.58-3.85 from anterior end and a little anterior to the junction

of the oesophagus and intestine ; two subventral rows from buccal capsule to cloacal region, each consisting of 90-92 combs and spines with 45-46 on either side of vulva, combs gradually narrowing behind the vulva and becoming more lengthened and spine-like, and spines more shortened from posterior fourth of body ; combs, prevulvar 0.16×0.11 , spines, postvulvar 0.22×0.11 , and posteriormost 0.033×0.022 in size ; tail $0.31-0.33$ long ; eggs 0.055×0.044 in diameter.



TEXT-FIG. 3, *Rictularia nicobarensis* Soota & Chaturvedi (a) Combs of anterior region (b) Spines of middle region (c) Spines of posterior region,

Remarks.—Characters of 30 species of the above genus were tabulated by Dollfus and Desportes (1944-45). Subsequently Yamaguti (1961) listed 45 species under the genus. Out of these species only four viz., *R. cahirensis* Jägerskiöld, 1904, *R. elvirae* Porona 1889, *R. mjöbergi* Baylis, 1928, and *R. ratti* Khera, 1956, occur within Indian limits, and out of these in turn only the last one has been

recorded from a rat. But our species differs from it in body size, and in the number of combs and spines (57 in *ratti* vs. 92 in the new species). It also differs from the other three species in body size, in the number of combs and spines, and in the position of vulva.

Porrocaecum angusticolle (Molin, 1860), Baylis and Daubney, 1922.

Material examined.—Two ♂♂ and two ♀♀, Z. S. I. Reg. Nos. w 6906-7/1 host Crested—serpent eagle, location—stomach and intestine, locality—Burma Dera, Maya Bundar (Middle Andaman), collector—T. D. Soota, 27.iii.1969.

Male.—Body 47.4-52.8 long, 0.9-1.0 wide; head 0.2-0.22 long, 0.26-0.29 wide; oesophagus 3.4-3.47 long; ventriculus 0.9-0.94 long; intestinal caecum 2.2-2.3 long; tail 0.28-0.33 long; spicules equal, 0.77-0.88 long, with membrane narrowing towards tips; papillae, preanal 12-13, postanal 5-6 pairs clearly discernible.

Female.—Body 55-57 long, 1.2-1.5 wide; head 0.22-0.27 long and 0.3-0.33 wide; oesophagus 4.6-4.8 long; ventriculus 1.18-1.2 long; intestinal caecum 3.4-3.5 long; vulva 21-22 away from anterior end.

Remarks.—The genus forms the first locality record and the species first host record from these islands.

Contracaecum haliaeti Baylis and Daubney, 1923.

Material examined.—a ♂ and a ♀, Z. S. I. Reg. No. w 6908/1, host—Crested serpent eagle, location—intestine, locality—Wrightmyo (South Andaman), collector—T. D. Soota, 3.iv.1969.

Male.—Body 28.5 long, 1.27 wide; head 0.11 long and 0.21 wide; dorsal lip 0.11 wide; interlabia 0.077 long; oesophagus 4.4 long; ventriculus 0.28 and appendix 0.8 long; intestinal caecum 3.3 long; spicules equal, 3.85 long; tail 0.39 long; papillae, preanal 7-8, postanal 5 pairs clearly discernible.

Female.—Body 26.4 long, 1.16 wide; head 0.11 long and 0.21 wide; dorsal lip 0.13 wide; interlabia 0.09 long; oesophagus 3.63 long; ventriculus 0.33 and appendix 0.6 long; intestinal caecum 2.53 long; vulva 12.1 away from anterior end; tail 0.33 long; eggs 0.044 × 0.055 in diameter.

Remarks.—The genus forms the first locality record and the species first host record from these islands.

Ascaridia ? galli (Schrunk, 1788) Freeborne, 1923.

Material examined.—a ♂ and two ♀♀, Z. S. I. Reg. No. w 6909/1, host—Grey-headed parakeet, location—intestine, locality—Port Blair, collector—T. D. Soota, 1.iv.1969; two ♀♀, Z. S. I. Reg. No. w 6910/1, host and location—same as above, locality—Kalighat (North Andaman), 28.iii. 1969 three ♂♂ and five ♀♀, Z. S. I. Reg. No. w 6911/1, host Orange-cheeked parakeet 28.iii.1969. Other particulars as under two above.

Male.—Body 37.0-38.5 long, 1.2-1.35 wide; head 0.19-0.22 long and 0.24-0.34 wide; oesophagus 2.86-3.2 long; sucker 0.28-0.33

long and 0.28-0.33 away from cloaca ; spicules equal, 2.2-2.5 long ; tail 0.74-0.85 long ; papillae, preanal, three pairs and situated between sucker and cloaca, postanal, seven pairs.

Female.—Body 27.3-40.5 long, 1.1-1.4 wide ; head 0.16-0.18 long and 0.31-0.39 wide ; oesophagus 2.2-3.0 long ; vulva 14.6-22.0 away from anterior end ; tail 0.99-1.1 long.

Remarks.—The present specimens are doubtfully assigned to *A. galli* on the basis of caudal papillae and body measurements.

Diplotriaena sp.

Material examined.—Three ♀ ♀ (damaged), Z. S. I. Reg. No. w 6912/1, host—White-cheeked bulbul, location-body cavity, locality-South point, Port Blair, collector-T. D. Soota.

Female.—Body 35.0 long, 0.66 wide ; tridents 0.18 long, vulva 0.66 away from anterior end ; eggs 0.022×0.033 in diameter.

Remarks.—The genus forms the first locality record. Specific identification was not possible as the specimens represented were all females.

Hastospiculum macrophallos (Parona, 1889) Baylis, 1930.

Material examined.—a ♂ and two ♀ ♀ (damaged), Z. S. I. Reg. No. w 6913/1, host—*Varanus* sp., location-body wall, locality-Chukchukia, Car Nicobar, collector—T. D. Soota, 4.iii.1969.

Male.—Body 90.0 long, 0.72 wide ; oesophagus divided into two portions, anterior muscular 0.22, posterior glandular 15.6 long ; spicules alate, unequal, left 4.4 and right 0.55 long ; caudal alae well-developed and continuous round the posterior extremity ; papillae, preanal five pairs, of which anterior two lateral and posterior three subventral in position ; postanal three pairs, of which last two small.

Remarks.—Both the genus and the species form new locality records.

Tanqua tiara (Linstow, 1879) Blanchard, 1904.

Material examined.—a ♀, Z. S. I. Reg. No. w 6914/1, host—*Varanus* sp. location—stomach, locality—Car Nicobar, collector—T. D. Soota, 14.iii.1969.

Female.—Body 22.0 long, 0.66 wide ; head bulb 0.38 wide and with four swellings ; oesophagus 4.5 long ; nerve ring 0.6 away from anterior end ; vulva 9.13 away from posterior end ; tail 0.33 long.

Remarks.—All the measurements fall within the range given by Baylis (1939), excepting the situation of vulva which appears to be a little behind the middle instead of posterior quarter.

III—SUMMARY

The paper deals with eight species of nematodes from the Andaman and Nicobar Islands, out of which two viz., *Meteterakis andamanensis* Soota and Chaturvedi and *Rictularia nicobarensis* Soota

and Chaturvedi are described in detail and the remaining six show interesting hitherto unrecorded variations and form new locality records. It also includes some statistics bearing on the incidence and intensity of infection and host-parasite relationship.

IV—REFERENCES

- BAYLIS, H. A. 1939. *The fauna of British India, including Ceylon and Burma*. Nematoda, 2, 274 pp., London.
- BHALERAO, G. 1935. Helminth parasites of the Indian Elephant from the Andamans and Burma. *Indian Jour. Vet. Sci. and Anim. Husb.*, Delhi, 5, pp. 1-14.
- DOLLFUS, R. P. and DESPORTES, C. 1946. Sur le genre *Rictularia* Frolich, 1802 (Nematodes ; spiruroidea). *Ann. Parasit. Hum. et. comp.*, Paris, 20 (1/2), pp. 4-6.
- YAMAGUTI, S. 1961. *Systema Helminthum*, vol. 3. The nematodes of vertebrates, pt. 1 & 2, 1261 pp. New York.

TABLE I.—A List of Helminths of Andaman and Nicobar Islands

Sl. No.	Species	Host	Location	Locality
Trematoda				
1.	<i>Pfenderius popillatus</i> (Cobbold, 1882).	<i>Elephas maximus indicus</i>	Large intestine	Andamans
2.	<i>P. heterocoeca</i> (Fukui, 1929).	„ „ „	Intestine	„
3.	<i>Cercariae indicae</i> Sewell, 1922.	—	—	„
4.	<i>Acanthoparyphium cambellensis</i> Soota et al. 1969.	<i>Plurialis dominica</i> (Golden plover)	Intestine	Cambell Bay, Great Nicobar ; and Maya Bundar, Middle Andaman.
5.	<i>A. lobatum</i> Soota et al, 1970.	(Plover)	„	Maya Bundar, Middle Andaman.
6.	<i>Brachylecithum andamanensis</i> Soota et al. 1970.	<i>Halcyon chloris</i> (White collared King-fisher)	„	„
7.	<i>Diacetabulum nicobarensis</i> Soota et al. 1970.	<i>Tringa</i> sp. (Sand piper)	„	Galathea Bay, Great Nicobar.
8.	<i>Maculifer spiralis</i> Soota et al. 1969.	(Marine fish)	„	Cambell Bay, Great Nicobar.
9.	<i>Neodiplostomum elongatum</i> Soota et al. 1969.	<i>Spilornis Cheela</i> (Crested Serpent eagle)	Rectum	Casurina Bay and Galathea Bay, Great Nicobar.
10.	<i>Eumegacetes</i> sp.	<i>Plurialis dominica</i> (Golden plover)	Intestine	Cambell Bay, Great Nicobar.

Table 1 (Contd.)

Sl. No.	Species	Host	Location	Locality
Nematoda				
11.	<i>Equinurbia sipunculiformis</i> (Baird, 1859)	<i>Elephas maximus indicus</i>	Large intestine	Andamans
12.	<i>Murshidia falcifera</i> (Cobbold, 1882)	„ „ „	Intestine	„
13.	<i>Oswaldocruzia filiformis</i> (Goeze, 1782) Trav. 1917.	<i>Bufo melanostictus</i>	Rectum	Nancowry, Nicobars.
14.	<i>Ascaridia ? galli</i> (Schrank, 1788) Freeborn 1923.	(Orange cheeked Parakeet) Grey headed Parakeet	Intestine	Port Blair, South Andaman ; and Kalighat, North Andaman
15.	<i>A. andamanensis</i> Soota and Chaturvedi, 1970.	<i>Haliaetus leucogaster</i> (White Bellied Sea Eagle)	„	South Andaman.
16.	<i>A. nicobarensis</i> Soota et al. 1969.	(Nicobar Parakeet)	„	Great Nicobar
17.	<i>Syngamus indicus</i> (Monning, 1932).	<i>Elephas maximums indicus</i>	Larynx	Andaman.
18.	<i>Ophidascaris filaria</i> (Duj., 1845) Baylis, ~1921.	<i>Python</i> sp.	Intestine	Great Nicobar
19.	<i>Porrocaecum angusticolle</i> (Molin, 1860) Baylis and Daubney, 1922.	<i>Spilornis cheela</i> (Crested Serpent Eagle).	„	Maya Bundar, Middle Andaman.
20.	<i>Contracaecum haliaeti</i> Baylis and Daubeney, 1923.	„ „ „	„	Wrightmyo, South Andaman.
21.	<i>Meteterakis andamanensis</i> Soota and Chaturvedi, 1970.	<i>Bufo</i> sp.	Rectum	Maya Bundar, Middle Andaman

Table 1 (Contd.)

Sl. No.	Species	Host	Location	Locality
22.	<i>Rictularia nicobarensis</i> Soota and Chaturvedi, 1970.	<i>Rattus rattus</i>	Intestine	Car Nicobar
23.	<i>Hastospiculum macrophallos</i> (Parona 1889) Baylis, 1930.	<i>Varanus</i> sp.	Body Cavity	Car Nicobar
24.	<i>Tanqua tiara</i> (Linstow, 1879) Blanchard, 1904.	„ „	Stomach	Great Nicobar and Car Nicobar.
25.	<i>Abbreviata indica</i> Soota et al, 1969.	<i>Bufo</i> sp.	Rectum	Great Nicobar
26.	<i>Dracunculus medinensis</i> (Linnaeus, 1758) Gallandat, 1773.	Man	Connective tissue	Andaman.
27.	<i>Diplotriaena</i> sp.	<i>Pycnotus</i> sp.	Body cavity —	Port Blair, South Andaman, Nicobar
28.	<i>Ornithostrongylus nicobaricus</i> Maplestone, 1940. Acanthocephala.	(White cheeked Bulbul) <i>Caloenas nicobarica</i>		
29.	<i>Mediorhynchus cambellensis</i> Soota et al., 1969.	<i>Oriolus</i> sp.	Intestine	Cambell Bay, Great Nicobar
30.	<i>Plagiorhynchus charadrii</i> (Yamaguti, 1939)	<i>Plurialis dominica</i> (Golden Plover)	„	„ „
31.	<i>Centrorhynchus andamanensis</i> Soota and Kansal, 1970.	<i>Spilornis cheela</i> (Crested-serpent eagle)	„	Wrightmyo, South Andaman and Maya Bundar, Middle Andaman.
32.	<i>Prosthorhynchus nicobarensis</i> Soota and Kansal, 1970.	<i>Zoothera</i> sp. (Ground thrush)	„	Nicobar Car.
33.	<i>Pseudoporrorchis indicus</i> , Das, 1957.	<i>Centropus andamanensis</i> (Crow Pheasant)	„	Port Blair, South Andaman.
34.	<i>Centrorhynchus</i> sp.	(King fisher)	„	Maya Bundar ,Middle Andaman.

TABLE 2—Host-Parasite list Showing the incidence and intensity of infection observed from the specimens collected by the Andaman and Nicobar Survey, 1969 (February—April).

Sl. No.	Host Examined.	Parasites.	Incidence of infection.	Intensity of infection
1.	<i>Funambulus pennanti</i> Northern palm squirrel	nil	nil	nil
2.	<i>Rattus rattus</i>	<i>Rictularia nicobarensis</i> (N)	1/5	low
3.	<i>Mus</i> sp.	nil	nil	nil
4.	Heron	nil	nil	nil
5.	<i>Haliaetus leucogastor</i> white-bellied sea eagle	(N)	1/2	low
6.	<i>Spilornis cheela</i> Crested serpent eagle	<i>Porrocaecum angusticolle</i> (N)	1/2	Medium
6a.	„	<i>Contracaecum haliaeti</i> (N)	1/2	Low
6b.	„	(C)	2/2	High
6c.	„	<i>Centrorhynchus andamanensis</i> (A)	2/2	High
7.	<i>Amaurornis phoenicurus</i> White breasted water hen	nil	nil	nil
8.	Plover			
8a.	„	(C)	2/6	High
8b.	„	<i>Acanthoparyphium cambellensis</i> (T) <i>A. lobaumi</i> (T)	1/6	Medium
9.	Water fowl.	nil	1/6	Medium
10.	<i>Capella</i> sp. Snipe	(C)	nil	nil
11.	<i>Tringa</i> sp. Sand piper	nil	1/1	High
			nil	nil

Table 2 (Contd.)

1	2	3	4	5
12.	<i>Calidris</i> sp. Stint	(T)	1/1	Low
13.	<i>Psittacula eupatria</i> Grey headed Parakeet.	<i>Ascaridia galli</i> (N)	3/9	Medium
14.	<i>Psittacula longicauda</i> Alexandrine Parakeet	nil	nil	nil
15.	Orange Cheeked Parakeet. Grey-headed Parakeet.	<i>Ascaridia galli</i> (N)	1/3	High
16.	<i>Treron</i> sp. Imperial Pigeon (grey)	(C)	1/2	High
17.	<i>Ducula</i> sp. Green Pigeon	(C)	1/3	High
18.	<i>Treron</i> sp. Imperial Pigeon (Bronz winged)	(C)	1/2	High
19.	Ringed Dove.	(C)	1/1	High
20.	<i>Streptopelia tranquebarica</i> Turtle Dove.	(C)	1/3	Medium
21.	<i>Centropus andamanensis</i> Crowpheasant	<i>Pseudoporrorchis indicus</i> (A)	1/3	High
21a.	„	(C)	1/3	Medium
22.	<i>Eurystomus orientalis</i> Broad billed Roller.	(N)	1/2	Low
23.	<i>Merops</i> sp. Chestnut headed Bee-eater	nil	nil	nil
24.	<i>Halcyon chloris</i> White collard Kingfisher	<i>Brachylecithum andamanensis</i> (T)	1/4	Medium

Table 2 (Contd.)

1	2	3	4	5
25.	<i>Halcyon smyrnensis</i> White breasted king fisher	<i>Centrorhynchus</i> sp. (A)	1/5	Medium
25a.	„	(C)	1/5	Medium
26.	<i>Dryocopus javensis hodgei</i> Ggreat Black wood pecker	nil	nil	nil
27.	Marhatta wood pecker	nil	nil	nil
28.	<i>Artomus</i> sp. Swallow shrike	(C)	1/2	High
29.	<i>Oriolus</i> sp. Oriole	(C)	2/8	High
30.	<i>Dicrurus anda manensis</i> Drongo	nil	nil	nil
31.	<i>Dicrurus paradiseus</i> Racket tailed drongo	nil	nil	nil
32.	Grey shrike. <i>Corocina</i> sp.	nil	nil	nil
33.	Cuckoo shrike	nil	nil	nil
34.	<i>Pericrocotus flammeus andamanensis</i> Scarlet minivet	nil	nil	nil
35.	<i>Hirundo rustica</i> Swallow	nil	nil	nil
36.	<i>Motacilla caspica</i> Grey wagtail	nil	nil	nil
37.	<i>Pycnotus</i> sp. White cheeked bulbul	<i>Diplotriaena</i> sp. (N)	1/1	Low

Table 2 (Contd.)

1	2	3	4	5
38.	<i>Pycnotus jocosus</i> Red whiskered bulbul	nil	nil	nil
39.	<i>Monticola solitarius pandoo</i> Blue rock thrush	nil	nil	nil
40.	<i>Capsychus saularis andamanensis</i> Magpie robin	(C) (N)	1/2 1/2	Medium low
41.	<i>Zoothera</i> sp. Ground thrush	<i>Prosthorhynchus nicobarensis</i> (A)	1/2	Medium
42.	<i>Aplonis panayensis</i> Glossy tree stare	(N)	1/9	Low
42a.	„	(C)	2/9	Medium
43.	<i>Acridotheris tristis</i> Common myna	(C)	1/1	High
44.	<i>Gracula religiosa andamanensis</i> Hill myna	nil	nil	nil
45.	<i>Sturnus erythropygius andamanensis</i> White headed myna	(C)	1/3	High
46.	<i>Corvus macrorhynchus andamanensis</i> Jungle crow	(C)	1/2	High
47.	Water snake	(C)	1/1	Very High
48.	Land snake	nil	nil	nil
49.	Marine snake	nil	nil	nil

Table 2 (Contd.)

1	2	3	4	5
50.	<i>Varanus</i> sp.	<i>Tanqua tiara</i> (N)	1/1	low
50a.	„	<i>Hastospiculum macrophallos</i> (N)	1/1	Medium
51.	<i>Calotes</i> sp.	nil	nil	nil
52.	Wall lizard	nil	nil	nil
53.	<i>Bufo</i> sp.	<i>Meteterakis andamanensis</i> (N)	1/2	Very High
54.	Marine fish	nil	nil	nil

Signs employed :
A—Acanthocephala ; C—Cestodes ; N—Nematodes ; T—Trematodes.

THE HELMINTH FAUNA OF ANDAMAN AND
NICOBAR. ACANTHOCEPHALA

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(With 2 Text-figures)

I—INTRODUCTION

The paper deals with description of three species of Acanthocephala of the genera *Centrorhynchus* Lühe, 1911, *Prosthorhynchus* Kostylew, 1915, and *Pseudoporrorchis* Joyeux et Baer, 1935, the material of which was collected by the Andaman and Nicobar Survey, 1969 (February-April) led by the senior author. All the three genera form first host and locality records.

We are thankful to Dr. A. P. Kapur, Director, Zoological Survey of India, Calcutta, and Dr. B. S. Chauhan, Deputy Director, Zoological Survey of India, for their kind encouragement in the completion of this paper.

II—DESCRIPTION

***Centrorhynchus andamanensis* Soota and Kansal, 1970**

(Text-fig. 1, a-c)

1970. *Centrorhynchus andamanensis* Soota and Kansal, *Proc. Indian Sci. Congr.*, Pt 3 : 450.

Material examined.—Holotype—a ♂, Z. S. I. Reg. No. w 6920/1, host—crested serpent eagle, location—intestine, locality—Burma Dera, Maya Bundar (Middle Andaman), collector—T. D. Soota, 23.iii.1969. Paratypes—11. Z.S.I.Reg.No.w 6921/1, other details as in holotype.

Description.—Male : Body slender, 34-36* long, 0.25-0.6 wide at the maximum; proboscis 1.3 long, 0.25-0.4 wide at the maximum, and armed with 24-28 longitudinal rows of hooks with 38-40 hooks in each (14+6+18) which are of three types : anterior large and rooted,

* All measurements are in millimeters.

posterior smaller and unrooted, and middle still smaller and rooted; proboscis receptacle double-walled, 0.72 long and 0.35 wide at the maximum; lemnisci two, long (though not clearly discernible); testes two, lying at tandem, overlapping, anterior one 0.75 long, 0.27 wide, posterior 0.7 long, 0.25 wide; cement glands four, elongated (though not clearly discernible); prostatic reservoir cylindrical; bursa muscular.

Female : Body 25-65 long, 0.2-0.8 wide at the maximum; proboscis and hooks same as in male; eggs oval, without polar prolongation, 0.04×0.015 in diameter.

Discussion.—The present species comes closest to *C. giganticum* Travassos, 1921, in the shape of proboscis and the arrangement of proboscis hooks, but differs from it in the size of body, in the number of longitudinal rows of hooks, and in the number of hooks in each row. It comes close to *C. knowlesi* Datta and Soota, 1954, in the shape of body, but differs from it in the size of body, in the number of longitudinal rows of hooks, in the number of hooks in each row, and in the shape of genitalia. It also comes close to *C. milvus* Ward, 1956, in the shape of genitalia, but differs from it in all other characters.

The genus forms the first locality record from the Andaman.

Prosthorhynchus nicobarensis Soota and Kansal, 1970

(Text-fig. 2, a-c)

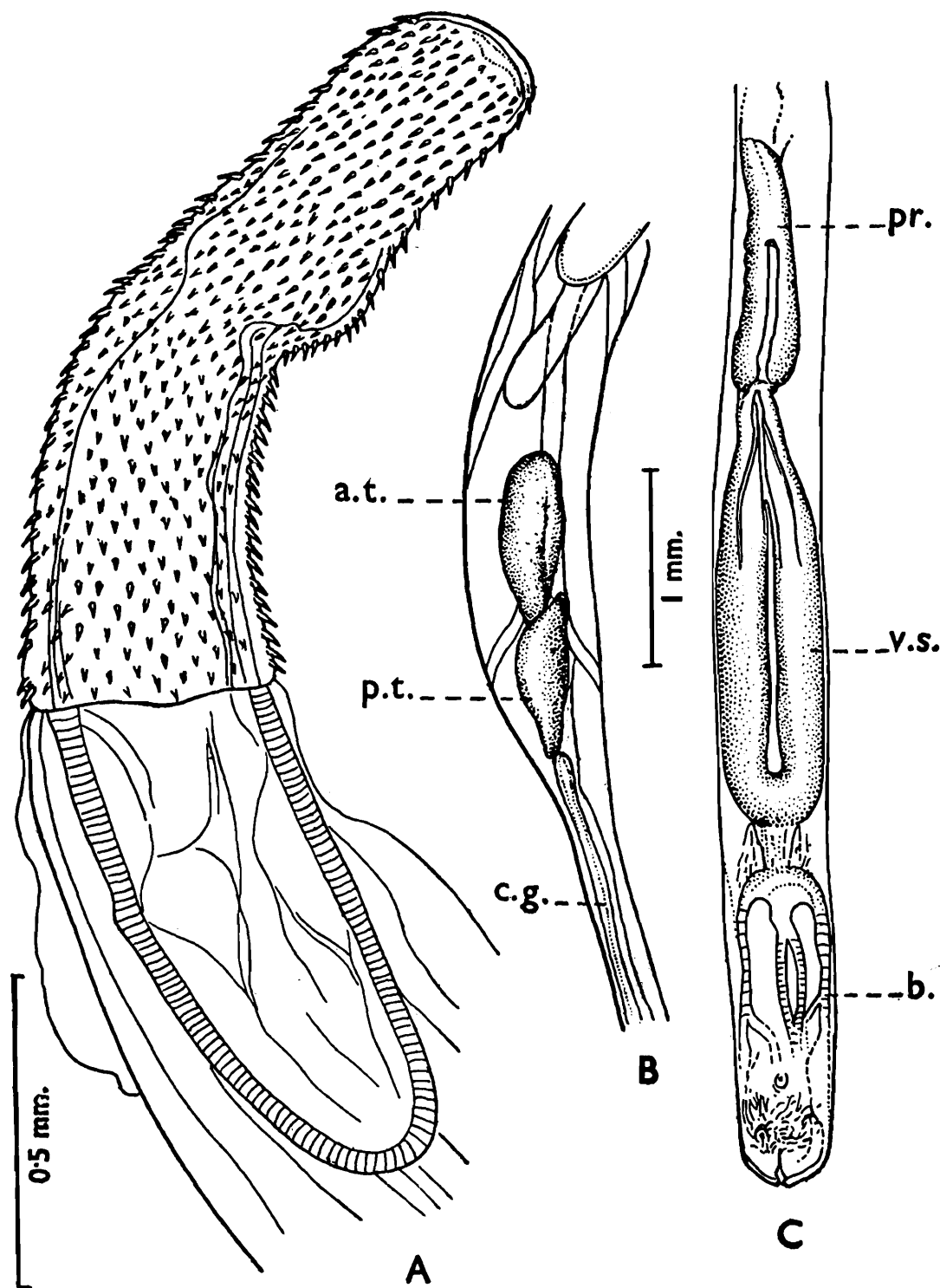
1970. *Prosthorhynchus nicobarensis* Soota and Kansal, *Proc. Indian Sci. Congr.*, Pt 3 : 450.

Material examined.—Holotype—a ♀, Z.S.I. Reg. No. w 6924/1, host—ground thrush, location—intestine, locality—Car Nicobar, collector—T. D. Soota, 11.iii.1969. Paratypes—two ♀ ♀, Z. S. I. Reg. No. w 6925/1, other details as in holotype.

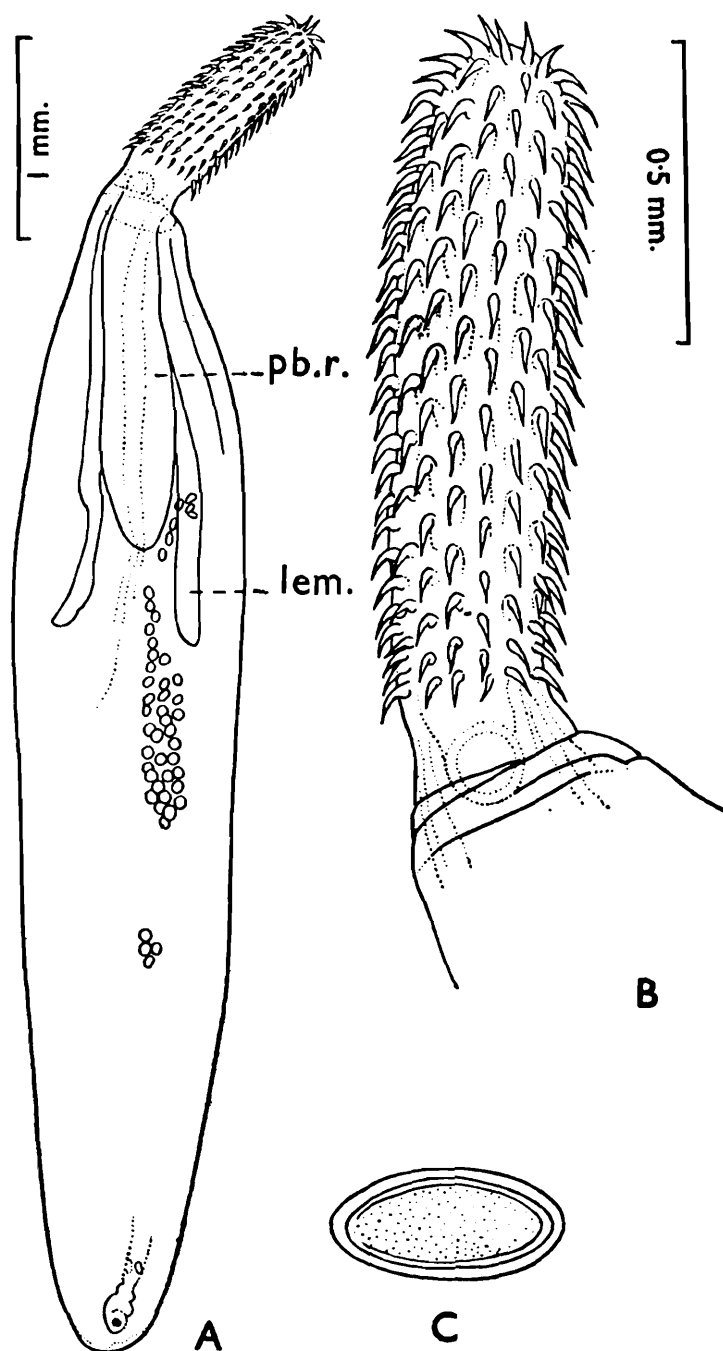
Description.—Female : Body cylindrical, 7-8.5 long, 1.1-1.5 at maximum width; proboscis cylindrical, 1.1 long, 0.3 at maximum width, and armed with 14-16 longitudinal rows of hooks with 14-15 hooks in each; anterior hooks rooted with the roots directed posteriorly, but posterior ones rootless and of lesser number; proboscis neck hookless, 0.1 long; proboscis receptacle double-walled, 1.62 long, 0.3 wide at the maximum; nerve ganglion situated in middle of proboscis sheath; lemnisci tubular, two, of equal size, 2.0 long, 0.1 at maximum width; eggs elliptical, 0.07×0.035 in diameter, double-walled, middle wall thick, and lacking the polar prolongation.

Discussion.—The species comes close to *P. scolopacidis* Kostylew 1915, and *P. reticulatum* (Westrumb, 1821) in the number of hooks in each longitudinal row, but differs from them in the number of longitudinal rows of hooks, and in the size of body and in the size of eggs.

The genus forms the first locality record from India.



TEXT-FIG. 1. *Centrorhynchus andamanensis* Soota and Kansal A. Anterior region, B. Body region showing testes and cement glands, C. Posterior region of male.



TEXT-FIG. 2. *Prosthorrhynchus nicobarensis* Soota and Kansal. A. Entire female, B. Anterior region, C. Egg.

***Pseudoporrorchis indicus* Das, 1957**

1957. *Pseudoporrorchis indicus* Das, *J. Parasit.*, **43** (6) : 659.

Material examined.—Five ♂♂, four ♀♀, and nine juveniles, Z. S. I. Reg. No. w 6926/1, host—*Centropus andamanensis*, location—intestine, locality—Port Blair, collector—T. D. Soota, 6. iii. 1969.

Description.—Male: Body almost cylindrical, 27-28 long, 0.85-1.0 at maximum width; proboscis ovate, 0.62 long, 0.42 at maximum

width, and armed with 20-22 longitudinal rows of hooks with 9-10 hooks in each; hooks gradually decreasing in size antero-posteriorly and agreeing with the description of the species as given by Das; proboscis sheath cylindrical, 1.2 long, 0.29 at maximum width, formed of two concentric muscular layers and with an elliptical posterior extremity; nerve ganglion situated almost in the middle of proboscis sheath; lemnisci long, tubular, nucleated, and in some cases reaching upto anterior testes; testes two, lying at tandem, oval and almost equal in size, 0.9 long, 0.5 at maximum width; cement glands four, long, tubular, and varying in size, followed by a tubular reservoir touching bursa which is muscular, capped and well-developed; lacunar system almost clear in both sexes.

Female : Body large, 22-45 long, 0.9-1.1 at maximum width; proboscis and hooks same as in the male; eggs 0.06×0.03 in diameter.

Discussion.—Though the present specimens show some variations from the original description given by Das (1957) in respect of size of body, hooks, and eggs, these variations are quite negligible and do not demand the creation of a new species, and hence the specimens are being referred to the above species. Although the genus and the species have already been recorded from India, they form first locality record from Andaman.

III—SUMMARY

The paper deals with three species of acanthocephala (belonging to three genera) from the Andaman and Nicobar Islands, out of which two viz., *Centrorhynchus andamanensis* Soota and Kansal and *Prosthorhynchus nicobarensis* Soota and Kansal are described in detail and the remaining one shows interesting hitherto unrecorded variations. All the genera form new locality records.

IV—REFERENCE

- DAS, E. N. 1957. On juvenile and adult forms of *Pseudoporrorchis indicus*, a new species of acanthocephala from India.—*J. Parasit.*, Lancaster, **43** (6), pp. 659-663.

V—ABBREVIATIONS

a.t. anterior testis; b. bursa; c.g. cement glands; lem. lemnisci; p. r. prostatic reservoir; p. t. posterior testis; pb. r. proboscis receptacle; v. s. vesicula seminalis.

THE COCCINELLIDAE (COLEOPTERA) OF GOA

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(With 2 Text-figures)

I—INTRODUCTION

Very little is known of the fauna of Goa. This is especially true of the family Coccinellidae popularly called the lady-beetles. Dieke (1947) in his account of the genus *Epilachna* (*sens. lat.*) of Asia, Europe and Australia records four species, namely *Epilachna dubiosa* Dieke, *Epilachna pytho* Mulsant, *Afidenta minima* (Gorham) and *Afissa flavicollis* (Thunberg) from Murmugao, Goa. The Zoological Survey of India has been carrying out the faunistic survey of the Union territory of Goa for the last few years and as a result a large number of representative species of the fauna have been collected and are being studied. The present account deals with the lady-beetles collected by the Survey's parties led by Shri K. S. Pradhan, Superintending Zoologist, during 1966 and 1967 in different parts of Goa. It is based on 761 specimens belonging to 17 species grouped under two subfamilies and several tribes as mentioned below. All the species listed constitute first records from Goa and one of these, namely *Illeis bistigmosa* (Mulsant), is the first record from the Indian mainland. My thanks are due to Shri Pradhan for the interesting specimens brought by him.

II—LIST OF SPECIES OF THE COCCINELLIDAE RECORDED FROM GOA

Subfamily I. EPILACHMINAE

1. *Epilachna vigintioctopunctata* (Fabricius)

Subfamily II. COCCINELLINAE

Tribe (i) SCYMNINI

2. *Scymnus* (*Scymnus*) *nubilus* Mulsant
3. *Scymnus* (*Pullus*) *coccivora* Aiyar
4. *Scymnus* (*Pullus*) *quadrillum* Motschulsky

Tribe (ii) ASPIDIMERINI

5. *Cryptogonus quadriguttatus* (Weise)

6. *Pseudaspidimerus circumflexa* (Motschulsky)

Tribe (iii) JAURAVIINI

7. *Jauravia limbata* Motschulsky

Tribe (iv) CHILOCHORINI

8. *Chilochorus nigrinus* (Fabricius)9. *Chilochorus rubidus* Hope10. *Brumus suturalis* (Fabricius)

Tribe (v) SYNONYCHINI

11. *Menochilus sexmaculatus* (Fabricius)12. *Micraspis cardoni* (Weise)13. *Verania discolor* (Fabricius)

Tribe (vi) COCCINELLINI

14. *Coccinella transversalis* Fabricius15. *Harmonia arcuata* (Fabricius)

Tribe (vii) PSYLLOBORINI

16. *Illeis bistigmata* (Mulsant)17. *Illeis cincta* (Fabricius)

III—TAXONOMIC ACCOUNT

Subfamily I. EPILACHNINAE

1. *Epilachna vigintioctopunctata* (Fabricius)

1775. *Coccinella 28-punctata* Fabricius, *Systema entomologiae* : (Type locality—Tranquebar.)
 1850. *Epilachna vigintioctopunctata* (Fabricius) : Mulsant, *Ann. Soc. Agric. Lyon*, (2) 2 : 834.
 1947. *Epilachna sparsa* (Herbst) : Dieke, *Smithson. misc. Coll.*, 106 (15) : 32.
 1966. *Epilachna vigintioctopunctata* (Fabricius) : Kapur, *Proc. Nat. Inst. Sci. India*, 32B (3 & 4) : 152.

Material.—5 examples : Goa, Colem, 23.xi.1967.

Remarks.—This species is widely distributed in the Oriental and Australian regions. It is variable both in the pronotal and elytral spots but can easily be distinguished by its sharp and distinct sutural angle at the apex of the elytra and by its characteristic male and female genitalia. This is a well-known pest of brinjals and potatoes in various countries.

Subfamily II. COCCINELINAE

(i) Tribe SCYMNINI

2. *Scymnus (Scymnus) nubilus* Mulsant

1850. *Scymnus nubilus* Mulsant, *Ann. Soc. Agric. Lyon*, (2) 2 : 972 (Type loc.—Assam).
1931. *Scymnus (Scymnus) nubilus* Mulsant : Korschefsky, *Coleopt. Cat., Berl.*, 16 (118) : 143.

Material.—5 examples : Goa, Mercas, 24. iii. 1966 (1 ex.); Veluz, Valpoi Nagargaon, 13. iv. 1966 (1 ex.); Nuvem, Majorda, 20. iv. 1966 (1 ex.); 3 km. E. of F. R. H., Sanguem, 17. xi. 1967 (1 ex.); Dona Paula, Panjim, 25. xi. 1967 (1 ex.).

Remarks.—This species is widely distributed in different parts of India and has also been recorded from Burma. It is a predator of aphids infesting crops and plantations.

3. *Scymnus (Pullus) coccivora* Aiyar

1925. *Scymnus coccivora* Aiyar, *J. Bombay nat. Hist. Soc.*, 30 : 491 (Type loc.—Coimbatore, S. India).
1931. *Scymnus coccivora* Aiyar : Korschefsky, *Coleopt. Cat., Berl.*, 16 (118) : 142.

Material.—3 examples : Goa, Margao, 1. iv. 1966 (1 ex.) ; 2 km. E. of Colva, 12. xi. 1967 (2 exs.).

Remarks.—Recorded earlier from southern India, the species is an important predator of coccids. The larvae of the species have also been recorded to feed upon the eggs of mealybugs. The species is widely distributed, being found in other parts of the country also. It is variable in colour-pattern and the three examples mentioned above being darkish brown in colour, resemble the typical colouration of the species.

4. *Scymnus (Pullus) quadrillum* Motschulsky

1858. *Scymnus quadrillum* Motschulsky, *Etud. Ent.*, 7 : 120 (Type loc.—“Indes orientales”).
1900. *Scymnus (Pullus) quadrillum* Motschulsky : Weise, *Dtsch. ent. Z.*, 28 : 436.
1931. *Scymnus (Pullus) quadrillum* Motschulsky : Korschefsky, *Coleopt. Cat., Berl.*, 16 (118) : 144.
1942. *Scymnus (Pullus) quadrillum* Motschulsky : Kapur, *Indian J. Ent.*, 4 (1) : 60.
1956. *Scymnus (Pullus) quadrillum* Motschulsky : Puttarudriah and Channa Basavanna, *J. Bombay nat. Hist. Soc.*, 54 (1) : 156.

Material.—One example : Goa, Kavlem, Ponda, 8. iv. 1966 (1 ex.).

Remarks.—This species is widely distributed in India and has been known to predate upon cotton aphid *Aphis gossypii* Glover, and

aphids infesting brinjal in Mysore State (Puttarudriah and Channa Basavanna, 1956). Its life-history has been worked out by Kapur (1942) who also recorded five species of aphids as its hosts in Delhi.

(ii) Tribe ASPIDIMERINI

5. *Cryptogonus quadriguttatus* (Weise)

1895. *Aspidiphorus quadriguttatus* Weise, *Dtsch. ent. Z.*, 1895 : 326 (Type loc.—Sikkim).
 1900. *Cryptogonus quadriguttatus* (Weise) : Weise, *Dtsch. ent. Z.*, 28 : 428.
 1948. *Cryptogonus quadriguttatus* (Weise) : Kapur, *Trans. R. ent. Soc. Lond.*, 99 : 97.
 1963. *Cryptogonus quadriguttatus* (Weise) : Kapur, *Bull. Brit. Mus. (Nat. Hist.) Ent.*, 14 (1) : 23.

Material.—One example : Goa, Colva Road, (from rice field), 14.iv.1966.

Remarks.—Originally described from Sikkim this species of predacious Coccinellidae of the tribe Aspidimerini is distributed in India from Kumaon Hills in Uttar Pradesh to the Patkai Mountains in Assam. The only example here resembles the typical colouration of the species. The present record of the species from Goa is worthy of note.

6. *Pseudaspidimerus circumflexa* (Motschulsky)

1858. *Platynaspis circumflexa* Motschulsky, *Etud. Ent.*, 7 : 118 (Type loc.—Ceylon).
 1900. *Aspidimerus circumflexa* (Motschulsky) var. *testacea* Weise, *Dtsch. ent. Z.*, 28 : 423.
 1948. *Pseudaspidimerus circumflexa* (Motschulsky) var. *testacea* (Weise) : Kapur, *Trans. R. ent. Soc. Lond.*, 99 : 122.
 1966. *Pseudaspidimerus circumflexa* (Motschulsky) : Kapur, *Proc. Nat. Inst. Sci. India*, 32B (3 & 4) : 166.

Material.—2 examples : Goa, 2 km. E. of Colva, 12.xi.1967; nr. Medical College Park, Panjim, (on Chrysanthemum), 27.xi.1967.

Remarks.—One of these examples resembles the typical *circumflexa*, with a large semicircular, black spot occupying the middle half of the basal margin of the pronotum and the testaceous elytra with an oblong-oval, sutural spot in the basal one-third of the suture an oblong discal spot in the middle of the length of each elytron. The other example whose dorsal surface is without any black spot, otherwise similar to *circumflexa* (Mots.) in structure, is var. *testacea* Weise. The species is found both in Ceylon and India. The type-locality of the nomino-typical form as well as of the variety, referred to above, is Ceylon. It is recorded from the southern and northern parts of India (Kapur, 1948) as well as from the Andamans (Kapur, 1966).

(iii) Tribe JAURAVIINI

7. *Jauravia limbata* Motschulsky

1858. *Jauravia limbata* Motschulsky, *Etud. Ent.*, 7 : 188 (Type loc.—Ceylon).

1900. *Clanis limbata* (Motschulsky) : Weise, *Dtsch. ent. Z.*, **28** : 432.
 1908. *Sticholotis limbata* (Motschulsky) : Weise, *Stettin ent. Ztg.*, **69** : 227.
 1946. *Jauravia limbata* Motschulsky : Kapur, *Ann. Mag. nat. Hist.*, (11) **13** : 82.

Material.—One example : Goa, 2 km. E. of Colva, 12. xi. 1967.

Remarks.—Originally described from Ceylon, this species was further recorded from Malabar, S. India by Kapur (1946). The example mentioned above agrees with the type specimen in its oval and convex shape, black eyes, pale testaceous pronotum, fuscous scutellum and a discoidal black area on the elytra. Its occurrence in Goa is of interest as it shows an extension in the range of its geographical distribution.

(iv) Tribe CHILOCHORINI

8. *Chilocorus nigritus* (Fabricius)

1798. *Coccinella nigrita* Fabricius, *Suppl. Ent. Syst.*, : 79 (Type loc.—East Indies).
 1850. *Chilocorus nigritus* (Fabricius) : Mulsant, *Ann. Soc. Agric. Lyon*, (2) **2** : 463.
 1966. *Chilocorus nigritus* (Fabricius) : Kapur, *Proc. Nat. Inst. Sci. India*, **32B** (3 & 4) : 171.

Material.—One example : Goa, Margao (on banyan tree), 25.iii. 1966.

Remarks.—Distributed widely in India and neighbouring countries the species plays an important role in checking the populations of certain armoured scale insects which occur as serious pests of plants. It has also been shipped out of India for trial in the biological control of coccids of coconut palms in the islands of Seychelles at the end of 1938 (Vasey-Fitzgerald, 1953).

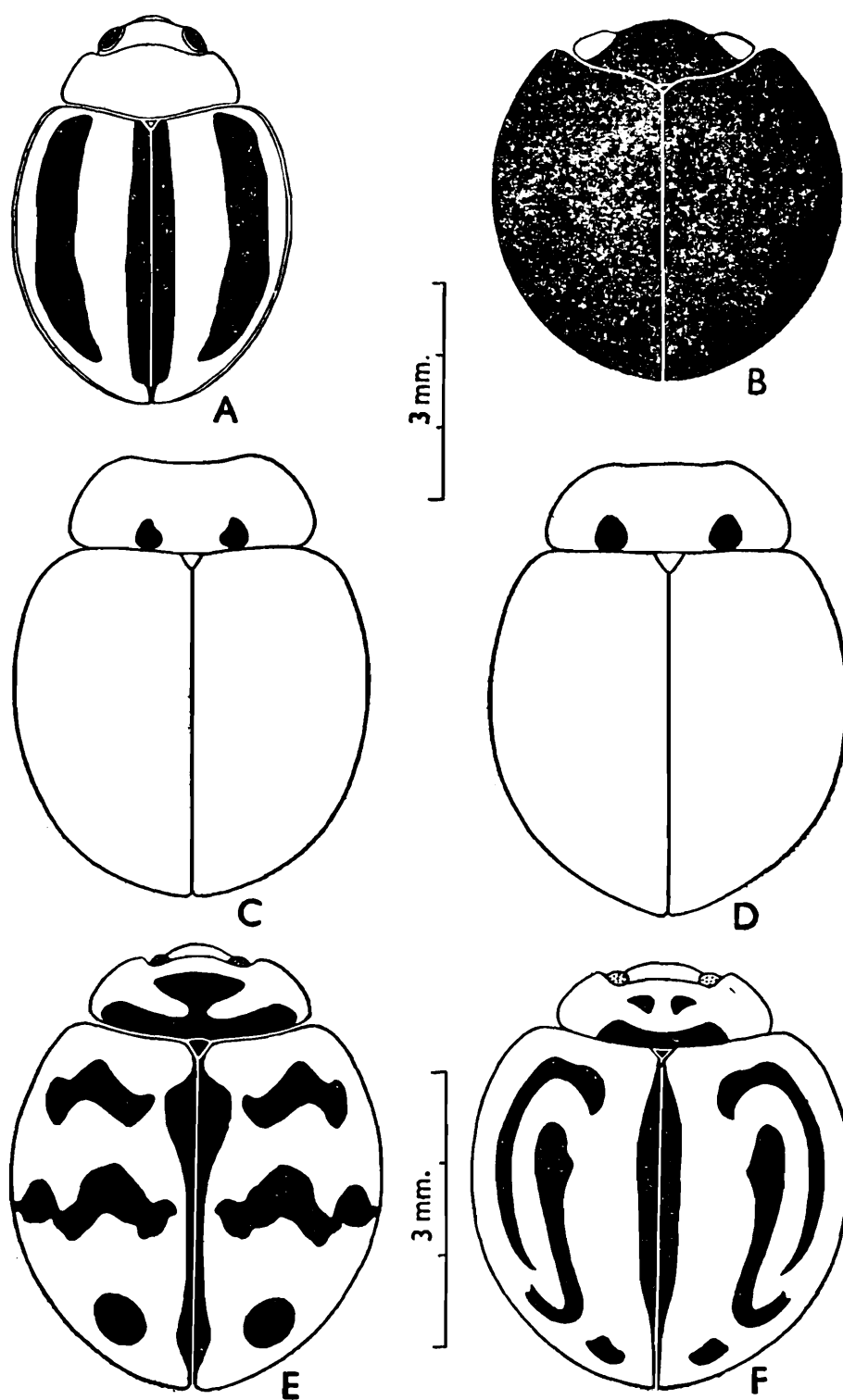
9. *Chilocorus rubidus* Hope

(Text-fig. 2 B)

1831. *Chilocorus rubidus* Hope, *In Gray, Zool. misc.* : 31 (Type loc.—Nepal).
 1850. *Chilocorus rubidus* Hope : Mulsant, *Ann. Soc. Agric. Lyon*, (2) **2** : 453.
 1956. *Chilocorus rubidus* Hope : Kapur, *Rec. Indian Mus.*, **52** (2-4) : 262.

Material.—One example : Goa, Margao, 2.iv.1966.

Remarks.—The species is widely distributed in the Palaearctic and Oriental Regions. Like most other members of the genus *Chilocorus*, the species is also an important predator of scale insects. The species has been recorded earlier from Kashmir, Kumaon Hills (U. P.), Chitral (Pakistan) and Malaysia by the author. This constitutes first record of the species from the peninsular India.



TEXT-FIG. 1. Outline of beetles showing colour pattern—
 A. *Brumus suturalis* (Fabricius). B. *Chilocarus nigrinus* (Fabricius), C. *Illeis bistigmata* (Mulsant), D. *Illeis cinota* (Fabricius), E. *Menochilus sexmaculatus* (Fabricius), F. *Micraspis cardoni* (Weise) (3 mm. scale for Figs. A-F.)

10. *Brumus suturalis* (Fabricius)

(Text-fig. 1 A)

1798. *Coccinella suturalis* Fabricius, *Suppl. Ent. Syst.* : 78 (Type loc.—India).
 1850. *Brumus suturalis* (Fabricius) : Mulsant, *Ann. Soc. Agric. Lyon*, (2) 2 : 494.
 1942. *Brumus suturalis* (Fabricius) : Kapur, *Indian J. Ent.*, 4 (1) : 8 (Bionomics).

Material.—54 examples : Goa, Margao (Fatorda), 23.iii.1966 (3 exs.); Old Goa, 27.iii.1966 (1 ex.); Calangute, 29.iii.1966 (1 ex.); Margao, 2.iv.1966 (5 exs.) 7.iv.1966 (1 ex.); Vasco, 9.iv.1966 (1 ex.); 11.xi.1967 (2 exs.); Bichotim, 10.iv.1966 (1 ex.); Colva Road, 14.iv.1966 (10 exs.); Vasco Road Margao, 15.iv.1966 (11 exs.); Durbate Ponda, 17.iv.1966 (2 exs.); Majorda, 20.iv.1966 (5 exs.); Sanguem, 16.xi.1967 (2 exs.); 3 km. E. of F. R. H. Sanguem, 17.xi.1967 (1 ex.); Molem, 21.xi.1967 (2 exs.); Pernem, 22.xi.1967 (1 ex.); Panjim, 27.xi.1967 (6 exs.).

Remarks.—This species is widely distributed throughout the Oriental Region. It feeds upon a variety of hosts, e.g., mites psyllids, coccids and aphids and thus helps controlling them. The record of this species in large numbers in Goa is, therefore, of interest. Kapur (1942) has described its life history, seasonal occurrence and hosts in detail and recorded altogether three species of aphids, six species of coccids and one species of mite as its host.

(v) Tribe SYNONYCHINI

11. *Menochilus sexmaculatus* (Fabricius)

(Text-fig. 1 E)

1781. *Coccinella sexmaculata* Fabricius, *Spec. Ins.* : 96 (Type loc.—East Indies).
 1943. *Menochilus sexmaculatus* (Fabricius) : Timberlake, *Bull. Hawaiian Sug. Plrs. Ass. Exp. Stn. (Ent. ser.)*, No. 22, 47 : 40.
 1958. *Menochilus sexmaculata* (Fabricius) : Kapur, *Rec. Indian Mus.*, 53 : 333.

Material.—127 examples : Goa, Margao, 22.iii.1966 (3 exs.), 1. iv.1966 (10 exs.), 2. iv.1966 (18 exs.); Margao (Fatorda), 23.iii.1966 (8 exs.); Marces, 24.iii.1966 (1 ex.); Mapuca (Mahpsa), 29.iii.1966 (8 exs. & 2 pupae); Collem, 3.iv.1966 (1 ex.); Sanguem, 5.iv.1966 (1 ex.); 16.xi.1967 (10 exs.); 17.xi.1967 (17 exs.); Canacona, 6.iv.1966 (8 exs.); Vasco, 9.iv.1966 (9 exs.); Bicholim, 10.iv.1966 (9 exs.); Colva Road, 14.iv.1966 (4 exs.); Vasco Road, Margao, 15.iv.1966 (11 exs.); Majorda, 20.iv.1966 (4 exs.); Cortalim, 15.xi.1967 (3 exs.); Pernem, 22.xi.1967 (1 ex.); Altinho, Panjim, 26.xi.1967 (1 ex.); Nr. Med. College Park, Panjim, 27.xi.1967 (2 exs.).

Remarks.—Distributed widely in India and in the neighbouring Indo-Malayan subregion, this species has been reported to feed upon

aphids. The size and colour-pattern of the species are variable and the specimens from Goa are lighter in their general ground colour when compared to the examples from peninsular India.

12. *Micraspis cardoni* (Weise)

(Text-fig. 1 F)

1892. *Verania cardoni* Weise, *Ann. Soc. ent. Belg.*, 36 : 19 (Type loc.—Chota Nagpur).
 1894. *Coelophora cardoni* (Weise) : Gorham, *Ann. Soc. ent. Belg.*, 38 : 202.
 1932. *Coelophora cardoni* (Weise) : Korschefsky, *Coleopt. Cat., Berl.*, 16 (120) : 588.
 1943. *Micraspis cardoni* (Weise) : Timberlake, *Bull. Hawaiian Sug. Plrs'. Ass. Exp. Stn. (Ent. ser.)*, No. 22, 47 : 28.

Material.—One example : Goa, Bicholim, (on cashew tree), 10.iv.1966.

Remarks.—This species was originally described under the genus *Verania* and subsequently transferred to *Coelophora* by Gorham (1894). Timberlake (1943) placed this species in *Micraspis* Chevrolat on account of its more orbicular form and broad epipleura. The species preys upon aphids and coccids which infest plantations. Besides Chota Nagpur, (Bihar), the species is recorded from Belgaum, Kanara (Mysore State) and Ceylon (Gorham, 1894).

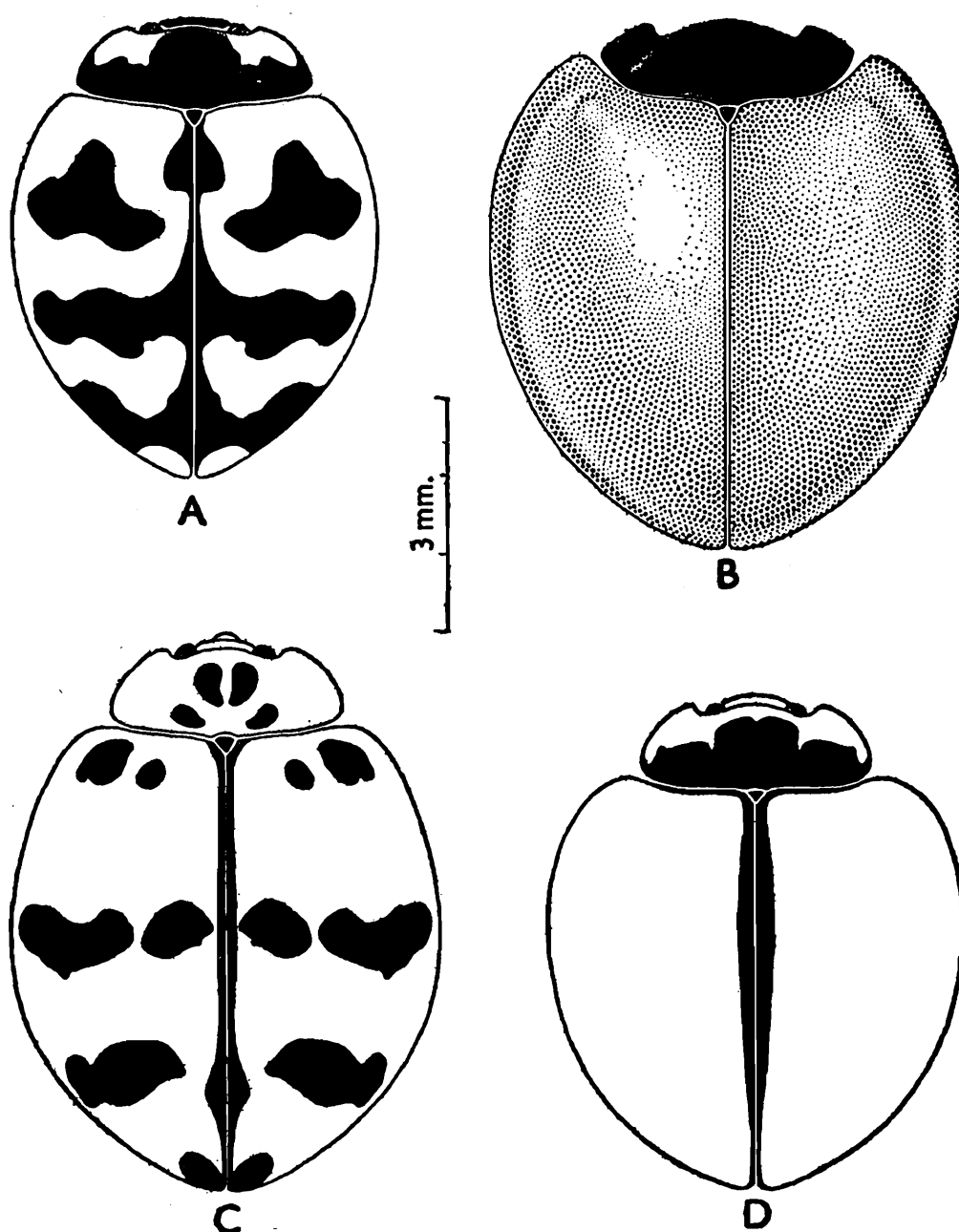
13. *Verania discolor* (Fabricius)

(Text-fig. 2 D)

1798. *Coccinella discolor* Fabricius, *Suppl. Ent. Syst.* : 77 (Type loc.—India).
 1850. *Verania discolor* (Fabricius) : Mulsant, *Ann. Soc. Agric. Lyon*, (2) 2 : 369.
 1966. *Verania discolor* (Fabricius) : Kapur, *Proc. Nat. Inst. Sci. India*, 32B (3 & 4) : 178.

Material.—475 examples; Goa, Margao, 22.iii.1966 (2 exs.); 25.iii.1966 (1 ex.); 1.iv.1966 (65 exs.), 2.iv.1966 (39 exs.), 6.iv.1966 (23 exs.), 7.iv.1966 (7 exs.); Margao (Fatorda), 23.iii.1966 (1 ex.); Mangeshi, Panjim, 27.iii.1966 (52 exs.); 27.xi.1967 (60 exs.), Mapuca, 29.iii.1966 (6 exs.); Canacona, 6.iv.1966 (1 ex.); Bicholim, 10. iv. 1966 (44 exs.); Valpoi, Nagargaon, 13.iv.1966 (2 exs.); Colva Road, 14.iv. 1966 (7 exs.); Vasco Road, Margao, 15.iv.1966 (64 exs.); Majorda, 20.iv.1966 (10 exs.) ; 3 Km. N. W. of Ponda, 14.xi.1967 (50 exs.); Sanguem, 16.xi.1967 (11 exs.); 19.xi.1967 (5 exs.); 2 Km. N.E. of F. R. H., Molem, 21.xi.1967 (1 ex.); Pernem, 22.xi.1967 (17 exs.); Colem, 23.xi.1967 (2 exs.).

Remarks.—This species occurs throughout India and is widely distributed in the Oriental region and to some extent in the adjacent parts of the Palaearctic region. It feeds upon the aphids infesting crops. The colour-pattern on the pronotum is variable and several varieties are recognized in the above-mentioned material.



TEXT-FIG. 2. Outline of beetles showing colour pattern—
 A. *Coccinella transversalis* (Fabricius). B. *Chilocorus rubidus* Hope. C. *Harmonia arcuata* (Fabricius). D. *Verania discolor* (Fabricius) (3 mm. scale for Figs. A-D).

(vi) Tribe COCCINELLINI

14. *Coccinella transversalis* Fabricius

(Text-fig. 2 A)

- 1781. *Coccinella transversalis* Fabricius, *Spec. Ins.* : 97 (Type loc.-Coromandel).
- 1943. *Coccinella ransversalis* Fabricius : Timberlake, *Bull. Hawaiian Sug. Plrs.' Ass. Exp. Stn. (Ent. ser.)*, No. 22 : 14.
- 1962. *Coccinella transversalis* Fabricius : Kapur, *Proc. 1st All-India Congr. Zool.* : 479.
- 1966. *Coccinella transversalis* Fabricius : Kapur, *Proc. Nat. Inst. Sci. India*, 32B (3 & 4) : 178. fig. 9E.

Material.—72 examples ; Goa, Margao, 6.iv.1966 (2 exs.); Colva Road, 14.iv.1966 (2 exs.); Vasco, 11.xi.1967 (3 exs.); Margao Camp, 12.xi.1967 (1 ex.); Sanguem, 16.xi.1967 (11 exs.); 17.xi.1967 (7 exs.); 19.xi.1967 (33 exs.); Molem, 20.xi.1967 (1 ex.); Pernem, 22.xi.1967 (1 ex.); Colem, 23.xi.1967 (7 exs.); Altinho, Panjim, 27.xi.1967 (1 ex.) Arvalem waterfalls, 28.xi.1967 (1 ex.).

Remarks.—Described originally from Coromandel, S. India, the species extends to the Palaearctic Region as far north as Japan and in the South to the Australian continent. The colour-pattern of this species is variable. In the material under study the pattern is more like the examples described from the type locality.

15. *Harmonia arcuata* (Fabricius)

(Text-fig. 2 C)

- 1787. *Coccinella arcuata* Fabricius, *Mantissa Insectorum*, 1 : 55 (Type loc.—“China Dom.”).
- 1850. *Harmonia arcuata* (Fabricius) : Mulsant, *Ann. Soc. Agric. Lyon*, (2) 2 : 77.
- 1966. *Harmonia arcuata* (Fabricius) : Kapur, *Proc. Nat. Inst. Sci. India*, 32B (3 & 4) : 179.

Material.—One example : Goa, Molem (F.R.H. compound), 23.xi.1967.

Remarks.—The species occurs in peninsular and north-east India and has also been recorded from several other parts of the Oriental Region as well as from Australia. It is also variable in colouration especially in the elytral pattern. The one example referred to above bears typical pattern of the species.

(vii) Tribe PPYLLOBORINI

16. *Illeis bistigmosa* (Mulsant)

(Text-fig. 1 C)

- 1850. *Psyllobora bistigmosa* Mulsant, *Ann. Soc. Agric. Lyon*, (2) 2 : 168 (Type loc.—Penang.)
- 1874. *Thea bistigmosa* (Mulsant) : Crotch, *Revision of Coccinellidae* : 135.
- 1932. *Illeis bistigmosa* (Mulsant) : Korschefsky, *Coleopt. Cat., Berl.*, 16 (120) : 440.
- 1943. *Illeis bistigmosa* (Mulsant) : Timberlake, *Bull. Hawaiian Sug. Plrs'. Ass. Exp. Stn. (Ent. ser.)*, No. 22 : 60. (Sumatra).
- 1961. *Illeis bistigmosa* (Mulsant) : Bielawski, *Ann. Zool., Warsz.*, 19 (8) : 366.
- 1966. *Illeis bistigmosa* (Mulsant) : Kapur, *Proc. Nat. Inst. Sci. India*, 32B (3 & 4) : 179.

Material.—4 examples : Goa, Margao, (on Chilli plant), 22.iii.1966 (1 ex.); Canacona, (on mulberry tree), 6.iv.1966 (3 exs.).

Remarks.—These examples from Goa differ from the typical example described from penang by the absolutely reduced otherwise

absence of pronotal spots. The beetles are smaller in size than the examples recorded from Andamans by Kapur (1966). The Goa examples can be distinguished from other species of the genus by the characteristic male and genitalia, described earlier by Bielawski (1961) and Kapur (1966) by their more convex and rounded shape of the body. This constitutes the first record of the species from the Indian mainland. Members of the tribe Psylloborini are fungivorous in their habits.

17. *Illeis cincta* (Fabricius)

(Text-fig. 1 D)

- 1798. *Coccinella cincta* Fabricius, *Suppl. Ent. Syst.* : 77 (Type loc.- India orientalis).
- 1874. *Thea cincta* (Fabricius) : Crotch, *Revision of Coccinellidae* : 135.
- 1932. *Illeis cincta* (Fabricius) : Korschefsky, *Coleopt. Cat., Berl.*, **16** (120) : 558.
- 1943. *Illeis cincta* (Fabricius) : Timberlake, *Bull. Hawaiian Sug. Plrs'. Ass. Exp. Stn. (Ent. Ser.)*, No. 22 : 60 (Key to species ; from Ceylon).
- 1961. *Illeis cincta* (Fabricius) : Bielawski, *Ann. Zool., Warsz.*, **19** (8) : 356.

Material.—7 examples : Goa, Margao, (on Chilli plant), 22.iii.1966 (3 exs.); Panjim, Altinho, (at light), 28.iii.1966 (1 ex.); (on brinjal plant), 2.iv.1966 (1 ex.); Canacona, (on mulberry tree), 6.iv.1966 (1 ex.); Valpoi, Nagargaon, (from forest nursery), 13.iv.1966.

Remarks.—The species has been recorded mainly from the southern India. It is larger in size and more elongate in outline than *I. bistigmosa*. The characteristic male genitalia distinguish it from other members of the genus commonly found in India. It is possible this species feeds on the mildew on the plants mentioned above.

IV—SUMMARY

Very little is known of the Coccinellidae of Goa. The present paper is based on the material of the family collected during March-April, 1966 and November-December, 1967 by Mr. K. S. Pradhan. It consists of a total of 761 specimens belonging to 17 species all of which constitute new records for Goa. Almost all the species are well distributed in the mainland of India except one, *Illeis bistigmosa* (Mulsant), which was originally described from Penang and was later reported from Sumatra and the Great Nicobar Island. The species reported from Goa in this paper belong to two subfamilies, seven tribes and thirteen genera.

V—REFERENCES

- BIELAWSKI, R. 1961. Bemerkungen über die mannlichen Genitalien von Arten der Gattung *Illeis* Muls., nebst Beschreibung einer neuen Art und einer Unterart (Coleoptera, Coccinellidae). —*Ann. Zool., Warsz.*, **19** (8), pp. 353-368.

- DIEKE, G. H. 1947. Ladybeetles of the genus *Epilachna* (*sens. lat.*) In Asia, Europe and Australia.—*Smithson. misc. Coll.* Washington, **106** (15), pp. 1-183.
- GORHAM, H. S. 1894. Observations on some species of the family Coccinellidae collected near Konbir and Mandar, India, Bengal, by P. Cardon.—*Ann. Soc. ent. Belg.*, Bruxelles, **38**, pp. 209-211.
- KAPUR, A. P. 1942. Bionomics of some Coccinellidae, predacious on aphids and coccids in north India.—*Indian J. Ent.*, Delhi, **4** (1), pp. 49-66.
- KAPUR, A. P. 1946. A revision of the genus *Jauravia* Mots. (Coleoptera, Coccinellidae).—*Ann. Mag. nat. Hist.*, London, (11) **13**, pp. 73-93.
- KAPUR, A. P. 1948. A revision of the tribe Aspidimerini Weise (Coleoptera-Coccinellidae).—*Trans. R. ent. Soc. Lond.*, London, **99**, pp. 77-128, 1 pl., 17 figs.
- KAPUR, A. P. 1966. The Coccinellidae (Coleoptera) of the Andamans.—*Proc. Nat. Inst. Sci. India*, Delhi, **32B**, (3 & 4), pp. 148-189.
- PUTTARUDRIAH, M. and CHANNA BASAVANNA, G. P. 1956. Some beneficial coccinellids of Mysore.—*J. Bombay nat. Hist. Soc.*, Bombay, **54** (1), pp. 156-159.
- TIMBERLAKE, P. H. 1943. The Coccinellidae or Laybeetles of the Koeble Collection.—*Bull. Hawaiian Sug. Plrs' Ass. Exp. Stn. (Ent. ser.)*, Honolulu, No.22, pp. 1-67.
- VASEY-FITZGERALD, D. 1953. Review of the biological control of coccids on coconut palms in the Seychelles. *Bull. ent. Res.*, London, **44**, pp. 405-413.

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