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MICROECOLOGICAL STUDIES ON *PALLISENTIS ALLAHABADI* AGARWAL, 1958 (ACANTHOCEPHALA) A PARASITE OF FRESHWATER FISH

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INTRODUCTION

While examining the fishes of Gobindsagar Lake for acanthocephalan infections, *Channa punctatus* (Bloch) was found to be infected with *Pallisentis allahabadi* Agarwal, 1958. The present communication deals exclusively with the microecological studies of this parasite. Seasonal variations in the parasite population and its associations with the host fish have been studied.

MATERIAL AND METHODS

Living fish hosts were brought to the laboratory and examined at regular intervals. Total body length and sex of the fishes were recorded. The number of male and female parasites recovered from each fish were recorded separately. For studying the distribution of parasites the intestine was arbitrarily divided into five equal parts (Fig.1) and the number of male and female worms recovered from each part was recorded separately.

Invasion index was calculated according to Tenora and Zejda (1974) :

$$\text{Invasion Index} = \frac{\text{Total number of parasites x number of infected hosts}}{\text{Total number of hosts examined}}$$

RESULTS AND DISCUSSION

Seasonal variations in the parasite population

Monthly data indicate that the invasion intensity (percent infect) was maximum during winter months (October-December) and minimum in summer (May - July) (Table I and Fig. 2). The hormonal state of the host could be one of the factors regulating parasitic population in different seasons. Unfavourable conditions such as high temperature and scarcity of water in ponds leading to the decrease in the population of crustaceans (intermediate hosts) is thought to be the other possible factor leading to the decrease in parasite population.

Kennedy (1972) observed that in the experimentally infected Goldfish, with different population densities of acanthocephalan *Pomphorhynchus laevis* Zoega in muller, 1776, there was 30 percent decrease in the recovery after one week with 12°C rise in the water temperature. In the light of Kennedy's study the decrease in the invasion intensity during summers is supposed to be due to some physiological changes occurring in the fish host due to rise in temperature.

Amin (1975a) observed that the infections of *Acanthocephalus parksidei* Amin, 1975* in various hosts was at its peak during spring and attributed it to the availability of the source of infection (intermediate host).

Komarova (1974) observed that the helminth infection rates of fry and larvae of eight carp species in the Kremerchung reservoir, USSR is affected by different conditions of temperature and water level. Hot dry summers lead to the decrease in water level and hence decrease parasite species.

Khera and Wadhawan (1983) found that the infection of *Moniliformis moniliformis* (Bremser) in *Rattus rattus rattus* was maximum in the month of May and attributed it to the availability of intermediate host and hormonal state of the host.

From the above discussion it seems that season influences the parasitic infection in two ways. One is the influence of change in atmospheric conditions on the definitive host causing some physiological change leading to change in parasite population and the other is the influence of season on the population of intermediate host and thus controlling the parasite population.

Male to female ratio (MFR)

The present investigations indicate very high MFR in both male and female fish hosts (Table I). It was also observed that the MFR was very high in the anterior part of the intestine and pyloric caeca but less than unity in the posterior parts of the intestine (Table II). This is because the male worms when once established survive better and longer than females (Kennedy, 1972). So the MFR increase in the anterior part of the intestine which is the most favourable site while in posterior region, which receives the discarded worms, more females were found. No significant seasonal changes in the sex ratio, as observed by Amin and Burrow (1977), were observed during present investigations. Amin and Burrow (1977) observed that the sex ratio in *Echinorhynchus salmonis* Muller, 1784 in the Smelt was nearest to unity (even) during spring season and increase in favour of females towards autumn. A similar trend was observed by Kennedy (1972) for *P. laevis* in Gold fish, *Carassius auratus*. Khera and Wadhawan (1983) reported the sex ratio for *M. moniliformis* in *Rattus rattus rattus* in favour of female worms.

Kennedy (1972) reported that for *P. laevis* there are no separate zones of attachment for male and female parasites as there was no consistent difference in sex ratio along the length of intestine.

High MFR observed during present investigations seems to be a natural way of parasite population control. Grundmann, Warnock and Wassom (1976) reported that "constant conditions occur in some parasite species where mating pairs in a host occur only in limited

*Amin, 1975b

number" This type of state is considered important in population control. Of the 132 fish hosts examined 33 were found infected with male parasites only and three with female parasites. Where the male and female worms coexist the MFR was very high. So the actual number of mating pairs is quite less leading to a controlled production of infective acanthors.

Sex of host and parasites

Exept in summers (May - July) the invasion intensity (Percent infect) of the worms was more in male fish than in the female fish. Of the total fishes examined 68 out of 92 males (73.91 Percent) were found infected in comparison to 22 out of 40 (55 Percent) females (Table I).

Amin (1975a) observed that more males (76 Percent of 17) of *Semotilus atromaculatus* were infected with *A. parksidei* than females (47 Percent of 17) in the late autumn and male fishes had a relatively higher mean of 3.4 worms per host fish as compared to 3.0 in female hosts. Later in spring he reported increased parasitic load to a mean of 6.13 per fish in male hosts whereas the corresponding mean of 2.68 in females showed a slight decline. The observations of Thomas (1964a) for *Neoechinorhynchus rutili* (Muller, 1780) Yamaguti, 1963, in brown trout and of Amin and Burrow (1977) for *Echinorhynchus salmonis* were reverse. These authors reported more invasion intensity in the female hosts than the males.

The overall data of present investigations indicate that MFR was more (5.21) in male fishes as compared to (3.46) in female fishes (Table I). This low MFR in female fishes is considered to be due to the hormonal compatibility of the host and the parasite.

Host's size (age) and parasite

During present investigations 132 fish hosts ranging from 6-26 centimetres in size were examined and placed in seven groups with respect to their size. The mean number of worms infecting single fish host and invasion index for each group was calculated. It was observed that increase in the size of fish host was accompanied with an increased parasitic infection. The larger fishes were more heavily infected than the smaller fishes (Fig.3).

The increase in the invasion index and mean number of parasites per infected fish with the increase in size (age) of the host is attributed to two factors. One is the increased volume of food ingested by large fishes including the intermediate hosts. A study by Hart (1931) on Lake White fish, *Coregonus clupeaformis* in Ontario gives an example of this type. The amphipod contents (including *Pontoporeria hoyi*) in the diet of the White fish infected with *Echinorhynchus* sp. notably increased with the increase of fish size(13-55 cms. long fishes in five size groups). Similarly using eight age classes of White fish (2-9 years) from Cold Lake, Seng (1975) showed that a similar increase in the prevalence of *P. affinis* in the diet of older fishes corresponded with the heavier infection of *E. salmonis*. The other factor is as reported by Thomas (1964b) for trout, *Salmo trutta*, that the larger surface area of the gut in older fishes than that in younger fishes makes more space available to accommodate greater number of parasites.

TABLE - I

		HOST			PARASITE			
Month	Sex	Examined	Infected	% infect	Total	Male	Female	MFR
	M	9	4	44.44	10	9	1	9.00
June	F	4	2	50	5	4	1	4
	T	13	6	46.15	15	13	2	6.5
	M	7	3	42.85	10	9	1	9
July	F	4	3	75.00	8	6	2	3
	T	11	6	54.54	18	15	3	5
	M	8	6	75.00	20	16	4	4
August	F	4	2	50.00	6	4	2	2
	T	12	8	66.66	26	20	6	3.33
	M	8	6	75.00	37	30	7	4.28
September	F	3	2	66.66	9	8	1	8
	T	11	8	72.72	46	38	8	4.75
	M	9	9	100	57	47	10	4.7
October	F	3	2	66.66	3	3		
	T	12	11	91.66	60	50	10	5
	M	5	5	100	30	24	6	4
November	F	3	2	66.66	5	4	1	4
	T	8	7	87.50	35	28	7	4
	M	8	8	100	69	58	11	5.27
December	F	2	1	50.00	2	2		
	T	10	9	90.00	71	60	11	5.45
	M	7	7	100	71	58	13	4.45
January	F	3	1	33.33	3	1	2	0.5
	T	10	8	80.00	74	59	15	3.93
	M	9	8	88.88	105	97	8	12.12
February	F	3	2	66.66	7	6	1	6
	T	12	10	83.33	112	103	9	11.44
	M	8	5	62.50	19	13	6	2.16
March	F	3	1	33.33	2	2		
	T	11	6	54.54	21	15	6	2.5
	M	7	5	71.42	11	9	2	4.5
April	F	4	1	25.00	1		1	
	T	11	6	54.54	12	9	3	3
	M	7	2	28.57	3	1	2	0.5
May	F	4	3	75.00	7	5	2	2.5
	T	11	5	45.45	10	6	4	1.5
	M	92	68	73.91	442	371	71	5.22
Total	F	40	22	55	58	45	13	3.46
	T	132	90	68.18	500	416	84	4.95

M : Male ; F : Female ; T : Total ; MFR : Male to Female Ratio

TABLE -II: Month wise data of *Pallisentis allahabadi* Agarwal, 1958 in different parts of host's intestine

Month	Sex	Number of fishes examined		Number of fishes infected		Total number of worms		worms in different parts of intestine I		II		III		IV		V	
						M	F	M	F	M	F	M	F	M	F	M	F
June	M	9	13	4	6	13	2	8		5	1		1				
	F	4		2													
July	M	7	11	3	6	15	3	8	1	7			2				
	F	4		3													
August	M	8	12	6	8	20	6	14	3	4		2	2		1		
	F	4		2													
September	M	8	11	6	8	38	8	22	2	11		3	5	2	1		
	F	3		2													
October	M	9	12	9	11	50	10	20	4	24	1	4	5			2	
	F	3		2													
November	M	5	8	5	7	28	7	16	2	9		3	5				
	F	3		2													
December	M	8	10	8	9	60	11	36	3	21	3	3	3		2		
	F	2		1													
January	M	7	10	7	8	59	15	39	5	16	4	3	2	1	4		
	F	3		1													
February	M	9	12	8	10	103	9	64	3	27	3	8	3	3		1	
	F	3		2													
March	M	8	11	5	6	15	6	12	2	1	2		2	2			
	F	3		1													
April	M	7	11	5	6	9	3	7		2	1		1		1		
	F	4		1													
May	M	7	11	2	5	6	4	2	2	4	1		1				
	F	4		3													
Total	M	92	132	68	90	416	84	248	27	131	16	26	32	8	9	3	
	F	40		22													
MFR						4.95		9.18		8.18		0.81		0.89			

Amin (1974) and Amin and Burrow (1977) also reported increase in parasite infection with the increase in host's size (age). Amin (1974) observed only partial overlap of generations and concluded that the effect of cumulative infections is important in determining worm density but only within one worm generation.

Distribution of the parasite in the host's intestine

No parasite was recovered from the pre-caecal part of the alimentary canal. The rest of the alimentary canal was divided into five equal parts (Fig. 1) arbitrarily and the number of male and female parasites recovered from each part was recorded separately. The parasites recovered from the pyloric caeca were included in those recovered from the first part (inter-caecal part) of the intestine.

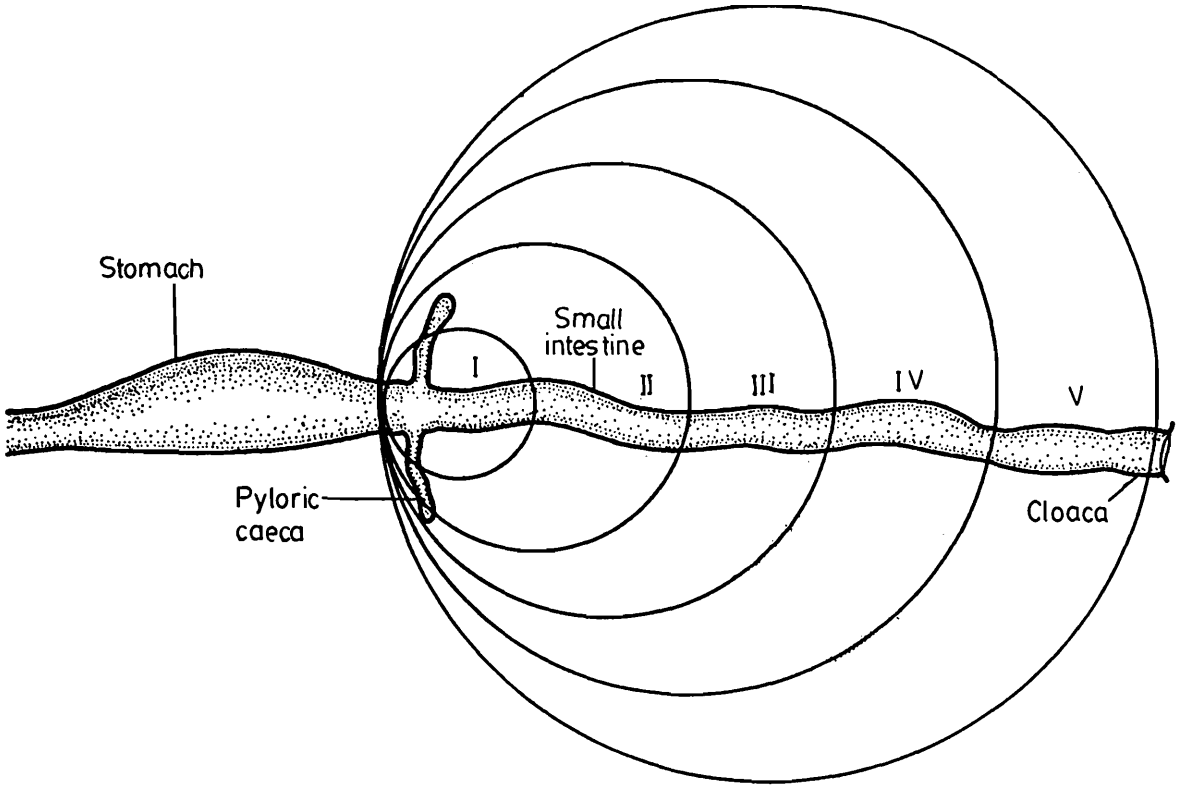
The data indicate that the number of parasites is maximum in the anterior - most region of the intestine and there is gradual decrease in the percentage distribution antero-posteriorly (Table II and Fig. 4). This preference for the anterior region of intestine is due to the availability of required nutrients in that region. Zone in which the acanthocephalans are usually found is known as "Zone of viability" (Burlingame and Chandler, 1941).

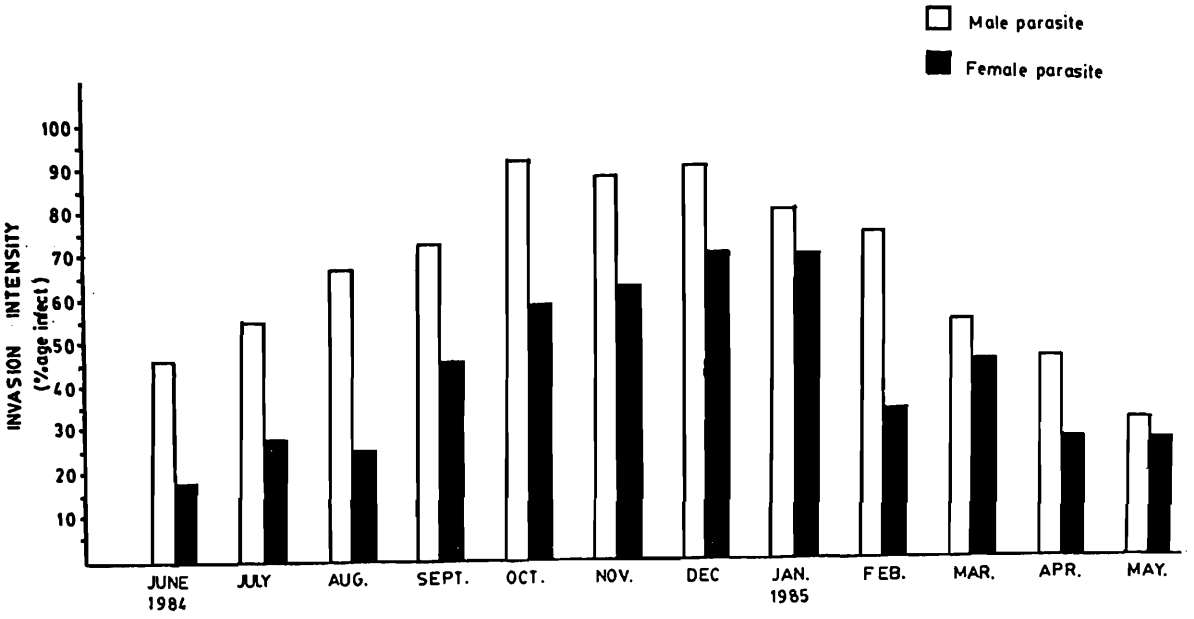
The evidence from the studies of uptake of substances by acanthocephalans in vivo and in vitro has shown that nutrition in acanthocephalans depends upon the absorption of nutrients present in the lumen of host's intestine through trunk region (Edmonds, 1965; Hammond, 1968; Hibbard and Cable, 1968). Edmonds (1965) using ^{14}C-labelled leucine and ^{32}P-labelled sodium phosphate has shown that in vivo these substances pass into *Moniliformis dubius* Meyer, 1932 and are obtained from the host's gut contents rather than its gut mucosa. So the possibility of the role of proboscis in nutritions was discarded by him. This interpretation of activity of nutrition fits with the observed distribution of acanthocephalans in the alimentary canal. The decrease in the number of parasites from anterior to posterior regions of the alimentary canal corresponds to the graded decrease in the concentration of useful nutrients.

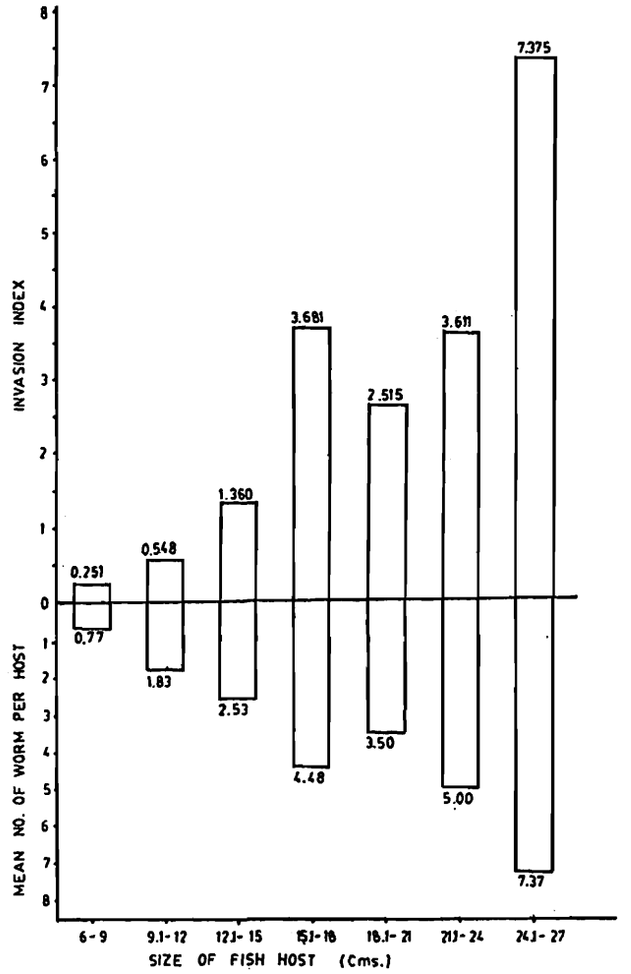
Similar pattern of distribution of parasite in the intestine was observed by Crompton (1973) and Amin (1975a).

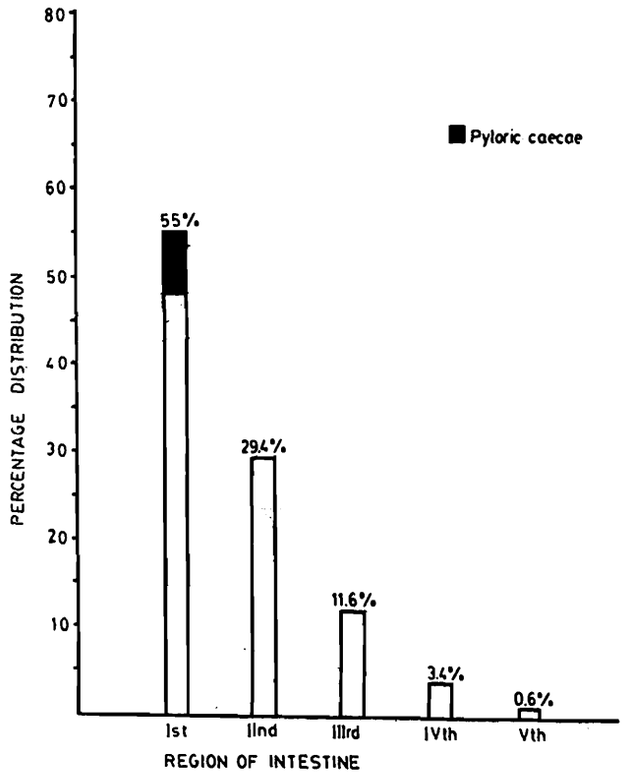
Intraspecific reaction

It is observed that as the number of parasites increase they go on spreading in posterior region of the intestine. In case the parasite number is small then the infection is confined to the anterior region of the intestine only (Fig. 1). This indicates that a sort of intraspecfific competition or reaction exists among the worms for restricting to the favourable site in the intestine of the host fish. Moreover the worms found in the posterior- most (cloacal) region were either dead or very sluggish in their movements and were not attached to the cloacal wall. These are the worms which are either discarded from the anterior regions of the intestine as a result of intraspecific reaction or had died their natural death and were on their way to being discarded.


Stomach
Small intestine
I
II
III
IV
V
Pyloric caeca
Cloaca


Male parasite
Female parasite
INVASION INTENSITY (%age infect.)
100
90
80
70
60
50
40
30
20
10
JUNE 1984
JULY
AUG.
SEPT.
OCT.
NOV.
DEC
JAN. 1985
FEB.
MAR.
APR.
MAY.


INVASION INDEX
MEAN NO. OF WORM PER HOST
0.251
0.77
0.548
1.83
1.360
2.53
3.681
4.48
2.515
3.50
3.611
5.00
7.375
7.37
6-9
9.1-12
12.1-15
15.1-18
18.1-21
21.1-24
24.1-27
SIZE OF FISH HOST (Cms.)


Pyloric caecae
PERCENTAGE DISTRIBUTION
55%
29.4%
11.6%
3.4%
0.6%
Ist
IInd
IIIrd
IVth
Vth
REGION OF INTESTINE

In experimental infections by acanthocephalan, *M. dubius* the site was extended posteriorly when more individuals, than as could be accommodated at the normal site, were present in the rat's intestine (Burlingame and Chandler, 1941, Holmes, 1961). The site of *Echinorhynchus truttae* Schrank, 1788 was more extended in the small intestine of trout when 30 cystacanths were ingested rather than 15 (Awachie, 1966). "One interpretation of the distribution of *P. minutus* in natural infections in Mallard is that the site of the parasite extends posteriorly when many individuals are present" (Crompton and Harrison, 1965).

Amin (1975a) observed similar pattern for the distribution of the parasite, *E. salmonis* in the host's intestine in relation to the intensity of infection.

According to Crompton (1973) the apparent restriction of many species of helminths to precise region of the tract means that a population may be confined to relatively constant space and thus that the population density at which individuals interfere with each other may soon be reached.

SUMMARY

Pallisentis allahabadi Agarwal, 1958 has been studied with regard to its seasonal variations and its associations with the host fish, *Channa punctatus* (Bloch). During the period June, 1984 to May, 1985 as many as 132 fish hosts were examined at monthly intervals. Of these 90 hosts (68.8 per cent) were found infected with *P. allahabadi* (Table I). Of the 500 parasites recovered 416 were males and 84 females. The data collected were analysed and studied for seasonal variations in parasite population, male to female ratio (MFR), distribution of parasite in the host's intestine and the effect of host's size (age) and sex on parasitic infections.

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CHEWING-LICE (PHTHIRAPTERA : INSECTA) COLLECTED DURING SCRUB-TYPHUS SURVEY OF MANIPUR, INDIA.

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INTRODUCTION

During the Second World War (1945) Dr M.L. Roonwal, as mammalogist attached to the Army Headquarters in course of the investigations on tsutsugmushi disease (Scrub-typhus) in the Assam-Burma war front collected in 1945 several vertebrate and invertebrate groups including the insects. A series of papers appeared on these collections viz., Roonwal (1949 a-b; 1950),Roonwal & Nath (1949), Kapur (1956), Menon (1953), Menon, A..G.K. (1955), and Nath (1953). The insect collections also include some chewing-lice off the Falconiformes.

Since the chewing-lice have been branded as transmitters of typhus, rickettsiasis and are also definitive vectors of bird filaria, dog tape worm, infectious equine anaemia, dermatitis, etc., though their actual role in disease transmission is not as marked as that of Sucking-lice, it is felt desirable to report in this paper the species collected to supplement the results of the investigations already published.

Species so far reported from Manipur State are also included in this paper.

SYSTEMATIC ACCOUNT

Order PHTHIRAPTERA

Suborder AMBLYCEROPHTHIRINA

Family MENOPONIDAE

1. *Colpocephalum turbinatum* Denny, 1842, one Male from *Milvus migrans lineatus* (J.E. Gray), Imphal Valley, 21.xii.1945, coll. Dr. M.L.R. (Z.S.I. Reg. No. 579/H16) ; 2 Males , 5 females from *Gyps himalayensis* Hume (R3), 9 km off Imphal, 25.xi.1945, coll. Dr. M.L.R. (Z.S.I. Reg. No. 575-578/H16)

Suborder ISCHNOCEROPHTHIRINA

Family PHILOPTERIDAE

2. *Falcolipeurus quadripustulatus* (Burmeister,1838), 11 Males, 1 2 Females , and 6 (nymphs) from *Gyps himalayensis* Hume (R3), 9 km off Imphal, 23.xii.1945, coll. Dr M. L. R. (Z.S.I. Reg. No. 815/H16, 867 / H16)

3. *Degeeriella regalis* (Giebel,1966), 1 Male from *Milvus migrans lineatus* (J.E.Gray) (R2), Imphal Valley, Manipur, 21.xi,1945, coll. Dr M.L.R. (Z.S.I. Reg. No. 815/H16)

4. *D. rufa* (Burmeister,1838), 4 Males from *Falco tinnunculus interstinctus* Horsfield, Kangra Tongli, 25 km off Imphal , 23.xi.1945, coll. Dr M.L.R. (Z.S.I. Reg. No. 808-809/ H16)

5. *Craspedorrhynchus* sp. near *spathulatus* (Giebel, 1874), 1 Male from *Milvus migrans lineatus* (J.E. Gray) , Imphal, 21.xi.1945, coll. Dr M.L.R. (Not registered because of damaged condition).

All the above specimens are from birds of prey (Falconiformes). Other species reported from Manipur State are listed below.

LIST OF SPECIES RECORDED FROM MANIPUR

Suborder AMBLYCEROPHTHIRINA

Family MENOPONIDAE

1. *Myrsidea bhutanensis* Tandan, 1972, from *Garrulax r.ruficollis* (Jardine *et* Selby), Kangpokpi, Manipur (Tandan, 1972).

2. *M. orientalis* Tandan, 1972, from *G.p. pectoralis* (Gould), Kangpokpi, Manipur (Tandan, 1972).

Family RICINIDAE

3. *Ricinus fringillae de* Geer , 1778, from *Emberiza a. aureola* Pallas, Moirang, Manipur (Rheinwald, 1968).

4. *R. rubeculae* (Schrank, 1776), from *Saxicola caprata* (Linne), Kangla Tongli, Manipur (Rheinwald, 1968).

Suborder ISCHNOCEROPHTHIRINA

Family PHILOPTERIDAE

5. *Alecdoecus annularis* Ansari , 1955, from *Halcyon s. smyrnensis* (Linne), Imphal, erroneously reported as *A. annulatus* Ansari (Tendeiro, 1965).

6. *Brueelia sternotypicus* Ansari, 1956, from *Garrulax p. pectoralis* (Gould), Manipur (Ansari, (1956).

7. *B. ventratum* Ansari, 1956, from *G.R. ruficollis* (Jardine *et* Selby), Manipur, (Ansari, 1956).

8. *Coloceroides unchalli* Tendeiro, 1972, from *Macropygia unchall tusalia* (Blyth), Kangpokpi, Manipur (Tendeiro, 1972).

9. *Columbicola theresae* Ansari 1955, from *Streptopelia t.tranquebarica* (Hermann), Manipur (Tendeiro, 1962).

10. *Degeeriella discocephalus (aquilarum)* Eichler, 1943 , from *Aquila pomarina hastata* (Lesson), Manipur (Clay, 1958).

11. *D. rufa* (Burmeister, 1838), from *Falco tinnunculus* Linne, Manipur (Clay, 1958).

12. *Fulicoffulal urida* (Nitzsch, 1818), from *Fulica a.atra* (Linne), Manipur (Clay & Hopkins, 1960).

13. *Nitzschiella doreyana* Eichler, 1950, from *Macropygia unchall tusalia* (Blyth), Manipur (Tendeiro, 1974).

14. *Rallicola indicus* Emerson & Elbel, 1961, from *Metopidius indicus* (Latham), Moirang, Manipur (Emerson & Elbel, 1961).

15. *Sturnidoecus laticephalum* Ansari, 1967, from *(Aethiopsar albicinctus), Acridotheres albocinctus* Godwin-Austen & Walden, Manipur as *S. bannoo laticephalum* (Ansari, 1967).

Family TRICHODECTIDAE

16. *Damalinia indica* (Werneck 1950), on *Muntiacus muntzak* (Zimmermann), Imphal (Werneck, 1950).

Of the above sixteen species, only the last one is from a mammal and all the rest are from birds. On comparison of these sixteen with those made by Dr. M.L. Roonwal, only one species viz., *D.rufa* is found between them common and the rest of the four are new records for Manipur.

SUMMARY

During the Second World War, Dr M.L. Roonwal, then Mammalogist, Army Headquarters,collected various animal groups including the insects in course of the investigations on tsutsugmushi disease (Scrub-typhus) in Assam-Burma war front in 1945. These insect collections include some chewing-lice also. Though few, since the lice are usually branded as carrying typhus and other disease causing agents,it is felt desirable to report the species encountered. A list of species reported from the state of Manipur is also provided and a comparison shows that of the five species collected, four are now being reported for the first time.

ACKNOWLEDGEMENTS

The author sincerely thanks Dr M. L. Roonwal, former Director of the Zoological Survey of India, collector of present material and for drawing his attention to the collections under study. His thanks are also due to Dr B. S. Lamba, Scientist 'SF'- in Charge, Zoological Survey of India,Calcutta and Dr R. S. Pillai, Scientist 'SE' nd Officer-in-Charge, Southern Regional Station, Zoological Survey of India, for all facilities and encouragement.

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PREDATORS AND PARASITES OF APHIDS FROM NORTH WEST AND WESTERN HIMALAYA III. TWENTYFIVE SPECIES OF COCCINELLIDAE (COLEOPTERA : INSECTA) FROM GARHWAL AND KUMAON RANGES

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INTRODUCTION

The coccinellids or ladybird beetles are regarded as a significant component in the whole complex of factors utilizable in pest management (Hodek, 1973). Most of the previous works reveal the stray records of different coccinellids in association with their prey and fail to exhibit the real association. The reported polyphagy of many coccinellids, as Hodek (1959) also pointed out, may result from the failure of investigators to distinguish between acceptability and suitability of their food. About three decades ago, Thompson (1951) warned that the accumulation of such inaccurate information will lead to a faulty decision in biocontrol programme.

The present communication is the first consolidated report of aphidophagous coccinellid through an extensive survey in the Garhwal and Kumaon ranges of western Himalaya over a period of 3 years (1982-'85). An analysis of data reveals that 25 species of coccinellids prey upon 52 species of aphids infesting 45 different host plants. Among them, 6 are newly recorded as aphidophagous species from India (denoted by * mark) and 8 from western Himalaya (denoted by **mark). The host plants of aphids are given in parenthesis.

MATERIAL AND METHODS

During field survey, coccinellid larvae, pupae and adults found in association with the aphid colony were collected from several localities of Garhwal and Kumaon ranges of western Himalaya (Fig. 1). These were brought to the field laboratory at Joshimath c 1875 meters (Garhwal), Uttar Pradesh and were kept in separate round plastic containers (8 x 5 cms) with adequate specific aphid species (mostly apterous viviparous females and nymphs) on fresh leaves/stems in case of adults and larvae and without aphids in case of pupae. Adequate moisture was maintained through wet-cotton pads placed within the containers. The open mouth of the containers were tightly closed by nylon nets. Adults emerged from the pupae were subsequently placed within the containers having specific aphid species on plant material. The prey aphids and the plant material were renewed at regular intervals (usually after 24 hrs.).

Observations were made everyday whether the coccinellid adults and larvae really feed on the specific aphid species or not. Unless there is feeding and/or breeding experiments, such observations were discontinued after about a week. Coccinellid adults and larvae that were collected in aphid association but do not feed on that aphid species in the laboratory condition were excluded from the present list.

SYSTEMATIC ACCOUNTS

Family COCCINELLIDAE

Subfamily CHILOCORINAE

Tribe CHILOCORINI

1. ** **Chilocorus rubidius** Hope

Prey aphid : *Micromyzodium filicium* David (*Cheilanthes* sp.).
Season : August.
Habitat : Herbage.
Locality : Hanumanchatti, Lambagar (Garhwal).

Adult of this coccidophagous species were noted to feed on aphids in the area of study which also supports earlier records from India (Raychaudhuri *et al.*, 1979; Ghosh and Raychaudhuri, 1982).

Tribe PLATYNASPINI

2. ** **Platynaspis saundersi** Crotch

Prey aphids : *Aphis gossypii* Glover (*Cucurbita* sp.), *A. kurosawai* Takahashi (*Artemisia vulgaris*), *Cavariella aegopodii* (Scopoli) (*Salix tetrasparma*), *Eriosoma lanigerum* (Hausmann) (*Pyrus malus*), *Macrosiphoniella pseudoartemisiae* Shinji (*Artemisia vulgaris* sp), *Melanaphis* nr. *aurandinariae* (Takahashi) (*Pyrus pashia*), *Sappaphis* sp. (*Cotoneaster obtusus*), *Shinjia orientalis* (Mordvilko) (*Pteris* sp.).

Season : May-July.
Habitat : Cropfield, orchard, herbage.
Locality : Bargaon, Gobindghat, Helong, Joshimath, Karnaprayag, Pulnagaon, Rabigaon, Sakri, Salnagaon, Tapaban, Urgam (Garhwal), Khati (Kumaon).

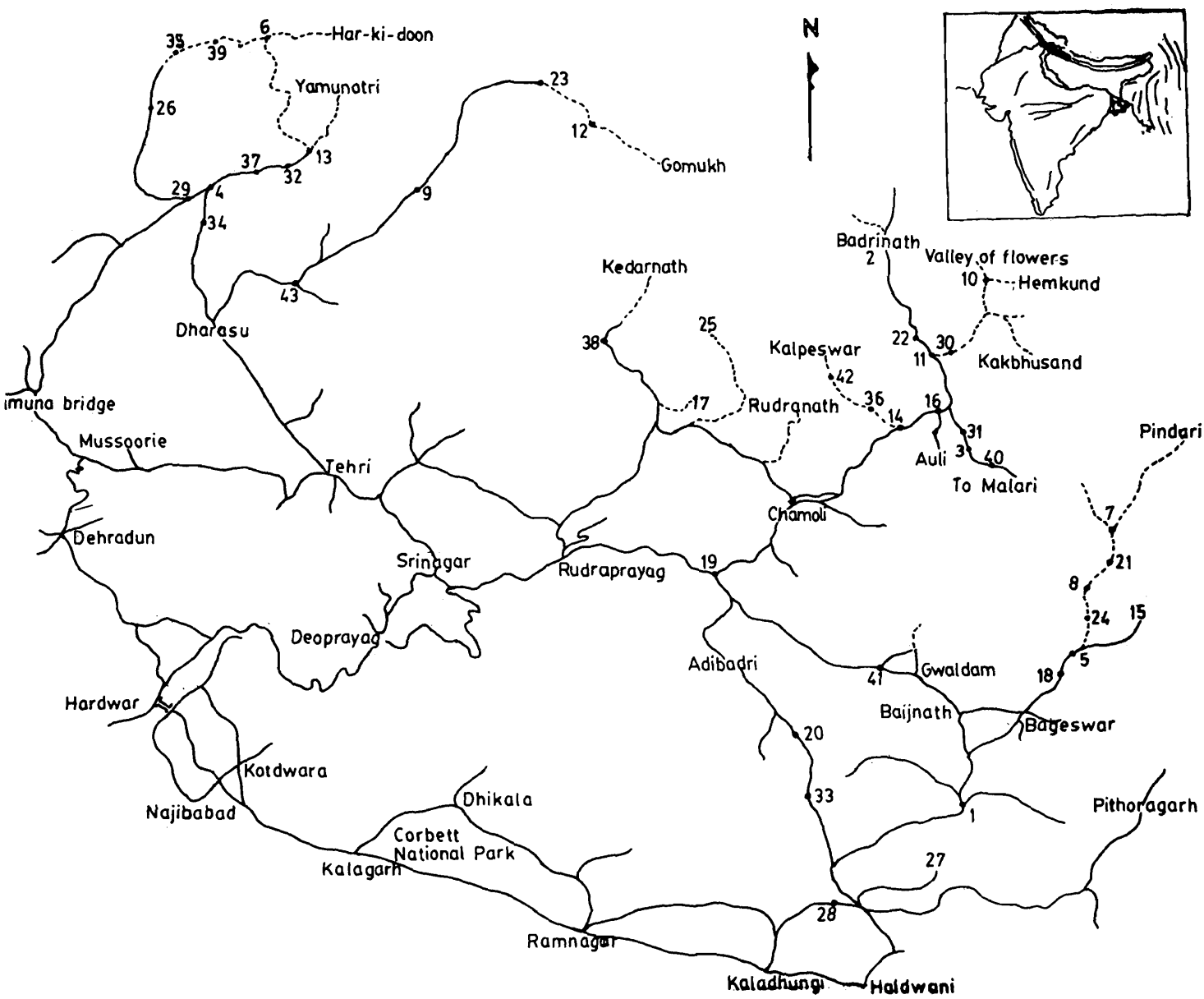
This is the only representative of aphidophagous Platynaspini in India. Previously it was reported once from Kalimpong preying on an unidentified aphid (Rao, 1969).

Subfamily COCCINELLINAE

Tribe COCCINELLINI

3. **Adalia tetraspilota** (Hope)

Prey aphids : *Aphis kurosawai* Takahasi (*Artemisia vulgaris*), *Brachycaudus helichrysi* (Kaltenbach) (*Prunus persica*), *Callaphis juglandis* (Goeze) (*Juglans regia*), *Capitophorus carduinus* (Walker), *C. eleagni* (del Guercio) (*Cnicus wallichii*), *Cavariella*


N
Har-ki-doon
Yamunotri
Gomukh
Badrinath
Valley of flowers
Hemkund
Kakbhusand
Kedarnath
Kalpeswar
Rudranath
Auli
To Malari
Pindari
Chamoli
Dharasu
Tehri
Mussoorie
imuna bridge
Dehradun
Srinagar
Rudraprayag
Deoprayag
Adibadri
Gwaldam
Baijnath
Bageswar
Hardwar
Kotdwara
Najibabad
Dhikala
Corbett
National Park
Kalagarh
Ramnagar
Kaladhungi
Haldwani
Pithoragarh

aegopodii (Scopoli) (*Salix tetrasperma*), *Chromaphis juglandicola* (Kaltenbach) (*Juglans regia*), *Eriosoma lanigerum* (Hausmann) (*Pyrus malus*), *Liosomaphis himalayensis* Basu (*Berberis asiaticum*), *Hyalopterus pruni* (Geoffroy) (*Prunus persica*), *Macrosiphum rosae* (Linnaeus) (*Rosa* sp.), *M. (Sitobion) miscanthi* (Takahashi) (*Triticum aestivum*), *M. (S.) rosaeiformis* Das (*Rosa* sp.), *Melanaphis* nr. *aurandinariae* (Takahashi) (*Pyrus pashia*), *Mollitrichosiphum* sp. (*Alnus nepalensis*), *Myzus dycei* Carver (*Urtica dioica*), *Myzus sorbi* Bhattacharya and Chakrabarti (*Sorberia tomentosa*), *Prociphilus* sp. (*Lonicera quinquelocularis*).

Season : March - July.
Habitat : Cropfield, herbage, orchard, tree.
Locality : Joshimath, Rana, Tapaban (Garhwal); Dawali (Kumaon).

This is the only aphidophagous *Adalia* species, so far recorded from India (Rao, 1969, Verma and Chowdhuri, 1975).

4. *Aiolocaria hexaspilota (Hope)

Prey aphid : *Lachnus salicis* Chakrabarti and Raha (*Salix babylonica*).
Season : October.
Habitat : Garden.
Locality : Joshimath (Garhwal).

5. * Calvia punctata (Mulsant)

Prey aphid : *Myzus dycei* Carver (*Urtica dioica*).
Season : July.
Habitat : Roadside herbage.
Locality : Joshimath (Garhwal).

6. Calvia sp.

Prey aphid : *Mollitrichosiphum* sp. (*Alnus nepalensis*).
Season : July.
Habitat : Tree.
Locality : Joshimath (Garhwal).

7. Coccinella septempunctata L.

Prey aphids : *Aphis rubi elliptici* Stroyan and Nagaich (*Rubus ellipticus*), *Brachycaudus helichrysi* (Kaltenbach) (*Erigeron* sp., *Prunus persica*), *Brevicoryne brassicae* (L.) (*Brassica campestris*, *B. oleracea*), *Cavariella aegopodii* (Scopoli) (*Salix tetrasperma*), *C. indica* Maity and Chakrabarti (*S. babylonica*), *Eriosoma lanigerum* (Hausmann) (*Pyrus malus*), *Eutrichosiphum* sp. (*Quercus* sp.), *Hayhurstia atriplicis* (L.) (*Chenopo-*

dium album), Hyalopterus pruni (Geoffroy) *(Prunus persica), Liosomaphis himalayensis* Basu *(Berberis asiaticum), Lipaphis erysimi* (Kaltenbach) *(Brassica campestris, B. oleracea , Raphanus sativus), Macrosiphum rosae* (L.) *(Rosa* sp.*), M. (Sitobion) miscanthi* Takahashi *(Triticum aestivum), M. (S.) rosaeiformis* Das *(Rosa* sp.*), Melanaphis* sp. *(Pyrus pashia), Melanaphis* sp. *(Bambusa sp.), Myzocallis polychaetus* David *(Quercus* sp.*), Myzus dycei* Carver *(Urtica dioica), M. sobi* Bhattacharya and Chakrabarti *(Sorberia tomentosa), Phorodon cannabis* Passerini *(Cannabis sativa), Prociphilus* sp. *(Lonicera quinquelocularis), Rhopalosiphum maidis* (Fitch) *(Triticum aestivum), Sappaphis* sp. *(Cotoneaster obtusus), Shinjia orientalis* (Mordvilko) *(Pteris* sp.*), Taoia indica* (Ghosh and Raychaudhuri) *(Alnus nepalensis), Takecallis himalayaensis* Chakrabarti *(Bambusa* sp.*), Uroleucon sonchi* (L.) *(Sonchus arvensis).*

Season : March - October.

Habitat : Cropfield, garden, orchard, roadside herbage, tree.

Locality : Datmeer, Ghangaria, Helong, Jhopra, Joshimath, Madmaheswar, Sakri, Taluka (Garhwal); Dhakuri, Khati, Mukteswar, Nainital (Kumaon).

8. **C. transversalis Thunberg

Prey aphids : *Brevicoryne brassicae* (L.) *(Brassica campestris, B. oleracea, Raphanus sativus), Macrosiphum (S.) miscanthi* Takahashi *(Triticum aestivum).*

Season : April - May.

Habitat : Cropfield.

Locality : Joshimath (Garhwal).

This species is collected for the first time from temperate region. Previously this was known from Andhra Pradesh, Karnataka and West Bengal (Rao,1969, Nath and Sen,1976, Joshi et al.,1979, Ghosh et al., 1981).

9. **Coelophora sexareata** (Mulsant)

Prey aphid : *Shinjia orientalis* (Mordvilko) (*Pteris* sp.).

Season : September.

Habitat : Herbage.

Locality : Joshimath, Mouri (Garhwal).

10. ** **Exochomus uropygialis** (Mulsant)

Prey aphids : *Eriosoma lanigerum* (Hausmann) *(Pyrus malus), Prociphilus* sp. *(Lonicera quinquelocularis), Shinjia orientalis* (Mordvilko) (*Pteris* sp.).

Season : May - July.

Habitat : Orchard, roadside herbage.

Locality : Gongotri, Joshimath, Lanka (Garhwal).

11. ** Halyzia sanscrita Mulsant

Prey aphids : *Avecennina indica* Chakrabarti and Maity *(Prunus cornuta), Capitophorus formosartemisiae* (Takahashi) *(Artemisia vulgaris), Chaitophorus kapuri* H.R.L. *(Populus ciliata), Cinara* sp. *(Pinus excelsa), Mollitrichosiphum* sp. *(Alnus nepalensis), Pemphigus mordvilkoi* Cholodkovsky *(Populus ciliata), Prociphilus* sp. *(Lonicera quinquelocularis), Shinjia orientalis* (Mordvilko) *(Pteris* sp.*).*

Season : May - August.

Habitat : Herbage, tree.

Locality : Badrinath, Govindghat, Joshimath, Lambagarh, Sayanachatti (Garhwal).

Though known to be mycophagous (Hodek, 1973), this coccinellid has been observed to feed and breed on the following aphids - viz., *Mollitrichosiphum* sp. *(Alnus nepalensis)* and *Shinjia orientalis* (Mordvilko) *(Pteris* sp.*).*

12. Harmonia eucharis (Mulsant)

Prey aphids : Brachycaudus helichrysi (Kaltenbach) *(Anaphalis marginata, Prunus amygdalus, P. domestica, P. persica), Chaitophorus kapuri* H.R.L. *(Populus ciliata), Cinara* sp. *(Pinus excelsa), Eriosoma lanigerum* (Hausmann) *(Pyrus malus), Hayhurstia atriplicis* (L.) *(Chenopodium album), Hyalopterus pruni* (Geoffroy) *(Prunus persica), Liosomaphis himalayensis* Basu *(Berberis asiaticum), Macrosiphoniella pseudoartemisiae* Shinji *(Artemisia vulgaris), Macrosiphum rosae* (L.) *(Rosa* sp.*), Pemphigus matsumurai* Monzen *(Populus ciliata), Phorodon cannabis* passerini *(Cannabis sativa).*

Season : March - September.

Habitat : Garden, orchard, roadside herbage, tree.

Locality : Helong, Joshimath, Lambagarh, Rabigaon, Sakri, Taluka ,Thorali (Garhwal); Khati (Kumaon).

13. *H. sedecimnotata (Fabricius)

Prey aphids : Eriosoma lanigerum (Hausmann) *(Pyrus malus), Mollitrichosiphum* sp. *(Alnus nepalensis).*

Season : May - July.

Habitat : Orchard, tree.

Locality : Joshimath, Rabigaon (Garhwal).

14.** Harmonia (Leis) dimidiata (Fabricius)

Prey aphids : Cavariella indica Maity and Chakrabarti *(Salix babylonica), Cinara* sp. *(Pinus excelsa), Epipemphigus imaicus* (Cholodkovsky) *(Populus ciliata), Eriosoma lanigerum* (Hausmann) *(Pyrus malus), Macrosiphoniella pseudoartemisiae* Shinji *(Artemisia vulgaris), Phorodon cannabis* Passerini *(Cannabis sativa).*

Season : April - May, September - October.

Habitat : Orchard, roadside harbage, tree.
Locality : Joshimath (Garhwal).

15. **Hippodamia (Adonia) variegata** (Goeze)

Prey aphids : Aphis clematidis Koch *(Clematis buchaniana), A. kurosawai* Takahashi *(Artemisia vulgaris), Aphis* sp. *(Boerhaavia diffusa), Brachycaudus helichrysi* (Kaltenbach) *(Erigeron bonariensis), Brevicoryne brassicae* (L.) *(Brassica campestris), Capitophorus formosartemisiae* (Takahashi) *(Artemisia vulgaris), Liosomaphis himalayiensis* Basu *(Berberis asiaticum), Lipaphis erysimi* (Kaltenbach) *(Brassica campestris), Macrosiphoniella pseudoartemisiae* Shinji *(Artemisia vulgaris), Macrosiphum (Sitobion) miscanthi* Takahashi *(Triticum aestivum), Melanaphis* nr. *aurandinariae* (Takahashi) *(Pyrus pashia), Myzus dycei* Carver *(Urtica dioica), M. Sorbi* Bhattacharya and Chakrabarti *(Sorberia tomentosa), Rhopalosiphium maidis* (Fitch) *(Triticum aestivum), Shinjia orientalis* (Mordvilko) *(Pteris* sp.*)*.
Season : March - May, August.
Habitat : Cropfield, orchard, harbage.
Locality : Joshimath, Karnaprayag, Monsoona, Sonprayag (Garhwal); Kausani, Loharkhet (Kumaon).

16.* **Lioadalia nr. luteopicta** Mulsant

Prey aphid : Cavariella sp. *(Chaerophyllum acuminatum).*
Season : August.
Habitat : Herbage.
Locality : Ghangaria (Garhwal).

This beetle species also occurs on balsam woolly aphid, *Adelges piceae* in India (Rao *et al.*, 1971).

17. **Menochilus sexmaculatus** (Fabricius)

Prey aphids : Aphis kurosawai Takahashi *(Artemisia vulgaris), Cavariella indica* Maity and Chakrabarti *(Salix babylonica), Epipemphigus imaicus* (Cholodkovsky) *(Populus ciliata), Macrosiphoniella pseudoartemisiae* Shinji *(Artemisia vulgaris, M. sanborni* (Gillette) *(Chrysanthemum* sp.*), Macrosiphum (Sitobion) miscanthi* Takahashi *(Triticum aestivum), Phorodon cannabis* Passerini *(Cannabis sativa), Prociphilus* sp. *(Lonicera quinquelocularis).*
Season : May - July, September - October.
Habitat : Cropfield, herbage, tree.
Locality : Joshimath, Kalimath, Uttar Kashi (Garhwal); Kausani, Kapkot, Khati, Turturia-bridge (Kumaon).

18. ** **Micraspis discolor** (Fabricius)

Prey aphid : Capitophorus eleagni (del Guercio) *(Cnicus wallichii).*

Season : June.
Habitat : Herbage.
Locality : Joshimath (Garhwa

19. * **Oenopia billieti** (Mulsant)

Prey aphids *Macrosiphum rosae* (L.), *M. (Sitobion) rosaeiformis* Das *(Rosa* sp.), *Myzus sorbi* Bhattacharya and Chakrabarti *(Sorberia tomentosa), Prociphilus* sp. *(Lonicera quinquelocularis), Sappaphis* sp. *(Cotoneaster obtusus), Shinjia orientalis* (Mordvilko) *(Pteris* sp.).
Season : May - July.
Habitat : Garden, roadside herbage.
Locality : Joshimath, Uttar Kashi (Garhwal); Dawali, Khati (Kumaon).

20. **O. kirby** Mulsant

Prey aphids : *Aphis kurosawai* Takahashi (*Artemisia vulgaris*), *Cavariella aegopodii* (Scopoli) (*Salix tetrasperma*), *C. indica* Maity and Chakrabarti (*Salix babylonica*), *Capitophorus formosartemisiae* (Takahashi) (*Artemisia vulgaris*), *C. eleagni* (del Guercio) (*Cnicus wallichii*), *Eriosoma lanigerum* (Hausmann) (*Pyrus malus*), *Liosomaphis himalayensis* Basu (*Berberis asiaticum*), *Macrosiphoniella pseudoartemisiae* Shinji (*Artemisia vulgaris*) *M. sanborni* (Gillette) (*Chrysanthemum* sp.), *Macrosiphum rosae* (L.), *M. (Sitobion) rosaeiformis* Das (*Rosa* sp.), *Mollitrichosiphum* sp. *(Alnus nepalensis), Myzus dycei* Carver *(Urtica dioica), Phorodon cannabis* Passerini *(Cannabis sativa).*
Season : May - October.
Habitat : Garden, orchard, herbage, tree.
Locality : Joshimath, Sayanachatti, Uttar Kashi (Garhwal); Almora, Dhakuri, Kausani, Nainital, Ranikhet (Kumaon).

Ghosh, Debnath and Chakrabarti (1986) studied development of this species on *Capitophorus formosartemisae, Brevicoryne brassicae, Eriosoma lanigerum* and *Macrosiphum (Sitobion) rosaeiformis.*

21. **O. sauzeti** Mulsant

Prey aphids : Aphis gossypii Glover *(Cucumis* sp.), *A. kurosawai* Takahashi *(Artemisia vulgaris), Brachycaudus helichrysi* (Kaltenbach) *(Prunus persica), Capitophorus eleagni* (del Guercio) *(Cnicus wallichii), Capitophorus formosartemisiae* Takahashi *(Artemisia vulgaris), Cavariella aegopodii* (Scopoli) *(Salix tetrasparma), C. indica* Maity and Chakrabarti *(Salix babylonica), Eriosoma lanigerum* (Hausmann) *(Pyrus malus), Hayhurstia atriplicis* (L.) *(Chenopodium album), Hyalopterus pruni* (Geoffroy) *(Prunus persica), Liosomaphis himalayensis* Basu *(Berberis asiaticum, Berberis* sp.), *Macrosiphoniella pseudoartemisiae* Shinji *(Artemisia vulgaris), Macrosiphoniella sanborni* (Gillette) *(Chrysanthemum* sp.), *Macrosiphum rosae* (L.), *M. (Sitobion) rosaeiformis* Das *(Rosa*

sp.), *Malanaphis* nr. *aurandinariae* (Takahashi) *(Pyrus pashia), Mollitrichosiphum* sp. *(Alnus nepalensis), Myzus dycei* Carver *(Urtica dioica), Phorodon cannabis* Passerini *(Cannabis sativa), Shinji orientalis (*Mordvilko) *(Pteris* sp.*).*

Season : April - October.

Habitat : Cropfield, orchard, garden, roadside herbage, tree.

Locality : Barkot, Gobindghat, Helong, Joshimath, Karnaprayag, Monsoona, Rari, Sakri, Sayanachatti, Taluka, Uttar Kashi (Garhwal); Bharari, Dhakuri, Kapkot, Kausani, Khati, Nainital (Kumaon).

This species is widely distributed throughout the Himalayan ranges of India. In 1968, a good number of this beetle were sent to NewZealand to control cabbage and cereal aphids but failed to establish there (Rao *et. al.*, 1971). Ghosh, Debnath and Chakrabarti (1986) studied the development of this species on the following aphids viz.,*Capitophorus formosartemisiae, Brevicoryne brassicae, Eriosoma lanigerum, Macrosiphum (Sitobion) rosaeiformis.*

22. Oenopia sp.

Prey aphids : Macrosiphoniella pseudoartemisiae Shinji *(Artemisia vulgaris), Rhopalosiphoninus* sp. *(Elsholtzia fruticosa).*

Season : July.

Habitat : Herbage.

Locality : Joshimath, Syanachatti (Garhwal); Khati (Kumaon).

23. ** Pania luteopustulata (Mulsant)

Prey aphids : Brachycaudus helichrysi (Kaltenbach), *Brevicoryne brassicae* (L.) *(Brassica campestris), Cavariella aegopodii* (Scopoli) *(Salix tetrsparma), Eriosoma lanigerum* (Hausmann) *(Pyrus malus), Macrosiphoniella pseudoartemisiae* Shinji *(Artemisia vulgaris), M. sanborni* (Gillette) *(Chrysanthemum* sp.*), Macrosiphum rosae* (L.) *(Rosa* sp.*), M. (Sitobion) miscanthi* Takahashi *(Triticum aestivum), M. (S.) rosaeiformis* Das *(Rosa sp.), Myzus dycei* Carver *(Urtica dioica), M. sorbi* Bhattacharya and Chakrabarti *(Sorberia tomentosa), Phorodon cannabis* Passerini *(Cannabis sativa), Prociphilus* sp. *(Lonicera quinquelocularis), Shinjia orientalis* (Mordvilko) *(Pteris* sp.*).*

Season : May - July, September - October.

Habitat : Cropfield, garden, roadside herbage, tree, orchard.

Locality : Joshimath, Nanugoan, Taluka (Garhwal).

Ghosh, Debnath and Chakrabarti (1986) studied the development of this species on the following aphid species viz., *Capitophorus pseudoartemisiae, Brevicoryne brassicae, Eriosoma lanigerum, Macrosiphum (Sitobion) rosaeiformis.*

24.* Synharmonia signatella (Mulsant)

Prey sphid Melanaphis sp. *(Bambusa* sp.*).*

Season : July.
Habitat : Tree.
Locality : Taluka (Garhwal).

Subfamily SCYMNINAE

Tribe SCYMNINI

25. **Scymnus** spp.

Prey aphids : Aphis craccivora Koch *(Vigna* sp.*), A. gossypii* Glover *(Cucurbita* sp.*), A. kurosawai* Takahashi *(Artemisia vulgaris), A. ruborum* Borner *(Rubus ellipticus), A. verbasci* Schrank *(Verbascum thapsus), Brachycaudus helichrysi* (Kaltenbach) *(Prunus persica), Brevicoryne brassicae* (L.) *(Brassica campestris), Capitophorus formosartemisiae* (Takahashi) *(Artemisia vulgaris), Eriosoma lanigerum* (Hausmann) *(Pyrus malus), Lipaphis erysimi* (Kaltenbach) *(Brassica oleracea), Macrosiphoniella pseudoartemisiae* Shinji *(Artemisia vulgaris), M. sanborni* (Gillette) *(Chrysanthemum* sp.*), Macrosiphum rosae* (L.) *(Rosa* sp.*), Melanaphis* nr. *aurandinariae* (Takahashi) *(Pyrus pashia), Rhopalosiphum maidis* (Fitch) *(Zea mays), Shinjia orientalis* (Mordvilko) *(Pteris* sp.*), Toxoptera citricidus* (Kirkaldy) *(Citrus* sp.*), Uroleucon sonchi* (L.) *(Sonchus arvensis).*

Season : April - October.

Habitat : Cropfield, garden, herbage, orchard.

Locality : Helong, Joshimath, Nanugoan, Rabigaon (Garhwal); Almora, Kapkot, Khati (Kumaon).

DISCUSSION

Most coccinellids are active fliers and able to move about in search of suitable hosts. In fact, the tendency to disperse or migrate from areas where hosts are not available sometimes substantiate their effectiveness in preventing pest outbreaks. Coccinellid aggregation in mountains e.g.,*Coccinella septempunctata, Hippodamia* species (Mani, 1962) have been noticed and perhaps after the hibernation when predator population in the field is very less, these predators migrate towards the pest population sites. Thus, the preservation of these hibernating sites of the predators are also important. The similar orientation pattern of adult and larval stages of any predatory beetle further compensate the time lag in population synchronisation of prey and predators.

With regard to their prey utilization pattern, *C. septempunctata* (26) ranks the top followed by *Oenopia sauzeti* (21), *Adalia tetraspilota* (18) and others. Further, members of subfamily Aphidinae are much more prone to predation by coccinellids followed by Pemphiginae, Drepanosiphinae, Greenideinae and Chaitophorinae. Pronounced predatory activity is noticed during the spring-summer months when large number of coccinellids appear from their hibernation quarters. This period also coincides with the period of abundance of aphid prey.

Though George (1957) noticed that *Brevicoryne brassicae* was avoided by coccinellids for waxy covering on the former's body, in our study we observed that as many as five coccinellid species are predaceous on this aphid. Similarly, *Eriosoma lanigerum*, another aphid species with similar waxy body covering was found to be predated by at least 11 coccinellid species. *Hyalopterus pruni* was seen to be predated upon by *A. tetraspilota*, while *A. decempunctata* (Dixon, 1958) and *A. bipunctata* (Hawkes, 1920) immediately reject it. Our observation which is also in conformity with Hodek (1959) shows that this aphid seems to be the essential food for *C. septempunctata*. Since, *H. pruni* generates the population in summer, the coccinellids can ingest the wax at higher temperature. We could get abundance of *Platynaspis saundersi* and its descendant larvae predating at least on 8 aphid species, though its aphidophagous nature has been questioned by Hodek (1973). Similarly, *Halyzia sanscrita*, a mycophagous species, exhibits aphidophagous habit in the present area of study.

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SUMMARY

This paper reports 25 species of coccinellids as predators of 52 species of aphids, infesting 45 different host plants from Garhwal and Kumaon ranges of western Himalaya, India. Among them, 6 species are newly recorded as predators of aphids from India and 8 from western Himalaya.

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NEMATODES OF VEGETABLES AND PULSES FROM PATNA DISTRICT, BIHAR— II

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INTRODUCTION

In an earlier communication (1984) the present authors recorded eighteen species of phytoparasitic nemotodes from Patna district, Bihar. The present paper is the second in series and deals with eight species belonging to seven genera of six families. Almost all the species are being recorded for the first time from Bihar and many hosts are also new.

SYSTEMATIC ACCOUNT

Family TYLENCHIDAE Filipjev, 1934.

1. **Tylenchus ? butteus** Throne & Malek, 1968.

Females (4) : L =) Male 0.377 - 0.432 mm, a = 26-36, b = 5.4, - 6.1, c = 4.4-5.2, c' = 10.5-13.0, V= 60-65, stylet=9-13 µm. Males (2) : L=0.33-0.34mm, a=37.0-42.5, b=5.0-5.1, c=3.7-3.9, c'=13-14, stylet=9-10 µm, spicula=11.7 µm, gubernaculum=3.9-5.2 µm.

Host : Chilli, Castor.

Locality : Dargahitola, Metra.

Remarks : The specimens fit well in the description of the species by Andrassy (1979), the only difference being unhooked tail tip. However, we prefer to put these in this species provisionally than erect a new species.

The species is being recorded from Bihar for the first time. The hosts reported here are also new.

Family NACOBIDAE (Chitwood & chitwood, 1950)

2. **Rotylenchulus reniformis** Linford & Oliveira, 1940

Females 5 (immature) : L = 0.370 - 0.396 mm, a=24-26, b=2.3-3.1, c=14-22, c'=2.0-2.5, V=72-78, stylet =15-16 µm. Males (2) : L=0.253-0.510mm, a=20-34, b=2.7-3.7, c=11-21, c'=2.1-2.6, stylet=13-15 µm, gubernaculum = 7-8 µm.

Host : Tomato, eggplant, smoothgourd, banana, pigeonpea and castor.

Locality : Baikatpur, Chhattarpur, Dargahitola, Inglis, Nirpur and Nukunpura.

Remarks: The specimens fit well in the description of the soecies by Swarup et al.(1967) & Dasgupta et al.(1968).

Family PARATYLENCHIDAE (Thorne, 1949) Raski, 1962

3. **Paratylenchus nainianus** Edward & Misra, 1963.

Female (1) : L=0.296 mm, a=15, b=3.9, c=22.8, c'=2, V=86, stylet=26 µm.

Host : Eggplant.

Locality : Umerabad.

Remarks: The specimen fits well in the description of the species by Raski (1975). The present specimen shows conoid tail with acute terminus as in some of the specimens of Raski.

This is the first record of the species from Bihar and host is also new.

Family NOTHOTYLENCHIDAE (Thorne, 1941)

4. **Nothotylenchus bhatnagari** Tikyani & Khera, 1969

Females (5): L=0.065-0.767 mm, a=28-38, b=5.7-6.8, c=10.9-16.6, c'=3.7-7.0, V=79-86, stylet= 9.0-11.7 µm.

Males (2): L=0.390-0.594 mm, a=30-35, b=4.6-5.5, c=9.3-10.1, c'=4.4-5.6, stylet=7.8-9.1 µm, spicula=13-19 µm, gubernaculum=6.5-7.8 µm.

Host : Eggplant, bean, onion, 'sonf', pea, castor.

Locality : Dargahitla, Bidhipur, Hathidah, Nirpur, Pandarak, Chhattarpur, and Nukunpura.

Remarks: The specimens fit well in the original description of the species. They show longer ranges of deManian indices. They differ only in having longer postuterine sac (smaller than one vulval body diameter in original description). However, this one difference is considered here only as intraspecfic variation among widely separated populations.

Bihar constitutes a new locality record and hosts mentioned above are also new.

Family APHELENCHIDAE (Fuchs, 1937) Steiner, 1949

5. **Aphelencus avenae** Bastian, 1865.

Females (8) : L=0.546-0.786mm, a= 20-36, b = 7.3-10.0, b' = 4.0 - 5.4, c = 17 - 40, c'

= 1.1 - 3.1, V = 72 - 80, Stylet = 14.3 - 19.5μm.

Males (4) : L = 0.468—0.600mm, a=20-38, b=6.4-7.6, b' = 3.6-4.2, c=21.0-28.5, c' =1-2, stylet=15.6-21.0 μm, spicula=19.5-23.4 μm, gubernaculum = 7.8-10.4 μm.

Host : Tomato, lemon, okra, turmeric, lobia, eggplant, smoothgourd, banana, 'sonf', bean, coriander, chilli, pea, pigeonpea, gram, and 'masur'

Locality : Maner, Neora, Silhauri, Paligunj, Lai, Inglis, Kanpa, Dilawarpur, Patot, Jaynagar, Bedhari-Inglis, Chattarpur, Haridasbigha, Athmalgola, Bakhtiyarpur, Nukunpura, Amta, Adimpur, Metra, Bidhipur, Nirpur, and Dargahitola.

Remarks : The males are stated to be rare in the species by Goodey & Hooper (1965) and Das (1960). Khera (1970) recorded 1 : 4 as male-female ratio. In the present case it was found to be 1 : 9.

The specimens showed some variations in the ranges of deManian indices. This is the first record of the species from Bihar. Smoothgourd, turmeric, 'sonf', are new hosts for the species. From locality record it appears having wide distribution in Bihar.

Family APHELENCHOIDIDAE (Skarbilovich, 1947)

6. **Aphelenchoides parietinus** (Bastian, 1865) Steiner, 1932

Females (2) : L = 0.338 - 0.541 mm, a = 22 - 32, b = 6.5 - 9.6, b'= 3.2 - 4.2, c = 14 - 15, c' 3.5 - 3.6, V = $^{22-52}$ 69-77, Stylet = 13 μm.

Host : Eggplant, pigeonpea.

Locality : Hathidah, Patot.

Remarks : The species is being recorded for the first time from Bihar and pigeonpea seems to be new host.

7. **Aphelenchoides saprophilus** Franklin, 1957

Male (1) : L =0.390mm, a = 25, b = 7.3, b' = 3.2, c = 13.5, c' = 3.5, Stylet = 13 μm, basal width = 6.5 μm. Specula-dorsal prong = 15.6 μm, ventral prong = 7.8 μm, basal width = 6.5 μm.

Host : Castor.

Locality : Dargahitola.

Remarks : The specimen tallies with the original description of the species except the

protuberance on the dorsal prong of the spicule. The body dimensions are more close to the specimens from Orissa recorded by Khera & Chaturvedi (1975).

This is the first record of the species from Bihar and host is also new.

8. **Seinura hechlerae** Chaturvedi *et al*, 1979

Male (1) : L = 0.498 mm, a = 33, b = 8.3, b' = 3.1, c = 7.04, c' = 7.6, V = 62.6, Stylet = 13 µm.

Females (12) : L = 0.338 - 0.351 mm, a=21 - 26, b = 6.8 - 7.3, b' = 3.4 - 4.4, c = 7.7 - 8.1, c' = 5.3 - 5.8, V = ?, Stylet = 13 - 14 µm.

Host : Chilli, Castor.

Locality : Kasimpur, Dargahitola.

Remarks : The specimens fit well in the original description of the species. However, they show some variations in body size, values of 'a' & 'c' in deManian formula. Chaturvedi et al. (1979), described the species from jute fields of West Bengal therefore the present record from Bihar as well as hosts are new.

SUMMARY

Eight species of tylenchid nemotedes, *Tylenchus ?butteus, Rotylenchulus reniformis, Paratylenchus nainianus, Ditylenchus bhatnagari, Aphelenchus avenae, Aphelenchoides parietinus, A. saprophilus* and *Seinura hechierae* are reported to be associated with vegetables and pulses in Patna district, Bihar.

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FIELD OBSERVATIONS ON THE MALAYAN GIANT SQUIRREL, *RATUFA BICOLOR GIGANTEA* (M'CLELLAND) AND SOME OTHER DIURNAL SQUIRRELS OF JALPAIGURI DISTRICT, WEST BENGAL

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INTRODUCTION

The giant squirrels *(Ratufa)* are most distinctive. From a review of the ecology, feeding habits and distribution of the giant squirrels, Thorington and Cifelli (in press) concluded that they exhibit a number of characteristics which make them of considerable interest and potential use as indicator species and that authentic study on the ecology of *Ratufa* will not only provide a picture of the habitat quality but also guidelines for the formulation of strategies of conservation. Within the Indian limit, three species of giant squirrels, viz., the Indian Giant Squirrel, *Ratufa indica* (Erxleben), the Grizzled Indian Giant Squirrel, *R. macroura* (Pennant) and the Malayan Giant Squirrel, *R. bicolor* (Sparrmann) occur. The first two are restricted to the Peninsular India and the third to the northeastern India. Studies on the habits, ecology, and distribution of *R. indica* were made by Hutton (1949), Abdulali and Daniel (1952), Khajuria (1955), Moore and Tate (1965) and Krishnan (1972). Phillips (1935) revealed some ecological aspects of *R. macroura* in Sri Lanka. Detailed investigations on the ecology of *R. bicolor* and some other species of giant squirrels were carried out in Malaya and Vietnam (Tien 1972, Mackinnon 1978, Payne 1979a, 1979b, 1980). No detailed information about the habit and ecology of *R. bicolor* occurring in the Indian range are available. Only one subspecies, *R. b. gigantea* (M'clelland) occurs within the Indian range.

In connection with the study of species-composition of rodents in West Bengal a faunistic survey tour to Jalpaiguri district, was undertaken by the authors from 2nd to 23rd September, 1983. During the survey, authors could get some opportunity of direct observations on the activity pattern and population of *R. b. gigantea* in different forest ranges of Jalpaiguri district. These findings are reported in the present paper along with notes on the other two species of diurnal squirrels, *viz.*, *Callosciurus pygerythrus* (Geoffroy) and *Funambulus pennanti* Wroughton occurring in the district. The report is mainly based on 69 sighting records of *R. b. gigantea* and 36 sighting records of other two species.

STUDY AREA

Three forest ranges, *viz.*, Diana, Khuntimari and Chilapata of the Jalpaiguri district have been surveyed. In all the forest ranges of the district, plantation and forest exploitation are regular processes. At Diana, forest is of mixed primary type and mainly composed of plants like *Dalbergia sisso, Acacia catechu, Salmalia malabarica, Albizzia lebbek, Duabanga sonneratiodes, Wrightia tomentosa, Trewia nudiflora,* etc., with creepers and thick under-

growth. At Khuntimari, forest is quite rich and moist tropical type, consisting of *D. sisso, A. catechu, Sterculia villosa, Dillenia pentagyna, Eugenia jambolana, Phyllanthus emblica, Elaeocarpus ganitrus*, etc. Undergrowth is very thick and interspersed with various species of grasses. Patches of dry mixed forest, predominated by *Shorea robusta, Tectona grandis, Gmelina arborea and Terminalia belerica* are also met with. Forest at Chilapata is largely secondary mixed deciduous, consisting chiefly of various planted trees and thick undergrowth. Trees are mostly common to that of Khuntimari. All the three ranges have considerable area of riverine grass jungle particularly at Chilapata. Forest villages with some cultivated land are found in each range. 'Pucca' and 'Kacha' roads of nearly 2-4 metre wide, pass through the forest ranges, thus dividing them into a number of blocks, each ranging 100 to 200 hectares in area.

METHOD

The authors and other three party members along with the Forest department people surveyed the forests from about 6.00 hours to about 13.30 hours and again from 15.00 hours to about 23.00 hours. Survey was done on foot along the jungle roads, but occasional entry was made deep inside the forest to follow or chase the animals. During the survey work, in addition to making collections of zoological specimens by trapping, netting and shooting, field observations were made on the habits and activity of different species of mammals. Survey was conducted from 4th to 6th at Diana, 8th to 14th at Khuntimari and 16th to 21st at Chilapata during the month of September. However, about 32 hours of survey work distributed in different days were wasted due to heavy rain. To have an idea about the relative abundance of different species of diurnal squirrels specific survey along the jungle roads (a total of about 7 km.) covering nearly 300 hectares of Chilapata forest range was made in the morning and evening of 17th and 18th September.

Date and timing of each sighting of the diurnal squirrels together with the name of the species, type of activity, location of the animal on the plant were recorded. As far as possible scientific or local names of the plants were noted. The range of activity of the animal in the canopy was estimated by eye to the nearest two meters. The records relate to the animal at the moment of first sighting. However, observation on the undisturbed animal was continued so long it could be followed. Most of the plants and food items were identified by the authors in the field with the help of the State Forest Department people and rest were collected and identified with the help of the scientists of the Botanical Survey of India, Calcutta.

Five specimens of *R. b. gigantea* (2 Male, 3 Female) were collected and their reproductive condition, stomach-contents studied.

Two dreys of *R. b. gigantea* and in same number of *F. pennanti* were collected for detailed examination.

OBSERVATIONS

Sighting frequency :

Specimens of *R. b. gigantea* were recorded in all the three forest ranges throughout the study period. Out of a total of 69 sighting records, five were made at Diana, 40 at Khuntimari and 24 at Chilapata. For *C. pygerythrus*, 19 sighting records were made at the Chilapata range. Out of 17 sighting records of *F. pennanti*, four were made at Diana and 13 at Chilapata range. First two species of squirrels were recorded in the forest proper, and the last one near hamlets.

Activity hours :

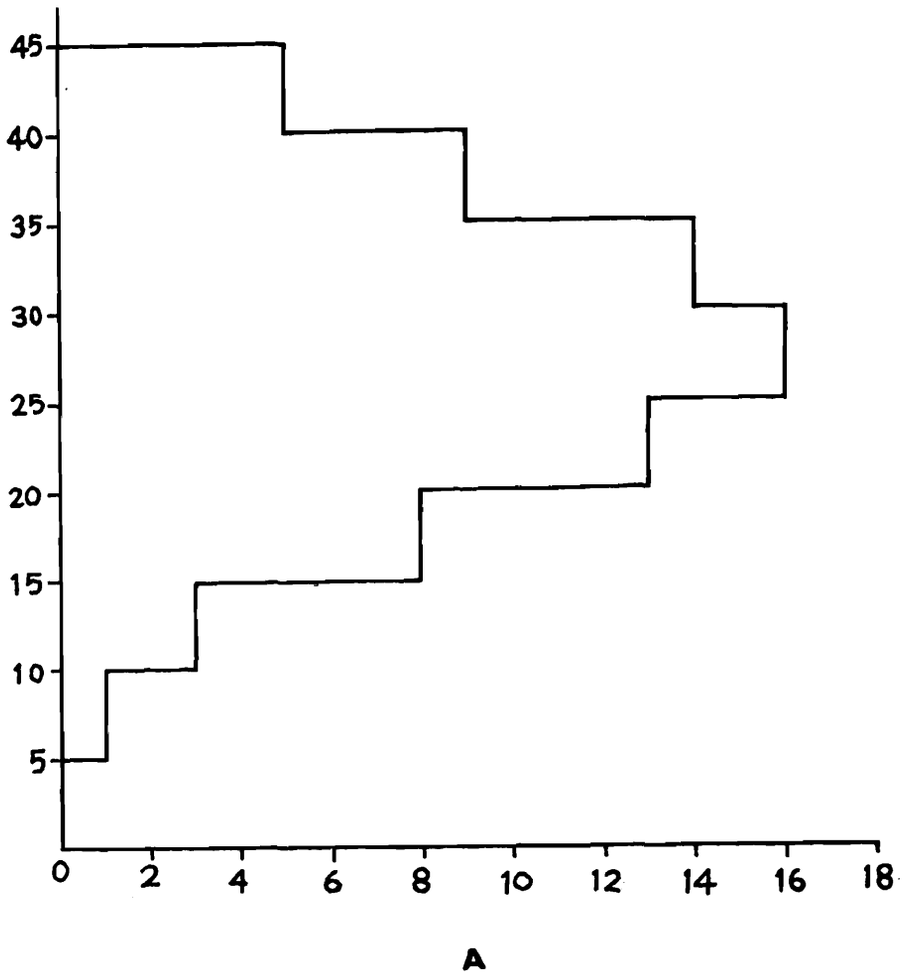
Sightings of *R. b. gigantea* were recorded during the day, from 7.00 hours to 18.10 hours except between 12.05 hours and 15.15 hours. However, no survey was conducted inside the forest from 13.30 hours to 15.30 hours and only casual observations were made from the camp itself. From the frequency of hourly sighting records (Table 1), it appears that peak of activity is reached late in the morning from 8.00 to 9.00 hours and in the afternoon 16.00 to 17.00 hours. Activity hours of *F. pennanti* almost tally with that of *R. b. gigantea*. However, for *C. pygerythrus*, activity reached at its peak just before dusk, *i.e.*, between 17.00 and 18.00 hours. Frequency of hourly sighting records revealed that all the three species of squirrels remain active from about an hour after the sunrise to dusk, with a lean period at noon. At the time of heavy or moderate rains no specimens of *R. b. gigantea* could be noticed, but during drizzles it could be seen feeding.

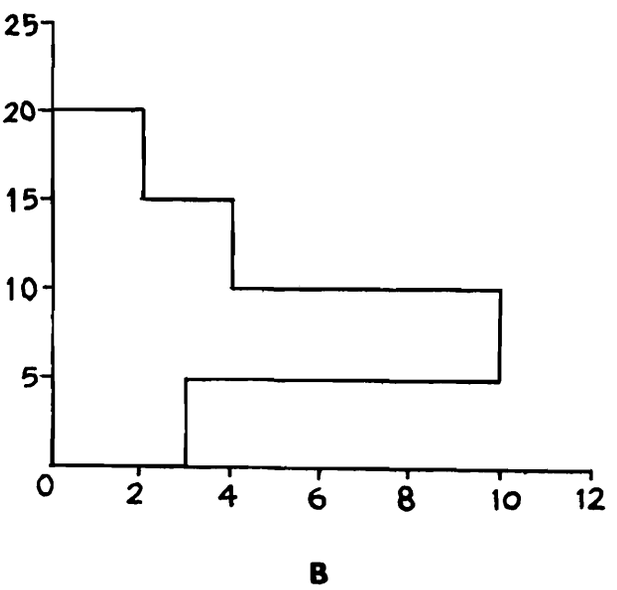
Vertical distribution :

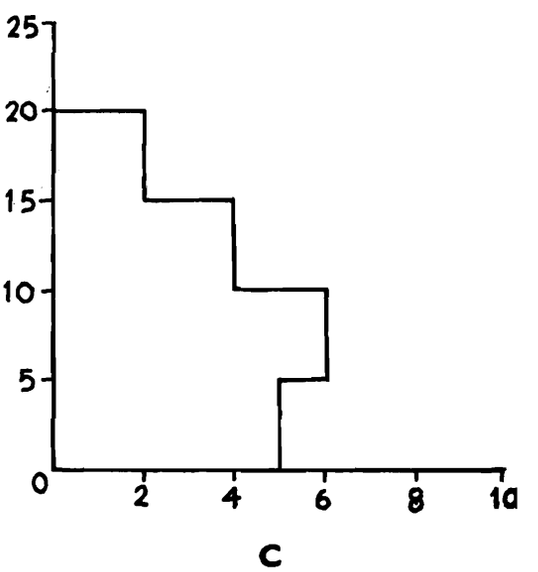
Based on the location of the squirrels in the tree at the time of first sighting, vertical distributions of three species are graphically represented in Text-fig. 1. The graph shows that *R. b. gigantea* is strictly arboreal. It does not descend below 5 metre and mostly found above 15 metre. Maximum sightings were recorded at a height of 20-25 metre. The other two species were found below 18 metre. Both of them, particularly *F. pennanti*, often came down to the ground for feeding, ascending other trees or some man-made structures. Maximum sightings of both species were recorded at a height of 5-10 metre. The Malayan Giant Squirrel totally avoids the ground and passes from one tree to another with powerful horizontal and descending leaps or through some connecting branches.

Drey :

While moving through all the three forest ranges, a good number of dreys of *R. b. gigantea* were observed. These dreys can easily be located by their large, globular structure and being situated in a somewhat open area of the plant particularly at the beginning of slimmer branch or twig. Both the dreys collected were brown in colour, made up of leaves, twigs and tendrils. Single circular opening of the drey is situated on one side of the upper surface. The diameter of the dreys varied widely being 25 cm. and 52 cm. No padding material or stored food articles were found inside. Young ones were absent from both the dreys. None of the dreys were observed below 18 metre. Only one drey could be seen in a tree. There was no plant specificity for the construction of drey, but they were mostly located on *S. robusta* and *D. sisso*.







Text-fig. 1. Graphic representation of the vertical distribution of three species of squirrels based on sighting records.
Vertical axis = Height in meters ; Horizontal axis = Number of sightings ; A. *R. b. gigantea*, B. *C. pygerythrus*, C. *F. pennanti*

Dreys of *F. pennanti* were observed on trees as well as on the roof of huts. Dreys collected were globular in structure, 10 and 12 cm. in diamerer, with a somewhat triangular opening on the upper side. Varieties of material such as, leaves, cotton, jute, grass, paper and even wire were used in the construction of drey. Out of two dreys examined, floor was padded with cotton in one. However, no stored food material was found.

Dreys of *C. pygerythrus* could not be noticed.

Home range :

Since the individual specimen of squirrel could not be marked, it is not possible to state authentically the home range of each species. Most of the dreys of *R. b. gigantea* were located in the central region of a forest block, but animals were often seen foraging in the region where the forest opens particularly along the jungle roads. It was also observed that Malayan Giant Squirrel was passing from one block of the forest to the other by crossing the jungle roads through canopy. This suggests that at least for feeding, *R. b. gigantea* moves round a quite large area covering one or more blocks of the forest, each ranging from 100 to 200 hectares.

From direct observations, it appears that the home range of *F. pennanti* is relatively less, being restricted within one or two trees or to the neighbouring huts of the village.

No estimate about the home range of *C. pygerythrus* could be made as this animal is very wary and hides in the thick foliage as soon as an intruder is observed. Moreover, no drey of this species in the forest could be located.

Population :

From the frequency of the sighting records it appears that forest at Khuntimari supports a good population of *R. b. gigantea*, but the other two species of diurnal squirrels are apparently absent. The secondary mixed forest of Chilapata sustains three species of diurnal squirrels and from sighting records it appears that the population of *R. b. gigantea* is the highest followed by *C. pygerythrus*. In the mixed primary forest of Diana, population of diurnal squirrels appears to be less than in the other two forest ranges surveyed. However, at Diana, *R. b. gigantea* and *F. pennanti* occur. The latter species was apparently scarce and restricted to the outskirts of the forest range.

A specific survey was conducted in about 300 hectares of Chilapata forest range. It gives an idea about the relative population density of three species of squirrels (Table 2). The number of dreys were also counted during specific survey. As many as 38 dreys of *R. b. gigantea* and 3 dreys of *F. pennanti* were observed. Findings of the present survey indicate the higher population density of *R. b. gigantea* as compared with that of other two species of squirrels. However, it was also felt that in the forest, *R. b. gigantea* is very conspicuous by its large size, loud harsh cackle, deep black-light buff coloration, and habit of dropping seeds, fruits or even twigs during feeding. Tilting of the finer branches of the trees due to their movement often draws attention from far distance. On the other hand, *C. pygerythrus* is often overlooked owing to their relatively small size, wary habit and agouti coloration

which matches with the colour of the bark. Thus, the estimate of relative population density from sighting is inevitably rough. However, taking all the three species of diurnal squirrels into account, the overall squirrel density at the Chilapata forest range appears to be very low, being about 0.05 animal per hectare.

Food habit :

Most of the sighting records of *R. b. gigantea* were made during their feeding. When undisturbed, it was found to feed on a single tree for even up to 40 minutes. However, about 50 per cent of this time was spent on actual feeding and the rest in search of food or observation. A particular animal could be seen feeding on a particular fruiting tree daily in the morning or afternoon, following a definite track from its drey. Fruiting trees at the outskirts of the forest or along the jungle roads were most preferred for foraging. However, it was never seen to feed on the trees of the forest village.

During feeding, *R. b. gigantea* regularly drops seeds, fruits, leaves, twigs from the canopy and also makes sound. It was observed to feed on a variety of plant species, consuming leaves, flowers, bark and fruits. Depending on the type and condition of the fruit, it may consume the entire fruit, only the soft part or seed. In table 3, food items taken by *R. b. gigantea* along with the number of feeding occasion have been shown. From the frequency, *D. sisso* appeared to be the most preferred plant, followed by *S. robusta.* However, this may be a seasonal feature. None of the records showed feeding on insects or other animals. Analysis of the stomach contents of five specimens revealed only vegetable matter.

Feeding of *C. pygerythrus* was recorded only on three occasions and never on the species of plants selected by *R. b. gigantea.* Once it was observed to feed on the bark of *Acacia catechu* and on two occassions on seeds of *S. villosa.*

Funambulus pennanti apparently feeds only on the trees of forest villages. Of the five feeding records of this species, three involve fruits of *Ficus bengalensis* and one each on the seeds of *Areca catechu* and fruits of *Psidium guava.*

Reproduction :

No sign of breeding activity was observed in any of the three species. In all the three females specimens of *R. b. gigantea* vaginal orifice was perforated and mammae were prominent. However, none of them was lactating or contained foetuses or visible embryos.

DISCUSSION

Hourly sighting records of all the three species revealed that they remain active in the morning and afternoon and take rest during mid day as has been mentioned by Prater (1980).

Earlier records about the vertical distribution of squirrel species, assigned them to arboreal, terrestrial and scansorial categories (Harrison 1962). All the three species in the present study are principally arboreal and may occur in the same forest range. However, there is a clear line of demarcation in the utilisation of the forest strata by each of them.

Table 1. Hourly sighting records of three species of diurnal squirrels in the forest of Jalpaiguri district, West Bengal.

Species	Frequency of sighting records									
	7.00-8.00 hours	8.00-9.00 hours	9.00-10.00 hours	10.00-11.00 hours	11.00-12.00 hours	12.00-13.00 hours	15.00-16.00 hours	16.00-17.00 hours	1700-18.00 hours	18.00-19.00 hours
R. b. gigantea	6	20	9	4	3	1	5	16	4	1
C. pygerythrus		2	3	1	1	1		1	8	2
F. pennanti	1	5	3	1	1		1	2	2	

Table 2. Sighting records of the three species of diurnal squirrels during the specific Survey at Chilapata.

Species	Number of sighting records	
	On 17.9.1983	On 18.9.1983
R. b. gigantea	7	8
C. pygerythrus	6	4
F. pennanti	4	4

Table 3. Food items taken by the diurnal squirrels in the forest of Jalpaiguri District, West Bengal

Species of squirrels	Species of plant on which feed	Part of plant consumed	Feeding occasion
R. b. gigantea	*Dalbergia sisso*	Flower	3
		Leaves	6
		Bark	2
		Fruit	6
	Shorea robusta	Fruit	8
		Leaves	4
		Bark	5
	Careya arborea	Fruit	2
	Gmelina arborea	Bark	1
	Schima wallichii	Seed	2
		Leaves	1
	Phyllanthus emblica	Leaves	1
	Ficus bengalensis	Fruit	2
		Bark	1
	Trewia nudiflora	Fruit	2
	Putranjiba roxbergii	Fruit	2
	Elaeocarpus ganitrus	Fruit	2
	Michelia champaca	Seed	1
		Leaves	1
	Terminalia belerica	Fruit	1
		Bark	1
C. pygerythrus	*Acacia catechu*	Bark	1
	Sterculia villosa	Seed	2
F. pennanti	*Ficus bengalensis*	Fruit	3
	Psidium guava	Fruit	1
	Areca catechu	Seed	1

Although *C. pygerythrus* and *F. pennanti* have considerable overlapping vertical distribution, practically no competition exists between the two. Former is restricted to the forest proper, while the latter is almost confined to the villages. Mackinnon (1978) also found differential use of the various strata of the same forest structure by the seven species of diurnal squirrels.

From the food habits, it appears that squirrels are mostly dependant on the fruits. Howeve, many of the plant species of the present survey area have irregular fruiting cycles. Some species fruit once in every two, three or even five years, so that fruiting patterns of no two successive years are exactly the same. Thus, it is difficult for the frugivorous animals to locate the food in a routine way in every year. Again, different plant species have different chemical and physical defences against herbivore predators. The predators have to evolve way of breaking down the defence. Thus, any given plant predator is able to utilise only a small percentage of the forest flora. As a result to locate the suitable feeding plants, an animal has to move a lot within the forest. This may be one of the factors for the larger home range of the Giant Squirrel.

Number of the dreys of the Giant Squirrel observed in a particular region of Chilapata forest range were more than the number of animals visible in that area. It suggests that the same individual may build a number of dreys within its home range as it is reported for *R. indica* (Krishnan 1972). However, it could not be ascertained whether a particular individual was using more than one drey simultaneously or rotationally or only one drey discarding the older ones.

It has been noted that dreys of *R. b. gigantea* are constructed on the comparatively slimmer branches. This is obviously to provide additional protection to young ones and even the adults during rest against heavier predators.

All the three species of the present study have been observed to feed only on plants. However, records of their omnivorous habit are not uncommon. According to Tickell (in Blanford 1891, p. 374) Malayan Giant Squirrel takes insects and eggs of birds. Ghosh (1981) reported an incidence of flesh eating by *C. pygerythrus*. Agrawal (1965), McCann (in Moore and Tate 1965, p. 74), Sood and Dilber (1977) referred to the omnivorous habit of *F. pennanti*. In fact, rodents, though principally herbivorous, also feed on insects, eggs and flesh (Jameson 1952, Prasad 1954, Harrison 1954, Prakash 1962, Fall *et. al.*, 1971, Chakraborty 1977). It has also been established by the above studies that consumption of a wide variety of food items is to select the best possible balanced diet from the available food resources. Thus, in the present study though all the three species were observed to consume only plant material, they can probably take other food items, if required.

Food habit, and foraging regions of the three species of squirrels indicate that inspite of their occurrence in the same geographical area, there is apparently no competition among them for food. The Malayan Giant Squirrel does not appear to feed on the trees of forest villages. The authors had, however, opportunity of observing a specimen of *R. indica*

feeding on a ripe papaya *(Carica papaya)* at a height of only three meters in a garden of Kumli, a village adjacent to the Periyar Sanctuary, Idduki district, Kerala.

From the food habits of three species it may be concluded that, though *F. pennanti* shares some amount of human food, none of them appears to be pest at least in the present study area.

Based on the trapping data, Harrison (1969) stated that spuirrel-abundance ranges from 0.6 to 1.9 per hectare in different forest areas of Malaysia. At Krau Game Reserve, Pahang, Malaysia, at least seven species of squirrels occur and their density is about two animals per hectare (Mackinnon 1970). Thus, diversity as well as density of diurnal squirrel species appeared to be much less in the area of our study than in other regions. In the forest of Jalpaiguri, legal as well as illegal felling of trees is a regular feature which destroy a good number of dreys along with the young ones. Well established populations of various species of frugivorous birds, Rhesus Macaque, *Macaca mulatta* (Zimmermann), and Langur, *Presbytis entellus* (Dufresne) share considerable amount of forest flora with the squirrels. Extensive grass jungle within the forest are of no use to squirrels for food or shelter. Moreover, squirrels particularly *R. b. gigantea*, are often killed for flesh and skin by the local people. All the above factors may contribute to the relatively low population density of diurnal squirrels in the forests of Jalpaiguri district.

SUMMARY

Peak activity of the three species of diurnal squirrels of Jalpaiguri district is attained during morning and the afternoon. There is clear cut demarcation about the utilisation of canopy among the three species. Dreys of *R. b. gigantea* and *F. pennanti* revealed no stored food material or young ones. All the three species feed on the fruits, seeds, bark of the different available plant but there is apparently no competition among them for food. Population of *R. b. gigantea* in the jungle of Jalpaiguri is more than other two species of squirrels. In the study area, density of diurnal squirrels was about 0.05 animal per hectare. No sign of breeding in any of the three species was observed during the survey.

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STUDIES ON PREDATORY PROSTIGMATID MITES OF NORTHEAST INDIA WITH DESCRIPTIONS OF NEW SPECIES AND NEW RECORDS FROM INDIA

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INTRODUCTION

Many of the prostigmatid mites belonging to the families : Stigmaeidae, Bdellidae, Cunaxidae, Tydeidae and Cheyletidae, are known to be efficient predators of phytophagous mites and small insects and thereby play important role in biological control programme Chaudhri *et al.*, 1974; Ueckermann & Smith—Meyer, 1987). However, our knowledge regarding prostigmatid mites from India is scanty and excepting Gupta & Ghosh (1980) practically nothing is known from India. So far as the predatory prostigmatid-mites of northeast India is concerned, practically no studies have so far been made although that region is florestically very rich with luxuriant vegetation and, hence, it can be presumed that fauna thereof will also be equally rich. Therefore, with a view to exploring the predatory prostigmatid mite fauna of northeast India and also to throw some light if they have any importance in natural control of pests, this programme was taken up and this, being the first part of the study dealing with the faunal survey, is presented in this paper.

A total of 34 species under 8 families and 14 genera are dealt with, of which, 21 species, 9 under Stigmaeidae, 5 under Bdellidae, 3 under Cunaxidae, 2 under Tydeidae and 1 each under Cheyletidae and Anystidae are described here as new to science. In addition, 2 species and 5 genera are reported here for the first time from India. Incidentally, all are new reports for the region. Descriptions and illustrations of all the new species are given here. Measurements given in the text are in microns. All the types are deposited in the National Collection of the Zoological Survey of India, Calcutta. The entire collection was made by the author.

Order PROSTIGMATA

Key to the families of predatory prostigmatid mites found in northeast India.

1. Without palpal thumb-claw complex 2
   With palpal thumb-claw complex 5

2. Rod-like solenidion on tarsus I usually lying flush with tarsus in a specialised membra nous depression; anteriorly propodosoma with a tubercle bearing 1-pair of setae, soft bodied, without projection over gnathosoma .....Eupodidae
   Rod-like solenidion on tarsus 1 erect, arising from a small circular membranous base 3

3. Cheliceral bases fused, or if not fused, not capable of lateral scissors-like motion over gnathosoma.....Tydeidae
   Cheliceral free, attached at base and free to move scissors-like laterally across gnathosoma.....4

4. With 2 pairs of genital suckers, the relatively long palpi turned inward, distal segment usually claw- like, free living.....Cunaxidae
   With 3 pairs of genital suckers, the relatively long palpi elbow -like with distal setae, free living .....Bdellidae

5. Chelicerae free, hinged at bases so that they are capable of scissors-like motion in a horizontal direction .....Anystidae
   Chelicerae bases fused or partly fused, with needle- like or hook -like movable chelae 6

6. Cheliceral bases closely fused with gnathosoma and without indication of suture; peritreme usually M- shaped, may be present on gnathosoma .....Cheyletidae
   Chelicerae bases fused with each other but not with gnathosoma having suture ; conspicuous; pertreme usually present on anterior portion of propodosoma 7

7. Dorsal plating absent or feebly developed; cheliceral bases fused to form stylophore which dorsally may bear sinuous chambered peritreme or else the peritreme reaching into chelicerae; freeliving .....Caligonellidae.
   Dorsal plating variable ; peritremes not reaching into chelicerae ; cheliceral bases independently movable but may be adnate or stylophore like ; legs I and II directed anteriorly and III and IV directed posteriorly .....Stigmaeidae.

Family STIGMAEIDAE Oudemans, 1931

Key to the genera and species of Stigmaeidae occurring in northeast India

1. Propodosoma covered by one or more unpaired plates .....*Agistemus*,
   Hysterosoma covered by one extensive plate.....*Ledermulleria* L. *parryorum* sp. nov.

2. Propodosomal shield reticulate.....3
   Propodosomal shield not reticulate 6

3. Ratio of setae ae/ae-ae more than 2.....4
   Ratio of setae ae/ae-ae less than 2..... *heterophylla* sp. nov.

4. Ratio of setae ae/ae-ae more than 3 .....*gamblei* sp. nov.
   Ratio of setae ae/ae-ae more than 3.....5

5. Reticulation pattern of propodosomal and hysterosomal plates as in fig 1 ..... *fleschneri* Summers
   Reticulation pattern of propodosomal and hysterosomal plates as in fig 8..... *lakoocha* sp. nov.

6. Setae ae/ae - ae 1.5 or more 9
   Setae ae/ae-ae less than 1.5 7

7. Setae a/a-a less than 1..... *hystrix* sp. nov.
   Setae a/a-a 1 or more than 1 8

8. Setae a and 1a almost equal ..... *javanicum* sp. nov.
   Setae 1a considerably longer than a ..... *edulis sp.* nov.

9. All dorsal setae barbed 10
   Dorsal setae not barbed..... 11

10. Setae 1e much longer than e ..... *obscura* sp. nov.
    Setae 1 e much shorter than e ..... *industani* Gonzalez

11. Postocular body very large almost touching setae be and ce .....
    ..... *macrommatus* Gonzalez
    Postocular body never so large 12

12. Setae ae and be almost of same length ..... *exsertus* Gonzalez
    Setae ae shorter than be 13

13. Setae c and 1a almost of same length ..... *aramatai* sp. nov.
    Setae c longer than 1a ..... *garrulus* Chaudhri *et al.*

Genus **Agistemus** Summers

1. **Agistemus fleschneri** Summers
(Fig. 1)

1960. *Agistemus fleschneri* Summers, Proc, ent.. Soc. Wash., **62** : 237-240.

Female : Dorsal propodosomal plate with polygonal reticulation, reticulation on median plate with not less than 12 cells between successive dorsocentral setae, as figured., covering 2/3 of hysterosoma, with polygonal cell-type reticulation. Measurements of setae : ae-44, ae/ae-ae- 2.5, be-69, be/be-1.5, ce-60, ce/ce-ce- 61, a-50, a/a-a-. 73, la-47, b-46, lm-52, c-52, li-56, e-33, le-13. Palpus extends upto genutibial joints. Legs moderately long with smooth setae. Dorsal setae weakly barbed. Postocular body inconspicuously outlined, its diameter not twice greater than that of eyes. Ventral opisthosomal setae strong ; g_1 extends beyond g_2 Body 365 long, 170 wide.

Material examined : 1 Female, Arunachal Pradesh, Siji, ex unknown plant, 15.x.1981; 1 Female, Assam, Badarpur, ex litchi, 7. xii. 1983; 1 Female, Manipur, Bishenpur, ex mango, 22.xi.1985; 1 Female, Tripura, Agartala, ex *Lantana*, 12.xii. 1983.

Remarks : Earlier, this mite was reported from Assam, Delhi, Punjab and West Bengal in India (Gupta, 1985) and from outside India it was reported from U.S.A. (Gonzalez, 1965) and Taiwan (Tseng, 1982). Wood (1967) and Tseng (1982) considered *Agistemus* Summers as synonym of *Zetzellia* Oudemans which the present author does not agree at this stage. This mite was often associated with eriophyid colony on mango (Manipur) but its feeding was not observed.

2. **Agistemus aramatai** sp. nov.
(Figs. 2-4)

Female : Propodosomal and hysterosomal plates smooth, with 3 pairs of setae on the former plate and 5 pairs on the latter plate. All setae weakly barbed. Setae ae>ae-be, be≥be-be, ae/ae-ae- 1.5, a-la -67, ae-44, be-67, ce-49, a-44, b-broken, la-44, c-53, lm-44, setae b nearer to la than to lm. Palp tibial claw of same length as that of palp tarsus. $Pg_1>Pg_2$, $g_1=g_3>g_2=g_4$. Chaetotaxy of legs in respect of segments : femur, genu, tibia and tarsus : 1-5, 3, 6, 12, 11-4, 1,6,10,III-2,0,6,7,IV-2,0,6,? Body 408 long, 256 wide. Postocular body distinct.

Male : Unknown.

HOLOTYPE : Female, INDIA : Arunachal Pradesh, Garu, ex *Castanopsis armata*, 15. vii. 1981.

Remarks : This species is close to *Agistemus unguiparvtis* Gonzalez (1965) but differs in respect of relative length and ratios of dorsal setae. It differs from A. *garrulus* Chaudhri et al. (1974) in relative length of ae/ae-ae. This mite was collected from a colony of *Tetranychus cinnabarinus* on which it might have fed as the gut content of the predator was deeply reddish.

3. **Agistemus obscura** sp. nov.
(Figs. 5-7)

Female : Body 443 long, 112 wide. Propodosomal plate distinct, with 3 pairs of setae, all reasonably long, barbed and measure : ae-47, ae/ae-ae-1. 8, be/be-be-1. 1, ce-60, ce/ce-ce-.40. Postocular body as figured, diameter-33. Propodosomal plate unornamented. Seta be longer than the distance between its base and that of ce, all the setae thick and gently barbed. Hysterosoma well differented, unornamented with setae a-51, b-62, la-64, lm-67, c-67, li-60, le-40, e-22, e almost half of le and the latter is shorter than ae, he-53. Humeral plate distinct. Posterior portion of hysterosoma striated. Tibial claw longer than tarsus, the latter with 3-forked seta. Ventrally, Pg_1 and Pg_2 equal, 18 long, g_1-g_3-16-18, g_4-12. Legs I-

IV with claws, each rayed. Genu I with 1 long barbed seta, other tibiae with 2 barbed setae; tarsus I with 2 long setae; tarsus II with long setae, tarsus III-IV lack long setae. Intercalaries plate closer to median plate.

Male : Unknown.

HOLOTYPE : Female INDIA : Manipur, Imphal, ex *Ficus obscura*, 14. xi.1983.

Remarks : This new species is close to *Agistemus longisetus* Gonzalez(1963) from which it differs in relative ratios of ae/ae-ae and a/a-a. Further, from A. giganteus Ehara and Wongsiri (1984) it differs in relative length of be/be-be and also in length of e and l e as e longer than l e in giganteus while it is half the length of l e in this new species.

4. **Agistemus lakoocha** sp. nov.
(Figs. 8 - 10)

Female : Body 331 long, 204 wide. Palp tibial claw slightly shorter than palptarsus. At the base of tibial claw, 4 stout setae present. Palp tarsus with a trifid seta. Propodosomal and hysterosomal plates reticulate, the former bears 3 pairs of setae measuring : ae-38, ae/ae-ae- 2.5, be-71, be/be-be-1.4, ce-58, ce/ce-ce-.6. Area immediately posterior to propodosomal plate with transverse striation, laterally obliquely striated. All setae thick, not serrate. Propodosomal plate gently reticulate. Median plate reticulate with 5 pairs of setae measuring a-47, la-44, b-47, lm-53, c-53, he-35. Area lateral to median plate longitudinally and posterior to median plate transversely striated. Setae li-54, le-33, e-17. Paragenital setae 2 pairs, annogenital setae 4 pairs. Genu I and II each with 1 lateral seta, those of other legs not discernible. Tarsus I with 2 long setae, tarsus II with 1 long seta, tarsus III - IV without such seta. Postocular body well demarcated.

Male : Unknown.

HOLOTYPE : Female INDIA : Arunachal Pradesh, Tezu, on *Artocarpus lakoocha*, 23.i.1983.

Remarks : This new species resembles *Agistemus fleschneri* Summers (1960) from which it differs in relative length and ratios of dorsal setae and in leg chaetotaxy.

5. **Agistemus heterophylla** sp. nov.
(Figs. 11-14)

Female : Propodosomal plate with 3 pairs of setae and hysterosomal plate with 5 pairs of setae, both the plates with reticulation as figured. All setae long, unbarbed measuring ae-40, be-78, ce-58, ae/ae-ae- 1.2, be/be-be-1. 1, ce/ce-ce-. 31, he-45, a-58, la-71, b-56, lm-64, c-64, li-56, le-31, e-20. Palptarsus almost as long as palptibial claw. Tarsus I-IV with 2 claws, tarsus I with 1 long seta, tarsus II with 1 long seta, tarsus III-IV without long setae.

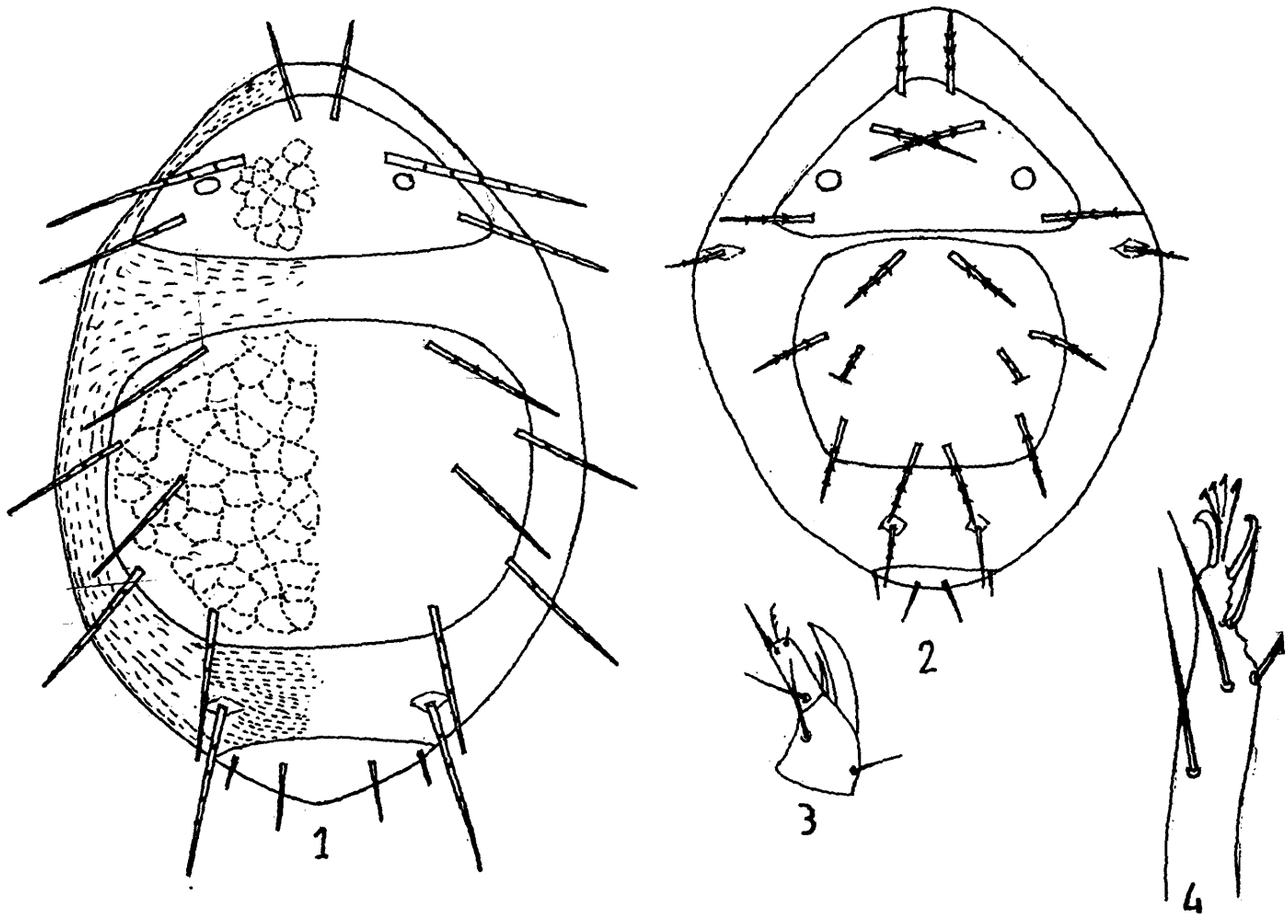
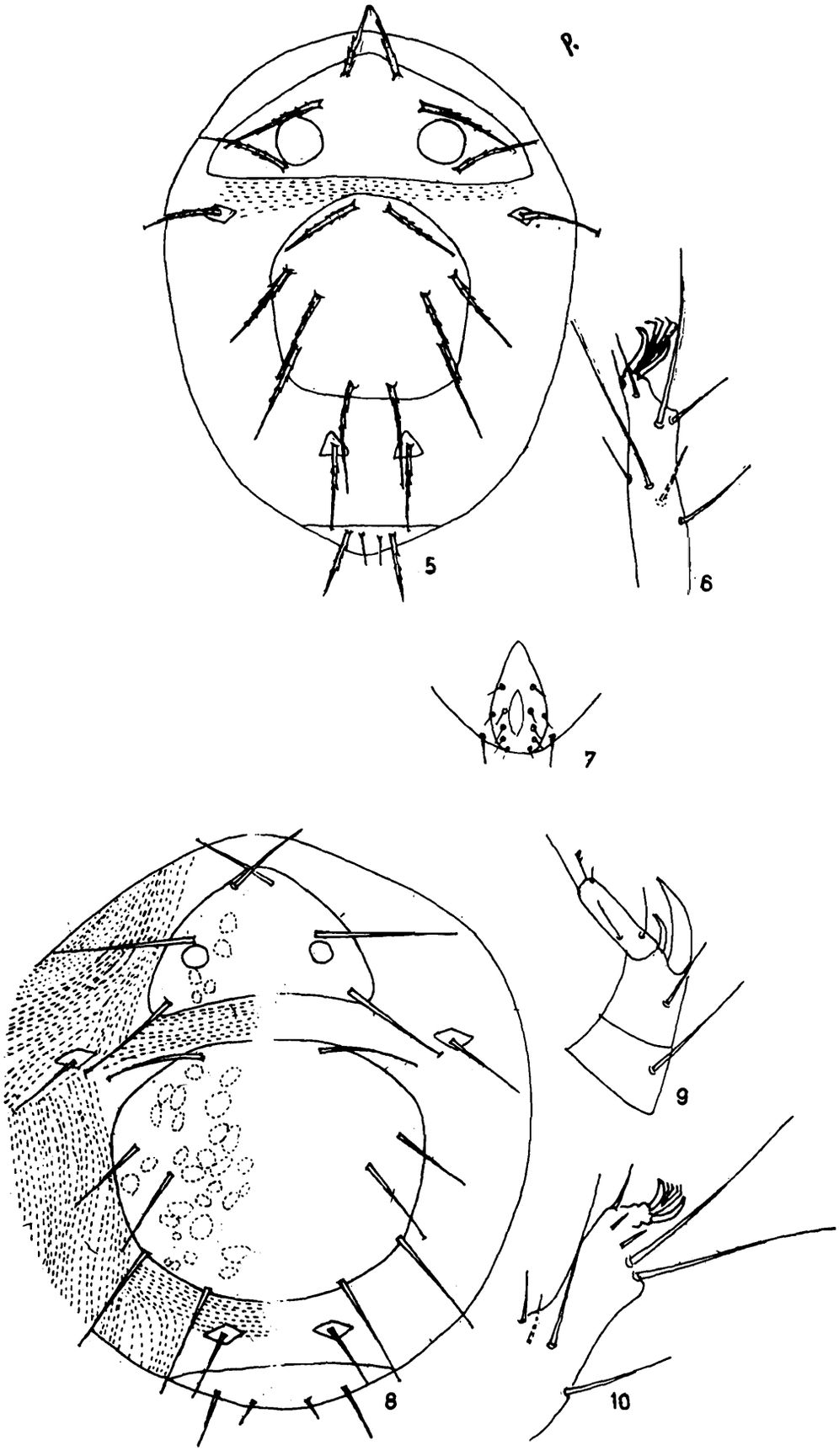


Fig. 1. *Agistemus fleschneri* Summers dorsal aspect.

Figs. 2-4 : *Agistemus aramatai* sp. nov. (Female). 2-dorsal aspect; 3-tibial and tarsal segments of palp ; 4- tarsus of leg I.



Figs. 5-7 : *Agistemus obscura* sp. nov. (Female). 5- dorsal aspect; 6- leg I, 7- Venter ot opisthosoma.

Figs. 8-10 : *Agistemus lakoocha* sp. nov. (Female). 8- dorsal aspect; 9- tibial and tarsal segments ; 10- tarsus of leg I.

Barbed seta on genu I shorter than segment. Paragenital setae 2 pairs, subequal. Genital seta g_1 reaches almost upto g_3; $g_1.g_2=g_3=g_4$. Leg chaetotaxy : femora I-IV-5, 4,2,2; genu I-IV-3, 1, 0, 0; tibia I-IV-6,6,6,6.

Male : Unknown.

HOLOTYPE: Female, INDIA : Arunachal Pradesh, Loilang, ex *Girardinia heterophylla*, 22.i.1983.

Remarks: This species is close to *Agistemus fleschneri* Summers (1960) but differs from the latter in relative lengths of be/be-be and ce/ce-ce. From A. *impavidus* Chaudhri *et al.* (1974) it differs in relative ratios of e/l e which is less than 1 in this new species and one and half times in *impavidus*. This mite was seen in the field in a colony of *Eotetranychus*, chasing a nymph.

6. **Agistemus hystrix** sp. nov.
(Figs. 15-17)

Female : Propodosomal and hysterosomal plates well demarcated, the former bearing 3 pairs of setae and the latter with 5 pairs of setae. Most of the dorsal setae thick and minutely barbed. Integument transversely striated between propodosomal and hysterosomal plates. Measurements of setae : ae/ae-ae-1.4, be-73, ce-51,he-44, a-56/a-a- .67, b-56, b/b-b- 4, la-broken, lm-broken, le-20, e-26. Diameter of postocular body-28. Paragenital setae 2 pairs, extends upto the tip of g_2. Body 458 long, 295 wide. Dorsalmost seta of femur I-44 long. Chaetotaxy of femur and genu of legs I,II,III,IV: 5,4; 4, 1; 2, 0; 2, 0. Apical sensillum of palptarsus trifid; Setation of tibia I - IV nude.

Male : Unknown.

HOLOTYPE: Female, INDIA : Manipur, Moreh, ex *Castanopsiss hystrix*, 25.xi.1983.

Remarks: This new species is close to *A. terminalis* (Quayle, 1912) but differs from the latter in relative ratio of ae/ae- ae, ce> he and palptarsus as long as tibia I. From *A. siamensis* Ehara and Wongsiri (1984) it differs in relative length of a/a-a which is less than 1 in this new species and more than 1 in *siamensis*.

7. **Agistemus exsertus** Gonzalez
(Figs. 18-19)

1963. *Agistemus exertus* Gonzalez, *Acarologia*, **2** : 343 - 344.

Male : Propodosomal and hysterosomal plates with 3 and 5 pairs of setae respectively, all setae nude, long, measure : ae - 49, be-47, ce-53, ae-ae-31, ae-be-26, be-ce-40, a-53, b-34, c-51, la-56, lm-34, a-a-53, he-38. Postocular body distinct. Pg_1 shorter than Pg_1- Pg_2.

Female : Could not be collected.

Material examined : 1 Female, Assam, Bhuban hills, ex an undetermined weed, 6. xii. 1983.

Remarks : This is first report of this species from India. Earlier to this it was known from Taiwan (Tseng, 1982) and Japan (Gonzalez, 1963). It was found in the colony of an eriophyid species but it was not seen to attack it.

8. Agistemus macrommatus Gonzalez
(Figs 20-22)

1965. *Agistemus macrommatus* Gonzalez, *Univ. Calif. Pub. Ent.*, **41** : 38-39.

Female : Propodosomal and hysterosomal shields smooth. Dorsal setae thick and insignificantly barbed. Integument transversely striated between propodosomal and hysterosomal plates ; integument posterior to it transversely striated. Measurements of setae : ae-51, ae-ae- 33, ae/ae-ae- 1.5, be- 78, be-be- 72, ce-56, be>be-ce, a-58, a-a- 53, b- 60, c- 67, la- 56, lm- 67, he-56, e- 35, le- 15 ; diameter of postocular body - 35. Paragenital setae 2 pairs, annogenital setae 4 pairs ; g_1 extends almost upto the middle of g_2. Palptarsus and tibial claw of same length ; palptarsus with 3-tined seta. Dorsalmost seta of femur I as long as or slightly shorter than the lateral seta. Body 560 long, 250 wide.

Material examined : 2 Females, Arunachal Pradesh. Deban, ex papaya, 16. i. 1983.

Remarks : The description of Gonzalez (1965) more or less agrees with the present description. Originally it was described basing on specimens collected from Coimbatore and was subsequently reported from Taiwan (Tseng, 1982). In the field, it was found to be feeding on the nymph of *Eutetranychus orientalis* (Klein).

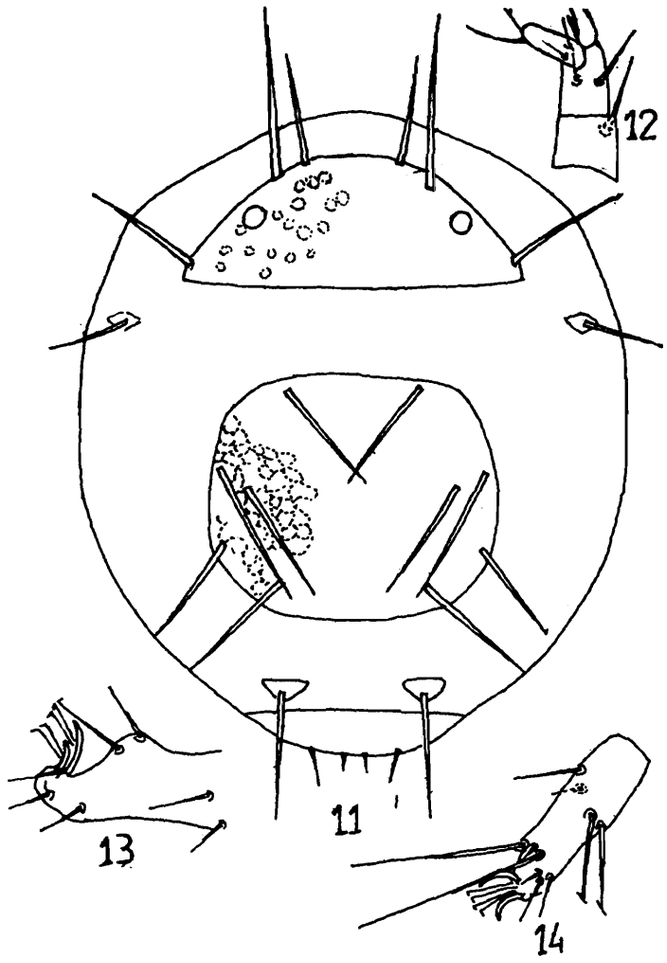
9. Agistemus industani Gonzalez
(Fig. 23)

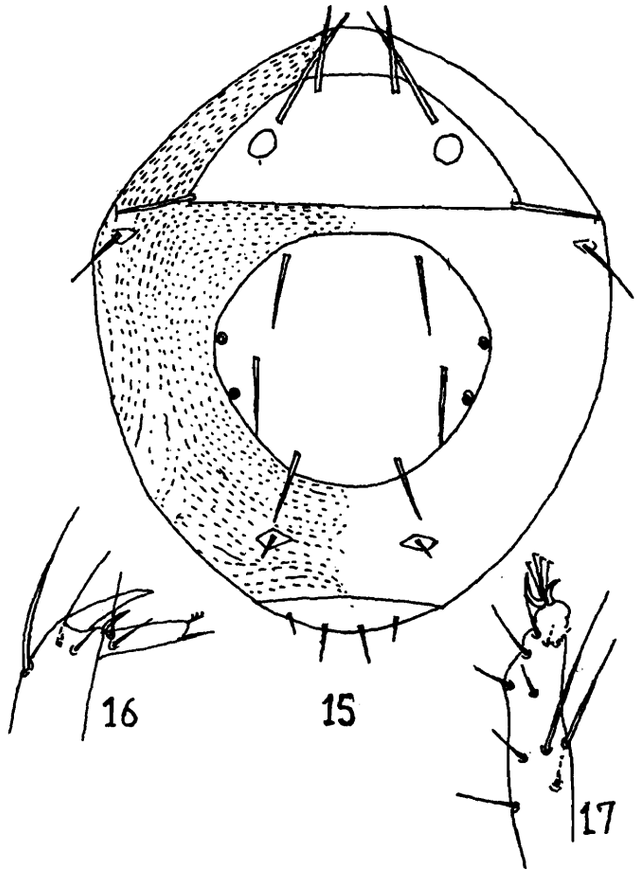
1965. *Agistemus industani* Gonzalez, *Univ. Calif. Pub. Ent.*, **41** : 40.

Female : Body 492 long, 295 wide. Measurements of setae : ae-56. ae-ae- 29, ae/ae-ae-1. 9, be-78, be-ce- 71. ce-60, a- 56, a-a-49, b-67, a-b- 67, c- 69, la-67, lm- 67, e- 38, le- 24, li- 67, he- 51. All dorsal setae barbed minutely, thick, not tapered ; g_1 extends upto half of g_2. Dorsalmost seta of genu I little over 1.3 times as long as lateral seta.

Material examined : 1 Female, Nagaland, Kohima, *ex Maoulla puya*, 14. xi. 1985.

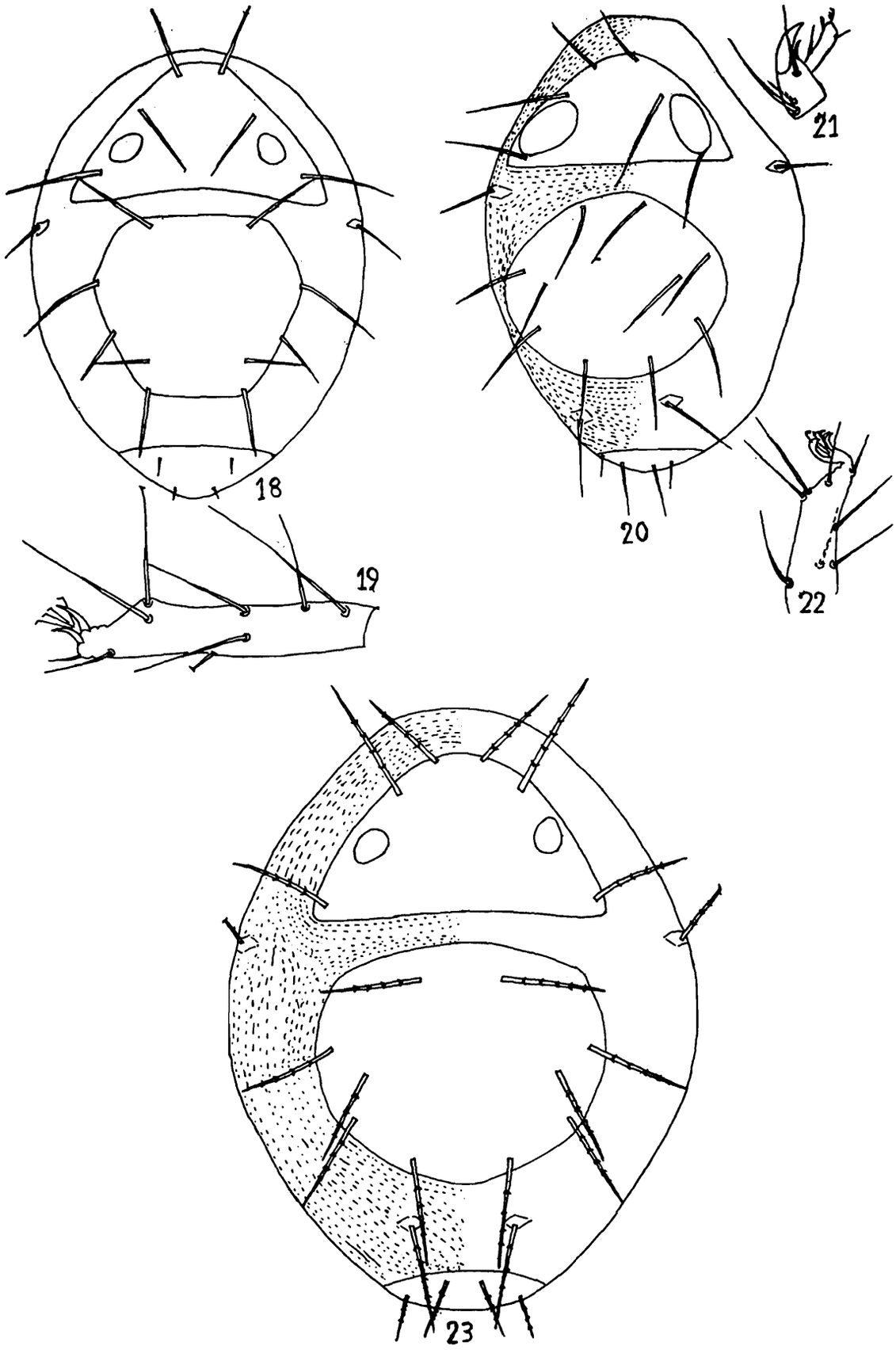
Remarks : This species was earlier known from Coimbatore. It is the second report of this species from India. It was collected from a colony of *Eotetranychus* sp. on which it was not found feeding.





Figs. 11-14 : *Agistemus heterophylla* sp. nov. (Female). 11-dorsal aspect; 12- tibial and tarsal segments of palp ; 13- tarsus of leg II ; 14- tarsus of leg I.

Figs. 15-17 : *Agistemus hystrix* sp. nov. (Female). 15-dorsal aspect; 16. tibial and tarsal segments of of palp ; 17- tarsus of leg I.



Figs. 18-19 : *Agistemus exertus* Gonzalez (Female) : 18- dorsal aspect; 19- tarsus of leg I.

Figs. 20-22 : *Agistemus macrommatus* Gonzalez (Female). 20- dorsal aspect; 21- tibial and tarsal segments of palp ; 22- tarsus of leg I.

Fig. 23 : *Agistemus industani* Gonzalez (Female) - dorsal aspect.

10. **Agistemus javanicum** sp. nov.
(Figs. 24-26)

Female : Body 450 long, 290 wide. Propodosomal and hysterosomal plates well demarcated with the former bearing 3 pairs of setae and the latter bearing 5 pairs of setae. Measurements of setae : ae-49, ae-ae- 35, ae/ae-ae- 1. 4, be-71, a-56, a-a-56, b-51, a/a-a-1, 1a - 60, lm-71, c-51, li-62, le-24, e-33, he-56. Integument between propodosomal and hysterosomal plates transversely striated, lateral area of hysterosomal plate longitudinally striated. Palp tarsus with 3 tined seta. Chaetotaxy of femur, genu and tibia of legs : I- 5, 4, 6 ; II- 4, 1, 6 ; III- 2, 0, 6, IV- 2, o, 6. Seta g_1 longer than Pg_1. All setae on tibia I and II nude. Palptibial claw greater than palptarsus. Pg_1 and Pg_2 almost of same length. Postocular body almost as long as broad.

HOLOTYPE: Female, INDIA : Manipur, Ukhrul, ex *Cleidion javanicum*, 16. xi. 1983.

Remarks : This new species is close to *Agistemus terminalis* (Quayle, 1912) but differs in having ae/ae-ae-1. 4, a/a-a-1, li<lm and e<li.

11. **Agistemus edulis** sp. nov.
(Fig. 27)

Male : Propodosomal and hysterosomal plates distinct with 3 pairs of setae on former and 5 pairs on the latter. Measurements of setae : ae-44, be-78, ce-62, a-56, b-62, c-67, la-67, ae-ae-31, ae-be-26, a-b-67. Width of postocular body much less than the distance between be-ce. Striation transverse between anterior propodosomal and posterior hysterosomal shields. Legs all crumpled and, hence, chaetotaxy not discernible.

Female : not known.

HOLOTYPE: Male, INDIA ; Arunachal Pradesh, ex *Macheles edulis*, 24.i.1983.

Remarks : It is close to *Agistemus siamensis* Ehara & Wongsiri (1984) but differs in relative length of dorsal prpodosomal setae.

12. **Agistemus gamblei** sp. nov.
(Figs 28-30)

Female : Propodosomal and hysterosomal plates distinct, reticulate, the former with 3 pairs of setae and the latter with 5 pairs of setae. The measurements of setae : ae-44, ae/ae-ae-3.6, be-76, be/be-be-1.4, ce-67, ce/ce-ce- 6, a-44, la-47, lm-58, c-56, he-39, li- 53, le-26, e-33, a/a-a-. 5 ae>ae-be, a-la= little less than one and half of a, be nearer to la than to lm. Postocular body not well demarcated. Body 408 long, 204 wide.

Male: Unknown.

HOLOTYPE: Female, INDIA : Arunachal Pradesh, Digaru, ex *Machilus gamblei*, 28.i.1983.

Remarks : This new species differs from *Agistemus impavidus* Chaudhri *et al.* (1974) in relative length of e/le which is .6 in this new species and 1.6 in *impavidus* and from A. *fleschneri* it differs in relative ratios of ae/ae-ae as it is 3.6 in this new species and 2.5 in *flechneri*.

13. **Agistemus garrulus** Chaudhri, Akbar & Rasool

1974. *Agistemus garrulus* Chaudhri, Akbar & Rasool, Univ. Agril. Lyallpur, Pakistan, p. 197-200.

Material examined: 1 Female, Meghalaya, Songsok, ex mulberry, 28. ix. 1988.

Remarks: This species was collected in association with *Panonychus ulmi* chasing a nymph of the latter. This is the first record of the species from India and earlier to this it was known only from Pakistan.

Genus **Ledermuelleria** Oudemans

14. **Ledermulleria parryorum** sp. nov. (Figs. 31-32)

Female : Length (excluding gnathosoma) 257, 235 wide. Body oval. Dorsum entire, no suture between propodosomal and hysterosomal regions, dorsum reticulate, the walls of network thin and indistinct, visible only with high powered microscope. Dorsum bears 8 pairs of setae, all being spine-like, barbed. The length of setae : anteriormost-72, 4 laterals measure respectively 89, 78, 82, 78; posteriormost-56; 2 setae present mediodorsally ; both being 74 long, one pair of eyes present between second pair of propodosomal setae. Gnathosoma : palptarsus extends upto tibiae I, palptibial claw well developed. Chelicerae fine, neele-like. Legs all very short ; tarsi of first leg with 1 pair of setae, a pair of claws present. Ventrally, with 2 pairs of preanal setae, 3 pairs of annogenital setae present.

Male : Unknown

HOLOTYPE: Female, INDIA : Arunachal Pradesh, Hyauling, ex *Mussandra parryorum*, 26. i. 1983.

Remarks : This new species is close to *Ledermuelleria acidophila* Wood (1972) from which it differs in setation of dorsal plate and in striation pattern of dorsal plate. From *L. corticola* Wood (1966) it differs in nature of hysterosomal setae.

Family BDELLIDAE Duges, 1834

Key to the genera and species of Bdellidae occur in northeast India

1. Tibia I, II, IV and tarsi III, IV with long sensory setae .... Odontoscirinae *Bdellodes*, 2
   Tibia I, IV and tarsi III, IV with long sensory setae ..... Bdellinae, *Bdella*, 3

2. Chelicera with 2 setae, hysterosoma with 11 pairs of setae .... *Bdellodes manipurensis* sp. nov.
   Chelicera with 1 seta, hysterosoma with 15 pairs of setae .... *Bdellodes grandiflora* sp. nov.

3. Hysterosomal setae of characteristic shape as in fig. .....*Bdella khasyana* sp. nov.
   Hysterosomal setae not like above 4

4. Palp tibiotarsus with 9 setae ..... *Bdella atro* sp. nov.
   Palp tibiotarsus with 10 setae ..... *Bdella anguistifolius* sp nov.

Subfamily BDELLINAE Grandjean
Genus **Bdella** Latreille

15. **Bdella atro** sp. nov.
(Figs. 33-35)

Female : Body 855 long, 358 wide. Propodosoma and hysterosoma not separated by suture. Entire dorsum finely striated. Striation of propodosoma anteriorly transverse, posterior to that longitudinal and tortuous. Hysterosomal striae mostly longitudinal laterally. Propodosoma with 2 pairs of sensilla, anterior pair 90 long, posterior pair 71 long; anterior sensilla and posterior sensilla 78 apart ; median propodosomal setae-67 long. Hysterosomal setae 9 pairs, internal humeral-76 long. Chelicera longer than palp femur, transversely striated. Hysterosomal setae of similar length. Ventral idiosomal setae of moderate length, simple, pointed. Each genital plate with 2 pairs of setae, of those, 2 are in linear row ; 1 pair of preanal setae present. Each leg with 2 well developed claws and empodium, each 5-7 rayed. Tibia I - 112 long, II - 89, III-110, IV-112 long. Coxal setal formula : I-2, II-2, III-2, IV-2. Other leg setae.

	Coxa	Trochanter	Basifemur	Telofemur	Genu	Tibia	Tarsus
I	3	5	3	3	4	7 + 1 trichoboth.	20
II	?	6	3	4	3	5 + 1 trichoboth.	26
III	3	5	4	3	4	7	14 + 1 trichoboth
IV	3	?	?	?	4	5 + 1 trichoboth.	14 + 1 trichoboth.

Fifth segment of palp cylindrical with 2 long setae ; 3rd and 4th segments equal.

Male : Unknown

HOLOTYPE: Female, INDIA : Arunachal Pradesh, Siji, ex *Viburnum atro*, 15. x. 1981.

Remarks : This new species differs from *Bdella neograndjeani* Meyer & Ryke (1959) in relative length of propodosomal sensory setae and in palpal chaetotaxy. This mite was observed in a colony of *Tarsonemus* sp. on which probably it fed.

16. **Bdella angustifolius** sp. nov.
(Figs 36-38)

Female : Body 1020 long, 525 wide. Palp with striation, 3rd and 4th segments almost equal ; 5th segment cylindrical with a pair of long setae. Chelicera 510 long, a pair of setae present. Hypostome transversely striated, striation indistinct, with 6 pairs of setae. Dorsum of idiosoma striated as figured ; anterior sensillum - 89 long, posterior sensillum- 89 long, median propodosomal seta- 85. Hysterosomal thick, pointed, internal humeral-80 long, external humeral - 80 long. Venter of hypostome appears to be striated. Each genital plate with 4 setae in linear arrangement. Legs with claw having at least 5 rays. Coxal setal formula of legs I-IV : I-2, 2, 3, 3. Length of tarsus and tibiae of legs I-IV : I- 182, 78 ; II-156, 78 ; III- 170, 89 ; IV-172, 90. Leg chaetoraxy not clearly discernible. Tarsus III-IV with a trichoboth, tibiae I, II and IV also with sensory setae.

Male : Unknown.

HOLOTYPE: Female, INDIA; Manipur, Moreh, ex *Canthium angustifolium*, 24. xi. 1983.

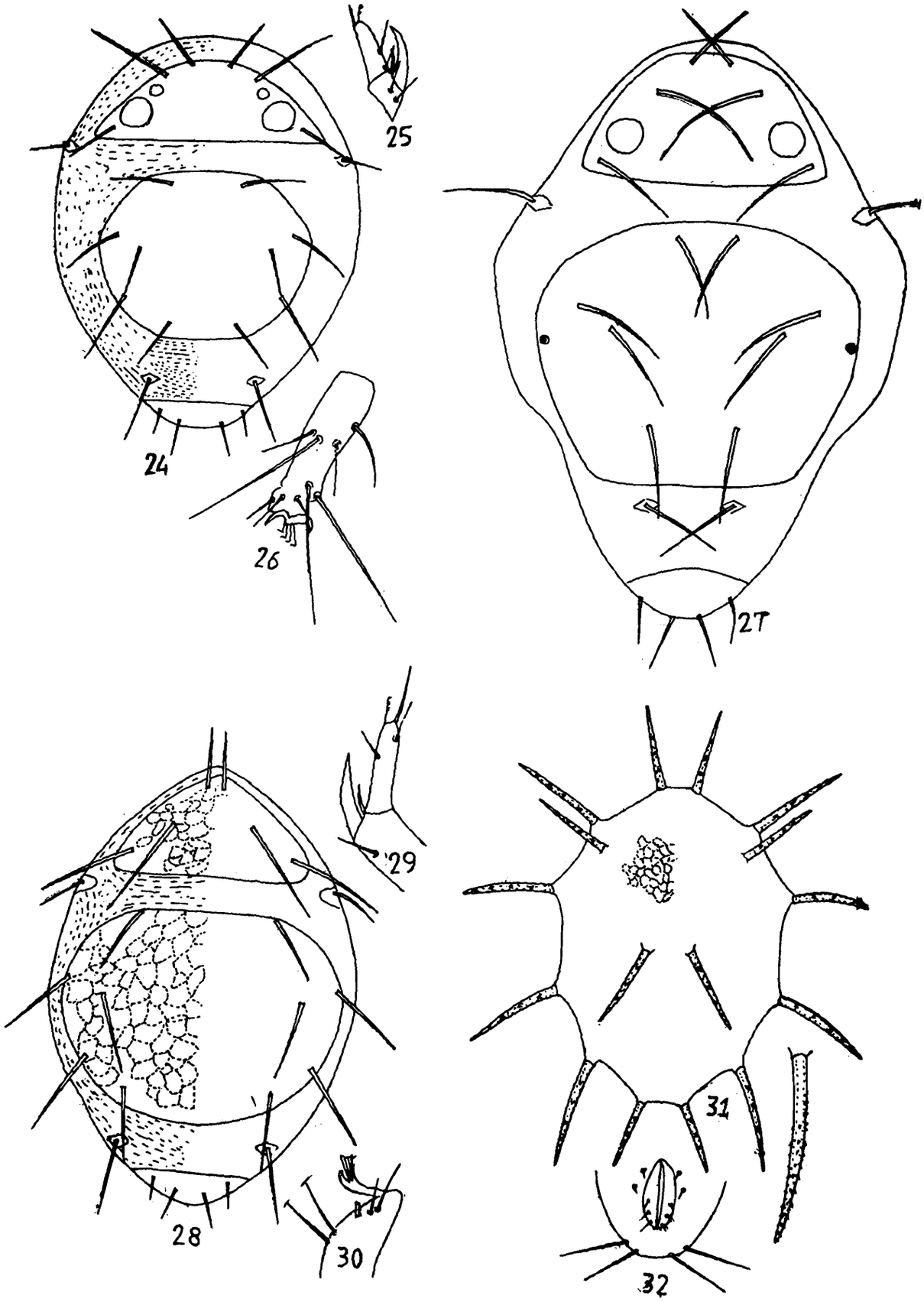
Remarks: This species differs from *Bdella atro* sp. nov. in palpal and leg chaetotaxy and from *B. thori* Meyer & Ryke (1959) in palpal chaetotaxy.

17. **Bdella khasyana** sp. nov.
(Figs. 39-41)

Female : Suture absent between propodosoma and hysterosoma. Two pairs of eyes present on each side of propodosoma. Propodosoma with 4 pairs of setae. Lateral propodosomal seta longer than median propodosomal seta. Striation on propodosoma mostly longitudinal ; hysterosoma bears 9 pairs of setae and those are of characteristic shape as figured. Striation of hysterosoma transverse in the region of dorsocentral setae and longitudinal laterally. Chelicera with longitudinal striation, chela edentate ; movable dgit sickle shaped ; 2 setae on chelicera. Palp with normal segmentation ; tibiotarsus with 6 setae, 2 long whip - like setae present terminally ; genu with 4 setae. Hypostome with 6 pairs of setae. Each leg with 2 claws and rayed empodium. Detail leg chaetotaxy not discernible as the legs are crumpled.

Male : Unknown.

HOLOTYPE: Female, INDIA : Arunachal Pradesh, Along, ex. *Litsaea khasyana*, 19. xi. 1981.

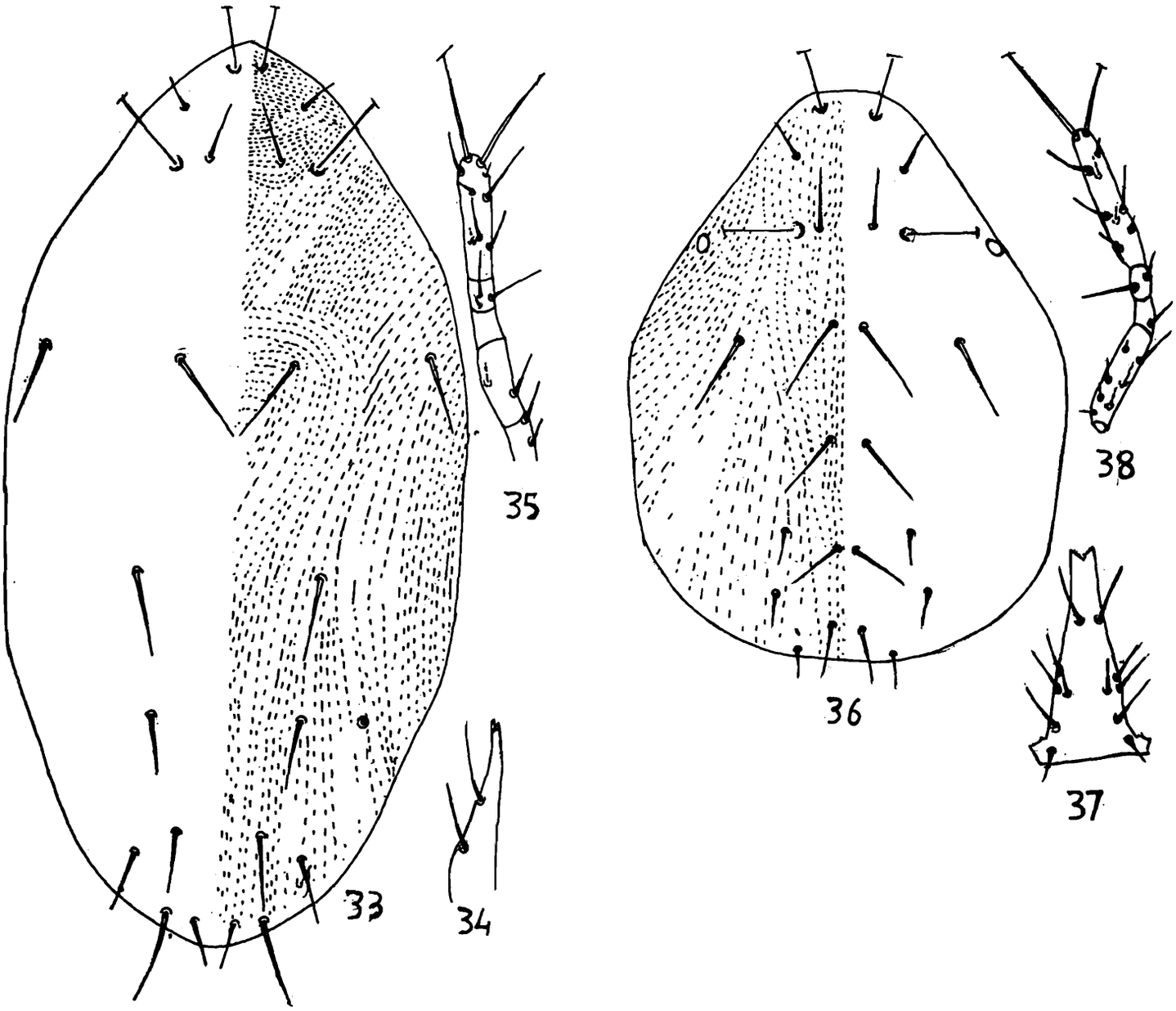


Figs. 24-26: *Agistemus javanicum* sp. nov. (Female). 24- dorsal aspect; 25- tibial and tarsal segments of palp ; 26- tarsus of leg I.

Fig. 27 : *Agistemus edulis* sp. nov. (Male)- dorsal aspect.

Figs. 28-30 : *Agistemus gamblei* sp. nov. (Female). 28- dorsal aspect; 29- tibial and tarsal segments of palp; 30- tarsus of leg I.

Figs 31-32 : *Ledermulleria parryorum* sp. nov. (Female). 31-dorsal aspect; 32- venter of



Figs. 33-35 : ***Bdella atro*** **sp. nov. (Female) 33-dorsal aspect, 34-chelicera; 35- palp.**

Figs. 36-38 : ***Bdella angustifolius*** **sp. nov. (Female). 36-dorsal aspect; 37- ventral aspect of gnathosoma ; 38- palp.**

Remarks: This species differs from *Bdella captiosa* Atyeo (1063) but differs in relative length of dorsal idiosomal setae and their characteristic shape.

Genus **Bdellodes** Oudemans

18. **Bdellodes manipurensis** sp. nov.
(Figs. 42-44)

Female : Body 663 long (from base of gnathosoma to posterior tip of body), 331 wide (at the base of II coxae). Propodosoma and hysterosoma continuous having no suture in between. The striation of propodosoma mostly transverse, in mid-dorsal region of propodosoma the striation transverse and longitudinal towards the margin. Propodosoma bears 4 pseudostigmata each with a long seta, anterior one 112 long. The setae on hysterosoma much longer (over 110 long). One median eye and 2 pairs of lateral eyes present on propodosoma ; 11 pairs of setae present on hysterosoma ; posterior setae longer than the distance between their bases. Ventrally, hysterosoma with 4 pairs of setae. The length of setae from basal pairs onwards ; 27, 33, 45, 45. Hypostome longitudinally striated allthrough ; Chelicera little inflated at base with 2 setae. Movable digit sickle shaped. Pedipalp with no seta on coxa, basifemur with 8 setae (5 dorsal, 3 ventral), telofemur with 1 seta, genu with 3 setae, tibiotarsus - 11 setae. Among the 2 whip like setae on tibiotarsus, one is slightly longer than the other. Palp segments all along transversely striated. All the legs with a pair of claws and rayed empodium.

HOLOTYPE: Female, INDIA : Manipur, Imphal, *ex mango*, 26. i. 1983.

Remarks: The new species differs from all the related species by presence of 11 pairs of hysterosomal setae as well as in setation palptarsus.

19. **Bdellodes grandiflora** sp. nov.
(Figs. 45-48)

Female : Body 750 long, 270 wide. Propodosoma with striation not of superimposed type. Anterior propodosomal sensory seta 123 long, posterior sensory seta 134 long, median propodosoma 124 long, quite thick. No demarcation between propodosoma and hysterosoma. Striation pattern in propodosomal plate mostly longitudinal, striation transverse anteriorly. Hysterosoma with 15 pairs of setae, all thick and appear to be weakly barbed. Chelicera with 1 seta and having 2 digits, both edentate, movable digit sickle shaped. Palp with tibiotarsus long, cylindrical with 12 setae including 2 whip like setae measuring respectively 189, 299 ; a thick seta present at the tip ; genu with 4 setae and telofemur with 1 seta ; telofemur and genu almost of same length. Hypostome ventrally with 6 pairs of setae. All legs with a pair of claws and rayed pulvillus.

Male : Unknown

HOLOTYPE: Female, INDIA : Arunachal Pradesh, Garu, ex *Thunbergia grandiflora*, 16. x. 1981. Paratype Female, data same as for holotype.

Remarks : This species resembles *Bdellodes tanta* Atyeo (1963) in having 1 seta on chelicera but differs from it in having genu with 4 setae only insted of over 6 setae. It also resembles *Bdellodes oraria* Atyeo (1963) in having genu with 4 setae but differs from it in having 1 cheliceral seta.

Family CUNAXIDAE Thor, 1902

Key to the genera and species of Cunaxidae occur in northeast India

1. Palp 3 segmented ..... *Neocunaxoides cerasoides* sp. nov.
   Palp 5 segmented ..... *Cunaxa*, 2

2. Dorsal scutum transversely divided into 2 scuta, femoral process of palp longer and flange like .....*Cunaxa capreolus*

3. Palp genu with a strong, blunt and broadly tipped process.....
   ..... *Cunaxa curassavica* sp. nov.
   Palp genu without such process 4

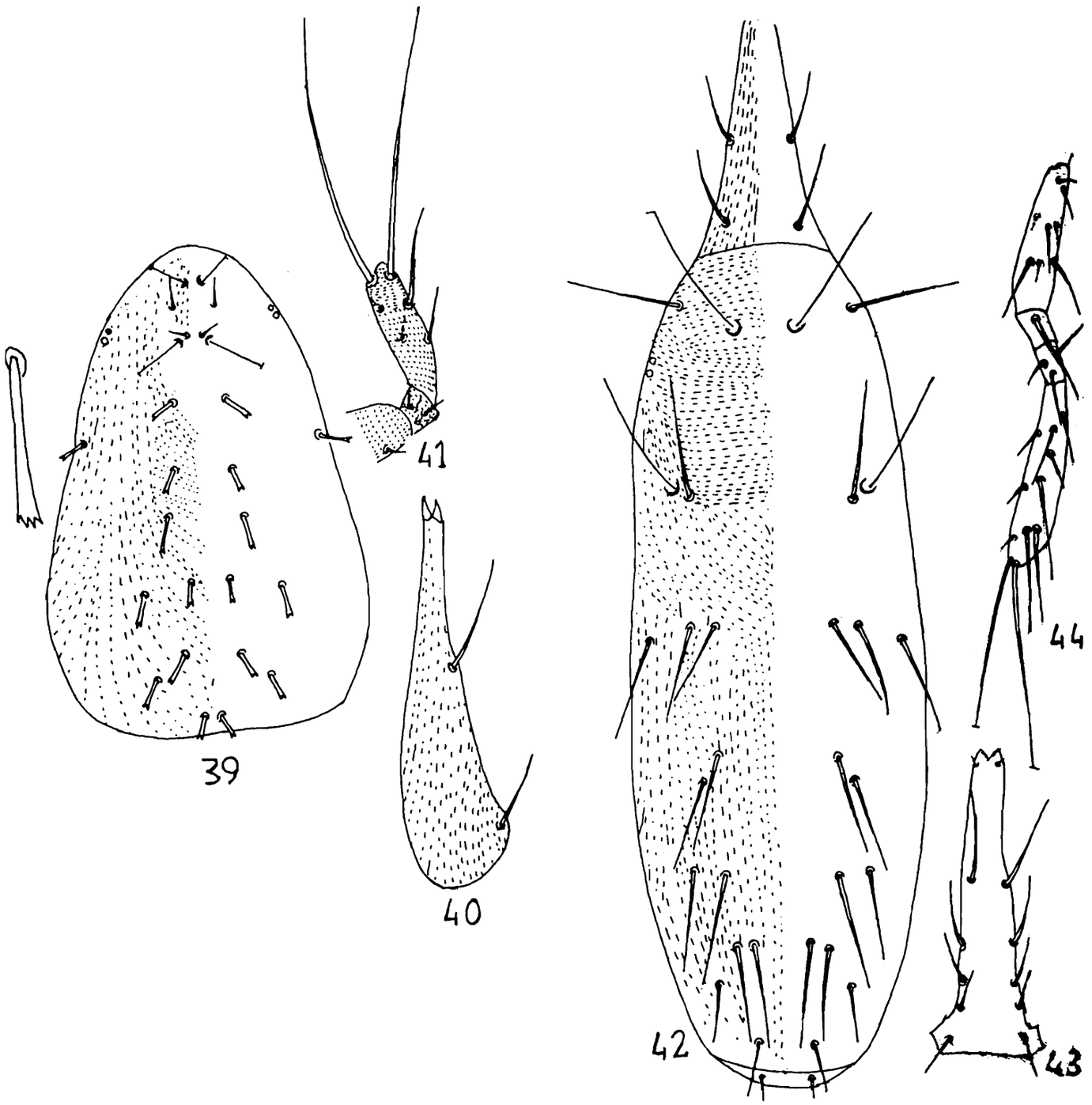
4. Palp with strong spine on the mesal surface of genu, tibia and tarsus.....
   ..... *C. setirostris*
   No such spine 5

5. Tibiotarsus with inner spine and in addition with 3 other setae ; chelicera exceeds the length of palptibiotarsus.....*C. bambusae*
   Tibiotarsus with altogether 2 setae, having no spine ; Chelicera extends upto the length of palptibiotarsus ..... *C. crista* sp. nov.

Genus **Neocunaxoides** Smiley

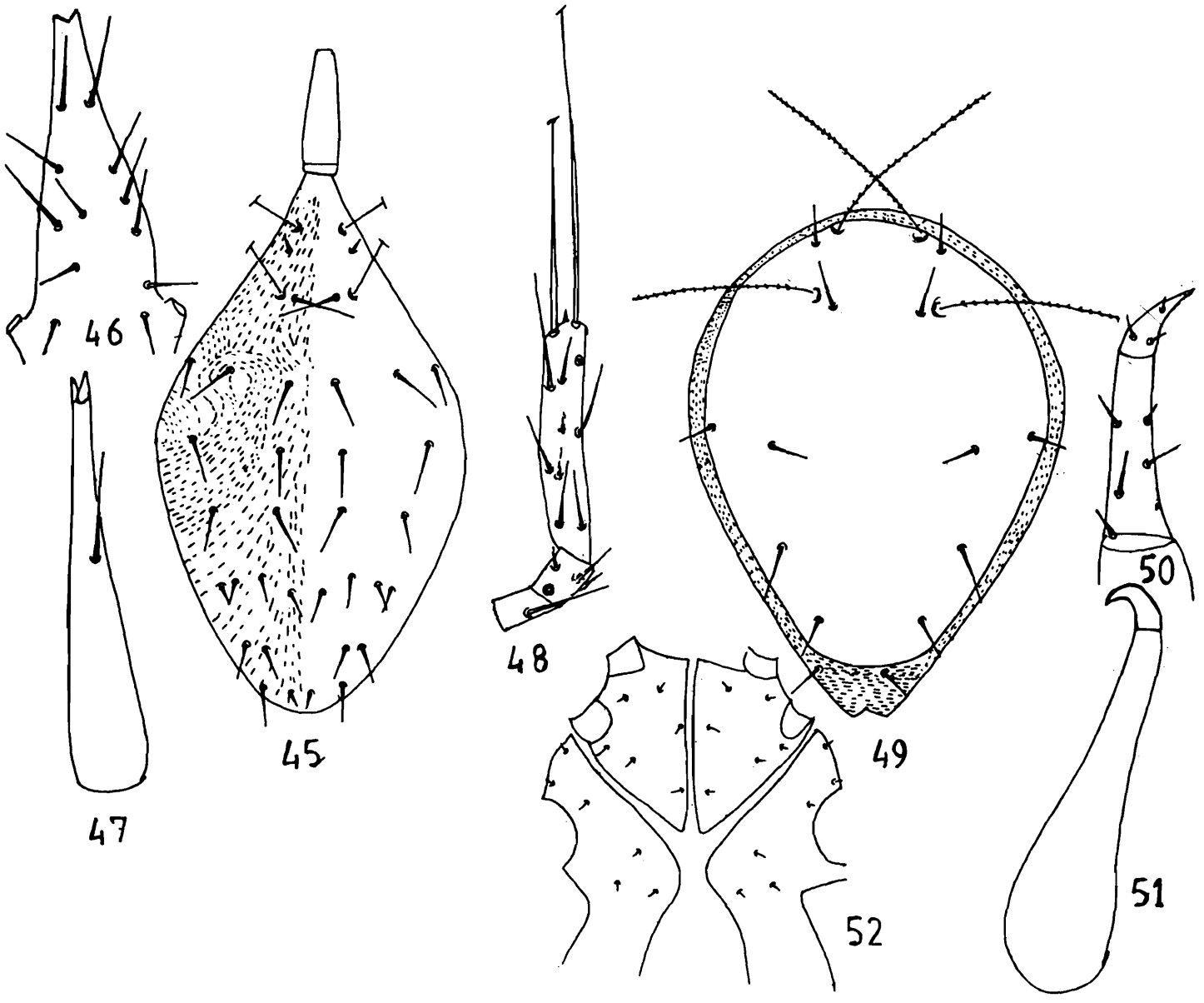
20. **Neocunaxoides cerasoides** sp. nov.
(Figs 49-52)

Female : Palp 3 segmented, 85 long, as long as hypostome. Chaetotaxy of palpus ; trochanter= nil, femur- 1 anterior dorsal, 2 outer lateral, 2 inner lateral ; tibiotarsus - 1 outer lateral, 1 inner lateral, 1 distal. Chelicera elongate, attenuate distally, broad at base, extending upto the base of tibiotarsus, dorsally striated. Fixed digit of chelicera absent, movable digit pointed, curved. Gnathosoma attenuate distally, broadest at base with 1 pair of marginal setae. Dorsum covered with single shield, anterior portion with 2 pairs of finely branched sensory setae and 2 pairs of simple setae ; posterior portion with setae L1, D1 - D3. Ventrally anterior portion divided medially into 2 distinct plates, anterior portion with



Figs. 39-41 : *Bdella khasyana* sp. nov. (Female). 39-dorsal aspect; 40-chelicera ; 41- palp.

Figs. 42-44 : *Bdellodes manipurensis* sp. nov. (Female). 42-dorsal aspect; 43-ventral aspect of gnathosoma; 44-palp.



Figs. 45-48 : *Bdellodes grandiflora* sp. nov (Female). 45- dorsal aspect; 46- ventral aspect of gnathosoma; 47- chelicera; 48- palp

Figs. 49-52 : *Neocunaxoides cerasoides* sp. nov. (Female). 49- dorsal aspect ; 50- palp ; 51- chelicera ; 52- anterior ventral aspect.

coxae I and II posterior portion with coxae III and IV. Anteroventral plate with 6 setae ; lateroventral plate also with 6 setae. Leg I and II directed anteriorly, III and IV directed posteriorly. Leg chaetotaxy of basifemur, telofemur, genu tibia and tarsus.

	Basi femur	Telo femur	Genu	Tibia	Tarsus
I	2	4	6	9	15
II	3	3	7	7	18
III	3	3	6	5	14
IV	1	2	7	5	10 + 1 trichoboth

Tarsi I-IV with 2 claws and empodium with 4 raylets. Body 321 long, 229 wide.

Male : Unknown

HOLOTYPE: Female, INDIA : Assam, Badarpur, ex *Polyalthia cerasoides*, 7. xii. 1983.

Remarks : This species differs from N. *pradhani* Gupta & Ghosh (1980) in chaetotaxy of palp and leg.

Genus **Cunaxa** V. Heyden

21. **Cunaxa crista** sp. nov.
(Figs 53-55)

Female : Palp 5 segmented, 113 long, as long as hypostome. Chaetotaxy of palp : trochanter-nil, basifemur - 1 outerlateral, telofemur - 1 outerlateral, genu- innerlateral, 1 outerlateral, tibiotarsus- 1 innerlateral and 1 distal. Chelicera attenuate, extending almost upto palp tibiotarsus. Fixed digit of chelicera absent, movable digit curved. Gnathosoma subtriangular, attenuate distally. Propodosoma with very indistinct sclerotized shield with 2 pairs of finely branched sensory setae. Hysterosoma without shield, indistinctly striated with seta L 1 and D 1-D5 .... Coxa II and I contiguous ; coxae III and IV also contiguous; leg I and II directed anteriorly, III and IV directed posteriorly. Leg chaetotaxy:

	Basi femur	Telo femur	Genu	Tibia	Tarsus
I	2	1	4	5	14 + 2 solenidia
II	2	2	5	5	15 + 1 Solenidion
III	1	2	5	5	14
IV	1	2	4	3 + 1 trichoboth	7

Tarsus I-IV with 2 claws and with rayed empodium. Body 392 long, 158 wide.

Male : Unknown

HOLOTYPE: Female, INDIA : Arunachal Pradesh, Likabali, ex *Caesalpinia crista*, 7.x.1981.

Remarks : This new species is close to C, *bambusae* Gupta & Ghosh (1980) from which it differs in chaetotaxy of palp and legs.

22. **Cunaxa curassavica** sp. nov.
(Figs. 56-57)

Female : Palp 174 long, much longer than hypostome. Chaetotaxy of palpus : trochanter- 0, basifemur- 1 outerlateral, telofemur- 1 dorsal seta placed laterally, 1 ventrolateral spine, genu- 1 outerlateral, 1 innerlateral, 1 antero dorsal and 1 process at the basal innerlateral position as figured ; tibiotarsus with 1 medially placed innerlateral spine, 1 basally placed innerlateral spine, 1 medio dorsal, 1 outerlateral and 1 distal ; the latter 4 setae all simple. Chelicera attenuate distally, 3 pairs of marginal setae, the basal pair being the longest. Propodosoma with shield having 2 pairs of short simple setae and 2 pairs of long sensory strae. Hysterosoma striated without shield having setae L1, D1-D5. Chaetotaxy of legs :

	Basi femur	Telo femur	Genu	Tibia	Tarsus
I	1	4	7	7 + 1 Sol.	14 + 1 tricho. + 1 Sol.
II	2	4	6	6	13 + 1 Sol.
III	3	4	5	5	10
IV	1	4	5	2 + 1 trichoboth	9 + 1 trichoboth

Leg I-IV with 2 claws. Body gnathosoma 490 long, 325 wide.

Male : Unknown

HOLOTYPE: Female, INDIA : Arunachal Pradesh, Itanagar, ex *Asclepias curassavica*, 3. xi. 1981.

Remarks: This species is close to C. Setirostris (Hermann, 1804) but differs in chaetotaxy of palp.

23. **Cunaxa setirostris** (Hermann)

1804. *Cunaxa setirostris* Hermann, *Apteologique*, p. 60-62.

Material examined: 1 Female, Arunachal Pradesh, Keying, ex *Eugenia* sp., 20. xi. 1981.

Remarks: Formerly, it was known from soil (Singh & Mukherjee, 1971), Andaman Isls. (Gupta & Ghosh, 1980) while outside India it is known to be a cosmopolitan species.

24. **Cunaxa bambusae** Gupta & Ghosh

1980. *Cunaxa bambusae* Gupta & Ghosh, *Rec. zool. Surv. India*, **77** : 198-199.

Material examined : 1 Female, Arunachal Pradesh, Likabali, ex *Combretum decandrum*, 17. x. 1981.

Remarks : It was known earlier from Andaman Nicobar Isls. (Gupta & Ghosh, 1980).

25. **Cunaxa capreolus** (Berlese)

1890. *Scirus capreolus* Berlese, Acari, Myriopoda et Scorpiones hucusque in Italia reperta, Fasc. 57, No. 9.

Material examined: This mite was seen associated with *Tetranychus neocaledonicus* and might be feeding on it as the gut content of that species was reddish. In India, it was earlier reported from nests (Gupta & Paul, 1985) and outside India it is known from U.S.A.

Family TYDEIDAE Karmer, 1877

Key to the genera and species of TYDEIDAE occurring in northeast India

1. With hysterosomal setae L2 in normal lateral position 2
   With hysterosomal satae L2 in dorsal position, femora III and IV each with a prominent forked seta ..... *Parapronematus ferox* sp. nov.
2. Dorsal striae forming reticulate pattern ..... *Lorryia stricta* sp. nov.
   Dorsal striae forming no reticulate pattern ..... *Tydeus*

26. **Parapronematus ferox** sp. nov.
(Figs. 58-63)

Female : Gnathosoma visible from above. Palpal setal formula : 5, 1, 2 ; distal segment long and slender with 3 short, thick may be barbed setae placed anteriorly the other two placed little below the level, other segments as figured. Propodosomal striation indistinct, even under high magnification, P2 missing, P1 placed posteriorly between sensory setae. Setae stout, barbed ; sensory seta-49, P1-24. Striation pattern on hysterosoma very much indistinct. First and second rows of hysterosomal setae similar to propodosomal setae, third and forth rows much longer, weakly barbed. Ventrally genital area as figured. Leg chaetotraxy as for genus. Tibia and tarsus I subequal. Solenidion short, slender placed little ahead of the midpoint of the segment, tibia with 2 pairs of setae and a solenidion which is very short and anteriorly placed ; other leg setae pilose. Femur III and IV each with long Y-shaped setae. Length of body excluding gnathosoma 266, width 156.

Male : Unknown.

HOLOTYPE: Female, INDIA : Arunachal Pradesh Miao, ex *Rubus ferox*, 10. i. 1983.

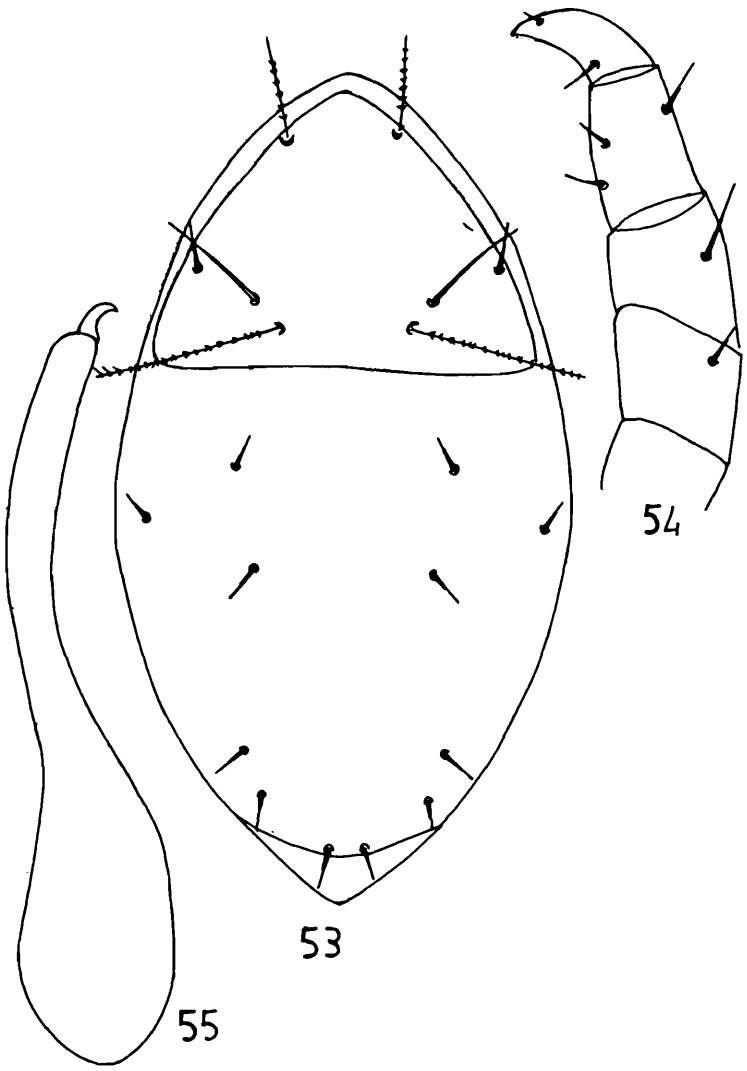
Remarks : This species is close to *P. acaciae* Baker (1965) but differs from it in having forked seta one and half times as long as segment ; tibial solendion not being rounded, in tibial setal pattern and in relative length of posterior hysterosomal setae.

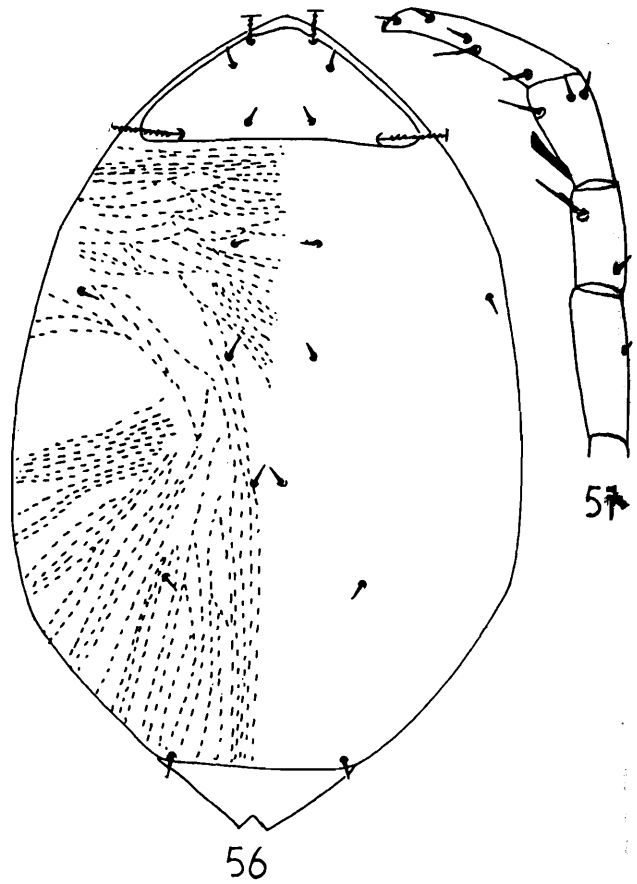
27. **Lorryia stricta** sp. nov.
(Figs 64-67)

Female : Gnathosoma distinct. Distal palpal segment longer than broad. Body outline irregular, indented all along but more prominent anteriorly and posteriorly. Palp setal formula 5, 1, 2. Reticulation of propodosoma as illustrated. Propodosoma with a pair of sensory setae almost touching the base of D1, in addition to 3 pairs of propodosomal setae, P3-44, P2-27, P1-26, all strong and curved, S1-45. Hysterosoma with L1 in normal lateral position. D1-31, D2-26, D3-26, D4-24, L1-26, L2-29, L3-27, L4-24, L5-20. Tips of hysterosomal reticulation as indicated. A short strip between D1 and D2 without reticulation. All empodia with strong claws. Tarsus I with simple seta and rod-like solenidion. Tarsus with dorsal longitudinal striation. Ventrally 5 pairs of genitals; 4 pairs of parageni-tals and 1 pair of anal setae present. Leg setal formula :

I	8, 3, 3, 2, 1, ?
II	6, 2, 2, 3, 0, ?
III	5, 2, 1, 2, 1, ?
IV	5, 2, 1, 1, 0, ?

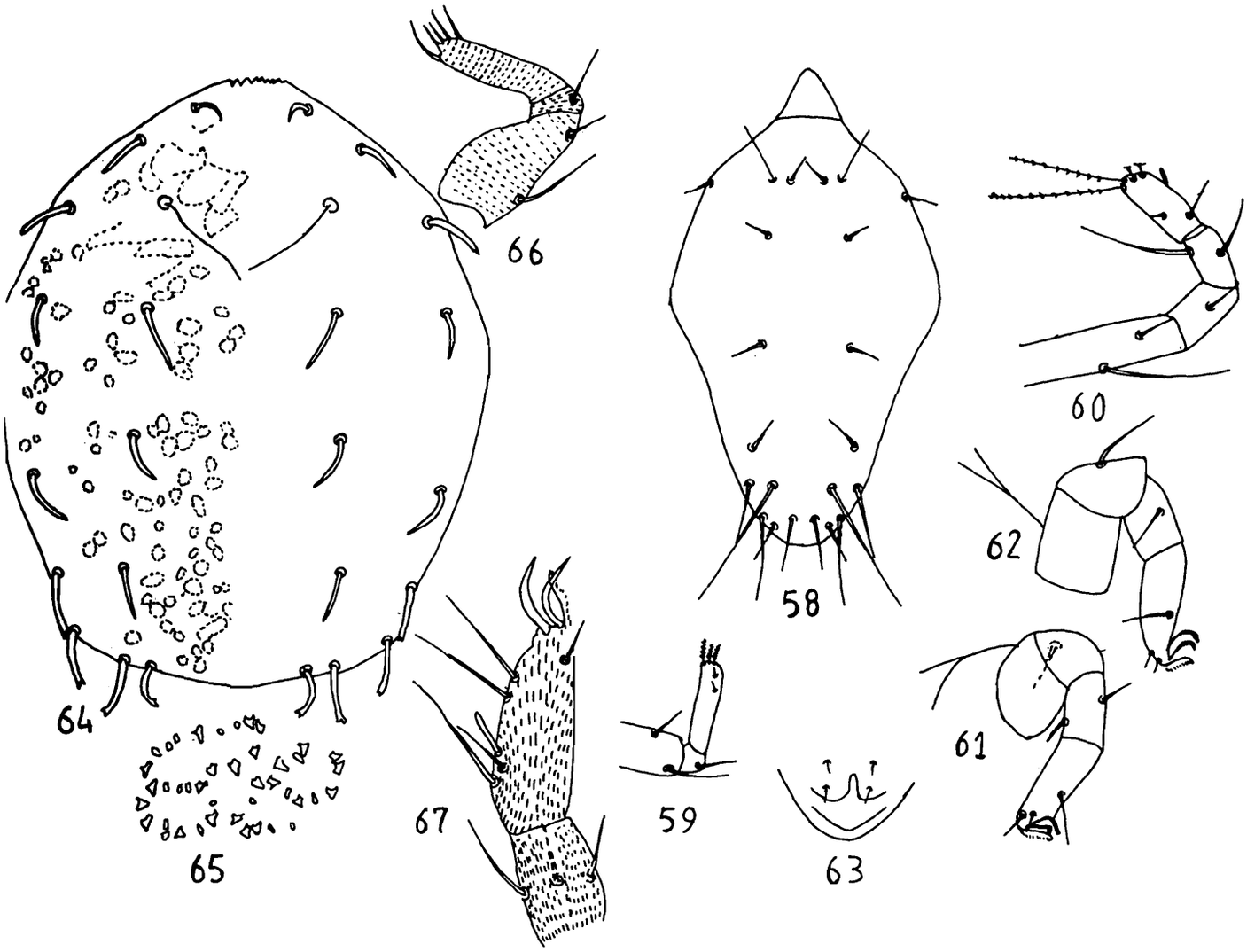
Male : Unknown.





Figs. 53-55 : *Cunaxa crista* sp. nov. (Female) 53- dorsal aspect; 54-palp; 55-chelicera.

Figs. 56-57 : *Cunaxa currasavica* sp. nov. (Female). 56-dorsal aspect; 57-palp.



Figs. 58-63 : *Parapronematus ferox* sp. nov. (Female). 58- dorsal aspect; 59-palp; 60-leg I; 61- leg III; 62- leg IV; 63-genital region.

Figs. 64-67 : *Lorryia stricta* sp. nov. (Female). 64- dorsal aspect; 65- ornamentation pattern of dorsum ; 66-palp ; 67- tibia and tarsus of leg I.

HOLOTYPE: Female, INDIA : Nagaland, Botsa ex *Erythrina stricta*, 26. i. 1983.

Remarks : This new species is close to *L. formosa* Cooreman (1958) but differs from it in striation pattern of dorsum, in shape of dorsal idiosomal setae and in palp chaetotaxy.

28. **Tydeus** sp.

Material examined : 1 Female, Meghalaya, Rongjeng Reserved Forest, ex Magnolia champa, 1. x. 1988.

Remarks: Because of being in badly damaged condition, the specific identity could not be determined.

Family CHEYLETIDAE Leach, 1814

Key to the general and species of CHEYLETIDAE occur in northeast India

1. Eyes not evident, setae on the margins of dorsal shield acicular.....*Cheyletus*
   Omega of tarsus I distinctly expanded towards its base, usually with 1 tooth at the base of pedipalpal claw.....*C. malaccensis*
   Eyes present(one paired), dorsal body setae fan like.....
   .....*Hemicheyletia, H. indica* sp. nov.

Genus **Cheyletus** Latreille

29. **Cheyletus malaccensis** Oudemans

1930. *Cheyleus malaccensis* Oudemans, *Ent. Ber. Ned. Ver.*, 1(12). 84.

Material examined : 1 Female, Meghalaya, Rongjeng, ex paddy, 2. x. 1988.

Remarks : This mite was collected from a colony of Schizotetranychus andropogoni infesting paddy. However, no feeding was observed. This mite was earlier known from U.K., Portugal, Czechoslovakia, Germany, Iran, Turkey, U.S.A., U.S.S.R., Australia(Hughes, 1976) and from India it was reported from house dust (Gupta & Datta Ray, 1975).

Genus **Hemicheyletia** Volgin

30. **Hemicheyletia indica** sp. nov.
(Figs 68-70)

Female : Palp claw with 7-8 teeth. Stylophore cone-shaped. Both outer and inner comb with 7 setae. Tegmen covered with microtubercles of same size. Eyes large, protuberant.

Peritreme curved. Dorsal setae 15 pairs in addition to humerals ; marginal setae elongate, spatulate with 5 ribs ; 2 pairs of propodosomal and 4 pairs of hysterosomal setae, highly modifeid and stag-horn like, those on hysterosoma slightly wider than those on propodosoma. These specialised setae look cluster of irregularly shaped sclerotic particles. Tarsus I as figured. Solenidion on tarsus I much longer than guard seta.

Male : Unknown.

HOLOTYPE: Female, INDIA : Arunachal Pradesh, Miao, ex *Pavetta indica*, 10.i.1983.

Remarks: This new species is similar to H. wellsi (Baker, 1949) but differs in dorsal setal structure and in chaetotaxy of leg I.

Family ANYSTIDAE Oudemans, 1902

Key to the genera and species of ANYSTIDAE occur in northeast India

1. Prodorsal shield absent ..... *Walzia*
   Prodorsal shield present ..... *Anystis nagalandensis* sp. nov.

Genus **Anystis** V. Heyden

31. **Anystis nagalandensis** sp. nov.
(Figs. 71-77)

Female : Gnathosoma : Palp tibia with 3 claws, 2 almost of same length and the other one smaller ; palp tarsus bears at least 14-15 long thick setae and a short spine. Chelicera broad basally and gradually narrowed down disatally; movable chela hooklike. Each chelicera with 8 setae (2 dorsally, 6 ventrally).

Legs : Legs radiate from the body and the coxae are grouped together. All the legs are profusely covered with setae. Tarsi with combed claw, middle hairs are longer than those at the ends.

Dorsum: Naso on anterior margin of idiosoma bearing a pair of sensilla. Propodosomal shield trapezoidal bearing 3 pairs of setae. Two pairs of eyes present laterally, placed little posterior from 3rd coxal bases. Area between naso and propodosomal plate transversely striated. Apart from the 3 pairs of setae, there are other 6 pairs of long setae present on dorsum, all being setose.

Venter : The setae on genital plate as figured.

HOLOTYPE Female INDIA : Nagaland, Botsa, ex fern, 30. xi. 1985.

Remarks: This species is close to Anystis *baccarum* Linnaeus 1958 but differs in shape of prodorsal shield and in having very small spine on palp. From A. salicinus (Linn. 1758; as figured by Smith Meyer, 1987) in lacking ornamentation on prodorsal shield.

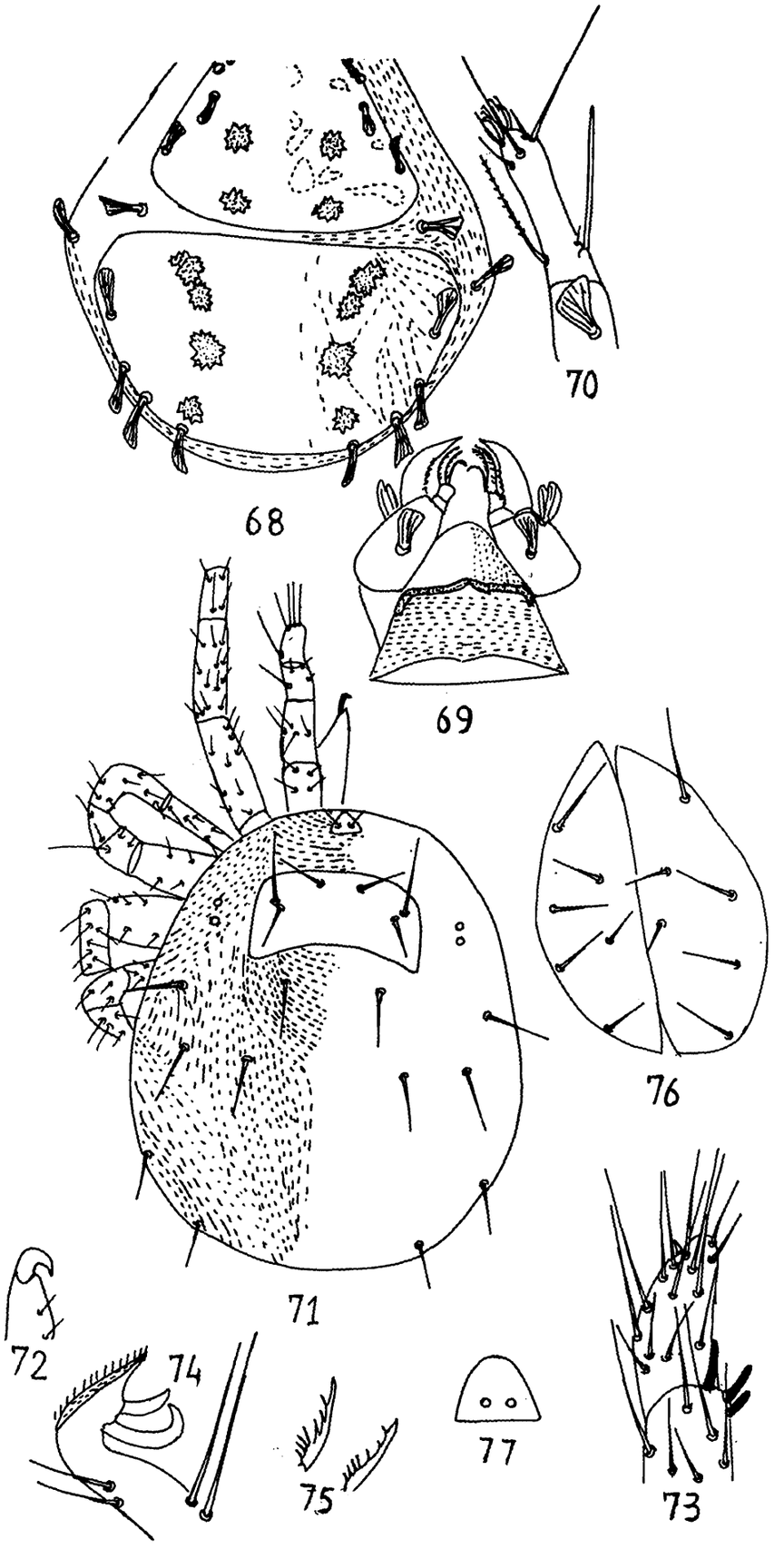


Fig. 68-70 : *Hemicheyletia indiaca* sp. nov. (Female). 68- dorsal aspect; 69- gnathosoma; 70- tibia and tarsus of leg I.

Figs. 71-77 : *Anystis nagalandensis* sp. nov. (Female). 71-dorsal aspect; 72-chelicera; 73-tibial and tarsal segments of palp; 74-tarsal appendages of leg; 75-claw; 76-annogenital area; 77- Naso.

Genus **Walzia** Oudemans

32. **Walzia** sp.

Material examined : 1 Female, Meghalaya, Rongjeng, ex palm, 30. ix. 1988.

Remarks : The species identity could not be ascertained due to lack of adequate information.

Family CALIGONELLIDAE Grandjean, 1944

Genus **Molothrognathus** Summers & Schlinger

33. **Molothrognathus** sp.

Material examined : 1 Female, Tripura, Agartala, ex bamboo, 12. xii. 1983.

Remarks : Because of being in badly damaged condition, the specific identity could not be determined.

Family EUPODIDAE Koch, 1842

Genus **Eupodes**

34. **Eupodes** sp.

Material examined : 1 Female, Meghalaya, Songsok, ex mango, 27. ix. 1988. 1 Female, Tripura, Agartala, ex palm, 12. xii. 1983.

SUMMARY

A total of 34 species of predatory prostigmatid mites are reported from various parts of northeast India. These include 21 new species, 9 under Stigmaeidae, 5 under Bdellidae, 3 under Cunaxidae, 2 under Tydeidae and 1 each under Cheyletidae and Anystidae and all these are described and illustrated here. In addition, 2 species and 5 genera are also recorded here for the first time from India. Keys to all taxonomic categories are provided.

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