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ON FOUR NEW SPECIES OF AVIAN NEMATODES
FROM ORISSA, INDIA

By

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INTRODUCTION

In the course of an Avifaunistic Survey in Koraput district, Orissa, during February-March, 1977, the authors came across a number of new species of nematodes. The present paper deals with the descriptions of four new avian nematodes. One each belonging to the genera *Thelazia* (*Thelaziella*) Travassos, 1918, *Oxyspirura* (*Cramispirura*) Skrjabin, 1931, *Ceratospira* Schneider, 1866 and *Squamofilaria* Schmerling, 1925.

SYSTEMATIC ACCOUNT

Order SPIRURIDA

Superfamily THELAZIOIDEA

Family THELAZIIDAE Skrjabin, 1915

Genus 1. *Thelazia* (*Theiaziella*) Travassos, 1918

Thelazia (*Thelaziella*) *orissae* n. sp.

One male and three female nematodes were collected from under the nictitating membrane of a bird, the Crested Honey Buzzard, *Pernis ptilorhynchus ruficollis* Lesson. The parasites belong to the family Thelaziidae and the genus *Thelazia* (*Thelaziella*) Travassos, 1918. The present specimens do not agree with any of the known species of the genus *Thelazia* and therefore, a new specific name is proposed to accommodate them.

Host : *Pernis ptilorhynchus ruficollis* Lesson

Location : Eye

Locality : Chitrakonda, Koraput district, Orissa, India,

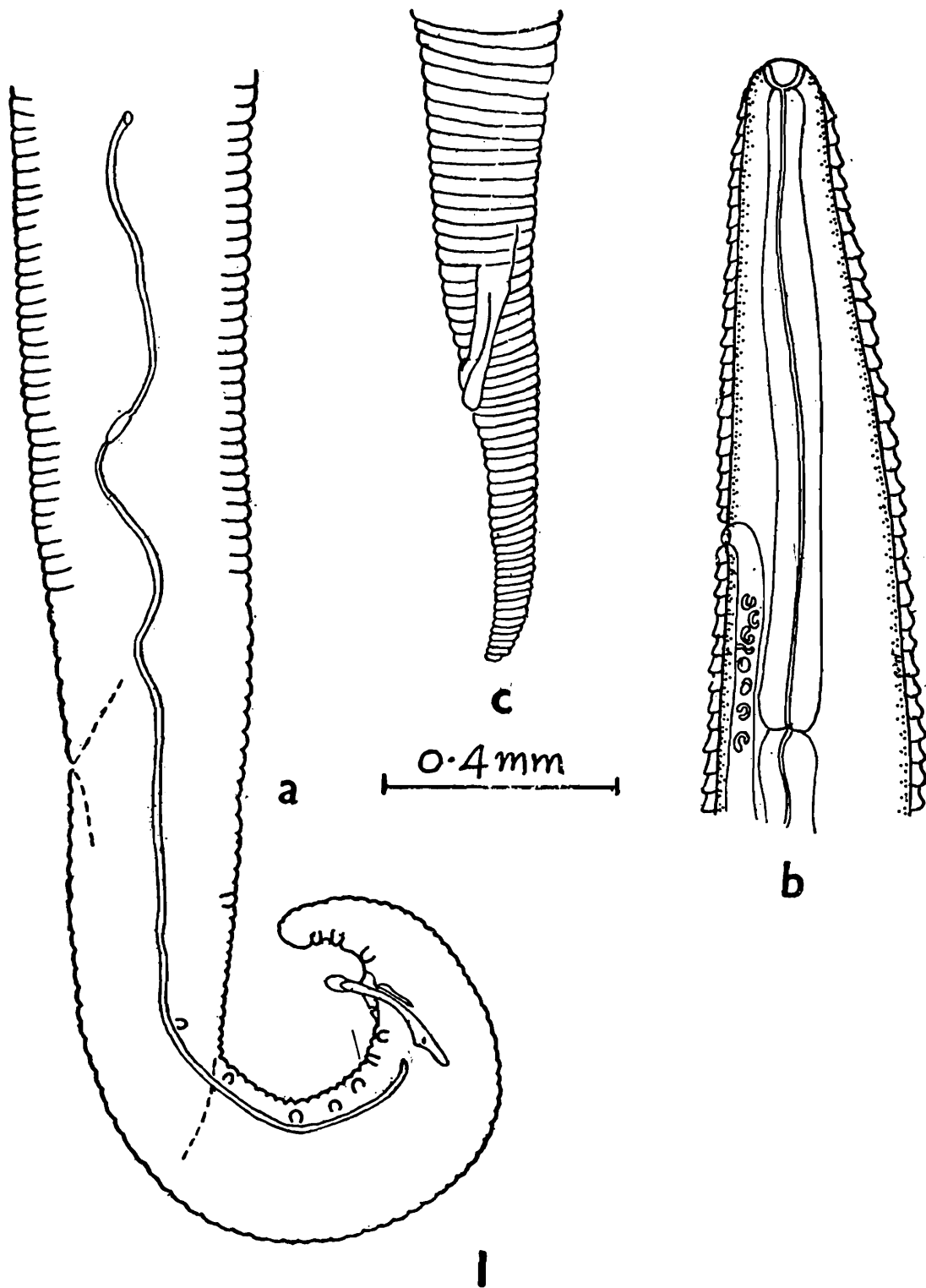


Fig. 1. *Thelazia (Thelaziella) orissae* n. sp. (a) Posterior end of a male, lateral view. (b) Anterior end of a female, lateral view. (c) Posterior end of a female, lateral view.

DESCRIPTION

The body is finely striated in transverse direction. Mouth without lips. A small buccal capsule is present. Oesophagus is short.

Male : The tail is curved ventrally and bluntly rounded. A very small caudal ala is limited to cloacal region. The number of caudal papillae is 12 pairs, of which three are postanal and nine preanal in position. The spicules are unequal and dissimilar. The right spicule is alate, rounded distally with a bulbular swelling while the left one slender, simple, and pointed, with a slight swelling at a distance 0.54 mm from the proximal end. The gubernaculum is poorly developed.

Female : The tail is long, rounded and curved ventrally. The vulva is located in the oesophageal region of the body. The uteri are opposed.

AFFINITIES

The present parasite belongs to the genus *Thelazia* (*Thelaziella*) Travassos, 1918, in having mouth without lips, short buccal cavity, two lateral and four submedian cephalic papillae, and moderately short oesophagus. The present parasite does not agree with any other species so far described under the genus *Thelazia* (*Thelaziella*) in the presence of small alae, supported by paired pedunculated papillae.

Specific diagnosis of *Thelazia* (*Thelaziella*) *orissae* : Body with striae, a very small caudal ala limited upto cloaca in male ; unequal and dissimilar spicules ; nine pairs of preanal papillae, eight of them being sessile and one paired pedunculated at the alated region of the cloacal aperture, and three pairs of sessile postanal papillae ; gubernaculum poorly developed. Tail bluntly rounded in both sexes ; vulva on a prominence ; vagina anteriorly directed. Viviparous.

Measurements in mm of *Thelazia* (*Thelaziella*) *orissae*

	<i>Male</i> (1 ex)	<i>Female</i> (3 ex)
Length of body	13.50	17.90-20.25
Breadth of body	0.54	0.47-0.49
Length of buccal capsule	0.36	0.027-0.036

	<i>Male</i> (1 ex)	<i>Female</i> (3 ex)
Nerve ring from the tip of the anterior end	0.14	0.18-0.2
Length of oesophagus	1.00	1.03-1.08
Breadth of oesophagus	0.09	
Length of tail	0.14	0.36-0.38
Length of left spicule	1.85	
Length of right spicule	0.13	
Length of gubernaculum	0.063	
Length of ala	0.07	
Vulva from the anterior extremity of the body		0.77
Eggs (length × breadth)		0.036 × 0.018

Types : All type specimens are deposited in the National Zoological Collection of India, at the Zoological Survey of India, Calcutta.

Holotype, a male, from eye of the bird *Pernis ptilorhynchus ruficollis*; India: obtained by N. Majumdar from Chitrankonda, Koraput district, Orissa on 16 March, 1977; Regd. No. WN 510.

Paratypes, three females, with the same data as for the holotype, Regd. No. WN 511.

Genus 2. *Ceratospira* Schneider, 1866

Ceratospira psittaculæ n. sp.

Five males and 12 females nematodes were collected from under the nictitating membrane of a bird, the Southern Blossomheaded Parakeet, *Psittacula cyanocephala cyanocephala* (Linnaeus). The parasites belong to the family Thelaziidae and the genus *Ceratospira*. The present specimens do not agree with any of the known species of the genus *Ceratospira* and therefore a new specific name is proposed to accommodate them.

Host : *Psittacula cyanocephala cyanocephala* (Linnaeus)

Location : Eye

Locality : Madpad, Koraput district, India

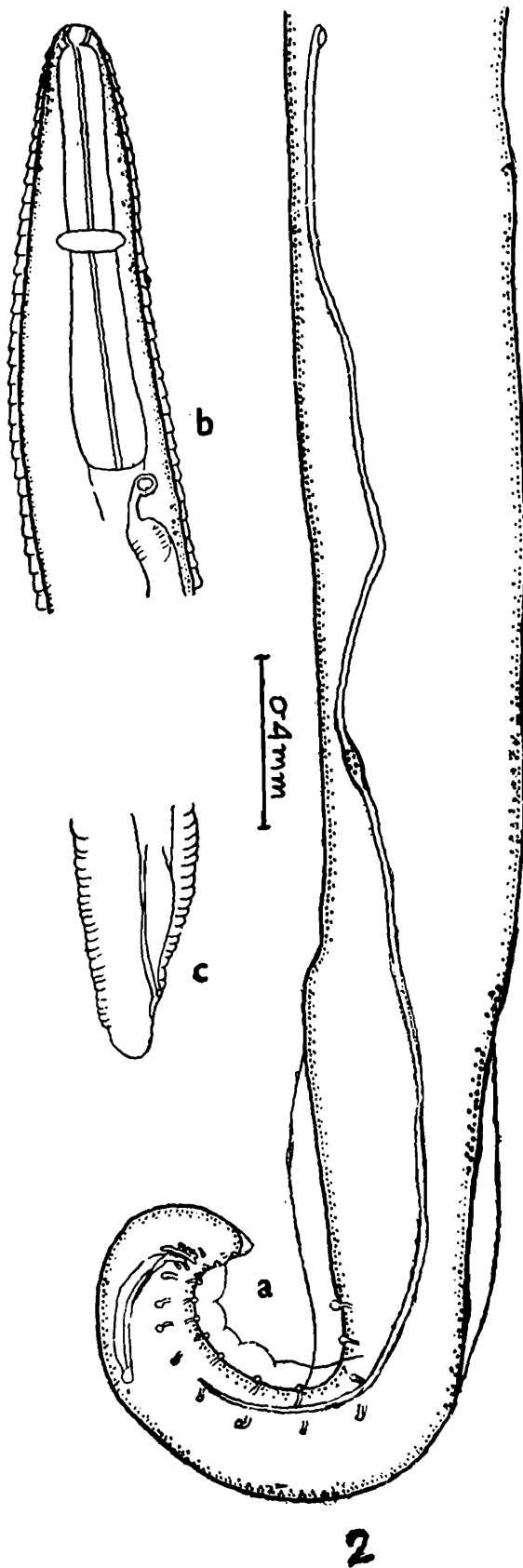


Fig. 2. *Ceratospira psittaculae* n. sp. (a) Posterior end of a male, lateral view. (b) Anterior end of a female, lateral view. (c) Posterior end of a female, lateral view.

DESCRIPTION

The body is striated in transverse direction. Mouth surrounded by papillae. A short buccal capsule present.

Male : The tail short and rounded. The caudal extremity spirally coiled. Caudal alae well developed. Gubernaculum present. Spicules very unequal and dissimilar. The cuticular striations coarse and close together in the oesophageal region, elsewhere less prominent and farther apart.

Female : The tail short, straight and rounded. The vulva located in the oesophageal region. The cuticular striations coarse and close together throughout the body. The uteri opposed.

AFFINITIES

The genus *Ceratospira* was proposed by Schneider in 1866 and its type-species is *Ceratospira vesiculosa*. Since then only five species have been described under this genus. Of the five species so far described the present species differs markedly in various body measurements. The left spicule of *C. vesiculosa* Schneider 1866 and *C. thriponaxis* Wehr, 1930 is 3 mm long, whereas in *C. ophthalmica* (Linstow, 1898) Ranson, 1904, *C. oculata* (Jairajpuri and Siddiqui, 1969), *C. inglisi* Schmidt and Kuntz, 1971, are 0.968 mm, 2.11 mm and 1.64 mm respectively and their spicules ratio in respective of right and left are 1 : 37, 1 : 13.2 and 1 : 85, while the present specimens have right spicules 0.16-0.22 and the left spicules 1.7-2.2 long and the spicules ratio of right and left is 1 : 11. It also differs in number and arrangements of caudal papillae from all the other species under this genus.

Specific diagnosis of *Ceratospira psittaculae* : Body with coarse striae ; caudal alae well developed in male ; spicules very unequal, dissimilar, right spicule boat-shaped, stout, rounded distally ; left one simple, slender, pointed, with a slight swelling at a distance 0.82-0.92 from proximal end. The ratio of the spicule is 1 : 11. Gubernaculum present. Caudal extremity spirally coiled. Nine to ten pairs of pedunculated preanal, two pairs pedunculated adanal, three pairs

sessile and two pairs pedunculated, post anal papillae present and symmetrical in position. Vulva near the posterior end of oesophagus.

Measurements in mm of *Ceratospira psittaculae*

	Male (5 ex)	Female (12 ex)
Length of body	9.30-12.4	12.30-12.60
Breadth of body	0.25-0.33	0.27-0.31
Length of buccal capsule	0.018	0.018
Breadth of buccal capsule	0.045	0.036
Nerve ring from the tip of the anterior end	0.23	0.27
Length of oesophagus	0.49-0.54	0.49-0.54
Breadth of oesophagus	0.054-0.077	0.06
Length of tail	0.027-0.063	0.072
Length of left spicule	1.7-2.2	
Length of right spicule	0.16-0.77	
Length of gubernaculum	0.036-0.095	
Length of caudal alae	0.54	
Vulva from the anterior extremity of the body		0.51-0.58
Eggs (length × breadth)		0.036 × 0.018

Types : All type specimens are deposited in the National Zoological Collection of India, at the Zoological Survey of India, Calcutta.

Holotype, a male, from eye of the bird, *Psittacula cyanocephala cyanocephala* (Linnaeus); India: obtained by N. Majumdar from Madpad, Koraput district, Orissa on 19 February 1977, Regd. No. WN 512.

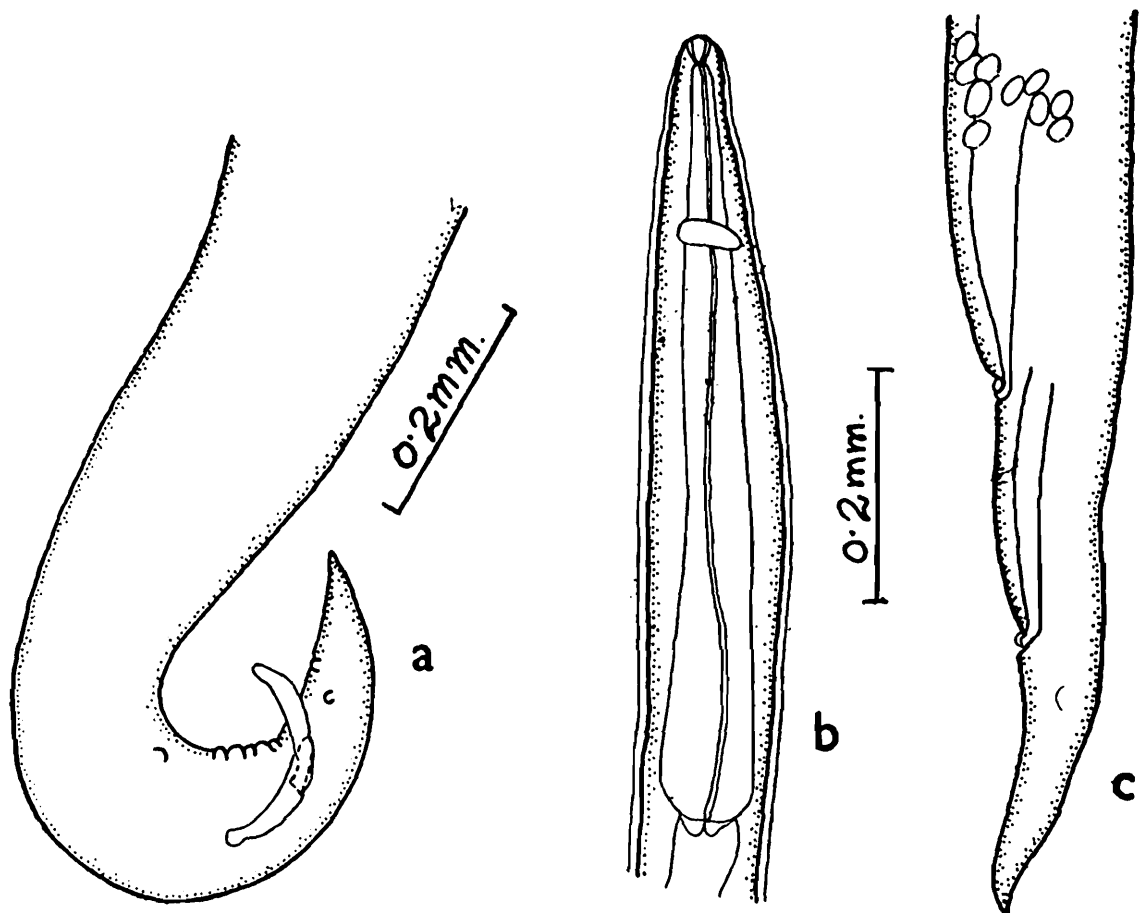
Paratypes, 4 males and 12 females, with the same data as for the holotype, Regd. No. WN 513.

Genus 3. *Oxyspirura* Drasche in Stossich, 1897

Subgenus *Oxyspirura* (*Gramispirura*) Skrjabin, 1931

Oxyspirura (*Cramispirura*) *rhpidurae* n. sp.

A single male and a single female nematode specimens were collected from under the nictitating membrane of a



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Fig. 3. *Oxyspirura* (*Cramispirura*) *rhpidurae* n. sp. (a) Posterior end of a male, lateral view. (b) Anterior end of a female, lateral view, (c) Posterior end of a female, lateral view.

bird, the Orissa Whitethroated Fantail Flycatcher, *Rhipidura albicollis orissae* Ripley. The parasites belong to the family Thalaziidae and the genus *Oxyspirura* Drasche 1897. The present specimens do not agree with the descriptions of any of the known species of the genus *Oxyspirura* and therefore, a new specific name is proposed to accomodate them.

Host : *Rhipidura albicollis orissae* Ripley.

Location : Eye

Locality : Govindapalle, Koraput district, Orissa.

DESCRIPTION

The body finely striated in transverse direction. The mouth surrounded by papillae. The proximal end is pointed and conical.

Male : Spicules equal and similar. A narrow cervical alae present. Four pairs of preanal and two pairs postanal papillae present.

Female : Vulva in the posterior end.

AFFINITIES

The present form described above comes closure to *Oxyspirura (Cramispirura) properoi* (Skrjabin, 1929), Skrjabin, 1931, in shape of spicule but differs slightly in the size of spicule and in the number and arrangement of caudal papillae.

Specific diagnosis : *Oxyspirura (Cramispirura) rhipidurae* n. sp. Body with fine striae. A narrow cervical alae present in male. Spicules equal, similar, boat-shaped. Six pairs of caudal papillae of which four pairs preanal and two pairs postanal. Vulva is in the posterior end.

Measurements in mm of *Oxyspirura (Cramispirura) rhipidurae* n. sp.

	Male (1 ex)	Female (1 ex)
Length of body	4.8	8.55
Breadth of body	3.15	0.2
Length of buccal capsule	0.022	0.025
Nerve ring from the tip of the anterior end	0.13	0.16
Length of oesophagus	0.58	0.63
Breadth of oesophagus	0.072	0.063

	Male (1 ex)	Female (1 ex)
Length of tail	0.14	0.2
Length of spicules	0.099	
Vulva from the posterior extremity of the body		0.376
Eggs (length × breadth)		0.027 × 0.018

Types : All type specimens are deposited in the National Zoological Collection of India, at the Zoological Survey of India, Calcutta.

Holotype, a male, from eye of the bird, *Rhipidura albicollis orissae* Ripley : India : obtained by N. Majumdar from Govindapalle, Koraput district, Orissa, on 27 February 1977 ; Regd. No. WN 514.

Paratype, a female, with the same data as for holotype, Regd. No. WN 515.

Order SPIRURIDA

Superfamily FILARIOIDEA

Family FILARIIDAE (Wemland, 1858)

Cobbold, 1879

Genus *Squamofilaria* Schmerling, 1925

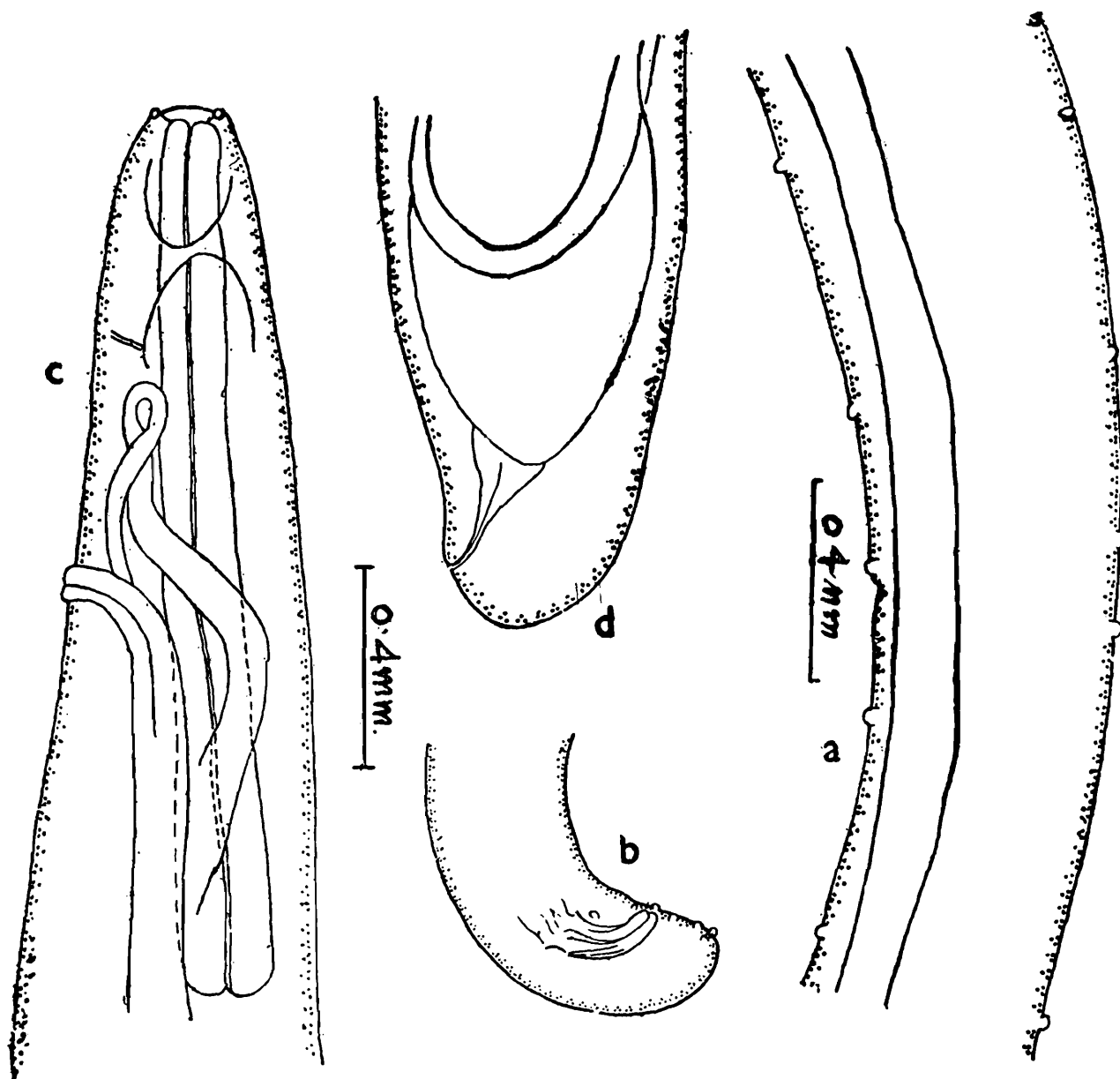
Squamofilaria oriolae n. sp.

Three males and four females specimens were collected from coelomic cavity from a bird, the South Indian Black-headed Oriole, *Oriolus xanthornus maderaspatanus* Franklin. The parasites belong to the family Filariidae and the genus *Squamofilaria* Schmerling, 1925. The present specimens do not agree with any of the known species of the genus *Squamofilaria* and therefore a new specific name is proposed to accomodate them.

Host : *Oriolus xanthornus maderaspatanus* Franklin.

Location : Coelomic cavity.

Locality : Madpad, Koraput district, Orissa.



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Fig. 4. *Squamofilaria oriolae* n. sp. (a) Middle portion of the body of a male, lateral view. (b) Posterior end of a male, lateral view. (c) Anterior end of a female, ventral view. (d) Posterior end of a female, lateral view.

DESCRIPTION

The cuticle thick and devoid of transverse striation. Tail short and round. Oesophagus cylindrical and undivided.

Male : Spicules short, equal, rounded distally and massive in the proximal end. Five pairs of sessile caudal

papillae, of which two pairs preanal, three pairs postanal and a single sessile median papilla just in front of the cloaca present.

Female : Vulva in the anterior end, tail round.

AFFINITIES

The present species belongs to the genus *Squamofilaria* Schmerling, 1925. The specimens come very close to *Squamofilaria sici* (Strachan, 1957) in various body measurements but differ from it in the number and arrangement of caudal papillae and also in the size of the spicules.

Specific diagnosis of *Squamofilaria oriolae* : Body devoid transverse striation. Oesophagus cylindrical, undivided. Buccal capsule small. Tail short and round. Posterior extremity spirally coiled in male. Spicules equal, short, rounded distally and massive in the proximal end. Two pairs of preanal, three pairs of postanal and a single sessile median papilla just in front of the cloaca present. Some small insignificant papillae scattered irregularly, especially about the middle portion of the body of the male. These are less prominent in the body of female. Vulva in the anterior end.

Measurements in mm of Squamofilaria oriolae

	<i>Male</i> (3 ex)	<i>Female</i> (4 ex)
Length of body	12.65-14.85	36.02-40.01
Breadth of body	0.33-0.44	0.60-0.66
Length of oesophagus	1.04-1.1	1.1-1.43
Breadth of oesophagus	0.38-0.44	0.110-0.131
Length of buccal capsule	0.022	0.033
Nerve ring from the tip of the anterior end	0.20-0.22	0.20-0.22
Excretory pore from anterior end	0.33	0.33

	<i>Male</i> (3 ex)	<i>Female</i> (4 ex)
Length of tail	0.09-0.1	0.08-0.11
Length of spicules	0.19-0.20	
Valva from the anterior end		0.50-0.77
Eggs (length × breadth)		0.077 × 0.33-0.044

Types : All type specimens are deposited in the National Zoological Collection of India, at the Zoological Survey of India, Calcutta.

Holotype, a male, from coelomic cavity of the bird, *Oriolus xanthornus maderaspatanus* Franklin. India : obtained by N. Majumdar from Madpad, Koraput district, Orissa on 18 February 1977 ; Regd. No. WN 516.

Paratypes, two males and four females, with the same data for the holotype, Regd. No. WN 517.

ACKNOWLEDGEMENTS

The authors are indebted to the Director, Zoological Survey of India for giving laboratory facilities.

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BIOMORPHOLOGY OF ORIENTAL APHIDIDAE-I
GREENIDEOIDA CEYLONIAE v.d. GOOT
(HOMOPTERA ; APHIDIDAE)

By

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INTRODUCTION

Greenideoida ceyloniae v. d. Goot 1917 is member of sub-family Greenideinae. Its distribution is so far restricted to Meghalaya and Tripura in India, Malaysia and Sri Lanka (Raychaudhuri, 1980) and has a specific host *Mesua ferrea*, a member of the plant family Guttifereae, which is distributed in the tropical belt of South East Asia (Deb, 1981). Ghosh (1976) recorded sexuales and the apterous viviparous morph from Shillong, Meghalaya, and Agarwala (1982) recorded the fundatrix and alate viviparous female morphs from Agartala, Tripura. Raychaudhuri (1956) provided a brief description on the apterous viviparous female and fundatrix. This species of Oriental origin was so far not studied for its seasonal preponderance and developmental morphology. Seasonal variations in various morphs were also not accounted for. This is the first investigation of a *Greenideoida* species in respect of its developmental morphology, seasonal preponderance and morph succession and distribution on the host plant. Similar study is lacking in respect of any member of the tribe Greenideini from India which is represented by 77 species including 65 endemic species.

MATERIALS AND METHODS

Five plants of *Mesua ferrea* located in College Tilla, Agartala were chosen as the study site in the present investigation. Weekly observation on the population composition, morph distribution and host condition were taken between February 1983 and January 1984. Samples of aphids representing different morphs were collected each month in 70% alcohol and studied for their morphological variations. During March—April 1983, apterous and alate viviparous female morphs were reared on caged plants individually to get samples for the studies on the changes in the morphology from the first instar nymph to the adult stage.

LIST OF ABBREVIATIONS USED IN THE TEXT

Al.	= Alate viviparous female
Ap. (p)	= Apterous viviparous female (Pigmented form)
Ap. (NP)	= Apterous viviparous female (Non-pigmented form)
h. t. 2	= Second segment of hind tarsus
L. ant.	= Length of antenna
L. base	= Length of base of last antennal segment
L. body	= Length of body
L. h. t. 2	= Length of second segment of hind tarsus
L.h. tib.	= Length of hind tibia
L. p. t.	= Length of processus terminalis
L. siph	= Length of siphunculus
L. u.r.s.	= Length of ultimate rostral segment
p. t.	= Processus terminalis
u. r. s.	= Ultimate rostral segment
w. body	= Maximum width of body

RESULT

I. SEASONALITY AND PREPONDERANCE

Heavy infestation was recorded in the spring of 1983. Population declined with the rise in temperature in late

February and further dwindled in the first week of March. No aphid incidence was recorded throughout summer and rainy periods, i.e., from the second half of March to the second half of September until 28th September when few

TABLE 1. Seasonal preponderance of *Greenideoida ceyloniae* on *Mesua ferrea*

Month		Degree of Infestation	Morph composition	Infestation sites
1983				
February	6	Heavy	Al, Ap (P), Ap (NP)	Young leaves, Buds
	20	Moderate	Al, Ap (P)	Maturing leaves
March	4	Poor	Al	Senescing leaves
	25	None	None	None
April	10	„	„	
	25	„		
May	9	„		
	24	„		
June	20	„		
	25	„		
July	9	„		
	27	„		
August	11			
	28			
September	10			
	28	Few	Al	New leaves
October	15	Moderate	Al	New leaves
	29	Heavy	Al, Ap (NP)	Young leaves
November	10	Heavy	Al, Ap (NP), Ap (P)	Young leaves, Mature leaves
	24	Heavy	„ „ „ „ „	Young leaves, Mature leaves
December	10	Heavy	Al, Ap (P), Ap (NP)	Young leaves, Mature leaves
	25	Moderate	Al, Ap (P)	Mature leaves New sprouting
1984				
January	10	Poor	Al, Ap (P)	Mature leaves, New sproutings
	24	Poor	Al, Ap (P)	Mature leaves, New sproutings

Notations : Al=Alate viviparous female ; Ap (P)=Apterous viviparous female (Pigmented form) ; Ap (NP)=Apterous viviparous female (Non-pigmented form).

alatae were found feeding on new leaves. Population build-up started from the first half of October and heavy infestation prevailed till the first half of December thence slight decline in population was observed. Poor degree of infestation was recorded in January, the last observation date in this study (Table 1).

It is evident from the table 1 that *G. ceyloniae* occurred on its host for six months in a year and heavy infestation was recorded during three months. In rest of the period infestation was either moderate or poor and sometime even a few aphids only. Heavy infestation always comprised of alate viviparous females and apterous viviparous females of both pigmented and non-pigmented forms, while moderate and poor infestations comprised of alatae and pigmented form apterae only. From the table 1 it is also evident that immigrant alatae initiated colonizing new leaves of the host in late September and first generation aphid comprised of alatae only. These alatae gave birth to apterae of the non-pigmented form and soon infestation became heavy. With the maturation of leaves the pigmented form of apterae also appeared and made prolific infestation of new shoots and maturing leaves. Simultaneously, the non-pigmented form of apterae and alatae infested the young leaves. However, in the third month, the non-pigmented form of apterae disappeared leaving behind alatae and apterae (pigmented form). The non-pigmented form reappeared in February with the bearing of new and young leaves by the host but did not lasted long, although the pigmented form continued to thrive on the mature leaves and new shoots. With the onset of summer, the host was deserted by emigrant alatae.

II. MORPH SUCCESSION AND DISTRIBUTION ON THE HOST

The alate viviparous female occurred on all the infestation sites of the host and thrived throughout the period of its host association (Table 2). The first apterous generation produced is of the non-pigmented form which infested

preferably the young leaves. This is succeeded by the pigmented form of apterae which infested the new shoots,

TABLE 2. Morph succession and distribution on *Mesua ferrea*.

Morph	Site of infestation	Period of occurrence
Alate viviparous female	New leaves	Throughout
	Young leaves	
	Mature leaves	
	Senescing leaves	
Apterous viviparous female (non-pigmented form)	Young leaves	February 1983
		October 1984
		November
Apterous viviparous female (pigmented form)	Mature leaves	January 1983
	Buds	February
	New shoots	November 1984
	New leaves	December

new leaves and also the maturing leaves. The two forms of apterae seldom occurred together on the same leaf. Senescing leaves were colonized by alatae and its alatoid progeny only while new shoots were occupied by the pigmented form of apterae. So dense were the infestation that none of the new shoots survived after 5-6-leaf stage.

III. CHANGES IN THE ONTOGENY OF VIVIPAROUS MORPHS

i. APTEROUS VIVIPAROUS FEMALE

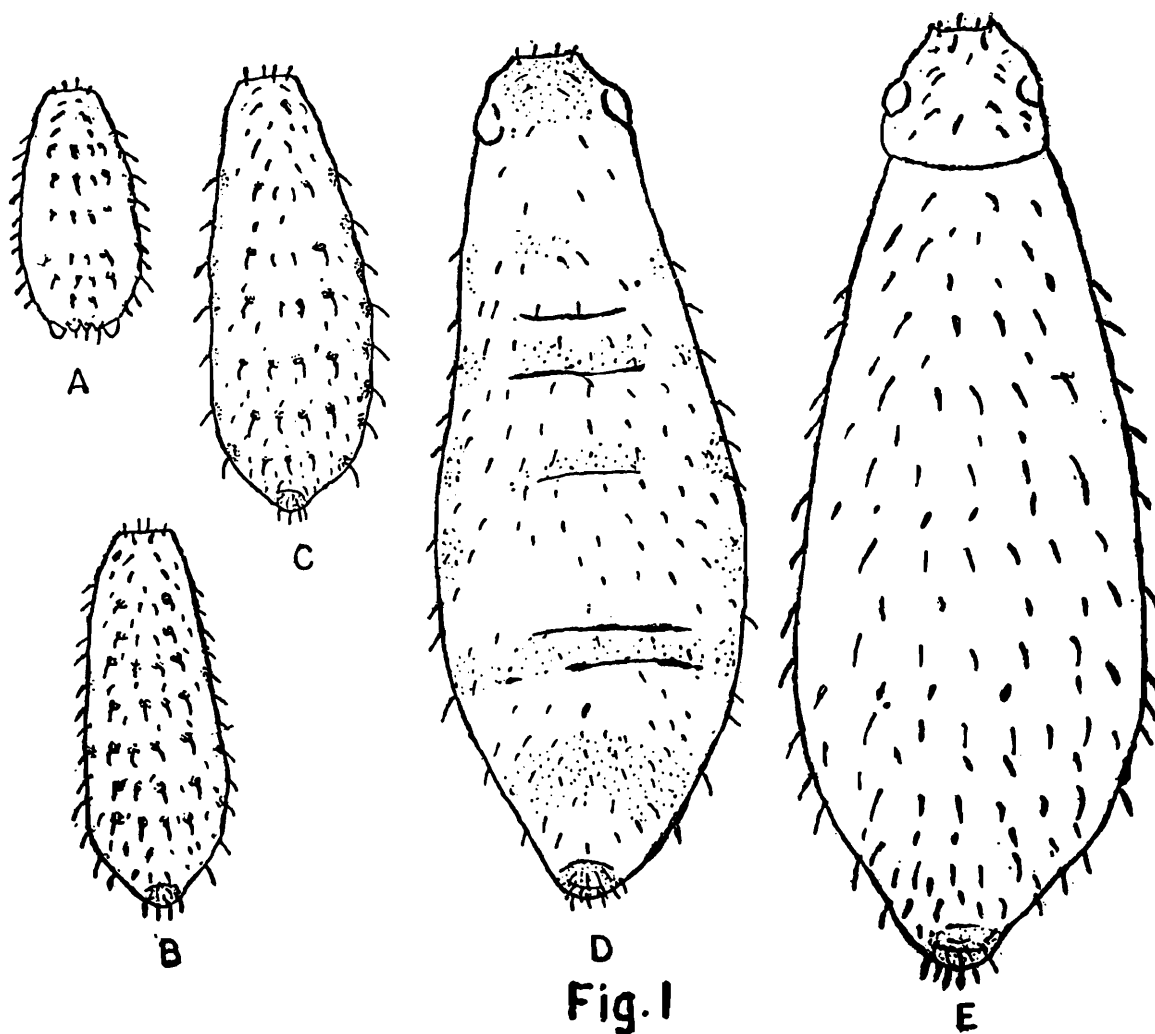
(Non-pigmented form)

Firat instar nymph

(Figs. 1A-6A)

Body 0.6-0.7 mm long and 0.25-0.3 mm in maximum width. Head smooth, without any frontal tubercles, fused with pronotum. Antennae 4-segmented, about 0.65 mm long as the body ; p. t. 2-2.5 × base of last antennal segment ; basal two segments smooth ; flagellum gradually distinctly imbricated toward apex apically ; flagellar hairs long with acute apices ; primary rhinaria circular, not ciliated and not protuberant. Rostrum elongated, with blunt apex ; segments 4 and 5 (u.r.s.) distinctly divided, 0.18-0.25 mm long

and about $2.35 \times$ h.t. 2, bearing 4 secondary hairs. Legs pale brown, smooth; femora stout; tarsi imbricated; first tarsal segments with 2 ventral hairs. Dorsum of abdomen smooth, membranous, with segmentally arranged long acute



Figs. 1A—1E: Apterous viviparous female (Non-pigmented form)—
Body: 1A—first instar, 1B—second instar, 1C—third instar,
1D—fourth instar, 1E—Adult.

hairs placed on tuberculate bases; each segment with 6 similar hairs—one pleural on each side, one marginal on each side and two dorsospinal ones. Siphunculi smooth, stumpy pale brown, without any hair, 0.06-0.15 mm long. Cauda semicircular.

Second instar nymph
(Figs. 1B-6B)

Body 1.07-1.2 mm long and 0.36-0.47 mm in maximum width. Antennae 4-segmented, about 1.05 mm long; p. t. about $3 \times$ base of last antennal segment. Ultimate rostral

segment 0.3-0.32 mm long and $3.4 \times$ h. t. 2, bearing 6 secondary hairs ; segments 4 and 5 less distinctly separated than in the first instar. Legs pale brown ; hind tibiae with

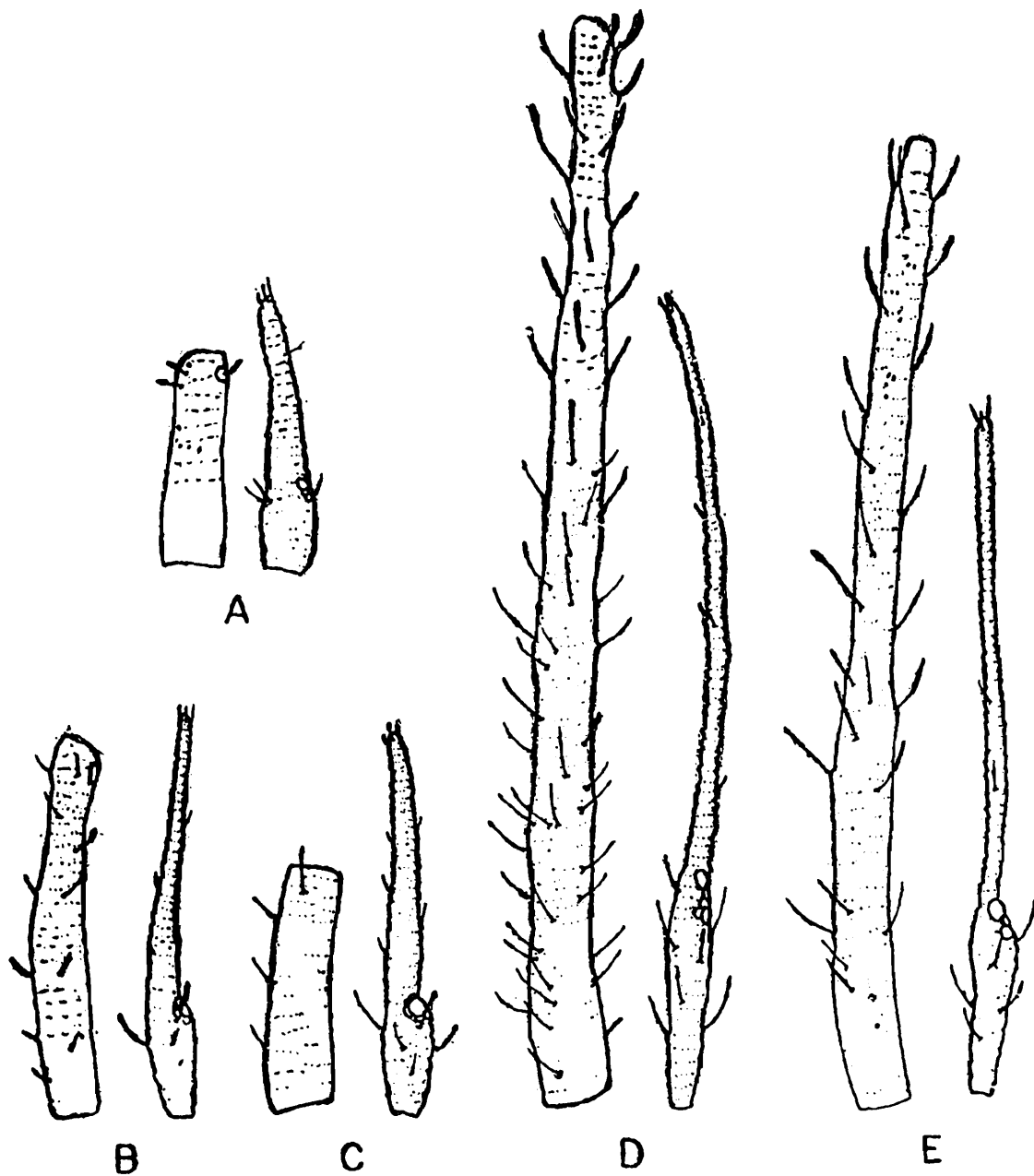


Fig. 2

Figs. 2A—2E : Apterous viviparous female (Non-pigmented form)—
Antennal segment III and p.t. : 2A—first instar, 2B—second
instar, 2C—third instar, 2D—fourth instar, 2E—Adult.

stridulatory ridges ; first tarsal segments with two long and one short ventral hairs. Dorsum of abdomen smooth and membranous. Siphunculi 0.37-0.42 mm long, about $2-8 \times$ body and bearing hairs on distal half region. Cauda semicircular bearing several long hairs. Otherwise as in first instar nymph.

Third instar nymph
(Figs. 1C-6C)

Body 1.3-1.8 mm long and 0.51-0.78 mm maximum width. Antennae 3-segmented, about 1.71 mm long ; p. t. $2.57 \times$ base of last antennal segment. Eyes multifaceted with distinct triommatidia. Ultimate rostral segment 0.45-0.57 mm long, $4.48 \times$ h. t. 2, bearing 8 secondary hairs ; segments 4 and 5

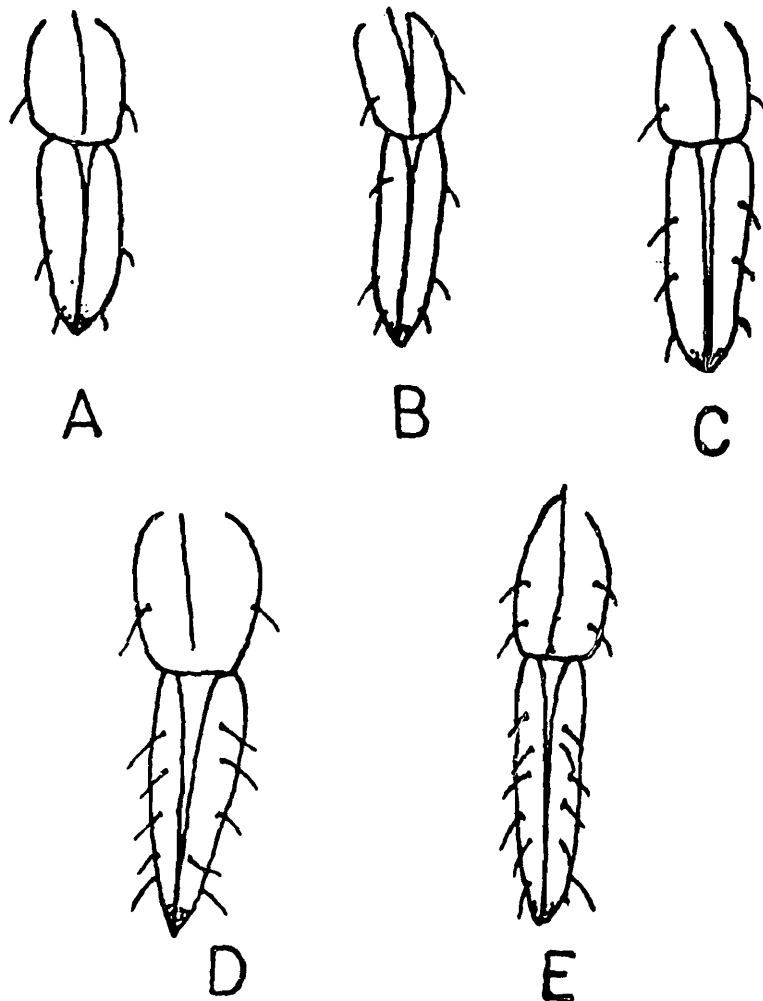


Fig. 3

Figs. 3A-3E : Apterous viviparous female (Non-pigmented form)—
u. r. s. : 3A—first instar, 3B—second instar, 3C—third instar,
3D—fourth instar, 3E—Adult.

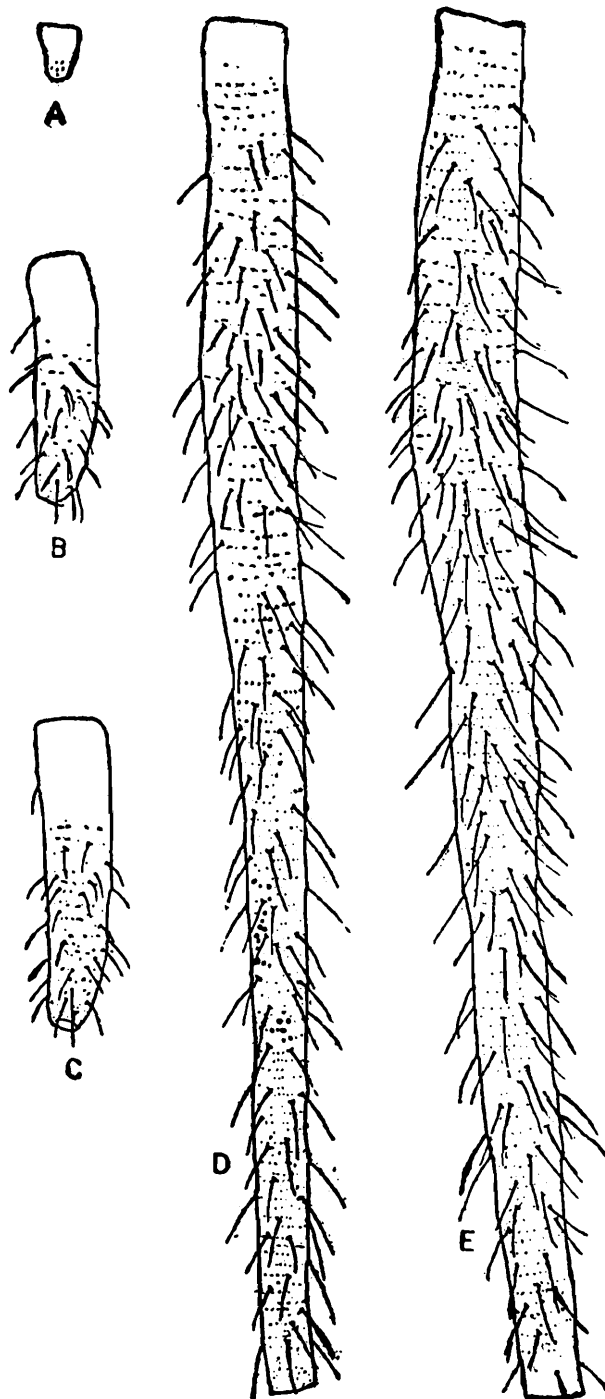
not distinctly separated. Legs pale brown ; femora, tibiae and tarsi with spinules or spinular imbrications ; first tarsal segment with two long and two short hairs. Dorsum of abdomen smooth ; tuberculate bases of abdominal hairs less

prominent. Siphunculi 0.7-1.2 mm long, bearing longer hairs in distal half region and shorter hairs in proximal half region. Otherwise as in second instar nymph.

Fourth instar nymph

(Figs. 1D-6D)

Body 2.2-2.6 mm long and 0.8-1.1 mm in maximum width. Antennae 6-segmented, about 2.67 mm long; flagellum distinctly imbricated throughout; p. t. about 2.65



Figs. 4A—4E: Apterous viviparous female (Non-pigmented form)—
Siphunculus: 4A—first instar, 4B—second instar, 4C—third
instar, 4D—fourth instar, 4E—Adult.

× base of last antennal segment. Ultimate rostral segment 0.76-0.85 mm long, $6.96 \times$ h. t. 2 and bearing 8 secondary hairs. Legs with spinular imbrications throughout; first tarsal segments with 5 ventral hairs. Dorsum of abdomen smooth, bearing upto 10 long and acute hairs on each

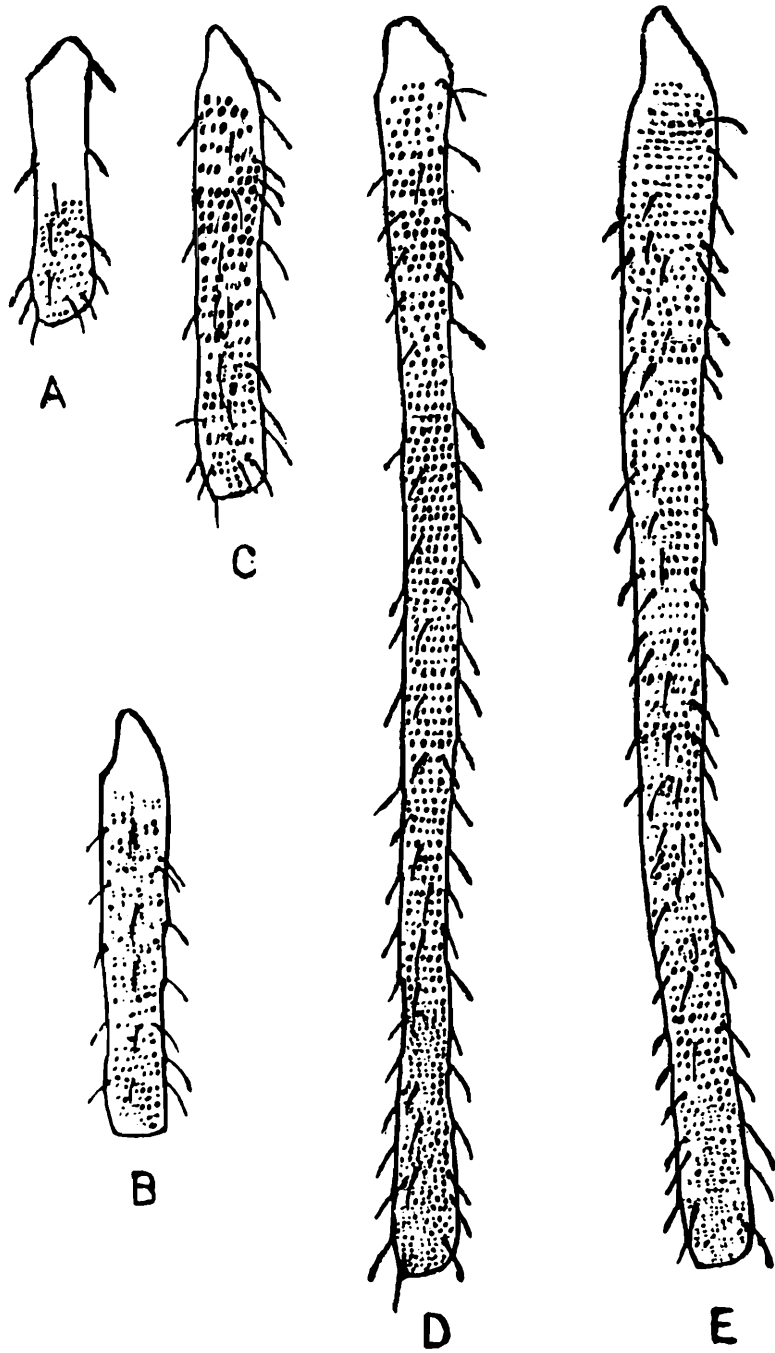


Fig. 5

Figs. 5A—5E: Apterous viviparous female (Non-pigmented form)—
Hindtibia: 5A—first instar, 5B—second instar, 5C—third
instar, 5D—fourth instar, 5E—Adult.

segment. Siphunculi 1.25-1.5 mm long, cylindrical, bearing hairs throughout except near the base. Otherwise as in third instar nymph.

Adult morph
(Figs. 1E-6E)

Body 2.5-3.12 mm long and 1.06-1.18 mm in maximum width. Antennae 6-segmented, 2.56-2.71 mm long; p. t. 2.66-3.09 × base of last antennal segment. Ultimate rostral segment 0.9-0.98 mm long, 7.69 × h. t. 2, bearing upto 12

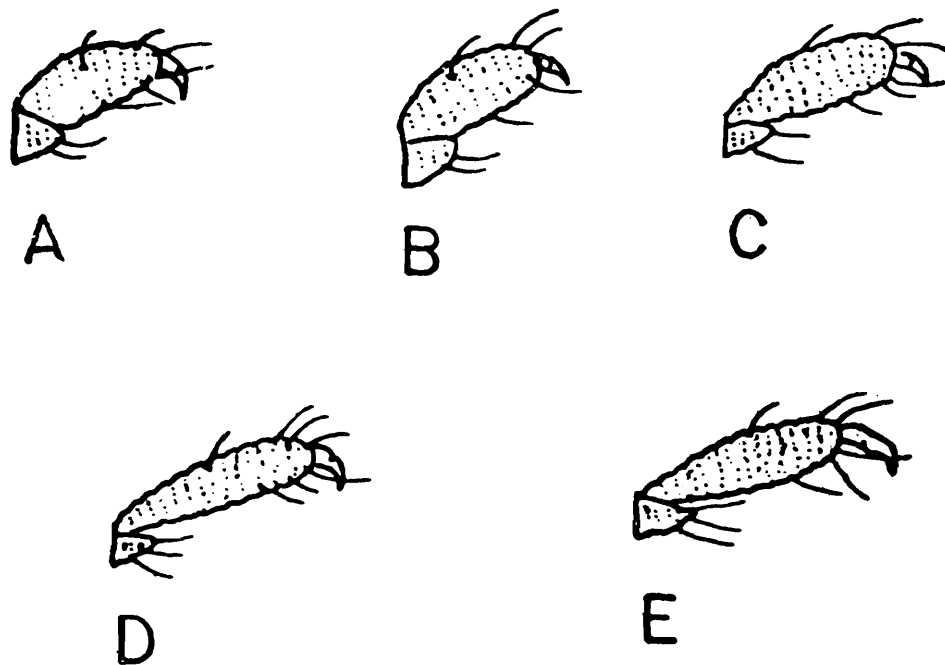


Fig. 6

Figs. 6A—6E: Apterous viviparous female (Non-pigmented form)—
h. t. 2: 6A—first instar, 6B—second instar, 6C—third instar,
6D—fourth instar, 6E—Adult.

secondary hairs. First tarsal segments with 5 ventral hairs. Dorsum of abdomen pale and smooth; dorsal hairs without tuberculate bases; hairs gradually becoming longer caudad. Siphunculi 1.87-2.23 mm long, narrow towards apex, outwardly curved and bearing hairs throughout except near the base. Otherwise as in fourth instar nymph.

II. APTEROUS VIVIPAROUS FEMALE (Pigmented form)

First instar nymph

(Figs. 7A-12A)

Body 0.76-0.83 mm long and 0.28-0.39 mm as maximum width. Antennae 4-segmented, about 0.26 mm long, p. t. $0.62 \times$ base of last antennal segment. Ultimate rostral

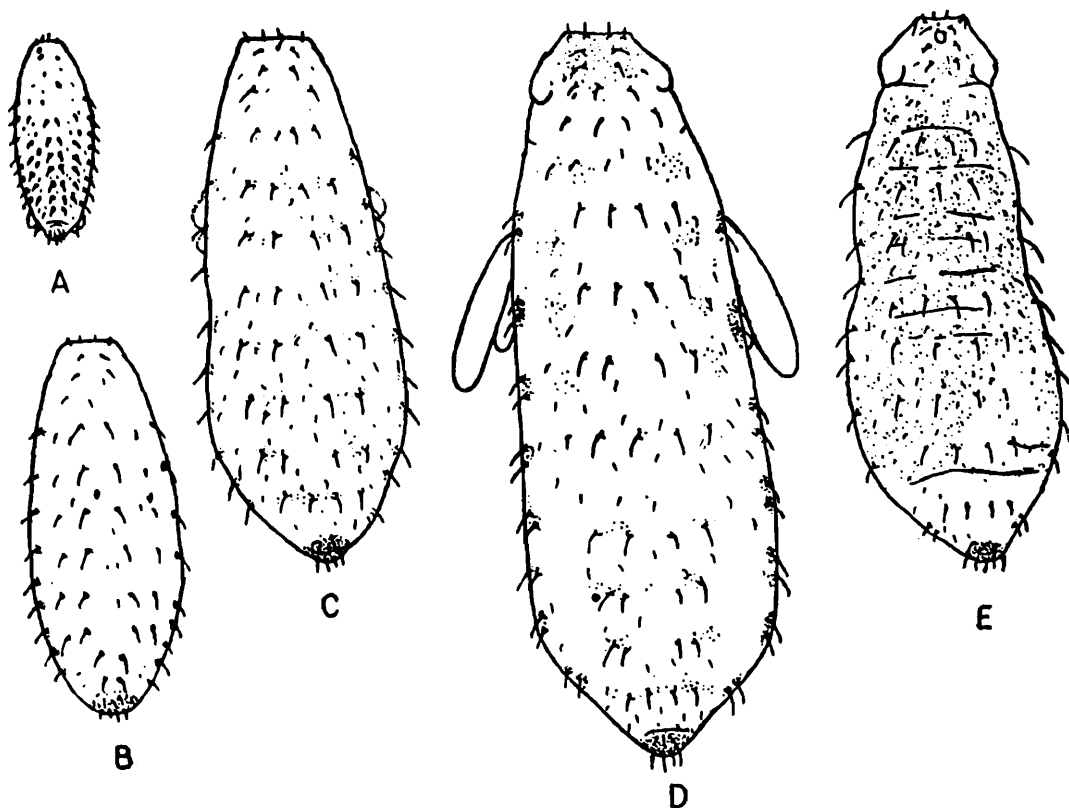


Fig. 7

Figs. 7A—7E : Apterous viviparous female (Pigmented form)—Body : 7A—first instar, 7B—second instar, 7C—third instar, 7D—fourth instar, 7E—Adult.

segment 0.23-0.25 mm long, $3 \times$ h. t. 2, bearing 6 secondary hairs ; segments 4 and 5 not distinctly separated. Legs stout ; first tarsal segments with 2 ventral hairs. Dorsum of abdomen slightly pigmented, dorsal hairs long and acute, 6 on each ante-siphuncular segments, with tuberculate sclerotic bases, 4 such hairs on post-siphuncular segments with prominent bases. Siphunculi stumpy, 0.05-0.06 mm long and without any hair. Cauda semicircular. Otherwise similar to first instar nymph of non-pigmented form.

Second instar nymph

(Figs. 7B-12B)

Body 0.64-0.9 mm long and 0.3-0.4 mm as maximum width. Antennae 4-segmented, about 0.43 mm long; p.t. 2.15 × base of last antennal segment. Eyes many-faceted.

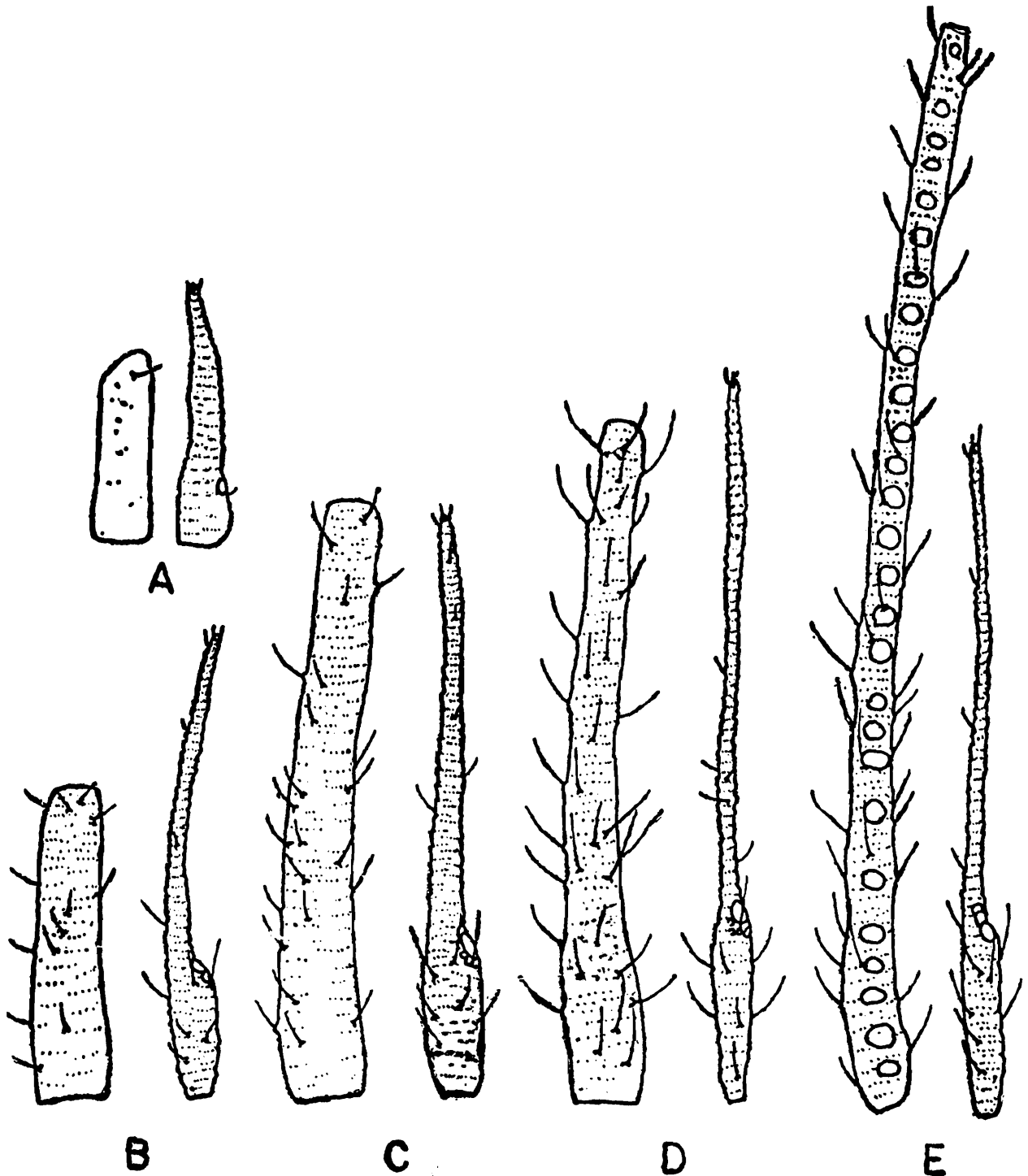


Fig. 8

Figs. 8A—8E: Apterous viviparous female (Pigmented form)—
Antennal segment III and p.t.: 8A—first instar, 8B—second
instar, 8C—third instar, 8D—fourth instar, 8E—Adult.

Ultimate rostral segment 0.28-0.33 mm long, $3 \times$ h.t. 2, bearing 8 secondary hairs. Legs pale brown; hindtibiae with few stridulatory ridges; first tarsal segments with 3

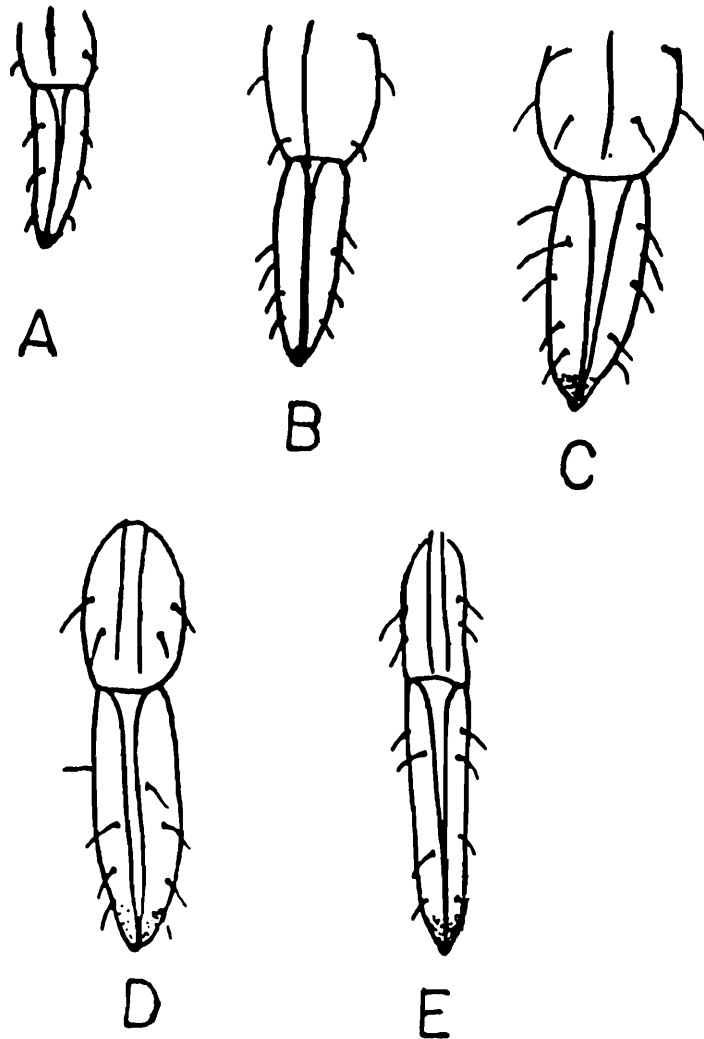


Fig 9

Figs. 9A-9E: Apterous viviparous female (Pigmented form)—
u. r. s.: 9A—first instar, 9B—second instar, 9C—third instar,
9D—fourth instar, 9E—Adult.

ventral hairs. Siphunculi 0.6-0.8 mm long, broader at base and narrower at apex, bearing hairs on distal half region only. Otherwise similar to first instar and second instar nymphs of non-pigmented form.

Third instar nymph
(Figs. 7C-12C)

Body 1.48-1.92 mm long and 0.78-0.83 mm maximum

width. Antennae 5-segmented, about 1.08 mm long; p.t. $2.2 \times$ base of last antennal segment. Ultimate rostral segment 0.47-0.8 mm long, $5.84 \times$ h.t. 2, bearing 8 secondary hairs. Legs brown; hindtibiae with stridulatory ridges; first tarsal segments with 4 ventral hairs. Dorsum of abdomen smooth; dorsal hairs on non-tuberculate bases, upto 10 hairs on each of the ante-siphuncular segments, less

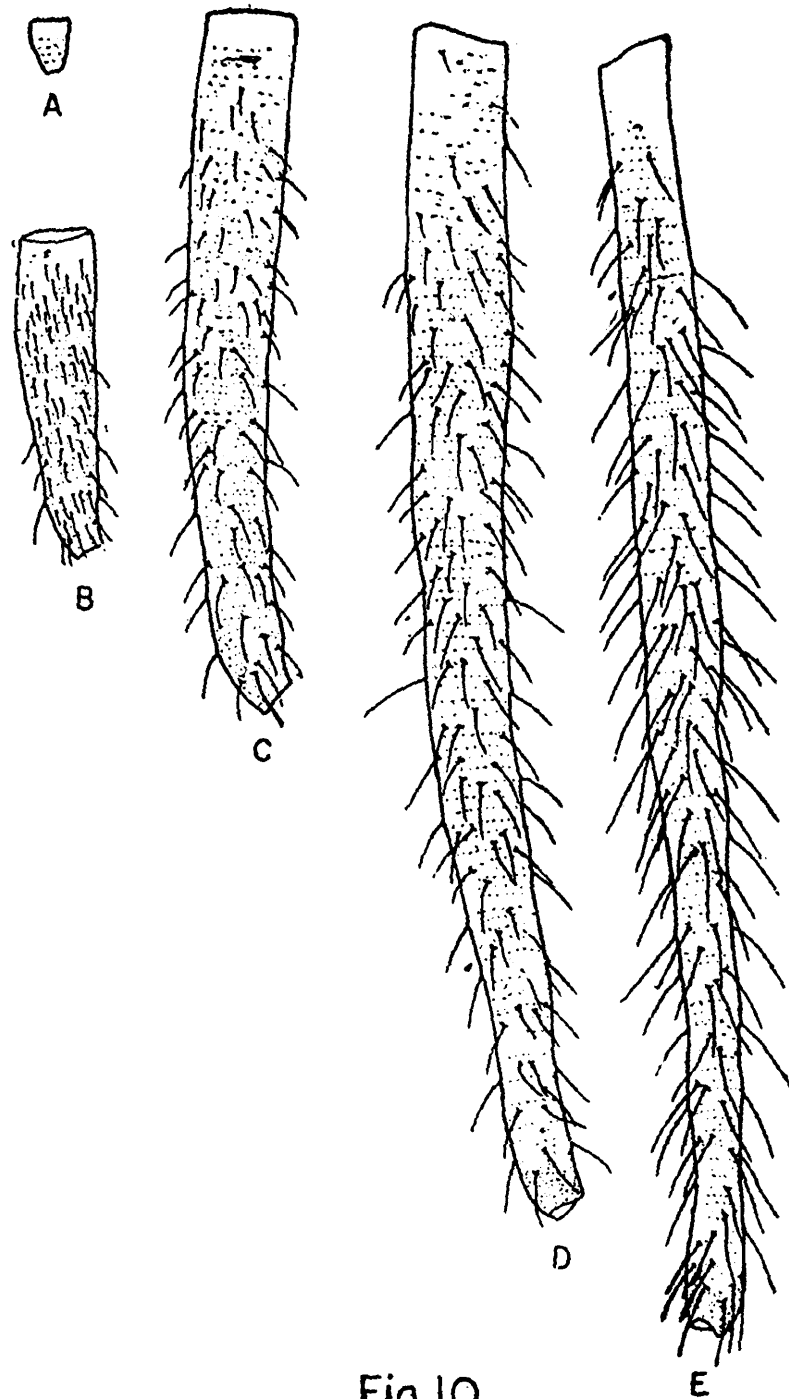


Fig.10

Figs. 10A—10E : Apterous viviparous female (Pigmented form)—siphunculus : 10A—first instar, 10B—second instar, 10C—third instar, 10D—fourth instar, 10E—Adult.

but more longer on post-siphuncular segments. Siphunculi 0.62-0.82 mm long, bearing hairs throughout except near the base. Otherwise similar to second instar and third instar nymphs of non-pigmented form.

Fourth instar nymph

(Figs. 7D-12D)

Body 1.72-2.1 mm long and 0.78-0.98 mm as maximum width. Antennae 6-segmented, about 1.37 mm long ;

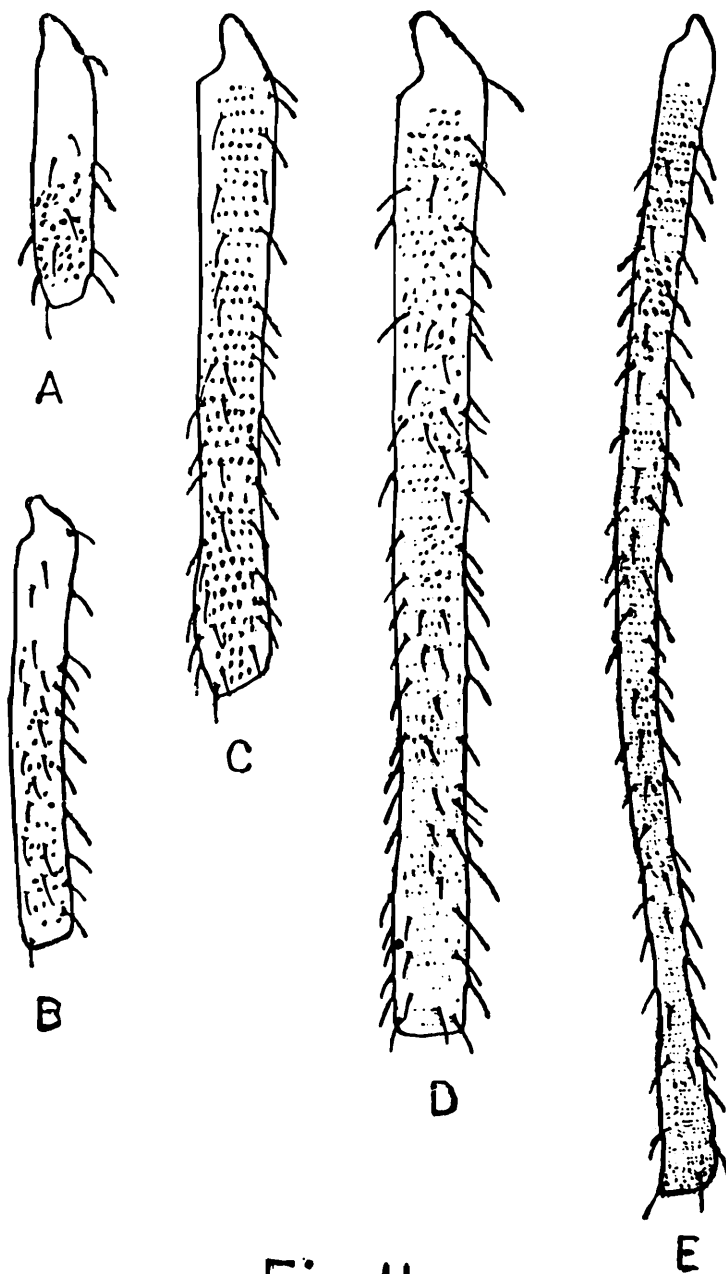


Fig. 11

Figs. 11A—11E: Apterous viviparous female (Pigmented form)—Hind-tibia: 11A—first instar, 11B—second instar, 11C—third instar, 11D—fourth instar, 11E—Adult.

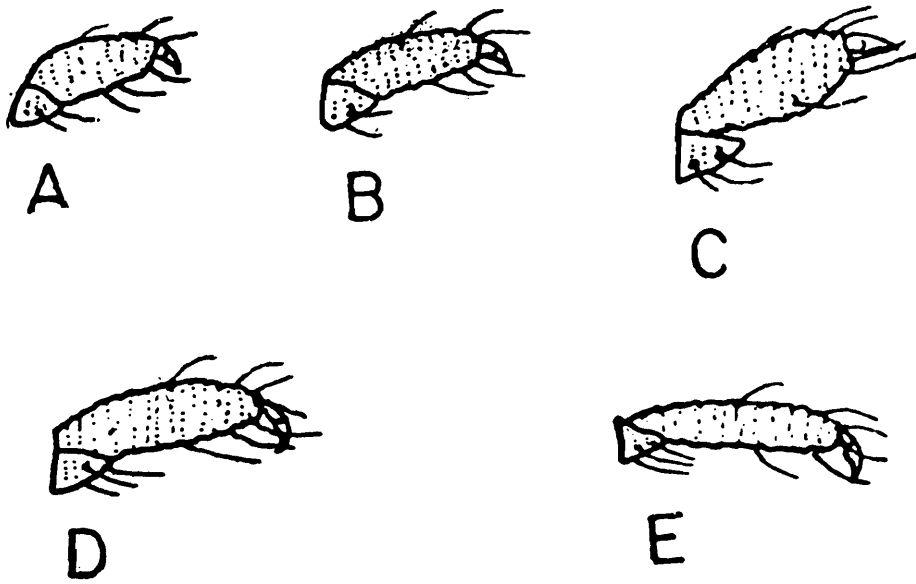


Fig.12

Figs. 12A—12E: Apterous viviparous female (Pigmented form)—
h. t. 2 : 12A—first instar, 12B—second instar, 12C—third instar,
12D—fourth instar, 12E—Adult.

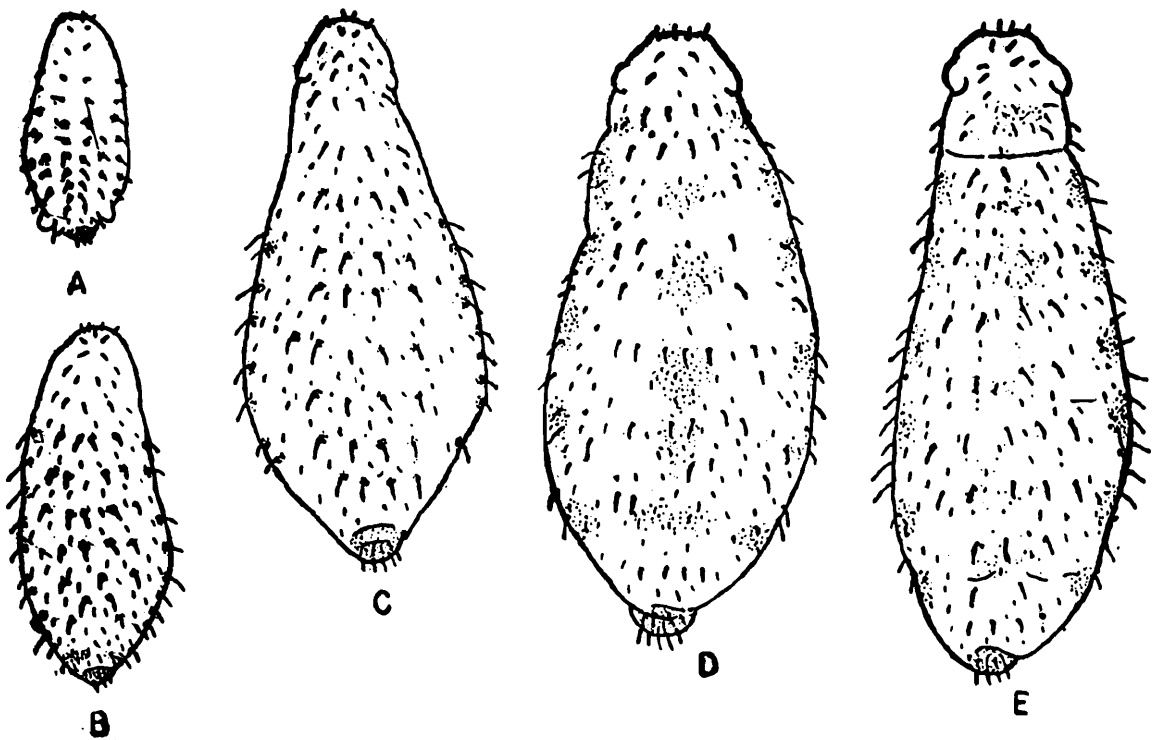


Fig.13

Figs. 13A—13E : Alate viviparous female—Body : 13A—First instar,
13B—second instar, 13C—third instar, 13D—fourth instar, 13E—
Adult (wing omitted).

flagellum imbricated throughout; p.t. $1.84 \times$ base of last antennal segment. Ultimate rostral segment $0.76-0.84$ mm long, $5.86 \times$ h.t. 2, bearing 8 secondary hairs. Legs brown, first tarsal segments with 5 ventral hairs. Dorsum of abdomen pigmented, rugose and spinulose; dorsal hairs

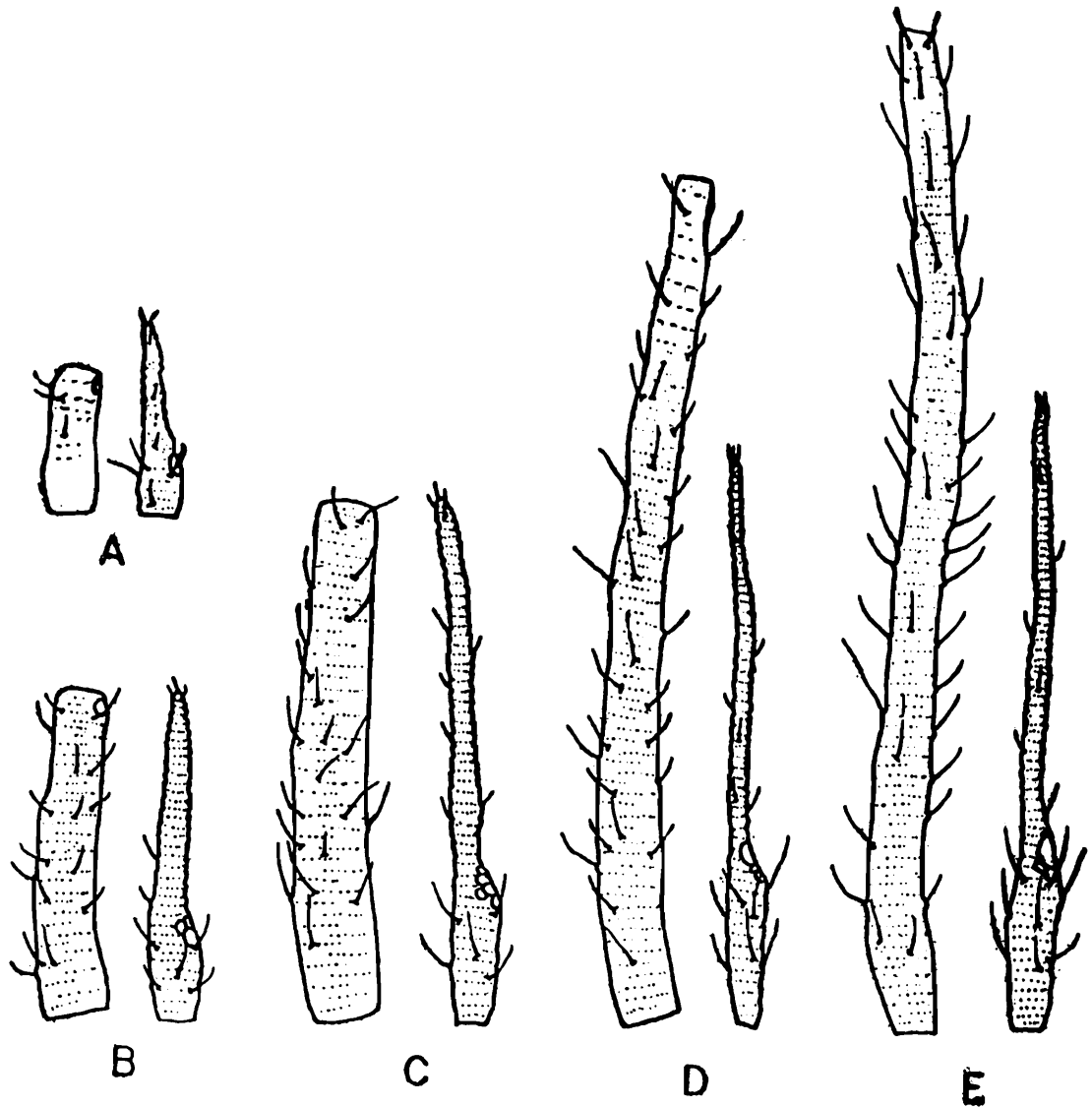


Fig.14

Figs. 14A—14E: Alate viviparous female—Antennal segment III and p. t. : 14A—first instar, 14B—second instar, 14C—third instar, 14D—fourth instar, 14E—Adult.

stout and acute. Siphunculi $0.65-1.25$ mm long, broader towards basal half and somewhat narrow towards apices, spinulose, bearing hairs throughout except near the base, without any reticulation. Cauda semicircular, bearing many long hairs. Otherwise as in third instar and fourth instar nymphs of non-pigmented form.

Adult viviparous female
(Figs. 7E-12E)

Body 1.51-2.18 mm long and 0.62-1.9 mm maximum width. Antennae 6-segmented, 1.15-1.59 mm long ; p. t. 1.8-2.0 × base of last antennal segment. Ultimate rostral segment 0.78-0.81 mm long, 6.85 × h.t. 2 and bearing 8 secondary hairs ; segments 4 and 5 not distinctly separated. Legs brown, spinulose ; first tarsal segments with 5 ventral

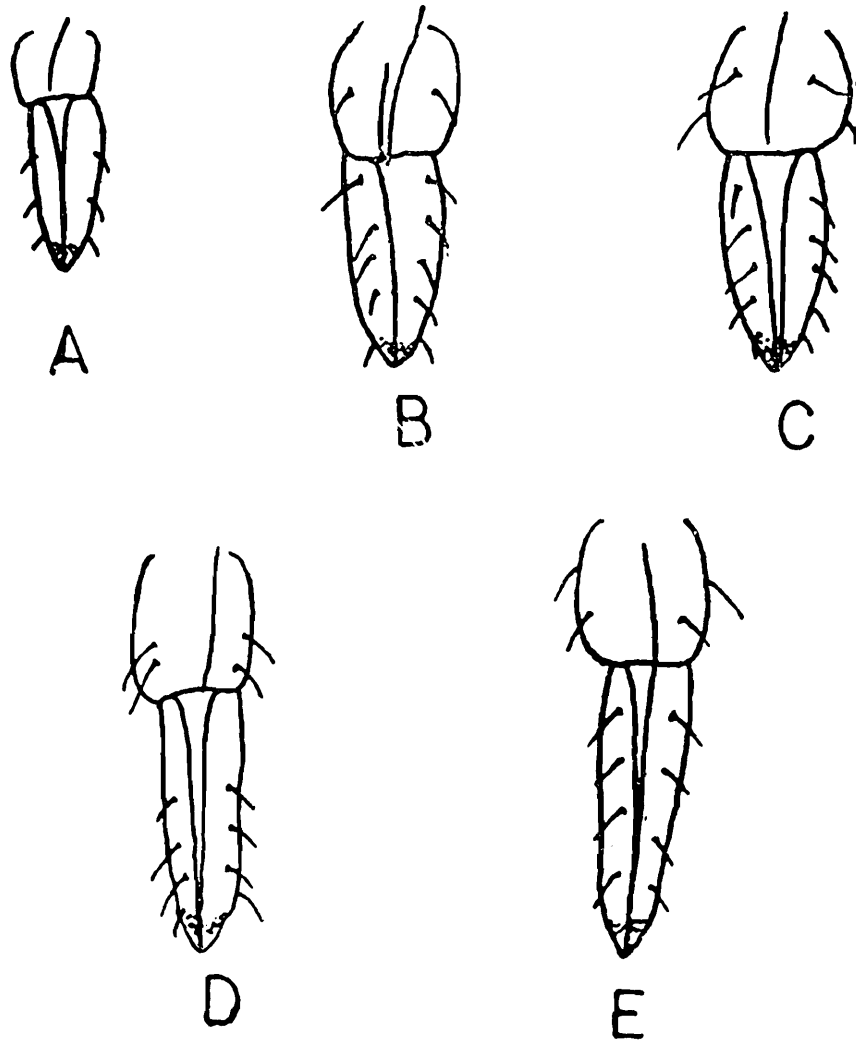


Fig. 15

Figs. 15A—15E : Alate viviparous female—u.r.s. : 15A—first instar
15B—second instar, 15C—third instar, 15D—fourth instar,
15E—Adult.

hairs. Dorsum of abdomen pigmented except in the dorso-median region which is pale ; sclerotic and rugose patches on the two sides along pale region of ante-siphuncular segments ; post-siphuncular segments pale. Siphunculi deep brown or black, curved outward, 0.65-0.98 mm long, bearing

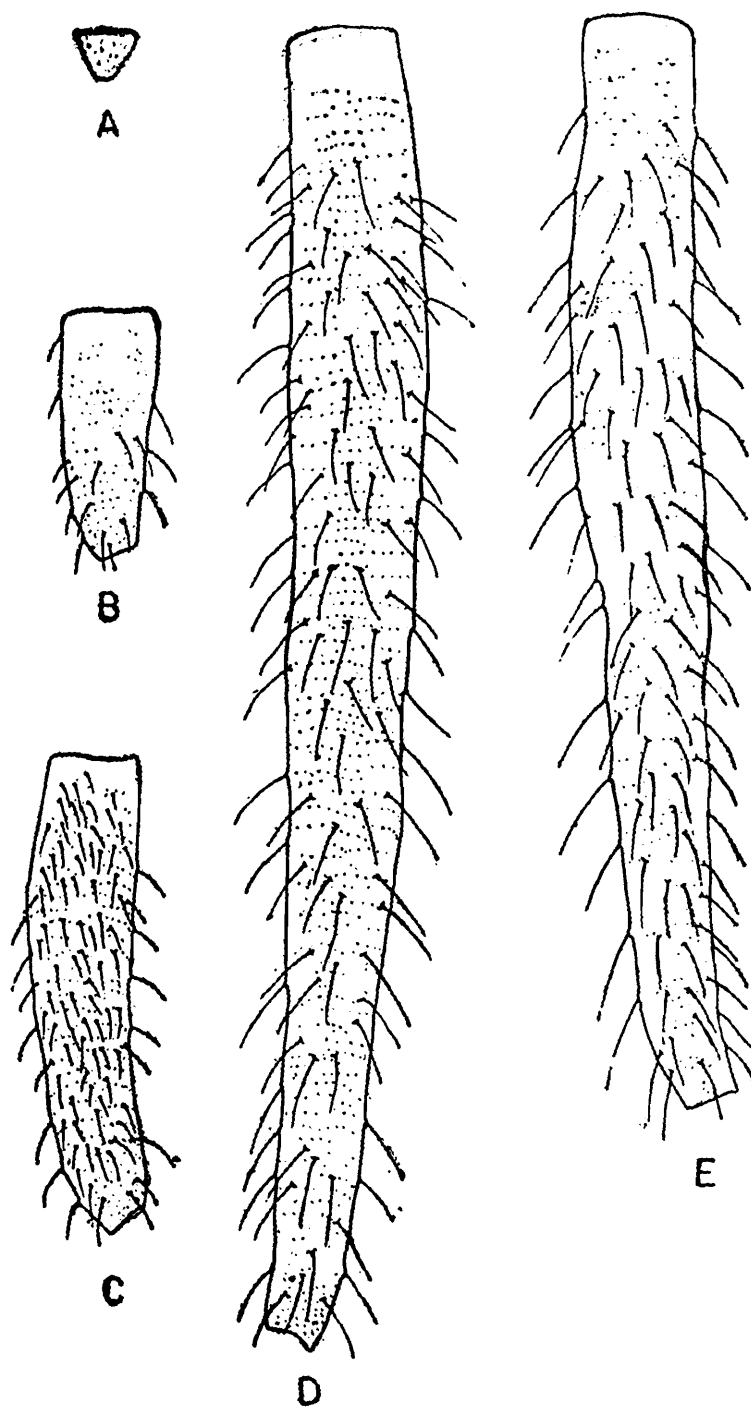


Fig.16

Figs. 16A—16E ; Alate viviparous female—siphunculus : 16A—first instar, 16B—second instar, 16C—third instar, 16D—fourth instar, 16E—Adult.

hairs throughout except near the base ; spinulose throughout. Cauda pale. Otherwise similar to fourth instar nymph.

III. ALATE VIVIPAROUS FEMALE

First instar nymph

(Figs. 13A-18A)

Body 0.75-1.09 mm long and 0.3-0.6 mm as maximum width. Head smooth. Antennae 4-segmented, about 0.7 mm long ; flagellum with spinular imbrications ; p.t. $2.1 \times$ base of last antennal segment ; without any secondary

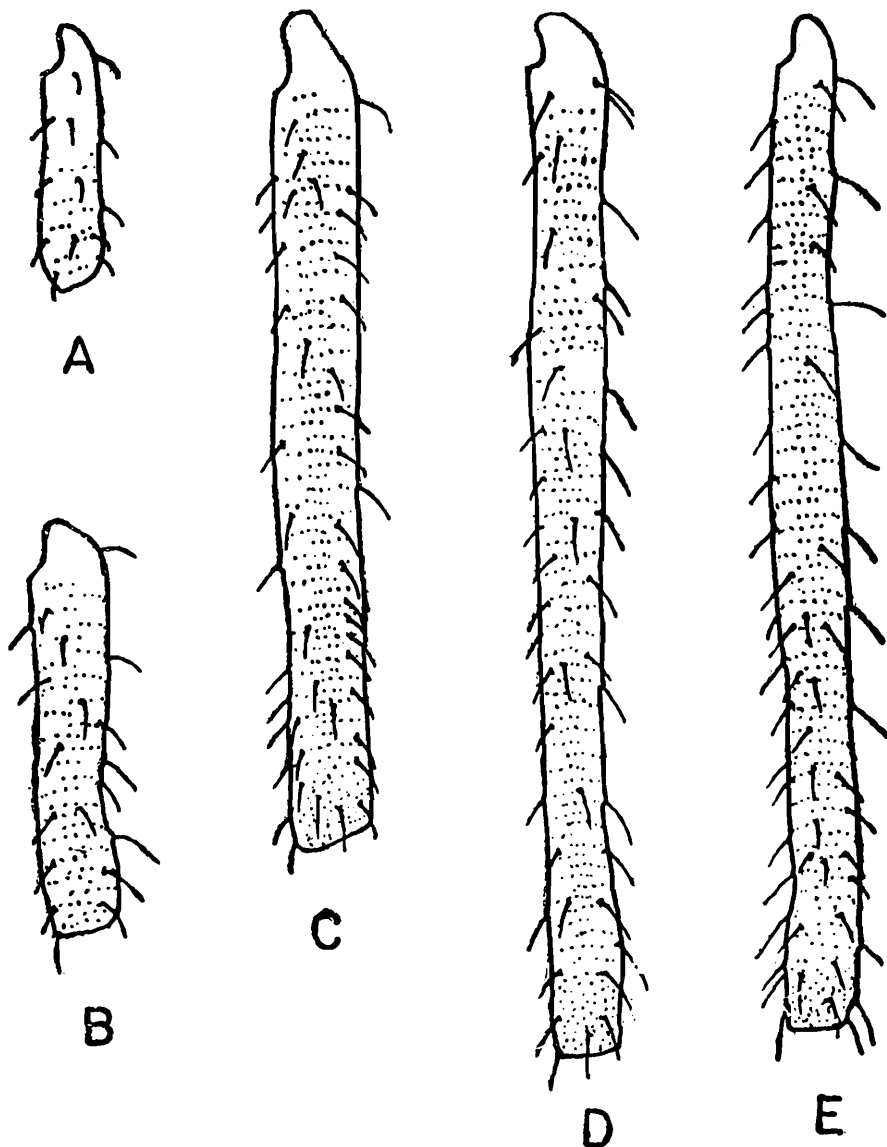


Fig.17

Figs. 17A-17E : Alate viviparous female—Hindtibia : 17A—first instar, 17B—second instar, 17C—third instar, 17D—fourth instar, 17E—Adult.

rhinaria ; primary rhinaria rounded, non-ciliated. Rostrum blunt ; ultimate rostral segment 0.3-0.4 mm long, $3.9 \times$ h.t. 2, bearing 6 secondary hairs. Dorsum of abdomen smooth, dorsal hairs long, acute, placed on tuberculate bases, 6 hairs on each segment, hairs gradually longer caudad. Siphunculi stumpy, 0.16-0.3 mm long, without any hair. Cauda transversely semioval. Legs pale brown, smooth. First tarsal segments with two ventral hairs. Otherwise similar to first instar nymph of apterae.

Second instar nymph

(Figs. 13B-18B)

Body 1.2-1.6 mm long and 0.5-0.64 mm as maximum width. Antennae 4-segmented, 3rd segment incompletely divided, about 0.9 mm long ; p.t. $2.26 \times$ base of last antennal

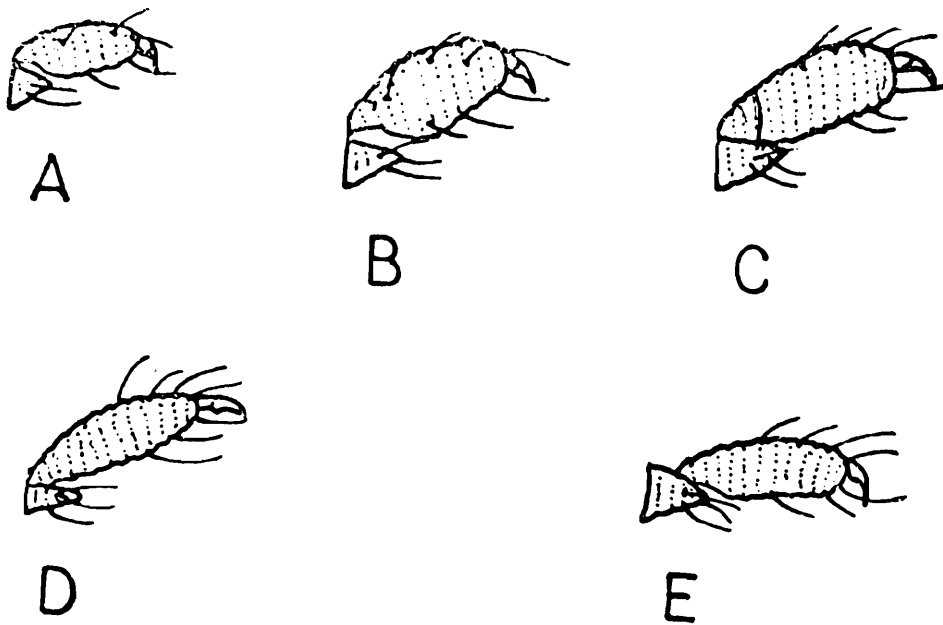


Fig 18

Figs. 18A-18E : Alate viviparous female—h. t. 2 : 18A—first instar, 18B—second instar, 18C—third instar, 18D—fourth instar, 18E—Adult.

segment ; flagellum slightly imbricated, bearing long and acute hairs ; without any secondary rhinaria. Ultimate rostral segment 0.35-0.46 mm long, $4.0 \times$ h.t. 2 and with 10

secondary hairs. Dorsum of abdomen pale brown, nearly smooth. Siphunculi cylindrical, 0.19-0.25 mm long, bearing hairs throughout. Legs pale brown ; femora, tibiae and tarsi with spinules ; hind tibiae with stridulatory ridges ; first tarsal segments with 3 ventral hairs. Otherwise similar to second instar nymph of apterae.

Third instar nymph

(Figs. 13C-18C)

Body 1.4-1.9 mm long and 0.55-0.86 mm as maximum width. Antennae 5-segmented, about 1.6 mm long, p.t. $2.7 \times$ base of last antennae segment. Wing buds on meso- and metathoracic segments distinguishable. Ultimate rostral segment 0.5-0.6 mm long, $1.81 \times$ h.t. 2 and bearing 6 secondary hairs. Dorsum of abdomen pale brown, nearly smooth ; dorsal hairs upto 10 on each of the ante-siphuncular segments. Siphunculi pale, 0.1-0.14 mm long, broader basally and narrow apically, bearing hairs throughout except near the base. Cauda semioval. Legs pale brown ; first tarsal segments with hairs. Otherwise similar to third instar nymph of apterae.

Fourth instar nymph

(Figs. 13D-18D)

Body 2.34-3.04 mm long and 0.7-0.8 mm as maximum width. Antennae 6-segmented, about 1.92 mm long ; without any secondary hairs, wing-buds prominent, without venation. Ultimate rostral segment 0.8-0.9 mm long, $6.7 \times$ h.t. 2 and bearing 8 secondary hairs. Dorsum of abdomen nearly smooth, dorsal hairs without any tuberculate base. Siphunculi 0.26-0.33 mm long, pale brown, outwardly directed, bearing hairs throughout but less so near the base and apex. Cauda roundly semioval. Otherwise similar to fourth instar nymph of apterae.

Adult viviparous female

(Figs. 13E-18E)

Description similar to as provided by Raychaudhuri (1956) and Agarwala (1982).

IV. ANALYSIS OF VARIATIONS : (tables 3, 4 & 5) :

Both quantitative and qualitative variations are evident in the ontogenic stages of each morph. Absolute measurements of various characters like the length of the body, antennae and siphunculi exhibit large differences between different instars of each morph. Certain characters like length of u. r. s. and h. t. 2 are less variable and except for minute distinguishable variations in succeeding instars, overlapping variations are more often seen. Number of dorsal hairs on the abdomen changes appreciably from the first instar to the adult stage and along with it also changes their quality. In the first two instars of each morph dorsal abdo-

TABLE 3. Measurements (average of 10 specimens) of some morphological characters in apterous viviparous female (non-pigmented form) of *G. ceyloniae*.

Characters	First instar		Second instar		Third instar		Fourth instar		Adult	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
L. Body	0.6	0.7	1.07	1.2	1.3	1.8	2.2	2.57	2.5	3.12
W. Body	0.25	0.36	0.35	0.47	0.5	0.8	0.86	1.1	1.06	1.2
L. ant.	0.46	0.7	0.82	1.05	1.1	1.2	1.0	1.7	1.4	1.6
L. base	0.062	0.093	0.09	0.2	0.14	0.17	0.14	0.17	0.78	0.16
L.p.t.	0.16	0.19	0.28	0.37	0.31	0.46	0.16	0.37	0.17	0.37
L.u.r.s.	.018	.025	.028	.03	.045	.058	.076	.085	.093	.097
L.h.t.2	0.08	0.11	0.08	0.09	0.11	0.12	0.1	0.12	0.1	0.14
L. siph.	0.06	0.1	0.37	0.4	0.7	1.2	1.3	1.5	1.9	2.2
L.h.tib.	0.16	0.2	0.2	0.37	0.37	0.55	0.5	0.6	0.7	0.8

TABLE 4. Measurements (average of 10 specimens) of some morphological characters in apterous viviparous female (pigmented form) of *G. ceyloniae*.

Charac- ters	First instar		Second instar		Third instar		Fourth instar		Adult	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
L. Body	0.76	0.83	0.64	0.9	1.5	1.9	1.7	2.1	1.5	2.2
W. body	0.3	0.4	0.3	0.4	0.8	0.83	0.8	0.98	0.6	1.0
L. ant.	0.24	0.27	0.35	0.45	1.18	1.37	2.01	2.61	2.15	2.76
L. base	0.06	0.062	0.046	0.062	0.14	0.156	0.17	0.2	0.19	0.2
L. p. t.	0.03	0.046	0.12	0.14	0.23	0.4	0.42	0.5	0.45	0.59
L. u. r. s.	0.023	0.025	0.028	0.033	0.047	0.08	0.076	0.084	0.078	0.081
L. h. t. 2	0.05	0.06	0.09	0.11	0.09	0.12	0.09	0.12	0.09	0.14
L. siph.	0.04	0.06	0.06	0.08	0.6	0.8	0.65	1.2	0.6	0.98
L. h. tib.	0.16	0.17	0.2	0.26	0.34	0.47	0.47	0.59	0.47	0.6

TABLE 5. Measurements (average of 10 specimens) of some morphological characters in alate viviparous female of *G. ceyloniae*.

Charac- ters	First instar		Second instar		Third instar		Fourth instar		Adult	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
L. body	0.75	1.09	1.2	1.6	1.4	1.8	2.3	3.04	2.5	2.7
W. body	0.3	0.6	0.5	0.64	0.55	0.8	0.8	1.07	0.8	0.97
L. ant.	0.3	1.0	0.8	1.1	1.3	1.5	1.7	1.9	2.0	2.6
L. base	0.03	0.1	0.1	0.14	0.1	0.16	0.16	0.25	0.18	0.2
L. p. t.	0.03	0.2	0.25	0.3	0.34	0.4	0.4	0.5	0.43	0.56
L. u. r. s.	0.034	0.04	0.034	0.046	0.047	0.057	0.078	0.09	0.078	0.086
L. h. t. 2	0.06	0.13	0.09	0.1	0.1	0.12	0.1	0.14	0.1	0.14
L. ship	0.06	0.12	0.4	0.44	0.8	0.9	1.35	1.9	1.6	2.3
L. h. tib.	0.16	0.4	0.3	0.33	0.34	0.46	0.6	1.03	0.62	0.8

minal hairs are six in number on each segment and with tuberculate bases, but these bases become non-tuberculate from the third instar and their number increases upto ten per segment in the fourth instar and adult. Number of secondary hairs on u.r.s., although varies among ontogenic stages, often overlap between the two succeeding instars. Siphunculi and antennae change their characters more appreciably than other structures. Non-hairy, smooth and stumpy siphunculi of the first instar becomes hairy and cylindrical in the second instar, spinulose or imbricated and apically narrowed in the third instar and outwardly directed in the fourth instar and the adult. Number of antennal segments is always four in the first and second instars, five in the third instar and six in the fourth instar and the adult. Antennal segment III and p.t. increase in length more appreciably than the rest of the segments and remain distinct in length in each of the nymphal instars and adult.

Inter-morph variations in each instar are also notable. In apterae viviparae, the non-pigmented form can be easily separated from the pigmented form at any stage of development in the longer body, longer antennae and longer siphunculi. Besides, in life, the progeny of the two forms are easily distinguishable in the absence of the dark pigment of the body and pale siphunculi on the non-pigment form. Most of the qualitative characters are rather constant among morphs except for the presence of spinule and rugosity in the third and

fourth instars and adult of the pigmented form and its nearly total absence in the non-pigmented form. In alatae viviparae the wing-bud is not discernable until second instar and secondary rhinaria on the antenna appear only in the adult.

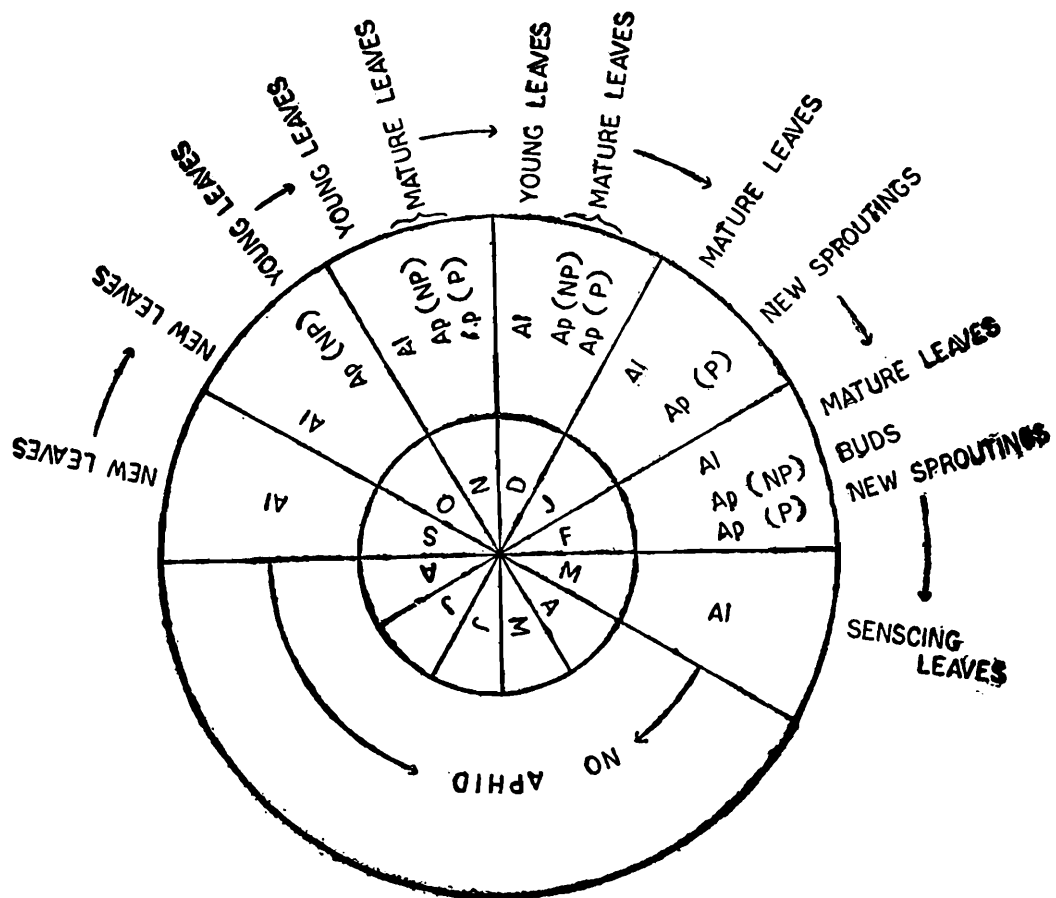


Fig. 19 : Life table

Notably the stridulatory ridges, which is one of the characteristics of the subgenus *Paragreenideoida* to which *ceyloniae* belongs, are more or less distinct in the second instar and becomes more prominent in later stages.

DISCUSSION

Aphids, being polymorphic insects, are easily susceptible to non-genetic variations caused by the host-condition, climatic changes and crowding effect because of parthenogenetic viviparity. Very often it is hard to distinguish the developing stages of two closely related species and even within a species between different morphs. In *G. ceyloniae*

where polymorphism occurs almost throughout the period of aphid incidence on its specific host, it is necessary to know the morphology of different morphs in their developing and adult stages and the variations between them.

In the present investigation alate morph maintains its population on the host from the inception in September till the end of March of the following year. The first apterous generation of the non-pigmented form appear towards the end of October. This morph prefers feeding on young leaves and in the following months spread to new leaves and new shoots where the pigmented form of apterae are produced. The non-pigmented form disappears with the maturation of leaves and the pigmented form occupies its place. Until the onset of spring in February of the following year this situation persists when the host start bearing young leaves, and this sets the production of the non-pigmented form again. For about one month all the three morphs occur on the same host but the non-pigmented form is short-lived and disappears with the maturation of leaves. The distinct habitat of the two forms of apterae viviparae seems to be the result of high degree of polymorphism and is a positive factor in the exploitation of host. Further, the availability of alate viviparae throughout the duration of aphid incidence is indicative of monitoring the capacity of reproduction in this species which can be linked with the seasonality of the host plant. (Fig. 19) Morphological changes in the ontogeny of different morphs are important parameter in measuring the variation which is vital in the correct understanding of taxonomy and biology of aphids. Also, very often only immature specimens are available in the collection. Knowledge of characters of developing stages makes it possible to identify them. However, such knowledge shall be incomplete until more studied on the related species are accumulated. This seems to be more relevant in the case of aphids which are highly polymorphic. Unfortunately, such a study is wanting for majority of aphid species known till today (Eastop and Hills Ris Lambers, 1976). Present investigation has made

it possible to identify the *G. ceyloniae* by its various viviparous female morphs and their immature stages.

SUMMARY

This paper presents morphological changes in the ontogeny of apterous and alate viviparous female morphs of *Greenideoida ceyloniae* v. d. Goot, seasonal variations in the morphology of adult forms, seasonal preponderance and morph succession and distribution on *Mesua ferrea* for the first time from Oriental Region.

ACKNOWLEDGEMENTS

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STUDIES ON CAECA OF SOME INDIAN BIRDS

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INTRODUCTION

Intestinal caeca in birds are single or paired 'diverticulae found at the junction of the small and large intestine' (Van Tyne and Berger, 1976). Beddard (1898) stated that caeca in birds are generally small or absent, but the variations do occur in the two families, namely, Coraciidae and Todidae. Baker (1922-1929) utilised the caeca as a defining character in the general classification of birds in ordinal level. Apart from Mitchell's (1901) elaborate work on avian caeca (cited by Stresemann, 1928) and also the report of Bhaduri and Biswas (1947) dealing with 52 species and subspecies of Indian birds, no other comprehensive account is available. As regards the correlation between the food and the structure of caeca, Stresemann (1928) reported that the shape of caeca is hardly influenced by the method of feeding. He stated, for example, that in Columbidae, caeca are very small or altogether absent, while corn-eating pheasants have prominent caeca; owls have long caeca, while other flesh-eating birds like Accipitres have small ones or none. He pointed out that all passerines with their varied diet have small caeca which have been completely transformed into lympho-epithelial organs. Moreover, in Anseres, a relationship between diet and caecal shape exists; *Mergus* which is a fish-eater, possesses very short, functionless caeca, like other fish-eaters (e.g., Steganopodes), while in other Anseres long caeca, which are rich in follicles, do occur. In this context, it may be of interest to note that Bhaduri and Biswas (1947) made an attempt 'to correlate this structure with food habit of birds, but they

proved abortive in a general way, although in some groups there are elements of truth on this fact'.

Caeca may be classified in the following types :

(i) Functional : Very long caeca, the sum of caecal length being equal to that of the remaining part of the intestines (e.g., Galliformes).

(2) Functionless : Sometimes, one caecum being very reduced, resulting in an unequal pair (e.g., Accipitres, Upupidae).

(3) A short appendix of the intestine, the contents having no connection with the former (e.g., Passeres and *Columba*).

According to Mitchell (1901, cited by Stresemann, 1928), in primitive form caeca, where long and thin-walled, play a role in digestion. He pointed out that the two following forms have evolved from the former : (i) enlarged caeca which help in digestion ; besides they contain lymph follicles in their wall, and (ii) very small caeca or totally absent having no functional role. Welty (1963) mentioned that caeca absorb water and digested proteins along with the bacterial decomposition of crude fibrous foods. Recently, Van Tyne and Berger (1976) also pointed out that caeca might have important role in food digestion.

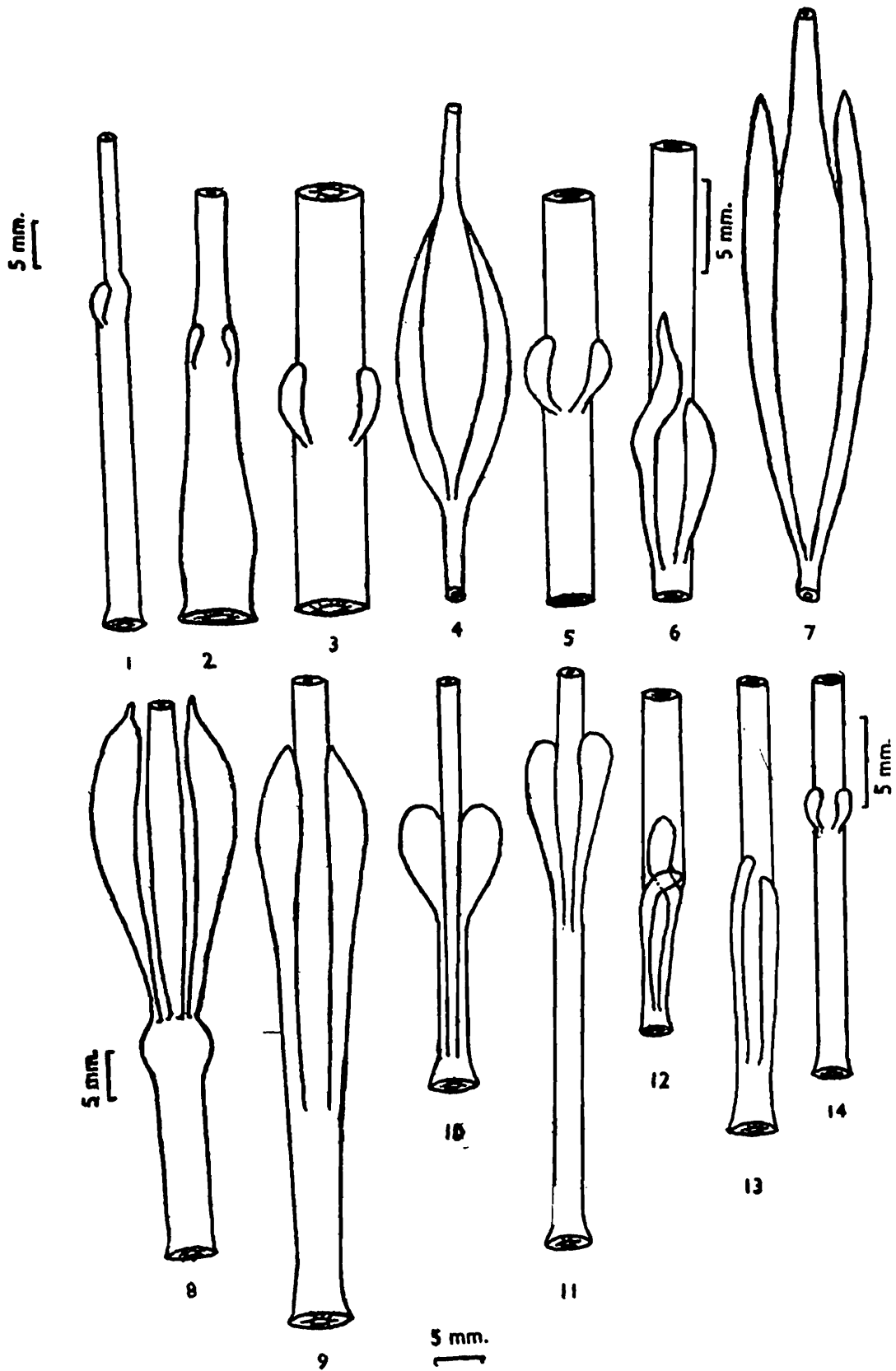
This paper deals with the intestinal caeca of birds from Bastar district, Madhya Pradesh, India, made by one of the authors (N.M.) during January-February, 1979. For systematic arrangement of the species in the Tables I and II, Ali and Ripley's (1968-1974) classification is adopted. The present authors studied 70 different species and subspecies belonging to 31 families in 12 orders, of which 41 species and subspecies boast caeca and the rest 29 species and subspecies are without them.

All the measurements are expressed in millimetres.

The study of food material was conducted by one of the author (N.M.) and corroborated from the compendium published by Ali and Ripley (1968-1974).

OBSERVATION

The data on the intestinal caeca, their measurements (in millimetres), and location in relation to the cloacal opening and food habits are tabulated in Table I.



Figs. 1-14. Intestinal caeca in birds

TABLE I—The measurements (in millimetres) of caeca and their position in relation to the cloacal opening
(R=right caecum ; L=left caecum)

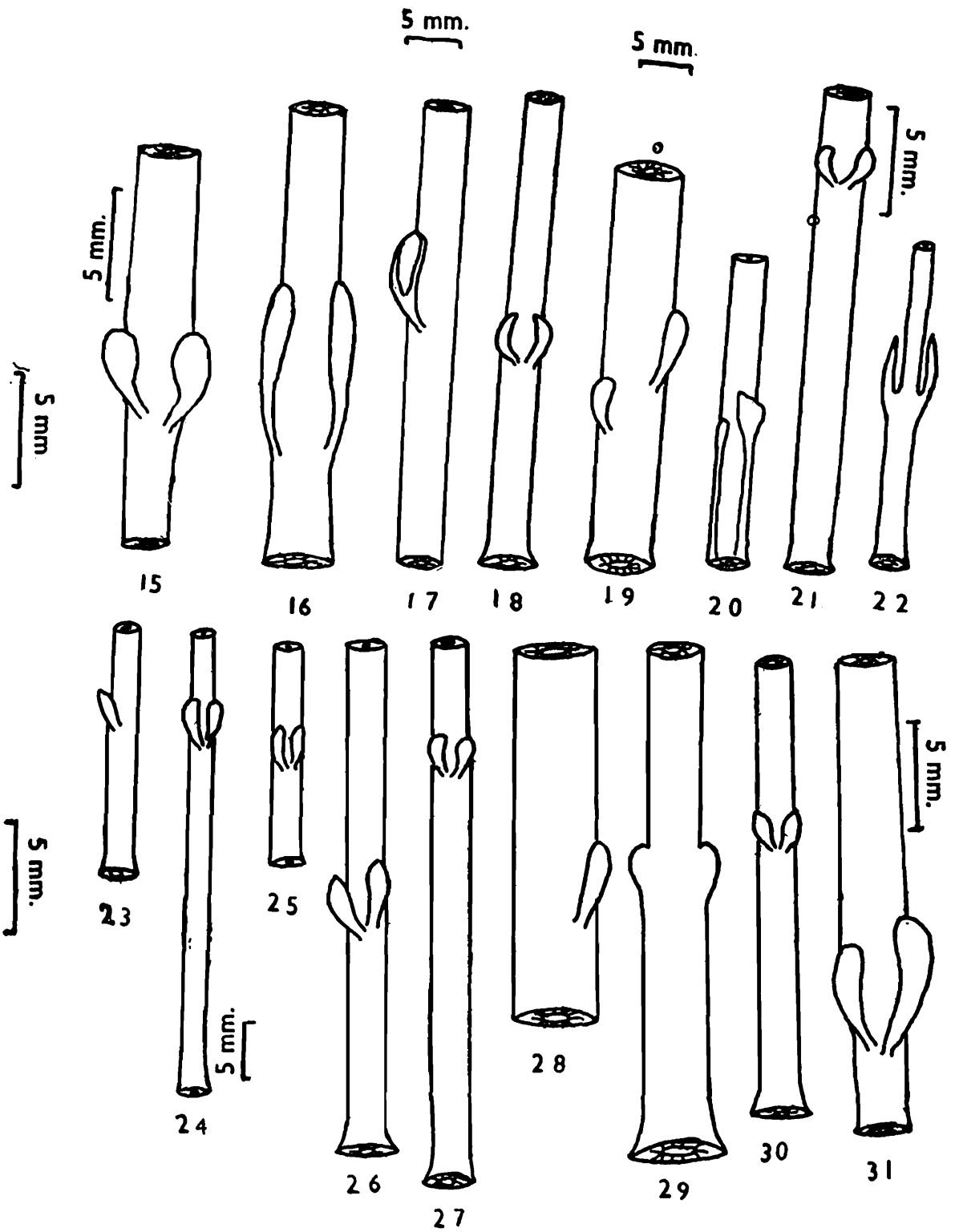
Order	Family	Name	Fig. No.	Food habits	No. of specimens	Maximum		Distance between cloacal opening and base of caeca
						Length	Width	
Ciconiiformes	Ardeidae	<i>Ardeola grayii grayii</i> (Sykes)	1	Fish, frog, crab, water beetles	1	R 4.50	2.00	31.50
Falconiformes	Accipitridae	<i>Accipiter badius dussumieri</i> (Temminck)	2	Rats, mice, lizards, frogs and insects	1	4.50	1.25	26.00
Charadriiformes	Jacaniidae	<i>Hydrophasianus chirurgus</i> (Scopoli)	3	Vegetable roots, aquatic insects and also molluscs	1	9.00	2.25	16.50
	Charadriidae	<i>Tringa ochropus</i> Linnaeus	4	Crustacea, molluscs, aquatic insects and worms	1	30.00	2.75	9.50
Columbiformes	Columbidae	<i>Treron phoenicoptera chlorigaster</i> (Blyth)		Wild figs. and berries	1	— — —	Absent	— — —
		<i>Ducula aenea sylvatica</i> (Tickell)		Wild fruits, tender foliage (Majumdar, 1984)	1	— — —	Absent	— — —
		<i>Streptopelia orientalis erythrocephala</i> (Bonaparte)		Grains and seeds	1	— — —	Absent	— — —
		<i>Streptopelia chinensis suratensis</i> (Gmelin)	5	Grains of jowar, pulses, weed seeds and oilseed (Majumdar, 1984)	1	8.00	2.50	20.00

Table I (Contd.)

Order	Family	Name	Fig. No.	Food habits	No. of specimens	Maximum		Distance between cloacal opening and base of caeca
						Length	Width	
Psittaciformes	Psittacidae	<i>Psittacula eupatria nipalensis</i> (Hodgson)		Wild fruits, vegetables and foliage (Majumdar, 1984)	1	— — —	Absent	— — —
		<i>Psittacula krameri borealis</i> (Neumann)		Fruits, cereal and seeds	1	— — —	Absent	— — —
		<i>Psittacula cyanocephala cyanocephala</i> (Linnaeus)		Fruits, grain and wild figs.	1	— — —	Absent	— — —
Cuculiformes	Cuculidae	<i>Cuculus varius varius</i> Vahl	6	Insects of various kinds and wild figs.	1	L 8.75 R 13.75	1.50	1.25
		<i>Rhopodytes tristis tristis</i> (Lesson)	7	Insects, lizards and frogs	1	50.50	3.50	3.50
Strigiformes	Strigidae	<i>Glaucidium radiatum radiatum</i> (Tickell)	8	Large insects, rats and mice	1	34.00	4.50	25.00
		<i>Ninox scutulata lugubris</i> (Tickell)	9	Large insects, frogs and also lizards	1	39.00	4.50	22.00
Caprimulgiformes	Caprimulgidae	<i>Caprimulgus asiaticus asiaticus</i> Latham	10	Insects of various kinds	1	27.00	4.25	2.50
		<i>Caprimulgus affinis monticola</i> Franklin	11	Insects in general	1	21.00	3.50	33.00
Apodiformes	Apodidae	<i>Hemiproctes longipennis coronata</i> (Tickell)		Flying insects	2	— — —	Absent	— — —

Table I (Contd.)

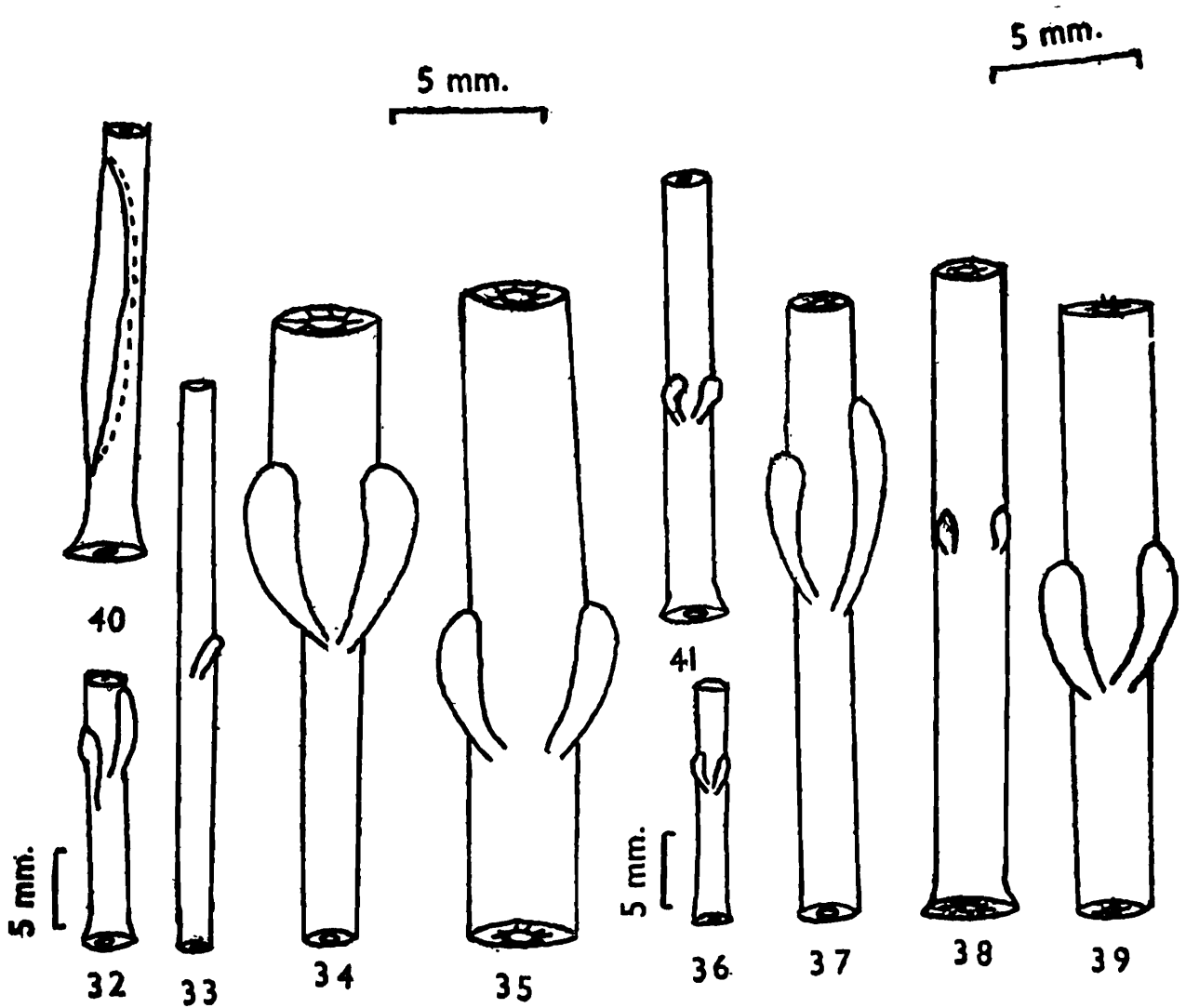
Order	Family	Name	Fig. No.	Food habits	No. of specimens	Maximum		Distance between cloacal opening and base of caeca
						Length	Width	
Coraciiformes	Alcedinidae	<i>Halcyon smyrensis fusca</i> (Boddaert)		Fish and aquatic insects	2	— — —	Absent	— — —
	Meropidae	<i>Merops leschenaulti leschenaulti</i> Vieillot	12	Winged insects	1	L 21.00 R 19.00	1.75 2.75	2.00
		<i>Merops orientalis orientalis</i> Latham	13	Winged insects	1	L 20.00 R 22.50	1.75 1.00	6.00
	Piciformes	Capitonidae	<i>Megalaima zeylanica caniceps</i> (Franklin)		Wild figs, berries, insects and nectar	1	— — —	Absent
<i>Megalaima haemacephala indica</i> (Latham)				Wild figs, berries and insects	1	— — —	Absent	— — —
Picidae		<i>Micropternus brachyurus phaiiceps</i> Blyth		Insects, nectar and fruits	1	— — —	Absent	— — —
		<i>Picus myrmecophoneus</i> Stresemann		Insects and nectar	1	— — —	Absent	— — —
		<i>Dinopium benghalense benghalense</i> (Linnaeus)		Fruits, insects and nectar	1	— — —	Absent	— — —
		<i>Picoides mahrattensis mahrattensis</i> (Latham)		Fruits and insects	1	— — —	Absent	— — —
		<i>Picoides nanus hardwickii</i> (Jerdon)		Fruit, insects and nectar	1	— — —	Absent	— — —
		<i>Carysocolaptes lucidus guttacristatus</i> (Tickell)		Insects and nectar	1	— — —	Absent	— — —



Figs. 15-31. Intestinal Caeca in birds.

Table I (Contd.)

Order	Family	Name	Fig. No.	Food habits	No. of specimens	Maximum		Distance between cloacal opening and base of caeca	
						Length	Width		
Passeriformes	Alaudidae	<i>Mirafra assamica affinis</i> Blyth	14	Wild seeds and insects	1	2.25	0.75	12.75	
		<i>Eremopterix grisea</i> (Scopoli)	15	Grass and weed seeds and insects	1	L 4.50 R 4.25	1.50	5.00	
	Hirundinidae	<i>Hirundo daurica nipalensis</i> Hodgson		Flying insects	1	—	—	Absent —	
		Laniidae	<i>Lanius cristatus cristatus</i> Linnaeus	16	Insects mice and lizard	1	7.75	1.00	47.05
	Oriolidae		<i>Oriolus xanthornus maderaspatanus</i> Franklin	17	Fruits, insects, and nectar	1	R 14.50	2.50	20.00
	Dicruridae	<i>Dicrurus adsimilis macrocercus</i> Vieillot		18	Insects	1	4.75	1.00	17.00
			<i>Dicrurus caerulescens caerulescens</i> (Linnaeus)		Insects and nectar	1	—	—	Absent —
		Sturnidae	<i>Sturnus malabaricus malabaricus</i> (Gmelin)	19	Wild fruits, insects, and nectar	1	L 7.50 R 5.00	2.00 1.50	L 15.00 R 11.00
	<i>Sturnus contra contra</i> Linnaeus			Insects, frogs and fruits	1	—	—	Absent —	
	Campephagidae	<i>Tephrodornis pondicerianus pondicerianus</i> (Gmelin)	20	Insects and spider	1	L 15.00 R 13.00	2.00 1.00	Nil	



Figs. 32-41. Intestinal Caeca in birds.

Table I (Contd.)

Order	Family	Name	Fig. No.	Food habits	No. of specimens	Maximum		Distance between cloacal opening and base of caeca		
						Length	Width			
Passeriformes		<i>Coracina melanoptera sykesi</i> (Strickland)	21	Insects and fruits	1 L	2.00	0.87	17.00		
					1 R	1.87	0.62			
		<i>Pericrocotus flammeus semiruber</i> Whistler & Kinnear	22	Insects	1	3.00	0.37	7.50		
		<i>Pericrocotus cinnamomeus cinnamomeus</i> (Linnaeus)	23	Insects	1 R	4.00	1.25	12.25		
		Irenidae	<i>Aegithina tiphia humei</i> Baker	24	Insects	1 L	2.00	0.50	15.50	
				1 R		2.37	0.62			
			<i>Chloropsis cochinchinensis jerdoni</i> (Blyth)	25	Insects and nectar	1	3.50	0.75	7.50	
		Pycnonotidae	<i>Pycnonotus melanicterus flaviventris</i> (Tickell)		Fruits and insects	1	—	—	Absent —	
				<i>Pycnonotus cafer humayuni</i> Deignan	26	Fruits and nectar	1	6.00	2.00	16.50
		Muscicapidae	<i>Pellorneum ruficeps ruficeps</i> Swainson	27	Insects	1	1.52	0.62	18.00	
				<i>Macronous gularis rubricapilla</i> (Tickell)	28	Insects	1 L	3.75	1.00	3.50
				<i>Chrysomma sinense sinense</i> Gmelin	29	Insects	1	2.50	0.50	11.00
				<i>Turdoides striatus orientalis</i> (Jerdon)	30	Insects and worms	1	3.50	1.50	23.50

Table I (Contd.)

Order	Family	Name	Fig. No.	Food habits	No. of Specimens	Maximum		Distance between cloacal opening and base of caeca
						Length	Width	
		<i>Alcippe poiocephala</i>	31	Insects and nectar	1	L 6.25	1.50	3.00
		<i>brucei</i> Hume				R 5.00	1.25	
		<i>Mucicapa tickelliae</i>	32	Insect	1	5.50	1.25	8.00
		<i>tickelliae</i> (Blyth)						
		<i>Muscicapa thalassina</i>		Insect	1	—Absent—		
		<i>thalassina</i> Swainson						
		<i>Orthotomus sutorius</i>	33	Insect and nectar	1	L 1.50	0.50	9.00
		<i>guzuratus</i> (Latham)						
		<i>Acrocephalus dumetorum</i>		Insects	1	—Absent—		
		Blyth						
		<i>Copsychus saularis saulabris</i>	34	Insects and nectar	2	6.75	1.50	9.75
		(Linnaeus)						
		<i>Copsychus malabaricus</i>	35	Insects	1	5.00	1.25	6.25
		<i>indicus</i> (Baker)						
		<i>Saxicoloides fulicata intermedia</i>	36	Insects	1	2.75	0.37	4.25
		Whistler and Kinnear						
		<i>Monticola cinclorynchus</i>		Insects and nectar	1	—Absent—		
		(Vigors)						
		<i>Zoothera citrina cyanotus</i>	37	Insects and fruits	1	L 7.25	1.00	10.00
		(Jardine and Selby)				R 5.25		
	Paridae	<i>Parus major stupae</i>		Insects	1	—Absent—		
	Sittidae	<i>Sitta frontalis frontalis</i>						
		Swainson		Insects	1	—Absent—		

Table I (Contd.)

Order	Family	Name	Fig. No.	Food habits	No. of Specimens	Maximum		Distance between cloacal opening and base of caeca
						Length	Width	
	Zosteropidae	<i>Zosterops palpebrosa palpebrosa</i> (Temminck)	38	Insects, fruits and nectar	1	1.50	0.62	11.50
	Motacillidae	<i>Anthus novaeseelandiae rufulus</i> Vieillot		Insects and larvae		—	—	Absent —
	Dicaeidae	<i>Dicaeum agile agile</i> (Tickell)		Insects and wild fruits	1	—	—	Absent —
		<i>Dicaeum erythrorhynchos erythrorhynchos</i> (Latham)	39	Insects, wild fruits and nectar	1	L 5.25 R 4.75	1.25 1.50	7.00
	Ploceidae	<i>Petronia xanthocollis xanthocollis</i> (Burton)	40	Seeds, pulses and insects		R 22.50	5.50	5.00
		<i>Lonchura punctulata punctulata</i> (Linnaeus)	41	Seeds, pulses cereals and fruits	1	1.50	0.62	4.25
		<i>Lonchura malacca malacca</i> (Linnaeus)		Seeds, pulses and cereals	1	—	—	Absent —
	Fringillidae	<i>Carpodacus erythrinus roseatus</i> (Blyth)		Insects, seeds and cereals	1	—	—	Absent —

DISCUSSION

Beddard (1898), and Van Tyne and Berger (1976) put much importance on the presence or absence and also the degree of development of intestinal caeca in birds, which according to them, can be adopted as a basis for avian taxonomy. Welty (1963) pointed out that the caeca are larger in primitive birds. In grouse, which is primitive from taxonomical viewpoint, caeca have undergone remarkable enlargement, and their combined length totals the length of the entire intestine. These enlarged caeca might have an important role in the physiology of digestion of the vegetable food matter. Gadow (1896) reported its absence or rudimentary state of development in parrots, some pigeons, kingfishers and woodpeckers. Bhaduri and Biswas (1947) also reported the absence of caecum in Picidae, Capitonidae, Psittacidae and Alcedinidae. They reported its absence in two species of green pigeons, and its occurrence in rock pigeon. Among doves, they noticed its presence in four species and its absence in the emerald dove. Marcus's (1864) finding also corroborates Gadow's.

The present investigators dissected only a few specimens in most of the cases, sometimes only single specimen, on the basis of which this paper is prepared. They did not find any trace of caecum in Psittacidae, Capitonidae, Picidae, Hirundinidae, Alcedinidae, Paridae, Sittidae, Motacillidae, Fringillidae and the green pigeons and imperial pigeon. In addition to this finding, the present authors would like to add that in another species of dove (*Streptopelia orientalis erythrocephala*), the caecum is conspicuously absent.

Van Tyne and Berger (1976) mention the presence of unpaired caecum in herons. The present investigators also noticed a single caecum in the Pond Heron (*Ardeola g. grayii*). In addition, we observed a single caecum on the right side in *Oriolus xanthornus maderaspatanas*, *Pericrocotus c. cinnamomeus* and *Petronia x. xanthocollis*, whereas in *Macronous gularis rubricapilla* and *Orthotomus sutorius guzuratus* only the left one is present. In *Chrysomma s. sinense* the

caeca slightly bulge out as rudimentary structures (Fig.29). In *Petronia x. xanthocollis* the unpaired caecum over lies the intestine in close apposition (Fig. 40). Excepting *Ardeola g. grayii* which feeds on frog, fish, crab and also on aquatic insects, the other six species mainly feed on a mixed diet of insect and fruit.

Pronounced asymmetry in the location of the caeca was reported by Bhaduri and Biswas (1947) in three species, namely, *Dendrocitta v. vagabunda* (Latham), *Milvus migrans govinda* Sykes and *Oenopopelia (=Streptopelia) tranquebarica* (Herman). The authors also have noticed similar asymmetry in *Sturnus m. malabaricus*. Bhaduri and Biswas (1947) noticed asymmetry in length of the two caeca in a few cases, namely, *Turdoides somervillei terricolor* (Blyth) (= *T striatus striatus* (Dumont), *Centropus s. sinensis* (Stephen), *Otus bakkamoena marathae* Ticehurst, *Athene brama indica* (Franklin) and *Querquedula (=Anas) queruedula* (Linnaeus) which they illustrated (p. 646) clearly. But they did not provide the measurements of individual caecum (pp. 647-649). In 11 species the authors observed this asymmetry and carefully measured both the caeca in individual cases as will be evident from the Table I as well as from the figs (Figs. 6, 12, 13, 15, 19, 20, 21, 24, 31, 37 and 39).

Bhaduri and Biswas (1947) reported that 'the origins of caeca measured from the cloacal openings are very varied in different families'. They also stated that 'some families like Dicruridae, Cuculidae etc., show close approximation of measurements'. On the basis of their findings, Bhaduri and Biswas (1947) speculated that 'these ought to indicate some close relationship in the members of the families', but they also cautioned that a large amount of data from each species should be collected. The present investigators find in Cuculidae and Dicruridae a marked difference in the relative distance. However, in two species *cuculus varius* and *Rhopodytes tristis* under the family Cuculidae (Figs. 6 and 7), the origin is very similar in relation to cloacal opening. This indicates that caecal characters might be considered useful for classification of species belonging to the same family.

Welty (1963) shows that the length of intestine might be deciding factor as to whether caecum will be absent or rudimentary or enlarged. This may perhaps be correlated to the intestinal length, that is short and broad or long and small in diameter. In this paper, the Table II shows the relative length and breadth of intestine of some species which are worth mentioning in context of Welty's (1963) observation.

TABLE II

The measurements (in millimetres) of intestine and their average breadth. **Long and narrow ; ++ short and broad.

Name of Species	Fig.	Total length of Intestine	Average breadth of Intestine
<i>Ardeola g grayii</i> (Sykes)**	1	860	3.0
<i>Sturnus malabaricus malabaricus</i> (Gmelin)++	19	245	6.0
<i>Tephrodornis pondicerianus pondicerianus</i> (Gmelin)++	20	140	3.0
<i>Pericrocotus cinnamomeus cinnamomeus</i> (Linnaeus)++	23	125	2.5
<i>Aegithina tiphia humei</i> Baker**	24	130	1.0
<i>Chloropsis cochinchinensis jerdoni</i> (Blyth)**	25	160	2.5
<i>Pycnonotus cafer humayuni</i> Deignan++	26	190	3.0
<i>Pellorneum ruficeps ruficeps</i> Swainson**	27	190	1.75
<i>Copsychus saularis saularis</i> (Linnaeus)++	34	185	4.0
<i>Copsychus malabaricus indicus</i> (Baker)++	35	190	4.0
<i>Dicaeum erythrorhynchos erythrorhynchos</i> (Latham)++	39	90	3.25
<i>Muscicapa tickelliae tickelliae</i> (Blyth)++	32	150	2.5
<i>Orthotomus sutorius guzuratus</i> (Latham)**	33	150	1.0
<i>Saxicoloides fulicata intermedia</i> Whistler and Kinnear++	36	130	2.25
<i>Zoothera citrina cyanotus</i> (Jerdine and Selby)**	37	230	2.0
<i>Zosterops palpebrosa palpebrosa</i> (Temminck)++	38	118	2.25

This finding indicates that there exists a general trend of enlargement of the caecum where the intestine is short but broad, in contrast to where the intestine is long and narrow.

According to Wallace (1971), paired caeca are usually rudimentary, but well developed in gallinaceous birds, anatids and the ostrich. The authors noticed that in Charadriidae, Cuculidae, Strigidae, Caprimulgidae, Meropidae and Ploceidae the paired caeca are enlarged.

Regarding the structural similarity of caeca in allied genera under the same family, no literature is available. In strigidae, the allied genera namely *Glaucidium* and *Ninox* (Figs. 8 and 9), very close resemblance in shape and size of caeca exists, and also their place of origin is similar. Moreover, in the genus *Caprimulgus*, in two different species *Caprimulgus affinis monticola* and *C. asiaticus asiaticus* (Figs. 10 and 11), the structural similarity is markedly noticeable, although in the larger species (*C. a. monticola*) because of the lengthening of the large intestine the point of origin has shifted further forward, whereas in the smaller species (*C. a. asiaticus*) the origin is nearer the cloacal opening.

Our observation implied that the length of intestine in relation to its breadth might be a deciding factor as to whether the caecum will be large or rudimentary. In those particular species in which the intestine is long and narrow, the caecum is small. In contrast, where the intestine is markedly short and broad, the caecum becomes enlarged, as is evident from the Table II (16 instances are given).

Why the caecum is absent in some species is difficult to interpret. The present investigators look forward to pursue this line in future.

At this stage, nothing can be commented on the significance of enlargement of the caecum, as both intra-familial (Strigidae) and inter-familial (Caprimulgidae) convergence exist. Instances of intra-familial divergence are also very marked in the families of Campephagidae and Ploceidae; and in Muscicapidae all grades of variation is noticeable.

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MOLLUSCAN FAUNA OF MANAULI ISLAND IN
RELATION TO ENVIRONMENTAL NICHE

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INTRODUCTION

The Manauli Island is situated between longitudes 79°7' to 79°8' E and latitude 9°12'30' to 9°13' N, in the Ramanathapuram District, Tamil Nadu. Reddiah (1970) reported a chain of well-developed fringing reefs from Tuticorin to Rameswaram Island in the south. Manauli is one of the islands in the series in between the Indian mainland and Sri Lanka and is placed about 15 km. south of Mandapam in the Gulf of Mannar. Ray (1946) and Satyamurti (1952 & 1956) published accounts on the taxonomy of the fauna of Mandapam, Pamban, Krusadai Islands etc. in the Gulf of Mannar. Pillai & Appukuttan (1980) reported on distribution of molluscs in the coral bed of south-eastern coast. Even then the knowledge is incomplete for the fauna of Manauli Island. Efforts have been made by us to present an account of the molluscs within different ecological zones of this island.

LIST OF MOLLUSCA COLLECTED

(Dead shells are excluded from the list)

Phylum	Mollusca
Class	Gastropoda
Order	Archaeogastropoda
Family	Trochidae
Subfamily	Monodontinae

1. *Cantharidus interrptus* (Wood)

- Family Phasianellidae
 2. *Phasianella nivosa* Reeve
- Family Neritidae
 3. *Clithon oualaniensis* (Lesson)
- Family Phenacolepadidae
 4. *Phenacolepas crenulata* (Broderip)
- Order Mesogastropoda
 Family Littorinidae
 5. *Littorina* (*Littoraria*) *kraussi* Rosewater
 6. *Littorina* (*Littorinopsis*) *scabra scabra* (Linnaeus)
 7. *Littorina* (*Littorinopsis*) *carinifera* (Menke)
 8. *Nodilittorina* (*Nodilittorina*) *pyramidalis pyramidalis*
 Quoy & Gaimard
- Family Planaxidae
 9. *Planaxis* (*Planaxis*) *sulcatus* (Born)
- Family Potamididae
 10. *Cerithidea* (*Cerithideopsilla*) *cingulata* (Gmelin)
 11. *Terebralia palustris* (Linnaeus)
 12. *Cerithium columna* Sowerby
 13. *Clypeomorus splendens* (Sowerby)
- Family Naticidae
 14. *Natica gualtieriana* Recluz
- Order Neogastropoda
 Family Muricidae
 15. *Morula granulata* (Duclos)
- Family Columbelloidea
 16. *Pyrene* (*Columbella*) *scripta* (Lamarck)
 17. *Mitrella marquessa* (Gaskoin)
- Family Nassariidae
 18. *Nassarius* (*Niotha*) *distortus* (A. Adams)
 19. *Nassarius* (*Alectrion*) *glans glans* (Linnaeus)
- Order Basommatophora
 Family Ellobiidae
 20. *Melampus flavus* Gmelin
- Family Atyidae
 21. *Haminoea galba* Pease

Order Stylommatophora

Family Onchidiidae

22. *Onchidium verruculatum* Cuvier

Class Bivalvia

Order Eulamellibranchiata

Family Mesodesmatidae

23. *Mesodesma trigona* Deshayes

GENERAL REMARKS

The island of Manauli stretches east to west and is formed out sandstone on almost all sides excepting a small western portion. It appears to be a continuous landmass, but as the tide rises tidal water enters about the middle of the island on one side from the east and on the other from west. These two creeks are fringed with mangroves. The southern and the eastern slopes of this island are fringed with washed coral blocks both living and dead. The central part of the island has a sand dune with growth of *Acacias*. The southern beach gradually slopes to sandy bottom embedded with living and dead coral boulders. The three ecological zones with their molluscan fauna are recognised as (1) Creeks and backwaters, (2) Mangrove swamps and (3) Coral-sand bottom of the sea.

(1) *Creeks and backwaters* : Mosquitoes and other insects were found breeding in the backwaters. The backwater pools have soft and loose mud, at the bottom, which is exposed during low tide. This area is inhabited by the estuarine potamidids and cerithids like *Cerithidea (Cerithideopsis) cingulata* (Gmelin), *Terebralia palustris* (Linnaeus) and *Cerithium columna* Sowerby. The snails of *Melampus flavus* (Gmelin) are seen crawling on the mud flats.

(2) *Mangrove Swamps* : The mangroves consist of *Avicennia marina*, *Bruguiera cylindrica*, *Rhizophora mucronata* etc. The molluscs of this zone include littoral forms like *Littorina (Littorinopsis) scabra scabra* (Linnaeus) and *Nodilittorina (Nodilittorina) pyramidalis pyramidalis* Quoy and Gaimard are dominant. These littorinids are found to crawl in shady

places of the trunks, branches and leaves of the mangrove plants at high water mark.

(3) *Coral-sand bottom* : The wide rampart of the island is the shallow sea with rippling clear water. Sandy shore slopes into the bottom which has algal vegetation and sparsely distributed coral lumps. While wading through the 20-30 cm. depth of water, *Cantharidus interruptus* (Wood), *Phasianella nivosa* Reeve and *Clithon oualaniensis* (Lesson) are observed on algal vegetation of alginophytes such as *Turbinaria decurrens*, *Sargassum wighte*, *Padina tetrastomatina* and agarophytes like *Hypnaea valentiae* and *Boergeseana forbessi*. The species *Natica gualtieriana* Recluz is collected nearby the algal patches. While wading through the water on the northern slope of the island, proceeding to a depth of 30-35, we come across the Atyid species *Haminoea galba* Pease on the sandy floor in small colonies. Nearby them the eggmasses are suspended in water, anchored to the sandy bottom. The snails have their shells covered with the lappets of their feet. Those shells at a further depth are found to crawl over the weeds. The snails are in abundance on the southern slope, facing the open sea. The bivalve *Mesodesma trigona* Deshayes is seen buried in the sandy substratum. On the coral blocks and weeds, the species *Pyrene (Columbella) scripta* (Lamarck) and *Mitrella marquessa* (Gaskoin) are seen in clear water and are always in submerged condition. The species *Nassarius (Niotha) distortus* (A. Adams) and *Nassarius (Alectrion) glans glans* (Linnaeus) are found in small number on the bare sandy bed in between the coral blocks.

At a greater depth, the sandy bottom is strewn with gravels, coral fragments and lumps. This habitat is occupied by the muricid, *Morula granulata* (Duclos).

Twenty three species were collected during the exploration and nine of them are estuarine.

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A NOTE ON *PHASCOLOSOMA ARCUATUM* (GRAY)
[SIPUNCULA : PHASCOLOSOMATIDAE]
IN THE HOOGHLY-MATLA ESTUARY,
WEST BENGAL, INDIA

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INTRODUCTION

While conducting benthic surveys of the tropical sipunculans of the mangrove belt in West Bengal, some information about the environment of *Phascolosoma arcuatum* (Gray) was obtained. The area is a new locality record for the species. Further, *P. arcuatum* was described by Gray (1828) from material collected in India. No specific locality was named. Rice and Stephen (1970) redescribed Gray's type and showed that *P. arcuatum* was a senior synonym of *P. lurco* Selenka, Bulow and de Man (1883).

HISTORICAL REVIEW

The only estuarine sipunculan so far recorded from India is a *Phascolosoma* (= *Physcosoma*) sp. reported from Port Canning, Lower Bengal by Annandale (1907). Whether it was *P. arcuatum* is not known. *P. arcuatum*, however, is well known from the mangrove areas of Java and Malaysia (Sluiter, 1891 ; Harms and Dragendorff, 1933 ; Chuang, 1965 ; Green and Dunn, 1976) and of N. E. Australia (Edmonds, 1980 ; Green, 1975).

GENERAL CHARACTERS OF THE AREA SURVEYED

The mangrove area including both swamps and forests of lower Bengal covers a fairly vast area starting from Sagardweep on the extreme west up to the River Matla in the east along the Indo-Bangladesh border. The species under

consideration is of Austro-Malayan distribution, whence it might have taken a wide adaptive dispersal towards India through Bangladesh in the further west. By virtue of its wide adaptive capacity the species occurs not only in non-mangrove coralline bed but also in mangrove coralline and muddy bed. In the muddy bed it constructs galleries and 3-5 such galleries are observed occurring side by side.

In fact, the Hooghly-Matla estuary comprises certain belts of which a few have been selected as sites for collection such as Gangasagar forming the southernmost end of the Sagardweep and Chemaguri on the bank of the Mooriganga, Harinbari on the bank of the Hooghly, Jhingakhali on the bank of the Raimangal and Jharkhali on the bank of the Vidya. Of the three main streams two are important, viz., the Mooriganga and the Vidya ; of these the former is the main tributary of the river Hooghly while the latter constitutes confluence with the river Matla. The third stream, i.e., the Raimangal meets the Kalindi that pours into the Bay of Bengal along the Bangladesh border. This riverine system takes part in the formation of the Hooghly-Matla estuarine complex. During the period of extensive survey in the littoral zone, it has been observed that the specimens of *P. arcuatum* occur abundantly in the intertidal niches of all the above mentioned localities depending on the variable nature of hydrological and edaphic condition amidst the biotic association being correlated with the views of Chaudhury (1982). The other subzone, i.e., subtidal one, is, however, occasionally visited by the species and the collector may find the species on proper exploration of this subzone.

OBSERVATIONS ON ECOLOGICAL BEHAVIOUR

Observations have been made on the methods of borrowing and feeding of *P. arcuatum*. An individual of 5 cm trunk-length, in a particular case, for example, was taken out alive from its burrow and then released on the exposed muddy substratum at the actual site of collection. On being disturbed, the specimen remained for half an hour with its introvert retracted. Subsequently, it started gently relaxing

and tilting the trunk portion only along its ventral side on the substratum so as to reach the preparatory stage for burrowing. Immediately afterwards, it just raised the anterior part of trunk off the ground, when the introvert becomes gradually everted. With further relaxation of the trunk and introvert, the latter at this stage touches the ground and slowly exposes the tentacular crown. By now, the animal lies with its entire trunk juxtaposed to the ground and the introvert remaining somewhat in an arched manner. Then it contracts the trunk so as to bring the body forward and eventually to an erect position when it fixes the introvert in the soil and sets out to burrow stealthily the soil particles with the aid of tentacles until it is completely hidden in the tube thus formed. The time for entire operation took about a couple of minutes. The particular spot of location of the individual was re-examined after about two hours, when the burrow could be traced out while chopping out by shovel a portion of the sub-soil from its entrance. It was noticed that the burrow reached straightway for about 20 cms downwards, then taking a 'U' turn to reach again the soil surface and that the individual remains in one of the arms up to a depth of about one cm from the surface.

The shape of the burrows of other specimens is apparently like a 'L' or hook, though actually it is 'U' or hairpin-like, since one of its arms is sometimes blocked by silt.

In feeding *P. arcuatum* was observed to extend its tentacles on the ground surface for the purpose of ingestion of muds and withdrawing the same from time to time to remove the accumulated debris. The tentacular crown, however, immediately retracts when touched by a laboratory glass dropper, if not by pouring drops of water from it. The animal has been noticed to feed in the afternoon during densely cloudy weather. The time of feeding, however, may be variable and was also observed at night by Green (1975).

On dissection it was found that the gut was full of mud. The gut contents reveal the presence of sporozoans, copepods and diatoms. The bulk of the organisms was constituted by diatoms.

DISCUSSION

Analysing from the view point of occurrence of *Phascolosoma arcuatum* from different areas in West Bengal, as presently surveyed, the species is restricted in the mangrove region only. It is found throughout the intertidal zone starting from above the mean high water spring tide (M.H.W.S.) to below the mean low water spring tide (M.L.W.S.) water levels, being exposed to a marked degree of variations in respect of both the highest and lowest rates of salinity. Similar observations were also made by the earlier workers on the occurrence of the species in other mangrove belts of Australo-oriental region, though unfortunately none of them could successfully explore the species from the broader spectrum of mangrove ranges, as has been presently done. Nonetheless, the species elicits its preference for dwelling in the mangrove to the non-mangrove belts.

Oglesby (1969) has pointed out that the salinity is the principal controller of the distribution of estuarine worms, and their distribution can be linked to their osmoregulatory ability. Studies on the salinity tolerance has been made on certain sipunculan species (Vide, Peebles and Fox, 1933 ; Tarifeno, 1975) although no such experiment has even been conducted for *P. arcuatum* in relation to the knowledge of its survival at the highest or lowest level of salinity tolerance. But the species penetrates at the Raimangal estuary down to 8.1‰ as observed in the present field study. So it is evident that the species in question has a wide range of adaptability starting from mangrove to non-mangrove niches under both the marine and estuarine conditions. It may further be stated that *P. arcuatum* also contributes its might towards the process of aeration of soil particles, thus aiding in luxuriant growth of vegetation and indirectly checking flood of the mangrove area. It is also known to enter into a characteristic food chain ecosystem, devouring the soilmicrobes and then in turn, being consumed by mud-dwelling fishes like *Boleophthalmus boddarti*, *Thyrsoidea macrura*, *Anguilla bengalensis* and other allied species. It may further

be mentioned that a few marine animals are quite tough, since they can well tide over difficult situations related to problems of water and salt balance, desiccation, O_2 - paucity, temperature limitation, etc., as stated by Oglesby (1969). On the basis of actual observation in nature, some of these factors may be correlated in that almost all the specimens of *P. arcuatum* at Chemaguri have been found in semi-terrestrial-habitat where these abiotic factors have been found to a marked degree.

SUMMARY

The species *Phascolosoma arcuatum* (Gray) is newly recorded from the mangrove zone of the Hooghly-Matla estuary, West Bengal. Some information about the ecological behaviour and the environment of the species is given.

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BEHAVIOUR OF BLACKBUCK, *ANTILOPE CERVICAPRA*
CERVICAPRA (LINNAEUS) DURING SOLAR
ECLIPSE OF 1980.

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INTRODUCTION

The valuable population of blackbuck in the Guindy Forest Park in Madras, Tamil Nadu has been the subject of a preliminary eco-behavioural study by us for the last two years (Menon and Kurup, under preparation). Considerable baseline data already acquired on the daily activity profile of this animal made the species particularly suitable for a comparative study of the behaviour during the eclipse. However, a more specific control period immediately preceding the eclipse was used for direct comparison with that of the activity pattern during the eclipse. Blackbuck is adapted for a life in the blazing plains and meadows of the drier regions and thus possesses a much higher tolerance threshold for direct sun which makes it more diurnal than many other species of ungulates. They tolerate a thermal limit of 90°F (32°C) in the shade for normal grazing in Kanha Park (Schaller, 1967) and upto 41°C at Guindy Park (our studies *op. cit*). At the same time they show considerable temporal variation in the timings of daily activity schedule in different seasons, responding to change in light intensity among other things. Schaller (*op. cit*) noted as much as one hour differential in the rising and first feeding time between cool and hot weather seasons.

Similarly, rutting seasons also varies in different regions, depending on the physical parameters, of which light intensity and temperature appear to be most significant.

As both these parameters suddenly change during the brief period of a solar eclipse, blackbuck behaviour during this time was expected to show changes. However it is to be borne in mind that phenomena like eclipses are rare events of short duration and as such data collected during such studies might indicate only broad trends difficult to prove significant statistically or otherwise.

STUDY LOCALE

Guindy park is a small relic of the characteristic dry deciduous thorn forest and scrub savanna once present extensively throughout the Coromandel (eastern) coast of Peninsular India. Originally it formed part of the present Governor's Estate of which only 380 acres now remain intact and under the control of State Forest Department. The blackbuck, along with an even greater population of spotted deer, continues to range in the adjoining campus of Indian Institute of Technology and the Governor's Estate as in the past, which were all part of the original area. Observations were carried out mainly in the disused Polo field, which is a grassy maidan and a favourite haunt of the animals round the year.

STUDY METHODS

The solar eclipse took place on 16 February 1980, lasting from 14. 17 hrs to 17.00 hrs across Peninsular India in a belt of 135 kms. At Madras it started at 14.39 hrs attaining totality around 15.44 hrs. It was considered necessary to have a specific timeset of control observations immediately preceding the eclipse for direct comparison. Accordingly three hour's observations from 14 to 17 hrs. were carried out during the 3 days prior to the eclipsc day. Observations were carried out from cover. Instataneous sampling at one minute interval using scan method (Altmann, 1974) was used

to collect the data. At each scan, activities of three individuals were recorded.

SIGHT AND SOUND EVENTS

A time sequential recording of the general sight and sound events beginning 20 minutes prior to the start, and through most part of the eclipse, providing a sort of back drop for the black buck behaviour was also recorded which is summarised below.

Time	Events	Time	Events
14.24	Partridges calling	15.28	A hush, scene very quite, cool breeze.
14.30	Coppersmith calling	15.38	Doves cooing
14.37	Crows cawing ; Partridges calling	15.41	Owls vocalizing
14.39	Partridges calling	15.43	Parrots vocalizing
14.41	Partridges calling	15.44	Parrot, crows, partridges vocalizing, DUSKINESS, hush
14.47	Crows cawing ; Partridges calling	15.50	Hush continues
14.48	Koel cooing	16.09	Hush continues
15.03	Crows cawing ; Bulbul twittering	16.09	First bird call after peak of eclipse (15.45) Doves cooing.
15.09	Bulbul twittering	16.16	Much cooing of doves
15.12	Birds twittering ; Partridges out feeding	16.23	Light brightens
15.23	Crows cawing	16.34	Light almost normal
15.24	Parrot flying homewards, light fading		

Against a single bird call during 20 minutes prior to the eclipse there was a spate of six calls by at least four identifiable species of birds during the peak of the eclipse.

RESULTS

An activity profile of four main categories were recorded. These were grazing, resting, standing and walking. Grazing and walking measure active trends and the other two gauge the inactive trends. Standing, however, can also be considered as a transient and intermediary state leading forward to activation or reverting backwards to resting state. In the present context of eclipse effect, it also appears to denote an indecisive, uncomprehending state.

The fluctuation of the activity profile during the eclipse is plotted in the text figures 1 and 2. Variations have been examined by means of ten minute intervals beginning from 14.39 hours at the start of the eclipse to 16.29 hours just six minutes before its conclusion and light intensity was near normal.

Grazing : During the first 30 minutes of the eclipse there was a pronounced increase in grazing which rises to a

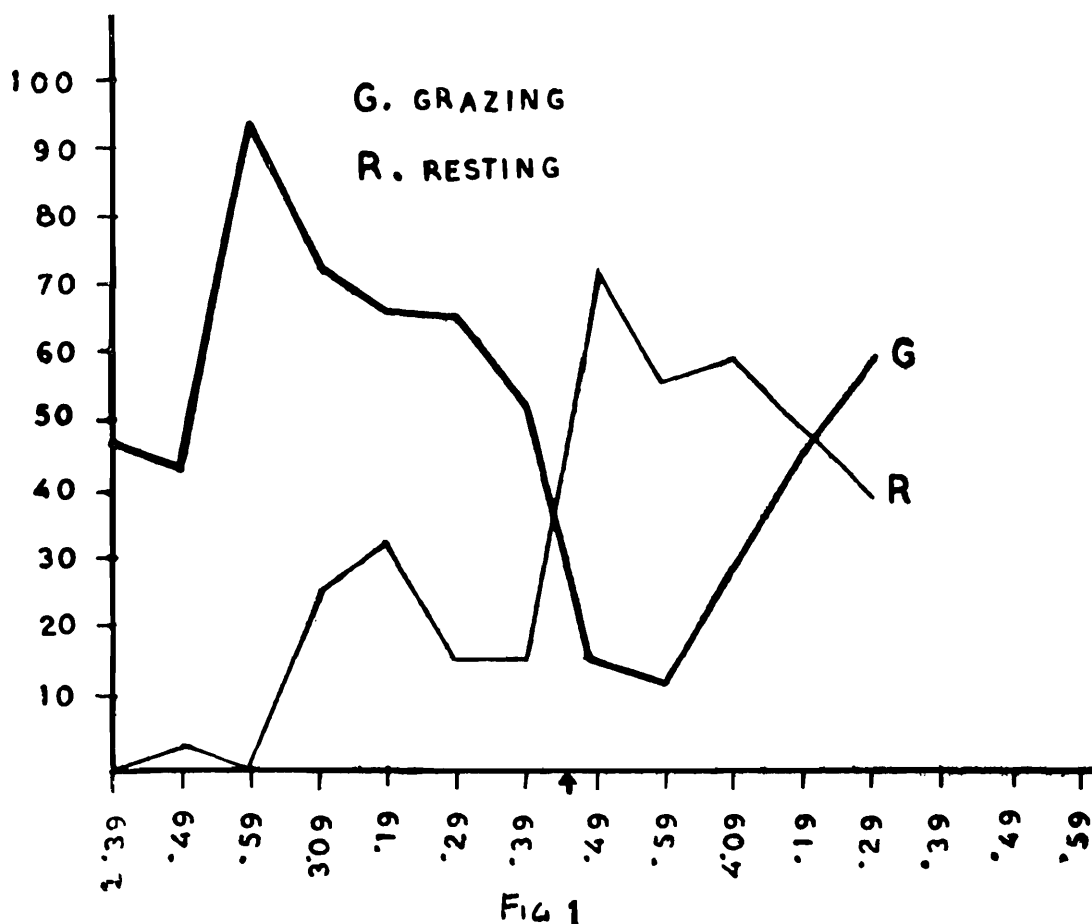


Fig. 1. Progress of grazing and resting activity during the eclipse. Arrow in this and next indicates totality. G : Grazing ; R : resting.

maximum of 93.33% of all activity. But thereafter grazing activity starts to decline to continue at moderate rate (Fig. 1) for the next 40 minutes. Then again occurs a further steep decline which seems to take place around the time close to the totality of the eclipse. Grazing is not seriously picked up till about 10 to 13 minutes after the totality but after this it steadily increases to form more than 60% of the activities towards the end of the eclipse.

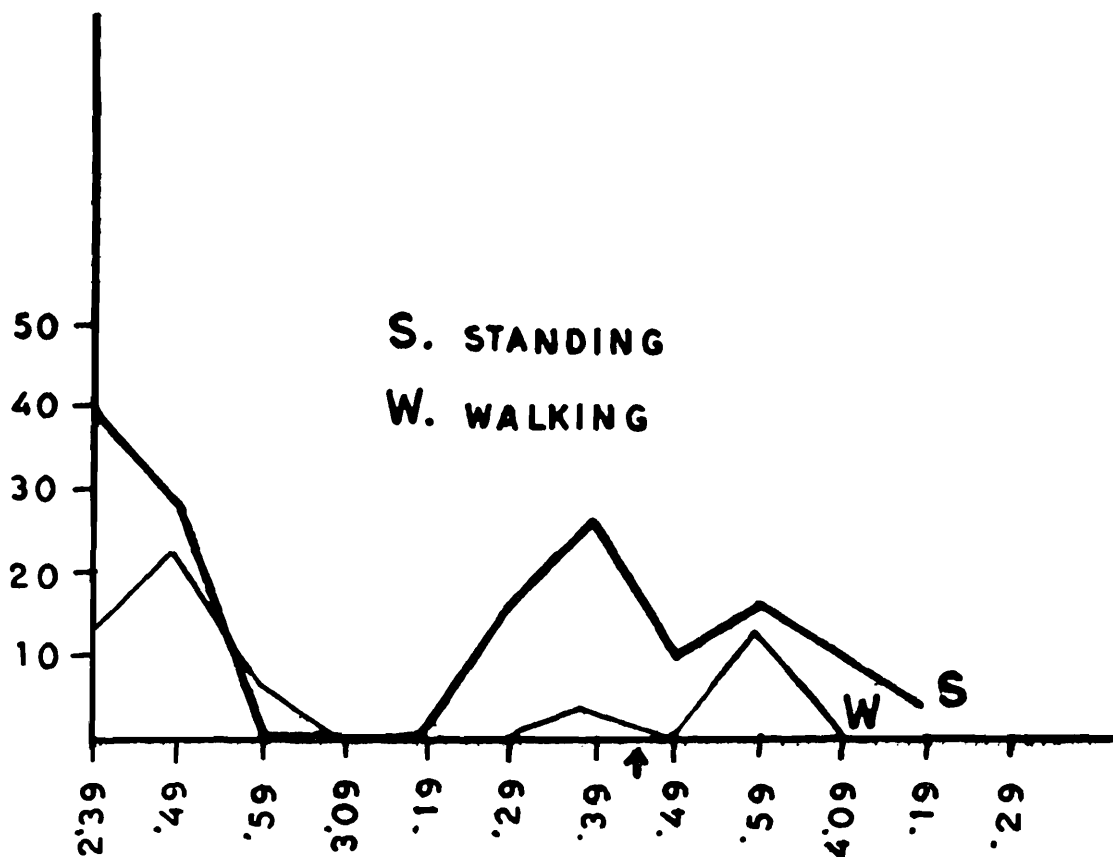


FIG 2

Fig. 2. Progress of standing and walking activities during the eclipse. S : Standing ; W : Walking.

Resting : The normal level of resting usual at this time of day started to increase half an hour after the commencement of the eclipse. This lasted for 20 minutes when this increase of resting stopped and gave way for an increase in standing, that is, while grazing animals continued to graze, more of the resting animals started to rise and stand.

This switch over to increased standing from resting activity lasted for another 20 minutes. Thereafter resting started to increase and became widespread and peaked around totality. But there was an immediate decline of resting soon after the totality, standing and walking increasing in its place.

Standing : Standing showed a complementary pattern to that of grazing (fig. 2). At the start of the eclipse there was a fall in the rate of standing corresponding to the rise in grazing. This also denotes that standing at this time is

in fact a forward prelude to grazing and not a reverting state to resting. Standing increased and reached its peak just five minutes before totality and at this time however it was apparently at the expense of both grazing and resting.

Walking : The immediately striking thing about walking is its minimal amount and its fluctuation pattern closely resembling that of standing. Walking or apparently purposeless movement was not much evident during the eclipse. The slight reduction in the early stage of eclipse resulted in an increase in grazing.

Comparison with activity profile of the normal control period :

Activity profile of the pre-eclipse control sample showed a mean of 36% resting, 32.5% standing, 27.5% grazing and walking limited to a mere 5%. Animals thus spent 67.5% of their time in resting or idly standing, indicating that this time of the day (14 hrs) is generally an inactive period. (Fig. 3). The very small amount of walking (5%), the second denoter of active state after the grazing is also supportive of the inactive tendency. Thus the predominant aspect of blackbuck behaviour normally at this time of the day is an inactive state.

Comparing to the activity profile during the eclipse period, it is seen that while the general pattern is more or less retained, the degree of change in each of these aspects is distinct. Resting doubles itself to a peak of 73%, whereas grazing, standing and walking drop precipitously. Grazing is reduced from 27.5% to 14% which is 49% reduction. Similarly standing is drastically reduced from that of normal period from 32.5% to a mere 11%, a 65% reduction. Walking goes down from 5% to 2%. However, grazing although falling to almost half the normal time, is during the eclipse the second major activity, instead of standing, which was the major activity during the former period. This is not readily explained except for the fact which was quite apparent, that this was not serious feeding. Blackbuck is often observed to about feigned feeding as a displacement activity to relieve tension during agonism or at times of

noncomprehension such as when confronted by unfamiliar objects (Kurup & Menon, op. cit.). A part of the grazing

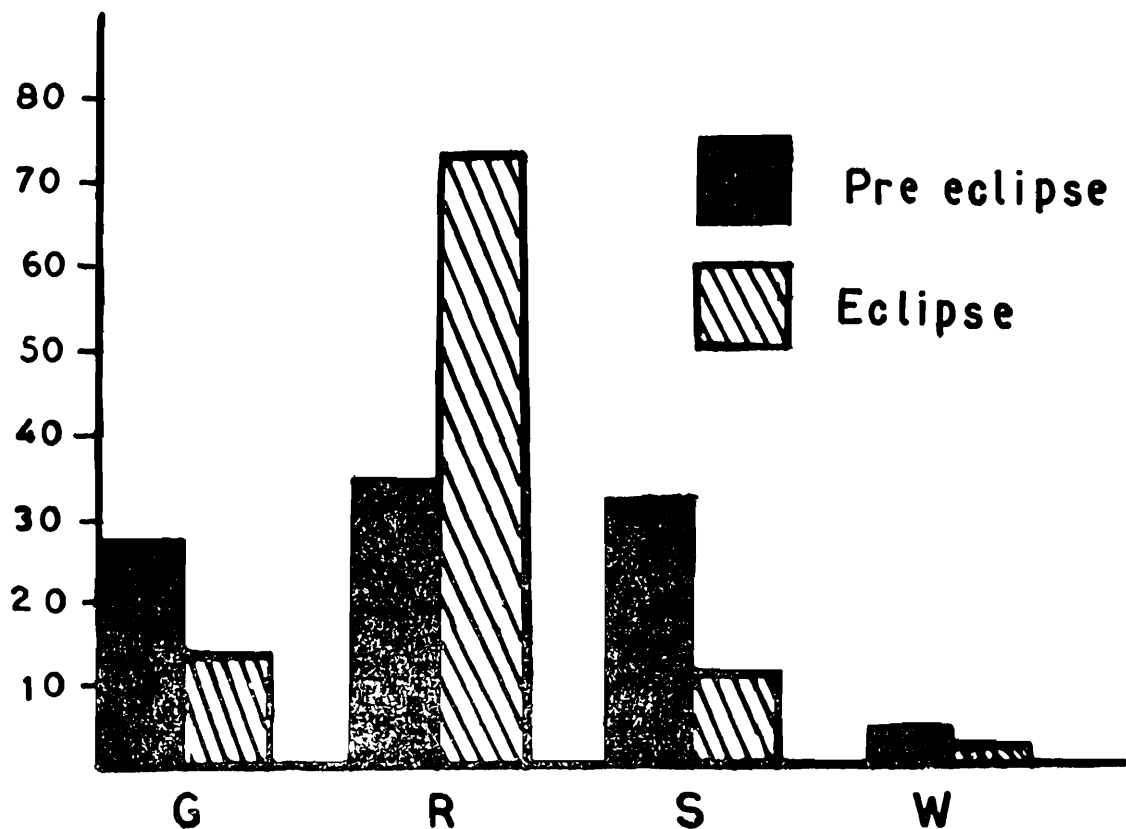


FIG 3

Fig. 3. Time budget of four major activities of blackbuck before and during eclipse compared. G : Grazing R : Resting S : Standing and W : Walking.

thus might have been a manifestation of a displacement response to the eclipse effect.

To sum up, the fluctuation of general activity profile of the blackbuck herd showed a trend to increase in the first half hour of the eclipse. Thereafter the general trend of decreasing activity and increasing inactivity manifests and progresses. It is briefly disturbed by an interlude of resting, individuals standing up as if faintly disturbed and puzzled. Approaching the peak of eclipse, the activity state denoted by grazing, drastically declines. The inactive resting state rises steeply to attain the peak at the totality of the eclipse. As soon as the totality is over, the resting is curtailed with resumption of activity. There is increased standing and walking, but

grazing is resumed only after about ten minutes, suggesting a sense of puzzlement. Thus a faint sense of puzzlement is apparent both before and after the peak of the eclipse.

SUMMARY

A comparative study of the behaviour of blackbuck was conducted in the Guindy Park, Madras, Tamil Nadu, during the solar eclipse of 1980. Activity profiles immediately before and during the eclipse were studied with regard to four main activities of grazing, walking, standing and resting. It is shown that compared to pre-eclipse control period, during eclipse, there was a detectable decline in active state and a conspicuous increase in inactive state. As regards activity fluctuation during the course of the eclipse, there was a general increase of activity in the first half hour of the eclipse, but after this a general trend of decreasing activity and increasing inactivity set in reaching their respective maxima at the totality. The fluctuation pattern is indicative of the occurrence of a faint sense of puzzlement both before and after the peak of the eclipse.

ACKNOWLEDGEMENT

We are thankful to Director, Zoological Survey of India for facilities provided, and also to Tamil Nadu Forest Department for the co-operation received.

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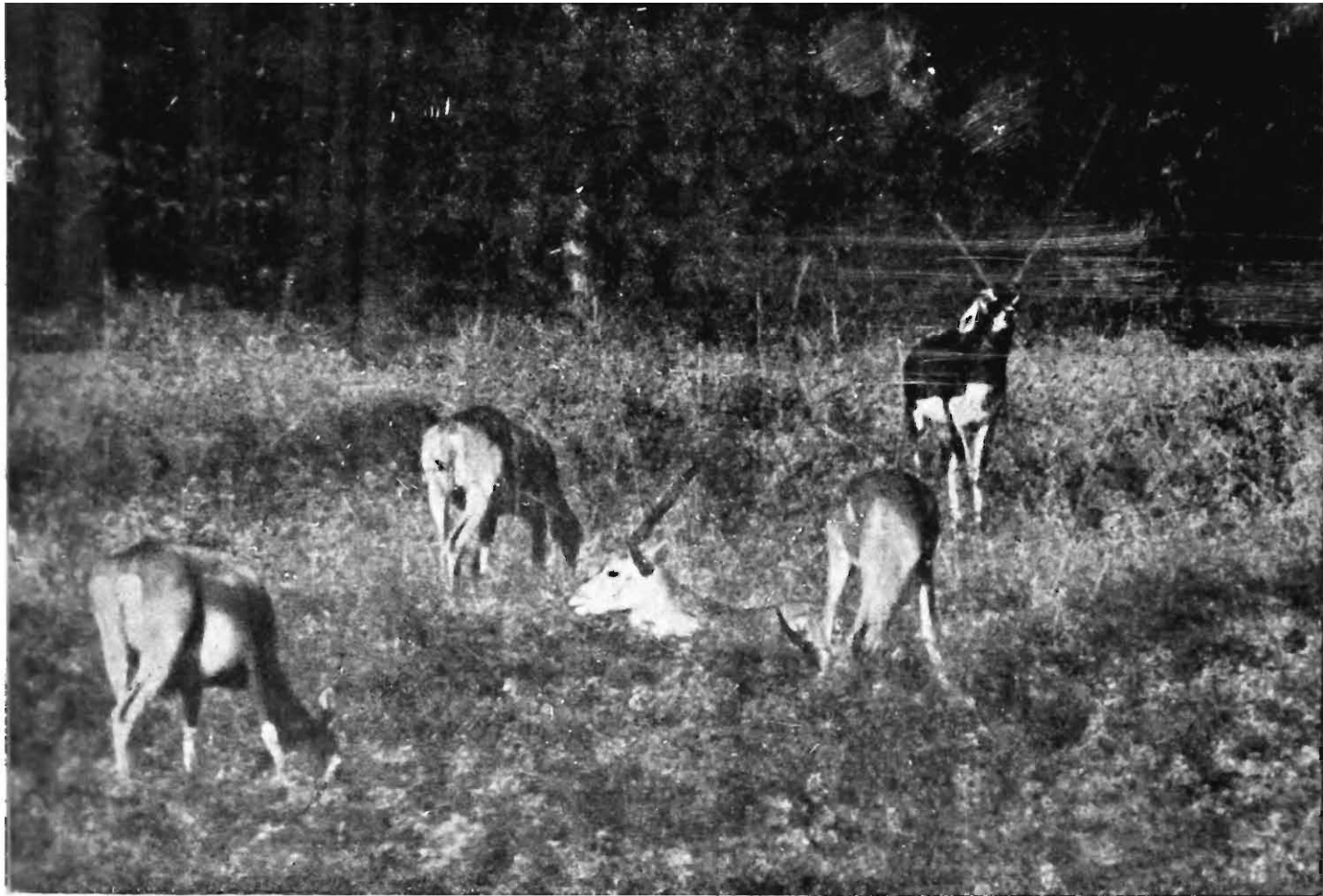


Fig. 1. Except the standing buck, others were resting, but three stood up and started grazing as the eclipse progressed for half an hour.

ON AN ABNORMAL CYPRINID FISH *PUNTIUS*
SARANA SARANA (HAMILTON) WITH A
FORKED BARBEL

By

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Forked barbels occurring in catfishes have been recorded by several workers. Occurrence of forked barbel in cyprinid fishes has not been reported so far. Tandon and Shrama (1971) observed forked barbel in the silurid *Callichrous (Ompok) macrophthalmus* from Patran, Dist. Patiala, Punjab. Ovais (1974) recorded forked right nasal barbel in *Clarias batrachus* from Bhopal, Madhya Pradesh. Datta and Ghosh (1975) reported a forked barbel in *Heteropneustes fossilis* from Barrackpore, West Bengal. Raghunathan (1976) noted forked barbel in *Ompok bimaculatus* from River Cauvery. Thakur and Singh Kohli (1976) reported forked left mandibular barbel in *Clarias batrachus* from Gunsar, District Darbanga, Bihar. Forked barbel and absence of pelvic fin was recorded by Edwin Chandrasekharan (1979) in the marine catfish, *Tachysurns maculatus* (Thunberg). Recently Babu Rao and Reddy (1984) reported a forked left maxillary barbel in *Mystus vittatus* (Bloch) from Hyderabad.

This note records the unilateral forked left posterior barbel in *Puntius sarana sarana* (Hamilton) (Family : Cyprinidae). This specimen was collected from Indravati River (a tributary of River Godavari) at Jagdalpur, District Bastar, Madhya Pradesh on 5.4.1979 by Dr. M. Hafeezullah & Party (present author was one of the party members). The left posterior barbel is forked after 3 mm. from its origin. The outer arm of the forked barbel measures 5.5 mm. in

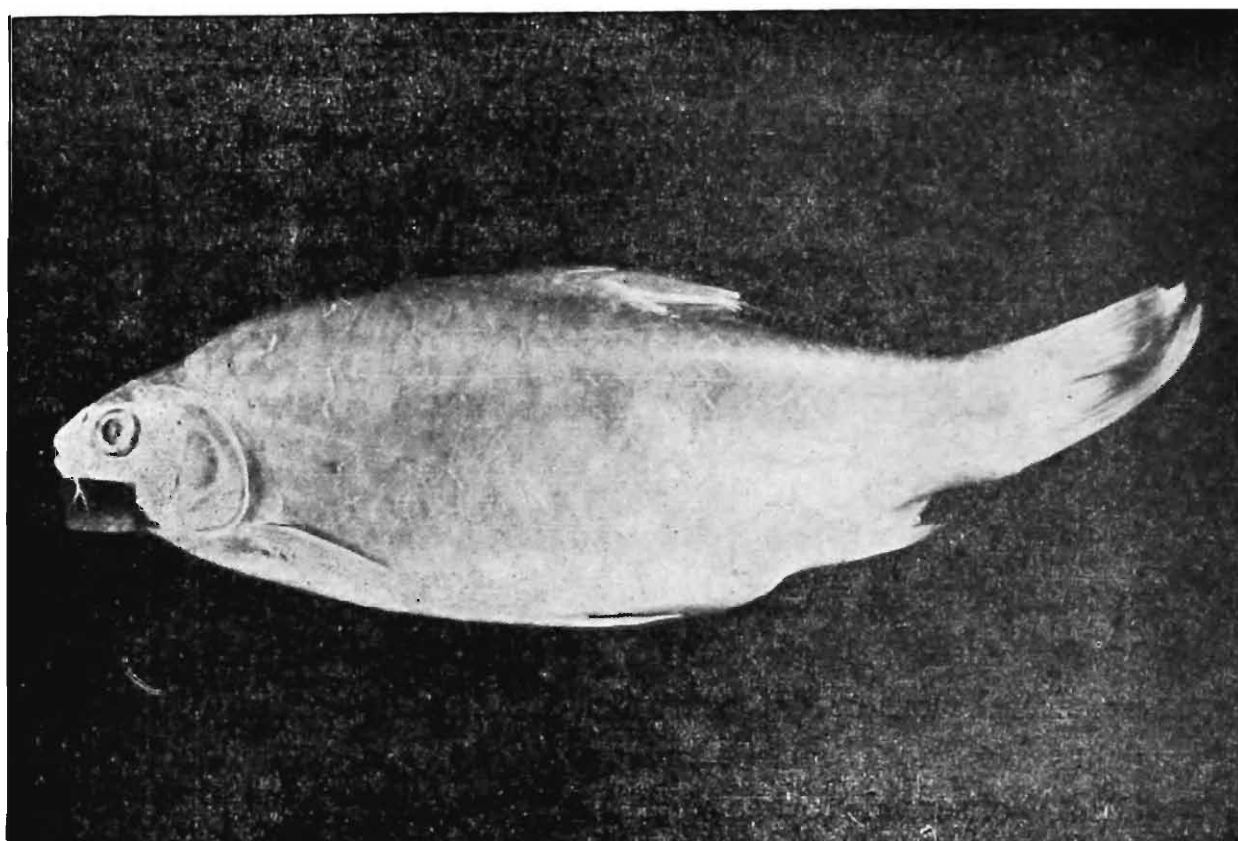


Fig. 1. *Puntius sarana sarana* (Hamilton) (205 mm. in Total Length) with forked barbel.

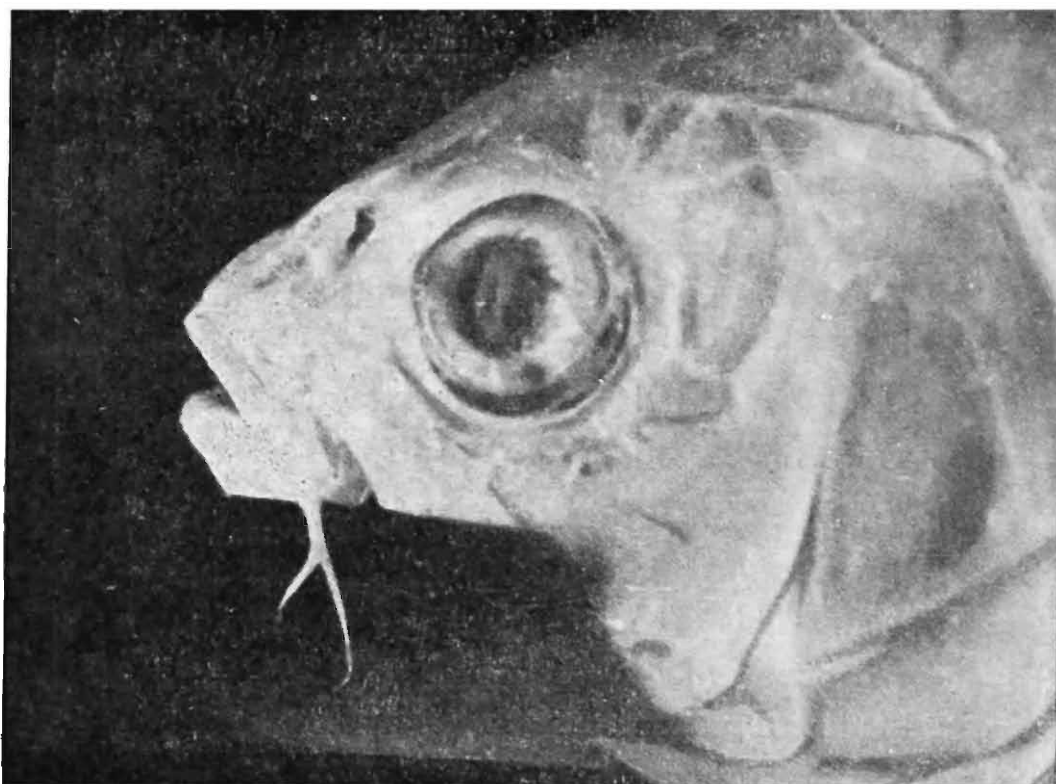


Fig. 2. Enlarged head of the same specimen showing the forked barbel.

length, while the inner arm measures 4.5. mm. The right unforked barbel is shorter than the left forked barbel and measures 7.5 mm. in length. The fish is otherwise normal in its external features.

The following are the meristic and morphometric characters of the abnormal specimen :

D=III/5 ; P=15 ; V=9 ; A=II/5 ; C=19 ; L.1.34.

Total length=205 mm. ; Standard length=165 mm. ; Head length=36.5 mm ; Body depth=60 mm ; Prepectoral distance 39.5 mm ; Preventral distance=83 mm ; Predorsal distance=84 mm ; Preanal distance=125 mm ; Pectoral fin length=31 mm ; Ventral fin length=27.5 mm ; Dorsal fin base=25.5 mm ; Anal fin base=16 mm ; Eye diameter=10 mm ; Snout length=11 mm ; Depth of peduncle=22 mm.

In the present specimen during early stage of development, in the course of tactile, gustatory, locomotary, aggressive or sexual activities, the barbel might have been injured or split, resulting in the growth of forked barel.

SUMMARY

An abnormal specimen of *Puntitus sarana sarana* (Hamilton) with forked left posterior barbel is reported. This abnormality is recorded for the first time in a cyprinid fish.

ACKNOWLEDGEMENT

The author is grateful to Dr. B.K. Tikader, Director, Zoological Survey of India for necessary facilities. He is also thankful to Dr. K. C. Jayaram, Joint Director and Dr. P. K. Talwar, Deputy Director, for encouragement.

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NOTES ON BORELLI'S MATERIAL OF DERMAPTERA
(INSECTA) WITH THE DESCRIPTION OF A NEW
SPECIES FROM PHILIPPINE ISLANDS

By

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The present study is based on five examples determined as *Chaetospania kurseonage* Hebard by Borelli (1926). Of these three examples belong to *Chaetospania borellii* Srivastava (1987) which was described on part of the material recorded by Borelli (l.c.) as *C. kurseongae*. The ♂ genitalia of this species is described here for the first time.

The remainin two examples represent an undescribed species of *Chaetospania* Karsch.

***Chaetospania borellii* Srivastava**

(Figs. 1-2)

Labia ridens var. *nitens* Borelli, 1923, *Boll. Musei Zool. Anat. comp. R. Univ. Torino*, 38 (N. S. 13) : 8 (Part of the material ; 1 ♂, 1 ♀, Luzon, Limay and 1 ♂ Surigao).

Chaetospania kurseongae (nec Hebard) var a ; Borelli, 1926, *Res. Biol.*, 1 (5) : 70.

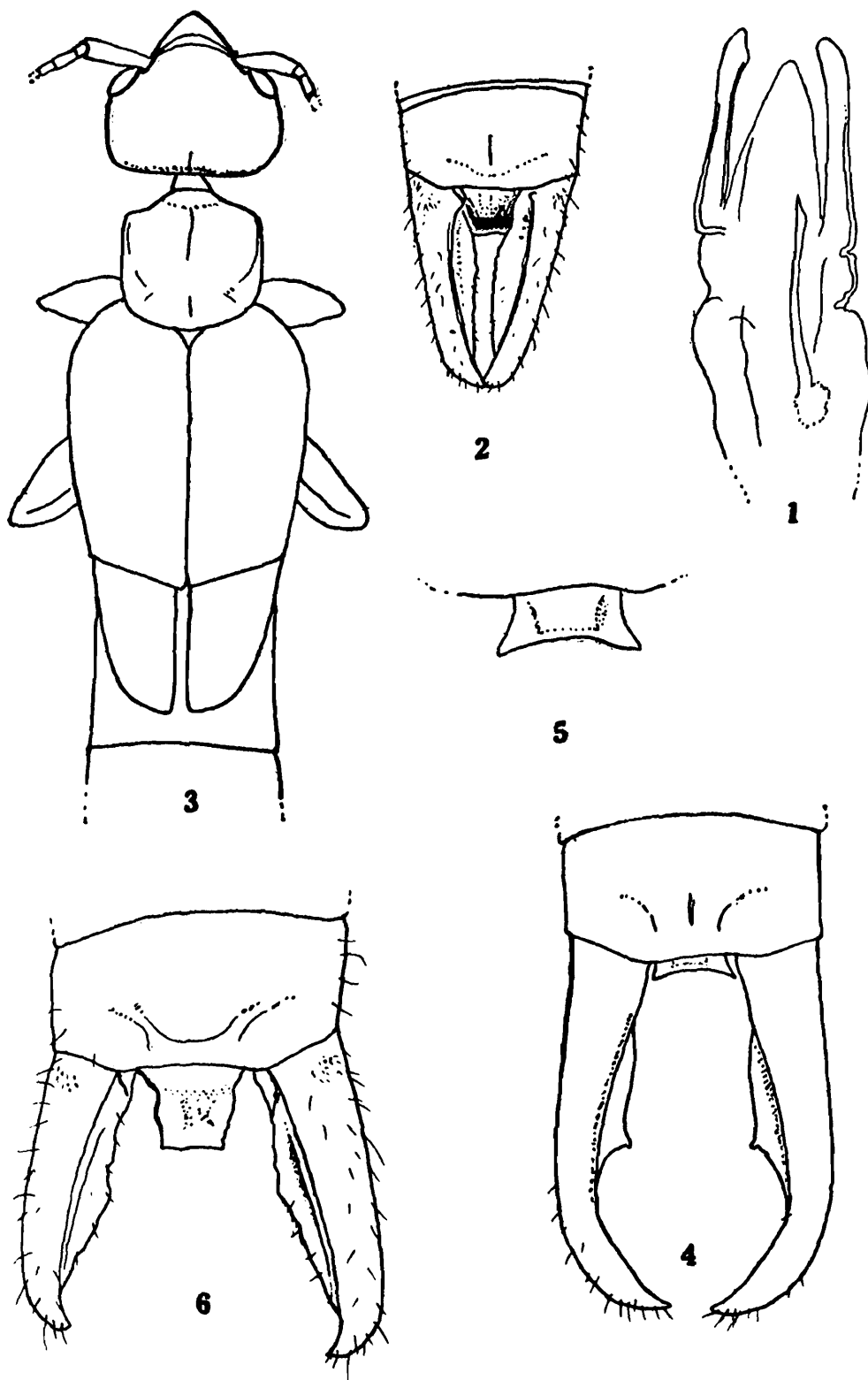
Chaetospania borellii Srivastava, *Boll. Mus. reg. Sci. nat. Torino* 5 (2) : 318.

Material examined : (I) 1 ♂ labelled as : (i) Island Samar, Baker—a printed label ; (ii) *Chaetospania kurseongae* var. handwritten by Borelli ; (iii) Museo di Zoologia della Univer-sita Torino-Italia-printed ; the genitalia mounted between two coverslips and pinned with the specimen.

(II) 1 ♂ (ultimate tergite and forceps missing) labelled as : (i) Surigao, Mindanao, Baker—printed ; (ii) var. *nitens*

Borelli-handwritten by Borelli ; (iii) Parameri-handwritten by Borelli ; Museo di Zoologia della Universita Torino-Italia.

(III) 1 ♀ labelled as : (i) Luzon, Limay, 10.1913, leg.



Figs. 1-6: *Chaetospania borellii* Srivastava ; ♂, (1) Genitalia ; ♀, (2) Ultimate tergite and forceps ; *Chaetospania makilingae* sp. n., Holotype ♂, (3) Anterior portion of body ; (4) Ultimate tergite and forceps ; (5) Pygidium, enlarged ; ♀ (6) Ultimate tergite and forceps.

G. Boettcher—a printed label ; (ii) ♀ -printed ; (iii) Museo di Zoologia della Universita Torino-Italia.

Measurements—(in mm)

	♂	♀
Length of body	4.4	6.4
Length of forceps	1.7	1.9

Remarks : This species was described on a ♂ which lacked genitalia.

The material referred here agrees well with the type of the species and the male genitalia and the ♀ are figured here for the first time.

The specimen listed under item II, though without hind portion of the body, may be treated as ♂ since it has been recorded as such by Borelli (1923) from Mindanao.

Besides, the material referred to by Borelli (1926) to *Chaetospania kurseongae* var a, belongs to this species on the basis of brief information furnished by him.

***Chaetospania makilingae* sp. n.**

(Fig. 3-6)

Labia ridens Bormans var. *nitens* Borelli, 1923, *Boll. Musei Zool. Anat. comp. R. Univ. Toriuo*, 38 (N. S. 13) : 8 (Part of the material-1 ♂ Mont Makiling).

Chaetospania kurseongae (nec Hebard) ; Borelli, 1926, *Res. Biol.*, 1 (5) : 70 (♂, ♀ var- b, Mt. Isareg).

Chaetospania sp., Srivastava, 1987, *Boll. Mus. reg. Sci. nat. Torino*, 5 (2) : 321, figs. 8-10.

♂ : General colour blackish brown ; head dark brown ; antennae light yellow, pronotum yellowish with a brownish curved patch in anterior half ; legs clear yellow. Finely pubescent.

Head about as long as broad, smooth, frons weakly raised, sutures faint, hind margin emarginate in the middle. Antennae (partly damaged-basal three segments on the right and four on the left remaining), basal segment narrowed

basally, about as long as the distance between antennal bases ; 2nd short, about as long as broad ; 3rd long and slender ; 4th about as long as the preceding but stouter. Pronotum about as long as broad, smooth, sides straight, depressed and parallel, anteriorly convex, hind margin rounded, median sulcus distinct in anterior half only ; prozona raised and metazona depressed. Legs typical for the genus. Elytra and wings well developed, former meeting along the middle line, hind margin obliquely truncate.

Abdomen gradually enlarging from base to apex, tergites moderately depressed, micro-reticulated. Penultimate sternite transverse, punctulate, hind margin rounded with slight emargination in middle. Ultimate tergite transverse, smooth, weakly convex, above the bases of forceps with a low elevation and depressed in middle, hind margin thickened. Pygidium vertical, hind margin emarginate in middle, postero-laterally produced into a triangular point, at base above feebly convex. Forceps remote at base, stout, almost straight in basal two thirds, afterwards incurved, internal margin with dorsal border straight and ventral border forming a flange and terminating into a triangular spine at $2/3$ of the length, afterwards branches depressed, apices gently hooked and pointed.

♀ : Agrees with males in most characters except pygidium prominent, horizontal, narrowed posteriorly, hind margin truncate, sides with one or two tubercles ; forceps simple and straight.

Measurements.—(in mm)

	Holotype	Paratype
	♂	♀
Length of body	7.2	6.4
Length of forceps	2.2	1.6

Material examined : Holotype ♂ labelled as : (i) Mt. Makiling Luzon, Baker-printed ; (ii) *Chaetospania kurseonge* Morgan Hebard, Bengale-handwritten by Borelli ; (iii) Museo di Zoologia della Universita, Torino-Italia ; genitalia not traceable, perhaps taken out earlier by Borelli.

Paratype ♀ labelled as : (i) Mt. Isarog, S. Luzon-printed ; (ii) Museo di Zoologia della Universita, Torino-Italia.

Types deposited in Museo ed Istituto di Zoologia Sistematica della Universita di Torino, Torino, Italy.

Remarks : It comes close to *Chaetospania borellii* Srivastava from Philippines but differs, in ♂, by the slightly larger size and distinctive pygidium in being vertical, concave posteriorly with postero-lateral angles produced into a triangular point and forceps with internal tooth situated at 2/3 of the length and more prominent.

The ♀ specimen designated here as the Paratype was determined as *Labia ridens* Bormans by Borelli (1923) along with a ♂, bearing identical locality labels, and were referred by him subsequently (1926) to *Chaetospania kurseongae* Hebard. The above ♂ specimen was referred to *Chaetospania* sp. by Srivastava (1987) which belongs to the described species.

ACKNOWLEDGEMENTS

I am thankful to the Director, Zoological Survey of India, Calcutta for providing necessary facilities and to Dr. Orsetta Elter, Curator, Museo ed Istituto di Zoologia Sistemata della Universita di Torino, Torino, Italy, for sending the valuable material for study.

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ON TWO NEW SPECIES OF THE GENERA
SCOTOPHAEUS SIMON AND *EHEMUS*
SIMON FROM INDIA (ARANEAE ;
GNAPHOSIDAE)

By

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INTRODUCTION

Practically there was no work in the past on the spiders of the family Gnaphosidae from India, although gnaphosidae spiders are abundant throughout the country, even the representative work by Pocock (1900) on Indian spiders contains no reference to this family. The spiders of the genus *Scotophaeus* are very little known. Very recently Tikader (1962, 1966, 1982) described four species, Tikader & Gajbe (1977) one species and Patel & Patel (1975) one species from India. The *Echemus* is being recorded for the first time from India.

While studying the spiders of the family Gnaphosidae the author encountered two new species of *Scotophaeus* and *Echemus*.

The type specimens are deposited in the National Zoological Collections, Zoological Survey of India, Calcutta.

***Scotophaeus bhadatae* sp. nov.**

General : Cephalothorax and legs brownish-green. Abdomen gray. Total length 7.00 mm. Carapace 2.30 mm. long, 1.90 mm. wide ; abdomen 4.50 mm. long, 2.90 mm. wide.

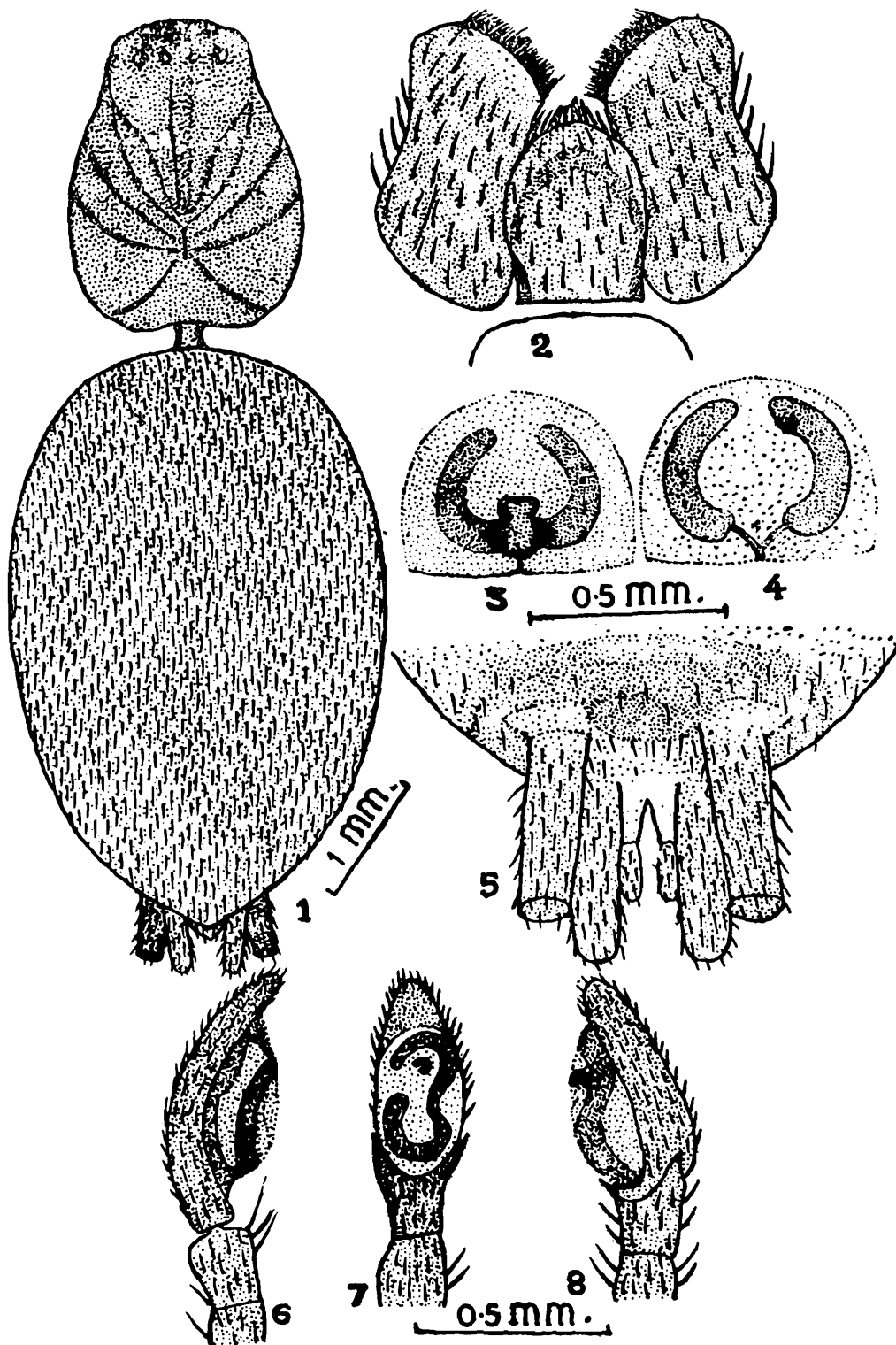


Fig. 1-8: *Scotophaeus bharratae* sp. nov. (1) Dorsal view of female, legs omitted. (2) Labium and maxillae. (3) Epigyne. (4) Internal genitalia. (5) Spinnerets. (6) Left male palp, retrolateral view. (7) Left male palp, ventral view. (8) Left male palp, prolateral view.

Cephalothorax : Longer than wide, convex, slightly narrowing in front, clothed with pubescence, posterior middle provided with a conspicuous fovea. Radiating strikes

diverge from fovea to lateral sides. Eyes pearly white except anterior medians which are black, posterior row of eyes slightly longer than the anterior row. Anterior row of eyes slightly procurved (as seen from infront), medians circular, larger than the laterals and closer to adjacent laterals than to each other. Posterior row of eyes slightly procurved, medians silvery white, elliptical and smaller than the adjacent laterals, equidistant from each other. Median ocular area longer than broad and narrow infront than behind as in fig.-1. Sternum heart-shaped, pointed behind and clothed with hairs. Labium nearly triangular, longer than wide, anterior margin of maxillae provided with conspicuous scopulae, shape as in fig. 2. Chelicera moderately strong, vertical, inner margin without tooth and outer margin with two similar teeth. Legs relatively long and strong, clothed with hairs and some spines, scopulae extend up to the base of matatarsi I and II. Legs formula 4123.

Abdomen : Longer than wide, oval, slightly narrowed behind, clothed with pubescence and hairs. Ventral side lighter in colour than dorsal. Epigyne as in fig. 3. Internal genitalia as in fig. 4. Spinnerets very prominent, anterior spinnerets widely separated, posterior spinnerets longer than others as in fig. 5. Male is darker in colour and half the size of the female. Male palp as in fig. 6, 7, 8.

Holotype : female (Reg. No. 5135/18) *allotype* one male (Reg. No. 5136/18) in spirit.

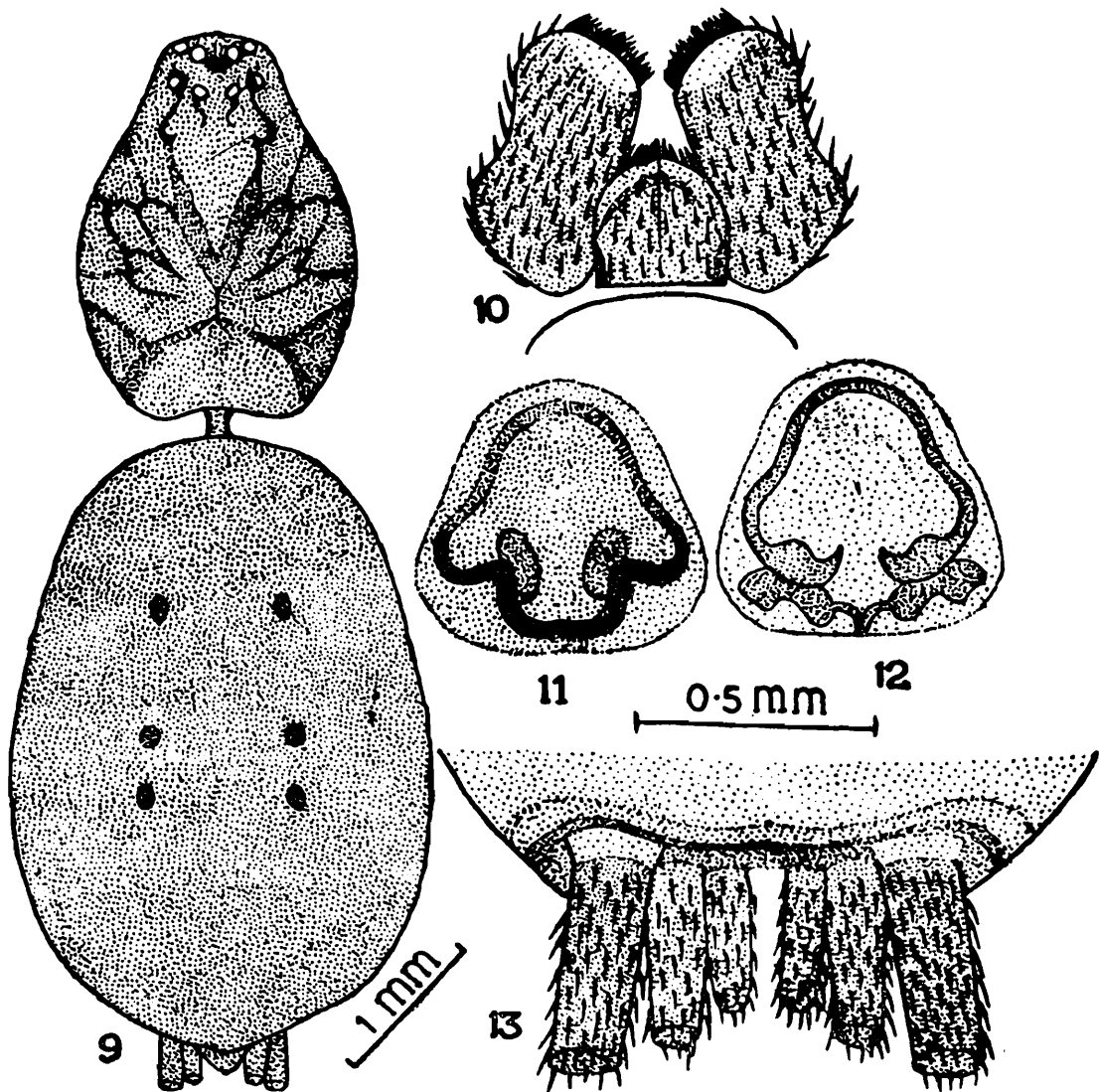
Type-locality : INDIA, West Bengal, Raharah, Dist. 24 Parganas. date 18.XI.1986. Coll. B. K. Tikader.

Remarks : This species closely resembles *Scotophaeus simlaensis* Tikader but differs from it as follows : (i) Cephalothorax and legs light brownish-green but in *S. bhartatae* brownish-green. (ii) Inner and outer margin of chelicera provided with one minute tooth and five teeth respectively but in *S. bhartatae*, inner margin without teeth and outer margin with two teeth. (iii) Epigyne and internal genitalia also structurally different.

Echemus viveki sp. nov.

General : Cephalothorax brown, legs reddish-green abdomen brownish-black. Total length 6.50 mm. Carapace 3.30 mm. long, 1.80 mm. wide ; abdomen 4.00 mm. long, 2.60 mm. wide.

Cephalothorax : Longer than wide, convex, narrow in-front, clothed with pubescence, posterior middle provided with an short inconspicuous fovea. Radiating strikes diverge from fovea to lateral sides. Eyes pearly white except anterior medians which are black, anterior row of eyes slightly procurved (as seen from in front), medians larger than the laterals and closer to laterals than to each other. Posterior



Figs. 9-13 : *Echemus viveki* sp. nov. (9) Dorsal view of female, legs omitted. (10) Labium and maxillae. (11) Epigyne. (12) Internal genitalia. (13) Spinnerets,

row of eyes strongly procurved, medians silvery white and smaller than the adjacent laterals and more or less equidistant to each other as in fig. 9. Median ocular area longer than wide and narrow behind than in front. Sternum heartshaped, narrow behind, rebordered, with sclerotized extensions to coxae, clothed with hairs. Labium nearly triangular, longer than wide, anterior margin of maxillae provided with conspicuous scopulae, shape as in fig. 10. Chelicerae moderately strong, vertical, inner margin provided with one minute tooth and outer margin with two dissimilar teeth. Legs relatively long and strong, clothed with hairs and some spines, scopulae extend upto the base of metatarsi III and IV. Preening comb on metatarsi III and IV. Legs formula 4123.

Abdomen : Longer than wide, oval, widest behind the middle, clothed with pubescence and three pairs of sagilla, Ventral side slightly lighter than the dorsal. Epigyne as in fig. 11. Internal genitalia as in fig. 12. Spinnerets prominent, anterior spinnerets widely separated as in fig. 13.

Holotype : Female (Reg. No. 5137/18) *paratype* one female (Reg. No. 5138/18) in spirit.

Type-locality : INDIA, West Bengal, Tibetan Nayabusta (Sonoda) Dist. Darjeeling date 31.XII.1970. Coll. J. M. Julka.

Remarks : This species closely resembles *Echemus angustifrons* (Westring) but differs from it as follows : (i) Cephalothorax light brown, abdomen gray but in *E. viveki* cephalothorax brown and abdomen brownish black. (ii) Outer margin of chelicera with three teeth but in *E. viveki* outer margin of chelicera with two teeth. (iii) Epigyne and internal genitalia also structurally different.

SUMMARY

The present paper deals with two new species *Scotophaeus bharatae* and *Echemus viveki* belonging to family Gnaphosidae.

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STUDIES ON CRUSTACEA OF BIHAR. I. TWO NEW
OSTRACODS FROM SUBTERRANEAN WATERS
OF MONGHYR

By

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INTRODUCTION

Studies on the subterranean fauna of Bihar has revealed the presence of interesting ostracods i.e. *Indocandona krishnakanti* Gupta and *Candonopsis urmilae* Gupta (in Press). The present new genus under report is interesting in many features as it possesses the combination of characters and is placed in the subfamily Herpetocyprillinae of the family cyprididae. Males are absent.

Family ; CYPRIDIDAE

Subfamily : HERPETOCYPRILLINAE

Prionocandona gen. nov.

Diagnostic characters : Shell subtriangular to deltoid in side view ; dorsum slightly convex, highest point anterior of centre, anterodorsal concavity above the eye ; ventre sinuate and inflexed with wide flap ; posterior acutely rounded, anterior widely rounded ; inflated ovate and hexagonal in dorsal view, anterior and posterior end broadly pointed, sides moderately convex, greatest breadth in the middle and more than height ; surface reticulate ; natatory setae on second antennae absent ; second thoracic leg with one reflexed seta smaller than the penultimate segment and one sickle shaped prominent claw ; furca narrow longer than half the length, stout serrate claws ; terminal seta equal to or longer than the terminal claws ; subterminal claw 75 percent of the terminal claw ; dorsal seta stout close to and 50 percent of the subterminal claw ; furcal ramus curved, dorsal margin serrate in

distal two third of the length, chitin support just like *Strandesia spinulosa* (Rome 1969).

The complete absence of natatory setae and structure of second thoracic leg shows close relationship with *Herpetocyprella* Daday (1909).

Type species : *Prionocandona Kantii* sp. nov.

Prionocandona Gupta is closely allied to the genus *Herpetocyprella* Daday (1909) but differs in shell size and structure, claw length of antenna, first thoracic leg, claw structure of the second thoracic leg and also the furca.

***Prionocandona kantii* sp. nov.**

(Figs. 1-3)

Female : Shell length 0.55-0.615 mm, height 0.3 mm, breadth 0.37 mm ; subtriangular to deltoid in side view, left valve slightly exceeds the right in length at its anterior and posterior extremities, dorsum slightly convex, highest point anterior of centre, antero-dorsal concavity above the eye point ; ventre sinuate and inflexed with wide flap provided with prominent pore canals, posterior acutely and anterior widely rounded ; in dorsal view inflated, ovate hexagonal in outline ; anterior and posterior ends broadly pointed (fig. 3 A, B), sides moderately convex, greatest breadth in the middle and more than height, duplicature narrow ; surface reticulate, scattered setae on ventral ; anterior and posterior margins ; inner lamella wider anteriorly.

Antennule (Fig. 1C) : 7 segmented, segmental ratio 23 : 7 : 10 : 6 : 6 : 6 : 6.

Antenna (Fig. 1D) : Natatory setae absent, endopod 4 segmented, segment 2 & 3 fused, length ratios 13 : 3 : 5 : 3, Y seta about 75 percent of first segment in length, distal segment of Y seta 58 percent of its total length, seta Y_1 is pilose, only T_1 & T_2 are present on the inner margin reaching the end of 4th endopod, on outer margin opposit T_1 T_2 are 2 small setae ; Z_1 Z_2 & Z_3 are on the outer side while Z_4 is small and on

the inner side of the antenna, claws G_1 G_3 are longer and reaching the tip of the terminal claw GM, G_2 is about 76 percent of G_3 , all the 4 claws are serrate in the distal end, GM is a narrow slender seta reaching the end of claw G_2 .

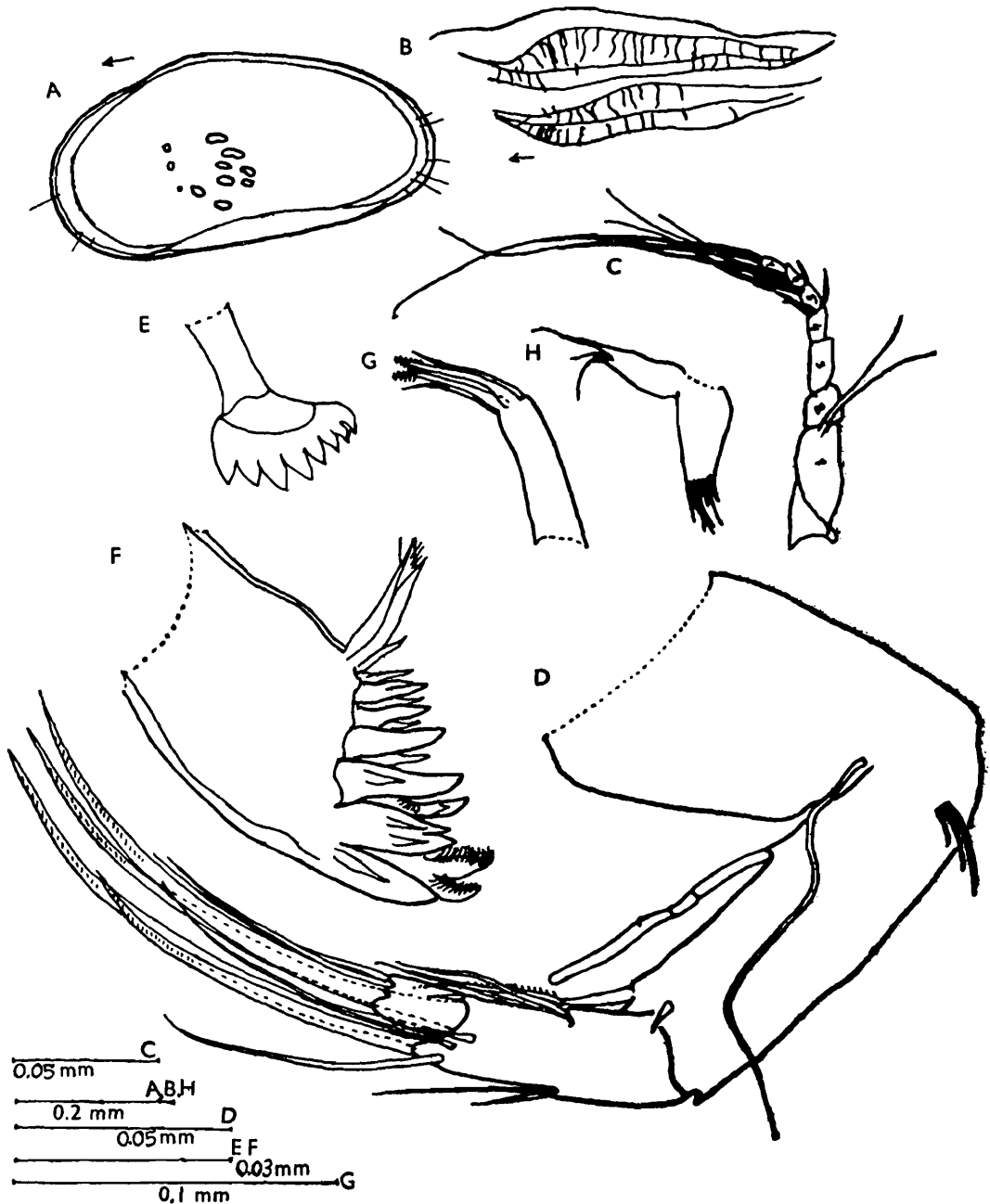


Fig. 1. A. Lateral view of the shell B. Ventral flap of shell
 C. Antennule D. Antenna E. Rakelike organ F. Mandible
 G. Maxillular spines H. Maxilla.

Rake like organ (Fig. 1 E) : 7-8 denticles.

Mandible : (Fig. 1 F, 2A) : 7 multidentate teeth with a row of accessory setae giving typical Cypridine structures,

mandibular palp 4 segmented, segment one with 2 long pilose and one simple seta on inner distal margin, segment 2 with 4 long, simple smooth setae on inner distal margin

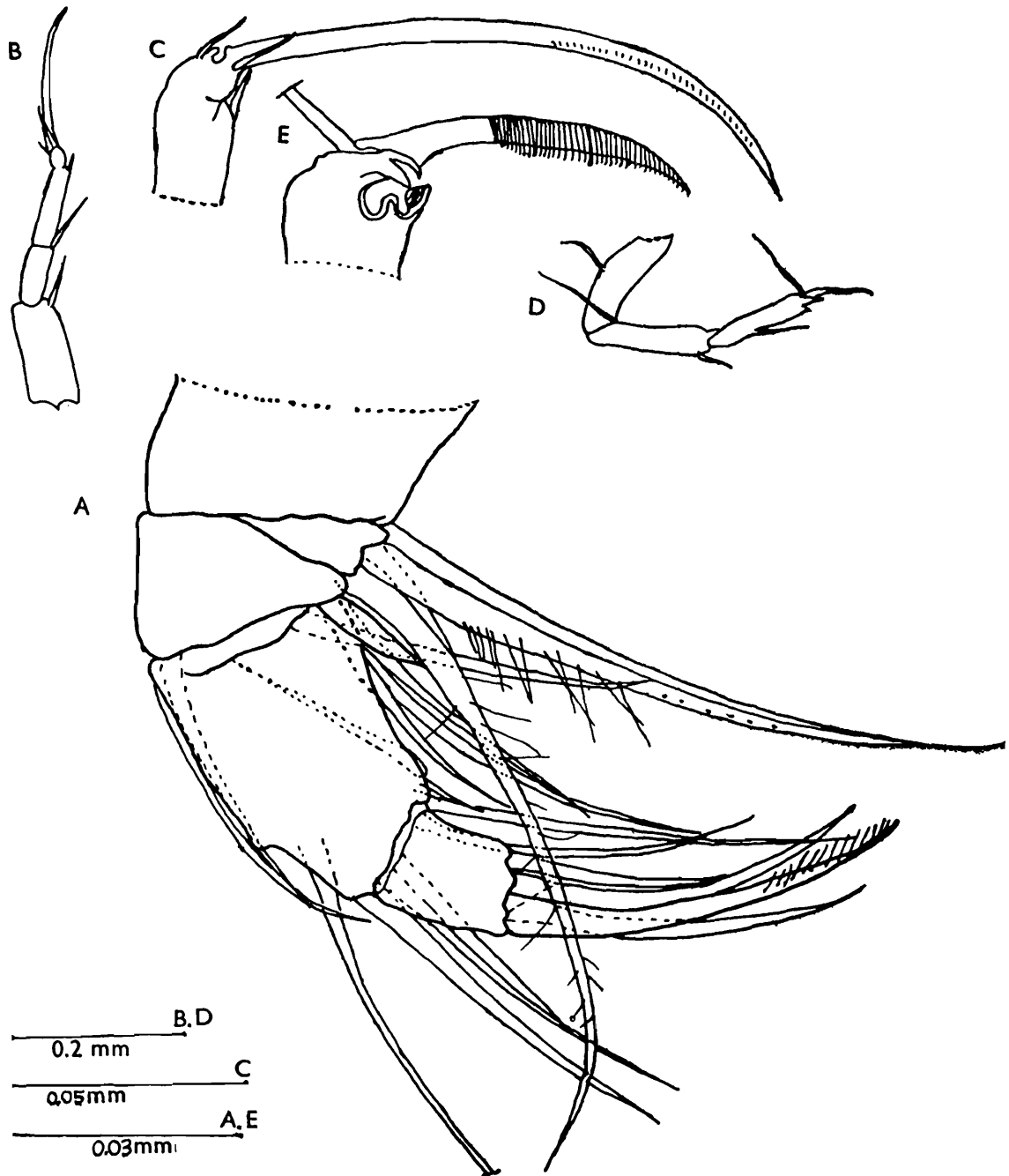


Fig. 2. A. Mandibular palp B. Thoracopod I C. Thoracopod I distal end magnified D. Thoracopod II E. Thoracopod II distal end magnified.

and 2 simple smooth setae on outer margin, segment 3 with 4 smooth long setae on the outer margin and 4 setae of varied length on the inner distal margin, segment 4 with terminal segment with 4 stout terminal setae of which the middle one is stronger with setose termination.

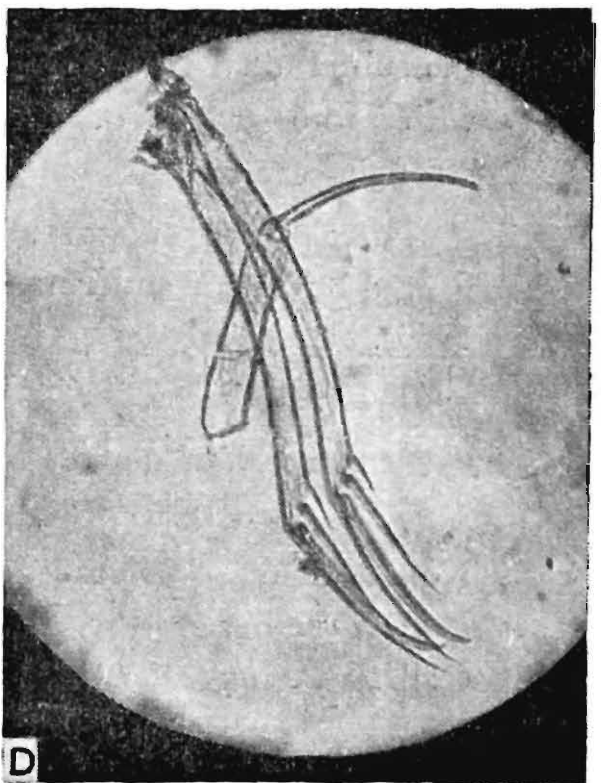
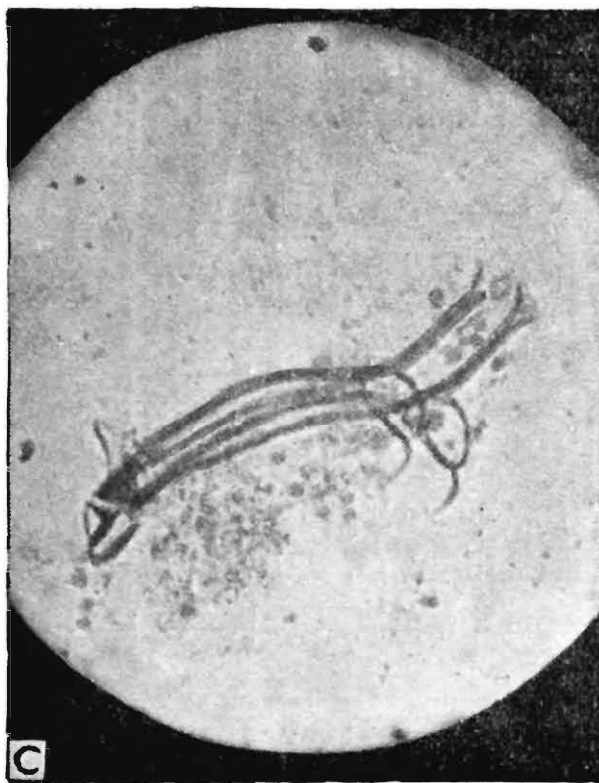
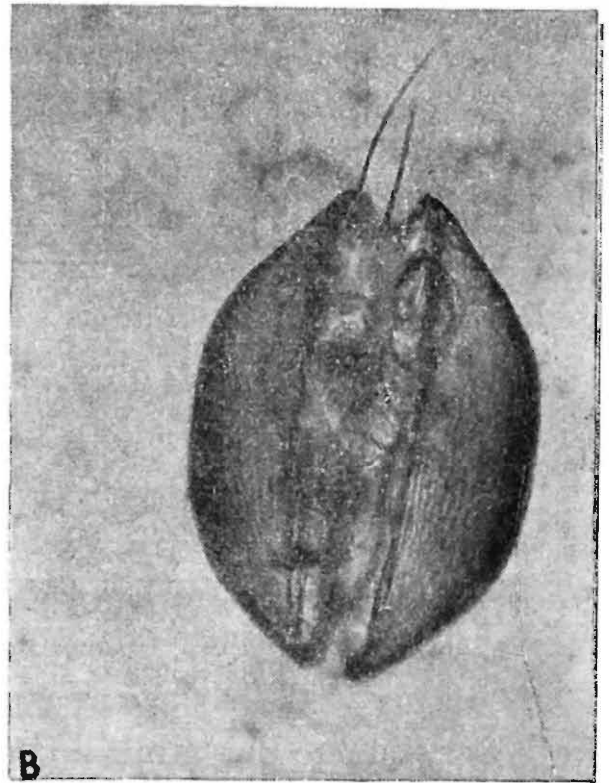
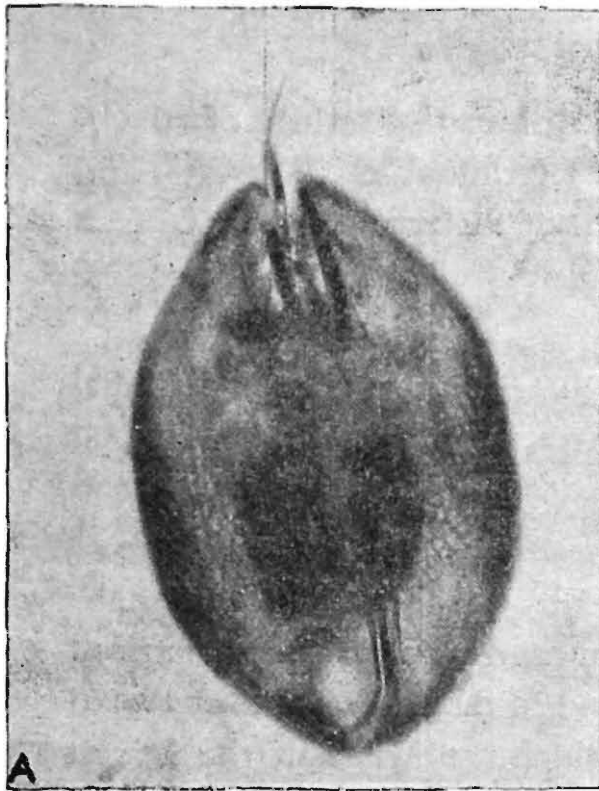


Fig. 3. A. Dorsal view of female
B. Ventral view of female
C. Furcal suport female
Furca (with Th-I) Female

Photograph
”
”
”

Maxillule (Fig. 1G) : Third lobe with two toothed spines.

Maxilla (Fig. 1H) : Female endopodite with 3 long setae of unequal size.

Thoracopod—I (Fig 2 B,C) : Length ratios of the 4 distal segments 27 : 9 : 14 : 2 ; terminal claw serrate and equal to the combined length of distal 3 segments, each segment with small seta at its distal inner end, the terminal segment has 2 minute setae.

Thoracopod—II (Fig. 2 D,E) : Four segmented, terminal segment greatly reduced with a terminal sickle shaped stout setose claw and a reflexed simple seta shorter than length of undivided penultimate segment, short seta located behind midposition of penultimate segment.

Furca (Fig. 3 C, D) : Furca long narrow, curved symmetrical, ramus 24 times the narrowest width, terminal seta longer than or equal to the terminal claw which is nearly half the length of the ramus, terminal claw stout, subterminal claw 75 percent of the length of terminal claw, dorsal seta stout and close to the subterminal claw, dorsal margin of ramus finely serrate with 5 to 6 groups of denticles in distal two third, claws strongly serrate.

Furcal Chitin support similar to *Strandesia odiosa* (Moniez) figured by Victor and Fernando (1979) and *S. spinulosa* (Rome 1969).

Eyes : Absent.

Male : Not known.

Holotype : 1 ♀ (on slide no-1+ shells in spirit) Reg. No. A 1036 Zoological Survey of India, G. P. R. S., Patna, Loc. Monghyr. Bihar, India, From a well in Belan Bazar ; Coll. L. P. Gupta, 27. IV. 83.

Paratypes : ♀ ♀ (Slide Nos. 2-5) Reg. No. A 1037.

30 ♀ ♀ (in spirit) Reg. No. A 1038, Details as for holotype.

Discussion : The new genus *Prionocandona* Gupta is closer to *Herpetocyprilla* Daday (1909) but differs in being much

smaller in size, the breadth being $\frac{2}{3}$ and height $\frac{1}{2}$ the length. The general outline of *Prionocandona* in dorsal view is hexagonal. The ventral flap is wider and provided with profuse pore canals. The sickle shaped terminal claw of thoracopod-II is elongated in this genus.

Prionocandona Gupta also have some similarity with *Candocyprinotus* Delorme 1970 so far as the absence of natatory setae and terminal segment of the second thoracic leg is concerned but it differs in many morphological features of its appendages.

In dorsal view it is very much similar in outline to the cyprioid *Prionocypris pigra* (Sars 1928) but differs in all other respects. The furca is very much similar to *Strandesia purpurascens* while the furcal support is morphologically similar to *Strandesia odiosa* (Victor & Fernando 1979) and *Strandesia spinulosa* (Rome 1969).

So much diversity in structure justifies its status as a new genus.

***Indocandona biharensis* sp. nov.**

(Fig. 4 A-K)

Description : Shell length 0.58 mm. height 0.25 mm. breadth 0.14 mm. laterally narrow oblong, anterior widely rounded, posterior narrowly rounded, dorsal margin evenly arched, highest in centre, seen dorsally oblong lanceolate with both extremities acuminate, greatest width in centre ; ventre slightly sinuate ; surface smooth, inner lamella narrow ; first antenna longer and slender, 3rd segment longer than other distal segments ; second antenna somewhat straight and not produced into ridge differing from *Indocandona krishnakanti* ; mandible with 7 teeth and one complex seta ; third lobe of maxillule with 2 dentate spines ; maxilla with one endopodial seta ; Thoracopod—I with very long smooth terminal claw, longer than combined length of endopodial segments 2,3 and 4 ; second thoracic leg rather slender and similar to *I. krishnakanti* Gupta but without row of microtrichs at the bases of minute spines, dorsal margin of third

segment and lower margin of first segment smooth and all the setae smooth except reflexed seta; furca just like *I. krishnakanti* but claw is not serrate; furcal support different from *I. krishnakanti*; only one egg present in the female.

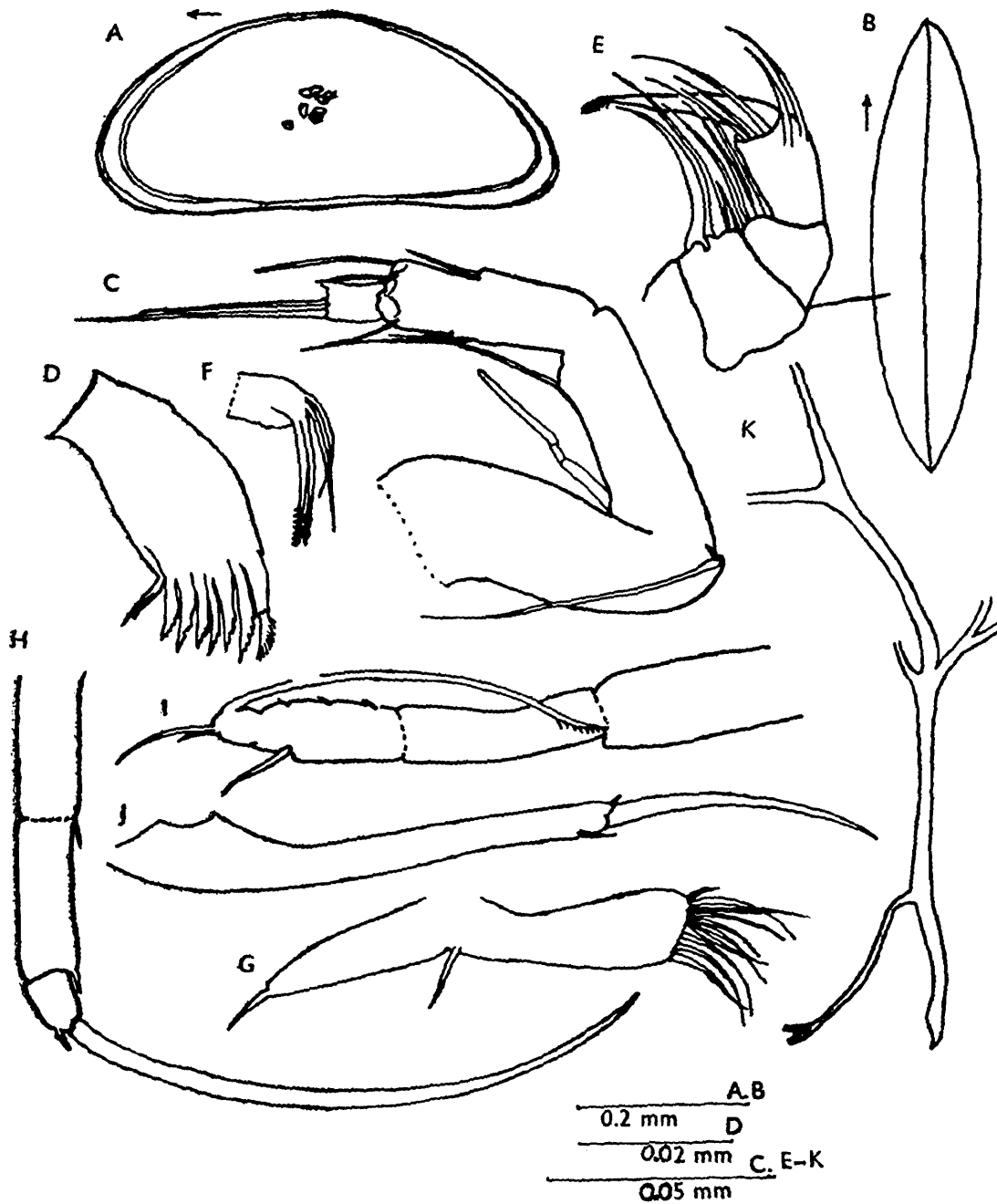


Fig. 4. A. Lateral view of the shell B. Dorsal view of the shell C. Antenna (Terminal claws broken) D. Mandible E. Mandibular palp F. Maxillular spine G. Maxilla H. Thoracopod-I I. Thoracopod-II J. Furca K. Furcal support.

Material: 1 ♀ (on slide No. 1) + broken shell in spirit.
Reg. No. A 1039. Zoological Survey of India, G.P.R.S.,

Patna, Loc. Monghyr, Bihar, India, from a well in Belan Bazar. Coll. *L. P. Gupta*, 27. IV. 83.

Remarks : The species differs from *I. krishnakanti* in its shall shape, morphology and minute details of second antenna mandibular palp, maxillule, second thoracopod, furca and furcal support.

SUMMARY

Two new ostracod crustacea *Prionocandona Kantii* Gen. et sp. nov. and *Indocandona biharensis* sp. n. have been described from subterranean water of Monghyr, Bihar. Their relationships have been discussed.

ACKNOWLEDGEMENT

The author is thankful to the Director, Zoological Survey of India, Calcutta and Officer-in-Charge, ZSI, Patna, for providing the necessary facilities for the work. The author is also thankful to Dr. D. L. Danielopol of Limnological Instt, Austrian Academy of Sciences, Gaisberg, Austria, for providing initial impetus for work on subterranean ostracoda and kind suggestions and also to Dr. D. L. Delormme, Canada Department of Energy, Inland water Branch, Calgary, Alberta, for providing literature. Thanks are also due to Shri Ram Babu Sharma, Photographer for necessary help in the photography.

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STUDIES ON THE LIFE HISTORY OF INDIAN
DRAGONFLIES : *ORTHETRUM SABINA SABINA*
(DRURY) (ODONATA : LIBELLULIDAE)

By

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INTRODUCTION

In my endeavour to study the larval stages and the life history of Indian dragonflies, present is fourteenth paper in the series. In this paper findings are presented of the study on the larval development of *Orthetrum sabina sabina* (Drury). The last-instar larva has been described earlier (KUMAR, 1973).

The genus *Orthetrum* Newman is very widely distributed in the Old World and contains a large number of species : from the Indian sub-region alone more than a dozen species have been recorded (FRASER, 1936, KUMAR & PRASAD, 1981). *O. sabina sabina* has a very wide distribution, being recorded from most of India, Mesopotamia, Iraq, Iran, Thailand, Java, Samoa, Somaliland, Sumba, Timor, New Guinea, Australia, Egypt, Angola and other countries in the African continent.

O. sabina sabina is fairly common around temporary and perennial ponds during the summer and monsoon seasons and around slow running marshy streams during the rest of the year. Larvae are found in ponds and amongst vegetation in marshy streams.

MATERIAL AND METHODS

Eggs were collected on 26.iii.1976 from a copulating female near a perennial pond at Gorakhpur vill., Dehra Dun Valley, India (77°45' & 78°20' EL and 29°57' & 31°2' NL :

alt. ca. 650m). Hatching started on 5.iv. and continued till 12.iv. at a water temperature (max.) of 28°C. Study of larval development was begun on 5.iv. with rearing of larvae in II instar. Larvae Nos. 1, 2, 3 and 6 died in intermediate instars, but larvae Nos. 4 and 5 emerged as imagines on 3.vii. and 27.vi., having taken 99 and 91 days respectively from oviposition to emergence. The breeding record of these two larvae is tabulated in Table I.

The morphological data regarding larval development is derived from larvae 4 and 5. Larval length was measured from the anterior border of head (excluding the antennae) to the tip of the anal appendages. The terminology for the larval labium follows CORBET (1953).

DEVELOPMENT

Oviposition and egg : Oviposition occurs in temporary perennial ponds at the onset of S. W. monsoons. Many copulating pairs perch on the vegetation surrounding these water bodies. Egg laying was also observed in slow running marshy streams during autumn and summer. The unaccompanied female lays the eggs near the margins.

Eggs when released are dirty white but become yellow within 24 hours. They form a gelatinous substance as soon as they come in contact with water. Oval, length varies 0.272 to 0.315 mm.

Larval development : The prolarva (instar I) has a very short duration. The morphological changes from instar II to XIII are described below. The principal larval changes are : summarised in Table II.

Head : During the larval development of *O. sabina sabina* the shape of the head changes gradually from instar II to VII, when it attains the characteristic shape of the genus. In instar II the head is broadly triangular with anterodorsally placed bead-like eyes. As development proceeds it becomes squarish with a number of setae developing on the surface. In each instar the size of the head increases by 10 to 20 percent.

Table—I

Duration of development in *ORTHETRUM SABINA SABINA*

Eggs collected on 26.3.1976

Duration of egg stage 10 days

Eggs hatched on 05.4.1976

Instar	Larva 4 (duration in days)	Larva 5 (duration in days)
II	3	4
III	3	3
IV	6	5
V	9	7
VI	5	6
VII	6	6
VIII	10	7
IX	7	7
X	7	5
XI	7	5
XII	9	8
XIII	17	17
Emergence	3.7.1976 (♂)	27.6.1976 (♂)
Total number of days (from oviposition to emergence)	99	91

Antennae : The antenna becomes four-segmented in instar IV due to the division of first flagellar segment (Fig. 8), it again gains one more flagellar segment in instar V and become six-segmented in instar VI due to further division of the basal flagellar segment (Fig. 13). The final complement of seven segments is attained by instar VII (Fig. 17); thereafter it increases in length and setae are added on segments upto instar XIII.

Labium : From instar II to XIII the general shape of the labium does not change much and remains characteristically libellulid in type. Major changes occur only in the increase of number of premental and palpal setae and the number of of crenations and setae at the distal margin of prementum and palpus.

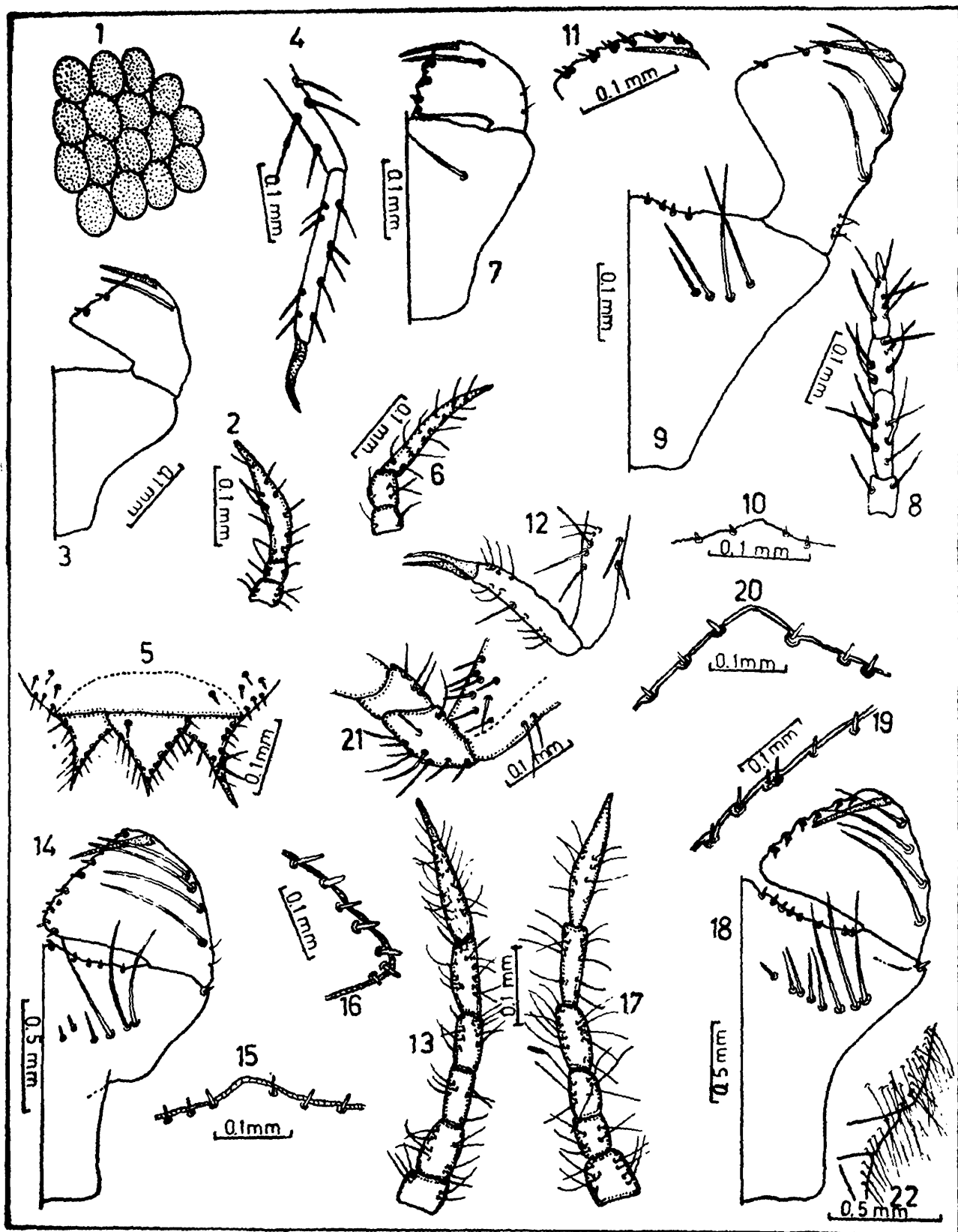
Premental setae : Their number rises to 4+4 in IV instar (Fig. 9) with the addition of setae mesially and laterally (Fig. 14), and it rises to 8+8 in instar VI (Fig. 18), with the

Table—II
Summary of morphological development of *Orthetrum sabina sabina*

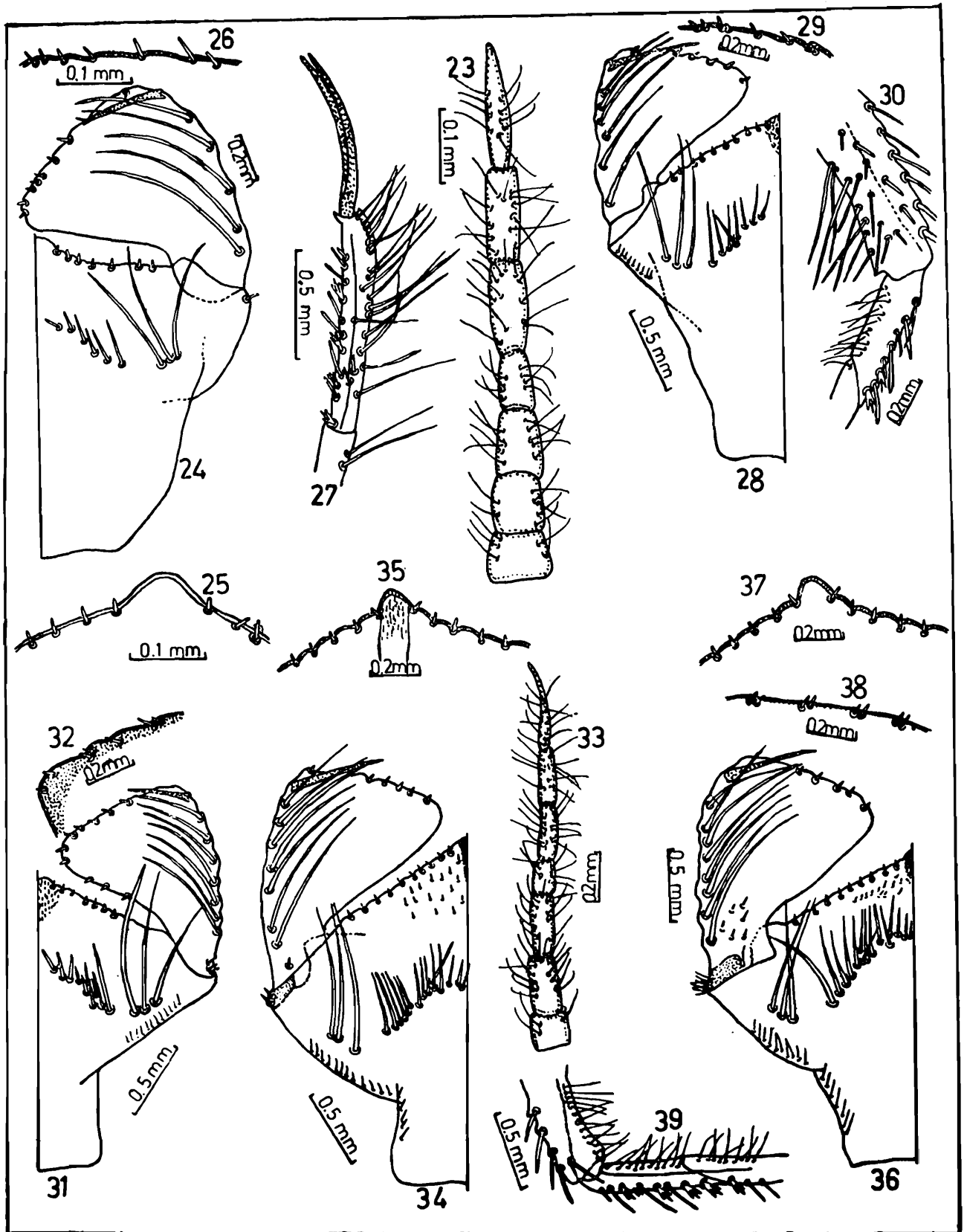
Instar	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
Antennal segments		3	3	4	5	7	7	7	7	7	7	7	7
*Premental setae	(—)	1+1	4+4 (4+3)	6+5	8+8 (7+8)	9+9	11+10	12+12 (11+11)	13+13	16+16 (16+15)	18+18	19+19	
*Palpal setae	1&1	1&1	3&3	4&4 (3&3)	4&4	5&5	6&6 (5&5)	7&7	7&7 (7&6)	7&7	8&8	8&8	
Tarsal segments	1	1	1	2	3	3	3	3	3	3	3	3	
Abdominal segments covered with wing-sheaths	(—)	(—)	(—)	(—)	$\frac{1}{2}$	1	$1\frac{1}{2}$	$2\frac{1}{2}$	$3\frac{1}{2}$	$4\frac{1}{2}$	$5\frac{1}{2}$	$6\frac{1}{2}$	
Anal cerci	(—)	(—)	(—)	(—)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	
Body length (in mm) including anal-appendages	1.12	2.02	2.72	3.24	4.75	5.20	6.47	9.24	11.50	14.20	16.34	19.80	

*Variations in number of setae in two larvae have been given within brackets

(+) present ; (—) absent



Figs. 1—22. (1) The eggs ; (2-5) 2nd instar larva ; (2) antenna ; (3) labium ; (4) tibial comb and tarsi ; (5) anal appendages ; (6-7) 3rd instar larva ; (6) antenna ; (7) labium ; (8-12) 4th instar larva ; (8) antenna ; (9) labium ; (10) enlarged view prementum ; (11) enlarged view palpus ; (12) tibial comb and tarsi ; (13-16) 5th instar larva ; (13) antenna ; (14) labium ; (15) enlarged view prementum ; (16) enlarged view palpus ; (17-22) 6th instar larva ; (17) antenna ; (18) labium ; (19) enlarged view prementum ; (20) enlarged view palpus ; (21) tibial comb and tarsi ; (22) enlarged view 9th and 10th abdominal segments.



Figs. 23—39. (23-27) 7th instar larva ; (23) antenna ; (24) labium ; (25) enlarged view prementum ; (26) enlarged view palpus ; (27) tibial comb and tarsi ; (28-30) 8th instar larva ; (28) labium ; (29) enlarged view distal margin palpus ; (30) enlarged view tibial comb and tarsi ; (31 & 32) 10th instar larva ; (31) labium ; (32) enlarged view distal margin palpus ; (33-35) 11th instar larva ; (33) antenna ; (34) labium ; (35) enlarged view distal margin prementum ; (36-39) 12th instar larva ; (36) labium ; (37) enlarged view distal margin prementum ; (38) enlarged view distal margin palpus ; (39) tibial comb and tarsi.

addition of 2 inretcalated setae. In instar VII, number rises to 9+9 (Fig. 24), due to addition of a small seta mesially on either side ; setae become 11+11 in eighth instar (Fig.28), one more seta is added laterally in ninth instar, while 3 setae are added mesially in eleventh instar. From instar VII (Fig. 24) onwards the 3 lateral setae are larger than, and separate, from the rest.

Palpal setae : The number increases to 3 & 3 in instar IV by addition of 2 setae basally (Fig. 9). In instar V, another seta is added basally. One more basal seta is added in instar VII (Fig. 24). In instar VIII, one seta is further added, on either side, in inter-polar position. The final complement of 8 & 8 is attained in instar XII (Fig. 36).

Median lobe ; It is almost straight and lacks crenations and piliform setae in instar II, but subsequently becomes curved and faint crenations are formed at the distal margin. From instar II onwards piliform setae arise from the distal margin. Later these setae increase rapidly (Figs. 10, 15, 20, 25 & 35) and by instar X they become numerous.

Palpus : In instar II the distal margin is formed into very faint crenations with 2 spiniform setae ; as the development proceeds the crenations become more distinct each provided a single or paired spiniform setae (Figs. 11, 16, 19, 26, 29 & 38).

Abdominal spines : Mid-dorsal abdominal spines on segments 4 to 8, become distinct after instar IX. Lateral abdominal spines are present on segments eight and nine in all instars.

Anal appendages : Median epiproct and paired lateral paraprocts are almost of the same length. Anal cerci increase in size from instar VI.

Coloration : When hatched larvae are pale yellowish. From instar II to VII they become brownish ; as the development proceeds they become darker, the anterior abdominal segments being pale yellowish while the posterior ones are sepia coloured both on dorsal and ventral sides.

Biology : *O. sabina sabina* is common around ponds, lakes and small streams in fields and thick jungles. Adults are on the wing almost throughout the year. They are commonly observed making short but fast flights from one bush to another.

Larvae of *O. sabina sabina* occur both in static as well as lentic aquatic biotopes, viz., temporary monsoon and perennial ponds, and slow running streams. The biology of *O. sabina sabina* has been discussed by me in earlier publications (KUMAR, 1979, 1981 & 1985). From studies in the laboratory and field, the observations indicate that it is multivoltine at Dehra Dun, being able to complete 3 larval generations in a year. Larval cohorts overlap slightly but there are 3 periods of emergence and oviposition occurring generally in the warmer months of the year. The larval duration in each summer generation (March to June and June to September) is approximately 90 days, whereas that of the winter generation (October to May) is prolonged to about 200 days (KUMAR, *l.c.*)

SUMMARY

Orthetrum sabina sabina has been reared from egg to adult. The principal changes in external morphology during larval development and characters which are helpful in distinguishing various instars have been described. Seasonal development has been studied in the field.

Key words : Larval development dragonfly/Seasonal development of *Orthetrum sabina* (Drury).

ACKNOWLEDGEMENTS

My sincere thanks are due to Dr. B. S. Lamba, acting Director, Zoological Survey of India (the then Officer-in-Charge, Zoological Survey of India, Dehra Dun), and Dr. Asket Singh, Joint Director, Zoological Survey of India, Madras, for permission to undertake the present study, laboratory facilities and constant encouragement.

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CESTODES OF DOMESTIC FOWL AT VISAKHAPATNAM
WITH DESCRIPTION OF A NEW SPECIES OF
RAILLIETINA (*RAILLIETINA*)

By

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INTRODUCTION

Studies on helminth parasites of domestic fowl (*Gallus gallus domesticus*) have been receiving attention from a long time. A number of cestode parasites have been reported from it at various parts of the world. Most of these species are cosmopolitan in distribution and well known. In the present study on cestodes of domestic fowl at Visakhapatnam, a new species of the genus *Raillietina* (*Raillietina*) has been encountered.

MATERIALS AND METHODS

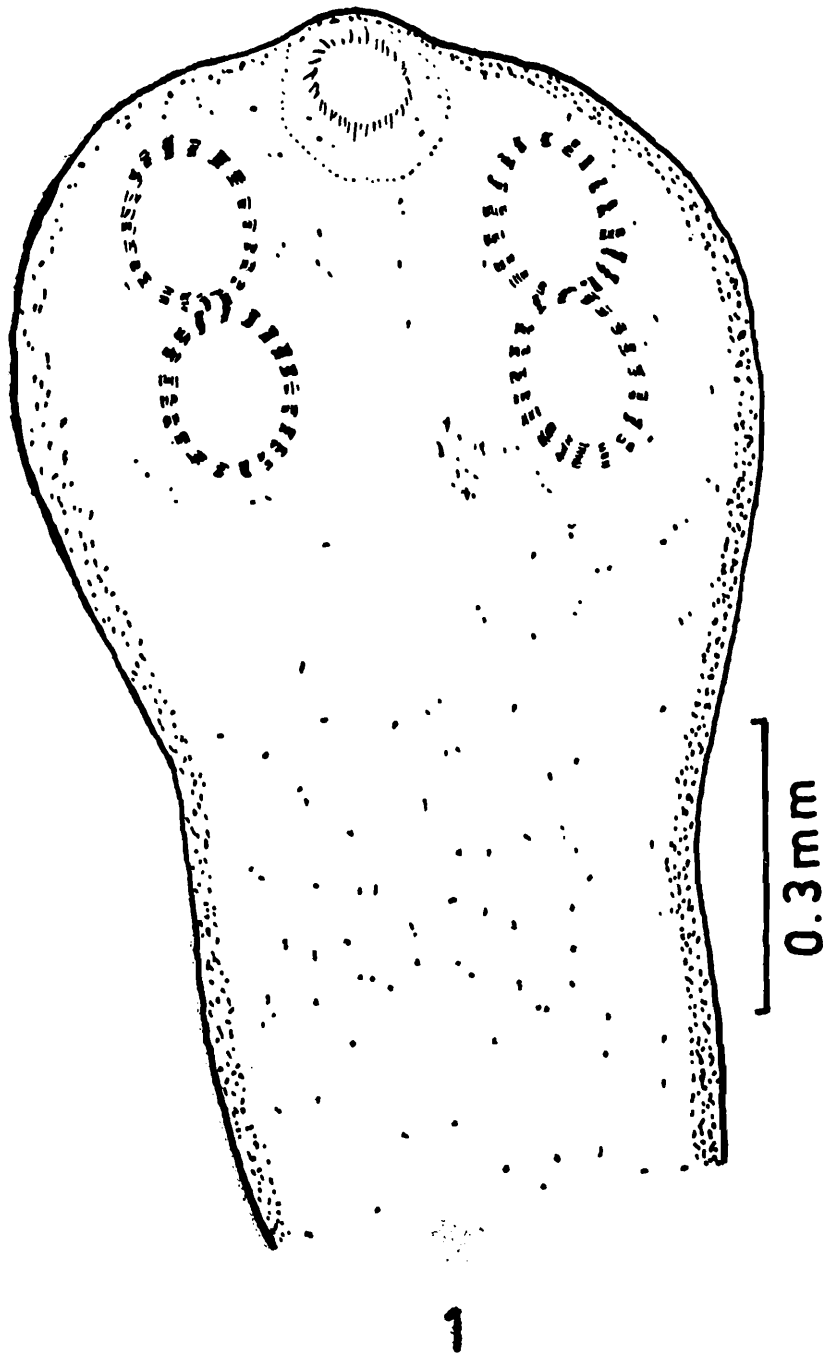
The intestine of the domestic fowls were procured from the locally poultry market and also from the cooking establishments of the campus hostels of the Andhra University. The intestines were opened in saline water in troughs and are lightly shaken in 1% Ringer's solution and the parasites were taken out. A number of whole mounts were prepared and stained with alum carmine. Camera lucida sketches were drawn. All measurements recorded in millimetres (mm).

***Raillietina* (*Raillietina*) *hanumantharaoi* n. sp.**

(Figs. 1-3)

Ten specimens of *Raillietina* (*Raillietina*) *hanumantharaoi* n.sp. could be obtained, associated with *R. (R.) echinobothrida*, *R. (R.) tetragona* and *R. (Skrjabinia) cesticillus* from a number of domestic fowls examined from Visakhapatnam.

R. (R.) echinobothrida (Mégnin, 1881), *R. (R.) tetragona* (Molin, 1858) and *R. (S.) cesticillus* (Molin, 1858) are identical with the previous descriptions.



Figs. 1-3. Camera lucida sketches of *R. (R.) hanumantharaoi* n. sp.

Fig. 1. Scolex.

The worms are pale white in colour and medium sized, measuring 250-280 in length and 0.08-3.76 in width. Scolex club-shaped, well developed and measures 0.816-0.896 in diameter. Rostellum measures 0.128-0.144 in diameter and armed with double rows of rostellar hooks. The hooks are

40-45 in each row and of same size, measuring 12-15 μm in length. Suckers are round and measure 0.160-0.176 in diameter. Suckers armed with 8-11 rows of minute hooks.

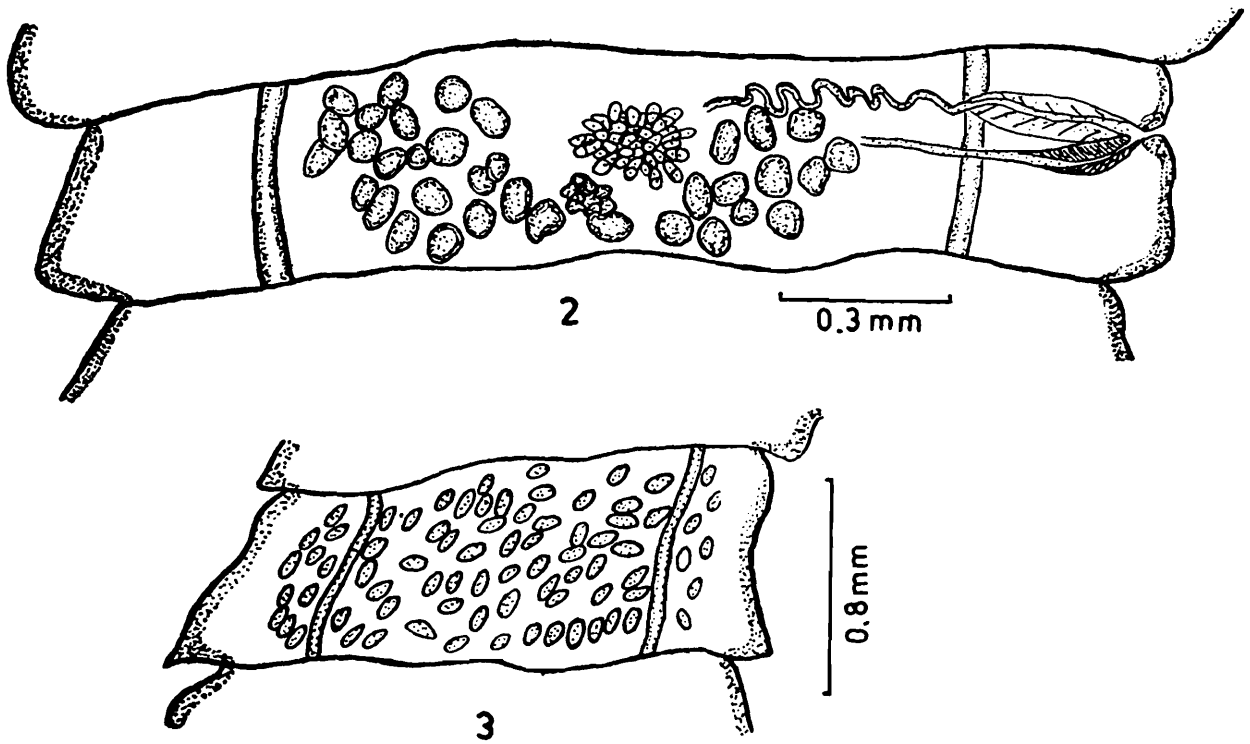


Fig. 2. Mature proglottid.

Fig. 3. Gravid proglottid.

Neck region long and measures 2.88-3.69 in length and 0.432-0.554 in width, proglottids craspedote in nature. All proglottids broader than long. Immature proglottids measure 0.080-0.176 in length and 0.688-0.880 in width. Mature proglottids broader measuring 0.192-0.320 in length and 1.040-1.696 in width. Gravid proglottids measure 0.48-1.07 in length and 1.728-3.760 in width. Genital pore unilateral and open in the anterior margin of the proglottid.

Osmoregulatory canals are lateral in position, dorsal and ventral canals are same in size, and measure 0.016-0.024 in diameter.

Testes round to oval in shape, 25-37 in number, distributed in between the osmoregulatory canals and more number to aporal side (18-24). Testes measure 0.064-0.128 in diameter. Vas deferens is a highly coiled tube. Cirrus sac very prominent, muscular and spindle shaped. Cirrus sac crosses the osmoregulatory canals and opens in the anterior margin

of the proglottid. Cirrus sac measures 0.240-0.448 in length and 0.0644-0.1120 in width and armed.

Ovary fan-shaped, situated in the middle of the proglottid and deeply lobulated. Ovary measures 0.192-0.608 in diameter. Vitelline gland a compact mass, post-ovarian and slightly aporal to the ovary. Vitelline gland measures 0.080-0.096 in diameter. Vagina is a thin tube, but becomes muscular before reaching the genital atrium and opening out, just adjacent to the cirrus opening into the common genital atrium. Vagina measures 0.064-0.080 in width at the base of genital atrium. Common genital atrium opens out by common genital opening.

Gravid proglottids are completely packed with uterine capsules, each capsule containing 8-12 eggs. Egg elliptical in shape and measures 0.012-0.019 in diameter.

DISCUSSION

There are a few species of *Raillietina* (*Raillietina*) reported from fowl—*R. (R.) echinobothrida* (Méglin, 1881); *R. (R.) dattai* Sinha, 1960; *R. (R.) tetragona* (Molin, 1858) and *R. (R.) shantungensis* Winfield et Chang, 1936.

The scolex of the present form is very big when compared to all other species of *Raillietina* (*Raillietina*) described. The present form differs from *R. (R.) echinobothrida*, in size of scolex, suckers and cirrus pouch, position of genital opening and number of testes and eggs; from *R. (R.) dattai* in the size of scolex, rostellar hook length, number of testes and position of genital opening; from *R. (R.) tetragona* size of scolex, suckers, rostellar hooks, cirrus pouch and number of testes; from *R. (R.) shantungensis* in length of strabila, size of scolex, suckers, rostellum, cirrus sac, number of testes and eggs and position of genital opening.

Raillietina (*Raillietina*) *loeweni* Bartel and Hansen, 1964 and *R. (R.) leiopoeae* Johnston et Clark, 1948 are the two forms with bigger scolecies but the present form differs from these two forms in all other characters like number of testes and eggs and other measurements. The present form shows slight

Comparative chart of measurements of the closely related species with those of new species of *Raillietina* (*Raillietina*)

	Present study	<i>R. (R.) echinobothrida</i>	<i>R. (R.) dattai</i>	<i>R. (R.) tetragona</i>	<i>R. (R.) shantungensis</i>	<i>R. (R.) loeweni</i>	<i>R. (R.) leiopoeae</i>	<i>R. (R.) korkei</i>
Strobila :								
Length	250-280	120-150	150-200	250-335	103	370-740	3-6	164
Width	0.08-3.76	1.5-4.0	2-3	1.7-4.0	4.0	1.85-2.44	—	2.0
Scolex	0.816-0.896	0.25-0.55	0.4	0.17-0.35	0.224	0.725-0.827	0.65	0.2
Rostellum	0.128-0.144	0.10-0.15	0.087×0.062	0.05-0.06	0.076	0.006-0.013	0.24-0.28	0.13
Rostellar hook size	12-15μm	0.01-0.013	0.008-0.01	0.006-0.008	0.014	0.007-0.008	0.039-0.052	0.018-0.020
Suckers	0.16-0.176	0.12-0.20	0.148-0.156	0.09-0.11	0.069	0.259-0.301	0.16	0.06-0.07
Neck width	0.432-0.554	0.34-0.48	0.28	0.08-0.10	—	—	—	—
Testes No.	25-37	22-30	32-40	20-30	43-57	45-70	22-23	24
Diameter of testes	0.064-0.128	0.096-0.112	0.032-0.08	0.048-0.064	—	0.036-0.062	—	0.035
Cirrus sac	0.24-0.448	0.149-0.163	0.272-0.320× 0.08-0.096	0.075-0.1	0.189	0.11-0.137× 0.072-0.091	0.1-13× 0.06-0.07	0.105-0.11× 0.05
Ovary	0.192-0.608	0.4-0.8× 0.28-0.32	0.27-0.32	0.24-0.27	—	—	—	—
Vitellaria	0.08-0.096	0.08-0.11	0.112-0.128	0.08-0.128	—	—	—	—
Eggs in	8-12	3-8	6-12	6-12	1-5	1-5	21-26	6-9
Diameter of egg	0.012-0.019	0.073-0.077	0.029-0.032	0.057-0.063	0.027-0.038	0.06-0.065	—	0.018×0.014

resemblances to *R. (R.) korkei* Joyeux et Houdemer, 1927 in the length of the worm, rostellum diameter and number of eggs in the uretine capsule. But its scolex is very small being 0.2 in diameter, whereas the present specimens scolexes measure 0.8-0.9 in diameter. It also differs in the width of the strobila, suckers diameter and size of the cirrus pouch and testes.

The present specimen is compared with all the above mentioned species and a comparative table is given below. Taking all these differences into consideration it is proposed to describe this as a new species of *Raillietina* (*Raillietina*) and named it as *Raillietina* (*Raillietina*) *hanumantharaoi* n.sp.

The new species, *R. (R.) hanumantharaoi* is named in honour of our beloved teacher, Dr. K. Hanumantha Rao, Professor of Zoology, Andhra University, Waltair.

Note : Specimens were deposited in the Department of Zoology, Andhra University, Waltair (R. No. SR/84/2).

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AVIFAUNA OF SHOLAPUR DISTRICT (MAHARASHTRA)
—A SEMI-ARID BIOTOPE

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INTRODUCTION

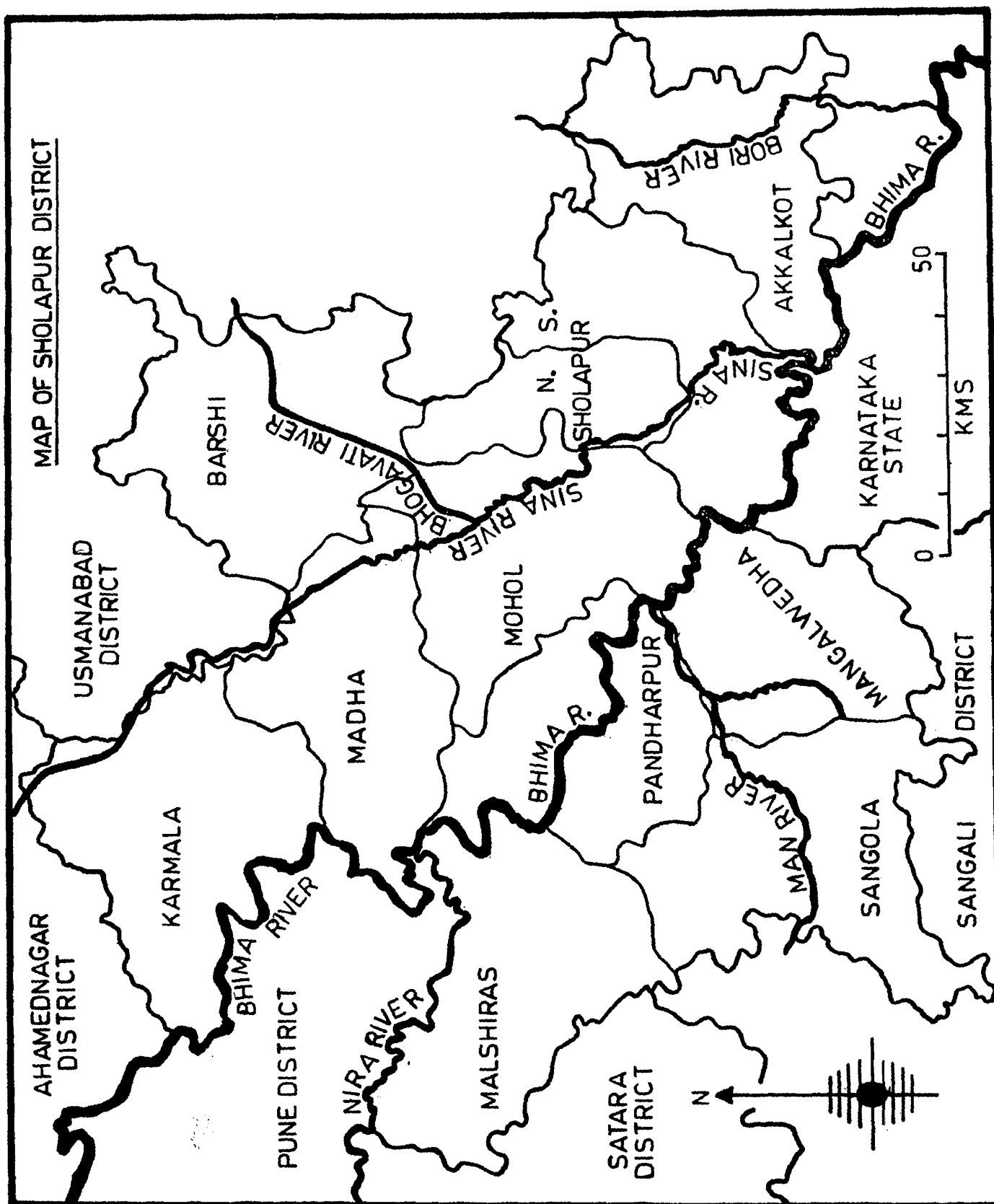
A survey of avifauna of Sholapur District (Maharashtra) was under-taken in the years 1978 (November,) 1980 (January-February) and 1983 (August-September). During this survey occurrence of different species of birds was recorded with special reference to their abundance in the 10 talukas of this district (Map 1). Besides, 16 species of birds were collected and deposited in the collections of the Zoological Survey of India, Western Regional Station, Pune. For each taluka, observation and collection spots were randomly selected—such as hilly area, plain barren land, agricultural field, road side, shrub forest, water bodies, streams, rivers and combination of these.

TOPOGRAPHY, CLIMATE AND VEGETATION

District Sholapur is situated in the northeastern part of Maharashtra State ($17^{\circ} 10'N$ & $18^{\circ} 32'N$ latitude and $74^{\circ} 42'E$ & $76^{\circ} 15'E$ longitude). It lies entirely in the basins of the Nira, Bhima, Sina, Man and Bhogawati rivers and their tributaries. The district terrain is formed of gently undulating plains which are generally 450 to 500 meters above the sea level. Some areas are hilly rising upto 600 meters.

The climate of the district is characterised by general dryness in the major part of the year. The cold season is from December to middle of February, followed by the hot

season which lasts upto May. June to September is the south-west monsoon season. The maximum day temperature varies from 25°C in winter to 40.5°C in summer. The average



Map 1.

annual precipitation varies from 300 mm to 600 mm and its distribution is unpredictable. During the hot season, all the rivers are fordable. Even the main river Bhima breaks into a number of stagnant pools of water just ankle-deep. However, during the peak of monsoon, not only the rivers but also the seasonal feeder streams are flooded, though for a short span of time.

The district lies in the semi-arid tract of the Deccan Plateau. It is barren and deficient in the tree growth except a few sheltered pockets of negligible dimension having some vegetation. Sholapur district occupies 230 sq km of forested area which constitutes only 0.94% of the total area of the district. Vast areas of Karmala taluka have scattered and scanty grass. At present, the forest growth is mainly observed in Malshiras, Sangola and Bershi talukas on the hill slopes and depressions. The district has four types of vegetation—dry thorny, dry deciduous, shrub and grassland. The main trees, shrubs and grasses observed are as follows :—

Bauhinia racemosa (Apta), *Acacia arabica* (Babhul), *Acacia catechu* (Khair) *cordia* sp. (Bhokar), *Zizyphus jujuba* (Bor), *Tamarindus indica* (Tamarind), *Pangamia glabra* (Karanj), *Azadirachta indica* (Neem), *Butea frondosa* (Palas), *Ficus bengalensis* (Banyan), *Albizia lebeck* (Shirish), *Dalbergia sissoo* (Shiasum), *Aegle marmelos* (Bel), *Terminalia crenulata* (Ain), *Anogeissus latifolia* (Dhavda), *Ficus religiosa* (Pimpal), *Phyllanthus emblica* (Awla), *Vitex negundo* (Nirgudi), *Lantana camera* (Ghaneri), *Agave vivipara* (Ghypat), *Carrissa carandus* (Karwand), *Cassia auriculata* (Tarvad), *Euphorbia nerifolia* (Nivdung) and grasses like *Anthistiria ciliata* (Bongruat), *Andropogon* Sp., *Heteropogon* sp., *Ischaemum* sp., and *Eragrostis* sp. (Scientific and common names mentioned from Maharashtra State Gazetteers-Sholapur District, 1977).

OBSERVATION AND RESULTS

A list of 148 bird species in the district with their regionwise abundance and status is given in Table-1. In general, the birds were found to be concentrating in

particular localities on the bank of rivers Bhima, Sina, Man, Bori and Bhogawati. Except Bhima, other rivers get dried up outside the rainy season to number of small ponds where different bird species were noticed. Besides these, better bird life was found in the vicinity of 'pazar tanks' (percolation tanks) like Hipparga lake near Sholapur city, Pathardi tank near Barshi town and Chincholi tank near Sangola village. At Bhimangar, a newly developed colony near Ujani Dam, more than 30 different bird species were seen feeding during day time and many of them roosting at night time (Mahabal, 1986).

Besides the common species of birds like Cattle Egret, Pariah Kite, Blue Rock Pigeon, Roseringed Parakeet, Indian Myna, House Crow, Jungle Crow and House Sparrow other species of birds such as Pond Heron, Indian Shikra, Indian Peafowl, Spotted Dove, Indian Koel, Spotted Owlet, Small Green Bee-eater, Redvented Bulbul and Indian Robin were found in good numbers all over the district. Ashycrowned Finch-Lark and Rufoustailed Finch-Lark were commonly seen occurring throughout the district, particularly at roadsides and on open barren land. The predatory bird species were found comparatively in better number in the district, of which the Red headed Merlin was abundant in Barshi taluka.

The Indian Courser and the Indian Sandgrouse are especially the birds of semi-arid biotope. They are found in fair population all over the district except in Madha, Malshiras and Pandharpur talukas. It is interesting to note that wherever a flock of Indian Sandgrouse was noticed, scattered flocks of Indian Courser were also observed nearby or vice-versa. The other birds of semi-arid biotope like Sociable Lapwing, Grey Shrike, Booted Tree Warbler and Desert Wheatear were seen occasionally or rarely in various talukas.

An important bird species of this semi-arid district is the Great Indian Bustard which has been declared as in 'endangered species' under the 'wildlife (Protection) Act 1972' (vide schedule I, part III : Birds). This bird was noticed

TABLE-1 : A systematic list of birds of Sholapur district showing regionwise abundance and status.

(+++)—Common, (++)—Occasional, (+)—Rare and (—)—Not observed
(R)—Resident, (LM)—Local Migratory and (WM)—Winter Migratory

Sl. No.	Species	Common Name	Taluka										Status
			Kar-mala	Mad-dha	Mal-shiras	Pandh-arpur	Sang-ola	Mangal-vedha	Mo-hol	Bar-shi	Shola-pur	Akkal-kot	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Order : PODICIPEDIFORMES													
Family : PODICIPEDIDAE													
1.	<i>Podiceps ruficollis</i> (Pallas)	Little Grebe	+	++	+	+++	-	-	+	++	++	++	R
Order : PELECANIFORMES													
Family : PHALACROCORACIDAE													
2.	<i>Phalacrocorax carbo</i> (Shaw)	Large Cormorant	-	+	-	++	-	-	-	-	-	-	R
3.	<i>Phalacrocorax niger</i> (Vieillot)	Little Cormorant	-	+	-	++	-	-	-	-	-	-	R
Order : CICONIIFORMES													
Family : ARDEIDAE													
4.	<i>Ardea cinerea</i> Linnaeus	Grey Heron	-	+	-	+	+	-	-	-	-	-	R/LM
*5.	<i>Ardeola grayii</i> (Sykes)	Pond Heron	++	++	++	+++	+	++	++	+++	+++	+++	R
6.	<i>Bubulcus ibis</i> (Linnaeus)	Cattle Egret	++	++	++	+++	+	+	++	+++	+++	+++	R
7.	<i>Egretta intermedia</i> (Wagler)	Median Egret	+	+	-	++	-	-	+	+	-	+	R
8.	<i>Egretta garzetta</i> (Linnaeus)	Little Egret	+	+	+	++	-	+	+	+	+	++	R
9.	<i>Nycticorax nycticorax</i> (Linnaeus)	Night Heron	-	+	-	+	+	-	-	+	+	+	R
10.	<i>Ixobrychus sinensis</i> (Gmelin)	Yellow Bittern	-	+	-	+	-	-	-	-	-	+	R
Family : CICONIIDAE													
11.	<i>Ibis leucocephalus</i> (Pennant)	Painted Stork	-	-	-	-	+	-	-	+	-	-	R/LM
12.	<i>Anastomus oscitans</i> (Boddaert)	Openbill Stork	-	+	-	+	-	-	-	-	+	-	R
13.	<i>Ciconia episcopus</i> (Boddaert)	Whitenecked Stork	+	-	-	+	-	-	-	+	-	-	R
14.	<i>Xenorhynchus asiaticus</i> (Latham)	Blacknecked Stork	-	+	-	+	+	-	-	-	-	-	R/LM

- Table-1 (Contd.)

Sl. No.	Species	Common Name	Taluka										Status
			Kar-mala	Mad-dha	Mal-shiras	Pandh-arpur	Sang-ola	Mangal-vedha	Mo-hol	Bar-shi	Shola-pur	Akkal-kot	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Family : THRESKIOBNIHIDAE													
15.	<i>Threskiornis melanocephala</i> (Latham)	White Ibis	-	-	-	+	-	-	-	-	-	-	R/LM
16.	<i>Pseudibis papillosa</i> (Temminck)	Black Ibis	+	-	-	++	+	-	-	+	-	+	R
17.	<i>Platalea leucorodia</i> Linnaeus	Spoonbill	-	+	-	+	-	-	-	-	-	-	R/LM
Order : ANSERIFORMES													
Family : ANATIDAE													
18.	<i>Tadorna ferruginea</i> (Pallas)	Brahminy Duck	-	+	-	++	-	-	+	+++	+	++	WM
19.	<i>Anas acuta</i> Linnaeus	Pintail	-	+	-	++	+	-	+	++	++	-	WM
20.	<i>Anas crecca</i> Linnaeus	Common Teal	-	-	-	+	-	-	-	++	+	-	WM
21.	<i>Anas poecilorhyncha</i> J.R.Forstor	Spotbill or Grey Duck	+	+	-	+	+	-	+	++	++	+	R
22.	<i>Anas querquedula</i> Linnaeus	Garganey Teal	-	-	-	-	+	-	-	+	+	-	WM
23.	<i>Anas clypeata</i> Linnaeus	Shoveller	-	-	-	+	+	-	-	+	+	-	WM
24.	<i>Nettapus coromandelianus</i> (Gmelin)	Cotton Teal	-	+	-	+	+	-	-	++	+	-	R
Order : FALCONIFORMES													
Family : ACCIPITRIDAE													
*25.	<i>Elanus caeruleus vociferus</i> (Latham)	Blackwinged Kite	++	+	+	+	+	-	+	+	+++	++	R/LM
26.	<i>Milvus migrans</i> (Boddaert)	Pariah Kite	++	+++	++	+++	+	++	++	+++	+++	+++	R
27.	<i>Haliastur indus</i> Boddaert	Brahminy Kite	-	-	+	+	-	-	-	-	+	+	R
*28.	<i>Accipiter badius dussumieri</i> (Temminck)	Indian Shikra	++	+	++	++	+	+	+	+++	++	+++	R
29.	<i>Butastur teesa</i> (Franklin)	White-eyed Buzzard	+	-	+	+	+	-	+	+	+	++	R/LM
30.	<i>Spizaetus cirrhatus</i> (Gmelin)	Crested Hawk-Eagle	+	-	-	-	-	-	-	+	+	-	R
31.	<i>Hieraaetus fasciatus</i> (Vieillot)	Bonelli's Hawk-Eagle	+	-	+	-	-	-	-	-	+	+	R
32.	<i>Hieraaetus pennatus</i> (Gmelin)	Booted Hawk-Eagle	+	-	-	-	-	-	-	+	+	-	WM

Table-1 (Contd.)

Sl. No.	Species	Common Name	Taluka										Status
			Kar-mala	Ma-ddha	Mal-shi-ras	Pan-dhar-pur	Sang-ola	Man-gal-vedha	Mohol Bar-shi	Shola-pur	Akkal-kot		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
33.	<i>Aquila rapax</i> (Temminck)	Twany Eagle	-	-	-	-	+	-	-	+	++	+	LM
34.	<i>Torgos calvus</i> (Scopoli)	King Vulture	-	-	+	-	-	-	-	-	-	-	R
35.	<i>Gyps indicus</i> (Scopoli)	Longbilled Vulture	-	-	+	-	-	-	-	-	+	-	R
36.	<i>Gyps bengalensis</i> (Gmelin)	Whitebacked Vulture	+	+	++	++	-	+	+	++	++	++	R
37.	<i>Neophron percnopterus</i> (Linnaeus)	White Scavenger Vulture	-	-	+	+	-	-	-	++	+	++	R
38.	<i>Circus macrourus</i> (S.G. Gmelin)	Pale Harrier	+	+	++	-	+	-	-	+	+	++	WM
39.	<i>Spilornis cheela</i> (Latham)	Crested Serpent Eagle	-	+	-	-	-	-	-	+	+	++	R
Family : FALCONIDAE													
*40.	<i>Falco chicquera</i> Daudin	Redheaded Merlin	-	-	-	+	-	+	+	+++	++	+	R
*41.	<i>Falco tinnunculus</i> Linnaeus	Kestrel	+	+	+	+	+	-	+	+	++	++	WM
Order : GALLIFORMES													
Family : PHASIANIDAE													
42.	<i>Francolinus pondicerianus</i> (Gmelin)	Grey Partridge	-	+	-	+	-	+	+	+	+	+	R
43.	<i>Perdicula argoondah</i> (Sykes)	Rock Bush Quail	-	-	+	-	-	-	-	+	-	-	R
44.	<i>Gallus sonneratii</i> Temminck	Grey Junglefowl	-	+	-	+	-	-	-	+	-	+	R
45.	<i>Pavo cristatus</i> Linnaeus	Indian Peafowl	+	++	-	++	-	+	++	++	+	++	R
Order : GRUIFORMES													
Family : RALLIDAE													
46.	<i>Amaurornis phoenicurus</i> (Pennant)	White-breasted Waterhen	+	+	-	++	+	-	+	+	+	++	R
47.	<i>Porphyrio porphyrio</i> (Linnaeus)	Purple Moorhen	-	-	-	+	-	-	-	+	-	+	R
48.	<i>Fulica atra</i> Linnaeus	Coot	-	-	-	+	-	-	-	++	-	-	WM

Table-1 (Contd.)

Sl. No.	Species	Common name	Taluka										Status
			Kar-mala	Mad-dha	Mal-shi-ras	Pan-dhar-pur	Sang-ola	Man-gal-vedha	Mohol	Bar-shi	Shola-pur	Akkal-kot	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Family : OTIDIDAE													
49.	<i>Ardeotis nigriceps</i> (Vigors)	Great Indian Bustard	+	-	-	-	-	-	-	++	-	-	R/LM
Order : CHARADRIIFORMES													
Family : JACANIDAE													
50.	<i>Hydrophasianus chirurgus</i> (Scopoli)	Pheasant-tailed Jacana	-	+	-	+	-	-	-	+	+	+	R
Family : CHARADRIIDAE													
Sub-family : CHARADRIINAE													
51.	<i>Vanellus gregarius</i> (Pallas)	Sociable Lapwing	+	-	-	-	-	-	-	+	-	+	WM
52.	<i>Vanellus indicus</i> (Boddaert)	Redwattled Lapwing	++	++	++	+++	+	+	++	-	++	++	R
53.	<i>Vanellus malabaricus</i> (Boddaert)	Yellow-wattled Lapwing	-	-	-	+	-	-	-	+++	++	+	R/LM
54.	<i>Tringa ochropus</i> Linnaeus	Green Sandpiper	-	-	-	+	-	-	-	+	+	+	WM
55.	<i>Tringa hypoleucos</i> Linnaeus	Common Sandpiper	+	-	-	+++	-	-	+	++	-	+	WM
Family : ROSTRATULIDAE													
56.	<i>Rostratula benghalensis</i> (Linnaeus)	Painted Snipe	-	+	-	+	-	-	-	+	-	-	WM
Family : RECURVIROSTRIDAE													
57.	<i>Himantopus himantopus</i> (Linnaeus)	Blackwinged Stilt	+	++	-	+++	+	+	+	+	++	+++	WM
Family : GLAREOLIDAE													
*58.	<i>Cursorius coromandelicus</i> (Gmelin)	Indian Courser	+	-	-	-	++	+	++	++	+	+++	R
Family : LARIDAE													
59.	<i>Sterna aurantia</i> J. E. Gray	Indian River Tern	-	+	-	+	-	-	+	+	-	-	R/LM
Order : COLUMBIFORMES													

Table-1 (Contd.)

Sl. No.	Species	Common Name	Taluka											Status
			Kar-mala	Ma-ddha	Mal-shi-ras	Pan-dhar-pur	Sang-ola	Man-gal-vedha	Mohol	Barshi	Shola-pur	Akkal-kot		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	
Family : PTEROCLIDIDAE														
*60.	<i>Pterocles exustus erlangeri</i> (Neumann)	Indian Sandgrouse	+	-	-	-	++	+	++	+++	++	+++	R/LM	
Family : COLUMBIDAE														
61.	<i>Treron phoenicoptera</i> (Latham)	Green Pigeon	-	-	-	+++	-	-	+	+	+	++	R/LM	
62.	<i>Columba livia</i> Gmelin	Blue Rock Pigeon	+	++	++	+++	++	+	++	++	+++	+++	R	
63.	<i>Streptopelia decaocto</i> (Frivaldszky)	Ring Dove	+++	+++	+	++	++	+	+	++	++	++	R/LM	
64.	<i>Streptopelia chinensis</i> (Scopoli)	Spotted Dove	+	++	+	++	-	-	+	++	+	++	R	
65.	<i>Streptopelia senegalensis</i> Linnaeus	Little Brown or Senegal Dove	+	-	+	+	++	+	++	+	+	+	R	
Order : PSITTACIFORMES														
Family : PSITTACIDAE														
*66.	<i>Psittacula krameri</i> (Scopoli)	Roseringed Parakeet	++	++	++	+++	++	++	++	+++	+++	+++	R	
67.	<i>Psittacula cyanocephala</i> (Linnaeus)	Blossom-headed Parakeet	+	+	+	+++	-	-	+	+	++	+++	R	
Order : CUCULIFORMES														
Family : CUCULIDAE														
*68.	<i>Clamator jacobinus serratus</i> (Sparrman)	Pied Crested Cuckoo	-	+	-	++	-	-	-	-	+	+	R	
69.	<i>Cuculus varius</i> Vahl	Hawk-Cuckoo or Brainfever Bird	+	+	+	++	+	+	+	+	+	++	LM/ WM	
70.	<i>Eudynamys scolopacea</i> (Linnaeus)	Koel	++	++	++	+++	++	+	++	++	++	+++	R	
71.	<i>Taccocua leschenaultii</i> Lesson	Sirkeer Cuckoo	-	-	-	+	-	-	-	-	-	+	R/LM	
72.	<i>Centropus sinensis</i> (Stephens)	Crow-Pheasant	+	++	+	+++	+	+	++	+	++	+++	R	

Table-1 (Contd.)

Sl. No.	Species	Common Name	Taluka										Status
			Kar-mala	Ma-ddha	Mal-shi-ras	Pan-dhar-pur	Sang-ola	Man-gal-vedha	Mohol	Barshi	Shola-pur	Akkal-kot	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Order : STRIGIFORMES													
Family : STRIGIDAE													
Subfamily : TYTONINAE													
73.	<i>Tyto alba</i> (Scopoli)	Barn Owl	-	-	-	+	-	-	-	+	-	+	R
Subfamily : STRIGINAE													
74.	<i>Bubo bubo</i> (Linnaeus)	Horned or Eagle-Owl	+	-	-	+	-	-	-	+	+	+	R
75.	<i>Athene brama</i> (Temminck)	Spotted Owlet	++	++	++	+++	++	+	++	++	++	+++	R
Order : CAPRIMULGIFORMES													
Family : CAPRIMULGIDAE													
76.	<i>Caprimulgus asiaticus</i> Latham	Little Nightjar	+	+	-	++	+	-	+	++	+	++	R
Order : APODIFORMES													
Family : APODIDAE													
Subfamily : APODINAE													
77.	<i>Apus affinis</i> (J. E. Gray)	House Swift	+	+	-	++	-	-	+	++	+	++	R
78.	<i>Cypsiurus parvus</i> (Lichtenstein)	Palm Swift	-	-	-	+	-	-	-	-	+	-	R
Order : CORACIIFORMES													
Family : ALCEDINIDAE													
79.	<i>Ceryle rudis</i> (Linnaeus)	Pied Kingfisher	+	++	-	++	-	-	++	+	+	+	R/LM
80.	<i>Alcedo atthis</i> (Linnaeus)	Small Blue Kingfisher	+	++	+	++	++	+	+	++	+	++	R
81.	<i>Halcyon smyrnensis</i> (Linnaeus)	Whitebreasted Kingfisher	++	++	+	+++	+	+	++	++	++	++	R

Table-1 (Contd.)

Sl. No.	Species	Common name	Taluka										Status
			Kar-mala	Mad-dha	Mal-shi-ras	Pan-dhar-pur	Sang-ola	Man-gal-vedha	Mohal	Bar-shi	Shola-pur	Akkal-kot	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Family : MEROPIDAE													
*82.	<i>Merops orientalis orientalis</i> Latham	Indian Small Green Bee-eater	++	++	++	+++	++	++	++	+++	++	+++	R
Family : CORACIIDAE													
*83.	<i>Coracias benghalensis indica</i> Linnaeus	Southern Roller	++	+	-	+++	+	+	+	++	+	+++	LM
Family : UPUPIDAE													
84.	<i>Upupa epops</i> Linnaeus	Hoopoe	+	+	-	++	+	+	++	+	++	++	R/LM
Family : BUCEROTIDAE													
85.	<i>Tockus birostris</i> (Scopoli)	Grey Hornbill	+	+	+	++	+	+	+	+	+	++	R
Order : PICIFORMES													
Family : CAPITONIDAE													
86.	<i>Megalaima viridis</i> (Boddaert)	Small Green Barbet	-	+	-	++	+	-	-	+	+	+	R
87.	<i>Megalaima haemacephala</i> (Muller)	Crimsonbreasted Barbet	+	++	+	+++	++	+	++	++	++	+++	R
Family : PICIDAE													
Subfamily : JYNGINAE													
88.	<i>Jynx torquilla</i> Linnaeus	Wryneck	-	-	-	+	-	-	-	-	-	-	WM
Subfamily : PICINAE													
89.	<i>Picoides mahrattensis</i> (Latham)	Yellowfronted Pied or Mahratta Woodpecker	-	+	-	++	-	-	+	+	+	++	R
Order : PASSERIFORMES													
Family : ALAUDIDAE													
90.	<i>Mirafra erythroptera</i> Blyth	Redwinged Bush Lark	-	+	-	+	-	-	-	+	+	+++	R

Table-1 (Contd.)

Sl. No.	Species	Common Name	Taluka										Status
			Kar-mala	Ma-ddha	Mal-shi-ras	Pan-dhar-pur	Sang-ola	Man-gal-vedha	Mohol Barshi	Shola-pur-	Akkal-kot		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
91.	<i>Eremopterix grisea</i> (Scopoli)	Ashycrowned Finch-Lark	++	+++	++	++	+++	++	+++	++	++	++	R
92.	<i>Ammomanes phoenicurus</i> (Franklin)	Rufoustailed Finch-Lark	++	+++	++	++	+++	++	+++	++	++	++	R
93.	<i>Galerida deva</i> (Sykes)	Sykes Crested Lark	+	+	-	+	+	+	+	-	+	++	R
94.	<i>Alauda gulgula</i> Franklin	Indian Small Skylark	+	+	-	+	-	-	-	-	+	-	R
Family : HIRUNDINIDAE													
95.	<i>Hirundo concolor</i> Sykes	Dusky Crag Martin	+	-	+	-	++	++	+	+	-	+	R
96.	<i>Hirundo rustica</i> Linnaeus	Common Swallow	+	++	+	+++	++	+	++	++	++	++	WM
97.	<i>Hirundo smithii</i> Leach	Wiretailed Swallow	-	-	++	++	-	-	+	+	+	++	R
98.	<i>Hirundo daurica</i> Linnaeus	Straited or Redrumped Swallow	-	+	+	+	-	-	-	+	-	-	R
99.	<i>Delichon urbica</i> (Linnaeus)	House Martin	+	+	+	++	+	-	+	+	+	++	WM
Family : LANIIDAE													
*100.	<i>Lanius excubitor lahtora</i> (Sykes)	Indian Grey Shrike	+	+	+	++	+	+	+	+	++	++	R/LM
101.	<i>Lanius vittatus</i> Valenciennes	Baybacked Shrike	-	+	++	+++	+	++	++	++	++	+++	R
102.	<i>Lanius schach</i> Linnaeus	Greybacked Shrike	+	+	+	++	-	+	-	+	++	+	R
Family : ORIOLIDAE													
103.	<i>Oriolus oriolus</i> (Linnaeus)	Golden Oriole	-	+	-	+++	-	+	+	++	++	++	LM
Family : DICRURIDAE													
*104.	<i>Dicrurus adsimilis macrocerus</i> Vieillot	South Indian Black Drongo or King Crow	+	++	+	+++	+	++	++	++	++	+++	R

Table-1 (Contd.)

Sl. No.	Species	Common Name	Taluka										Status
			Kar-mala	Ma-ddha	Mal-shi-ras	Pan-dhar-pur	Sang-ola	Man-gal-vedha	Mohol	Bar-shi	Shola-pur	Akkal-kot	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
105.	<i>Dicrurus caerulescens</i> (Linnaeus)	Whitebellied Drongo	-	-	-	-	-	-	-	++	+	++	R
	Family : STURNIDAE												
106.	<i>Sturnus pagodarum</i> (Gmelin)	Brahminy Maya	+	++	+ +	+++ +	+	++	++	++	++	++	R
107.	<i>Sturnus roseus</i> (Linnaeus)	Rosy Pastor or Rosy Starling	-	-	+	+++ -	-	-	-	+	++	++	WM
*108.	<i>Acridotheres tristis tristis</i> (Linnaeus)	Indian Myna	++	++	+++	+++	++	++	++	+++	+++	+++	R
109.	<i>Acridotheres fuscus</i> (Wagler)	Jungle Myna	-	-	-	++	+	-	-	+	+	++	R
	Family : CORVIDAE												
110.	<i>Corvus splendens</i> Vieillot	House Crow	++	+++	++	+++	+++	++	+++	+++	+++	+++	R
111.	<i>Corvus macrorhynchos</i> Wagler	Jungle Crow	++	++	++	+++	++	++	++	+++	+++	+++	R
	Family : CAMPEPHAGIDAE												
112.	<i>Tephrodornis pondicerianus</i> (Gmelin)	Common Wood Shrike	-	-	-	+	-	-	-	-	-	+	R
113.	<i>Pericrocotus cinnamomeus</i> (Linnaeus)	Small Minivet	-	+	-	++	-	-	-	+	+	++	R
	Family : IRENIDAE												
114.	<i>Aegithina tiphia</i> (Linnaeus)	Iora	+	+	-	++	-	-	+	-	+	++	R
	Family : PYCNONOTIDAE												
115.	<i>Pycnonotus jocosus</i> (Linnaeus)	Redwhiskered Bulbul	-	+	-	++	-	-	+	+	+	++	R
116.	<i>Pycnonotus cafer</i> (Linnaeus)	Redvented Bulbul	+	++	++	+++	++	++	++	++	+++	++	R

Table-1 (Contd.)

Sl. No.	Species	Common Name	Taluka										Status
			Kar-mala	Ma-ddha	Mal-shi-ras	Pan-dhar-pur	Sang-ola	Man-gal-vedha	Mohol	Barshi	Shola-pur	Akkal-kot	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Family : MUSCICAPIDAE													
Subfamily : TIMALIINAE													
*117.	<i>Turdoides caudatus</i> (Dumont)	Common Babbler	+	++	++	+++	+	++	+	+	+	+++	R
118.	<i>Turdoides malcolmi</i> (Sykes)	Large Grey Babbler	+	++	++	++	++	+	++	++	++	+	R
Subfamily : MUSCICAPINAE													
119.	<i>Rhipidura albicollis</i> (Vieillot)	Fantail Flycatcher	-	+	-	++	-	+	+	+	+	++	R
Subfamily : SYLVIINAE													
120.	<i>Prinia subflava</i> (Gmelin)	Plain Wren-Warbler	-	-	-	+	-	-	-	+	+	++	R
121.	<i>Prinia socialis</i> Sykes	Ashy Wren-Warbler	-	+	+	+++	+	+	+	++	++	++	R
122.	<i>Orthotomus sutorius</i> (Pennant)	Tailor Bird	+	+	+	+++	+	+	-	++	++	+++	R
123.	<i>Hippolais caligata</i> (Lichtenstein)	Booted Tree Warbler	-	+	-	++	-	-	-	+	+	+	WM
124.	<i>Sylvia hortensis</i> (Gmelin)	Orphean Warbler	-	-	-	+	-	-	-	-	-	+	WM
125.	<i>Sylvia curruca</i> (Linnaeus)	Lesser Whitethroat	+	++	-	+++	+	+	+	-	-	++	WM
126.	<i>Phylloscopus affinis</i> (Tickell)	Leaf Warbler	-	+	+	++	-	-	-	+	+	+	WM
Subfamily : TURDINAE													
127.	<i>Copsychus saularis</i> (Linnaeus)	Magpie-Robin	+	+	+	+++	++	+	++	+	++	++	R
128.	<i>Phoenicurus ochruros</i> (Gmelin)	Black Redstart	-	-	+	++	-	+	+	-	+	+	WM
129.	<i>Oenanthe deserti</i> (Temminck)	Desert Wheatear	+	-	+	-	+	-	-	-	+	-	WM
130.	<i>Saxicoloides fulicata</i> (Linnaeus)	Black Robin	++	++	+	+++	++	++	++	++	++	+++	R
131.	<i>Monticola solitarius</i> (Linnaeus)	Blue Rock Thrush	-	-	+	++	+	-	-	-	+	+	WM
Family : PARIDAE													

Table-1 (Contd.)

Sl. No.	Species	Common Name	Taluka										Status
			Kar-mala	Mad-dha	Mal-shi-ras	Pan-dhar-pur	Sang-ola	Man-gal-vedha	Mohol	Bar-shi	Shola-pur	Akkal-kot	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Subfamily : PARINAE													
132.	<i>Parus major</i> Linnaeus	Grey Tit	-	+	-	++	+	-	++	+	+	++	R
Family : MOTACILLIDAE													
133.	<i>Anthus similis</i> Jerdon	Rock Pipit	-	-	+	+	-	-	-	+	-	++	R
134.	<i>Motacilla flava</i> Linnaeus	Yellow Wagtail	+	+	+	++	+	+	+	++	+	++	WM
135.	<i>Motacilla caspica</i> (Gmelin)	Grey Wagtail	-	+	-	++	+	+	+	++	++	++	WM
136.	<i>Motacilla alba</i> Linnaeus	White Wagtail	-	-	-	+	-	-	+	+	+	++	WM
*137.	<i>Motacilla maderaspatensis</i> Gmelin	Large Pied Wagtail	+	++	+	+++	++	+	++	+	++	++	R
Family : DICAERIDAE													
138.	<i>Dicaeum erythrorhynchos</i> (Latham)	Tickell's Flowerpecker	+	+	-	++	+	-	+	+	+	++	R
Family : NECTARINIIDAE													
139.	<i>Nectarinia zeylonica</i> (Linnaeus)	Purplerumped Sunbird	-	++	-	+++	+	+	+	+	+	++	R
140.	<i>Nectarinia asiatica</i> (Latham)	Purple Sunbird	+	++	+	+++	+	+	++	++	++	+++	R
Family : ZOSTEROPIDAE													
141.	<i>Zosterops palpebrosa</i> (Temminck)	White-eye	-	+	-	++	-	+	-	+	++	++	R
Family : PLOCEIDAE													
Subfamily : PASSERINAE													
142.	<i>Passer domesticus</i> (Linnaeus)	House Sparrow	++	++	+++	+++	++	+++	+++	+++	+++	+++	R
Subfamily : PLOCEINAE													
143.	<i>Ploceus philippinus</i> (Linnaeus)	Baya Weaver-bird	+	++	++	+++	+	++	+	++	++	++	R/LM

Table-1 (Concluded)

Sl. No.	Species	Common name	Taluka										Status
			Kar-mala	Ma-ddha	Mal-shi-ras	Pan-dhar-pur	Sang-ola	Man-gal-vedha	Mohol	Barshi	Shola-pur	Akkal-kot	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Subfamily : ESTRILDINAE													
144.	<i>Lonchura malabarica</i> (Linnaeus)	Whitethroated Munia	++	++	-	++	-	-	+	+	++	++	R
145.	<i>Lonchura punctulata</i> (Linnaeus)	Spotted Munia	+	-	-	++	-	-	-	+	+	+++	R
Family : FRINGILLIDAE													
Subfamily : CARDUELINAE													
146.	<i>Carpodacus erythrinus</i> (Pallas)	Rosefinch	-	-	-	++	-	-	+	+	+	++	WM
Family : EMBERIZIDAE													
147.	<i>Emberiza buchanani</i> Blyth	Greynecked Bunting	-	-	-	+	-	-	-	-	+	++	WM
148.	<i>Melophus lathami</i> (Gray)	Crested Bunting	-	+	-	++	+	-	-	-	++	++	R

* —Specimens are deposited in the Collections of Zoological Survey of India, Western Regional Station, Pune.

TABLE-2 : *Some communal roosters observed in Sholapur district.*

(+)—Roosting observed, (–)—Roosting not observed

Name of village or town	Name of birds					
	Cattle Egret	Pariah Kite	Roser-inged Parakeet	Indian Myna	House and Jungle Crow	House Sparrow
Pandharpur	+	+	+	+	+	+
Akkalkot	–	–	+	+	+	+
Sangvi Village	+	–	–	–	–	+
Tanda Village	–	–	+	+	+	+
Sholapur City	+	+	+	+	+	+
Barshi town	+	+	+	+	+	+
Bhimanagar	–	–	+	+	+	+
Tembhurni	–	–	–	+	+	+
Akluj	–	–	–	+	+	+
Mohol	–	–	+	+	+	+
Sangola	–	–	+	+	+	+

once near Karmala village (Karmala taluka) and near Nanaj village (Sholapur taluka) in September, 1983. In the district, Government of Maharashtra has declared a Great Indian Bustard Sanctuary in 1979. According to Kulkarni (1980), the population of this bird in the district during the year 1978-1980 was around 35 to 40. Rego (1980) has also given an account of status of the Great Indian Bustards in the districts Ahmednagar, Sholapur and Aurangabad (Maharashtra) during the years 1978-1980. More detailed studies on movement and flock composition of bustards at Nanaj (Sholapur district) during 1981-1984 has been dealt with by Rahmani and Manakadan (1986). Records were also maintained on bird species roosting communally during night time in different villages and towns (Table-2).

In general, it can be said that the avifauna of this district is fairly represented. Comparatively, the bird life is better in Pandharpur, Madha, Akkalkot and Barshi talukas. The number of waterbird species are less and this is natural because of scarcity of water and semi-arid conditions. Out of the total bird species observed and collected, 30 were found to be winter migratory species.

Davidson and Wenden (1878) have listed 255 bird species from the Deccan (including Sholapur district). Butler (1881)

explored vast portions of the Deccan and South Mahratta Country (also covering Sholapur district) and catalogued altogether 452 bird species from this region. Checklist of Birds of Maharashtra (Abdulali, 1973) mentions 525 species from Maharashtra State, out of which 148 are hereby recorded separately from Sholapur district.

SUMMARY

A survey of avifauna of Sholapur District (Maharashtra State) was undertaken during different years. The district lies in the semi-arid tract of the Deccan Plateau and has less than 1% forested area out of the total area of the district. It was interesting to observe the birds of such semi-arid biotope. Altogether 148 different bird species and subspecies with their regionwise abundance and status in the district have been discussed in this paper. Beside this, some observations on the communally roosting bird species of the district have also been reported.

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