STUDIES ON THE ORIBATID FAUNA OF RAJASTHAN

BY

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A THESIS
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dedicated to my parents

SUPERVISOR'S NOTE

This is to certify that this thesis entitled "Studies on the Oribatid fauna of Rajasthan" submitted by Mr. A. Sankara Reddy, in partial fulfilment of the requirements for the award of the degree of Doctor of Philosophy in Zoology of the Birla Institute of Technology and Science, Pilani, is a record of his bonafide research work carried out under my direct supervision and guidance. No part of this thesis has been submitted for any other degree or diploma.

Dated: 23-5-72

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(A. Sankara Reddy)

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I. INTRODUCTION

Oribatids (Gr. Oreibates = mountain-ranging), generally called as moss mites, are grouped under the order Cryptostigmata of the subclass Acari, class Arachnida and the Phylum Arthropoda. The Acari, which includes both mites and ticks exhibits a superficial resemblance to insects in possessing an external skeleton and jointed legs; but differ from them in the adults having four pairs of legs, a pair of chelicerae and pedipalp in front of the mouth and in the absence of antennae. Mites and ticks are differentiated from other Arachnids in having a sac-like body with no sign of external segmentation, in lacking a distinct head and in having a six-legged stage, the larva, during post-embryonic development.

Mites are usually tiny, ranging from 0.1 mm to .2 mm in length and are found all over the world, from tropics to the Arctic and from deserts to rain forests. Acarines, in general, are either free-living or parasitic on plants and animals.

Oribatids are the free-living, soil-inhabiting saprophagous mites. They are mostly non-specialised feeders of organic matter, plant and animal detritus. Certain species of Galumna, Achipteria, Eupelops, and Scheloribates are also known to feed on living green plant material

(Wallwork, 1967). They are cosmopolitan in distribution and outnumber other acarines in organic-rich soils.

Oribatid mites, once considered as of taxonomic importance only, have gained economic importance because several species of oribatids are (a) the intermediate hosts of anoplocephalid cestodes (b) carriers of certain pathogenic fungal spores (c) have an important role in the biogene phage of humification and (d) also have been used by ecologists as soil indicators. Further, they are also known to play an important role as regulators of nematode populations (Rockett and Woodring, 1960).

Despite their economic importance, the much needed attention has not been paid by either ecologists or functional biologists towards Oribatei, and Acari in general, mainly due to the daunting task that confronted them in identifying these tiny soil animals. As Wallwork (1970) remarked "The determination of genus and species, even family, in many groups of the soil fauna remains the province of the specialist taxonomist, who is, himself, a rather rare animal". Taxonomy forms a fundamental branch of Life sciences and is much needed for any other line of investigation. Once the basic information on the occurrence and habitat of an organism or group of organisms is gained, their functional aspects can be undertaken.

Acarology in India is still in the infant stages and this, in fact, is very much true to Oribatidology. It

is evident from the literature that out of more than 500 genera and 5000 oribatid species described so far (c.f Balogh, 1965), only 13 species are on record from India. There had been hardly any concentrated effort to study them as a group from any part of this country. These important factors have been the incentive for the present author to undertake this investigation on the primary aspect - the taxonomy and systematics of the most economically important acarine group, the oribatid mites.

The author has selected for study the oribatid fauna of Rajasthan which is climatologically delineated into arid, semi-arid, humid and sub-humid zones and thus provides four different ecosystems. Faunistic survey of these zones would furnish useful data for comparison with the fauna of the other parts of the country and the World at large.

The oribatids, on which this study is based, were collected from different parts of Rajasthan such as, Bikaner, Jodhpur, Sirohi, Mt. Abu, Chittorgarh, Udaipur, Ajmer, Jaipur and Pilani and its surroundings. In the present study, 48 species belonging to 21 different families of the order Cryptostigmata have been worked out. Some new genera and species have been erected and are described in the text.

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II. REVIEW OF LITERATURE

A. CLASSIFICATION AND SYSTEMATIC POSITION OF CRYPTOSTIGMATA (ORIBATEI)

The order Cryptostigmata (Oribatei) is a large and heterogeneous taxon, consisting of usually dark colored mites which vary in size from 200 to 1,500 microns. Baker and Wharton (1952) summarized the characteristics of the group as follows:

> The gnathsoma is usually concealed within a camerostome, stigma and trachae may be present, opening into porose areas. Pseudostigmatic organs are generally present on the propodosoma. The body is usually strongly sclerotized, dark in color, and when not thusly armored the skin is leathery. The coxal apodemes are sunk beneath the skin but are still visible, although not as strongly so as in the Acaridiae. The tarsi have one to three claws and are without caruncles. The palpi usually have five movable segments. The two sexes are similar. Three pairs of genital suckers are present; the males do not possess adanal suckers; and both sexes generally have the genital and anal openings covered by lidlike shields.

There have been different opinions as to the taxonomic status and nomenclature of the oribatid mite. The classification of this group is still the subject of disagreement and therefore considered unstable. A brief review of the taxonomic assignment of Oribatei and the

different systems proposed in the higher classification of the Acari is presented here.

The history of literature on Oribatei dates back from Linnaeus (1758) who, for the first time, included 29 species of mites under the single genus ACARUS. The genus Acarus also included two or three species of Oribatids (c.f Michael, 1884). De Geer (1778) made for the first time an attempt at the classification and included Oribatidae along with Tetranychidae. The subsequent classifications until that of Megnin (1876) were either based purely on the ecological criteria (De Geer, 1778; Koch, 1842; Nicolet, 1855; Furstenburg, 1861); or on simple morphological characters, such as presence or absence of eyes (van Heyden, 1826); or on the nature of pedipalps (Dughes, 1839). Megnin's classification (c.f) of Acarina, though based on the terrestrial and aquatic habitats of mites, also included for the first time many morphological criteria like the ventral region of idiosoma, nature of peritremes, nature of mandibles and segmentation of ambulatory appendages. The name ORIBATEI was first created by Dughes (1833) who considered the group as a family in the order ACARI.

According to Evans et al. (1961), the modern classification schemes stem out after Krammer (1877) who divided the Acari into two major divisions or suborders i.e., TRACHEATA (adult mites with tracheae in some stages of development) and ATRACHEATA (adult without any traces of

tracheae). Krammer in his classification placed the family ORIBATIDAE in the suborder TRACHEATA of the order ACARINA. This classification was later followed, with some modifications, by Michael (1884), Canestrini (1891), Berlese (1899) and Reuter (1909).

Michael (1884) followed Krammer's two major divisions (Tracheata and Atracheata) in combination with Megnin's (c.f) skeletal and leg segmentation pattern. He included the family Oribatidae under the suborder Tracheata of the order Acarina. The family Oribatidae was divided into two subfamilies, PTEROGASTERINA and APTEROGASTERINA on the presence and absence of wings (pteromorphs), respectively.

Canestrini (1891) considered Acari as a class and proposed an ordinal status for Oribatei with the name CRYPTOSTIGMATA.

Berlese (1899) included a part of Astigmata (Sarcoptina) in the Cryptostigmata and retained the ordinal status to it. Later Berlese (1913) modified his earlier classification and reduced the ordinal status of Oribatei to subordinal level.

Reuter (1909) in turn modified Berlese system (1899) and retained the rank of Acari to ordinal level and proposed new names for all suborders. He considered Oribatei as a superfamily, ORIBATOIDEA, and included in the suborder SARCOPTIFORMES.

Oudemans (1906) considering the Acari as a class, divided it into five subclasses on the basis of the number of stigmata present on the acetabular region. In this classification, he elevated the Oribatei to a subclass, OCTOSTIGMATA, following Michael's (1884) conception that the Oribatei bear four pairs of stigmata. Later, Oudemans (1923) reviewed the history of classification and proposed a new system, giving only an ordinal status to Acari with six suborders viz. NOTOSTIGMATA, HOLOTHYROIDEA, PARASITIFORMES, TROMBIDIFORMES, SACROPTIFORMES and TETRAPODILII. On the basis of the natural affinities of the last three suborders, Oudemans (1931) combined them into a single suborder TROMBIDI-SARCOPTIFORMES.

Trägardh in 1932, proposed a new suborder PALEACARIFORMES for the group of mites which have uncovered gnathosoma and were considered by him as intermediate forms between the primitive oribatids and acarids. But, Grandjean (1932) assumed the characters of Trägardh's (c.f) paleocarids as more related to the primitive oribatids than to acarids and thus included paleocarids under the group ASTEGASIMA (mites with uncovered gnathosoma) and STEGASIMA included both (Ptyctima and Aptyctima oribatids).

The major outbreak in the system of classification of Acari as a whole started after Grandjean (1935), who divided Acari into two major divisions, ACTINOCHITINOSI and ANACTINOCHITINOSI, based on the presence and absence

of actinochitin in the body setae, respectively.

Baker and Wharton (1952), however, recognised only five suborders in the subclass Acari and included the Oribatei as a supercohort under the suborder Sarcoptiformes, Order Acarina. Oribatei was further divided into two cohorts, APTYCTIMA and PTYCTIMA, and the Aptyctima further included two subcohorts, PTEROGASTERINA and APTEROGASTERINA.

Evans et al. (1961) proposed ACTINOCHAETA and ANACTINOCHAETA in place of Grandjean's Actinochitinosi and Anactinochitinosi, respectively. These authors classified the subclass Acari into two superorders, ACARI-ACTINOCHAETA and ACARI-ANACTINOCHAETA, and the order Cryptostigmata is included under Acari-Actinochaeta.

Recently, van der Hammen (1968), used ANACTINOTRICHIDA and ACTINOTRICHIDA for Grandjean's Anactinochitinosi and Actinochitinosi; he, however, did not change the ordinal status of the Cryptostigmata except replacing it by the name ORIBATIDA.

In the subordinal classification, Grandjean (1953) attempted to group the Oribatid mites through a phylogenetic system considering the characteristics that are present during the pre-imaginal (nymphal) stages. His provisional classification included eleven divisions, viz. Paleocaroidea, Enarthronota, Lohmanniidae, Eulohmanniidae, Parahypochthoniidae, Mesoplophoridae, Phthiracaroidea, Epilohmanniidae, Nothroidea, Perlohmanniidae and Circumdehiscentiae. But,

this classification does not signify whether the Oribatei was divided into superfamilies (e.g. Paleocaroidea, Nothroidea and Perlohmannoidea) or equivalent divisions. According to van der Hammen (1959), the division 'Enarthronata' should be considered as a "Section" above superfamily level, where even the superfamilies are to be distinguished.

Johnston (1964), presented a classification at the II International Congress of Acarology, Ohio, on the basis of Grandjean's (1953) and van der Hammen's (1959) proposed systems. The skeleton of his summarized classification is as follows (only at the superfamily level):

Suborder: CRYPTOSTIGMATA (ORIBATEI)

Superfamily:
I. PALAECAROIDEA
II. PARAHYPOCHTHONOIDEA
III. ENARTHRONOTA
IV. MESOPLOPHOROIDEA
V. PHTHIRACAROIDEA
VI. PERLOHMANNOIDEA
VII. NOTHROIDEA
VIII. CIRCUMDEHISCENTIAE (the higher Oribatids)

Recently, Grandjean (1969) gave certain considerations to his earlier (1953) classification of Oribatei and has proposed two new divisions, viz., MIXONOMATA and PALAEOSOMATA. The Mixonomata suppresses the superfamily Perlohmannoidea, and in it were included seven superfamilies

viz., Lohmannoidea, Eulohmannoidea, Epilohmannoidea, Collohmannoidea, Perlohmannoidea, Euphthiracaroidea and Phthiracaroidea. The Palaeosomata is proposed to accommodate three superfamilies; Archeonothroidea, Palaeocaroidea and Ctenacaroidea. The group Enarthronota is to include seven superfamilies, viz., Heterochthonoidea, Cosmochthonoidea, Brachychthonoidea, Hypochthonoidea, Masophlophoroidea, Protoplophoroidea and Phyllochthonoidea.

For practical purposes, however, Oribatidologists generally follow the classification presented by Balogh (1961, 1965), in which only adult characteristics are used as criteria. In his classification, the Oribatei is divided into two main groups, namely, ORIBATEI INFERIORES and ORIBATEI SUPERIORES. The Oribatei superiores includes two subgroups, PORONOTICAE and PYCNONOTICAE. Balogh (1965) recognised eighty-seven families in his classification which were placed under twenty five superfamilies.

The present author feels that the retention of Evans' et al. (1961) proposed classification of the subclass Acarina into two superorders and the ordinal status of Cryptostigmata under the superorder Acari-Actinocheata, followed by the subdivision of the order into two main groups, Oribatei inferiores and Oribatei superiores, as proposed by Balogh (1961, 1965), is very practical and has been followed in the present work.

B. FAUNISTIC WORK IN GENERAL, WITH SPECIAL REFERENCE TO ORIBATIDS OF SOUTHEAST ASIA

Very little attention has been paid towards the taxonomic and faunistic aspects of Oribatei in the past. During the last 30 years, however, a good deal of work on the Oribatid fauna has been carried out in the American, Europian and African countries. A major contribution to our knowledge on the Oribatid mites of these countries comes from the extensive work of Hammer (1944, 1955, 1958, 1961, 1962, 1965) from North America, South America and Denmark; Hammer (1966, 1967, 1968) from New Zealand; Jacot (1928, 1929, 1929a, 1930, 1934, 1935, 1938 and 1938d), Higgins and Woolley (1965), Woolley (1965), and Woolley and Higgins (1963) from different provinces of United States; Franz (1953, 1954), Mihelcic (1945, 1956, 1956a, 1957 and 1966) and Schuster (1956) from Austria; Beck (1961, 1962, 1962a, 1964, 1965, 1966), Knulle (1954b, 1960), Markel (1964, 1964a), Moritz (1963), Sellnick (1955, 1960a) and Willmann (1931, 1935, 1939 and 1939a) from Germany; Dalanius (1950, 1960), Sellnick and Forsslund (1955), and Willmann (1943) from Sweden and Lapland; Evans (1952, 1952a, 1952b, 1952c), Evans et al. (1961), Seyed (1958, 1962, 1964, 1966), and Turk (1953) from Britain; Balogh (1943) and Csiszar (1960) from Hungary; Karppinen (1950, 1952, 1953, 1955, 1957, 1958, 1961, 1966) from Finland; Rafalski (1953, 1966) and Rajski (1958, 1959, 1959a, 1960a, 1967, 1968, 1970) from Poland; Kunst (1957, 1958, 1959,

1960, 1961), and Csiszar and Jeleva (1962) from Bulgaria; Winkler and Kunst (1959a) from Czecnoslovakia; Bulanova-Zakhvatkina (1957, 1960), Byzova (1964a), Daredzhanashvili (1964, 1965), Eitminavicute (1955, 1962, 1964, 1965, 1968), Krivolutsky (1962, 1964, 1966) and Sitinikova (1962) from USSR.

The notable workers who have studied the Oribatid fauna of African soils are Balogh (1958, 1959, 1959a, 1960, 1960a, 1961b, 1962, 1962b, 1966, 1966a, 1966b, 1966c, 1967c), Balogh and Csiszar (1963), Coetzer (1967-1968), Forsslund (1938, 1963), Pletzen (1961, 1963) and Wallwork (1960, 1961, 1961c, 1962, 1964), Wafa et al. (1964), and Abd-el-Hamid (1965, 1965a, 1965b) from Egypt.

As compared to the amount of work done in the Europian and African countries, our knowledge on Asian oribatids is very meagre. Noteworthy to mention are the works of Aoki (1958, 1958b, 1959, 1959a, 1961, 1964a, 1966, 1966b, 1966c, 1966d, 1967 and 1970), Aoki and Fujikova (1969), Aoki and Sujuki (1970), Fujikova and Aoki (1968, 1969, 1970) and Sujuki and Aoki (1970) from Japan; Bulanova (1960), Sitinikova (1962) and Byzova (1964b) from SSR; Mahunka (1964) from Mangolia; and Womersley (1945) from Australia.

As regards the Oribatid fauna of south-east Asia, a little work has been done by some workers. Csiszar (1961) described 15 new species and four new genera from

Indonesian soils. Balogh and Mahunka (1966) after making a Soil-Zoological expedition in Vietnam, reported 33 species of which 29 new species and 4 new genera were described. Pearse (1906) described 20 species of oribatids from Sikkim Himalaya, which included 12 known species, eight new species and one new genus in his collection. Recently, Aoki (1965) also described 10 species (four new and six known species), from Sikkim. Aoki (1965 and 1967) described a total of 40 species, including seven new genera, 25 new species and five new subspecies of Oribatids from Thailand. Sheals (1965) reported 22 species, of which six new species and one new genus were described from Nepal. Recently, Balogh (1970) described a total of 43 new species and seven new genera to Science from Ceylon.

C. WORK DONE IN INDIA

Very little is known about the Oribatid fauna of India. The first contribution to our knowledge on the taxonomy of oribatid mites from India came from Ewing (1910), who described four species of Oribatids from the soils of Niligiri Hills. The four species described by him are: Notaspis brevirortris, Oribata tessellata, Oribata nilgiria and Oribata apprassala. Later, Jacot (1933) redescribed two of Ewing's (1910) Indian oribatids viz. Oribata tessellata and O. nilgiria as Galumna tesselleta and G. nilgiria, respectively.

Baker (1945) described one new species, Scheloribates chauhani from Izatnagar (U.P.). There were no reports on Oribatid fauna for a long period of twenty years as far as known to the author and it was only in 1967 that Bhaduri and Raychaudhuri reported the occurrence of six genera of oribatids from soils of Calcutta. Bhaduri and Raychaudhuri (1968) again reported eight species of Oribatids, of which one subgenus and two species as new to Science, from Calcutta and suburbs.

The following is the list of Oribatids reported from India.

Notaspis brevirostris Ewing, 1910	Niligiri Hills (Mysore)
Oribata apprassala Ewing, 1910	"
Galumna tessellata (Ewing)	"
Galumna nilgiria (Ewing)	"
Scheloribates chauhani Baker, 1945	Izatnagar (U.P.)
Conoppia sp.,	Calcutta (W.B.)
Hoplophorella sp.,	"
Basilobelba sp.,	"
Xiphobelba sp.,	"
Archeozetes longisetosus Aoki, 1965	"
Allonothrus indicus Bhaduri and Raychaudhuri, 1968	"
A. monodactylus Wallwork, 1960	"
A. russeolus Wallwork, 1960	"
Lamellobates palustria Hammer, 1958	"

L. angolensis Balogh, 1958 — Calcutta (W.B.)

L. (P.) bengalensis, Bhaduri and Raychaudhuri, 1968 — "

At present, a total of 196 species of oribatids are reported from south-east Asia, including the Indian species.

D. ECOLOGY AND ECONOMIC IMPORTANCE OF ORIBATID MITES

Relatively, the taxonomy of oribatid mites has been better worked out than their ecology.

Oribatid mites are found in almost all soils, and are abundant in organic rich forest soils. Marshall (1964) recorded an average of 20,000 and 1,75,000 oribatid per square metre area of mull and mor respectively in Quebec, Canada (c.f Marshall, 1968).

Distribution and composition of oribatids in any type of soil are generally governed by the combination of microenvironmental factors like, temperature, moisture content, pH and ground vegetation (Strenzke, 1952; Karpinnen, 1955 and Rajski, 1961). The distribution pattern either horizontal or vertical is not static in mites. Krull (1939), Nazrova (1963), Subbotina (1963), Krivolutski (1968) and Mathur et al. (1971) stated that vertical movements of oribatid mites between epizeal to hemiedaphic or hemiedaphic to euedaphic soil layers or vice versa was motivated by

physical conditions of the soil and availability of the food at different soil layers. Gerd (1962) related the vertical distribution of mites to the type of soil environment and mentioned that they can be used as 'indicators of soil conditions'.

Karg (1963) stated that the increase of Oribatei in compost soil indicate its turning from anaerobic to aerobic process. He further referred the changing micro-biological process to the alternating dominance of Acaridae and Oribatei in that soil.

Jongerious (1963) has established the importance of oribatid mites in the transportation of organic material in an advanced stage of decay to deeper layers of the soil profiles. The findings of Hayes (1963), Crossley and Witkamp (1964) and Harding (1966) demonstrated the primary decomposition of leaf litter by the activity of certain oribatid mites (Phthiracarid mites).

Jacot (1930) reported the occurrence of fungal spores on the body surface of oribatid mites (Galumna and Neolides spp.) and elucidated the importance of these mites as fungal spore carriers from soil surface to plants parts and vice versa because of their migratory habits. Moskacheva (1961) and Saxena (1971) also isolated certain pathogenic and non-pathogenic fungal spores from the body surface and gut content of the oribatid mites.

Oribatid mites as predators of soil nematodes and their importance as regulators of nematode population has been suggested by Rocket and Woodring (1966).

The role of oribatid mites Galumna sp., as an intermediate host of anoplocephalid cestodes was first established by Stunkard (1937). This was confirmed by subsequent experiments conducted by various workers like, Stoll (1938), Stunkard (1940, 1941) and Potemkina (1941). Over 50 species of oribatid mites have been so far reported either as natural intermediate hosts or as experimental hosts (Kates and Runkel, 1948; Rajski, 1959; and Sigit, 1969).

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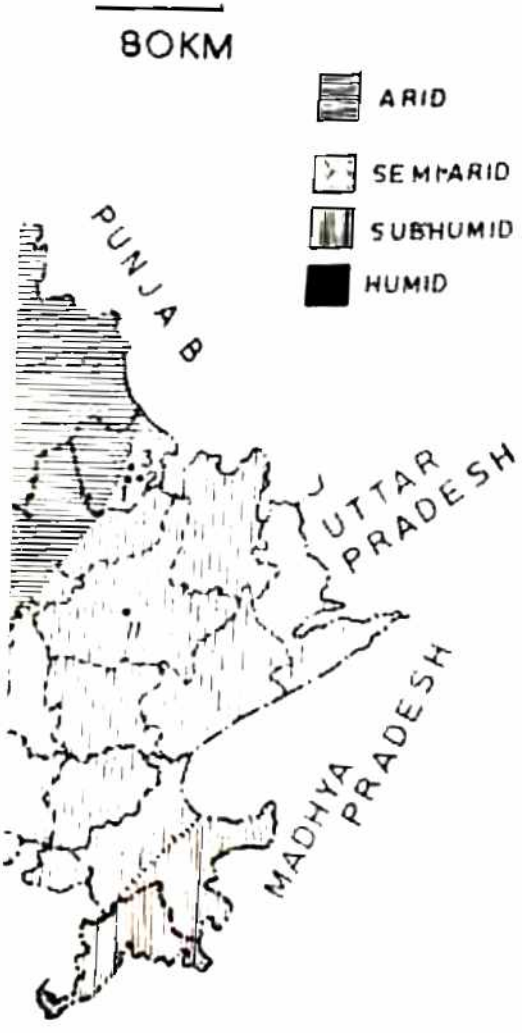
FIG. 1



1 PILANI 2. NARHAR
3 KHETHRI 4. BIKANER
5 JODHPUR 6 SIROHI 7 MT ABU
8 UDAIPUR 9 CHITTORGARH
10 AJMER 11 JAIPUR

III. MATERIAL AND METHODS

Rajasthan is situated in the north-western part of India between 23°3'N and 30°12'N latitudes and 69°30'E and 78°17'E longitudes and covers an area of about 3,42,274 square kilometres. The western and northern boundaries are marked by the eastern boundary of Pakistan. The rest of the boundary in the north and the north-east is bounded by Punjab and Uttar Pradesh, in the east and south-east by Madhya Pradesh and the south-west by Gujrat. Krishnan (1968) delineated Rajasthan State into four different climatic zones, viz. Arid, Semiarid, Humid and Subhumid zones, using Thornthwaite moisture index method based on temperature, mean rainfall and water balance.

In the present investigation, as many as 344 soil samples were collected in two instalments (23-3-1969 to 29-3-1969 and 18-10-1970 to 28-10-1970) from different biotopes of Rajasthan (Fig. 1) viz. Jodhpur, Bikaner, Sirohi, Mt. Abu, Udaipur, Chittorgarh, Ajmer and Jaipur. However, frequent visits to Khetri, Narhar, Pilani and its surroundings were made to collect and supplement soil samples for the present study.

For the detailed knowledge on the description of Geophysiography, soil types, floristic and vegetation of

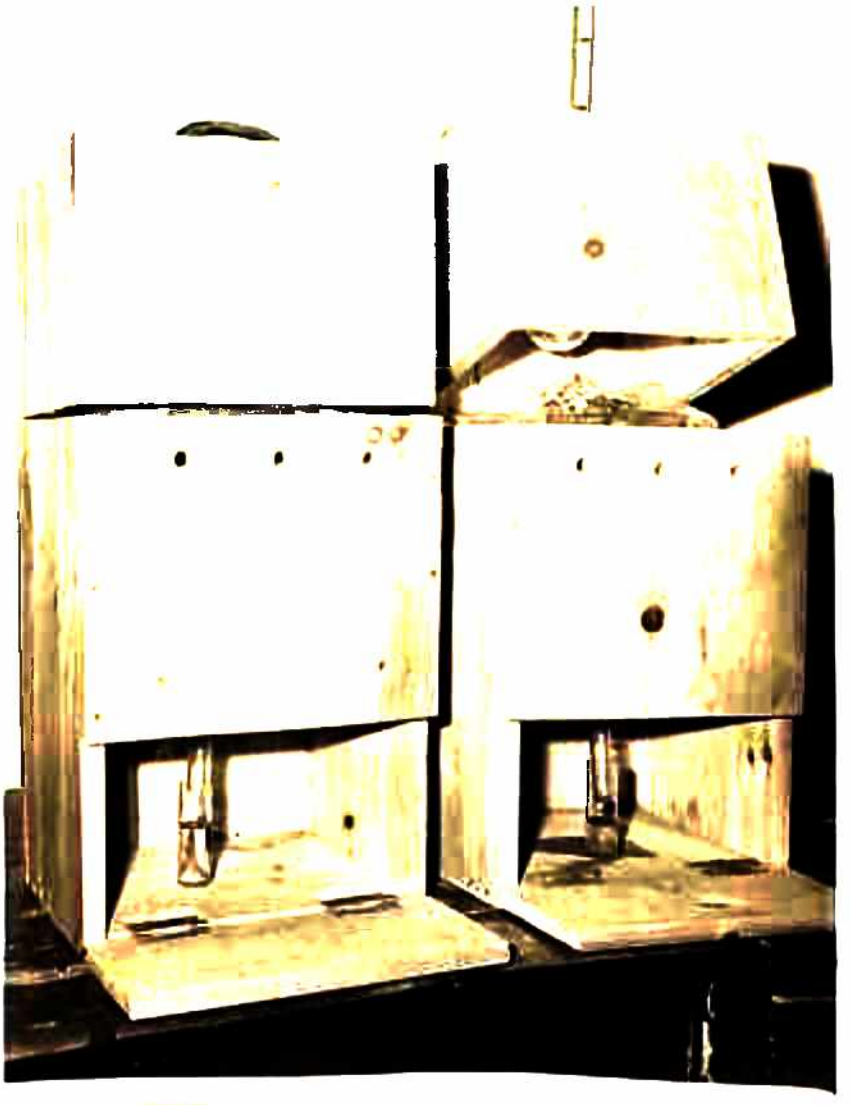


Fig. 1.B. Modified Tullgren funnel.

Table 1. General vegetation and soil type of the bio-topes surveyed

Locality	Vegetation	Soil type	References
Pilani	Prosopis, Anogeissus, Tephrosia, Heliotropium	Sandy	Nair and Nathawat, 1956
Narhar	Salvadora, Capparis, Eragrostis, Glinus, Sphaeranthus	Sandy, clayish	Joshi (personal communication)
Khetri	Euphorbia, Balanites, Barleria, Adhatoda, Cryptostegia	Brown-reddish, sandy, gritty	Nair et al., 1961
Bikaner	Zizyphus, Prosopis, Calligonum, Cyperus	Sandy	Joshi, 1956 Sarup, 1957
Jodhpur	Capparis, Prosopis, Tephrosia, Lasurius, Bothriochloa	Loamy, Sandy-gravel	Rao and Kanodia, 1962-63
Mt. Abu	Erythrima, Albizzia, Trama, Kydia, Carvia	Red and yellow soil, rocky	Jain, 1967
Sirohi	Prosopis, Capparis, Leptadenia, Aerva, Dichanthium, Crotalaria	Gray-brown, sandy	Mathur and Verma, 1964
Chittorgarh	Vegetation not explored	Mixed red and black soil	-
Udaipur	Boswellia, Grawia, Amaranthus, Tridax	Red-yellow. Clay, loamy, gravel	Ramdeo, 1969
Ajmer	Azadirachta, Zizyphus, Euphorbia, Ephedra	Brown, sandy-to-sandy, loamy	Sharma, 1958
Jaipur	Capparis, Gymnosporia, Acacia, Zizyphus	Alluvial, loamy, sandy-gravel	Joshi, 1957

Rajasthan, the present author refers to the excellent review by Joshi and Gupta (1972, in press). The soil type and the vegetation of the biotopes surveyed for the collection of mites in the present investigation are described in Table II. The locality and date of collection have also been mentioned at the end of the description of each species. Sampling was done in a random fashion, and the samples were transported to the laboratory in air tight polythene bags for the extraction of mites.

Modified Tullgren funnels described by Haarlv (1955) were employed for the extraction of mites. The apparatus (Fig.16) comprises of a clean, smooth and steep sided glass funnel (dia. 13 cms) fitted in a wooden box. A 40-watt electric bulb (fitted in the upper lid of the wooden box) was used to accelerate artificial temperature for dessicating the sample substrate. The distance between the electric bulb and the sample surface level was about 15 cms. A fine wire gauge of 25 mesh was arranged in the funnel to hold the material. A margin of about one cm. gap was left at the outer surface of the funnel and the sample media to prevent the animals from escaping out. A small specimen tube (7.5 cm. high and 2.5 cm. diameter) with 30% alcohol was placed under the free end of the funnel stem to collect the mites. With this set-up the extraction lasted for twenty-four hours to forty-eight hours, depending on the moist nature of the soil.

Mites were sorted out in small petri-dishes under the dissecting sterioscope binocular microscope at a magnification of 10 × or higher magnification, if necessary. The material was always examined both on white and black background to ensure the detection of both dark and light colored mites. The mites were collected by varisized eye droppers to minimize any damage or loss of setae while handling large number of specimens. Fine camel brushes (No. 0) were also employed for transferring mites during sorting, cleaning and mounting.

For permanent slide mounts, mites were processed and cleared in Nesbitt's solution[1] for 1-5 days depending upon the degree of sclerotization, and mounted in modified Hover's mounting media[2].

Due to the peculiar shape of the oribatid mites, the dorsum being highly convex in certain families, a temporary and closed mount has been preferred over the conventional permanent mounts. This temporary closed cavity slide preparation as suggested by Evans et al. (1961) is a modification of Grandjean's (1935) semi-open temporary mount technique.

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1. Nesbitt's solution:

Chloral hydrate	: 25 gms.
Dist. water	: 25 ml.
Hydrochloric acid (conc.)	: 2.5 ml.

2. Modified Hover's mounting media:

Dist. water	: 50 ml.
Gum arabic	: 30 gms.
Chloral hydrate	: 200 gms.
Glycerol	: 20 c.c.

The mites were cleared in a mixture of equal quantities of pure lactic acid and 90% alcohol and the containers were kept open in dust proof chambers for three to nine weeks depending upon the degree of sclerotization. The clearing process was accelerated by subjecting the material to moderate heat, whenever quick observation was necessary.

Temporary mounts were prepared by placing lactic acid cleared mite in the cavity-slide filled with lactic acid and covered with No. 0 cover glass (19 mm). These mounts permitted changes in orientation of the specimen, from lateral to dorsal or ventral above, by sliding the coverslip with a fine needle.

The specimens were studied in all aspects of external morphology. The appendages were dissected and mounted separately for detailed studies, wherever possible. Microscopic studies were made mainly with the help of a Leitz compound microscope but delicately sclerotized structures were also observed under Zeiss Opton phase-contrast microscope. Drawings were made by a Leitz camera-lucida (prismatic type) and all measurements are expressed in microns.

The terminology followed in the present work is after Grandjean (1935, 1938a, 1947, 1957). The somatic terminology used in the present work is as given by Evans

et al. (1961). The genera are discussed in the order suggested by Balogh (1961, 1963, 1965) and the species under each genera, are arranged alphabetically in the catalogue. The description of each new species, established in the present investigation, is also followed by a discussion. The classification employed here at the ordinal and familial level are in accordance with Evans et al. (1961) and Balogh (1965), respectively.

Specimens are preserved in Oudeman's solution[3]. Preserved specimens in small vials and mounted slides were numbered and labelled, giving relevant data including habitat, locality, date of collection, and name of specimen(s) collector. The collection of specimens will be deposited in the Soil Zoology Laboratory, Birla Institute of Technology and Science, Pilani.

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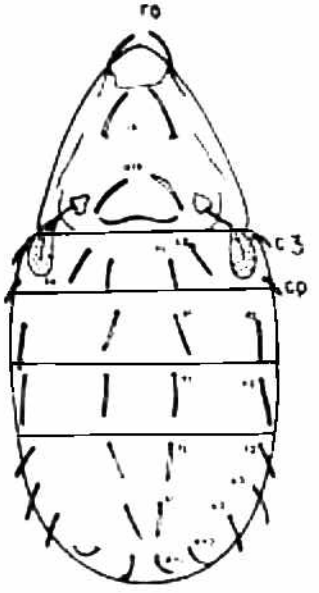
3. Oudeman's solution : 90% alcohol : 85 parts
Lactic acid (Gla) : 8 parts
Glycerol : 7 parts

IV. GENERAL EXTERNAL MORPHOLOGY

The body of an oribatid mite consists of anteriorly, the gnathosoma and posteriorly, the idiosoma. The gnathosoma is placed ventrally and remains covered by prodorsum (aspis) dorsally. The idiosoma (Fig. 2) of the oribatid mites is superficially divided into two segments, the anterior propodosoma and the posterior hystersoma. The propodosoma includes the body region consisting the attachment of the first two pairs of legs, whereas the hysterosoma includes the metapodosoma and opishthoma (Fig. 2). The dorsal region of the propodosomal and hysterosomal segments are called as prodorsum or aspis and the notogaster, respectively, and are usually separated by a distinct dorosojegal suture (dsj). The ventral region of the idiosoma includes the coxisternal (podosoma) and the ano-genital regions; the later is opisthosomal in position.

Various morphological structures of mites that are considered to be of taxonomic importance are described and discussed herewith.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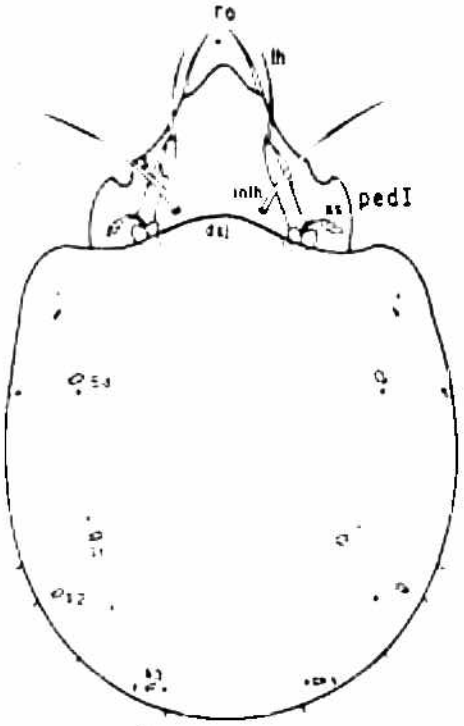
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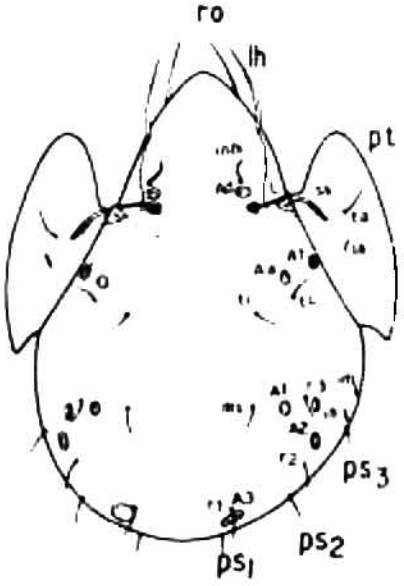
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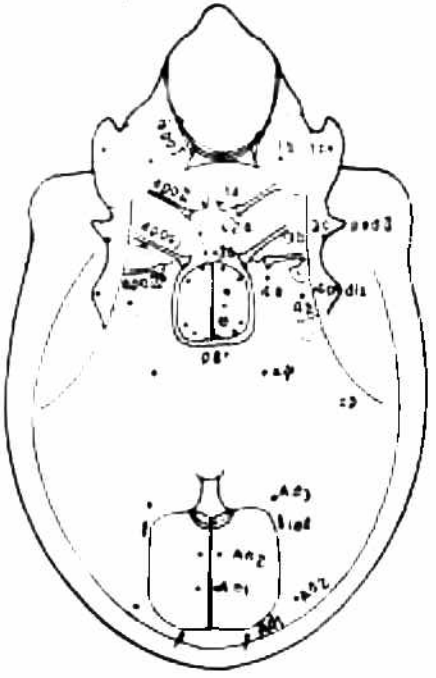

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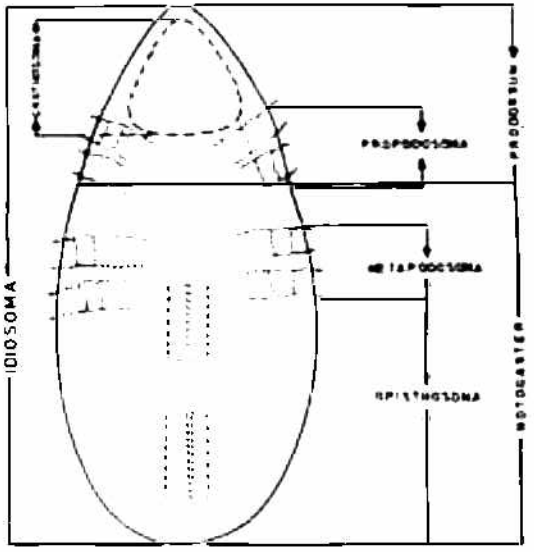

IDIOSOMA
PROPODOSOMA
METAPODOSOMA
OPISTHOSOMA
PRODOSOMA
HYSTEROSOMA

2

A. PRODORSUM (Figs. 3, 4 and 5)

Prodorsum is generally conical in shape, with a broad base posteriorly, and pointed or round rostrum (r) anteriorly. A pair of longitudinal ribbon-like chitinous ridges, the lamellae (l), extend from the postero-lateral to the median region of the prodorsum. The anterior distal ends of these lamellae are often connected by a weakly sclerotized ridge, the translamella (tla). A pair of setae, the lamellar setae (lh), are usually inserted on the anterior tip of the lamellae. The lamellar setae also may be inserted either medially or laterally to the prodorsum. The rostral setae (ro) are inserted either on the median or antero-lateral region of the rostrum. In the postero-median region of the prodorsum, there are inserted a pair of interlamellar hairs (inlh), which, in some cases, may be just lateral to the pseudostigmata in position. Further, there are two pairs of hairs (seldom one pair) inserted on the lateral surface of the prodorsum either anterior or posterior to the pseudostigmata which are called as the anterior exobothrydial setae (exa) and the posterior exabothrydial setae (exb) according to their position.

Bothrydia (Grandjean, 1936), or pseudostigmata of the older terminology, are the highly modified cup-like structures forming the insertions of the sensilli, and are usually located on the postero-lateral regions of the prodorsum. A pair of specialized sensory setae, the sensilli (ss) (pseudostigmatic organ of older terminology),

are inserted in the bases of the bothrydia. These sensilli are usually clavate, spindle, pyriform or capitate shaped and are either spiculate or pilose in nature. The term trichobothrium (Grandjean, 1936) denotes both bothrydium and sensillus.

The lateral wall of the prodorsum usually projects out of the body and forms flaps of the body surface, which overhang the legs and often the rostrum, are called as pedotecta (ped). The anterior extension of this flat-like projection of the lateral edges of the aspis is called as pedotecta-I (ped.I). Pedotecta I arise at the coxal articulation of the leg I and are often well developed in higher Oribatids. Posterior to the ped.I and in between the first and second pair of leg coxae, the pedotecta II (ped.II) are present. Pedotecta III lie in between legs II and III. Pedotecta IV now called discidia lie posterior to the leg III.

B. NOTOGASTER (Figs. 3, 4, 5 and 14)

Notogaster, the large exoskeletal plate of the hysterosoma, may be complete (Oribatei superiores) or sometimes divided into three to five segments by two to four horizontal coupures (horizontal hysterosomal bands). The number of setae on the notogaster varies from 16 pairs (holotrichy) in Oribatei inferiores to 10 pairs (seldom 14 or less than 10 pairs) in Oribatei superiores. The

presence of more than the usual number of setae on the body segments is referred to as 'neotrichy'. Each seta is usually inserted in a setal pore. The setal pores devoid of setae are called as 'alveoli'.

Other important structures of taxonomic importance present on the notogaster are lyrifissures, abdominal gland, and area porosae.

Fissures are slit like structures, symmetrically arranged on the dorsal surface of the pteromorphae, anterior latero-median and posterior region of the notogaster and are abbreviated as ia, im, ih and ip depending upon their positions on the notogaster.

The cuticular region of the area porosae (Aa, A1, A2, A3, A4) is usually thinner than of the notogaster and is supplemented with small pores and cilia, thus appearing as punctate. The number of area porosae usually ranges from 4-5 on the notogaster of higher Oribatids (Poronotic forms). The area porosae may also be present on the median and lateral region of the prodorsum, leg segments and chelicerae. In some cases (Fig. 14), the area porosae sink like a bag into the cuticle with only a slit like opening on the notogaster surface termed as 'sacculi' (sa); the later are called as 'pori' if diminished to point-like pores (Balogh, 1961).

The lateral abdominal gland (gla) or glande latero-abdominate of Grandjean (1954) or oil gland of Evans et al.

(1961) is usually present (seldom absent) on the latero-median region of the notogaster.

In the pterogasterine oribatids a characteristic wing like expansion, the pteromorpha (pt) is present on each side, anteriorly and laterally, of the notogaster. The size and shape of the pteromorpha vary considerably at the familial level among pterogasterine group. In general, the pteromorphae are relatively large (Galumnidae), bending downwards vertically, movably or immovably hinged to the sides of the notogaster. The smaller pteromorpha is the horizontal one, always immovable and never bending vertically downwards. Both the vertical and horizontal pteromphae are present in the Poronotic oribatids with only a few exceptions.

C. EPIMERAL REGION (Fig. 5)

The epimeral region is the most conspicuous structure on the ventral side of the podosoma. The coxae of each pair of legs in the Oribatid mite are fused with the corresponding sternal plates to form a coxisternum (Evens et al., 1961). The side walls of the coxae, in some cases, are retained and project inwards into the body, forming apodemata (apo.). The sternal plates resulted by the interception of horizontal epimeral ridges or apodemata are called as 'coxisternal plates'. The number of coxisternal setae is often represented by a formula, 9-3-3-4 as in Papillacarus khandavallensis (Fig. 41), showing the

sequence of setae present on the coxisternal plates I, II, III and IV. The propodosoma and metapodosoma are separated by a complete or incomplete transverse ridge known as 'apodemata sejugales' (aposj). The surface of the coxisternal region is usually either punctate or foveolated. A longitudinal circumpedal ridge (cp) stretches from a short distance from the border of the ventral plate to the anterior margin of pedotecta I.

D. ANO-GENITAL REGION (Fig. 5)

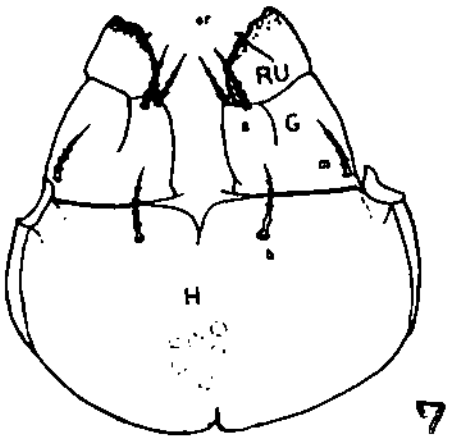
The genital and anal apertures are located on the ventral plate of the opisthosoma and each aperture is guarded by a pair of genital and anal plates, respectively. In case of primitive oribatids (Brachypyline oribatids), the genital and anal plates are usually extremely large, occupying the entire length of the ventral plate. The genital and anal plates when combined are V-shaped, the two being conjoined by a transverse straight line (Fig.47). Adjoining the genital and anal plates are present aggenital and adanal plates, a characteristic feature of the Oribatei inferiores. A transverse pre-anal plate (longitudinal in Brachychthonids) is also present in between the genital and anal plates in case of Lohmaannides. In Oribatei superiores, the genital and anal plates are more or less circular and never joining each other. The aggenital, adanal and pre-anal plates are totally absent. The number of setae present on the genital, anal, aggenital,

adanal and pre-anal plates (if present) has been evaluated as one of the most important characters of taxonomic value at familial as well as generic level. A pair of adanal fissures are present either parallel or antero-lateral to the anal aperture. In higher Oribatids, an exceptionally dark, sclerotized perigenital ring (pg) is present. The ventral plate of the opisthosoma is usually smooth, seldom areolated or reticulated.

E. GNATHOSOMA (Figs. 7, 8 and 9)

The gnathosoma of oribatid mites has been the subject of excellent investigations by workers like Grandjean (1947a,b, 1957), Trägardh (1931, 1932b) and Evans et al. (1961).

Gnathosoma which comprises the mouthparts, the precheliceral, cheliceral and pedipalpal appendages, is movably articulated to the antero-ventral region of the propodosoma by a transparent synarthrodial membrane. The mouth is covered dorsally by a labrum and ventrally by a pair of lateral lips. Rutella (ru), the modified infracapitular setae (Grandjean, 1957), lie on either side of the lateral lips and are massive and heavily sclerotized in higher Oribatids. The infracapitulum or the ventral region of the gnathosoma (Fig. 7) bears two or three pairs of adoral (or) setae on the lateral lips and three to seven (maximum nine, a case of maxillary neotrichy in Lohmannids) pairs of subcapitular setae viz.



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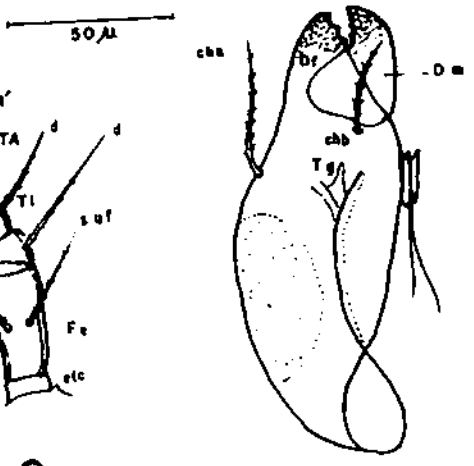

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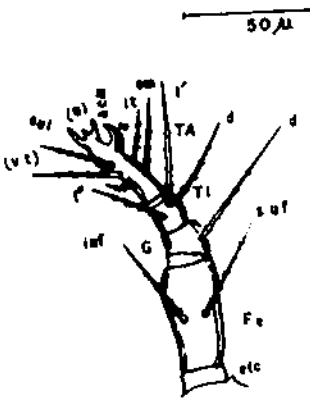

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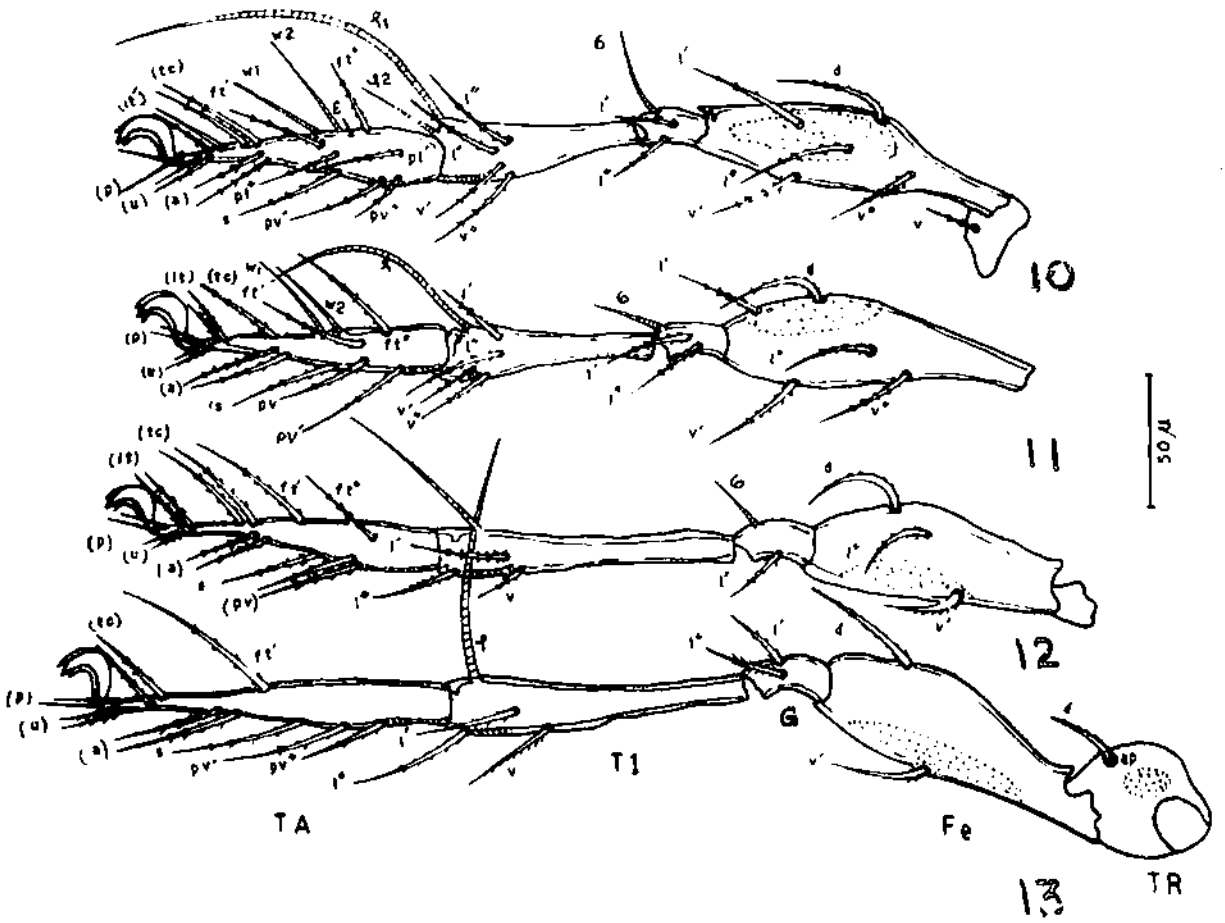


hypostomal setae (h) on the mentum (H), anterior (a) and median subcapitular setae (m) on the segment gena (G). The pedipalp or oribatid mite is usually five segmented viz. trochanter, femur, genu, tibia and tarsus and the number of setae present on these movably articulated segments is often expressed by a formula; e.g. 0-2-1-3-9 in Chaunoproctus sp. Solenidion (w), a sensory and modified seta (Grandjean, 1947), is always present on the palpal tarsus either free or fused with the acroculminal seta (acm). The condition of the fused acroculminal seta with solenidion is termed as 'corne double'.

The chelicera is almost always chelate and is comprised of fixed and movable digits. Each digit bears three to four dentate cusps. A pair of setae (cha and chb of Grandjean, 1947a) are present on the dorso-lateral surface of the cheliceral base. A small, circular area porosa is usually present on the dorsal surface of the chelicerae. In almost all cases, a conspicuous Trägardhs' organ (Fig. 8) is present on the dorsal surface of the chelicerae.

F. LEGS (Figs. 10, 11, 12 and 13)

The nymphal stages, proto-, deuto-, and tritonyphs and adult oribatids possess four pairs of legs, whereas the larval form has three pairs of legs. The legs are usually five segmented viz. trochanter, femur, genu, tibia and tarsus (apotele or ambulacrum to which the basal

portion of the claw is attached is not considered here as a separate segment, with an exception in Paleocarid adult where the femur is subdivided into basifemur and telofemur (Grandjean, 1954). All the leg segments are movably articulated. Two types of setae (true setae and modified sensory setae) are present on the leg and other body segments. According to Grandjean (1935), the true setae are devoid of protoplasmic core and have a solid axis surrounded by an external sclerotized layer usually ornamented with either cilia, spicules or barbs. On the contrary in the specialised modified setae viz. eupathidia, famulus, claws and rutella of gnathosoma (possibly solenidia), the actinochitin core is hollow with a protoplasmic extension of sensory cells into it and devoid of cilia, spicules and barbs.

The eupathidia (Grandjean, 1943, replacing his term 'acanthoides' 1935a) are found on leg tarsi I and II, and palpi. The famulus (ε) is found on leg tarsus I only. The solenidia (ω, φ, δ) are present on tarsi I-II, tibia I-IV and certain of the genua. Solenidia are devoid of actinochitin and optically isotropic.

The number of claws in the leg tarsi may be one (monodactyle), two (bidactyle) or three (tridactyle). Claws are always more or less sickle-shaped and strongly bent, with smooth or notched inner edge. However, in tridactylous forms, the median claw is always stronger and thicker than the laterals. All nymphal and larval forms are monodactyle.

Occurrence of area porosa on the leg segments is not ruled out in certain Oribatids. The trochanter of leg segments in some Oribatids also possesses a ventral keel (vk). The number of setae and solenidia on the leg segments are considered to be of taxonomic value. The leg setation in Oribatids may differ in position and in number too even at specific level.

V. SYSTEMATICS

During the course of the present investigation on the oribatid mites of Rajasthan, it has been possible to procure and study 48 species belonging to 21 families of the order Cryptostigamata. Of these, 20 species and one subspecies are described new to science and 21 species are new records for the country. Two new genera have been erected for the two species studied which differ from the so far accepted diagnosis of the various recognised genera of the order Cryptostigmata. One new subgenus has also been proposed to accommodate a new species under the known genus Haplacarus Wallwork, 1962 on the basis of certain marked distinguishing characters.

Of the total 48 species studied, 26 species belong to 11 different families of the group Oribatei inferiores and the remaining 22 species fall under 10 different families of Oribatei superiores. A taxonomic list of the species recorded from Rajasthan is given below. This is followed by the description of individual species and a general remark on their distribution and faunal composition of the biotopes examined.

The mode of description for all the new species is in accordance with the modern taxonomic trend (Aoki, 1970),

which is followed more widely at present. A comprehensive description is also furnished for the known species unless otherwise deemed necessary. Wherever possible taxonomic key has been provided for the new species described in the text.

TAXONOMIC LIST OF THE ORIBATID SPECIES STUDIED FROM RAJASTHAN

Order : CRYPTOSTIGMATA

A. ORIBATEI INFERIORES

I. CTENACARIDAE

Genus : Aphelecarus Grandjean

1. Aphelecarus acarinus (Berlese)*

II. BRACHYCHTHONIIDAE

Genus : Brachychthonius Berlese

2. B. cristatus sp.nov.

3. B. semiornatus rajasthanicus sub sp.nov.

III. HAPLOCHTHONIIDAE

Genus : Haplochthonius Willmann

4. H. nudatus sp.nov.

IV. COSMOCHTHONIIDAE

Genus : Cosmochthonius Berlese

5. C. areolatus sp.nov.

Genus : Dichthonius gen.nov.

6. D. lanceolatus sp.nov.

V. PHTHIRACARIDAE

Genus : Hoplophorella Berlese

7. H. noveus Jacot*

8. H. scapellata Aoki*

Genus : Hoplophthiracarus Jacot

9. H. histricinus Jacot*

10. H. siamensis Aoki*

11. H. nepalensis Sheals*

12. H. hardingii sp.nov.

VI. EUPHTHIRACARIDAE

Genus : Rhysotritia Markel and Meyer

13. R. ardua (C.L. Koch)*

14. R. clavata Grandjean*

VII. EPILOHMANNIIDAE

Genus : Epilohmannia Berlese

15. E. cylendrica (Berlese)*

16. E. pallida Wallwork*

VIII. LOHMANNIIDAE

Genus : Annectacarus Grandjean

17. A. asymmetricus sp.nov.

Genus : Haplacarus Wallwork

18. H. (Porocarus) semifoliatus subgen.nov. and sp.nov.

Genus : Papillacarus Kunst

19. P. khandavallensis sp.nov.

20. P. naraharensis sp.nov.

IX. NOTHRIDAE

Genus : Nothrus C.L. Koch

21. N. biciliatus (Sellenick)*

X. TRHYPOCHTHONIIDAE

Genus : Allonothrus van der Hammen

22. A. jodhpurensis sp.nov.

23. A. monodactylus Wallwork

24. A. russeolus Wallwork

XI. MALACONOTHRIDAE

Genus : Trimalaconothrus Berlese

25. T. chittorensis sp.nov.

26. T. novus (Sellenick)*

B. ORIBATEI SUPERIORES

XII. PLATEREMAEIDAE

Genus : Pedrocortesella Hammer

27. P. indiana sp.nov.

XIII. BASILOBELBIDAE

Genus : Basilobelba Balogh

28. B. africana Wallwork*

29. B. retiarius (Warburton)*

XIV. XENILLIDAE

Genus : Xenillus Robineau-Desvoidy

30. X. umaensis sp.nov.

XV. OPPIIDAE

Genus : Oppia C.L. Koch

31. O. abuensis sp.nov.

32. O. yodai Aoki*

Genus : Multioppia Hammer

33. M. wilsoni Aoki*

Genus : Striatoppia Balogh

34. S. aokii sp.nov.

XVI. CYMBAEREMAEIDAE

Genus : Scapharemaeus Berlese

35. S. mathurensis sp.nov.

XVII. ORIBATELLIDAE

Genus : Lamellobates Hammer

36. L. palustris Hammer

37. L. (Paralamellobates) bengalensis Bhaduri and Raychaudhuri

XVIII. GALUMNIDAE

Genus : Galumna von Heyden

38. G. flabellifera Hammer*

39. G. tessellata (Jacot)

XIX. ORIBATULIDAE

Genus : *Scheloribates* Berlese

40. *S. angulatus* Hammer*

41. *S. chauhani* Baker

42. *S. confusia* Coetzer*

43. *S. natalensis* Pletzen *

XX. CHAUNOPROCTIDAE

Genus : *Chaunoproctus* Pearse

44. *C. alveolata* sp.nov.

45. *C. longisetosus* sp.nov.

46. *C. pilanica* sp.nov.

XXI. HAPLOZETIDAE

Genus : *Peloribates* Berlese

47. *P. nudus* Hammer*

Genus : *Pynoribates* gen.nov.

48. *P. indicus* sp.nov.

Note: The mark (*) denotes the new record of the species for the country.

I. CTENACARIDAE Grandjean, 1934

Genus: Aphelacarus Grandjean, 1932

1. Aphelacarus acarinus (Berlese, 1910)

Parhypochthonius acarinus Berlese, 1910

Aphelacarus acarinus Grandjean, 1932a

The genus Aphelacrus was created by Grandjean (1934) with Parhypochthonius acarinus (Berlese, 1910) as the type. Later, Grandjean (1954a) in his monograph on paleocaroids, erected the family Ctenacaridae with three subfamilies (Ctenacarinae, Adelphacarinae and Aphelacarinae) in it. At present, the genus Aphelacarus is the single representative of the subfamily Aphelacarinae, of the family Ctenacaridae.

The present specimens agree in all the characters with Aphelacarus acarinus (Berlese, 1910) described by Grandjean (1932a).

Material examined: Six adult female from dumped manure, Botanical Garden, B.I.T.S. Campus, Pilani, 22.10.1968.

II. BRACHYCHTHONIDAE[1] Grandjean, 1947

Genus: Brachychtnonius Berlese, 1910

Brachychochthonius Jacot, 1938

Poecilochthonius Balogh, 1943

Grandjean (1947) erected the family Brachychthoniidae in which he included three genera viz., Brachychthonius Berlese, 1910; Brachychochthonius Jacot, 1938; and Eobrachychthonius Jacot, 1936. In the same work, Grandjean proposed a new group "Enarthronata" in which, the Brachychthonidae together with closely allied families were included. Accordi..g to recent classification by Grandjean (1969), the superfamily Brachychothonoidea is included under the group Enarthonata along with tne six otner superfamilies; Hypochthonoidea, Mesoplophoroidea, Heterochthonoidea, Cosmochthonoidea, Protoplophoroidea and Phyllochthonoidea.

The genus Brachychthonius was created by Berlese (1910) with B. brevis as the type species. Accordi ng to Evans (1952), the type species figured by Berlese (1910, fig. 38) is not Michael's (1888) species but a distinctly sculptured mite subsequently named Brachychthonius berlesei by Willmann (1928), hence he considered B. berlesei (Willmann) as the type species of the genus and not B. brevis (Michael). In the same work, Evans considered the genus Brachychochthonius Jacot, 1938 as a synonym of

Brachychthonius since Jacot's diagnostic characters for genus (dorsum of the abdomen divided into three longitudinal areas by two longitudinal grooves ... cephalothorax and dorsum of abdomen usually sculptured) are also present in B. berlesei. On the similar grounds, Evans (1952) considered Poecilochthonius Balogh, 1943 as a synonym of Brachychthonius.

The diagnostic characters of the genus Brachycnthonius are: Notogaster with two sutures; one suprapleural plate, notogasteral setae d3 marginal in position, hysterosoma with two blunt tubercles posteriorly; dorsal surface of the prodorsum and notogaster either smooth or sculptured (c.f Balogh, 1965).

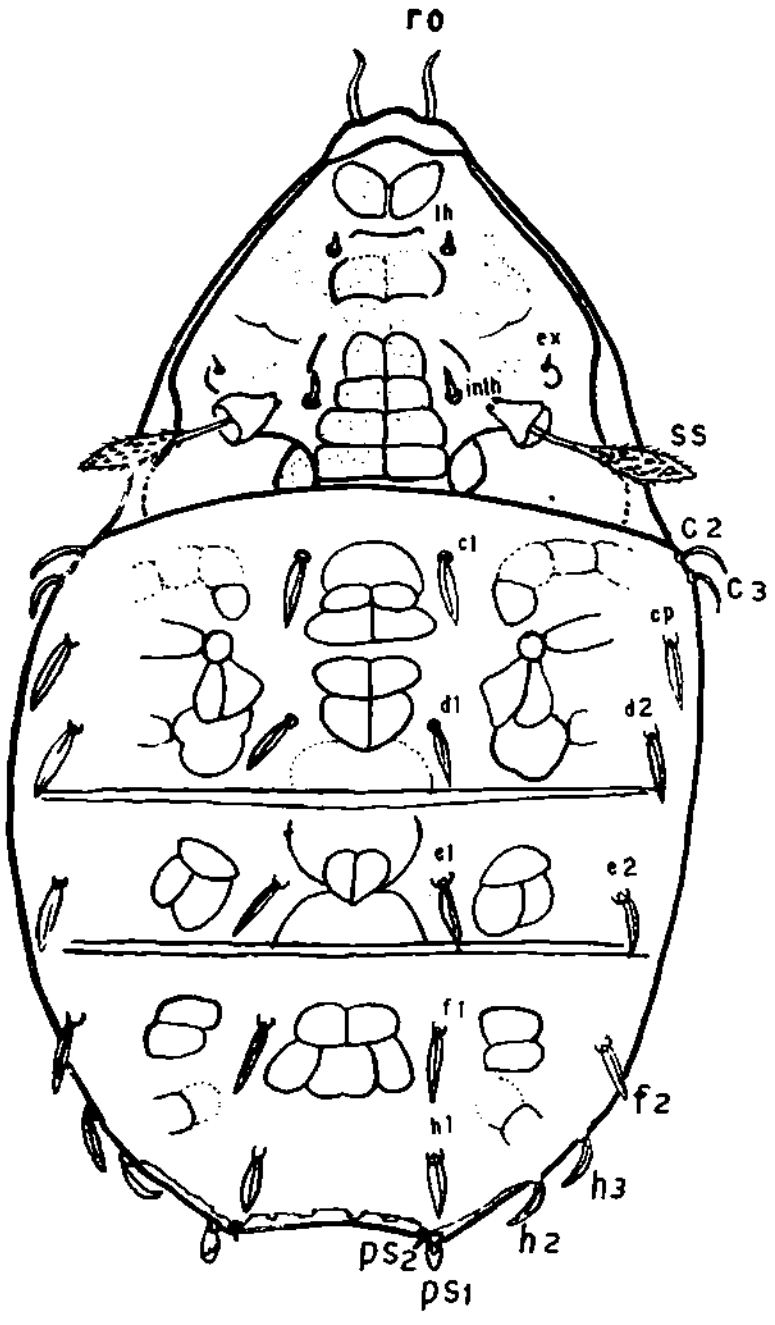
The following are the descriptions of one new species and one new subspecies of the genus Brachychthonius.

2. Brachychthonius cristatus sp. nov.

Color: Yellowish. Measurements: Body length 238 (220-250); length of prodorsum - 58, length of notogaster - 180.

Prodorsum (Figs. 14, 14a):

Rostrum conical, with a lateral incurvation on either side of the insertion of rostral setae. Posterior to the rostral setae a medially elated transverse ridge is present, which is continued backwards and outwards,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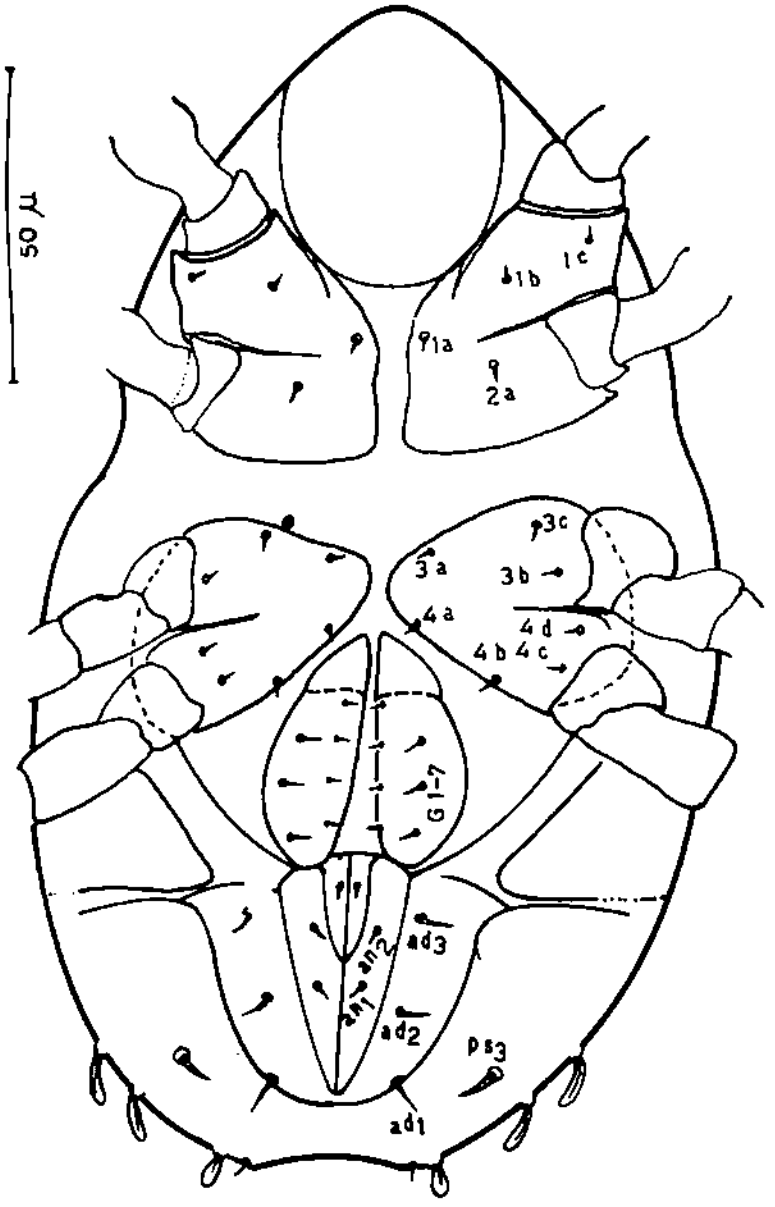
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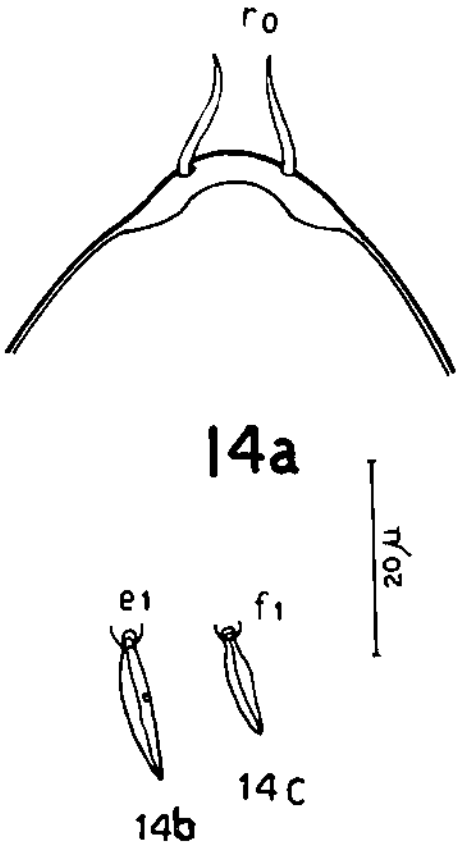
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stretching along the border of the prodorsum, incurved at the postero-lateral region of the insertion of exobothridial seta (exa) and ending at the posterior border of the propodosoma. In between the lamellar setae (lh), a transverse, but slightly bent, ridge is present. A little anterior to the interlamellar setae (inlh) a chitinized ridge is present on either side. There is also a crescent shaped ridge present posterior to the opening of the pseudostigmata (ps) and meeting the dorsosejugal suture on either side of the last row of light spotted areas. Rostral setae (ro) are thick, foliate and 12μ to 14μ in length. Interlamellar, lamellar and exobothridial setae are short and spine like. Botnridia is cup like, while the pseudostigmatic organ (sensillus) is spindle shaped and spiculate. There are six pairs of light spotted areas present medially on the prodorsum, and another pair of circular areas anterior to them on the rostrum.

Notogaster (Figs. 14, 14b, 14c):

Notogaster broader anteriorly, divided into three segments (D, E and F) by two transverse sutures. The segments (D) and (F) are almost equal and broader than the middle segment (E). A suprapleural plate (spl) is present at the lateral margins of the segments (D) and (E) and is devoid of setae. All notogastral setae, except c1, ps2 and ps3, are leaf like and lanceolate. Median notogastral setae, d1, e1 and f1 are longer than the remaining

notogastral setae. Abdominal gland absent. The pore on segment (D) is almost circular and not ringed. The lateral light spotted areas are less selerotised. The median region of segment (F) has four small areas which are devoid of an ovate pore connecting the central small areas as found in Brachychthonius foliatus Hammer, 1958. The sculpture of the prodorsum and notogaster is as shown in Fig. 14.

Epimeral region (Fig. 15):

Coxisternal plates I-II, and III-IV, are fused and separated medially on the sagittal plane. The setal formula of the epimerata I-IV is 3-1-3-4. All the epimeral setae are short, spine like and glabrous.

Anogenital Region (Fig. 15):

Genital plates are broad posteriorly, the anterior region is triangular and darker than the posterior region. There are seven pairs of genital, one pair of aggenital, one pair of preanal, two pairs of anal and three pairs of adanal setae present. Seta ad3 is longer than the remaining ventral setae.

Gnathosoma:

Chelicerae strong, setae cha and chb short and appears to be simple. Pedipalp five segmented.

Legs:

All legs five segmented, tarsi I to IV monodactyle and monotypical. Trochanter of leg I and II are devoid of setae, whereas III and IV bear one pair of setae each.

Discussion:

The present species closely resembles Brachychthonius foliatus Hammer, 1958 in the shape of foliate and lanceolate dorsal setae. The new species, however, differs from the above species by the combination of the following characters:

(a) rostral setae foliate and not bristle like as found in B. foliatus

(b) a strong chitinised ridge, stretching between the exobothridial and lamellar hairs, is double in B. foliatus whereas absent in new species, B. cristatus

(c) the sculpture of the prodorsal and notogastral region of B. cristatus is entirely different from that of B. foliatus.

Type data: Holotype adult females from litter - under Banana tree, Mt. Abu, 29.10.1969.

3. Brachychthonius semiornatus rajasthanicus subsp. nov.

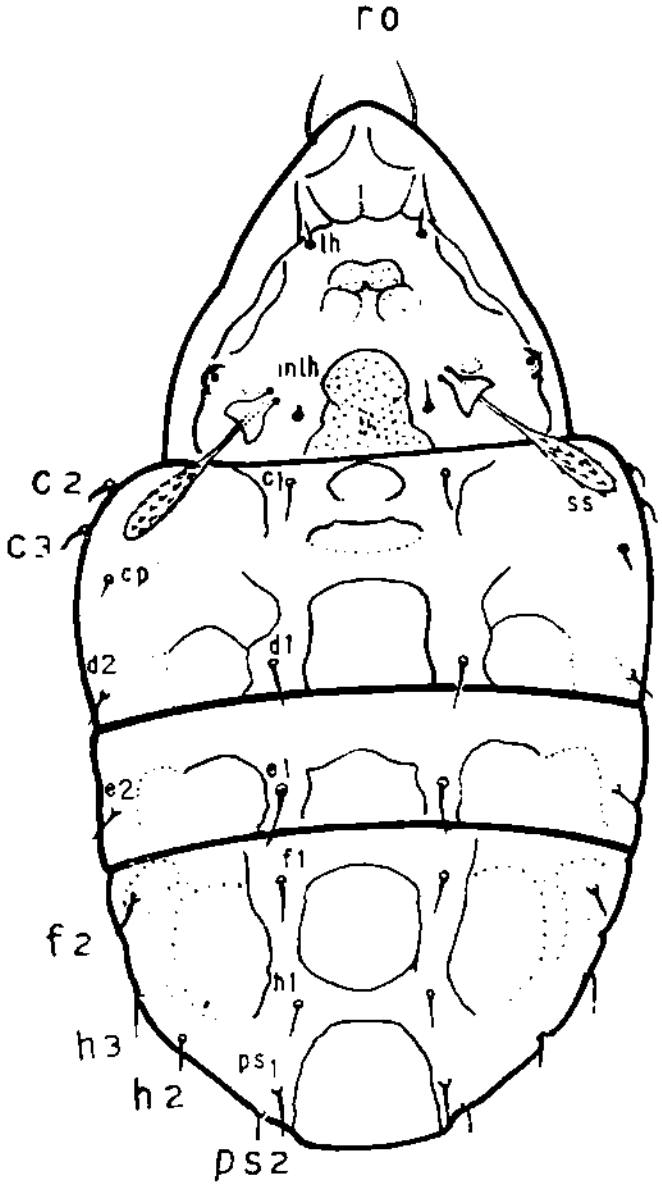
Color: Pale yellow. Measurements: Length of the body - 180; length of prodorsum - 60; length of notogaster - 120.

Prodorsum (Fig. 16):

Rostrum conical; rostral setae spinelike, longer than the other prodorsal setae and are inserted antero-laterally on the rostrum. Interlamellar hairs (inlh), lamellar hairs (lh) and exobothridial setae (ex) are short and with distinct setal pore. There are two short transverse ridges with their medial parts run forwards to the median tip of the rostrum and are postero-median to the insertion of the rostral setae. The presence of two lateral ridges and the light spotted areas on prodorsum are similar to the pattern present in B. semiornatus Evans, 1958 except that a transverse ridge on the posterior median region of the prodorsum is absent in the present specimens. Bothridia cup like, sensillus spindle shaped and spiculate.

Notogaster (Fig. 16):

Hysterosoma with 16 pairs of simple and spine like setae. The sculpturing of the hysterosoma fading towards the lateral margin of the body as in B. semiornatus. Segment (D) devoid of ovate pore. The antero-median light spotted areas of segment (D) are separate and not fused.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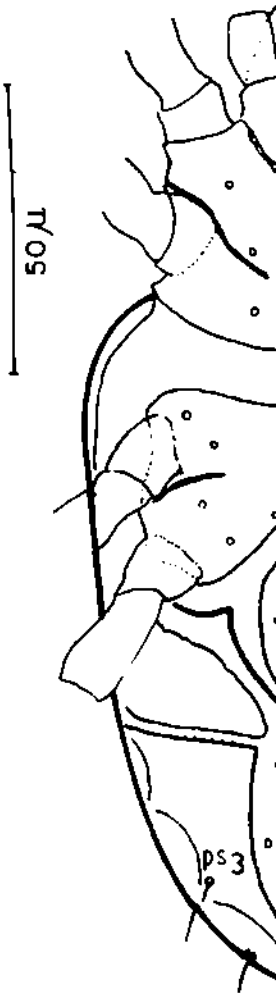
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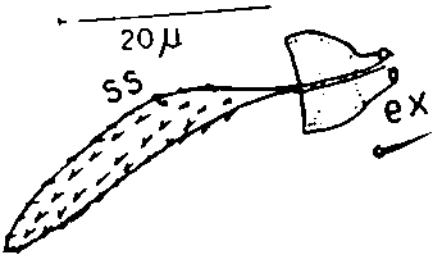

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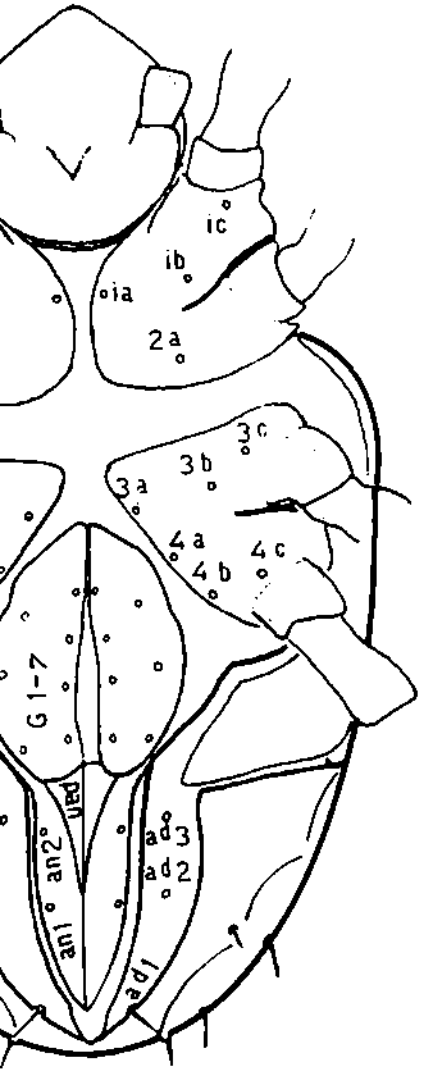


17

Epimeral region (Fig. 17):

Coxisternal plates I-II and III-IV fused. The setal formula of the epimerata I-IV is 3-1-3-4. All setae are snort and spine like.

Ano-genital region (Fig. 17):

Genital plates with seven pairs of setae (four pairs paraxial and three pairs antaxial in position); one pair of aggenital setae present. There are three pairs of anal, three pairs of adanal and one pair of preanal setae present. Adanal setae are slightly longer than the other ventral setae.

Type data: Holotype. One adult female from humus, under Nerium plant, Institute Campus, Pilani, 12.6.1969. Paratypes: Eight adult females, same data as holotype; 13 adult females, Mt. Abu, 28.10.1969 and six adult females from compost heaps, Mandore Garden, Jodhpur, 24.3.1969.

Discussion:

The described subspecies of Brachychthonius semiornatus Evans, 1952 resembles the species in many features as described here in the text, but differs in the following characters:

(a) absence of transverse ridge on the posterior region of the prodorsum

(b) absence of ovate pore on the segment (D)

(c) the antero-median light spotted areas of segment (D) are free and not fused unlike B. semiornatus.

Evans (1952) has not mentioned about the characters of the ventral region of the mite, hence not possible to make further comparisons.

III. HAPLOCHTHONIIDAE van der Hammen, 1959

Genus: Haplochthonius Willmann, 1930

Haplochthonius Willmann, 1930

Tetrachthonius Hammer, 1959

Van der Hammen (1959) erected the family Haplochthoniidae in which the genera Haplochthonius Willmann, 1930; Amnemochthonius Grandjean, 1948; and Tetrachthonius Hammer, 1959 were included. The genus Tetrachthonius was later considered as a synonym of Haplochthonius by Balogh (1965).

The genus Haplochthonius, to which the present specimens belong, was first erected by Willmann (1930) with Haplochthonius simplex as the type species. The diagnostic

characters of the genus are: Notogaster divided into four segments by three horizontal coupures (sutures); rostral hairs present, sides of the hysterosoma chitinized and preanal plate absent.

The following is the description of one new species of the genus Haplochthonius.

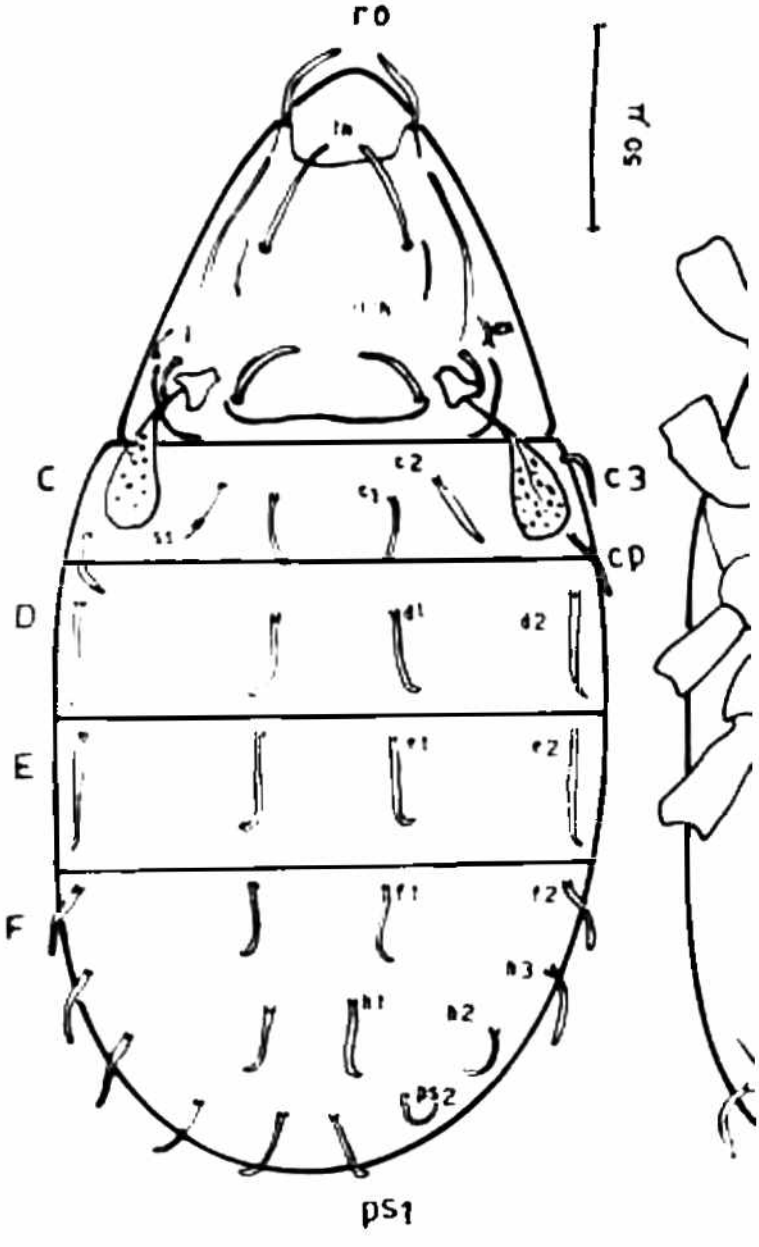
4. Haplochthonius nudatus sp. nov.

Color: Pale yellow. Measurements: Length - 263 (245-275); length of prodorsum - 95; length of notogaster - 180.

Prodorsum (Fig. 18):

Rostral hairs (ro) inserted on the rostral apophyses, uniformly thick throughout, strongly curved and meet in front of the rostral rectum. Lamellar hairs (30μ) thick, longer than the remaining prodorsal hairs and medially placed on the prodorsum. Interlamellar hairs (inlh) are lateral to the bothridia and shorter than the rostral setae. Exobothridial setae (exa and exb), are short and situated lateral to the bothridia. Bothridia cuplike, directed posteriorly; sensillus with a thin stalk and well flattened head, beset with short bristle-like structures.

On the lateral region of the prodorsum, a chitinized ridge is present, stretching from the rostral hairs upto the insertion of the anterior exobothridial setae exa and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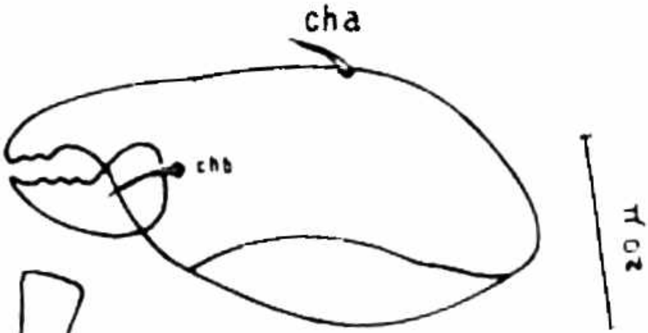
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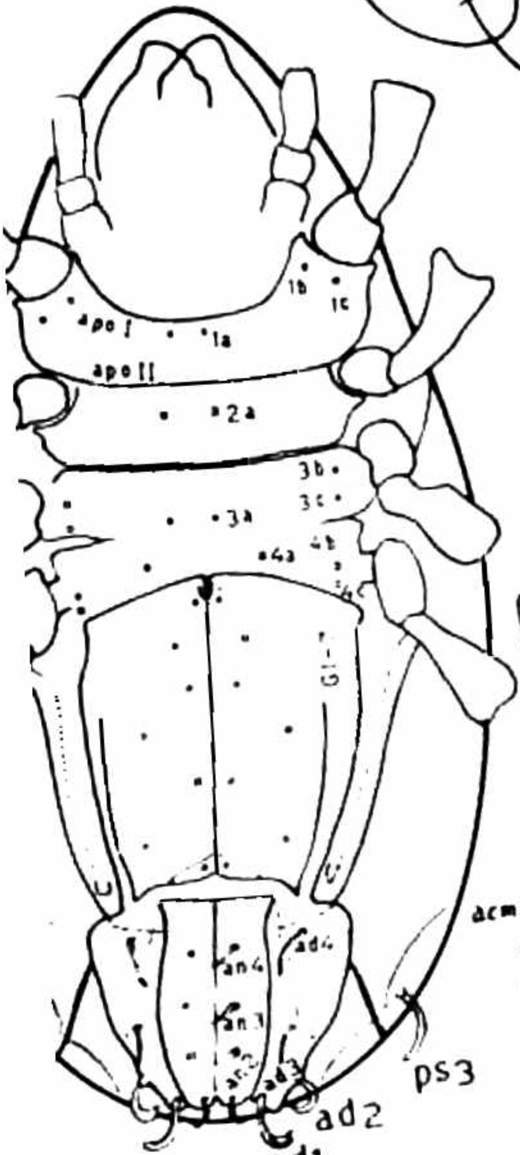
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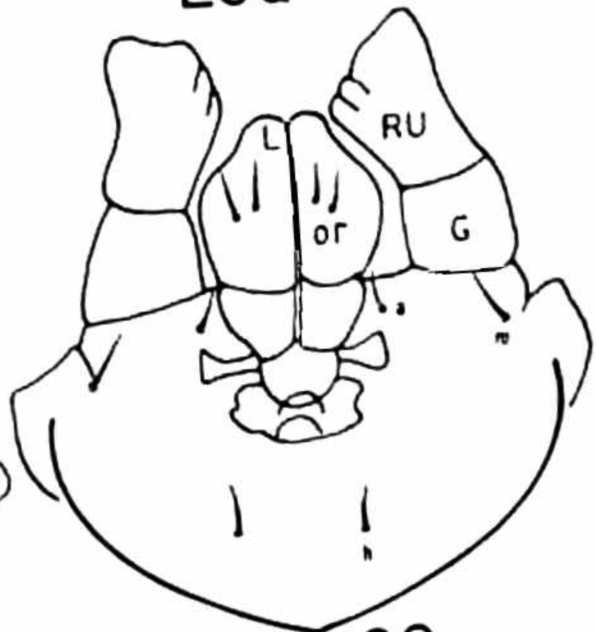
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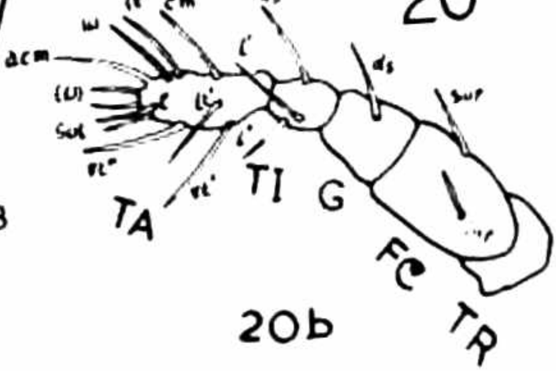
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exb. A less sclerotized transverse ridge is present to the insertion of interlamellar hairs. Two more such short transverse ridges are also present antero-medially on the prodorsum - in between the rostral and lamellar setae. The anterior one appears to connect the rostral apophyses as in H. clavatus Hammer, 1958.

Notogaster (Fig. 18):

Dorsosejugal suture distinct, the sides of the hysterosoma darkly sclerotized and more or less truncate. Hysterosoma divided into four segments by three transverse coupures as in other Haplochthonids. The posterior segment (F) about double to the median segments (D and E) in length. Notogaster with 16 pairs of thick and leaf like hairs . The lateral marginal setae d2 and e2 are longer than the other notogastral setae. Seta ps3 is ventrally inserted. The mutual distances between the notogastral setae: e1 - e1 ≥ f1 - f1 > c1 - c1 ≥ d1 - d1 > h1 - h1 > ps1 - ps1.

Epimeral region (Fig. 19):

Coxisternal plates I and II are separated by the epimeral ridge II, whereas the epimeral plates III and IV are fused to a single plate. Epimeral ridge III short and not connected medially. The setal formula of the epimerata I-IV is 3-2-3-3. Setae 3c and 4c are inserted directly posterior to setae 3b and 4b respectively. All

setae are short, thin and spine-like.

Ano-genital region (Fig. 19):

Genital plates usually long, broader anteriorly, with seven pairs of setae (four pairs paraxial and three pairs antaxial in position). G1 short and indistinct. Aggenital plates present and devoid of setae. Anal and adanal plates bear four pairs of setae each. An1 longer and thicker than the remaining anal setae. Preanal plates absent.

Gnathosoma (Figs. 20, 20a, b):

Anarthric (labiogenal articulation absent); hypostomal setae (h), median capitular setae (m), anterior seta of gena (a) and adoral setae (or) are short, spine-like and glabrous. Labrum rounded at the distal end, rutellum strong, setae cha and chb of chelicerae are short and smooth. The chaetotaxy of the five segmented pedipalp is 0-1-1-3-11.

Legs:

All legs monodactyle and monotypical. The chaetotaxy of legs not studied in detail.

Type data : Holotype. One adult female, from moss, Ajit Sagar Bund, Khetri, 27-2-1970. Paratype 18 females, same data as holotype.

Discussion:

The new species belongs to the genus Haplochthonius Willmann, 1930 because of the following characters:

(a) rostral hairs present

(b) sides of the hysterosoma chitinized

(c) no ribbon like hairs on the apex of palpus

(d) notogaster with three distinct transverse coupures.

The new species shows a close resemblance to H. clavatus (Hammer, 1958) in the following characters:

(a) rostral hairs inserted on the apophyses, strongly curved and almost meet in front of the rostral tetcum; a transverse line connecting the rostral apophyses is present

(b) presence of three transverse sutures on the hysterosoma

(c) general shape of genital, anal and adanal plates.

However, the characters in which H. nudatus differ with that of H. clavatus are given in the table.

Table V.1: Distinguishing characters between H. clavatus (Hammer) and H. nudatus sp.nov.

Characters	H. clavatus	H. nudatus sp.nov.
Sensillus	sensillus head clavate not much flattened	sensillus head not clavate but very much flattened
Chitinized transverse ridge behind inlh	absent	present
Seta exo	not mentioned	present and shorter than exa
Agennital setae	1 pair	absent
Anal and adanal setae	3 + 3	4 + 4
Genital setae	not mentioned; but figure shows only two setae	seven pairs
Median notogastral setal distance	e1-e1 > c1-c1 ≧ f1-f1 > d1-d1 ≧ h1-h1 > ps1-ps1	c1-c1 ≧ f1-f1 > c1-c1 ≧ d1-d1 > h1-h1 > ps1-ps1

IV. COSMOCHTHONIIDAE Grandjean 1947

Grandjean (1947) first erected the family Cosmochthoniidae with three genera viz. Haplochthonius Willmann, 1930; Cosmochthonius Berlese, 1910 and Heterochthonius Berlese, 1910. Further, Grandjean (1948a) included Amnemochthonius Grandjean, 1948 in Cosmochthoniidae. Later, Grandjean (1954)

separated the genus Heterochthonius from Cosmochthoniidae and has placed in a new family Heterochthoniidae. Hammen (1959) further separated Haplochthonius and Amnemocnthonius from Cosmochthoniidae and placed them under the family Haplochtnoniidae. At present, according to Balogh (1965), Cosmochthoniidae includes only two genera viz. Cosmochthonius and Trichthonius Hammer, 1961.

The genus Cosmochthonius is characterized with leg I tarsus monodactyle and tarsi II-IV tridactyle; while Trichthonius has a single claw on all leg tarsi. The material present before the author which belongs to the family Cosmochthoniidae include two distinct forms, one possessing the characters present in the genus Cosmochthonius, while the other are characterised with two claws on all leg tarsi. A new genus Dichthonius has been, therefore, erected to accommodate these bidactylous forms in the family Cosmochthoniidae (see page 52)

Genus: Cosmochthonius Berlese, 1910

Berlese (1910) erected the genus Cosmochthonius with Cosmochthonius lanatus Michael, 1885 as the type. Hammen (1959) while reviewing the Berlese primitive oribatids has pointed out that the type, C. lanatus possess a single claw on tarsus I and three claws on tarsi II-IV. According to him both Berlese (1910) and Michael (1885) have erroneously

described the type as a monodactyle form.

The diagnostic features of Cosmochthonius are: Leg I bidactylous and II-IV tridactylous, prodorsal hairs plumate or leaf shaped; notogaster with three horizontal sutures, notogastral setae of rows e and f erectile and are situated on intercalary sclerites; with 10 pairs of genital, four pairs of anal and four pairs of adanal setae. Aggenital plates present.

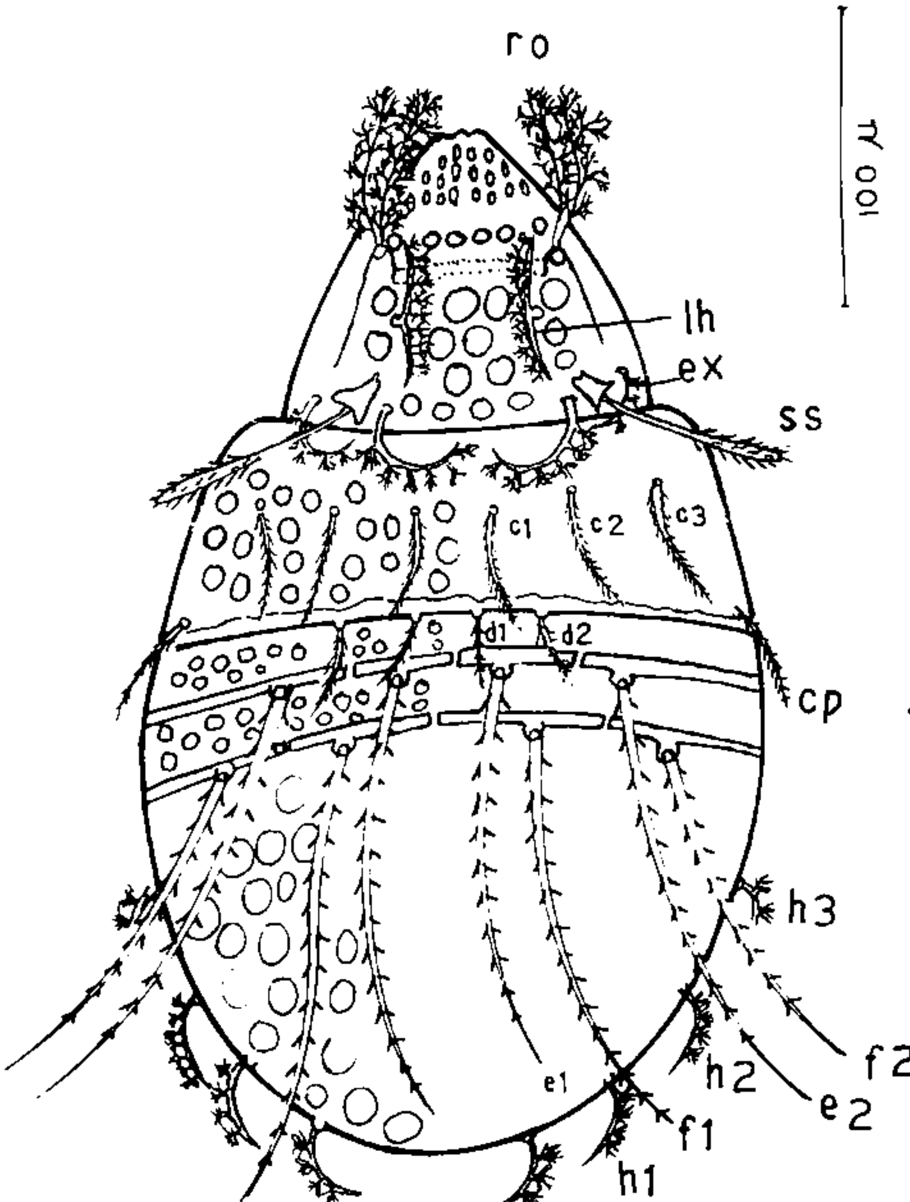
The following is the description of one new species of the genus Cosmochthonius.

5. Cosmochthonius areolatus n.sp.

Color: Pale yellow. Measurements: Total length of the body - 270; length of prodorsum - 110, length of notogaster - 160.

Prodorsum (Fig. 21):

The anterior median region of the rostrum is "U" shaped with a small knob like projections on either side. The dorsal surface of the rostrum consists of a lace of narrow longitudinal holes, which are arranged in three horizontal rows (Fig. 21). A thick longitudinal ridge transverse along the lateral margin of the prodorsum and the rostral hairs (ro) are situated on the tip of the lateral ridges. Rostral hairs are bush-like with branched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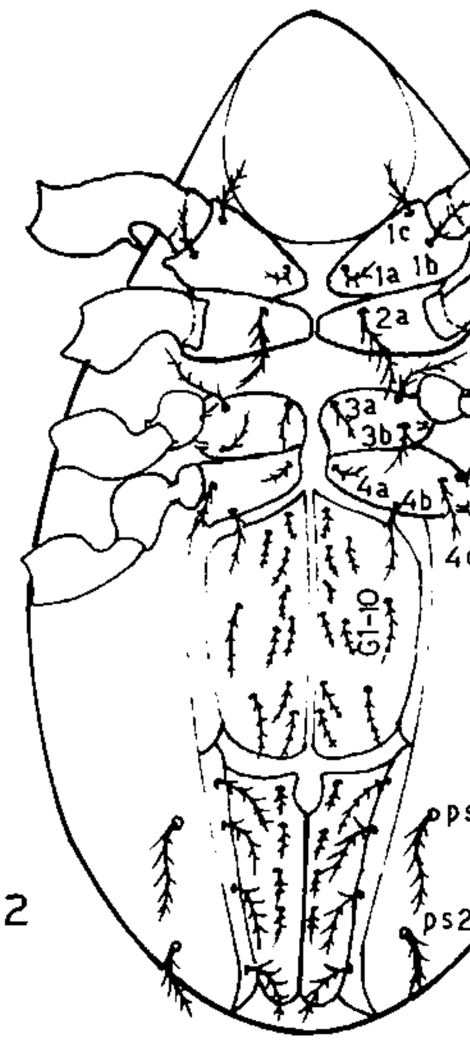
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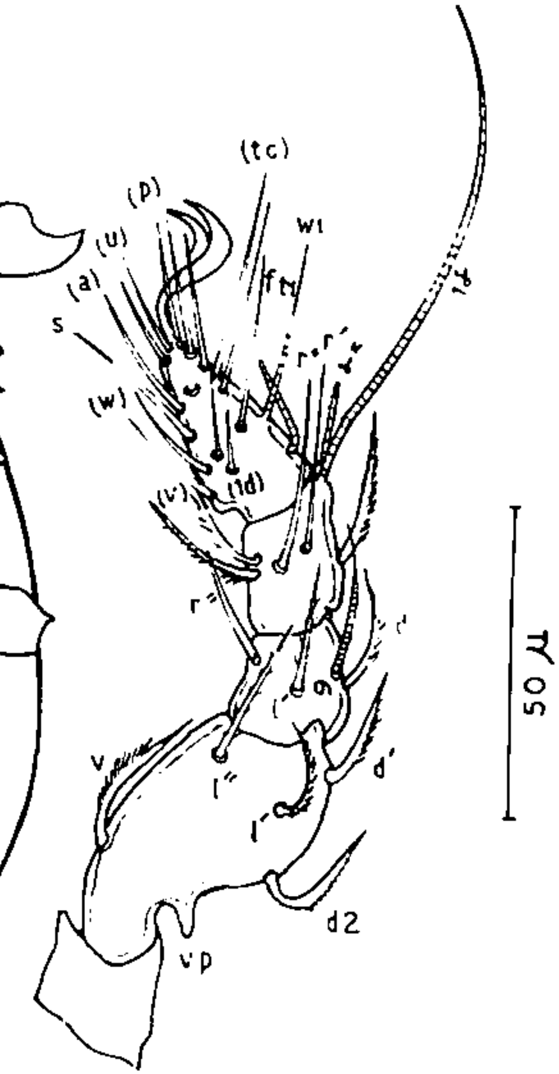
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secondary setae. Lamellar hairs bifurcated with unilaterally branched secondary setae and are medially inserted on the prodorsum. Exostigmatic setae (exa) and interlamellar setae (inlh) strongly curved and are with unilaterally branched secondary setae. Circular pits, bigger than their interspeces, are present on the median and posterior region of the prodorsum. However, these pits are smaller on the lateral region of the prodorsum. Sensillus spindle shaped with a thin stalk, and the sensillus head spiculate.

Notogaster (Fig. 21):

Hysterosoma divided into four segments by three horizontal notogastral coupures. The dorsal surface of the hysterosoma is covered with big circular pits which are present on the segments (D) and (E) also (hence the specific name). Setae c1, c2, c3 and cp are feather like and barbed. The distance between the setae d1-d1 is almost the same as between d1-d2. Setal rows of e and f are erectile, sparsely barbed and broader than those of C. semiareolatus Hammer, 1966. Marginal setae ps1, h1, h2 and h3 are strongly curved and pectinate, whereas setae ps2 and ps3 are barbed bilaterally.

Measurements of notogastral setae (length in microns):

c1, c2, c3 and cp	...	40-45
d1, d2	...	21

e1, e2 and f1	...	150
f2	...	120

Epimeral region (Fig. 22):

Setal formula of Epimerata I-IV: 3-1-3-3. Setae 2a unusually long and sigmoid in shape. All epimeral setae are barbed.

Ano-genital region (Fig. 22):

Genital plates are longer than broad, broader anteriorly and narrow posteriorly. There are ten pairs of genital (three antaxial and seven paraxial in position), four pairs of anal and four pairs of adanal setae present. The antaxially arranged genital setae are longer than the paraxial setae. Adanal setae are longer than the anal setae. All ano-genital setae are relatively barbed. The marginal regions of the genital, anal and adanal plates are darkly sclerotized.

Gnathosoma:

The setal formula of the five segmented pedipalp is 0-2-1-3-11, as in other species of the genus. Chelicerae normal and dentate. Hypostomal setae (h) are sigmoid and barbed.

Legs (Fig. 23):

Leg I bidactyle, II-IV tridactyle and heterodactyle. Chaetotaxy of legs I-IV is shown in table (V.2). Trochanter of leg I with a strong ventral spine posteriorly.

Table V.2: Chaetotaxy of leg segments I-IV of Cosmochthonius areolatus sp. nov.

Leg	TR	F	G	TI	TA
I	0	5	4(1)	4(3)	17(2)
II	0	5	4(1)	4(1)	15(2)
III	2	4	3(1)	3(1)	15
IV	2	3	4	4	14

* The figures in parenthesis denote the number of solenidion.

Type data : Holotype. One adult male, from humus, Birla Farm area, Pilani, 22.3.1969. Paratypes five adult males, same data as holotype.

Discussion:

The new species C. areolatus closely resembles C. semiareolatus Hammer, 1966 on the nature of the prodorsal and hysterosomal setae, but differs mainly with the presence of circular pits on the notogastral segments (D) and (E) which are absent in C. semiareolatus. The rostral tip of the C. areolatus is 'U' shaped and devoid of rostral spines.

The sculpture of rostrum is different from that of C. semiareolatus. Hammer (1966) has not mentioned the characters of the ventral region of the C. semiareolatus, hence cannot be compared with that of C. areolatus.

Genus: Dichthonius gen.nov.

Diagnosis:

Notogaster divided into five segments by four distinct sutures; notogastral setae c1, c2, f1 and f2 are linear-leaf shaped, with strong median vein and transverse secondaries which do not correspond to the marginal barbules. Rostral tectum with network like structure. Nine pairs of genital, four pairs of anal and four pairs of adanal setae present. Aggenital setae absent. Setal formula of the epimerata I-IV is 3-2-3-3. All legs bidactyle and heterodactyle. Chaetotaxy of leg tarsi I-IV is 15-12-11-11. Pedipalp five segmented; cheliceral setae, cha spine like and setae chb fork shaped.

Type species: Dichthonius lanceolatus sp. nov.

The description of the new species is given below.

6. Dichthonius lanceolatus sp.nov.

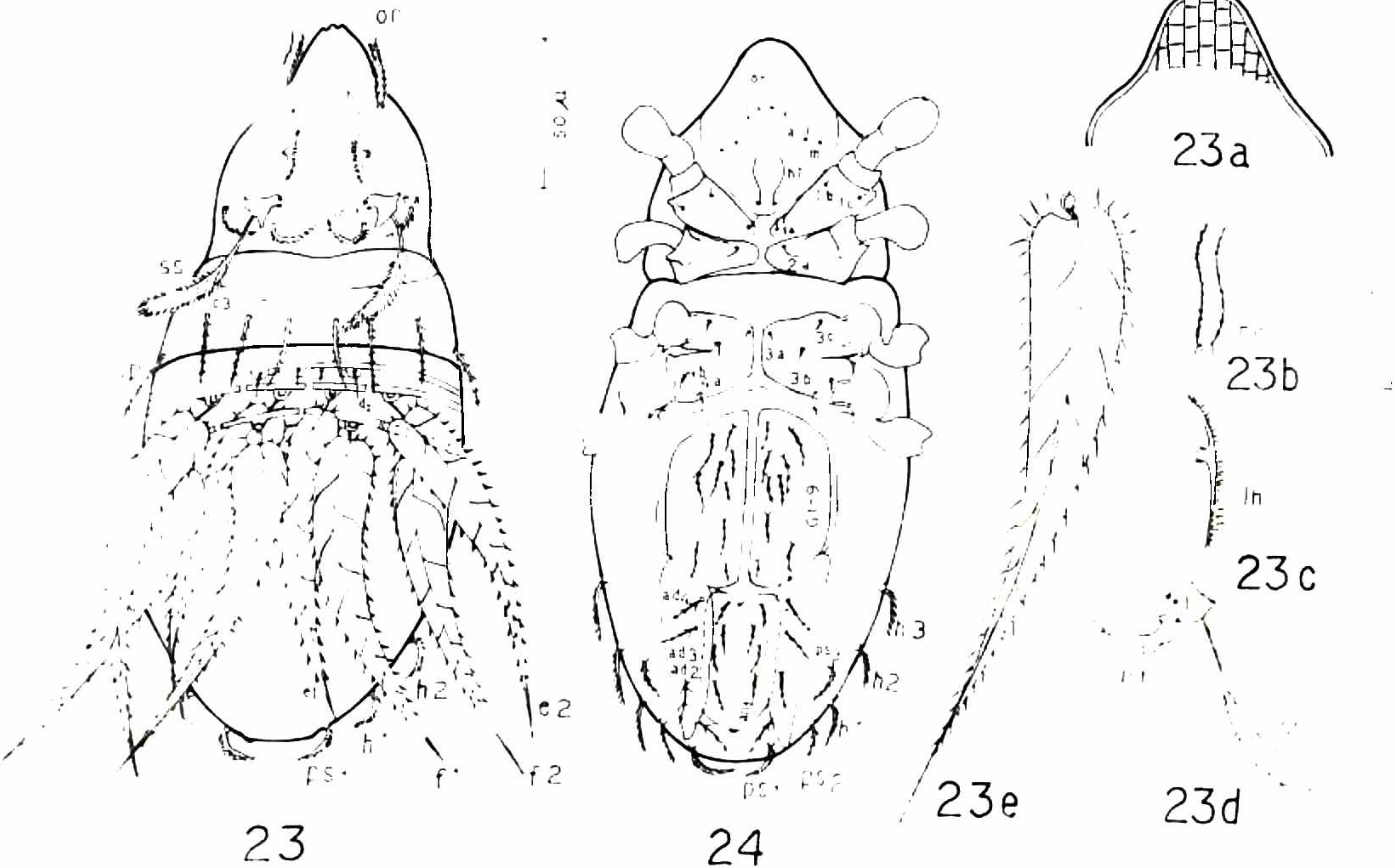
Color: Pale greyish. Measurements: Total length - 230; length of prodorsum - 80, and length of notogaster - 150.

Prodorsum (Figs. 23, 23a, 23b, 23c, 23d):

Rostral tectum weakly sclerotized and devoid of rostral teeth. The rostral surface consists of a net work like structure, with five to six rows of longitudinal sclerotized bars and each row is connected by two-four transverse bars thus exhibiting a peculiar pavement like structure (Fig. 23a). Rostral setae (ro) inserted far laterally on the rostrum, bifid, directed anteriorly and are densely barbed. Lamellar setae (lh) bifurcated, the anteriorly directed branch is longer than the posterior and are pectinate. Both interlamellar (inlh) and exobothridial hairs are strongly curved and pectinate. Sensillus head (ss) bottle brush like and densely pilose.

Notogaster (Figs. 23, 23e):

About double the length of prodorsum (150µ), broader anteriorly and tapering posteriorly. Hysterosoma divided by four distinct horizontal sutures (coupres) which are adjacent to each other. The anterior coupure is less sclerotized than the others. There are 16 pairs of notogastral setae. Segment (C) (anterior Notospis) consists of four pairs of setae, (c1, c2, c3 and cp) which are


or
50 μ
ss
c3
e2
f2
h2
h
f
ps
23
or
m
3a
3b
3c
ad3
ad2
h3
h2
ps
24
23a
23b
ln
23c
23d
23e

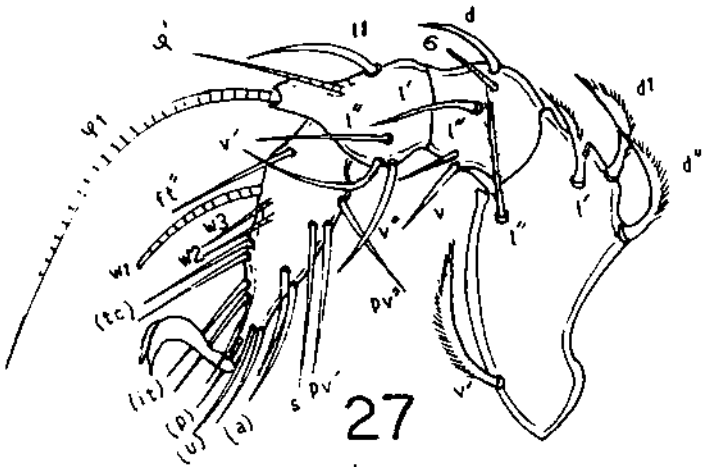
weakly barbed. Setae d1 and d2 are short, spine like, and are closely inserted on the apophyses of the second articulating band. Setae e1, e2 and f1, f2 are inserted on apophyses of the 3rd and 4th articulating bands, respectively. Setae e1, e2, f1 and f2 are of curious linear leaf shaped, with a strong median, vein and transverse secondaries which do not correspond to the lateral marginal barbules (Fig. 23e). Marginal and posterior notogastral setae (h1, h2, h3, p1, p2) are strongly curved and pectinate. Notogastral fissure (ih) laterally situated.

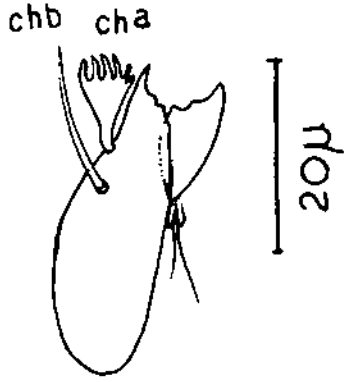
Epimeral region (Fig. 24):

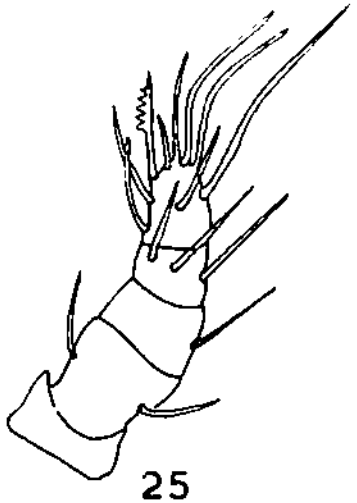
Coxisternal plates I and II separated by epimeral ridges II, whilst III and IV are fused to a single plate. Epimeral ridge IV short and laterally situated in between leg III and IV. The setal formula of the epimerata I-IV is 3-2-3-3. All epimeral setae, except, 1a and 2a are moderately barbed.

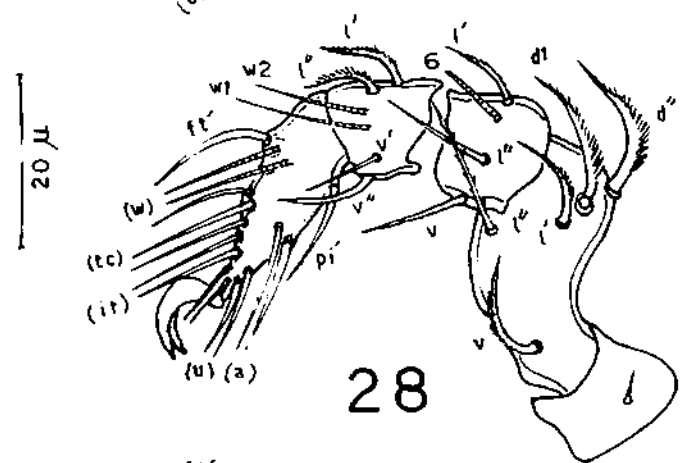
Ano-genital region (Fig. 24):

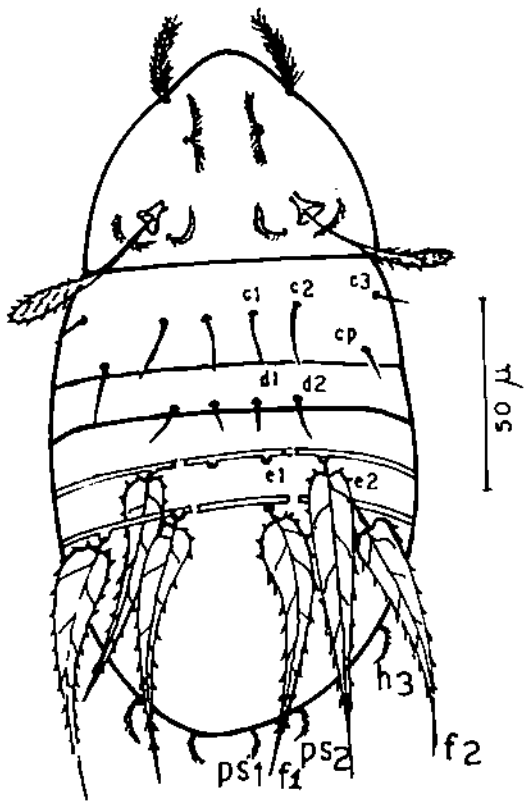
Genital plate pentagonal in shape, with nine pairs of setae (six paraxial and three pairs antiaxial in position). Aggenital plate present and devoid of setae. There are four pairs of anal and four pairs of adanal setae present. Seta ad4 is longer than the remaining adanal setae. All setae are barbed.

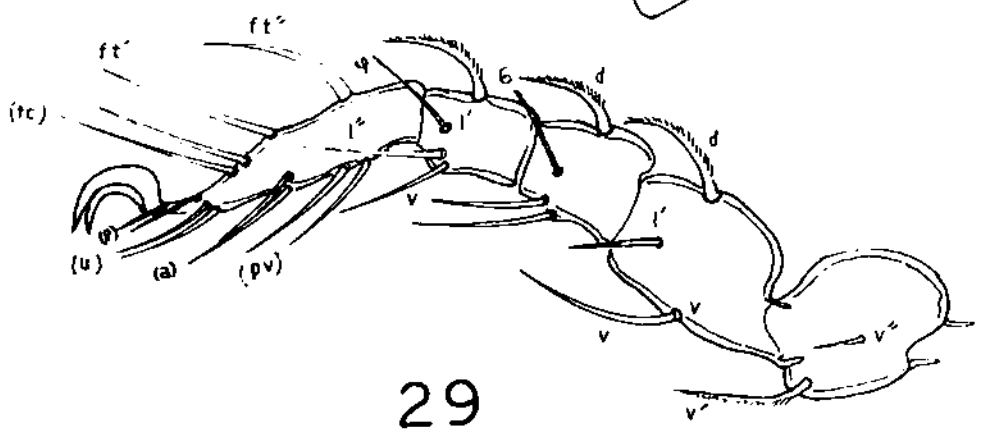

φ'
11
6
d
d1
d''
φ1
v'
ft''
w3
w2
w1
(tc)
(it)
(p)
(u)
(a)
s pv'
pv1
v''
v
l''
l'
27


chb
cha
20μ
26


25


20 μ
l'
l''
6
d1
d''
w1
w2
ft''
(w)
(tc)
(it)
(u)
(a)
pi'
v'
v''
v
28


c1
c2
c3
cp
d1
d2
50 μ
e1
e2
h3
f2
ps1
f1
ps2
30


ft'
ft''
(tc)
φ
6
d
l''
l'
v
(u)
(a)
(pv)
v''
29

Gnathosoma (Figs. 25, 26):

Labio-genal articulation diarthric; hypostomal setae (h) are sigmoid and barbed; setae (m1) and (m2) are closely inserted posterior to the palpal coxae, anterior setae of gena (a) and oral setae (or1, or2) are short and spine-like, or3 not discernible. The setal formula of five segmented pedipalp is 0- -2-1-3-9. Chelicerae normal, seta cha spine like and chb fork like as shown in figure (Fig. 26).

Legs (Figs. 27, 28, 29):

All legs bidactyle and heterodactylous. Chaetotaxy of legs I-IV is shown in the following table (Table V.3).

Table V.3: Chaetotaxy of legs I to IV in D. lanceolatus

Leg	TR	Fe	Ge	Tl	TA
I	0	5	4(1)	4(2)	15(2)
II	1	5	4(1)	4(2)	13(2)
III	2	3	3(1)	3(1)	12
IV	2	3	3(1)	3(1)	12

Note: Figures in parenthesis denote the number of solenidion

Tritonymph (Fig. 30):

The only specimen present in the collection exhibit the following characters.

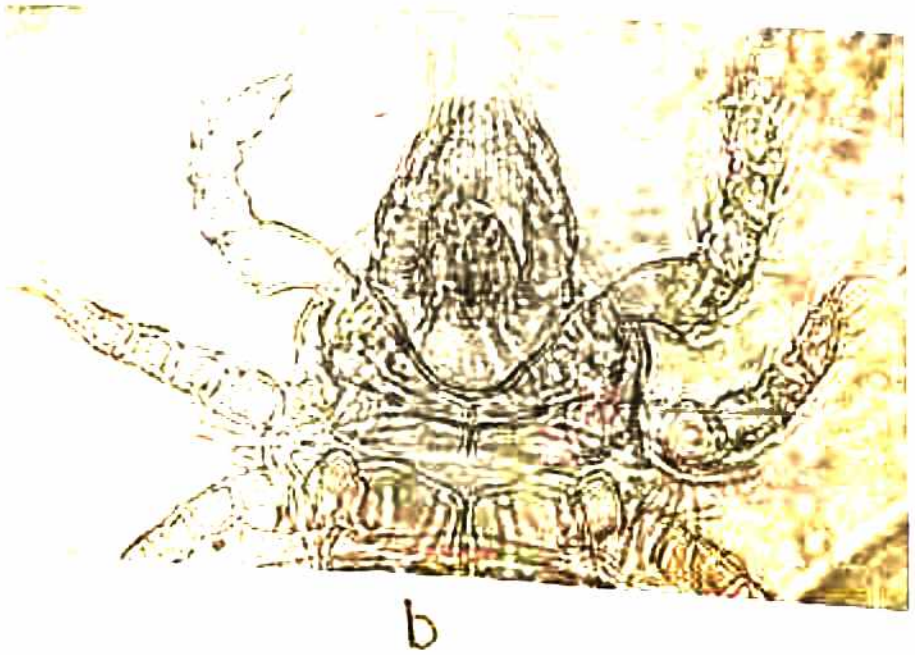
Rostral setae densely barbed, not branched, and inserted laterally on the rostrom. Lamellar setae bifurcated and unilaterally barbed. Exostigmatic setae (exa) and interlamellar setae (inlh) are equal in length, strongly curved and pectinate as in adult. Sensillus with a thin stalk, beset with short and fine bristles, the sensillus head densely pilose. Notogaster divided into five segments by four weakly sclerotized bands. Notogaster with 14 pairs of setae. The shape of setae e1, e2, f1 and f2 are as in adult mites. Hysterosomal marginal setae are short and appear to be pectinate. Epimeral setal formula is 3-2-2-2. All leg tarsi monodactyle.

Type data: Holotype Adult female, from humus, Birla Farm area, Pilani, 2.3.1969. Paratypes 13 adult females and one tritonymph, same data as holotype.

Discussion:

Balogh (1961, 1965) differentiated the two genera, Cosmochthonius Berlese, 1910 and Trichthonius Hammer, 1961 of the family Cosmochthoniidae on the basis of the number of claws present on the leg tarsi. According to him, the genus Cosmochthonius is diagnosed with leg I bidactyle (two claws) and leg II-IV tridactyle (three claws). Whilst, Trichthonius possess three claws on all leg tarsi. The described new species mainly differs from the above genera in the presence of two claws (bidactyle) on all leg tarsi.

a



b

The characters like the notogaster divided into five segments by four transverse sutures, the curious leaf-shaped notogastral setae (e1, e2, f1 and f2) and the chaetotaxy of leg tarsi further differentiates them from the other known species of the Cosmochthoniidae.

A new genus Dichthonius with D. lanceolatus sp.nov. as the type, has been erected, therefore, to accommodate the badactylous forms in the family Cosmochthoniidae.

V. PHTHIRACARIDAE Perty, 1841

The ptyctimous mites (mites that have the aspis movably hinged to the notogaster) were included until recently, under a single major taxon, cohort Ptyctima of the supercohort Oribatei (Baker and Wharton, 1952). The cohort Ptyctima, earlier included three families viz. Phthiracaridae, Mesoplophoridae and Protoplophoridae. Later, Grandjean (1954) erected a superfamily Phthiracaroidea and included the family Phthiracaridae along with two new families Pseudotritiidae and Oribotritiidae. He considered Protoplophoridae and Mesoplophoridae as two different families, of which the former was included under the group Enarthronata. However, Baker et al. (1958) and Woolley and Baker (1958) have again placed all ptychoid mites in the cohort Ptyctima under the single superfamily

Phthiracaroidea Grandjean, 1954. Further, Walker (1964) erected a superfamily Euphthiracaroidea which includes three families viz. Euphthiracaridae (= Pseudotritiidae), Oribotritiidae and Synichotritiidae (new family erected by Walker, 1954).

At present, the superfamily Phthiracaroidea consists of only one family Phthiracaridae with six genera viz. Phthiracarus, Hoplophorella, Hoplophthiracarus, Neophthiracarus, Steganacarus and Tropacarus.

The phthiracarids collected from Rajasthan are described under the genera Hoplophorella Berlese, 1923 and Hoplophthiracarus Jacot, 1933.

Genus: Hoplophorella Berlese, 1923

Berlese (1923) created Hoplophorella as a subgenus of 'Phthiracarus' Perty (=Hoplophora C.L. Koch) with Hoplophora cucullatum Ewing, 1909 as the type. He did not mention any diagnostic characters for the genus. Jacot (1933) considered Hoplophorella as a genus and presented the following diagnostic characters: dorsal surface of the body usually areolated or sculptured; anal plates strongly convex, considerably protruding when viewed laterally, anal plates with three pairs of hairs, closely adjacent to each other in inner margins.

The following two known species of the genus Hoplophorella mentioned below, are new records for India.

7. Hoplophorella noveus Jacot, 1933

The mites examined here agree in all characters with the species described by Jacot (1933b). This species has been so far reported from Florida (U.S.A.) only.

Material examined: Seven adult females, from litter under Nerium plant, Ajit Sagar Bund, Khetri, 27.2.1970.

8. Hoplophorella scapellata Aoki, 1965

The species has been described by Aoki (1965) from Thailand. The mites examined here agree in all characters with Thailand species, but differ in, that the interlamellar hairs are slightly smaller than the sensillus.

Material examined: 11 adult females, from litter under Nerium plant, Ajit Sagar Bund, Khetri, 27.2.1970. Three females from moss, Mt. Abu, 28.10.1969.

Genus: Hoplophthiracarus Jacot, 1933

The genus Hoplophthiracarus was erected by Jacot (1933) with Hoploderma hystricinum Berlese, 1908 as the type species. The distinguishing characters of the genus

are: the prominent and erectile interlamellar hairs; flattened, non-convex often retracted anal plates with two pairs of anal hair on inner margins (c.f Jacot, 1933).

The present collection includes three species (two known and one new species) of the genus Hoplophthiracarus.

9. Hoplophthiracarus histricinus (Berlese)

Hoploderma histricinum Berlese, 1908, 1918

Hoplophthiracarus histricinum Jacot, 1933

Phthiracarus histricinus Lombardini, 1936

Description:

Notogastral hairs thick and erectile, interlamellar hairs, prominent and conspicuous; sensillus long, slender and angular curved. Surface of the notogaster and aspis pitted and areolated. Three pairs of anal and two pairs of adanal setae present. Seta ad1 inserted slightly posterolateral to the seta an3. Known distribution: Florida (U.S.A.), Schweish Lapland, North America and France.

Material examined: Three adult females from litter, Mandore Garden (3 miles from Jodhpur), 24.3.1969; four adult from the same locality, 26.10.1969.

10. H. siamensis Aoki, 1965

Description: The present material agree in all characters with the species, described by Aoki (1965). Notogastral setae thick and spiculate; lamellar setae short, rostral setae smaller than interlamellar setae; and the interlamellar setae are spiculate. Three pairs of anal and two pairs of adanal setae present. Seta ad1 situated laterally in between the anal setae, an2 and an3. Known distribution: Thailand.

Material examined: Two adult females, from litter, Mandore Garden (3 miles from Jodhpur), collected along with H. histricinus, 26.10.1969.

11. H. nepalensis Sheals, 1956

This species has been described by Sheals (1965) from Rhodendran forests of the Nepal Himalaya. The present specimens agree in all characters with the Nepal species, except in that the notogastral setae are relatively shorter.

Material examined: Eight adult females, from litter, under banana tree, Mt. Abu, 28.10.1969. One adult female from Pilani, collected by Mr. Naik (date not mentioned).

12. Hoplophthiracarus hardingii sp.nov.

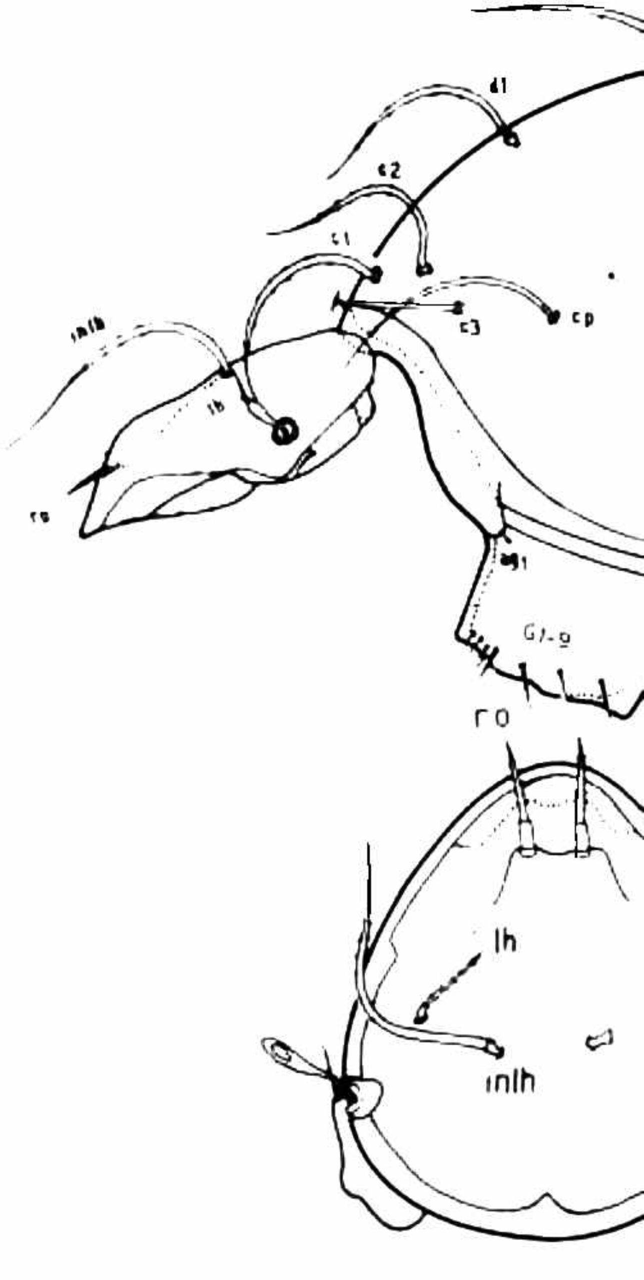
Color: Light brown. Measurements: Total length of the body - 1310; length of aspis - 350, length of notogaster - 960.

Prodorsum (Figs. 31, 32):

Lateral carinae present. Lamellar hairs short and about as long as rostral and exobothridial setae. Interlamellar hairs are well developed (280μ) and strongly curved. All prodorsal setae (lh, inlh, ro and ex) are spiculate. Trichobothria as in H. siamensis Sheals, 1965. Sensillus short and clevate. Dorsal surface of aspis puntate.

Notogaster (Figs. 31, 31a, 31b, 31c):

About 960 in length, slightly arched, with 17 pairs of long and curved setae. f1 and f2 setae present. All notogastral setae strongly curved and are spiculate. The relative length of the notogastral setae is: c1, c2, c3, cp > f1, f2 ≥ d1 > d2, e2 ≥ h1, h2, pa1, ps2 > ps3, ps4 ≥ h3. The positions of the discernible notogastral fissures (ia, im and ip) are as shown in Figure 31. Notogastral surface punctate.

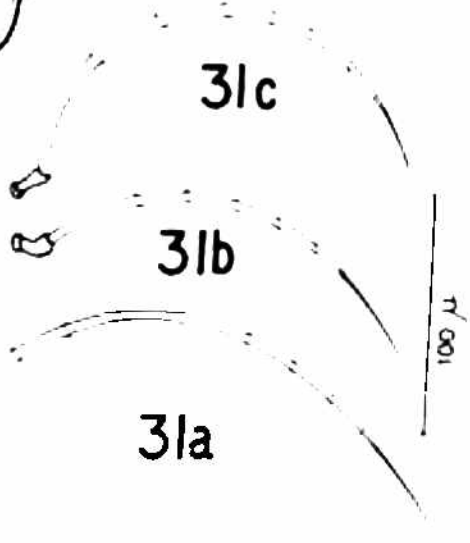


32


100 µ
f1
d2
e2
h1
h2
f1
ip
f2
h3
ps1
ps3
ps2
ps4
ad3
ad2
ad1
an2
an1

31

ex
ss


31c
31b
31a
100 µ

Ano-genital region (Fig. 31):

Nine pairs of genital and one pair of aggenital setae present; g5-g9 are short, indistinct and marginally situated on the anterior margin of the genital plate; whilst g1-g4 are longer than the other genital setae, distinct and situated in a line somewhat remote from the margin of the genital plate. There are two pairs of anal setae, curved distally, and are inserted marginally on the median region of the anal plate, whilst the three pairs of adanal setae are much longer than the anal setae. Adanal seta ad2 is the largest of all. All ano-genital hairs (except aggenital and g5-g9) are spiculate.

Gnathosoma:

The setal formula of the three segmented pedipal is 0-2-2-7 and palpal tarsus with one solenidia. Three pairs of adorsal setae present. Chelicerae strong and dentate; cha is longer than the seta chb.

Legs:

All legs monodactyle, the inner margin of the claw notched as in other hoplophthiracarids. The setal and the solenidion formula of leg I-IV exhibits a close similarity to H. nepalensis (Table V.4). Solenidion of tibia III coupled with seta d.

Table V.4: Chaetotaxy of legs I-IV of H. hardingii sp.nov.

Leg	TR	F	G	TI	TA
I	1	4	2(2)	3(1)	15(3)
II	1	3	2(1)	3(1)	12(2)
III	2	2	1(1)	2(1)	10(0)
IV	2	1	1(0)	2(0)	10

Note: Figures in parenthesis denote the number of solenidion.

Type data: Holotype adult female, from wet moss, Mt. Abu, 28.10.1969; paratype one female, same data as holotype.

Discussion:

The new species exhibits a close resemblance to H. nepalensis Sheals, 1965 in the number and position of anal and adanal setae. The new species also resembles to H. siamensis Aoki, 1965 in the shape of the sensillus only. However, the present species differs from the known species of Hoplophthiracarus by the combination of the following characters.

1. Dorsal surface of the notogaster and prodorsum punctate.
2. Interlamellar setae unusually long (280µ), strongly curved and spiculate.

3. Lamellar, rostral and exobothridial setae are short and spiculate.

4. Notogastral hairs 'sickle-shaped', thicker at the base and tapering at the distal end. All notogastral setae spiculate.

5. Two pairs of anal and three pairs of adanal setae are present. Ad2 is the largest of all.

6. Anal and genital plates smooth and not punctate or pitted.

7. The setal number of the trochanter I-IV are 2-2-2-2 as against 1-1-2-2 in H. napalensis.

VI. EUPHTHIRACARIDAE Jacot, 1930

Genus: Rhysotritia Märkel and Meyer, 1959

The genus Rhysotritia, of the family Euphthiracaridae, was first erected by Markel and Meyer (1959), with Rhysotritia ardus (= Hoplophora ardua C.L. Koch, 1841) as the type. Walker (1964) created a superfamily Euphthiracaroidea for the families, Euphthiracaridae Jacot, 1930; Oribotritiidae Grandjean, 1954 and Synichotritiidae Walker, 1964. In the same work, he has presented the following diagnosis for the genus Rhysotritia: relatively small in size, with weak to

moderately strong exoskeleton; aspis with weak central rib, rostral setae erect, scale posterior or dorsal to bothridium. Notogaster setae weak to strong; surface sculpturing usually inconspicuous. Ventral plates with simple sinuate to interlocking triangle, without lateral pocket. Anal plate almost completely fused with adanal plate; adanal setae spiculate, longer than smooth anals; a1 insertion on or very near interlocking triangle. Palpal setal formula of 1-1-8, 2-1-8 or 2-2-8. Leg IV solenidial formula 0-1-0; legs with one or three claws. Ovipositor coronal setae present.

The following two species of the genus Rhysotritia have been collected from Rajasthan soils.

13. Rhysotritia ardua (C.L. Koch 1841)

Hoplophora ardua C.L. Koch, 1841

Tritia lentula Berlese, 1887

Phthiracarus canestrinii Michael, 1898

Tritia ardua Sellnick, 1923

Oribotritia ardua Sellnick, 1928

Pseudotritiia ardua Jacot, 1930; Markel, 1958

Oribotritia loricata Willmann, 1931

Rhysotritia ardua Markel, 1964; Markel and Meyer, 1959

Markel (1964) has given an excellent redescription of this species. The species is cosmopolitan in distribution

and is reported from almost all provinces of Europe, North America, Africa and Asia (Kemerov prov., U.S.S.R.; Japan and Nepal). This is a first record of this species from India.

Material examined: Eight adult females from humus, Mandore Garden, two miles from Jodhpur, 24.3.1969; and three specimens from the same locality on 28.10.1969.

14. R. clavata Markel, 1964

This species was first described by Markel (1964) from Germany. The present specimens, the monodactylous rhysotritids, agree in all characters with the species described by Markel (1964). It is interesting to mention that this appears to be the second record of this species, and therefore, the first record from India and the Orient.

Material examined: Three adult females, from wet moss, Mt. Abu, 28.10.1969.

VII. EPILOHMANNIIDAE Oudemans, 1923

Genus: Epilohmannia Berlese, 1916

Oudemans in 1917, first erected the family Lesseriidae for the genus Lesseria Oudemans, 1917 and leter, he (1923) replaced the family name by the name Epilohmanniidae, because the generic name Epilohmannia

Berlese, 1916 had the priority against Lesseria Oudemans, 1917. The family Epilohmanniidae consists of only two genera viz. Epilohmannia Berlese, 1916 and Epilohmannoides Jacot, 1936.

The members of the genus Epilohmannia, which are widely distributed throughout the warmer regions of the world, are represented by hardly individuals belonging to two separate species in the present collection of mites from Rajasthan. The diagnostic characters of the genus Epilohmannia are: latero-abdominal gland present, with two ventral plates (schizogastric), lamellae absent and pedipalp two segmented. Type: Eplohmannia (sensu Lohmannia) cylendrica Berlese, 1904.

15. Epilohmannia cylendrica (Berlese)

Lohmannia cylendrica Berl., 1904
Epilohmannia cylendrica (s.lat) Lombardini, 1936
Epilohmannia cylendrica (s.sto) Wallwork, 1962
Lesseria szanisloi Oudemans, 1917
Epilohmannia szanisloi Schuster, 1960
Epilohmannia verrucosa Jacot, 1934

The detailed description of the species E. cylendrica and its synonyms have been fully described and discussed by Schuster (1960), Wallwork (1962) and Aoki (1965), hence deemed unnecessary to give the description of the known species again. The present specimens resemble to

E. szanisloi Schuster, 1960 (= E. cylendrica) in particular, in having two modified setae (a and s) on the tarsus of leg IV.

Material examined: Two adult females, from moss, Mt. Abu, one adult under the nerium plant, botanical garden, Institute campus, Pilani.

16. Epilohmannia pallida Wallwork, 1962

This species was described by Wallwork in 1962 from Ghana. The subspecies of this species, E. pallida pacifica Aoki, 1965 was described from Hawaiian Islands by Aoki (1965). This report stands as the first record to India and Asia. The only variable character noted in the Indian species are in the number of aggenital setae which are asymmetrical in arrangement (three setae on the left and four on the right side to the genital aperture). All other characters of the species E. pallida, like the presence of four modified setae (pv', a, s, and ft') on the leg tarsus IV notogaster with 15 pairs of setae (f1 virtual), seven pairs of genital and three pairs of each of aggenital, adanal and anal setae are also significant in the present specimens. Sexual dimorphism present. Males smaller than females, and the coxisternal ridges are weakly sclerotized in males.

Material examined: Six adult females and two males from litter, under nerium plant, Institute campus, Pilani, 2.2.1971. Four adult females from litter, under banana tree, Knetri, 26.7.1971.

VIII. LOHMANNIDAE Oudemans, 1917

Oudemans (1917) created the family Lohamanniidae for the genus Lesseria Oudemans (= Epilohmannia), whilst Grandjean (1931) restricted the family to the single genus Lohmannia Michael, 1898 (c.f Hammen, 1959). Grandjean (1934, 1950) further described five more genera (Meristacarus Grandjean, 1934; Thamnacarus Grandj. 1934; Cryptacarus Grandj. 1950; Annectacarus Grandj. 1950 and Topocarus Grandjean, 1950) under this family. Grandjean (1958) erected a superfamily Perlohmannoidea in which Lohmannidae was included along with three other allied families. Recently, he (1969) proposed a new group 'Mixonomata' suppressing the superfamily Perlohmannoidea, and in the same work he has created a superfamily Lohamannoidea for the single family Lohmanniidae. With the creation of a new family, Xenolohmanniidae for the genus Xenolohmanniia Balogh, 1969, the superfamily Lohmannoidea at present consists of two families and 17 genera (the largest superfamily of the Oribatei inferiores).

The following is the description of four new species of the genera, Annectacarus Grandjean, 1950; Haplacarus Wallwork, 1962, and Papillacarus Kunst, 1959.

Genus: Annectacarus Grandjean, 1950

The genus Annectacarus was erected by Grandjean in 1950, with A. mucronatus as type species. The diagnostic characters of the genus are: genital plates entire, without a transverse suture; adanal plate and anal plates fused into a paraproctal plate, adanal + anal setal formula (4 + 2) and preanal plate narrow. Notogastral neotrichy present, notogastral bands indistinct. Areaporosae present.

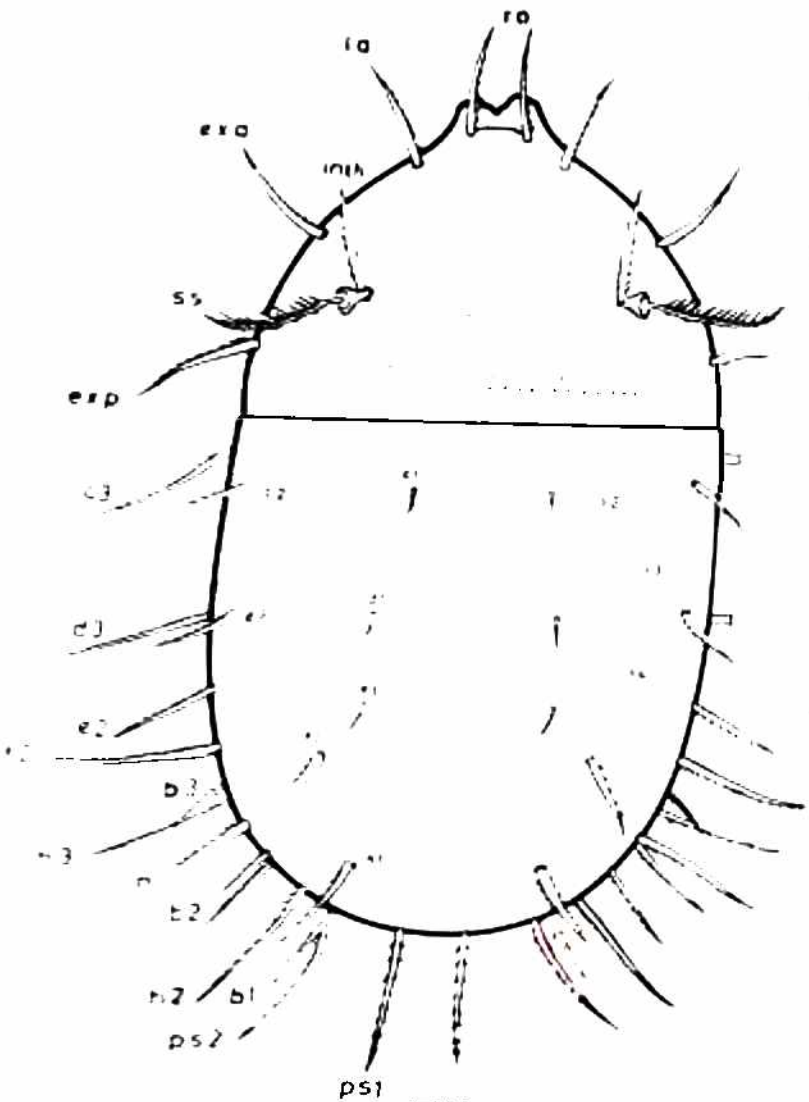
Following is the list of the four species described so far under this genus:

1. Annectacarus mucronatus Grandjean, 1950 .. France
2. A. africanus Balogh, 1961 .. E.Africa
3. A. insculptus Wallwork, 1962 .. Ghana
4. A. sejugatus Wallwork, 1962 .. Ghana

A new species of the genus is described below.

17. Annectacarus asymmetricus sp.nov.

Colour: Yellow-orown. Measurements: Total length of the body 520, length of prodorsum - 190, length of



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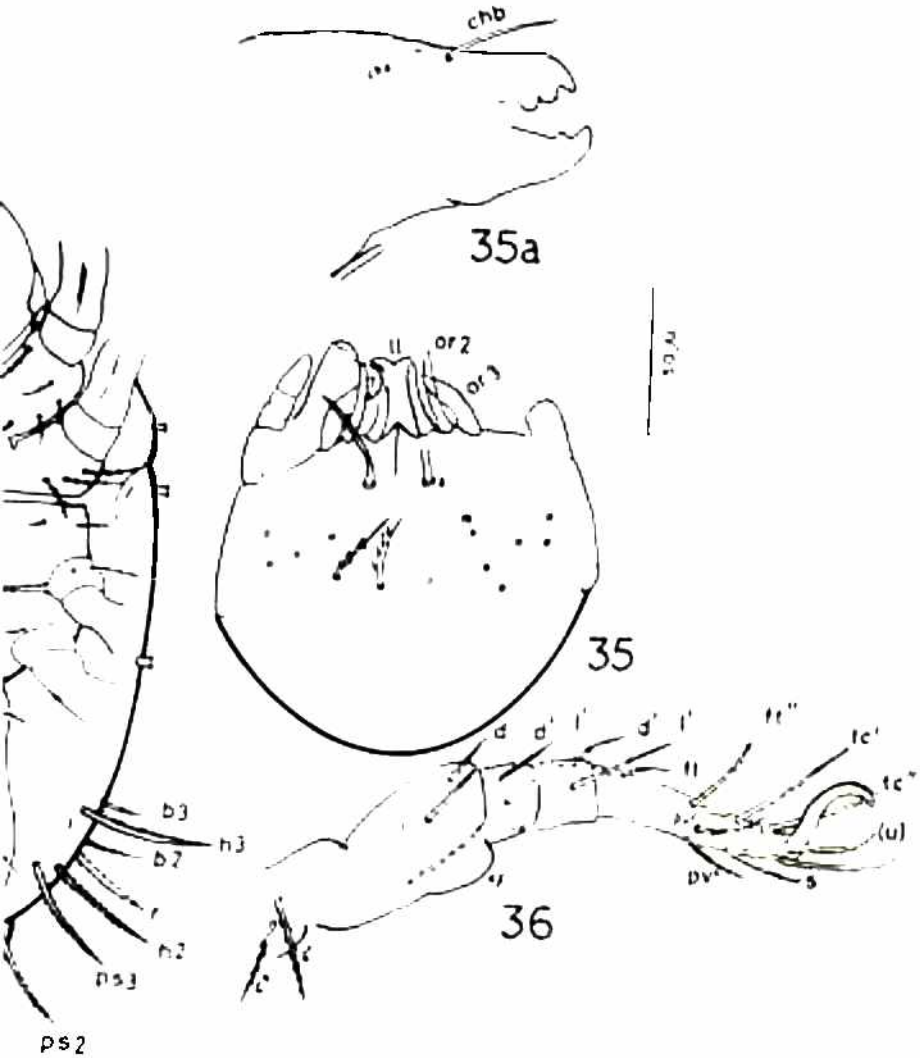
34


chb
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or2
or3
35
d
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l'
d'
l'
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lc''
(u)
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s
36
b3
h3
b2
h2
ps3
ps2

notogaster - 330.

Integuments: Microsculpture of the integument consists of polygonal reticulated structures with fine punctuation as found in other species of the genus. These structures are not distinct on the prodorsum and the ventral region of the body. Area porose absent on the notogaster and coxisternal region, but a pair of indistinct circular area porosae are absent on the posterior region of the prodorsum.

Prodorsum (Fig. 33):

The rostral tectum weakly sclerotized, with two incisions anteriorly and the rostral setae are inserted on a transverse chitinized ridge as found in A. insculptus Wallwork, 1962. The rostral, lamellar and interlamellar setae are equal in length (70µ); and exobothridial setae longer than the other prodorsal setae (80µ). All prodorsal setae are markedly barbed. Sensillus pectinate with 14 branches. Prodorsal band absent.

Notogaster (Fig. 33):

Notogastral neotrichy present (N-42). Setae c1, d1 and e1 are short, slender and smooth, whilst the remaining notogastral setae are barbed. Setae d2, e2, f2 are much thicker than the rest of the notogastral setae. Three indistinct vestiges of notogastral bands are present

corresponding to s2, s3 and s4 of A. insculptus. The notogastral band s2 is medially placed not touching the lateral walls, whilst the notogastral bands s3 and s4 are short and placed laterally, as shown in Fig. 33.

Length of notogastral setae (in microns)

c1, d1 and e1	..	20
c2, d2 and f1 and h1	..	50-55
c3, e2	..	70
f2	..	80
ps1, ps2, ps3, h2 and h3	..	90
b1, b2, b3	..	40-50

Epimeral region (Fig. 34):

Coxisternal neotrichy present and setae asymmetrical in arrangement. The coxisternal setal formula is 7-4-3-4 on the right side and 6-4-3-4 on the left side. All the median setae 1a, 2a, 3a and 4a are short and smooth. Area porose absent on the coxisternal region.

Ano-genital region (Fig. 34, 34a):

Genital plates entire, without transverse suture; with nine pairs of genital setae, six paraxial and three antiaxial in position, all antiaxial setae are longer than the paraxial setae and are barbed. Aggenital plates conspicuous, triangular in shape and are located antero-

lateral to the genital aperture. Preanal plate oroadly rectangular. Anal and adanal plates fused to a single paraproctal plate. Wallwork (1962) coined the term 'paraproctal plate' for the fused anal and adanal plates. Adanal and anal setal formula is 4 + 2, respectively.

Gnathosoma (Figs. 35, 35a):

Gnathosomal neotrichy present and asymmetrical in arrangement. Infracapitulum bears eight (seven on one side) pairs of setae; seta a smooth and foliate, the oral setae or1, or2 and or3 are foliate and their arrangement is as shown in Fig. 35. Palpi five segmented, and the setal formula is 0-1-0-1-10; chelicerae strong and dentate seta, chb nude and foliate.

Legs:

All legs monodactyle, with a strong claw. Solenidia w2 of tarsus I associated with seta ft'. The setal formula of legs I-IV are shown in table (Table V.5).

Tabove V.5: Chaetotaxy of legs I-IV of A. asymmetricus

Leg	Tr	Fe	G	Ti	Ta
I	0	5	4(1)	5(1)	17(2)
II	0	5	3(1)	5(1)	13(1)
III	2	4	2(1)	2(1)	10
IV	2	3	2	2	9

Note: Figures in parenthesis denote the number of solenidion

Type data: Holotype one adult, from moss, Mt. Abu, 29.10.1969.

Discussion:

In all the genera, belonging to the family Lohmannidae the number of setae on genital plate (either entire or divided are always ten pairs. Interestingly, in this new species, the number of genital setae found are only nine pairs. Until some more specimens with nine pairs of genital setae are found, the new species is included under the genus Annectacarus because of other closely resembling characters (Aoki, 1971, personal communication).

Genus: Haplacarus Wallwork, 1962

Haplacarus (Porocarus) subgen.nov.

Wallwork (1962) erected the genus Haplacarus with H. foliatus Wallwork, 1962 as the type species. The diagnostic characters of the genus are: genital plates entire and without a transverse suture. Anal and adanal plates fused to a paraproctal plate; four pairs of adanal and one pair of anal setae present on the fused paraproctal plate. Notogastral bands ten in number, notogastral neotrichy absent. Prodorsal and notogastral setae foliate. Cerotegument with micropapillate structures and devoid of polygonal reticulation. Areoporosae absent.

The specimen under study exhibits a striking resemblance to Haplacarus Wallwork, 1962 in the fusion of the anal and adanal plates to paraproctal plate and in the number of anal and adanal setae (1 + 4). But differs with that in the presence of area porosae on the prodorsum and the notogaster, and also in the presence of slender and shorter median notogastral hairs as compared to the foliate hairs in Haplacarus.

The present specimen also shows a relationship to Paulianacarus Balogh, 1961 in the presence of the area porosae on the prodorsum and notogaster. But the genus Paulianacarus possess two pairs of anal setae whilst only one seta in the present specimen. Further, the presence of two oval shaped area porosae on the posterior region of the prodorsum (antero-lateral to the bothridium) is another distinghishing and specific character of the new species described below.

A new subgenus Porocarus is, therefore, proposed to accommodate the new species in the genus Haplacarus.

Type species: Haplacarus (Porocarus) semifoliatus sp. nov.

The following is the key proposed for the identification of the new subgenus Porocarus.

1. 2+4 pairs of anal and adanal hairs on the fused paraproctal plate ..... Paulianacarus Balogh

1+4 pairs of anal and adanal hairs on the fused paraproctal plate Haplacarus Wallwork,S.L..... 2

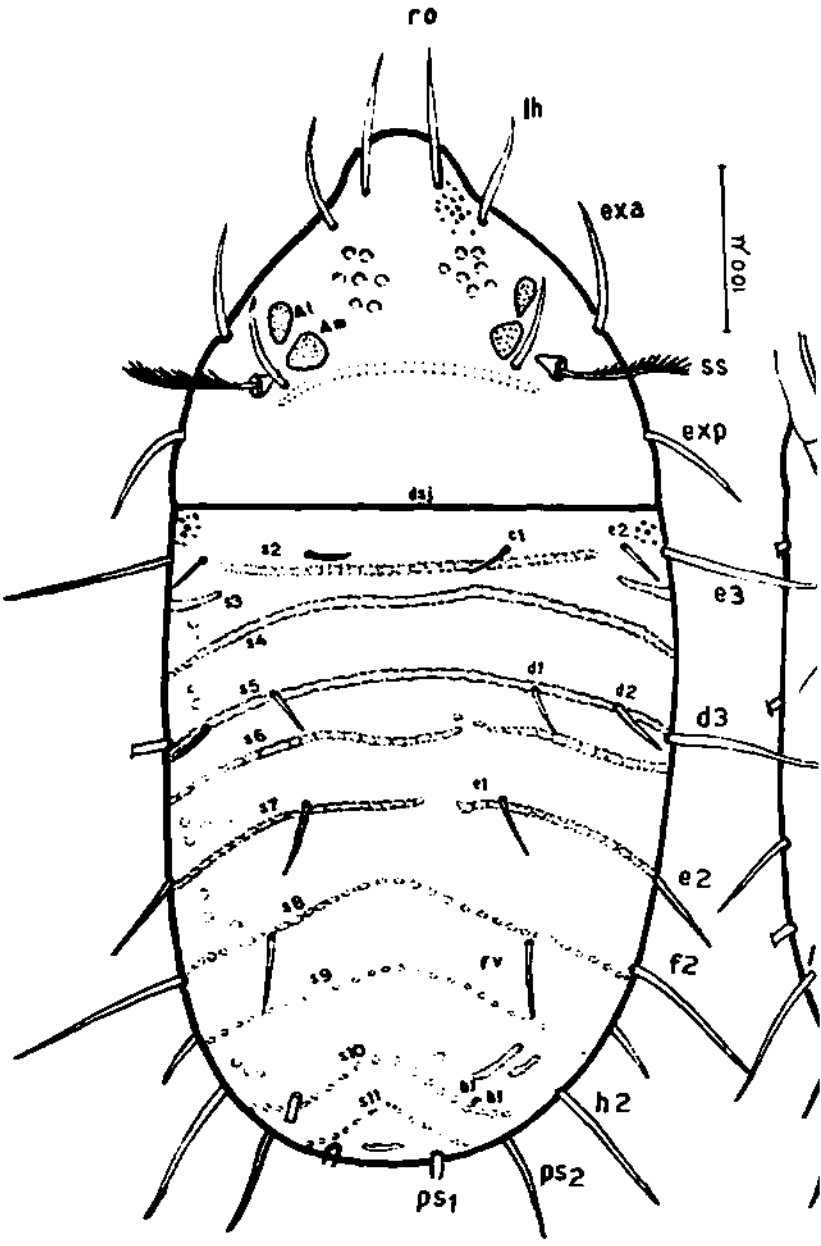
2. Area porose absent on the prodorsum and notogaster. All notogastral setae foliate
..... Haplacarus Wallwork S.S.

Area porose present on the prodorsum and notogaster. Median notogastral hairs slender and shorter than the marginal and posterior hairs
..... Porocarus Subgen.nov.

18. Haplacarus (Porocarus) semifoliatus sp.nov.

Color: Yellow brown. Measurements: Length of the body - 1035, width - 320, length of the prodorsum - 365, length of notogaster - 670.

Integument: The cerotegument with microsculpture of knob like refractive papillae on the ventral side of infracapitulum, coxisterna, genital, paraproctal and dorsal surface of leg segments; but sparsely distributed on the dorsal surface. Area porosae present on the prodorsum and on all notogastral segments except on the segment (F). There are three types of area porosae found on the dorsal surface of the body in this new species, (a) circular area porosae which are present on the anterior region of the prodorsum and on the notogaster, (b) area porosae of an irregular shape not sharply delimitable and are parallel to the notogastral band, (3) oval shaped,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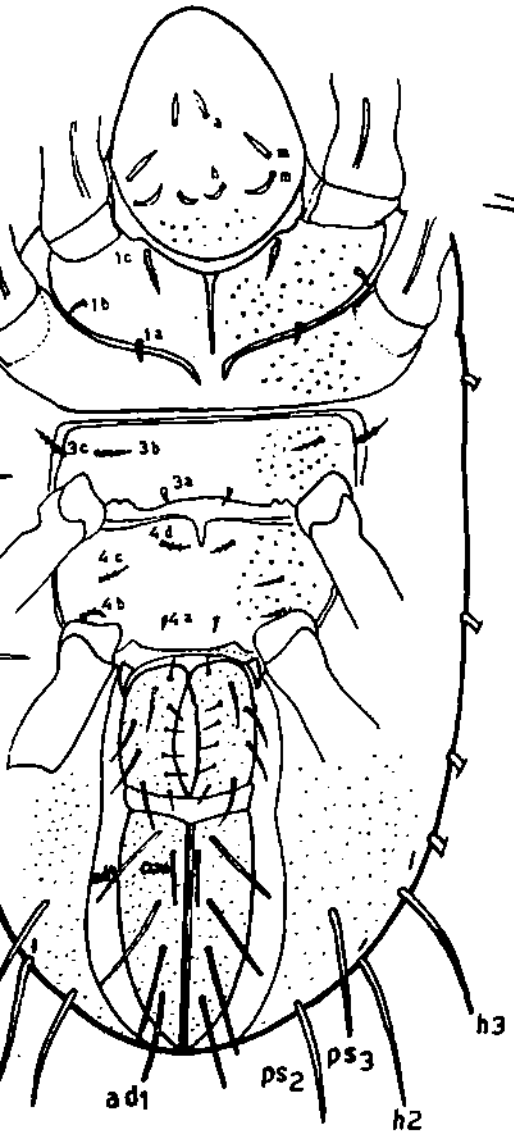
1c
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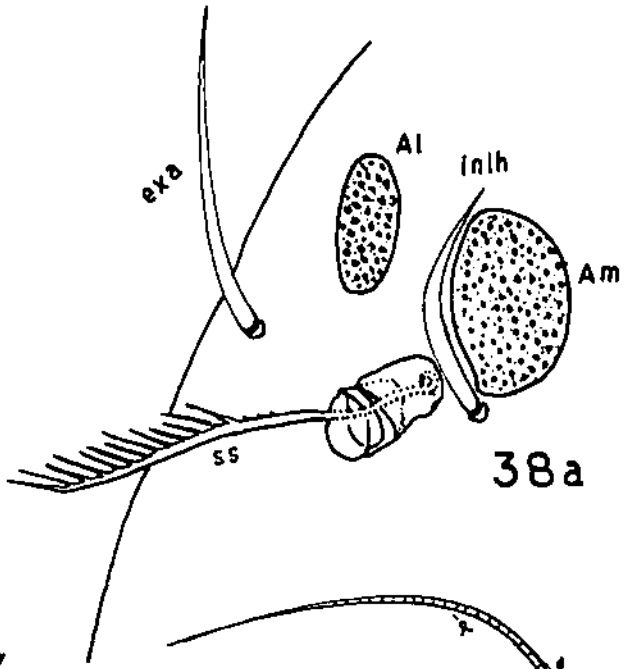
ps3
h2
ad1

38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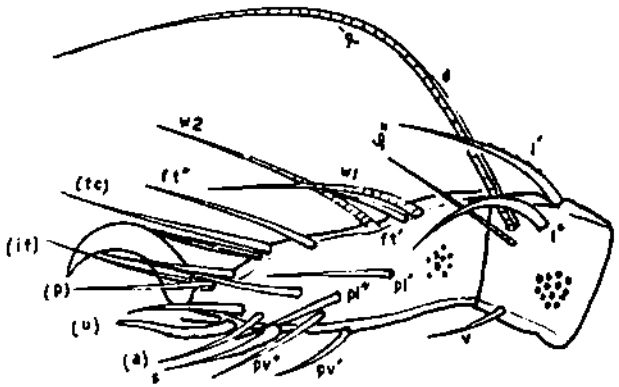
38a


w2
w1
(tc)
(it)
(p)
(u)
(a)

39

larger than the circular area porosae which are located antero-lateral to bothridium.

Prodorsum (Figs. 37, 39):

Rostral tectum entire, without incision. Rostral setae straight, not closely inserted to each other, are moderately foliate and are longer than the rest of prodorsal setae (140μ). Lamellar, interlamellar and posterior exobothridial setae are equal in length (100μ) but shorter than anterior exobothridial setae, markedly foliate and smooth. Sensillus pectinate, with 12-14 branches. A transverse prodorsal band is located posterior to the insertions of interlamellar setae. Two oval shaped area porosae designated as Am and A1, are present on the posterior region of the prodorsum. Am larger than A1, and are situated anterior-lateral to bothridia.

Notogaster (Fig. 37):

Notogaster broadly cylindrical, with ten notogastral bands which are devoid of punctation. The posterior notogastral bands are beeded like as shown in the figure. Notogastral band s1 lacking; s2 complete medially and extends only upto the insertions of the setae c2; s4, s8, s9, s10 and s11 complete; s6 and s7 incomplete, broken on mid-line, whereas s3 projected like a finger-tip on the lateral sides of the notogaster. All notogastral setae are

smooth and unbarbed. Only the marginal setae are foliated (hence the specific name '*semifoliatus*'). Fissures *i*a, *i*p and *i*h are distinct and their positions are as shown in figure.

Length of notogastral setae (in microns)

*c*1, *c*2 and *d*1	...	40
*d*2 and *e*1	...	55-60
*f*1	...	70-75
*e*2	...	85-90
*c*3 and *f*2	...	170-175
*d*3	...	180
*h*2 and *h*3	...	140-150
*ps*2 and *ps*3	...	120

(*h*1 and *ps*1 broken hence measurement not given)

Epimeral region (Fig. 38):

The coxisterna distinct as in other genera of the family Lohmannidae. The coxisternal setal formula 3-1-3-4. The setae 1*a*, 1*b*, 2*a*, 3*a* and 4*a* are short and smooth, whilst the remaining coxisternal setae are barbed.

Ano-genital region (Fig. 38):

Genital plates entire, without a transverse suture, genital plates with 10 pairs of setae, all the four antaxial setae are barbed and longer than the six unbarbed paraxial

setae. Aggenital plates triangular in shape and are located antero-lateral to the genital aperture. Anal and adanal plates fused. Four pairs of adanal and one pair of anal setae present on each of the paraproctal plate. Adanal setae longer than the slender anal setae. Preanal plate broadly rectangular.

Gnathosoma (Fig. 38):

Palpi four segmented. Palpal setal formula is 0-1-1-10. Chelicerae strong and dentate. Rotellum notched. The infracapitulum with four pairs of foliate setae (a, m1, m2 and h).

Legs (Figs. 39a, 39b):

All legs monodactyle. A conspicuous ventral ridge present on femora I and II, lacking on femora III and IV. The chaetotaxy of legs I-IV is represented by the formula 17-13-12-12 (solenidion not included). Solenidia (w1) of tarsus I associated with seta ft'. Setae u thick, foliate and serrated.

Table V.6: Chaetotaxy of legs I-IV of Haplacarus (P.) semifoliatus sp.nov.

Leg	T	Fe	G	Ti	Ta
I	0	5	4(1)	5(1)	17(2)
II	0	5	2(1)	4(1)	13(1)
III	2	3	2(1)	4(1)	12
IV	2	3	2(1)	3	12

Note: Figures in parenthesis denote the solenidion.

Type data: Holotype. One adult female, from litter under the Nerium plant near Sivabary Temple, Bikaner, 3-4-1969.

Discussion:

The distinguishing characters of the new species are:

(a) Presence of circular area porosae on the prodorsum and on the notogastral segments; and two pairs of oval shaped area porosae on the postero-lateral region of the prodorsum.

(b) Transverse prodorsal band located posterior to the interlamellar hairs and not extended upto posterior exobothridial setae.

(c) Rostral hairs longer than rest of the prodorsal setae.

(d) All prodorsal setae smooth and foliate.

(e) Notogastral band s2 complete medially and extend only upto the insertion of setae c2.

(f) Sensillus pectinate with 12-14 branches.

(g) Notogaster 1.8-1.9 times longer than the prodorsum.

(h) Tarsus I with solenidia w1 and w2; w1 of tarsus I associated with setae ft'.

(i) Median notogastral setae slender and shorter than the marginal notogastral setae.

The following table (Table V.7) gives a comparison of the main characters between H. foliatus, H. pairathi and H. semifoliatus sp.nov.

Table V.7: Comparison of main characters between H. foliatus, H. pairathi and H. semifoliatus

Character	H. foliatus	H. pairathi	H. semifoliatus sp.nov.
1. Length:Width	678:323	570:245	1035:510
2. Prodorsal setae	foliate, barbed	foliate, barbed	foliate and smooth
3. Area porosae on prodorsum and notogaster	absent	absent	present
4. Prodosal band	entire	entire	broken
5. Notogastral bands:	10	9	10
(i) s2	slightly projected beyond the level of the insertions of setae c2. Broken.	entire	extending upto the insertions of setae c2. Broken
(ii) s3	broken	entire	broken
(iii) s4	complete	broken	complete
(iv) s5	broken	complete	complete
(v) s6-s7	entire	broken	broken
(vi) s8	broken	entire	broken

(Contd.)

Table V.7 (Contd.)

Character	H. foliatus	H. pairathi	H. semifoliatus sp.nov.
6. Median notogastral setae	foliate and as long as marginal setae	foliate and as long as marginal setae	slender and shorter than marginal setae
7. Length of notogaster	1.3 times longer than prodorsum	1.5-1.7 times longer than prodorsum	1.8-1.9 times longer than prodorsum
8. Distribution	Ghana	Thailand	India

Genus: Papillacarus Kunst, 1959

The genus Papillacarus was erected by Kunst in 1959 with Lohmannia murcioides var. aciculata Berlese, 1905 as the type species. The genus is characterized as follows: Genital plate divided by a transverse suture, preanal plate longer than broad, anal and adanal plates separated by a longitudinal suture, four pairs of adanal and two pairs of anal setae present. Notogastral neotrichy and notogastral bands are present. Area porosae absent.

Following is the list of the species described so far under this genus:

1. Papillacarus murcioides Berlese, 1905 .. S. Europe
2. P. ramosus Balogh, 1961 .. Java
3. P. angulatus Wallwork, 1962 .. Ghana

4. P. undirostratus Aoki, 1965 .. Thailand

5. P. chamartinensis Perez-Inigo, 1967 .. Spain

Two new species of the genus Papillacarus from the specimens collected during the present study are described below.

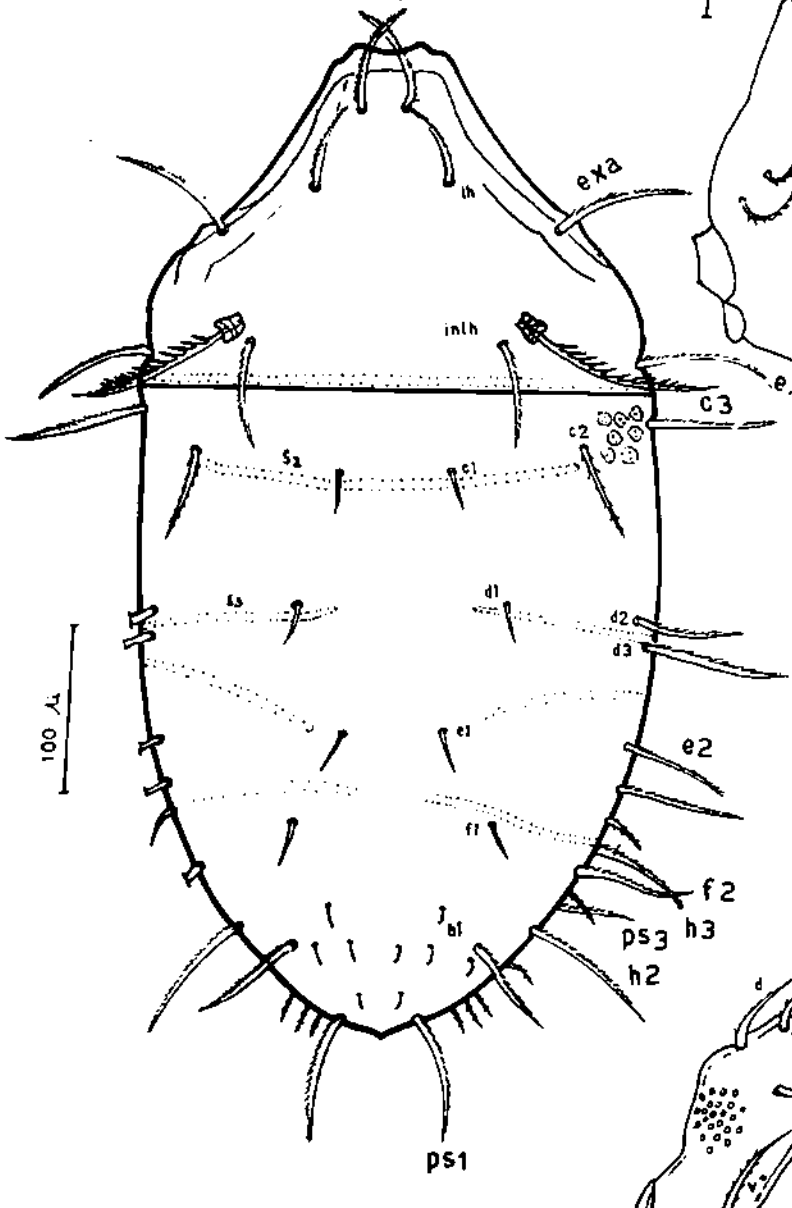
19. P. khandavallensis sp.nov.

Color: Yellow brown. Measurements: Total length of the body - 610; length of prodorsum - 210; length of notogaster - 400.

Integument: The chitinous integument, beneath the cerotegument, of the dorsal surface of the body is reticulate and uniformly punctate. Ventral surface of the body and the dorsal surface of the legs are punctate and devoid of polygonal reticular structures. Area porosae absent.

Prodorsum (Fig. 40):

Rostral tectum entire, slightly concave medially with uneven lateral protrusions when viewed under phase contrast. Lateral margins of the prodorsum have angular contours as in P. angulatus. Rostral and interlamellar setae equal in length (60µ) and exobothridial setae (exa and exb) are longer than the other prodorsal setae (80µ). All prodorsal setae are barbed. Sensillus pectinate with 15 branches. A complete transverse prodorsal band is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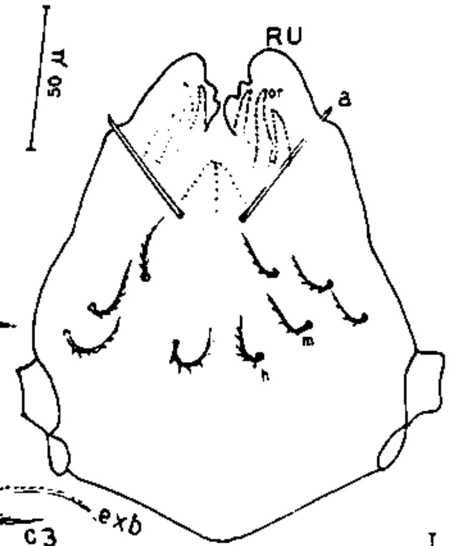
100 μ

40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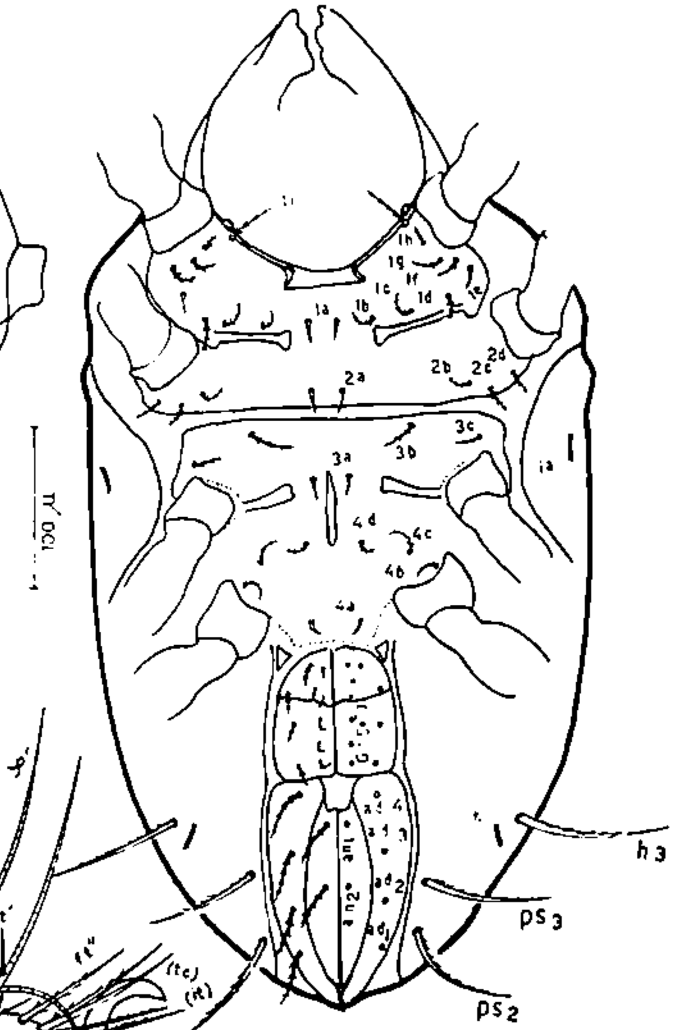
42


1a
1b
1c
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2b
3a
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3c
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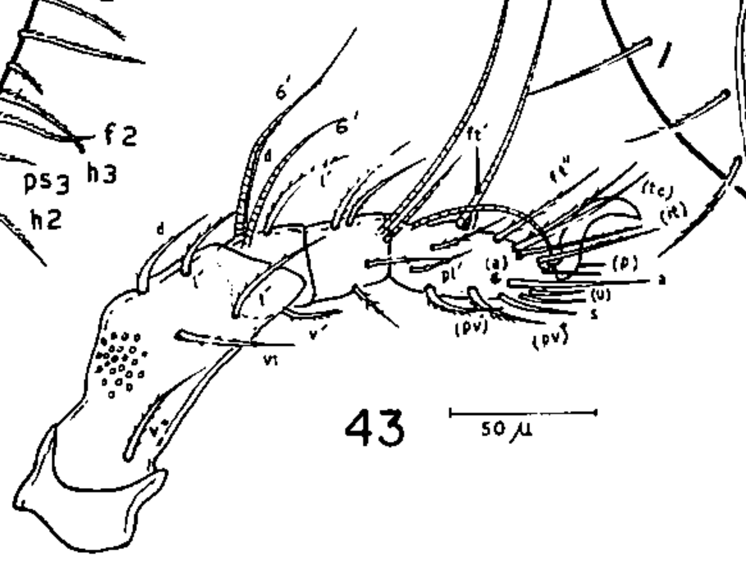
4b
4c
4d
h3
ps3
ps2
150 μ

41


ft'
ft''
(tc)
(it)
(p)
(u)
(a)
pl'
(pv)
50 μ

43

located posteriorly at the level of the insertions of interlamellar hairs.

Notogaster (Fig. 41):

Anteriorly truncate, convex medially and slightly tapering posteriorly. Notogaster with three notogastral bands; s1 lacking, s2 complete in the mid-line and extend only upto the insertions of the setae c2, s3 and s4 incomplete. Pygidial neotrichy present (N = 58). Notogastral fissures ia and ih are distinct on the ventral side of the body. Median setae c1, d1, e1 and f1 are short and smooth.

Length of notogastral setae (in microns)

c1, d1, e1 and f1	.. 25
c2	.. 55-60
d2, e2, f2, h1, ps1, ps2 and ps3	.. 65-75
c3, d3, h2 and h3	..90-95

Epimeral region (Fig. 41):

Epimeral plates exhibit neotrichy. The setal formula of epimerata I-IV is 9-3-3-4. All setae, except the median 1a, 1g, 2a, 3a and 4a, are barbed. Coxisternal region punctate.

Ano-genital region (Fig. 41):

Genital plate divided by a transverse suture, each plate with 10 pairs of setae (10 : 5+5). Aggenital plate triangular in shape and is located antero-lateral to the genital aperture. Preanal plate narrow with two protrusions medially. Anal and adanal plates separated by a complete longitudinal suture. Anal and adanal setal formula 2+4 respectively. All setae are barbed.

Gnathosoma (Fig. 42):

Chelicerae strong and dentate. Pedipali five segmented and the setal formula is 0-1-0-1-10. Adoral setae three pairs and foliate. Gnathosomal neotrichy present. The infracapitulum with six pairs of setae, setae a1 smooth and the remaining are strongly barbed.

Legs (Figs. 43a and 43b):

All legs monodactyle and sickle shaped. Femora of all legs I-IV contains a conspicuous ventral ridge. The setal formula of leg chaetotaxy is shown in the following table.

Table V.8: Chaetotaxy of legs of P. khandavallensis

Leg	T	Fe	G	Ti	TA
I	0	5	3(2)	4(1)	17(2)
II	0	5	2(2)	4(1)	11(2)
III	2	4	2(1)	3	10
IV	2	3	2(1)	3	10

Note: Figures in parenthesis denote the number of solenidion

Type data: Holotype: One adult female, Pilani, date not mentioned, collected by Mr. K.D.P. Rao. Paratype: One adult female, same data as holotype.

Discussion:

The distinguishing characters of the new species, P. khandavallensis are:

(1) rostral tectum slightly concave and devoid of rounded protrusions on the anterior region of the rostrum

(2) interlamellar hairs longer than lamellar hairs

(3) dorsal surface of the prodorsum and notogaster with polygonal reticulum which are uniformly punctate

(4) notogaster with 58 setae, median notogastral setae ($c1$, $c2$, $d1$, $e1$ and $f1$) are relatively long and smooth; and

(5) with three notogastral bands (s2, s3 and s4); s2 complete in the mid-line and extend only upto the insertion of the setae c2.

(The new species is named after the collector Mr. K.D.P. Rao, who has kindly presented the slides to me).

20. Papillacarus naraharensis sp.nov.

Color: Yellow brown. Measurements: Total length - 570; length of prodorsum - 170, length of notogaster - 400.

Integument: Dorsal and ventral surfaces of the body and the legs are covered by a thin cerotegument which is markedly papillate. The chitinous integument beneath the ceretegument, on the dorsal surface of the body is reticulate and not uniformly punctated; whilst the ventral surface of the body is devoid of reticulate structures but uniformly punctate. Area porosae absent.

Prodorsum (Fig. 44):

Rostral tectum with four roundish protrusions as in P. undirostratus Aoki, 1965. The lateral margins of the prodorsum without angular contour. The rostral setae are medially inserted on the anterior region of the prodorsum. Rostral (ro) and anterior exobothridial setae (exa) equal in length (70); interlamellar hairs smaller (30), whilst the posterior exobothridial setae are longer than the other prodorsal setae (95). All prodorsal hairs are distinctly

barbed. Senillus (ss) pectinate bearing 15 branches. A complete prodorsal band is present, traversing behind the insertions of the interlamellar hairs.

Notogaster (Fig. 44):

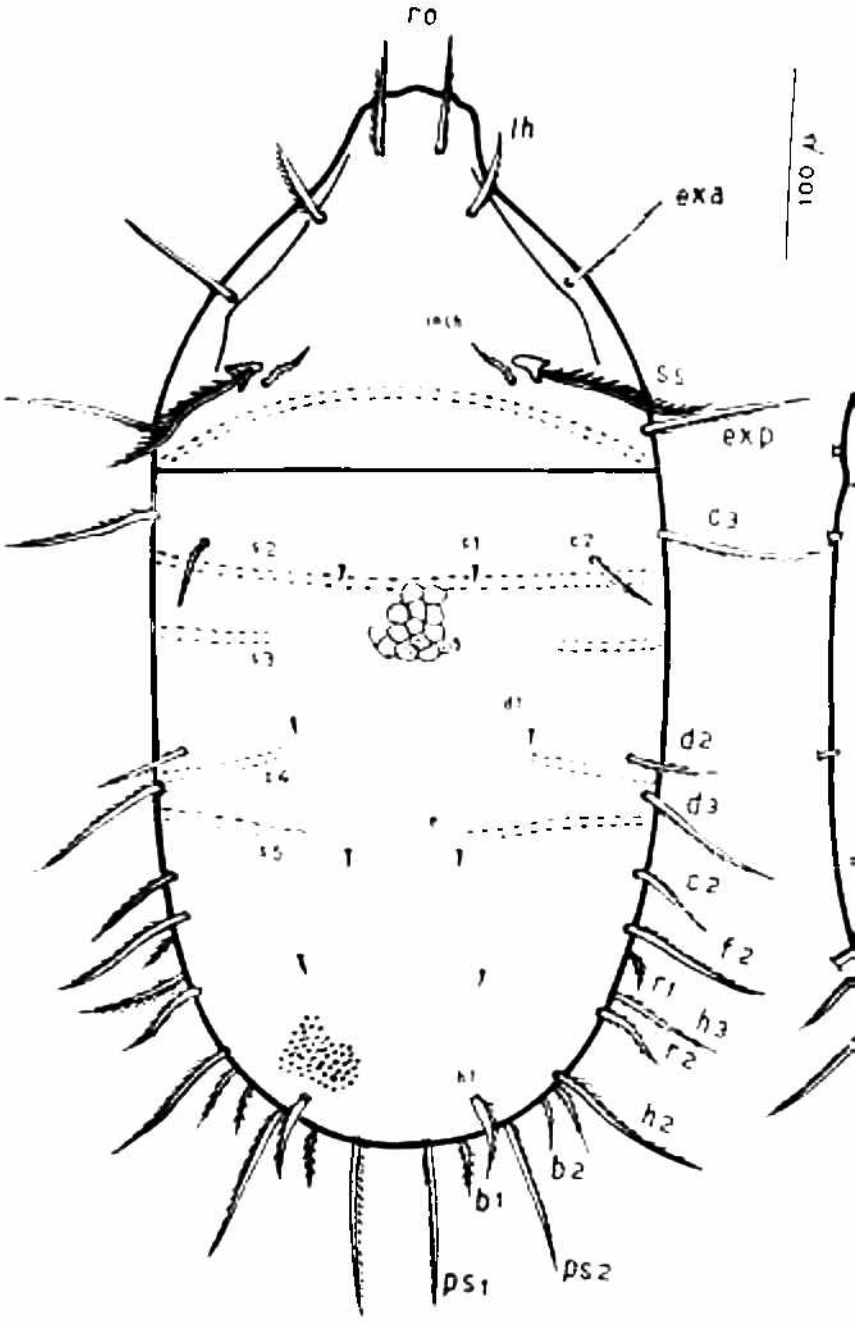
Notogaster with four notogastral bands and bears 46 setae. Pygidial neotrichy is evident only on postero-lateral margins of the notogaster. Notogastral band s1 lacking, s2 complete, whilst s3, s4 and s5 incomplete. All median notogastral setae c1, d1, e1 and f1 are short, spine like and smooth. Seta h1 is much thicker and foliated than the rest of the notogastral setae.

Length of notogastral setae (in microns)

c1, d1, e1 and f1	..	10
d2 and f2	..	55
f2, h3 and ps2	..	85-90
h2 and ps1	..	90
ps3	..	50
d3 and c3	..	90-95
h1	..	40

Epimeral region (Fig. 45):

Coxisterna I and II exhibit neotrichy. The setal formula of the epimerata I-IV is 9-4-3-4. The median coxisternal setae 1a, 2a, 3a and 4a are short and smooth;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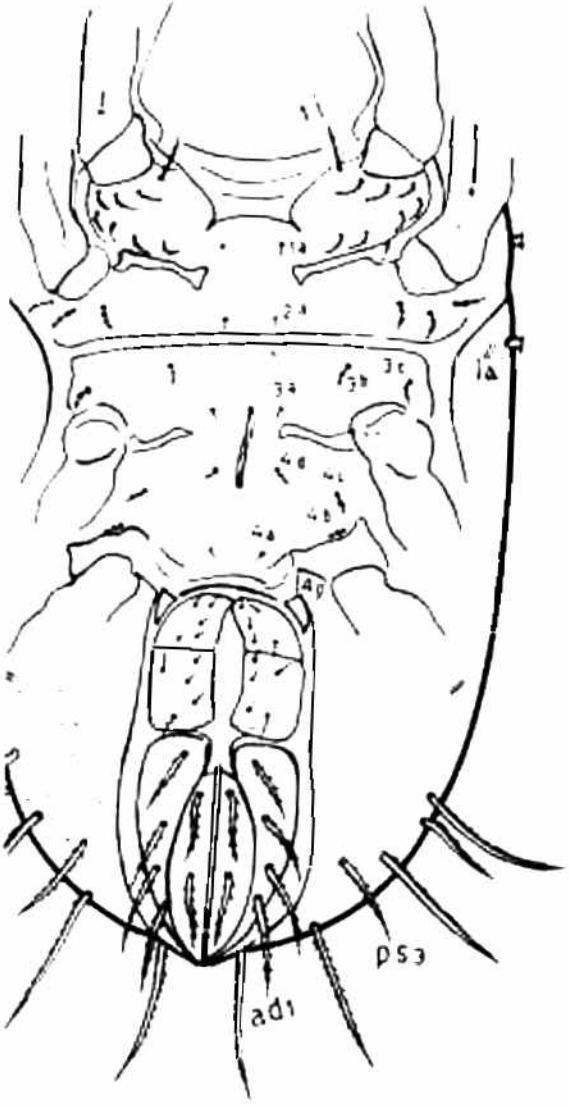


45

the remaining coxisternal setae are either pectinate or bilaterally barbed.

Ano-genital region (Fig. 45):

Genital plate divided usually by a transverse suture, with 10 pairs of setae (G - 10 : 5 + 5), all the genital setae are finely barbed. Aggenital plates triangular in shape and located antero-lateral to the genital aperture. Anal and adanal plates separated by a longitudinal suture. There are two pairs of anal and four pairs of adanal setae present. Preanal plate (PA) longer than wide as shown in figure. Notogastral fissures ia, im and ip are present and distinct ventrally.

Gnathosoma:

Infracapitulum with four pairs of setae. Maxillicoxal neotrichy absent. Chelicerae strong and dentate. Pedipalp five segmented. Palpal setal formula 0-1-0-1-10.

Legs:

All legs monodactylous, with a strong bent claw, without conspicuous teeth. Femora of all legs bear a conspicuous ventral ridge. The setal formula of the tarsi I-IV is 17-11-10-10.

Type data: Holotype, one adult female, from moss (pond), Narhar, four miles from Pilani, 28.10.1969. Paratype one adult, same data as holotype.

Discussion:

The new species P. naraharensis closely resembles to P. undirostratum Aoki, 1965 but differs with that and other known species in the following characters:

(1) rostral setae straight,

(2) presence of polygonal reticular structures on the dorsal surface of the body,

(3) four notogastral bands as against five in P. undirostratus and P. angulatus, and

(4) the coxisternal setal formula is 9-4-3-4 as against 8-4-3-4 in P. undirostratus and P. aciculatus; 7-4-3-4 in P. chamartinensis.

Comparison of the main characters of the two new species described in the genus Papillacarus in the present work are given in the following table (Table V.9).

Table V.9: Comparison of the distinguishing characters between P. naraharensis and P. khandvallensis

Characters	P. naraharensis	P. khandavallensis
1. Length:width	570:280	590:330
2. Anterior margin of rostrum	with four rounded protrusions	devoid of rounded protrusions
3. Interlamellar hairs	smaller than lamellar hairs	longer than lamellar hairs
4. Number of notogastral setae	46	58
5. Median notogastral setae c1, d1, e1, f1	minute and smooth	relatively long and smooth
6. Number of notogastral bands	4	3
7. Notogastral band s2	complete laterally	extend only upto the insertion of setae c2
8. Polygonal reticulation on prodorsum and notogaster	not uniformly punctate	uniformly punctate

IX. NOTHRIDAE Berlese, 1885

Genus: Nothrus C.L. Koch, 1836

The genus Nothrus was first erected by C.L. Koch in 1836, for the two species described by him that are nowadays considered representatives of the genus Camisia von Heyden, 1826 (c.f Van der Hammen, 1959). Koch in 1842, however, designated Nothrus palustris (a species described by him in 1839) as the type of the genus.

Berlese (1885) erected a family Nothridae for the genus Nothrus C.L. Koch, 1836 which was later amended into the family Camisiidae by Oudemans (1900).

Grandjean (1954) separated the genus Nothrus from Camisiidae on account of the presence of seta f1 in all stages, and consequently created the family Nothridae. At present (Balogh, 1965), the family Nothridae consists of - only one genus, Nothrus C.L. Koch, 1836.

The diagnostic characters of the genus Nothrus are: Seta f1 present in all stages (holotrichous), bothridium present, epimeres with neotrichy, few genital hairs marginal in position and legs tridactyle.

The collection of mites from Rajasthan included only one species (Nothrus biciliatus, C.L. Koch, 1842) of this genus.

21. Nothrus biciliatus C.L. Koch, 1841

Nothrus bicilatus C.L. Koch, 1841

_____ _____ Oudemans, 1929; Sellenick, 1929; Willmann, 1931; Hammer, 1955, 1966; Aoki, 1964, 1965, 1970

Camisia biciliata Oudemans, 1904

The present material agree in all characters with the species, especially with the New Zealand specimen (Hammer, 1966; Plate VIII, Fig. 29). A brief description of the species is given below.

Color: Yellow-brown. Measurements: Total length - 850; length of prodorsum - 320, length of notogaster - 530.

Adults and nymphal stages hototrichous (seta f1 present). Rostral setae thick and glabrous, interlamellar setae short, lamellar setae longer than the other prodorsal setae and are like the club shaped median notogastral setae. Translamella present. Areolation present within the framework of lamellar region. Dorsal surface of the notogaster areolated. Genital plates with 9 pairs of simple and short setae, two pairs of anal, three pairs of adanal setae present. Coxisternal I-IV neotrichy present (7-4-6-6). All legs tridactyle and heterodactylous. Bothridium present, sensillus long and sensillus head beset with short spines. Tritonymphs with a single claw.

Known distribution: Europe, Greeland, New Zealand, Japan and Nepal. This is the first record of this species

from India.

Material examined: Forty six adults and 29 tritonymphs from moss, Balasamand Lake (two miles from Jodhpur), 24.3.1969.

A. TRHYPOCHTHONIIDAE Willmann, 1931

Genus: Allonothrus van der Hammen, 1953

The genus Allonothrus was first established by van der Hammen (1953) with Allonothrus schuilingi (a species described by him in the same work) as the type under the family Trhypochthoniidae. The diagnostic characters of the genus Allonothrus are: adults deficient (f1 lacking); two pairs of anal and three pairs of adanal setae, genital neotrichy may be present (11-14 pairs) or absent (only 7 pairs) and legs may be monodactyle or tridactyle.

The following seven species were described so far under this genus:

Allonothrus schuilingi van der Hammen, 1953	.. New Guinea
A. pyriformes (Berlese, 1910)	.. Java
A. monodactylus Wallwork, 1960	.. Ghana
A. russeolus Wallwork, 1960	.. Ghana
A. ghanensis Wallwork, 1961	.. Ghana
A. indicus Bhaduri and Raychaudhuri, 1968	.. India
A. neotropicus Balogh and Mahunka, 1969	.. S. America

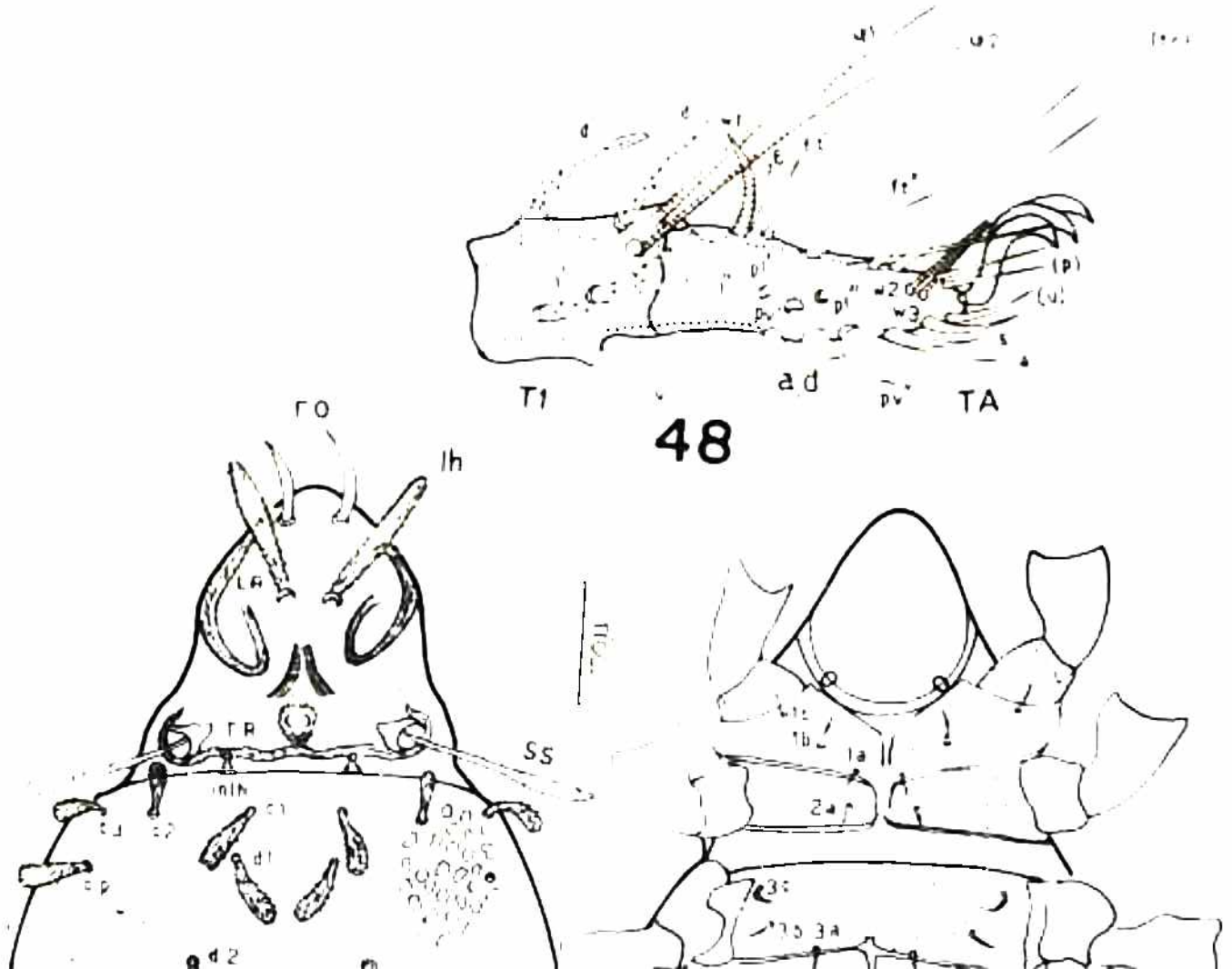
Three species of the genus Allonothrus (one new and two known species) are described in the following pages from the material collected in Rajasthan. A taxonomic key has been presented for the known species of the genus Allonothrus after the descriptions of the following species.

22. Allonothrus jodhpurensis sp.nov.

Color: Yellow-brown. Measurements: Total length - 730; length of prodorsum - 230, length of notogaster - 500.

Prodorsum (Fig. 46):

Rostral tectum broadly conical in shape, rostral hairs (ro) thick, weakly barbed and are inserted in small tubercles on the anterio-median region of the rostrum. Lamellar hairs (lh) inserted far posterior to the rostral hairs, clavat beset with dense setae and are longer than the other prodorsal hairs. Interlamellar hairs short, fan shaped and are inserted in lateral to bothridia in small tubercles. There are three types of ridges present on the prodorsum: (1) a pair of lateral ridges (Lr) which are marginal, curved inwards (towards the median region of the prodorsum) at the insertion of the first pair of legs, strongly elboed at the median region of the prodorsum and form a characteristic figure of '6' as shown in the figure (Fig. 46), (2) a pair of central ridges are present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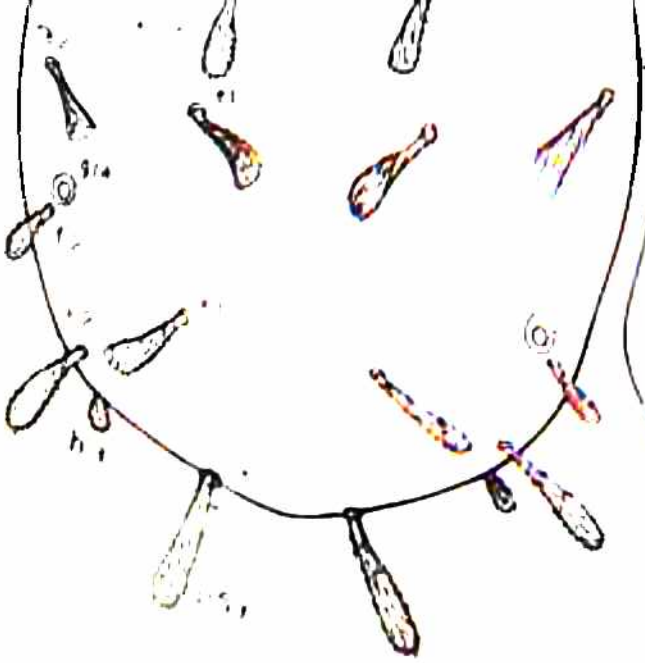

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47

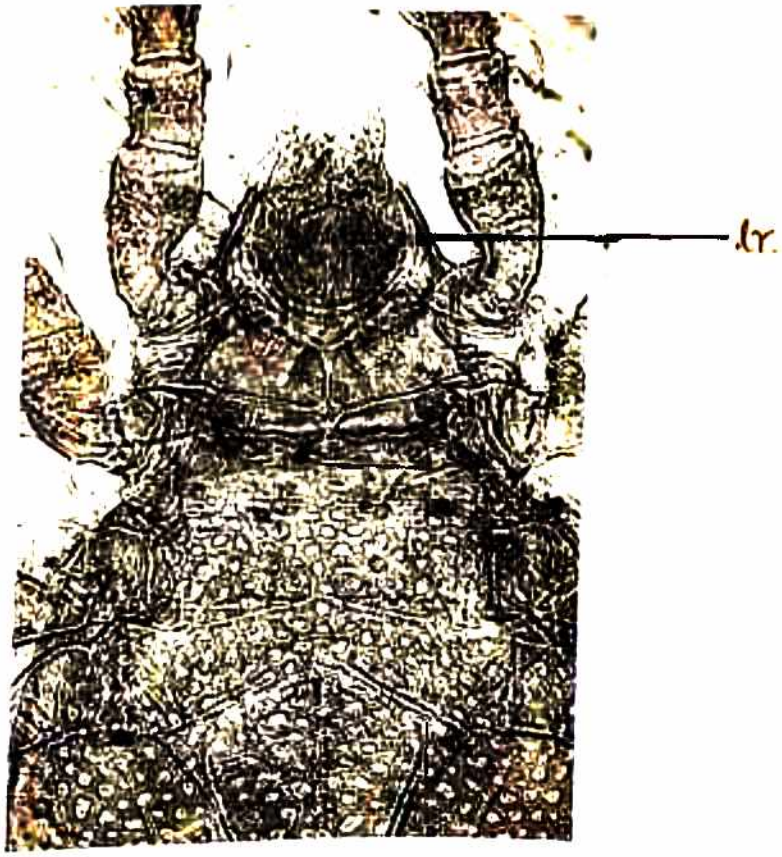
on the median region of prodorsum, convergent and coalesced anteriorly and, (3) a transverse uninterrupted ridge (TR) running across the prodorsum at the level of the insertions of the interlamellar hairs, encircling the bothridium at their terminal ends. Bothridium cup-like, sensillus clavate and beset with dense setae. A small trilobed pit like structure is present posterior to the central ridges. Prodorsal region punctate.

Notogaster (Fig. 46):

Notogaster with 15 pairs of spatulate to fan-shaped setae (f1 deficient). The arrangement of notogastral setae is shown in figure. Setae ps1 (110μ) much longer than setae h1. Setae ps3 situated just anterior to the ps2 in a vertical position; ps2, ps3, c3 and c2 are shorter than the other notogastral setae. Notogaster areolated with circular to irregular polygonal pores. Positions of notogastral fissures ia, im and ih are as shown in figure.

Epimeral region (Fig. 47):

Epimeral region punctate. Median sternal ridge absent on the coxisternal plate III. The setal formula of the epimerate I-IV is 3-1-3-3 as in other allonothrids. Setae 3c and 4c are curved and unilaterally barbed.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Ano-genital region (Fig. 47):

Genital plates with 13 pairs of setae, the posterior two pairs (g1 and g2) short and glaorous and the rest are barbed. Aggenital setae absent. Two pairs of anal and three pairs of adanal setae present. All setae are thick and smooth.

Gnathosoma:

Hypostome rounded posteriorly, the anterior and the median infra capitular setae are short and smooth. Infra capitular region punctate.

Legs (Fig. 48):

Legs tridactyle, all claws uniformly thick and strongly bent. Solenidion w1 and w2 of tarsus I erectile, the later being thinner and shorter than the former. Additional seta (ad) on tarsus I present.

Type data: Holotype. One adult female, from litter, Balasamand Lake (2 miles from Jodhpur), 24.3.1969; paratypes seven adults, same data as holotype.

Discussion:

The new species, A. jodhpurensis, is distinguishable from any other members of the genus by the combination of the following characters:

(1) lateral ridges strongly curved and are like the figure '6' in shape,

(2) transverse ridge uninterrupted (complete), the terminal ends of this transverse ridge encircle the bothridia,

(3) lamellar hairs far posteriorly situated to the rostral hairs thick and densely barbed,

(4) setae ps1 longer than h1 and h2,

(5) genital plates with 13 pairs of setae, and

(6) anal plates with two and adanal plates with three pairs of smooth setae.

23. Allonothrus monodactylus Wallwork, 1960

This species was first described by Wallwork (1960) from Ghana. Bhaduri and Raychaudhuri (1962) also reported this species from Calcutta (India). The mites collected from Khetri includes two monodactylous allonothrids which agree in all characters with the Ghana species. The detailed description of this species is given by Wallwork and therefore, deemed unnecessary to describe the known species again.

Material examined: Two adult females, from litter under banana tree, Ajit Sagar Garden, Khetri, 2.4.1970.

24. Allonothrus russeolus Wallwork, 1960

This tridactylous allonotrid species was first described by Wallwork (1960). Bhaduri and Rayachaudhuri

(1968, also reported this species from Calcutta (India). The present material agree in all characters with the African species.

Material examined: Twenty-eight adults and four tritonymps from Mandore Garden, Jodhpur, 26.10.1970. Six specimens from litter, Ajit Sagar Garden, Knetri, 25.4.1970.

Key for the identification of the known species of the genus Allonothrus:

1. Legs monodactyle, transverse ridge absent 2
   Legs tridactyle, transverse ridge present 3

2. With seven pairs of genital setae.....
   ..... A. monodactylus Wallwork
   with ten pairs of genital setae .....
   .....A. indicus Bhaduri and Raychaudhuri

3. Lateral ridges present, but not strongly curved; transverse ridge interrupted (broken) with 7 or 11-14 pairs of genital setae 4

   Lateral ridges strongly curved, characteristic 6-shaped; transverse ridge uninterrupted (complete), with 13 pairs of genital setae...A. jodhpurensis sp.nov.

4. All notogastral hairs fan shaped 6
   All notogastral hairs not fan shaped 5

5. Setae ps2 extraordinarily long, rod like and densely barbed; with 12 pairs of genital setae .....
   ..... A. ghanensis Wallwork

hair ps2 seta form, smooth; with seven pairs of genital setae ..... A. pyriformes (Berlese)

6. Genital neotrichy present, witn 11-14 pairs of setae 7

Genital neotrichy absent, with seven pairs of setae.. ..... A. schuilingi van der Hammen

7. Hair h1 about as long as hair ps1, hair e1 considerably shorter than half the distance between e1-h1, adanal setae, ad1 and ad2 smooth..A. russeolus Wallwork

Hair h1 about half as long as ps1, hair e1 as long half the distance between hair e1-h1. Adanal setae ad1 and ad2 ciliate, with 11 pairs of genital setae ..... A. neotropicus Balogh & Mahunka

XI. MALACONOTHRIDAE Berlese, 1916

Genus: Trimalaconothrus Berlese, 1916

Berlese (1916) created a subgenus Trimalaconothrus and separated it from the genus Malaconothrus of the family Malaconothridae on account of tridactylous legs. In the same work, Berlese designated Malaconothrus (Trimalaconothrus) indusiatus Berlese, 1916 as the type. Later authors considered Trimalaconothrus as the genus.

The diagnostic characters of the genus Trimalaconothrus are: bothridia absent, legs tridactyle, cerotegument porose and birefringent (c.f Balogh, 1965).

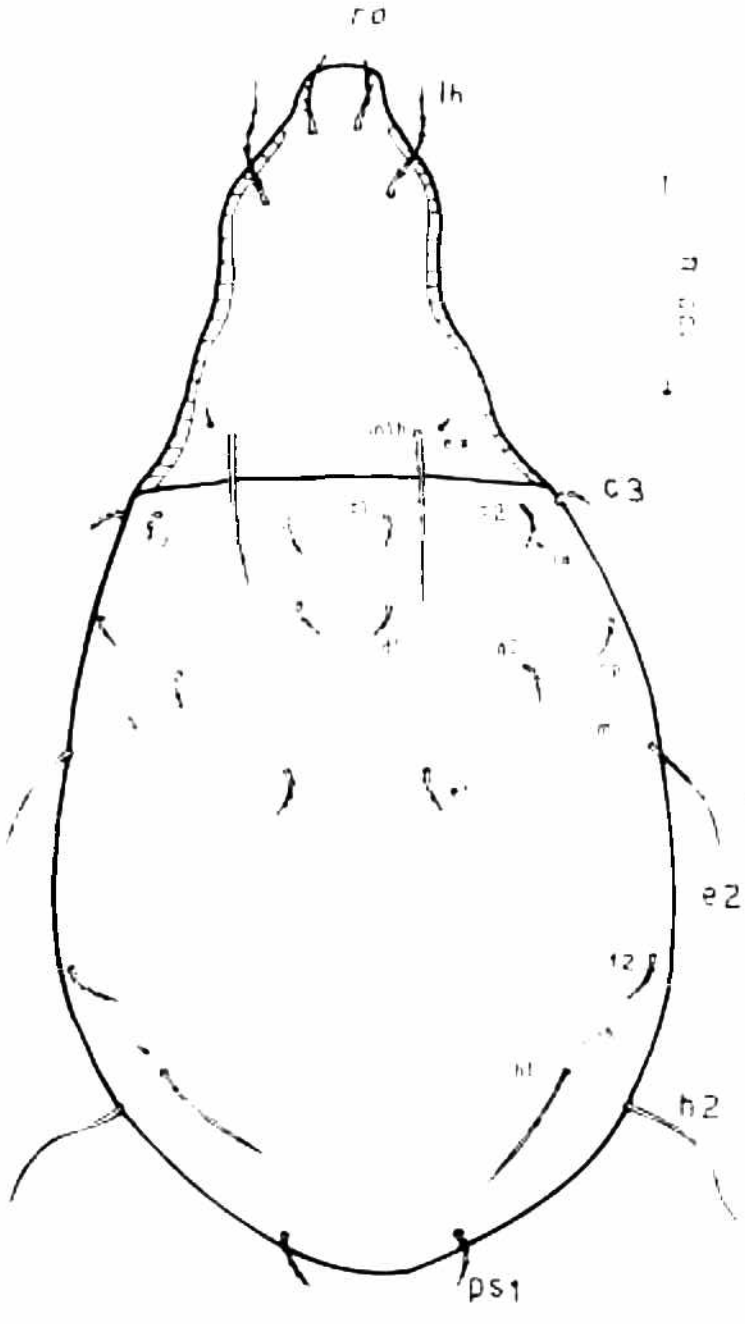
The following is the description of two species of the genus Trimalaconothrus.

25. Trimalaconothrus chittorensis sp.nov.

Color: Yellow-brown. Measurements: Total length of the body - 580; length of prodorsum - 200, length of notogaster - 380.

Prodorsum (Fig. 49):

Dorsal surface of the body covered by a thin layer of cerotegument consisting of circular granules, integument punctate and devoid of reticulation. Rostral hairs (ro) short, slightly longer than their mutual distance and are inserted medially on the rostrum. Lamellar hairs (1h) about as long as interlamellar hairs (75-80μ) but thinner than the later. Exobothridial hairs (ex) very short, nude and inserted lateral to the interlamellar hairs. Rostral, interlamellar and lamellar hairs are barbed. Lamellar ridges parallel to the sides of the prodorsum and are slightly S-shaped. Bothridia absent.



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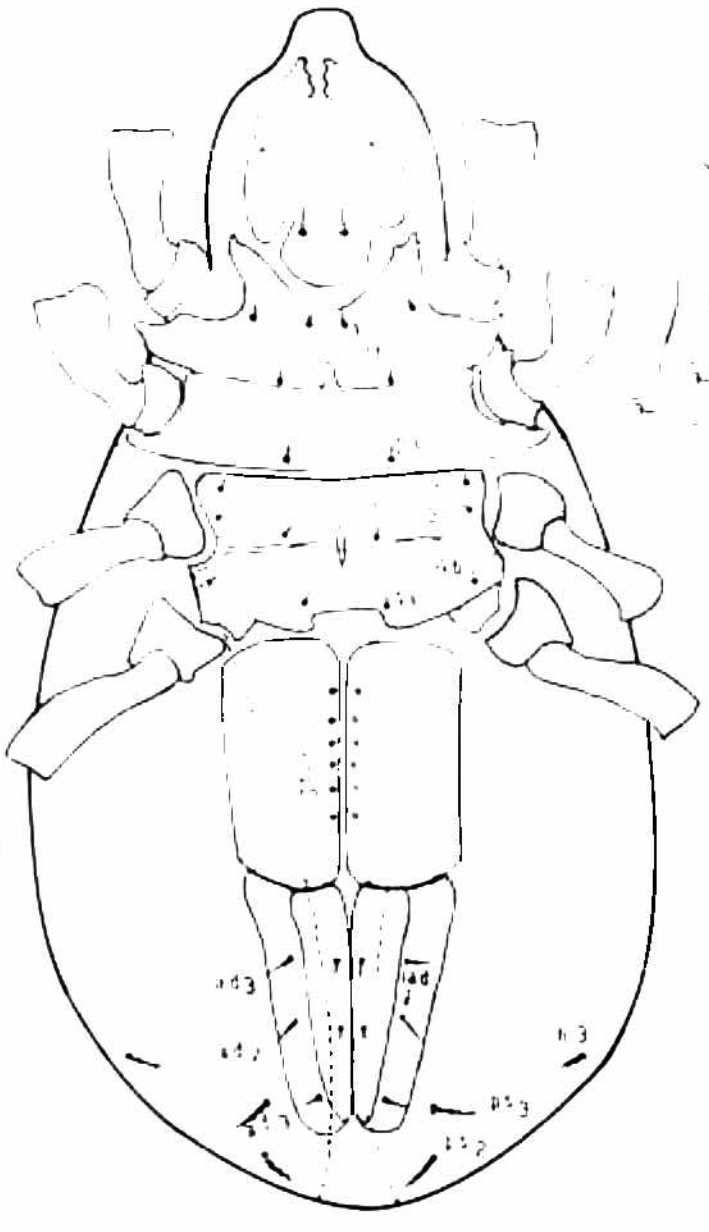

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50a

Notogaster (Fig. 49):

Notogaster with 15 pairs of setae (f1 deficient), all notogastral setae except e2, h1 and h2, are unilaterally barbed. Setae e1, h1 and h2 are longer than other notogastral setae, of which the seta h2 is the largest. Notogastral fissures, ia, im and ih are distinct and their positions are as shown in figure. The surface of the notogaster punctate. Abdominal gland absent.

Epimeral region (Fig. 50):

Apodemata I, II and III complete, medially connected, adpdemata IV interrupted in the mid-line and apodemata segugales (aposj) developed to their full length. Coxisternal region punctate. The setal formula of the epimerata I-IV is 3-1-3-3.

Ano-genital region (Fig. 50):

Genital plates longer than broad, about as long as anal plates. Six pairs of genital, two pairs of anal and three pairs of adanal setae present. Genital setae marginally arranged. Adanal setae longer than anal and genital setae. Aggenital setae absent.

Gnathosoma:

Infracapitulum stenarthric (Grandjean, 1957) i.e. the labial-genal articulation extends obliquely backwards,

well behind the base of the palps. Cheliceral setae barbed, cha longer than chb. Pedipalp five segmented (setal number of pedipalp not observed).

Legs (Fig. 50a):

All legs tridactyle and heterodactylous, median claw thicker than the laterals. The solenidion φ and _" of tibia I long, thin and anteriorly curled, solenidion w1 of tarsus I associated with ft'; ft" densely barbed, the anterior tip thin and curled; unquinal setae (u) of tarsi I-II characteristically fan-shaped and serrated. All leg segments fenestrated and striated.

Type data: Holotype one adult female, from moss, by the side of river bank, Chittorgarh, 1.10.1969. Paratypes three adults, same data as holotype.

Discussion:

The new species, Trimalaconothrus chittorensis, resembles to T. barracensis Hammer, 1961 in the general shape and barbed nature of the notogastral setae, but differs with that and other known species of the genus by the combination of the following characters:

(1) Lamellar ridges parallel to the sides of the prodorsum, not connected anteriorly,

(2) six pairs of genital, two pairs of anal and three pairs of adanal setae present,

(3) notogastral setae e2, h1 and h2 nude and longer than the other barbed notogastral setae,

(4) prodorsum and notogaster punctate, devoid of reticulate sculptures, and

(5) leg setae (u) fan-shaped, solenidion w1 of tarsus-I associated with seta ft'.

26. Trimalaconothrus novus (Sellenick, 1922)

Malaconothrus (Trimalaconothrus) novus Sellenick, 1922

Trimalaconothrus novus (Selln.) Knulle, 1957;

Hammer, 1952, 1955;

_____ ____ Csiszar and Jeleva, 1962

This species was first described by Sellenick (1922) from Poland. The present material agree in all characters with the specimens of this species, reported from Northern Canada (Hammer, 1952, p. 96, figs. 18, 18a). Trimalaconothrus novus (Selln.) however, differs with T. chittorensis (a new species described by the author in the present work) mainly in the presence of five pairs of genital setae, unbarbed notogaster setae and the interlamellar hairs much longer than the lamellar hairs.

Known distribution: Europe, N. America and S. America. This is the first report of this species from India.

Material examined: Twenty five specimens from moss, Khetri, 28.7.1969; 13 specimens from Mandore Garden, Jodhpur, 24.3.1969.

XII. PLATEREMAEIDAE Tragardh, 1931

Genus: Pedrocortesella Hammer, 1961

Tragardh (1931) established the family Plateremaeidae with a single genus Plateremaeus Berlese, 1908. Balogh (1961) altered Tragardh's original conception of the family and added the following seven more genera: Allodamaeus Banks, 1947; Aleurodamaeus Grandjean, 1954; Gymnodamaeus Kulczynski, 1902; Jacotella Banks, 1947; Pedrocortesia Hammer, 1958; Pedrocortesella Hammer, 1961 and Plesiodameus Grandjean, 1954. Balogh also mentioned one genus Heterodamaeus Ewing, 1917, in quirendum. However, the more recent classification proposed by Balogh (1965) for the family Plateremaeidae includes only four genera viz. Plateremaeus, Pedrocortesella, Pedrocortesia and Phereliodes Grandjean, 1931. He (1966) furtner differentiated the genera on the basis of the number of anal setae, and grouped all those plateremaeids with two pairs of setae to the genera Pedrocortesia or Pedrocortesella, three pairs to the genus Phereliodes and those with four to six pairs under the genus Plateremaeus.

The genus Pedrocortesella was first erected by Hammer (1961) with Pedrocortesella pulchra (a species described by her in the same work) as the type. The diagnostic characters of the genus are: notogaster with four to five pairs of hairs, marginal in position; lamellar hairs originate dorsally and rostral hairs marginally; with three pairs adanal, two pairs of anal, seven pairs genital and one pair of aggenital setae; propodosoma and hysterosoma laterally separated on the ventral side by an incision between legs II and III; the adult cuticle reticulated and covered by secretion (c.f. Hammer, 1961).

The following 11 species were hitherto described in the genus Pedrocortesella:

Pedrocortesella pulchra Hammer, 1961	..	Peru
P. africana Pletzen, 1963	..	S. Africa
P. parva Pletzen, 1963	..	S. Africa
P. gymnonota Hammer, 1966	..	New Zealand
P. sexpilosa Hammer, 1966	..	New Zealand
P. cryptonota Hammer, 1966	..	New Zealand
P. latoclava Hammer, 1966	..	New Zealand
P. africana Balogh, 1966	..	Central Africa
P. franzi Balogh, 1966	..	Central Africa
P. hardyi Balogh, 1968	..	New Guinea
P. japonica Aoki and Suzuki, 1970	..	Japan

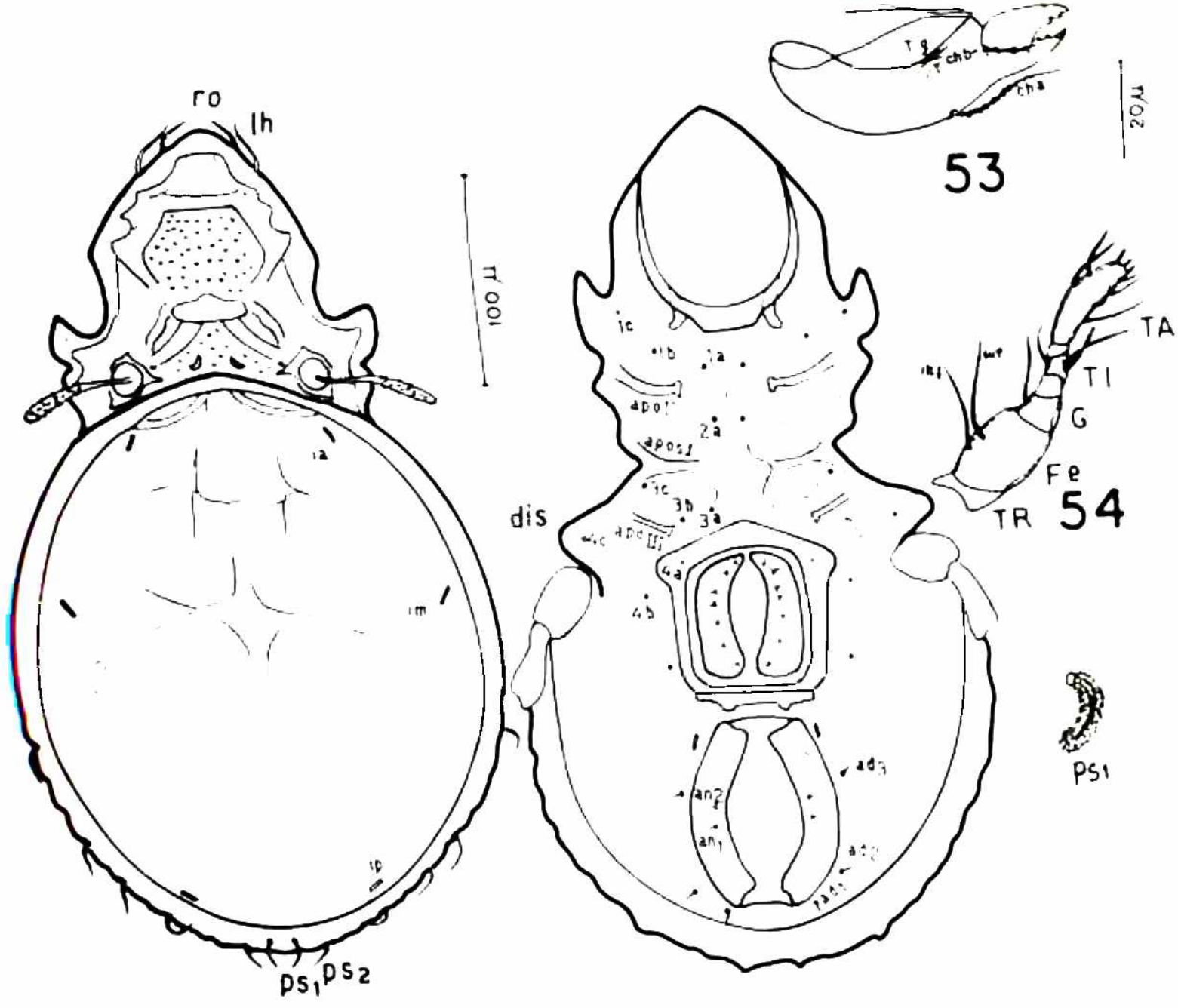
Following is the description of one new species of the genus Pedrocortesella.

27. Pedrocortesella indiana sp.nov.

Color: Dark-brown. Measurements: Total length of the body - 405; length of prodorsum - 125, length of notogaster - 280.

Prodorsum (Fig. 51):

Rostral tectum rounded; rostral hairs short, smooth, strongly curved and are inserted marginally to the rostrum. Lamellar hairs longer than rostral hairs, smooth and curved. Interlamellar hairs (inlh) very short and are inserted lateral to the bothridia in small tubercles. True lamellae absent. Two chitinous ridges (laths) divide the prodorsum into three regions; the posterior region is slightly elevated, whilst the anterior and the median regions are rather depressed. The median region of the prodorsum consists of knob-like micropapillate structures. Lateral region of the prodorsum punctate. Bothridia cup-shaped, with tooth like projections laterally and posterior. Sensillus (ss) slender, with long stalk and club shaped head beset with short spines. Pedotecta (ped I) well developed, pedotecta II short and discidium present.



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Notogaster (Fig. 51):

Oval in shape, rather flat dorsally. The lateral and posterior regions of the notogaster reticulated, whilst the dorsal surface of the notogaster with slightly asymmetrical chitinous laths (see Plate IIIa). Notogaster with six pairs of setae, marginally arranged, strongly curved, smooth and covered with a thick layer of cushion like secretion. Three pairs of notogastral fissures (ia, im and ih) are present and their positions are as shown in figure.

Epimeral region (Fig. 52):

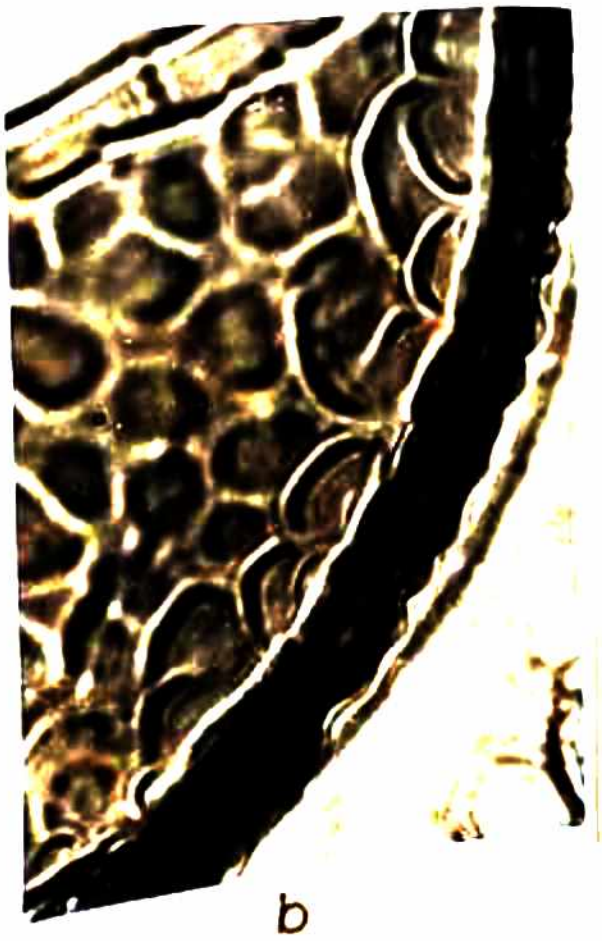
The apodemata I (apo-I) fused with postero-lateral margins of the gnathosoma; apodemata II well developed, slightly arched on the median region of the sternum, apodemata III short and far laterally situated. Apodemata IV absent. Apodemata sejugales (aposj) incomplete. Propodosma and hysterosoma are separated laterally by a short incision present in between legs II and III. The setal formula of the epimerata I-IV is 3-1-3-3. The median epimeral setae 1a, 2a and 3a are arranged in one plane, whilst 4a is located antero-lateral to the genital aperture. Epimeral region reticulated.

Ano-genital region (Fig. 52):

Genital plates more or less rectangular in shape, with seven pairs of genital setae and one pair of aggenital

a

c



b

setae. Perigenital ring present. Two pairs of anal and three pairs of adanal setae present. Anal setae are marginally inserted. Adanal fissure (iad) situated antero-lateral to the anal aperture. A chitinuous transverse ridge is present in between the genital and anal apertures. Genital and anal plates with small circular areolae and these structures are bigger and more prominent on the ventral plate (see Plate III-b).

Gnathosoma (Figs. 53, 54):

Chelicerae strong and dentate, cheliceral seta cha and chb are barbed. The setal formula of the five segmented pedipalp is 0-2-1-3-9. Labial-genal articulation straight and complete (Diarthrodial). Infracapitular setae (h, m and a) are short and smooth.

Legs:

The relative lengths of the legs I-IV are: $I > II \geq III < IV$; legs tridactyle, median claw thicker than lateral ones. Leg segments reticulated and covered by secretion.

Type data: Holotype: Adult female, from litter, Mandore Garden (near Jodhpur), 24.3.1969. Paratypes - 26 specimens, same data as holotype; 18 specimens from litter, under the bamboo tree, Gulalbagh Garden, Udaipur, 30.10.1969.

Discussion:

The new species Pedrocortesella indiana, closely resembles to P. franzi Balogh (1966) in the general shape and sculpture of the prodorsum and notogaster. It differs with that mainly in the presence of six pairs of notogastral hairs (four in African species).

The new species is distinguishable from the known members of the genus and P. franzi in particular, by the combination of the following characters:

(1) notogaster with six pairs of setae, all setae short, strongly curved and marginally inserted,

(2) notogastral setae h1 inserted anterior to ps1,

(3) presence of a transverse chitinous ridge in between the genital and anal aperture, and

(4) genital and anal plates with small, circular areolae; which are bigger and more prominent on the ventral plate.

XIII. BASILOBELBIDAE Balogh, 1961

Genus: Basilobelba Balogh, 1958

The genus Basilobelba was first erected by Balogh (1958) with Damaeus retiarius Warburton, 1912 as the type, and included the genus in the family Belbidae. Later, Balogh created a new family, Basilobelbidae, for

the genera Basilobelba and Xiphobelba Csiszar, 1961.

The diagnostic characters of the genus Basilobelba are: legs monodactyle, tritonymphal exuviae affixed medially by two arcned cnitinous filaments; six pairs of genital setae, ten to twelve pairs of ventral setae, mandibles normal, and rostrum rounded (c.f Balogh, 1965).

There are only two species described so far of this genus viz., Basilobelba retiarius (Damaeus retiarius Warburton, 1912) and Basilobelba africana Wallwork, 1961. It is of interest to mention that the mites collected from Mt. Abu included both the above mentioned species.

28. Basilobelba africana Wallwork, 1961

Only one specimen of this species was found in the samples collected from Mt. Abu, Rajasthan. The present specimen agree in all characters with the species, B. africana described by Wallwork (1962).

The body covered by a cerotegument, reticulated and finely punctate. Rostral hairs smooth, strongly elboed near the base, laterally inserted on the rostrum; lamellar and interlamellar hairs barbed and dorsally inserted on the prodorsum. Sensillus long, flagelliform, and barbed. Notogaster with 12 pairs of short and smooth setae. Setal formula of the epimerata I-IV is 3-1-3-3 to six pairs of genital, one pair of aggenital, three pairs of adanal and

two pairs anal setae present. Ten pairs of ventral setae are marginally inserted on the ventral plate. Chelicerae normal. Legs monodactyle. Nymphal exuviae in the adult mites connected by two filamentous structures.

This species was first described by Wallwork in 1962 from Ghana. This is the second record of this species and therefore, first record of it from India and Asia too.

Material examined: One adult, from moss, Mt. Abu, 28.10.1969.

29. Basilobelba retiarius (Warb)

Damaeus retiarius Warburton, 1912

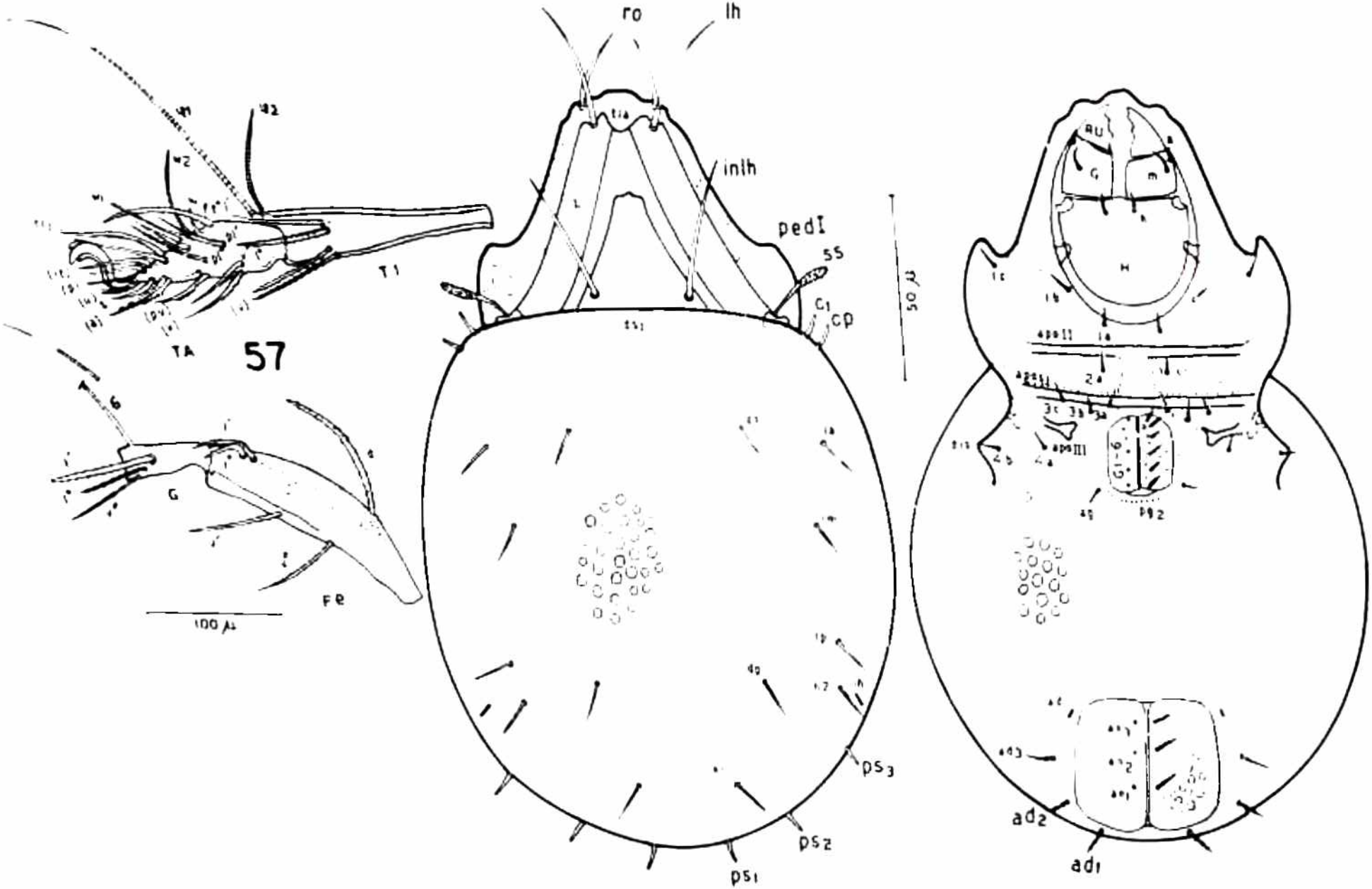
Hammation sollertius Granjean, 1959

Basilobelba retiarius (Warb.) Wallwork, 1961

The species B. retiarius differs from B. africanus mainly in the presence of long and densely barbed notogastral setae.

Known distribution: Australia, W. Africa and C. africa.

Material examined: Two adults from moss, Mt. Abu, 28.10.1969.



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55

56

notogaster - 670.

Prodorsum (Fig. 55):

Rostral tectum notched anteriorly; rostral hairs (85μ) shorter and thinner than lamellar and interlamellar hairs (150μ). Lamellae broad, without lamellar cusps (only a pair of apopyses on either side of the insertion of lamellar setae are found as in L. inermis Aoki, 1965a) and a broad translamella is present connecting the two inner apophyses of lamellae. Lamellar, interlamellar and rostral hairs smooth, sensillus clavate and barbed. Lamellae and lamellar region devoid of foveolation, whilst the lateral region of the prodorsum foveolated.

Pedotecta I well developed, discidium present.

Notogaster (Fig. 55):

Oval in shape, with 12 pairs of notogastral setae, the marginal setae about 50μ in length, whilst the humeral setae (c1, cp) and posterior setae (ps1, ps2 and ps3) are short and slightly thicker than the other notogastral setae. The arrangement of notogastral setae is shown in figure. Notogastral fissure (ih) present. Notogastral surface foveolated.

Epimeral region (Fig. 56):

Apodemata I fused with the lateral margins of the gnathosoma; apodemata II and apodemata sejugales (aposg) complete, extending to their full length, apodemata III short and far laterally situated and apodemata IV absent. The setal formula of the epimerata I-IV is 3-1-3-2; all epimeral setae thick and roughened. The whole ventral region of the body foveolated and punctate.

Ano-genital region (Fig. 56):

Six pairs of genital, one pair of aggenital, three pairs of anal and three pairs of adanal setae present. All setae are weakly barbed. Adanal fissure (iad) antero-lateral to seta ad3. Anal and genital plates foveolated.

Gnathosoma:

The setal formula of the five segmented pedipalp is 0-2-1-3-9. Cheliceral setae cha and chb are barbed. Labial-genal articulation complete and hence diarthrodial. Infracapitulum foveolated.

Legs (Fig. 57):

All legs tridactyle and heterodactylous. Ventral keel (ke) present on all leg femur. Chaetotaxy of legs I-IV is given in the following table (Table V.10).

Table V.10: Chaetotaxy of legs I-IV of X. umaensis sp.nov.

Leg	T	Fe	G	TI	TA
I	1	5	3(1)	4(2)	20(2)
II	1	4	2(1)	4(1)	15(2)
III	2	3	2(1)	3(1)	12
IV	2	2(3?)	1(1)	3(1)	11

Note: Figures in parenthesis denote the number of solenidion.

Type data: Holotype: Adult female from litter, near Sivabary Temple, Bikaner, 23.3.1969. Paratypes: Three specimens, same data as holotype.

The specific name is derived from that of author's wife name.

Discussion:

The new species Xenillus umaensis is readily distinguishable from all the known species of the genus by the combination of the following characters:

(1) with 12 pairs of notogastral setae, and two pairs of anal setae (unusual characters of the species),

(2) lamellae broad and devoid of lamellar cusps; lamellae connected anterialy by a broad translamella, lamellar region devoid of foveolation,

(3) prodorsal setae (ro, 1h, in1h) smooth,

(4) femur I-IV with ventral keel, and

(5) famulus (ε) short, situated in between the seta ft' and solenidia w2.

XV. OPPIIDAE Grandjean, 1954

The family Oppiidae consists of (c.f Balogh, 1965) 27 recognised genera. The only representatives of this large family in the present collection are the genera Oppia C.L. Koch, 1836; Multioppia Hammer, 1961 and Striatoppia Balogh, 1958.

Genus: Oppia C.L. Koch, 1836

The genus Oppia was erected by C.L. Koch in 1836, with Oppia nitens as the type. Several authors, after Koch, gave a new diagnosis for the genus and redescription of the type species (Jacot, 1934; van der Hammen, 1952; Schuster, 1956; Sellenick, 1960 and Kok, 1967).

The following is the summary of the diagnostic characters of the genus. Prodorsum without costulae; true lamellae absent and at most lamellae and translamellar traces may be present; light spotted areas may be present on the postero-median region of the prodorsum; bothridia cup shaped; sensillus may be glabrous, pilose or with radiating branches; notogaster with 10 pairs of setae,

two pairs of anal, three pairs of adanal, and one pair of aggenital setae; epimeral region distinct, epimerata III-IV usually fused and anteriorly arched; and discidium form a sharp process laterally on each side between leg III-IV (c.f Kok, 1967).

The present collection contains two distinct forms of this genus, one of which represents the species previously described from Thailand.

31. Oppia abuensis sp.nov.

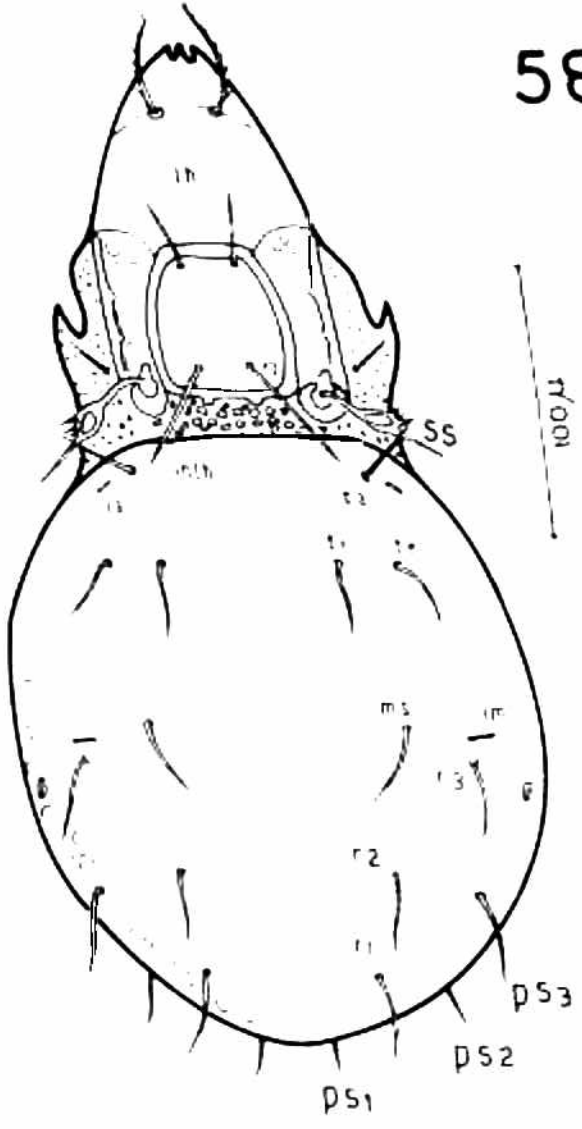
Color: Dark-brown. Measurements: Total length - 385; length of prodorsum - 150, length of notogaster - 235.

Prodorsum (Figs. 53, 53a):

Rostrum trimucronate, the median lobes less sclerotized than the lateral ones. Rostral setae (40μ), medially inserted on the rostrum, strongly elbowed and longer than the lamellar setae (30μ). Interlamellar hairs longer than other prodorsal hairs. Exobothridial setae short, inserted lateral to the bothridia. All prodorsal setae are moderately barbed. Bothridia cup-like; sensilli with long stalk and clavate head beset with four radiating spine like setae, of which the proximal one is the longest. Lamellae uniformly thick, convergent, the anterior ends of lamellae are connected by a distinct translamella (tla), the later

ro

58a



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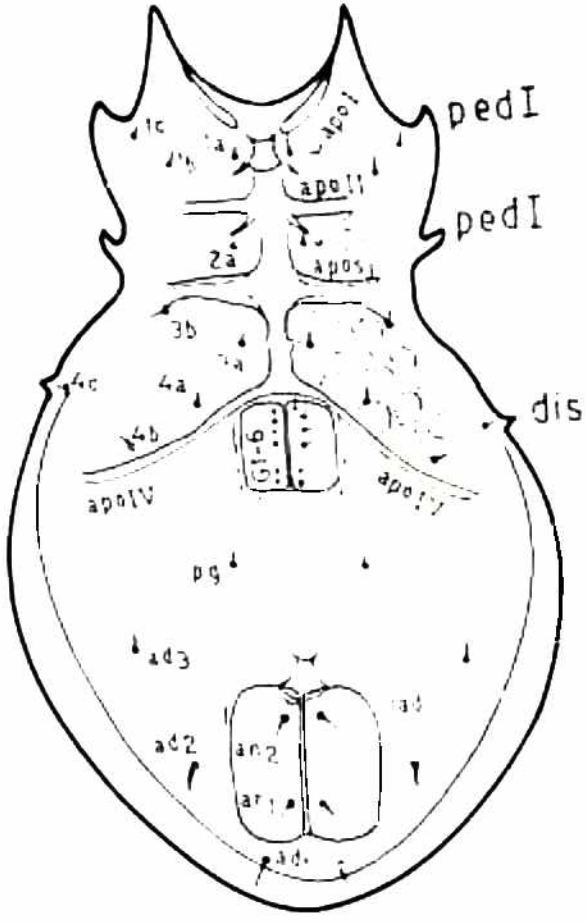

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transverses across the prodorsum anterior to the insertion of lamellar hairs. There is another transverse ridge (tr) connecting the posterior ends of the lamellae. A characteristic tetragonal frame-like structure, is thereby formed on the posterior median region of the prodorsum by two transverse ridges, tla and tr, connecting the anterior and posterior ends, respectively, of the lamellar ridges (L). A lateral ridge (tutorium) present on each side of the prodorsum, curving mediad in the direction of lamellar setae. Between the lamellae and tutorium (tu) there are five circular light areas present on each side. There are two more pairs of pale areas in the interlamellar region. The proximal region of the prodorsum consists of dark sclerotized, mosaic-like structure (Fig. 58). Lateral region of the prodorsum and the pedotecta region granulated.

Pedotecta I well developed; pedotecta II small and discidium present on the lateral side of the hysterosoma legs III and IV.

Notogaster (Fig. 58):

Oval in shape, integument smooth, except foveolated at the peripheral region. Ten pairs of notogastral hairs present, seta ta about as long as other notogastral setae. Fissures ia postero-lateral to seta ta and im anterior to r3 in position. The relative distance between the medial notogastral setae are: te-te > ms-ms > r2-r2 > ti-ti $\geq$ r1-r1.

Epimeral region (Fig. 59):

Epimerata 1, II and the fused III-IV are fenestrated. The coxisternal ridges of apodemata I, II and apodemata-sejugales (aposj) well developed and extend to mid-line where they join a conspicuous sternal ridge. Apodemata III absent. The ridges of apodemata IV strongly curved around the anterior margin of the genital aperture. The setal formula of the epimerata I-IV is 3-1-3-3. All epimeral setae short and weakly barbed.

Gnathosoma:

Infracapitular setae h, m and a are relatively barbed, labial-genal articulation diarthrodial. Pedipalp five segmented and the cheliceral setae cha and chb barbed.

Legs:

All legs monodactyle. Chaetotaxy of legs I-IV shown in the following table (Table V.11).

Table V.11: Chaetotaxy of legs I-IV of Oppia abuensis sp.nov.

Leg	T	Fe	G	TI	TA
I	0	5	2(1)	4(2)	19(2)
II	0	5	1(1)	4(1)	15(2)
III	2	3	1(1)	3(1)	12
IV	2	3	1(1)	3(1)	12

Type data: Holotype: Adult female, from moss, Mt. Abu, 28.10.1969. Paratype: 21 specimens, same data as holotype.

Discussion:

The new species Oppia abuensis differs from all the known members of the genus by the combination of the following characters:

(1) sensillus provided with four spine-like setae, of which the anterior one is remarkably longer than the rest,

(2) rostral setae strongly elbowed and unilaterally barbed,

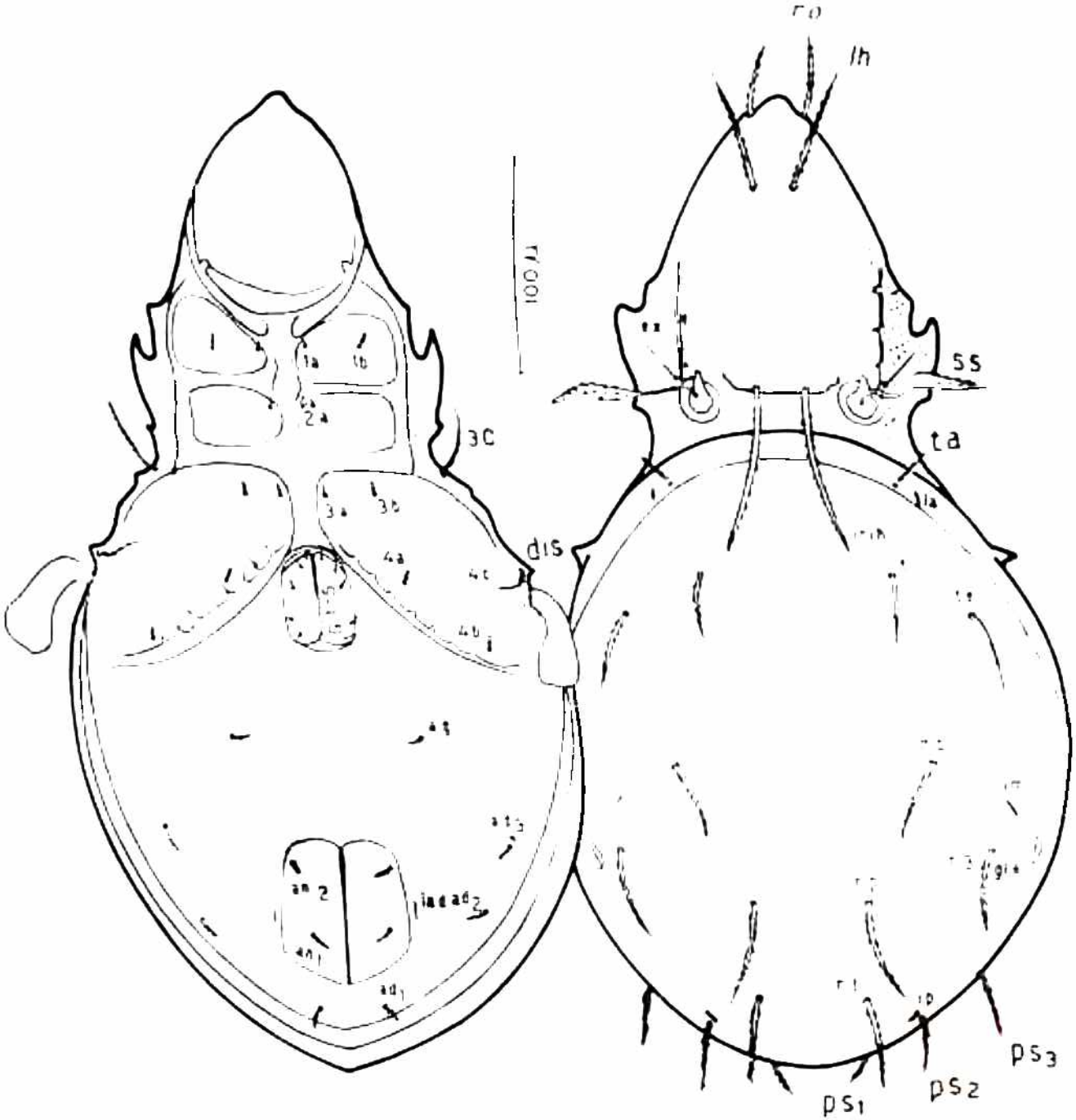
(3) interlamellar setae much longer than other prodorsal setae,

(4) proximal region of the prodorsum with darkly sclerotized mosaic like structures, and

(5) a characteristic tetragonal frame on the posterior median region of the prodorsum is another specific character of the species.

32. Oppia vodai Aoki, 1965

The specimens examined agree in almost all characters with the species Oppia vodai described by Aoki (1965) from Thailand. The only variation that are found in the present



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60

specimens are: interlamellar hairs (80μ) longer than the lamellar hairs (65μ), and the notogastral seta ta is barbed. Other characters of the Thailand species, like lamellae absent, lateral ridges weak, five pairs of genital, two pairs of anal, three pairs of adanal and one pair of aggenital setae; prominently projecting discidia, sclerotization of the prodorsum and coxisternal region are similar to the present specimens examined (Figs. 60, 61).

Known distribution: Thailand. This is the first record of this species for the country.

Material examined: Twenty-eight specimens from litter, Botanical Garden, Institute campus, Pilani.

Genus: Multioppia Hammer, 1961

The genus Multioppia was established by Hammer (1961) with Multioppia radiata as the type.

The diagnostic characters of the genus are: Hysterosoma with 12 pairs of hairs, true lamellae absent, lamellar and interlamellar hairs present, light spots present on the posterior median region of the prodorsum, bothridia have branches radiating from the posterior borders of the compressed clavate head, discidium strongly pointed on lateral side of the hysterosoma between legs III and IV and fissure iad situated close to the border of the anal

The genus is represented by only one species, Multioppia wilsoni Aoki, in the present collection.

33. Multioppia wilsoni Aoki, 1964

The specimens examined agree in all characters with the description of the species given by Aoki (1964a) from Laysan Island. This is the first record of this species from India and from the Orient.

Material examined: Nine specimens from litter, Khetri, 25-3-1969.

Genus: Striatoppia Balogh, 1958

The genus Striatoppia was first erected by Balogh (1958) with Striatoppia machadoi as the type.

The diagnostic characters of the genus are: Dorsum of hysterosoma with parallel lines extending backwards from shoulder, without densely granulated cerotegument; 9-10 pairs of club-shaped, spatulate or brush-shaped notogastral hairs; prodorsum with costula and tutorium, with 4-5 pairs of genital, two pairs anal, three pairs adanal and one pair of aggenital setae and legs monodactyle.

The following are the only five species described so far in this genus:

Striatoppia machadoi Balogh and Mahunka, 1958 .. Africa

S. madagascarensis Balogh, 1960 .. Africa

S. niliaca Popp, 1960 .. Egypt

S. margaritifera Balogh and Mahunka, 1966 .. Africa

S. papillata Balogh and Mahunka, 1966 .. Africa

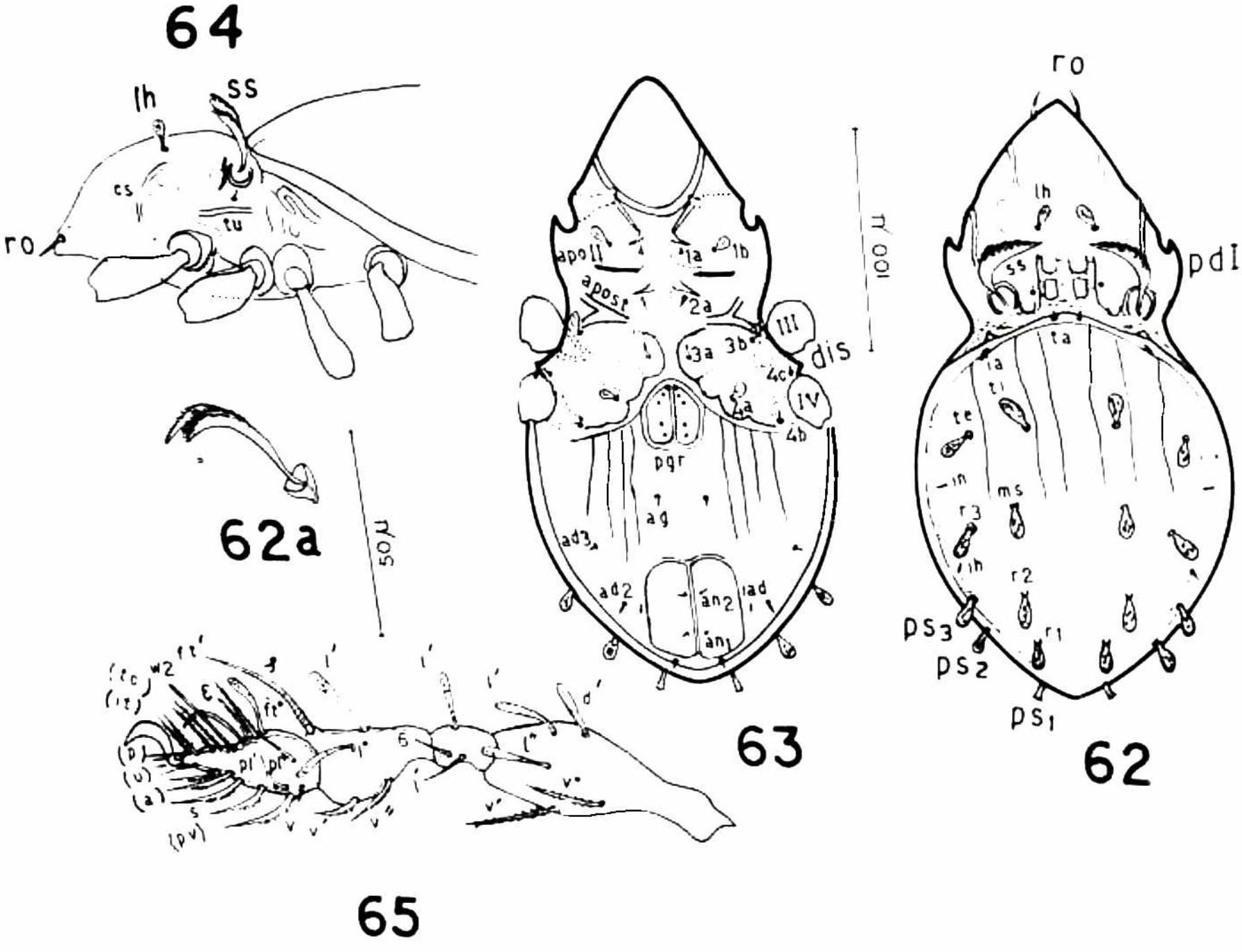
The present collection is represented by only three mites - belong to the genus Striatoppia. The following is the description of a new species of this genus.

34. Striatoppia aokii sp.nov.

Color: Dark-brown. Measurements: Total length - 270; length of prodorsum - 95, length of notogaster - 175.

Prodorsum (Figs. 62, 62c):

Rostrum conical in shape, rostral hairs smooth, setiform, and are inserted lateral to the rostrum. Lamellar hairs club-shaped, spiculate and medially inserted on the prodorsum. Interlamellar and exobothridial hairs short, setiform, and are lateral to the bothridia. A pair of longitudinal chitinous laths (costulae) are lateral to the lamellar setae extending backwards from the borders of the rostrum. Tutorium present. Lateral region of the prodorsum finely granulated. Two pairs of pale areola arranged in a row of two each and each row separated by darkly sclerotized bars are found on the proximomedian part of the prodorsum as in other member of the genus.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Bothridia cup-shaped and sensillis (Fig. 62a), densely barbed dorsally.

Notogaster (Fig. 62):

Notogaster with ten pairs of setae, all notogastral setae (except ta and psl) club-shaped and spiculate. Seta psl incrassate and apices dilated. Seta ta short, penicilliform and located antero-medially on the dorsosejgual suture. Notogaster with parallel chitinous lines extending backwards from the interior border of the notogaster. Lateral region of the notogaster foveolated and granulated.

Epimeral region (Fig. 63):

Epimerata I, II, and the fused III-IV reticulated. Epimeral ridges of the apodemata IV abut the anterior border of the genital aperture. Setal formula of the epimerata I-IV is 3-1-3-2, of which, setae 2a, 3b and 4a are club-shaped and spiculate, a characteristic feature of this species.

Ano-genital region (Fig. 63):

Genital plates with five pairs of setae, one pair of aggenital setae situated posterior to the genital aperture, two pairs of anal and three pairs of adanal setae present. Adanal fissure (iad) lateral to the adanal seta, ad2. Few chitinous longitudinal lines are present on

the ventral plate extending backwards from the borders of the apodemata IV.

Gnathosoma:

Pedipalp five segmented; chelicerae normal, and dentate, cheliceral setae cha longer than chb. Labial-genal articulation diarthrodial.

Legs (Fig. 65):

Legs I-IV monodactyle. Dorsal setae of all leg segments club-shaped. Chaetotaxy of the legs I-IV is given in the following table.

Table V.12: Chaetotaxy of legs I-IV of Striatoppia aokii

Leg	T	Fe	G	TI	TA
I	0	5	2(1)	4(1)	19(2)
II	0	5	2(1)	4(1)	15(2)
III	1	3	1(1)	3(1)	11
IV	1	2	1(1)	3(1)	10

Note: Figures in parenthesis denote the number of solenidion.

Type data: Holotype - Adult (sex not known), from litter, Ajit Sagar Bund, Khetri, 27.2.1970. Paratype - two specimens, same data as holotype.

The specific name is derived from and in honour of Dr. Jun-ichi Aoki, an outstanding Oribatidologist of Japan.

Discussion:

The new species *Striatoplia aokii* resembles closely to *S. niliaca* Popp, 1960, in general shape of the club-shaped notogastral and lamellar hairs. The new species, however, is easily distinguishable from the known species of the genus and *S. niliaca* in particular by the combination of the following characters:

(1) interlamellar hairs setiform, lamellar hairs club-shaped,

(2) notogastral hairs *ta* peniciliform, and *ps* incrassate and apices dilated,

(3) epimeral setae *1a*, *2b* and *4a* are club-shaped,

(4) with five pairs of genital, one pair of aggenital, two pairs of anal and three pairs of adanal setae, and

(5) two pairs of areolae on the proximomedian region of prodorsum.

XVI. CYMBAEREMAEIDAE Sellnick, 1928

Genus: Scapheremaeus Berlese, 1910

Berlese (1910) created a subgenus Scapheremaeus under the genus Cymbaeremaeus Berlese, 1896. He separated the subgenus Scapheremaeus from the genus on account of marginal field of notogaster being distinctly demarcated from the slightly convex middle field and diverse nature of the dorsal sculpture. Berlese designated Cymbaeremaeus (Scapheremaeus) patella as the type and added four more species to the subgenus (listed in the Table V.13). Later authors (Sellenick, 1928 and Willmann, 1931), however, considered Scapheremaeus a genus.

The diagnostic characters of the genus Scapheremaeus are: Marginal zone of the notogaster distinct from the central zone; notogastral setae usually marginal, at most two pairs in the median region, notogastral surface may be rugose, reticulate, areolate or smooth; rostral, lamellar and interlamellar hairs present, with six pairs of genital, two pairs of anal, three pairs of adanal, one pair of aggenital setae and legs monodactylous.

Mites collected from moss, Mt. Abu, included only two specimens belonging to the genus Scapheremaeus. The following is the description of a new species of this genus.

35. Scapheremaeus mathurensis sp.nov.

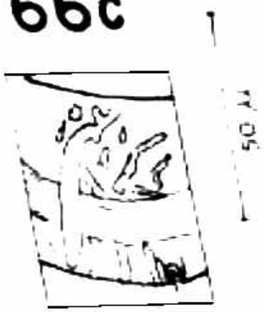
Color: Dark-brown. Measurements: Total length of the body - 470; length of prodorsum - 125, length of notogaster - 345.

Prodorsum (Figs. 66, 66a):

The peripheral region of rostrum with a series of arch-shaped ridges connected to each other. The rostral hairs (ro) smooth, strongly curved and are inserted antero-lateral to rostrum. Lamellae convergent, markedly elevated and connected by a distinct transverse ridge (translamella). A pair of club-shaped lamellar setae inserted on the anterior tips of the lamellae, interlamellar hairs very minute and are inserted in small tubercles lateral to bothridia. The interspace between the lamellae exhibits a texture of twig-like rugose structures. Lateral to the lamellae, on either side of the prodorsum, a pair of irregularly edged longitudinal ridges (tutorium) are present. Bothridia cup-shaped, sensillus short, with a very short stalk and globular transversely striped head and devoid of setae.

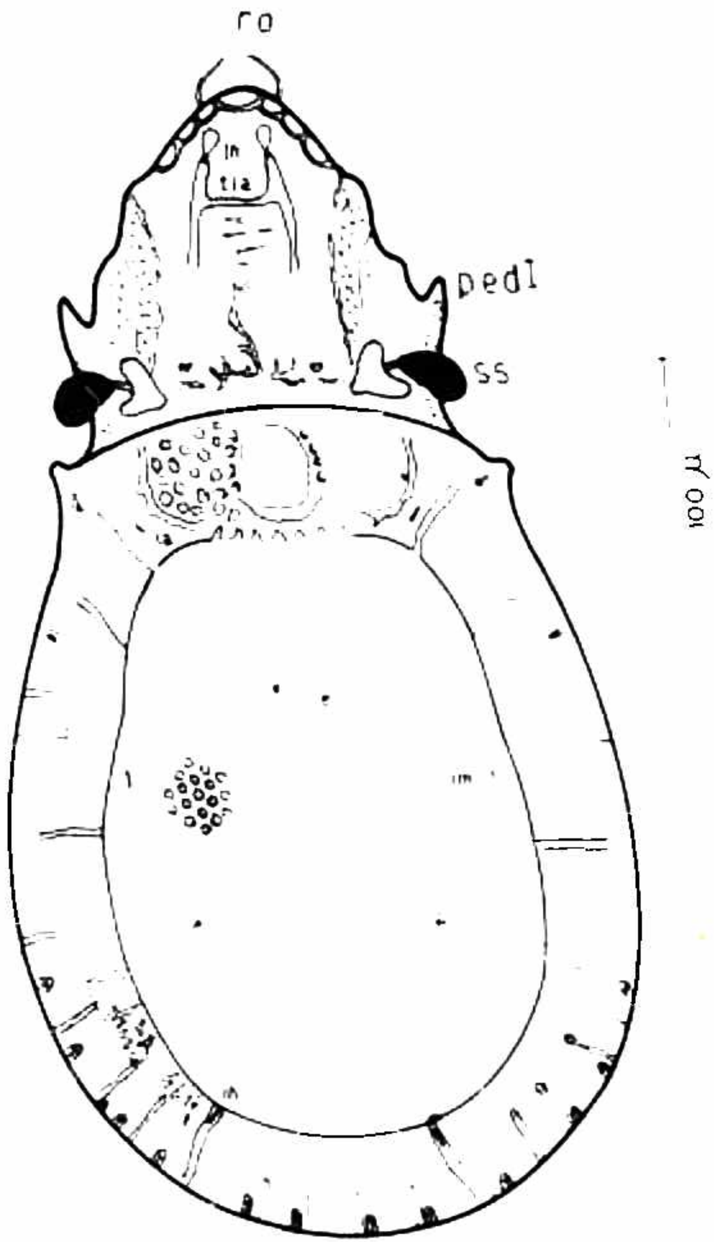
Pedotecta-I well developed, pedotecta-II small, and dilated anteriorly, discidium (pedotecta-III) present in between the legs II and III. The lateral region of the prodorsum, tutorium and pedotecta are distinctly granulated.

66c



66b

66a



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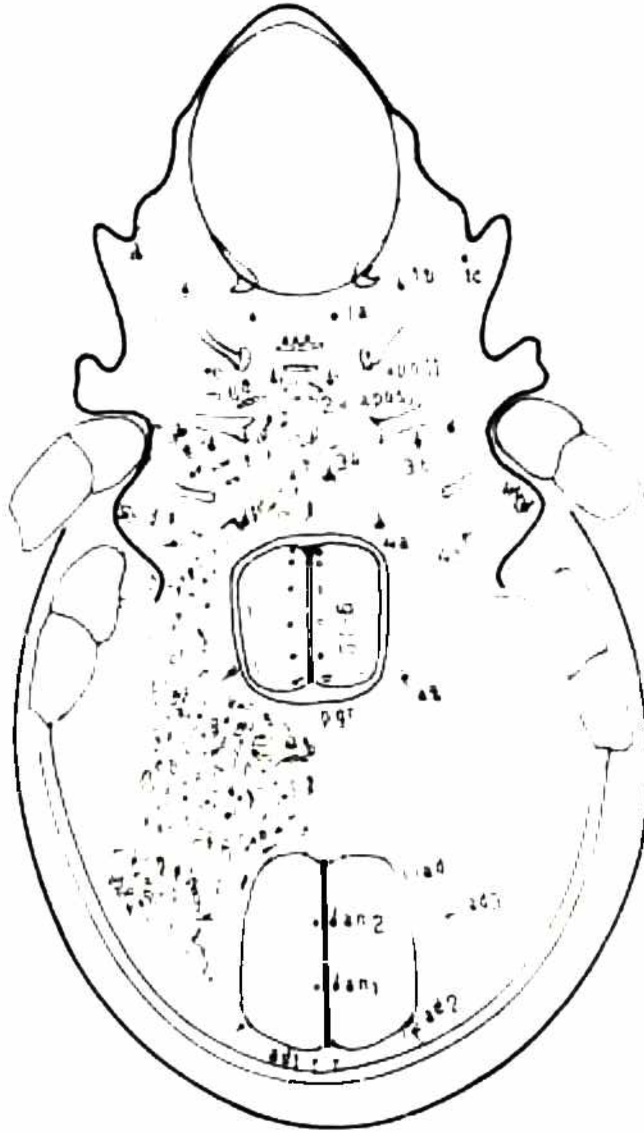

67

67a

Notogaster (Figs. 66, 66b):

Humeral region on either side of the notogaster with a small marked projection. The convex middle field and the flat marginal field of notogaster distinctly demarcated by a border line. The surface of the median field areolated, whilst the marginal field with twig like rugose texture. Notogaster with ten pairs of minute setae, of which six pairs are postero-marginal, one pair inserted at the humeral region and two pairs on the median field of the notogaster. Three pairs of notogastral fissures (ia, im, ih) are distinct (Fig. 66). Notogastral setae inserted on small node-like tubercles.

Epimeral region (Figs. 67, 67a, 67b):

Apodemata I fused with the lateral margins of the gnathosoma; epimeral ridges of apodemata II-III and apodemata sejugale are darkly sclerotised, short and laterally situated. The setal formula of the epimerata I-IV is 3-1-2-3. All setae short and smooth. Epimeral and ventral plates sculptured with twig-like structures as found on the lamellar region.

Ano-genital region (Figs. 67, 67c):

Genital plates longer than broad, the anterior and posterior margins of genital plates darkly chitinized. Genital aperture surrounded by a darkly sclerotized

Plate IV

perigenital ring (pg). Six pairs of genital, one pair of aggenital, three pairs of adanal and two pairs of anal setae present. Adanal setae adl closely inserted to each other posterior to anal aperture. Adanal fissure (iad) antero-lateral to anal aperture. Anal and genital plates areolated (Fig. 67c).

Labial-genal articulation diarthrodial. Legs monodactyle. Further details of legs and gnathosoma not studied in detail.

Type data: Holotype - Adult female, from moss, Mt. Abu, 28.10.1969. Paratype one specimen, same data as holotype.

The species is named in honour of Dr. S.N. Mathur.

Discussion:

It is of interest to mention that the new species S. mathurensis exhibits a close resemblance to S. fisneri, a species described by Aoki (1966) for the mites collected from bird's nest, in general shape and texture ornamenting the dorsal surface of prodorsum and notogaster (see Table V.13). The new species, however, differs from S. fisheri and other known species of the genus by the following characters:

(1) lamellar setae club-shaped and smooth,

Table V.13: Comparison of the main characters between the species belonging to the genus Scapheremaeus (c.f Aoki, 1964a)

Species	1	2	3	4	5	6	7
S. patella Berlese, 1910	A	Rg	T	r	S	?	1.25
S. guerini Berlese, 1910	B	Al	t	r	S	340	1.28
S. corniger Berlese, 1910	A	Al	t	R	S	410	1.21
S. marmoratus Berlese, 1910	B	RG	T(?)	r	S	480	1.35
S. pulchellus Berlese, 1910	A	Lf	t	r	S	300	1.39
S. reticulatus Berlese, 1910	A	Rt	T	r	S	430	1.45
S. marginalis Banks, 1896	B	Rt	T	r	S	?	1.37
S. Palustris Sellenick, 1928	A	Rt	T	r	S	460	1.36
S. clavifer Hammer, 1958	B	Kn	T	R	S	470	1.25
S. trirugis Hammer, 1958	B	Rg	T	r	S	410	1.25
S. glaber Hammer, 1958	A	Sm	T	r	S	560	1.39
S. stratus Hammer, 1958	A	Br	T	r	S	570	1.34
S. alveolatus Hammer, 1961	B	Al	T	r	S	410	1.39
S. pisacensis Hammer, 1961	A	Kn	T	r	S	570	1.28
S. abliteratus Hammer, 1961	B	Rt	T	r	U	540	1.38
S. sinuosus Aoki, 1964	B	Lf	t	R	U	380	1.48
S. fisheri Aoki, 1966	B	Al	T(?)	R	S	425	1.31
S. mathurensis sp.nov.	B	Al	T	R	S	475	1.26

Explanation of the abbreviation of characters: 1) Direction of sensillus. A: directed dorsoantero-laterally; B: directed rather laterally, more or less bending backwards. 2) Texture of the middle field of notogaster. Al: alveolated; Br: covered by brown round units; Kn: with indistinct knobs or tubercles; Lf: with longitudinally flowing folds or reticulation; Rg: rugose; Rt: reticulate; Sm: smooth. 3) Presence of translamella; T: translamella present; t: without translamella. 4) Structure of the posterior portion behind the raised middle field of notogaster; R: with round or arched chitinous ornamentation; r: without such ornamentation. 5) Posterior border of notogaster; U: uneven and undulating; S: smoothly rounded. 6) Body length in microns. 7) Ratio of the length of notogaster to its width.

(2) sensillus with striated globular head and devoid of barbation, and

(3) positions of notogastral setae (10 pairs) and the notogastral fissures are entirely different from the previously described species.

XVII. ORIBATELLIDAE Jacot, 1925

Genus: Lamellobates Hammer, 1958

The genus Lamellobates was erected by Hammer (1958) with Lamellobates palustris Hammer, 1958 as the type, under family Oribatellidae.

The diagnostic characters of the genus are: Lamellae broad, situated close together, anterior margins of lamellae without free tips, hysterosoma hairs (nine pairs) are situated both on the lateral and middle part of the hysterosoma, areaporosa absent on the notogaster, with six pairs of genital, two pairs of anal and two pairs of adanal hairs, and legs with a single claw.

The genus Lamellobates is represented by the following two known species in the present collection of Oribatids from Rajasthan.

36. Lamellobates palustris Hammer, 1958

L. palustris, the type of the genus Lamellobates was first described by Hammer (1958) from Argentine. Aoki (1965) also recorded the occurrence of this species in Thailand and provided an additional taxonomic feature for the species, namely a modified, thick and barbed lateral (l') setae on leg segments Genu II and Tibia II.

The material examined here agree in all characters with Thailand specimens (Aoki, 1965) of this species.

Known distribution: Argentine (Hammer, 1958), New Zealand (Hammer, 1966), Thailand (Aoki, 1965) and India (Bhaduri and Raychaudhuri, 1968).

Material examined: 17 adult females, from litter, Botanical Garden, Institute campus, Pilani.

37. Lamellobates (paralamellobates) bengalensis Bhaduri and Raychaudhuri, 1968

Material examined in the present work agree, in general, with the characters described for the species, Lamellobates (p.) bengalensis, by Bhaduri and Raychaudhuri (1968). The subgenus Paralamellobates erected by them was to differentiate Paralamellobates from the genus Lamellobates Hammer, 1958 on account of the lamellae with free tips. Examination of leg chaetotaxy of the species, however,

reveals that the modified, thick and barbed, lateral seta (l') is present only on Genu II and the same is absent on Tibia II. This character had been apparently overlooked by Bhaduri and Raychaudhuri.

The remarkable feature of possession of modified lateral seta (l') on both Genu and Tibia of legs II in Lamellobates and its absence in the Tibia of leg II of Paralamellobates is of taxonomic importance. This diagnostic feature can be considered complimentary to the presence or absence of free lamellar tips at subgeneric level.

Material examined: Fifteen adults from litter, Udaipur, 31.10.1969. Five adults, Institute campus, Pilani.

XVIII. GALUMNIDAE Jacot, 1925

Genus: Galumna von Heyden, 1826

Mites of the superfamily Galumnoidea, generally called as large winged mites, have been more extensively studied than any other group among higher Oribatids because of their economic importance as tapeworm vectors and fungal spore carriers. Their distribution seem almost world-wide and are abundant in surface layers of forest soils.

According to Balogh (1965), the family Galumnidae comprises 30 genera including six genera inquirenda. This large family, Galumnidae, is represented in the present collection by two previously described species belonging to the genus Galumna.

The genus Galumna was first established by von Heyden (1826) with Notaspis alatus Hermann, 1804 as the type. The diagnostic features of the genus are: Lamellar carinae present, lamellar setae inserted between lamellar (L) and sublamellar carinae (S); with 10 pairs of notogastral setae or setal alveoli; without conspicuous sexual dimorphism, posterior tubercle lacking in males, area porose present; with six pairs of genital, one pair of aggenital, two pairs of anal, two pairs of adanal setae. Legs usually tridactyle and heterodactyle (c.f Balogh, 1965).

The following two species were collected from Rajasthan soils.

38. Galumna flabellifera Hammer, 1958

This species was first described by Hammer (1958) from Andes Mountains (S. America). Later, Aoki in 1964 and 1964a recorded the same species from Thailand and Laysan, respectively. Saxena (1971) studied the biology of this species and also reported the occurrence of certain pathogenic fungal spores on the body surface and in gut

content of the Galumna flabellifera from Rajasthan.

Material examined here agree in all characters with S. American species described by Hammer. Since, a detailed description of this species is given by both Hammer (1958) and Aoki (1964, 1964a), it is deemed unnecessary to redescribe this species again.

Material examined: 47 specimens, from grasses, Central Lawn, B.I.T.S. Campus, Pilani; 21 specimens from Mandore Garden, Jodhpur, 26.10.1969.

39. Galumna tessellata (Ewing)

Oribata tessellata Ewing, 1910

Galumna tessellata Jacot, 1933

This species was first described by Ewing (1910) from Nilgiri Hills (S. India) as Oribata tessellata. Later, Jacot (1933) redescribed the cotypes of Ewing's species and placed them under the genus Galumna.

The material examined in the present study agree in all characters with the species G. tessellata, except that the notogastral hairs are longer (25μ) and fairly barbed in the present specimens (Fig. 5).

Material examined: 18 adult females and seven males from moss, Mount Abu, 28.10.1969; 13 specimens from grass, Central Lawn, B.I.T.S. Campus, Pilani, 22.4.1968.

XIX. ORIBATULIDAE Thor, 1929

Genus: Scheloribates Berlese, 1908

The taxonomic placement of the genus Scheloribates was a subject of controversy for many years until Baker and Wharton (1952) consolidated them under the family Oribatulidae.

The genus Scheloribates, under discussion, was first erected by Berlese (1908) with Zetes latipes C.L. Koch, 1844 as the type.

Balogh (1961) regarded the number of genital setae and the absence of rostral apophyses as diagnostic features for the genus. He (1961), therefore, lumped together the genera viz. Paraschelobates, Protoschelobates, Storkania, Styloribates and Propeschelobates, all instituted by Jacot in 1934 and 1936, respectively, as sysnomys of the genus Scheloribates Berlese.

Pletzen (1967) summarized the diagnostic characters of the genus Scheloribates as follows: "Pteromorphs varying from small, hardly decurved, to larger, relatively strongly decurved plates; lamellae tapering anteriorly and ending without cusps; a rostro-lamellar ridge present or absent; rostral apophyses present; areae porosae always reduced to sacculi; with 10 pairs of notogastral hairs, rarely more; number of genital hairs four, rarely five, apodemata IV (apodemata sejugales presently used) relatively short or long and abutting the genital orifice; femora generally keeled and legs either monodactyle or tridactyle".

Represented in the present collection are the following four known species of the genus Scheloribates.

40. Scheloribates angulatus Hammer, 1958

This species was first described by Hammer (1958) from Andes Mountains (South America).

The material examined here agree in all characters with the description and figure provided for the species S. angulatus by Hammer. Important characters of the species are:

Interlamellar hairs about as long as lamellar hairs, lamellar tapering anteriorly, all prodorsal hairs barbed; sensillus short and clavate; with 10 pairs of short and smooth notogastral hairs; four pairs of genital, two pairs of anal and two pairs of adanal setae. Adanal fissure antero-lateral to the anal aperture. The setal formula of the epimerata I-IV is 3-1-3-2. Coxisternal region and peripheral region of the notogaster foverolated. All legs tridactyle and heterodactylous in nature.

This is the first record of this species from India.

Material examined: Nine adult females from grasses, Central Lawn, B.I.T.S. Campus, Pilani, 22.4.1968; 28 specimens from litter, Mt. Abu, 28.10.1969; 16 specimens from grasses, Ajmer, 2.11.1969.

4. Scheloribates chauhani Baker, 1945

This species was first described by Baker (1945) for the mites collected from Izatnagar (Uttar Pradesh, India).

Material examined here agree in almost all characters with the species S. chauhani. A good deal of the description of characters of prodorsum, notogaster and ano-genital region of the mite were already given by Baker. The following characters are given as a supplement to Baker's original description of the species (Fig. 4).

Notogaster with 10 pairs of short and smooth setae. Four pairs of sacculi (Sa, S1, S2 and S3) and four pairs notogastral fissures (ia, im, ih and ip) present. Apodemata I fused with the postero-lateral region of the gnathosoma, apodemata II well developed and extend upto the median sternal plate; apodemata III short and laterally situated, apodemata sejugales long and abut the anterior margin of the genital aperture. Apodemata IV absent. The setal formula of the epimerata I-IV is 3-1-2-3. All epimeral setae are short and smooth. Perigenital ring present, encircling the genital aperture. Four pairs of genital, one pair of aggenital, two pairs of anal and two pairs of adanal setae present. Adanal fissure (iad) antero-lateral to the genital aperture. The coxisternal region foveolated.

Sexes distinct, males smaller than the females; the epimeral ridges of the apodemata weakly sclerotized in male. All legs tridactyle, median claw stronger than the laterals

interlamel ar setae longer than lamellar hairs and all prodorsal setae are distinctly barbed. This species is widely distributed in Rajasthan.

Material examined: 83 adult females, 21 males, from grasses, Central Lawn, B.I.T.S. Campus, Pilani, 22-4-1968; 16 specimens from Mt. Abu, 28.10.1969; eight specimens from Mandore Gardens (Jodhpur), 26.10.1969; 23 specimens from Udaipur, 31.10.1969.

42. *Scheloribates confusia* Coetzer, 1967

The material examined here agree in all characters with the species, *S. confusia* described by Coetzer (1967) from South Africa. A complete description of the species is given by Coetzer, therefore, it is deemed unnecessary to redescribe the species again.

This is the first record of this species from India.

Material examined: Seven adult females, and two males, from grasses, Bikaner, 25-10-1969; 13 specimens from litter, Ajmer, 2-11-1969; and 28 specimens from Jaipur, 3-11-1969.

43. *Scheloribates natalensis* Pletzen, 1963

This species was described by von Pletzen (1963) from South Africa.

The present material agree in all characters with the African species, *S. natalensis*.

The species, *S. natalensis* differs from *S. chauhani* in presence of a single claw, absence of sacculi, and presence of four pairs of area porosae, sensilli with a posteriorly thickened head, interlamellar hairs short and as long as lamellar hairs.

This is the first record of this species from India.

Material examined: Seventeen adults, from moss, Mt. Abu, 28-10-1969.

XX. CHAUNOPROCTIDAE Balogh, 1961

Genus: *Chaunoproctus* Pearse, 1906

Caloppia Balogh, 1958

The genus *Chaunoproctus* was first erected by Pearse (1906) with *Chaunoproctus cancellatus* Pearse, 1906 as the type. Pearse included the genus in the subfamily Notaspidinae of the family Oribatidae. Later, Balogh (1961) erected a separate family Chaunoproctidae for the only genus *Chaunoproctus*. He (1961) regarded the genus *Caloppia* Balogh, 1958 as synonym to *Chaunoproctus* Pearse, 1906 and consequently

transferred all the species described earlier by him (1958 and 1959) to Chaunoproctus.

The diagnostic features of the genus are: Notogaster foveolate, with 10 pairs of club-shaped to long and ciliated setae; five (rarely six) pairs of setal alveoli present on the notogaster; notogaster rounded, one tubercle on each shoulder; lamellae ribbon like, with or without cusps and connected by a distinct translamella; tutorium usually present, with six pairs of genital, two pairs of anal, one pair of aggenital and two pairs of adanal setae. Legs always tridactyle and heterodactyle.

Characters of the coxisternal region of Chaunoproctids were not studied by any author. The following additional characters are suggested: Apodemata sejugales almost always abut the anterior margin of the genital aperture; apodemata II usually well developed, apodemata III short and laterally situated and apodemata IV always absent. The epimeral setal formula 3-2-3-2; discidium present and circumpedal ridges well developed.

The following are the eight species described so far under the genus Chaunoproctus:

Chaunoproctus cancellatus Pearse, 1906	.. Sikkim
C. asperulus Pearse, 1906	.. Sikkim
C. minor (Balogh, 1958)	.. W. Africa
C. papillata (Balogh, 1958)	.. W. Africa
C. basilewskyi (Balogh, 1958)	.. W. Africa

C. vargai (Balogh, 1959)

C. cristatus Karpinnen, 1966 .. W. Africa

C. deleoni Higgins, 1966 .. C. Africa

.. S. America

The following is the description of three new species of the genus Chaunoproctus. A taxonomic key has been presented for identification of the three new species described in the present work.

44. Chaunoproctus alveolata sp.nov.

Color: Dark-brown. Measurements: Total length of the body - 510; length of prodorsum - 150, length of notogaster - 360

Prodorsum (Fig. 68):

Rostrum broadly conical in shape, rostral setae (90μ), thick, barbed and are inserted lateral to the rostrum. Lamellae uniformly thick, convergent and fuspidate. The inner lamellar cusps are connected by a distinct translamella. A pair of weakly sclerotized sublamellar ridges are present which are lateral to lamella. Tutorium present. Lamellar hairs (lh) about as long as rostral hairs, longer than interlamellar hairs and are inserted on the anterior tips of the lateral lamellar cusps. Interlamellar hairs (65μ) club-shaped, thicker than lamellar and rostral setae and about 2.1 times longer than the notogastral hairs. The interlamellar hairs are inserted in small weakly sclerotized tubercles on the posterior region of the prodorsum. Bothridia cup-shaped


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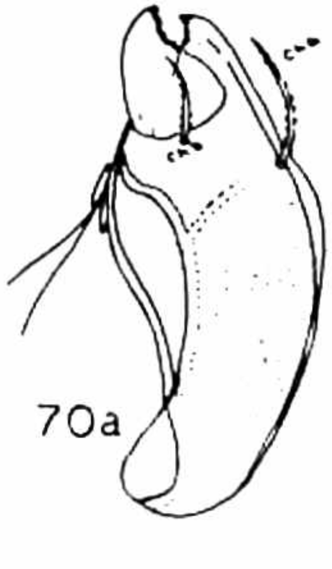
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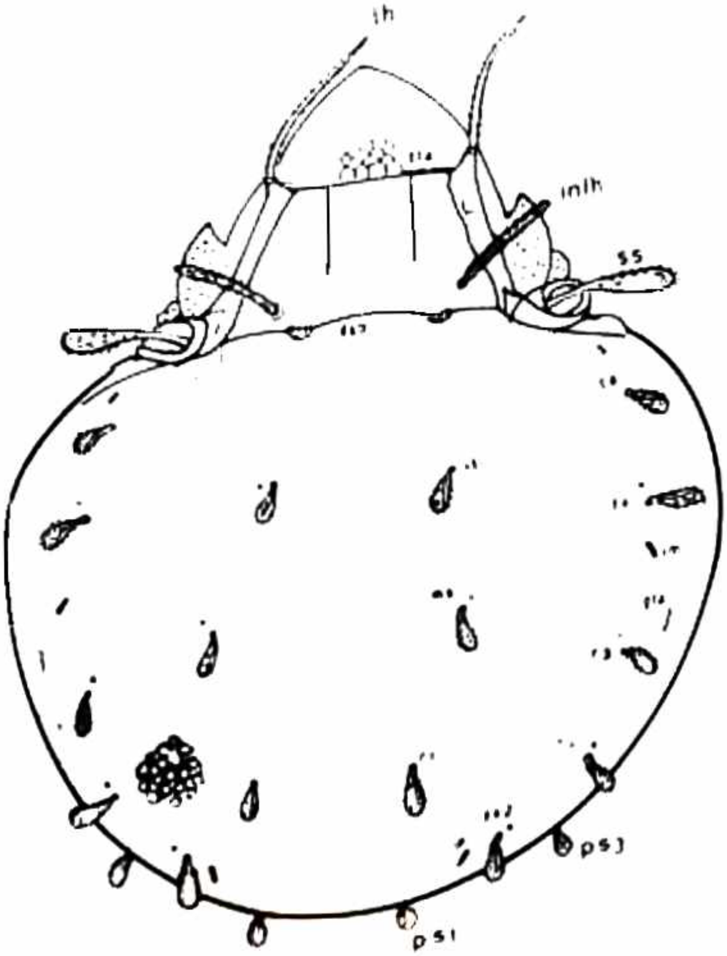
73



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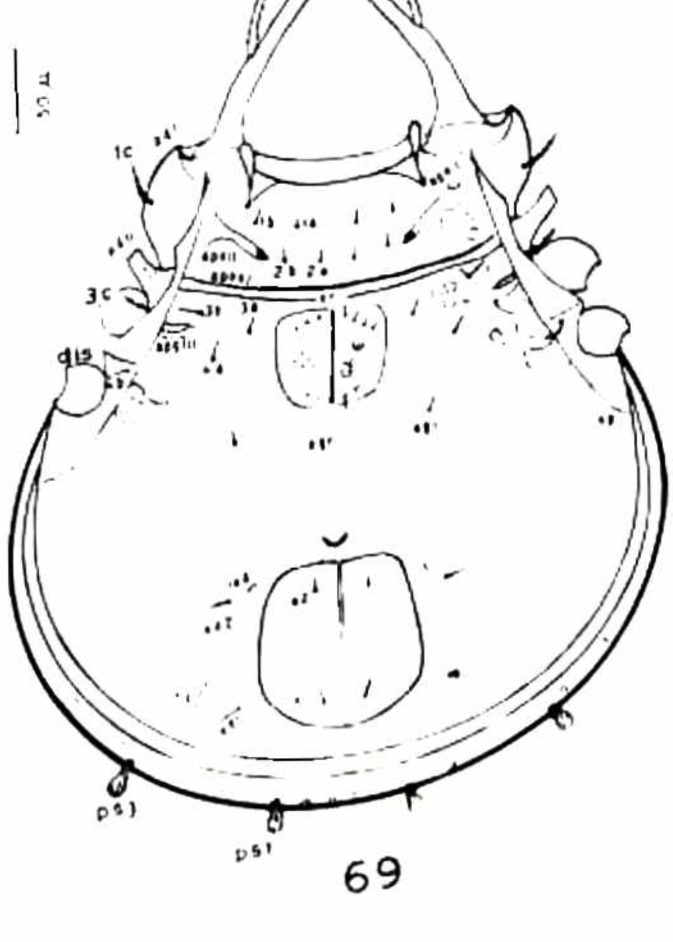

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sensilli with a short stalk and barbed clavate head.

Pedotecta I well developed, pedotecta II small and discidium (dis) present in between the legs III and IV and with a distinct transverse ridge. A characteristic hexagonal reticular structures are present stretching from translemalla towards the anterior region of the prodorsum. Interspace between the lamellar ridges devoid of reticulation but a pair of parallel lines extend from the translamella toward the proximal region of the prodorsum. Lateral region of the prodorsum and pedotecta papillaformes.

Notogaster (Fig. 68):

Hysterosoma rounded aveolated dorsally and peripheral region foveolate. Notogaster with 10 pairs of club-shaped setae, densely ciliated (30μ in length). Setae ps2 and ps3 shorter than the rest of the notogastral setae (20μ). Six pairs of setal alveoli are present lateral to the setae ti, ms, te, r2, r3 and ps2. Notogastral fissures im and ip present; fissure im posterior to the setae te and ip lateral to the seta ps2 in position. Area porosa absent. Dorsosejugal suture complete.

Epimeral region (Fig. 69):

Apodemata I (apo I) small, fused with the lateral margin of the gnathsoma, apodemata II well developed, whilst apodemata III short and laterally situated. Apodemata IV

aosent. The apodemata sejugales extended to their full lengtn and connected medially with the anterior margin of the perigenital ring (pgr). Epimeral region foveolated. The setal formula of the epimerata I-IV is 3-2-3-2. All epimeral setae are short and poorly barbed. Setae 1c and 4b are inserted ventrally on the pedotecta I and discidium, respectively. Circumpedal ridges well developed, extend from the border of the ventral plate upto the anterior margin of the pedotecta I.

Ano-genital region (Fig. 69):

Genital aperture surrounded by a weakly sclerotised perigenital ring (pgr). Genital plates with six pairs of short setae, one pair of aggenital setae are postero-lateral to genital aperture, two pairs of anal and two pairs of adanal setae present. Adanal setae are longer than anal setae. Adanal fissure (iad) antero-lateral to anal aperture. Anal and genital plates areolated.

Gnathosoma (Figs. ~~70~~, 70a):

The labial-genal articulation complete (diarthrodial); pedipalp five segmented, and the setal formula of the pedipalp is 0-2-1-3-9 (including the fused acroculminal-seta). Solenidia of palpal tarsus fused with the acroculminal seta (acm) thus forming 'corne double' (c.f Coetzer, 1967). Rutellum (Ru) strong and trinotched and darkly sclerotized. Chelicerae strong and dentate. Cheliceral setae barbed, and

cha longer than chb. Area porosa present on the chelicerae. Infracapitular setae (a,m) and hypostomal setae (h) are barbed. Hypostomal region finely foveolated.

Legs (Figs. 71, 72, 73 and 74):

All legs tridactyle and heterodactylous, median claw much thicker than the lateral ones. Trochanter of legs I and II small, without area porosa, whilst the trochanter III-IV well developed and area porosa present. Area porosa present on all leg femur. The chaetotaxy of legs I-IV is given in the following table (Table V.14).

Table V.14: Chaetotaxy of legs I-IV of Chaunoproctus alveeolata

Leg	T	Fe	G	T1	TA
I	1	5	3(1)	4(2)	18(2)
II	1	5	2(1)	4(1)	15(2)
III	1	3	2(1)	3(1)	15
IV	1	3	2	3(1)	12

Note: Figures in parenthesis denote the number of solenidion.

Type data: Holotype - Adult female, from moss, Narhar (near Pilani), 12.8.1969. Paratypes: 16 specimens, same data as holotype; three specimens from Mandore Garden (Jodhpur), 24.3.1968.

Discussion:

The new species Chaunoproctus alveolata exhibits a close resemblance to C. crinitus Karpinnen and C. papillata Balogh (both African species) in having the club-shaped notogastral setae and aveolate nature of the dorsal surface of notogaster. The new species, however, is easily distinguishable from them and the other known species of the genus Chaunoproctus by the following characters:

(1) presence of six pairs of notogastral setal alveoli,

(2) ratio between the length of interlamellar and notogastral hairs is about 2.1 as against 1.5 in C. crinitus and 0.8 in C. papillata,

(3) interspace between the lamellae devoid of reticulation,

(4) presence of a pair of chitinous ridges extending from the translamella towards the proximal region of the prodorsum,

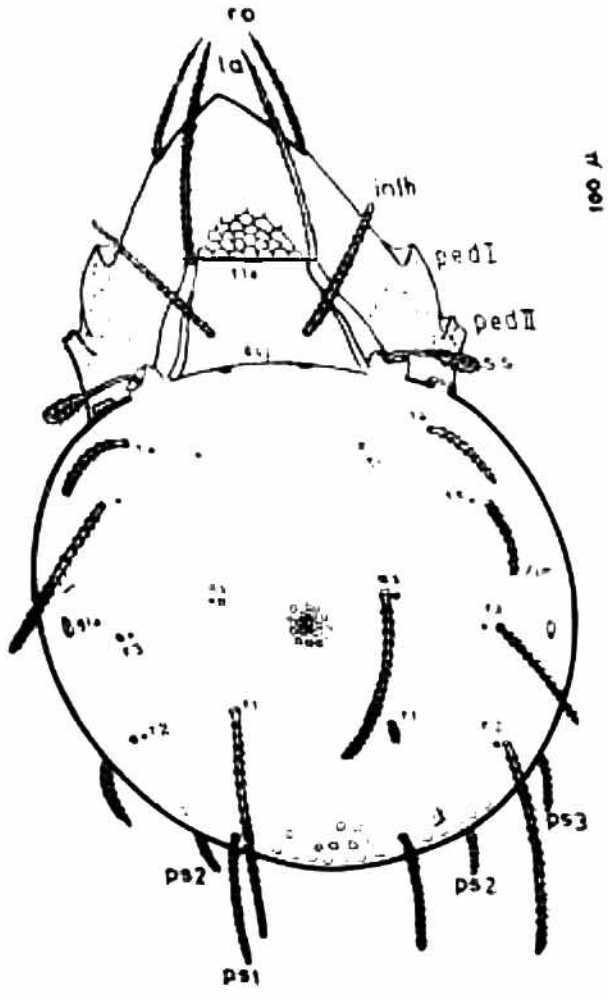
(5) discidium with a transverse ridge,

(6) all notogastral setae not equal in length, setae ps1 and ps2 short, and

(7) chaetatoxy of legs I-IV is 18-15-15-12.

45. Chaunoproctus longisetosus sp.nov.

Color: Dark-brown. Measurements: Total length of the body - 770; length of prodorsum - 260, length of notogaster - 51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la
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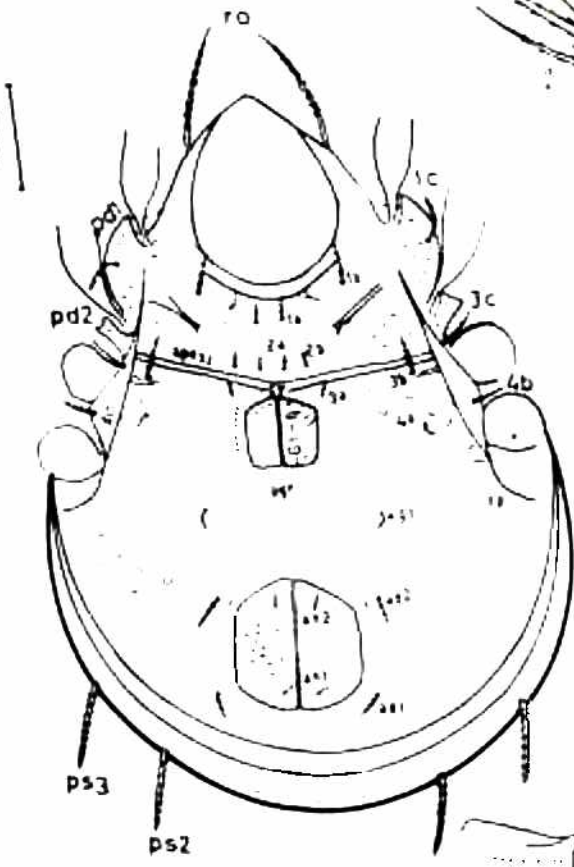
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3c
4b
ps3
ps2

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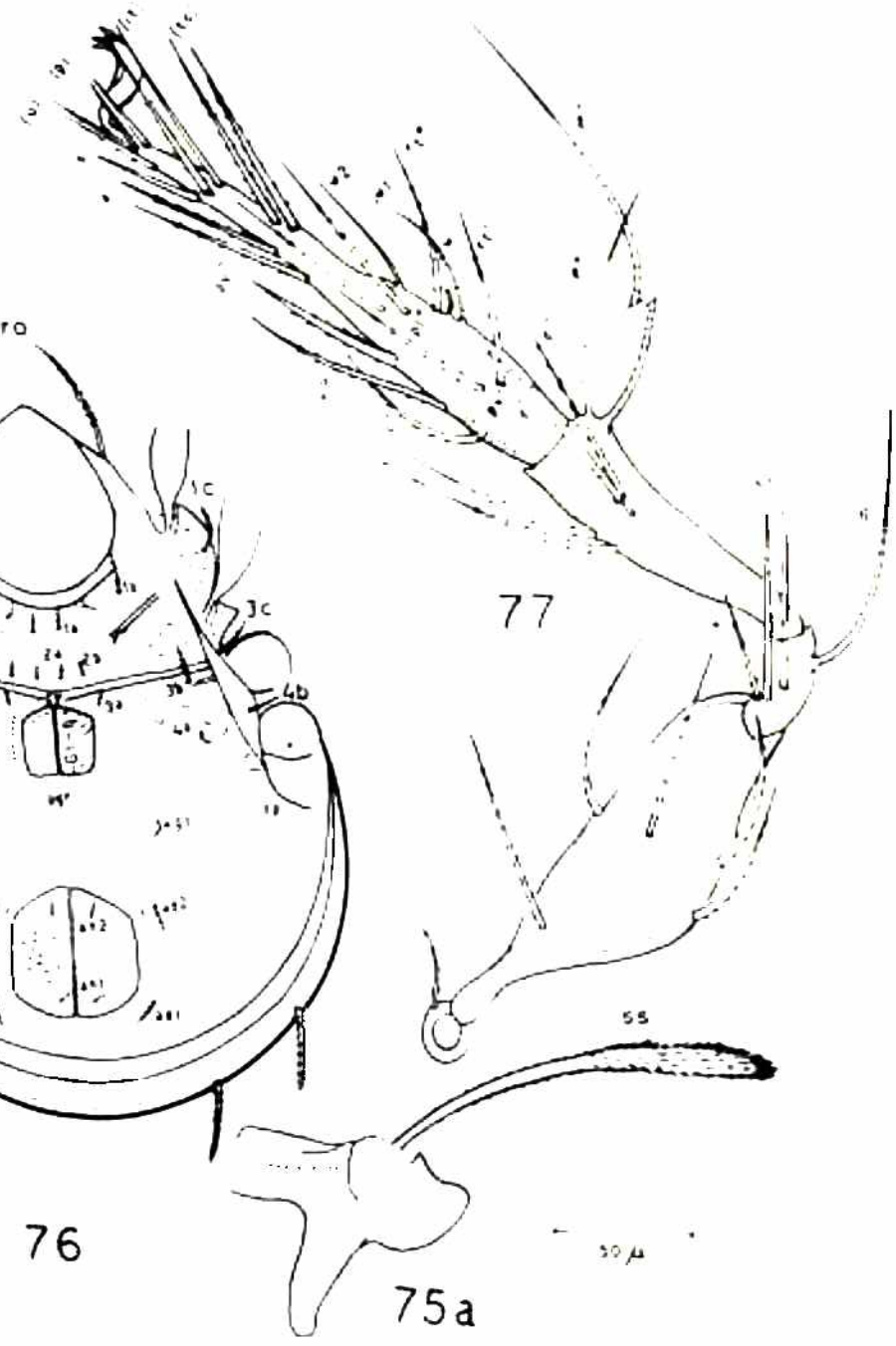
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ss
50 µ

75a

Prodorsum (Figs. 75, 75a):

Rostrum broadly conical, rostral setae (150μ) inserted lateral to the rostrum, slightly curved inwards and are as long as interlamellar hairs. Lamellar hairs (200μ) longer than the remaining prodorsal setae and are inserted on the lamellar apophyses. Lamellae broader posteriorly, convergent and devoid of lamellar cusps. Bothridia cup-like, sensilli with a long stalk and barbed clavate head. Polygonal reticular structures present on the anterior region of the prodorsum. Translamella and tutorium present. Pedotecta I well developed, pedotecta II small; discidium without a transverse ridge and is situated in between the legs III and IV. Lateral region of the prodorsum with papillae.

Notogaster (Fig. 75):

Notogaster rounded, lateral borders of the notogaster strongly chitinized; dorosejugal suture (dsj) complete, but medially less sclerotized. With 10 pairs of long and densely barbed setae, all setae not equal in length. Setae v1 and v2 (250μ) much longer than the remaining notogastral setae. Seta ta shorter than ps1, and as long as ps2 and ps3. Notogastral fissures ia, im and ip are as shown in figure. Dorsal surface of the notogaster areolated, whilst the peripheral region of the notogaster foveolate. Five pairs of setal alveoli present.

Epimeral region (Fig. 76):

Apodemata I fused with the lateral margins of the gnathosoma as in other chaunoproctids. Epimeral ridges of apodemata II well developed, whilst apodemata III very short and laterally situated. Apodemata IV absent. Apodemata sejugales (aposj) abut the anterior margin of the perigenital ring. The setal formula of the epimerata I-IV is 3-2-3-2; of which, setae 1a, 2a, 2b, 3a and 4a are short. All epimeral setae barbed. Circumpedal ridges well developed stretching from a short distance from the border of the ventral plate to pedotecta 1. Epimeral plates finely foveolated.

Ano-genital region (Fig. 76):

Genital plates with six pairs of short setae; one pair of aggenital setae, two pairs of anal and two pairs adanal setae. Adanal setae longer than other ano-genital setae. The perigenital ring present. The adanal fissure (iad) antero-lateral to the anal aperture in position. Both anal and genital plates areolated.

Gnathosoma:

Labial-genal articulation complete and hence diarthrodial. Pedipalp five segmented, and the setal formula is 0-2-1-3-9 (including the fused acroculminal seta). Solenidion of the palpal tarsus fused with the acroculminal

seta (acm) as in C. alveolata. Chelicerate strong and dentate. Cheliceral setae cha longer than chb and are serrate. The other characters of gnathosoma are same as in C. alveolata.

Legs (Fig. 77):

All legs tridactyle and heterodactylous. The lateral claws with a small inner tooth. Chaetotaxy of legs I-IV as given in the following table (Table V.15).

Table V.15: Chaetotaxy of legs I-IV in C. longisetosus

Legs	Tr	F	G	Tl	TA
I	1	5	3(1)	4(2)	20(2)
II	1	5	2(1)	4(1)	12(2)
III	1	3	1(1)	3(1)	15
IV	1	2	2	3(1)	12

Note: Figures in parenthesis denote the number of solenidion.

Type data: Holotype: Adult female, from moss, Mt. Abu, 28-10-1969. Paratype: Three adult females, same data as holotype.

Discussion:

The new species, Chaunoproctus longisetosus, is easily distinguishable from the known species of the genus

by the combination of the following characters:

(1) the notogastral setae unusually long, of which the seta r1 and r2 are much longer than the other notogastral setae; seta ta shorter than ps1 and about as long as ps2 and ps3,

(2) lamellar setae much longer than the rostral and interlamellar hairs,

(3) dorsosejugal suture complete and medially less sclerotized,

(4) discidium without transverse ridge,

(5) interspace between the lamellar devoid of chitinous ridges,

(6) lamellar cusps absent, and

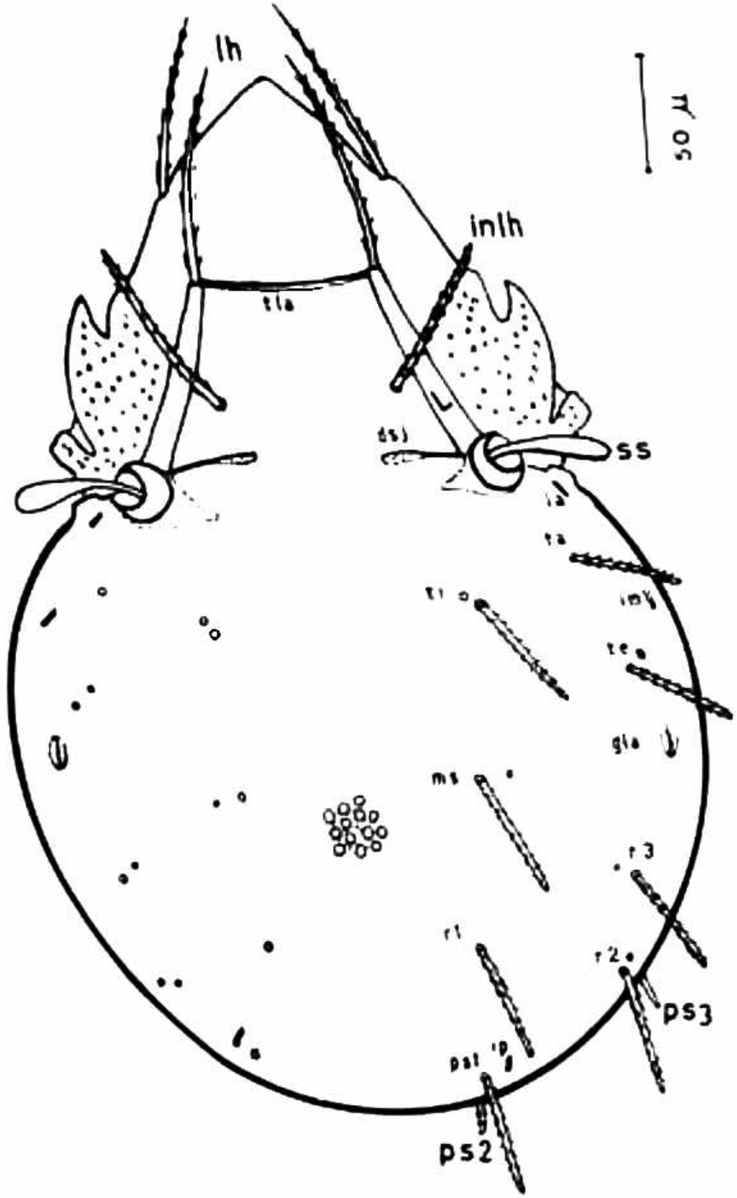
(7) the chaetotaxy of leg tarsi I-IV os 20-15-15-12.

46. Chaunoproctus pilanica sp.nov.

Color: Dark-brown. Measurements: Total length of the body - 480; length of prodorsum - 170, length of notogaster - 310.

Prodorsum (Fig. 78):

Rostral setae (80μ) directed anteriorly, as long as interlamellar hairs, shorter and thinner than the lamellar hairs. Lamellar hairs (98μ) longer than other prodorsal



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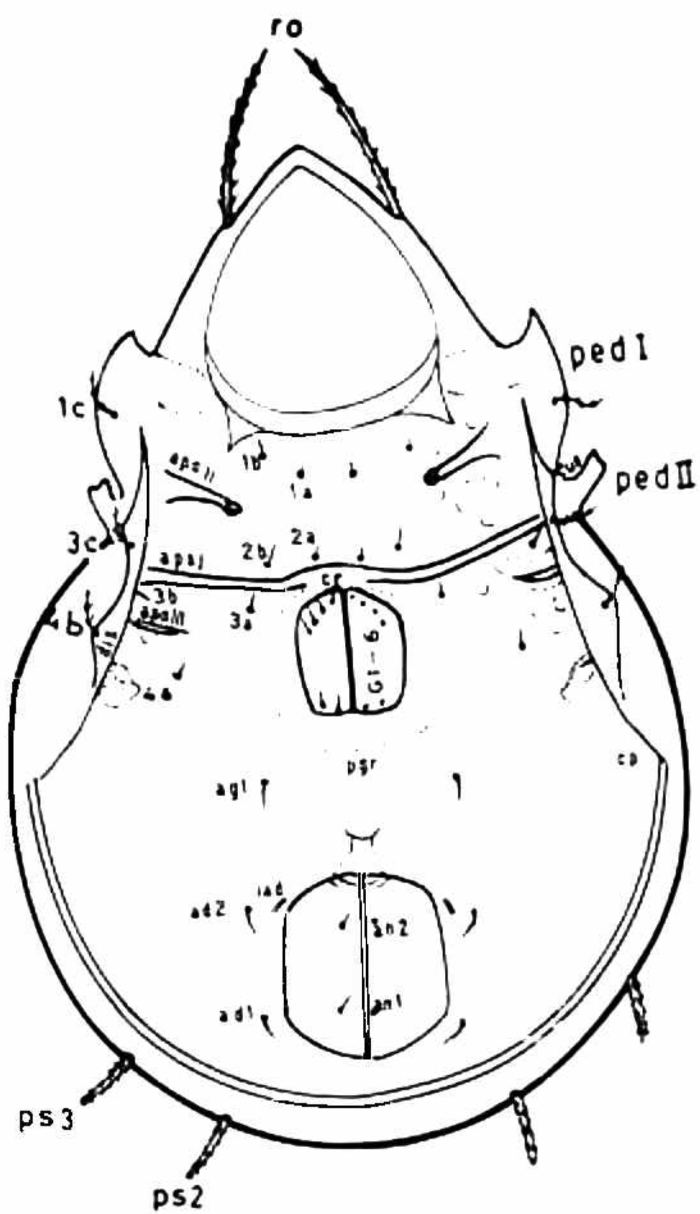


79

hairs, and are inserted at the tips of the lamellar apophyses. Interlamellar hairs are uniformly thick and the anterior tip not pointed. All prodorsal hairs strongly barbed. Lamellae ribbon like, broader posteriorly, covering anteriorly and occupies half the distance of the prodorsum. Sublamellae and lamellar cusps absent. A distinct translamella present connecting the lamellae. Tutorium present. Bothridia cup-like, sensilli (ss) with a thin stalk and barbed clavate head.

Pedotecta I well developed, pedotecta II small and discidium without transverse ridge. Lateral region of the prodorsum papillaformes and anterior region of the prodorsum reticulated as in C. longisetosus and C. alveolata.

Notogaster (Fig. 78):

Notogaster rounded, densely areolated dorsally and the peripheral region foveolate. With 10 pairs of notogastral setae, all setae equal in length (50-60μ) except the posterior ps2 and ps3 setae which are slightly smaller (30μ). Five pairs of setal alveoli are present accompanying the setae ti, te, ms, r2 and r3. Notogastral fissures im and ip and abdominal gland (gla) are present, and their positions as shown in figure. Dorsosejugal suture (ds1) incomplete medially. A pair of tubercles present on each shoulder.

Epimeral region (Fig. 79):

Epimeral region fairly foveolated. Apodemata I small and fused with the postero-lateral margins of the gnathosoma. Apodemata II well developed and apodemata III small and laterally situated. Apodemata IV absent. Apodemata sejugales (aposj) fused medially with the anterior border of the perigenital ring. Setal formula of the epimerata I-IV is 3-2-3-2, as found in other chaunoproctid mites.

Ano-genital region (Fig. 79):

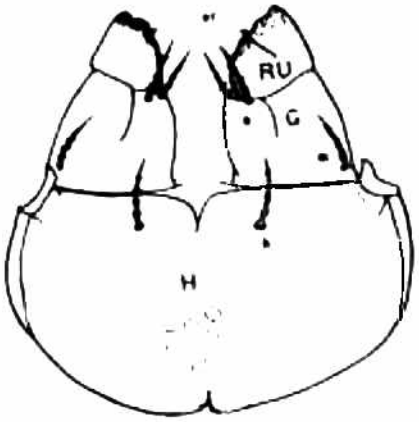
With six pairs of genital setae, one pair of aggenital, two pairs of anal and two pairs of adanal setae. Adanal fissure (iad) antero-lateral to the anal aperture. Adanal setae longer than the anal and genital setae. A darkly sclerotized perigenital ring (pgr) is present encircling the genital orifice.

Gnathosoma (Figs. 79a-c):

Pedipalp five segmented and the setal formula is 0-2-1-3-9. Solenidia of palpal tarsus associated with acroculminal seta (acm). Cheliceral setae cha and chb are barbed. Hypostomal region foveolated.

Legs (Figs. 80a-d):

All legs tridactyle and heterodactylous; the median claw stronger than the laterals. The chaetotaxy of legs



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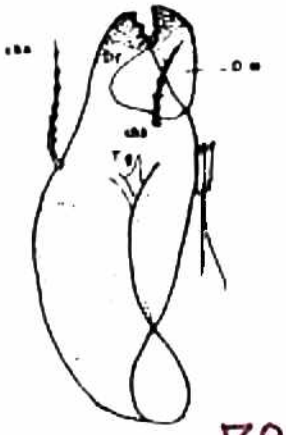

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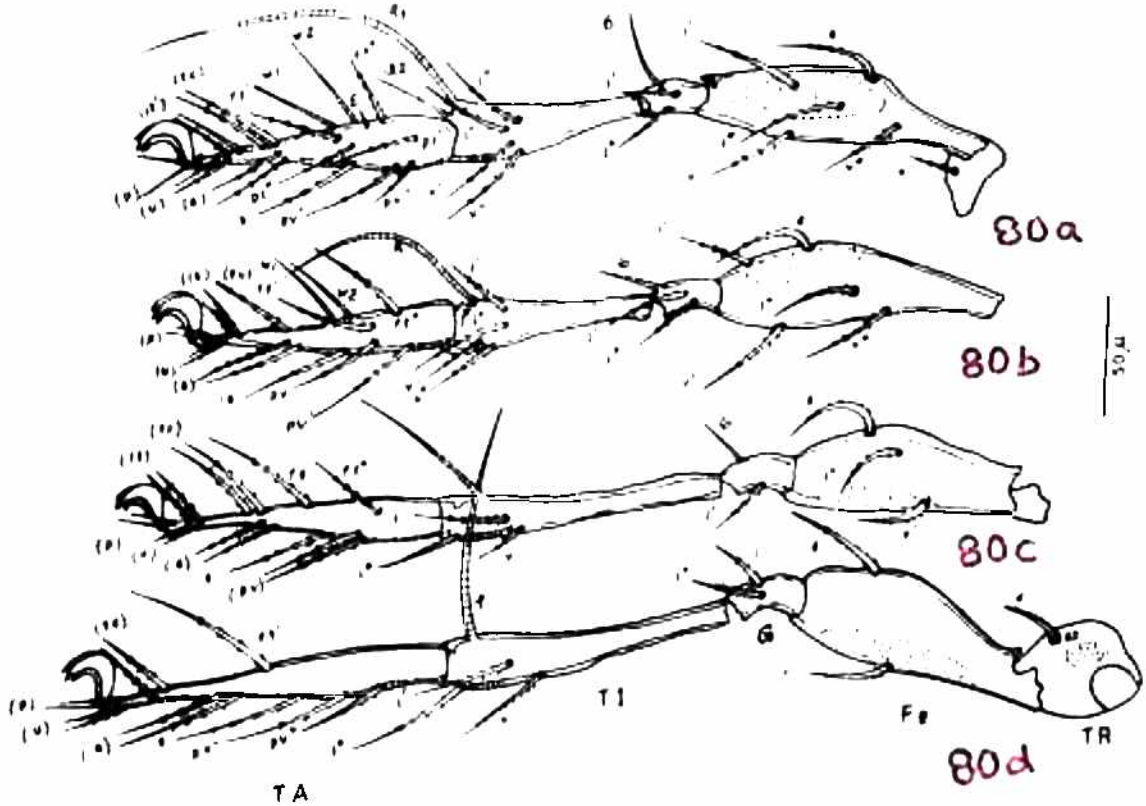


I-IV is given in the table (Table V.16).

Table V.16: Chaetotaxy of legs I-IV in C. pilanica

Leg	T	Fe	G	Tl	TA
I	1	5	3(1)	4(2)	18(2)
II	1	5	2(1)	4(1)	15(2)
III	1	3	1(1)	3(1)	15
IV	1	2	2	3(1)	12

Note: Figures in parenthesis denote the number of solenidion.

Type data: Holotype: Adult female, from moss, Joshi Pond, Pilani, 12-6-1968, Paratypes: Eight specimens, same data as holotype.

Discussion:

The new species Chaunoproctus pilanica is distinguishable from C. longisetosus and other species of the genus by the combination of the following characters:

(1) notogastral setae comparatively shorter than of C. longisetosus; seta ta about as long as ps1 and longer than ps2 and ps3,

(2) dorsosejugal suture incomplete medially,

(3) lamellar cusps and sublamellae absent, and

(c) chaetotaxy of legs I-IV is 18-15-15-12.

Key for the identification of the Indian species of the genus Chaunoproctus described in the present study:

1. Notogastral hairs club-shaped, sublammelar ridges present, discidium with a transverse ridge, dorsosejugal suture complete ..... C. alveolata

   Notogastral hairs not club-shaped, sublamellar ridges absent, discidium without transverse ridge, dorsosejugal suture either complete or incomplete 2

2. Dorsosejugal suture complete, notogastral hairs long and densely barbed, seta ta shorter than ps1 and as long as ps2 and ps3. Setae r1 and r2 longer than other notogastral setae. Chaetotaxy of leg tarsi I-IV 20-15-15-12 ..... C. longisetosus

   Dorsosejugal suture incomplete, notogastral hairs comparatively short, seta ta as long as ps1 and longer than ps2 and ps3, hysterosomal setae r1 and r2 about as long as the median and lateral notogastral setae. Chaetotaxy of leg tarsi I-IV is 18-15-15-12 ..... C. pilanica

XXI. HAPLOZETIDAE Grandjean, 1936

The members of the family Haplozetidae are characterised by the presence of triangular pteromorphae

which are movably hinged to the notogaster and genital plates each with 5-6 pairs of setae (rarely with four). Balogh (1961) differentiated the known genera of this family mainly on the number of notogastral, genital and aggenital setae, nature of dorsosejugal suture and in the number of claws present on the leg tarsi.

The family Haplozetidae is represented by two distinct forms in the present collection. One form belong to the genus Peloribates Berlese, 1908 while the other forms possess certain interesting features and differ from all the known genera of this family. For these forms a new genus is erected to accommodate them in the family Haplozetidae.

Genus: Peloribates Berlese, 1908

Parazetes Willmann, 1930

Euryparazetes Radford, 1950

The genus Peloribates was first erected by Berlese (1908) with Oribata peloptoides Berlese, 1888 as the type. Baker and Wharton (1952) regarded the genera Parazetes Willmann, 1930 and Euryparazetes Radford, 1950 as the synonyms of the genus Peloribates.

The diagnostic features of the genus Peloribates are: Notogaster with 13-14 pairs of setae; with five pairs of genital, one pair of aggenital, two pairs anal and three pairs of adanal setae; Pteromorphs broadly triangular and

movably hinged to the notogaster, with three pairs of sacculi present. Legs tridactyle.

The following is the only species of the genus Peloribates represented in the present collection.

47. Peloribates nudus Hammer, 1958

The species P. nudus was described by Hammer (1958) from Andes Mountain (South America).

Species examined here agree in all characters with P. nudus described by Hammer. The important characters of the species are as follows:

Hysterosoma as long as its width, with 14 pairs of setal alveoli (setae not discernible), three pairs of sacculi, pteromorphae movably hinged to the hysterosoma, triangular in shape, dorsal surface of the pteromorpha finely striated, and punctate. Lateral sides of the hysterosoma at the attachment of the pteromorphae consists of numerous brown spots of a cellular structure, (c.f Hommer, 1958). Lamellar, interlamellar and rostral hairs fairly long and barbed; lamellae present and translamella absent. Legs monodactyle and monotypical.

Known distribution: South America. This is the first record of this species from India.

Material examined: Six adult females from litter, under Nerium plant, Botanical Garden, B.I.T.S. Campus, Pilani.

Genus: Pynoribates gen.nov.

Diagnosis: Lamellae broad, tapering anteriorly and devoid of lamellar cusps, translamella absent; lamellar and interlamellar hairs short, shorter than rostral hairs, all prodorsal setae except exobothridial setae barbed; bothridia partially covered by lateral margin of the dorsosejugal suture; sensillus with a long stalk and filiform head; tutorium and translamella absent; dorsosejugal suture deeply arched; ptero-morphae broadly triangular in shape, movably hinged to notogaster; with 10 pairs of short and smooth notogastral setae, three pairs of sacculi, three pairs aggenital, six pairs of genital, three pairs of adanal and two pairs of anal setae; cerotegument covering the dorsal surface and ventral region of the body with rounded micropapillae; legs monodactyle and femur I not keeled. Type species: Pynoribates indicus sp.nov.

The following is the description of the type species of the genus Pynoribates.

48. Pynoribates indicus gen.nov and sp.nov.

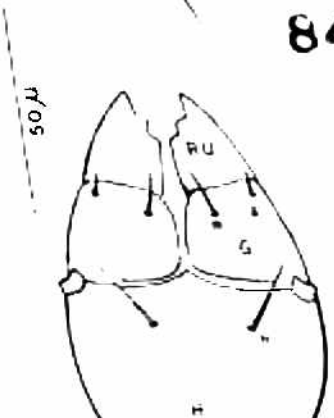
Color: Yellow-brown. Measurements: Total length of the body - 520; length of prodorsum - 110, length of notogaster - 410.

Prodorsum (Fig. 81):

Rostrum broadly rounded anteriorly, rostral setae (ro) situated dorso-lateral to the rostrum and longer than other prodorsal setae (40μ). Lamellae broader posteriorly, tapering anteriorly, slightly convergent and the anterior tips of the lamellae are bent towards the lateral margin of the prodorsum. Lamellar cusps and translamella absent. Lamellar hairs (lh) dorsomedially situated, short, strongly curved and are about as long as interlamellar hairs (30μ). Interlamellar hairs (inlh) are posterior to the lamellar hairs in position and the distance between the lamellar hairs lh-lh is equal to the distance between lh-inlh. Exobothridial setae very short, smooth and thinner than rostral hairs and are situated postero-lateral to bothridium. Bothridia cup-like, partly covered by lateral margins of dorsosejugal suture. Sensillus long, with a long stalk and filiform sensillar head which are barbed laterally (Fig. 81a).

Pedotecta I well developed, pedotecta II (ped.II) short, discidium (dis) present in between the legs II and III. The dorsal and ventral surface of the body covered by

84a



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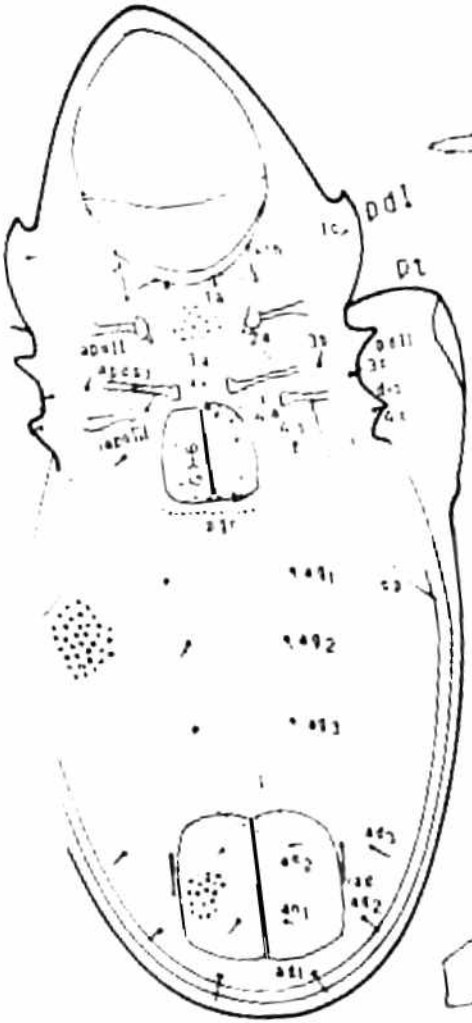
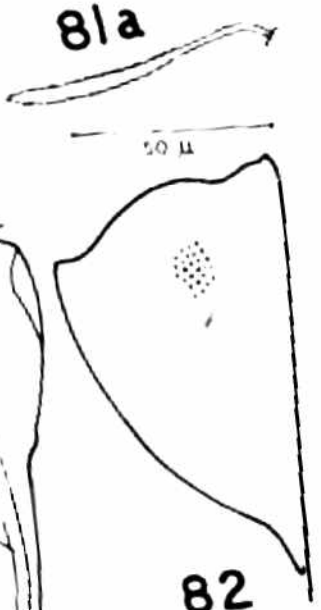
81





82

85

83

thin cerotegument which is markedly papillate.

Notogaster (Figs. 81, 82):

Hysterosoma four times longer than prodorsum. Dorsosejugal suture (dsj) deeply arched. The anterior borders of the pteromorphs are bilobed, with a small medial and large lateral lobes (Fig. 81b). Pteromorphae broadly triangular in shape, ventrally curved and movably hinged to the notogaster. Dorsal surface of the pteromorphs with fine and radiating striae. There are 10 pairs of short and smooth notogastral setae. Seta ta situated dorso-laterally on the anterior region of the notogaster and not on the pteromorphae. Three pairs of notogastral fissures (ia, im and ih) and three pairs of sacculi (sa, s1 and s2) are present. The positions of fissures and sacculi are shown in figure. The dorso-lateral surface of the notogaster in between the setae ta and ti is fenestrated with reticular network. The peripheral region of the notogaster foveolated.

Epimeral region (Fig. 83):

Apodemata I fused with the postero-lateral margin of the gnathosoma, apodemata II (apo-II) fairly developed laterally situated and never meet at the median sternal ridge. Apodemata III (apo.III) relatively shorter than apo-II and the epimeral ridges of apodemata sejugales (aposj) well developed and almost abut the antero-lateral margin of the

perigenital ring (pgr). The setal formula of the epimerata I-IV is 3-1-3-3. Seta 3a are closely inserted to each other on the median region of the sternal plate. Coxisternal plates finely foveolated.

Ano-genital region (Fig. 83):

A darkly sclerotized perigenital ring is present encircling the genital aperture. Genital plates with six pairs of short and barbed setae. There are three pairs aggenital setae present on the ventral plate in between the genital and anal apertures. The relative distance between the aggenital setae ag1-ag1 > ag2-ag2 ≥ ag3-ag3. Anal plates almost rectangular in shape, two pairs anal and three pairs of adanal setae present. The genital and anal plates punctate and also with foveolate scrolls. Adanal setae longer than anal setae.

Gnathosoma (Figs. 84, 84a and 84b):

The labial-genal articulation complete and hence diarthrodial (Fig. 84). Hypostomal setae (h) longer than other infracapitular setae (a and m). Chelicerae strong and dentate. Cheliceral setae cha longer than chb and are barbed. The weakly sclerotized organ of Trägardh (Tg) is cone-shaped. Pedipalp five segmented and the setal formula is 0-2-1-3-9 (including the fused acroculminal seta). The acroculminal seta (acm) of the palpal tarsus fused with the

ventrally bending solenidia, thus forming 'corne double'. The ventral region of the gnathosoma punctate.

Legs (Fig. 85):

All legs short, with a single and strongly bent claw. Femur of leg I devoid of keel whilst of leg II-IV are with ventral keel. The chaetotaxy of legs I-IV is given in the following table (Table V.17).

Table V.17: Chaetotaxy of legs I-IV in P. indicus

Leg	T	Fe	G	TI	TA
I	1	5	3(1)	4(2)	19(2)
II	1	5	2(1)	4(1)	15
III	1	3	1(1)	3(1)	14
IV	1	2	2	3(1)	12

Note: Figures in parenthesis denote the number of solenidion.

Type data: Holotype - Adult female, from moss, Mt. Abu, 28-10-1969. Paratypes - Seven females, same data as holotype.

The generic name is derived from and in honor of Mrs. Payne (Rhodesia) for her kind help in procuring the literature.

Discussion:

The new genus Pynoribates is provisionally placed under the family Haplozetidae because of the presence of:

(1) a broadly triangular pteromorphae which are movably hinged to hysterosoma, and

(2) in the presence of six pairs of genital setae.

Pynoribates exhibit a close resemblance to Pilobates Balogh, 1960 with the following characters:

(1) three pairs of aggenital setae,

(2) six pairs of genital setae, and

(3) a single claw on all leg tarsi.

Pynoribates differs from the genus Pilobates in the presence of:

(1) only 10 pairs of notogastral setae,

(2) area porosae absent and instead three pairs of sacculi present,

(3) translamellae absent, and

(4) notogastral seta ta situated dorso-laterally on the notogaster and not on the pteromorphae as is not the case with all Laplozetids.

The comparison of the main characters of the new genus Pynoribates with that of Pilobates are given in the following table (Table V.18).

Table V.18: Comparison of the main characters between the new genus Pynoribates and Pilobates Balogh, 1960

Characters	Pilobates	Pynoribates
Notogastral setae	14 pairs	10 pairs
Sacculi	absent	present/3 pairs
Areae porosae	present/3 pairs	absent
Translamella	present	absent
Location of tla	on the dorsal surface of ptero-morpha	dorso-laterally situated on notogaster, and not on ptero-morpha
Genital setae	6 pairs	6 pairs
Aggenital setae	3 pairs	3 pairs
Legs	monodactyle	monodactyle
Pteromorphae	triangular and movably hinged	triangular and movably hinged

B. GENERAL REMARKS

Rajasthan desert is delineated climatologically into four different zones; the arid, semi-arid, humid and sub-humid (Krishnan, 1968). The biotopes surveyed for the present investigation of oribatids include all the above zones (Fig. 1). Table II gives, in general, the soil types and vegetation of the localities surveyed. The faunal composition of oribatids is given in Table V.19.

The extreme climate of Rajasthan desert, characterized by high solar radiation, extreme variation (both diurnal and seasonal) of temperature and rainfall throughout the year play a greater role in modifying the vegetation (Joshi, 1951). This in turn, is also true to the occurrence of Oribatid fauna. When, on the basis of the Table V.19, the Oribatid fauna of the arid area (especially Bikaner) is compared with the very rich fauna of humid region (Mt. Abu), it is remarkable what the climate and the vegetation means to the microfauna in general and Oribatids in particular.

Bikaner, the western district of Rajasthan, which is surrounded by the desert and has an average annual rainfall never exceeding 50 cms, only 14 individuals representing three species were found in 36 samples. Mt. Abu which is situated 1,727 metres above sea level and records a rainfall of more than 150 cms per year, about 258 individuals representing 18 species were found in 70 samples. While the localities surveyed from semi-arid and sub-humid

regions a total of 389 and 36 individuals representing 31 and 3 species were found in about 500 and 25 samples, respectively.

It is evident from the table (Table V.19) that the species representation is very poor in certain semi-arid localities viz. Narhar (two species), Jaipur (one species), Ajmer (two species), Udaipur (3 species) and Chittorgarh (one species). It reveals that the dry desert air and the low moisture retaining capacity of the soil in semi-arid and arid regions inhibit the growth of mosses and ground vegetation and hence the low population of oribatid mites. It is interesting to mention that the soil samples collected from wet moss and from litter under shade resulted in collection of greater number of specimens and in the complexity of species too. A record of 18, 17 and 12 species were represented from Mt. Abu, Pilani and Jodhpur, respectively. Thus, it may be inferred that the oribatid mites have wide distribution in wet biotopes, while the fauna in the dry biotopes has a poor and independent development (Table V.19).

Of the 48 species recorded, Scheloribates angulatus Hammer, S. chauhani Baker, S. confusia Coetzer, Galumna flabellifera Hammer; Epilohmannia cylendrica (Berl.) and Brachychthonius semiornatus rajasthanicus are widely distributed (occurring in more than 3 localities) in Rajasthan soils.

The species, Scapharemaeus mathurensis, Xenillus umaensis, Basilobelba retiarius (Warb.), B. africana Wallwork, Striatoppia aokii, Chaunoproctus spp., Papillacarus spp., and Haplacarus semifoliatus seems to be restricted to drier zones, while the Allonothrus spp., Nothrus spp., are usually found in the water boggy places.

It is interesting to note that Allonothrus monodactylus Wallwork, Allonothrus russeolus Wallwork, Lamellobates palustris Hammer and L. (P.) bengalensis Bhaduri and Raychaudhuri reported from Calcutta are also found in Rajasthan. The Scheloribates chauhani Baker and Galumna tessellata reported from Uttar Pradesh and South India, respectively are not only present but are abundant in Rajasthan soils. Due to the paucity of literature on Indian oribatids, further comparison of the Rajasthan fauna with that of other parts of India is hardly possible.

The livestock population is larger in Rajasthan state as compared to other states in India, which contributes about 9.9 per cent to the country's total livestock wealth of about 33.5 million heads (Misra, 1967). Of the total livestock, Rajasthan accounts for about 18.2 per cent sheep (Misra, 1967). The fact that Anoplocephalid cestodes are great hazardous to sheep and only oribatid mites are the intermediate hosts and vectors of various sheep tapeworms, it is suggested that a complete faunistic survey and a detailed study on their ecology and biology of these

oribatid mites and their control should be undertaken by future workers.

Taole V.19. Faunal composition of Oribatids in the biotopes surveyed

Species	Semi-arid							Arid		Sub-Humid	Humid
	Pilani	Narhar	Khetri	Jaipur	Ajmer	Udaipur	Chittor-garh	Bikaner	Jodhpur	Sirohi	Mt. Abu
1. Aphelecarus acarius (Berl.)	+	-	-	-	-	-	-	-	-	-	-
2. Brachychthonius cristatus sp.nov.	-	-	-	-	-	-	-	-	-	-	+
3. B. semiornatus rajasthanicus ssp.nov.	+	-	-	-	-	-	-	-	+	-	+
4. Haplochthonius nudatus sp.nov.	-	-	+	-	-	-	-	-	-	-	-
5. Cosmochthonius areolatus sp.nov.	+	-	-	-	-	-	-	-	-	-	-
6. Dichthonius lanceolatus sp.nov.	+	-	-	-	-	-	-	-	-	-	-
7. Hoplophorella noveus Jacot	-	-	+	-	-	-	-	-	-	-	-
8. H. scaphellata Aoki	-	-	+	-	-	-	-	-	-	-	+
9. Hoplophthiracarus histricinus Jacot	-	-	-	-	-	-	-	-	+	-	-
10. H. siamensis Aoki	-	-	-	-	-	-	-	-	+	-	-
11. H. nepalensis Sheals	+	-	-	-	-	-	-	-	-	-	+
12. H. hardingii sp.nov.	-	-	-	-	-	-	-	-	-	-	+
13. Rhysotritia ardua (Koch)	-	-	-	-	-	-	-	-	+	-	-
14. R. clavata Markel and Meyer	-	-	-	-	-	-	-	-	-	-	+
15. Eoilohmannia cylendrica (Berl.)	+	-	+	-	-	-	-	-	-	-	+
16. E. pallida Wallwork	+	-	+	-	-	-	-	-	-	-	-
17. Annectacarus asymmetricus sp.nov.	-	-	-	-	-	-	-	-	-	-	+
18. Haplacarus semifoliatus sp.nov.	-	-	-	-	-	-	-	+	-	-	-
19. Papillacarus khandavallensis sp.nov.	+	-	-	-	-	-	-	-	-	-	-
20. P. naraharensis sp.nov.	-	+	-	-	-	-	-	-	-	-	-
21. Nothrus biciliatus (Sevnick)	-	-	-	-	-	-	-	-	+	-	-
22. Allonothrus jodhpurensis sp.nov.	-	-	-	-	-	-	-	-	+	-	-
23. A. monodactylus Wallwork	-	-	+	-	-	-	-	-	-	-	-
24. A. russeolus Wallwork	-	-	+	-	-	-	-	-	+	-	-
25. Trimalaconothrus chittorensis sp.nov.	-	-	-	-	-	-	+	-	-	-	-

Table V.19 (Contd.)

Species	Semi-arid							Arid		Sub-Humid	Humid
	Pilani	Narhar	Khetri	Jaipur	Ajmer	Udaipur	Chittor-garh	Bikaner	Jodhpur	Sirohi	Mt. Abu
29. B. retiarus (Warb.)	-	-	-	-	-	-	-	-	-	-	+
30. Xenillus umaensis sp.nov.	-	-	-	-	-	-	-	+	-	-	-
31. Oppia abuensis sp.nov.	-	-	-	-	-	-	-	-	-	-	+
32. O. yodai Aoki	+	-	-	-	-	-	-	-	-	-	-
33. Multioppia wilsoni Aoki	-	-	+	-	-	-	-	-	-	-	-
34. Striatoppia aokii sp.nov.	-	-	+	-	-	-	-	-	-	-	-
35. Scapheremaeus mathurensis sp.nov.	-	-	-	-	-	-	-	-	-	-	+
36. Lamellobates palustris Hammer	+	-	-	-	-	-	-	-	-	-	-
37. L. (P.) bengalensis Bhaduri ← Roychaudhuri	+	-	-	-	-	+	-	-	-	-	-
38. Galumna flabellibera Hammer	+	-	-	-	-	-	-	-	+	+	-
39. G. tessellata Jacot	+	-	-	-	-	-	-	-	-	-	+
40. Scheloribates angulatus Hammer	+	-	-	-	+	-	-	-	-	+	+
41. S. chauhani Baker	+	-	-	-	-	+	-	-	+	-	+
42. S. confusia Coetzer	-	-	-	+	+	-	-	+	-	+	-
43. S. natalensis Pletzen	-	-	-	-	-	-	-	-	-	-	+
44. Chaunoproctus alveolata sp.nov.	-	+	-	-	-	-	-	-	+	-	-
45. C. longisetosus sp.nov.	-	-	-	-	-	-	-	-	-	-	+
46. C. pilanica sp.nov.	+	-	-	-	-	-	-	-	-	-	-
47. Peloribates nudus Hammer	+	-	-	-	-	-	-	-	-	-	-
48. Pynoribates indicus sp.nov.	-	-	-	-	-	-	-	-	-	-	+

Note: The mark (+) denotes the occurrence of the species.

VI. SUMMARY

Studies on the systematics of Oribatid mites of Rajasthan form the main theme of the thesis. Oribatid mites show a very wide range of distribution and those occurring in the four different climatological zones, namely arid, semi-arid, humid and subhumid zones of Rajasthan, have been studied.

Forty-eight distinct species belonging to 21 families of the order Cryptostigmata are recorded during the present study and their taxonomy has been worked out in detail. Of these, 20 species and one subspecies are new to science and 21 are new records for India, including some new records for Asia. Two new genera and one new subgenus have been erected for the species which could not be accommodated within any of the known genera of the Oribatid system. Under the family Cosmochthoniidae a new genus, Dichthonius, is erected to accommodate the bidactylus cosmochthonoid species D. lanceolatus sp.nov. Under the family Haplozetidae a new genus Pynoribates has been proposed, with P. indicus sp.nov. as the type. A new subgenus Porocarus, under the genus Haplocarus Wallwork has also been proposed for the new species H. semifoliatus.

Taxonomic keys for identification of all species of the genus Allonothrus and for the three new species

described under the genus Chaunoproctus have been presented.

Of the oribatid species studied, Scheloribates angulatus Hammer, S. chauhani Baker, S. confusia Coetzer, Galumna flabellifera Hammer and Epilohmannia cylendrica (Berl.) are widely distributed in Rajasthan soils. Scapharemaeus mathurensis sp.nov., Xenillus umaensis sp.nov., Basilobelba retiarius (Warb.), B. africana Wallwork, Striatoppia aokii sp.nov., Chaunoproctus alveolata sp.nov., C. pilanica sp.nov., Papilocarus khandvallensis sp.nov. and P. naraharensis sp.nov. seem to be restricted to drier zones, whilst the species of Allonothrus, Nothrus and Trimalaconothrus are found only in wet biotopes.

In the light of the economic importance of Oribatid mites as tapeworm vectors and fungal spore carriers, it is suggested that a complete faunistic survey of oribatids, their biology, ecology and control studies should be undertaken.

As an adjunct to the systematic studies, and in order to facilitate the interpretation of morphological characters, a description of external morphology is included and taxonomic characters are defined and discussed. Further, a brief review of the classification and systematic position of the order Cryptostigmata is presented, together with a complete review of the faunistic work done in India, and abroad with special referemce to South-East Asia.

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LIST OF ABBREVIATIONS

a	=	anterolateral setae
Aa, Al, Am, Ap, A1, A2, A3	=	area porosae
acm	=	acroculminae seta (Pedipal P)
ad, Ad	=	adanal seta
Ag	=	aggenital plate
Ag, ag1, ag2, ag3	=	aggenital setae
Ah	=	humeral area porosa
Al	=	sublamellar area porosa
an, An	=	anal setae
ap	=	area porosa
apo I, apo II, apo III, apo IV	=	apodemata
aposj	=	apodemata sejugales
b	=	bothridium
bv"	=	antaxial ventral seta of femur
b1, b2	=	notogastral setae
c1, c2, c3,	=	notogastral setae
cp	=	cheliceral setae
cha, chb	=	circumpedal ridge
cp	=	coxisternal ridge
cr		

cus, (cs)	=	custodium
C	=	anterior notogastral segment
d (ds)	=	dorsal setae
da, d1,d2	=	notogastral setae
Df	=	digitus fixus of chelicerae
dis	=	discidium
Dm	=	digitus mobilis of chelicerae
dsj	=	dorsosejugal suture
D	=	notogastral segment
elc	=	lateral coxal spine
ex	=	exobothridial seta
exa	=	anterior exobothridial seta
exb, exp	=	posterior exbothridial seta
e1, e2	=	notogastral seta
E	=	notogastral segment
Fe	=	femur
ft', ft"	=	fastigial setae of legs
f1, f2	=	notogastral setae
F	=	notogastral segment
gla	=	aperture of lateral abdominal gland
G 1-12	=	genital setae
G	=	genu of leg and pedipalpal segment
	=	hypostomal setae (gnathosoma)

h1, h2, h3	=	notogastral setae
H	=	hypostome (gnathosoma)
ia, ih, im	=	notogastral (lyrifissures) fissures
iad	=	adanal fissure
inf	=	inferior seta of femur of pedipalp
inlh	=	interlamellar hair
ian	=	anal fissure
ip, ips	=	notogastral fissures
it', it"	=	iteral setae
ke	=	keel on the femur and trochanter
l	=	lateral setae
lh	=	lamellar setae
la	=	notogastral setae
lm, lp	=	notogastral setae
lt	=	lateral setae (pedipalp)
lr	=	lateral ridge (prodorsum)
mnt	=	"mentoniere" (chin plate)
ms	=	notogastral setae
p	=	proral setae preanal plate
pan	=	pedotecta
ped I, pet II, ped III, pd	=	
pgr	=	perigenital ring
pl',pl",(pl)	=	primilateral setae of leg segments

ps1, ps2, ps3	=	notogastral setae
pt	=	pteromorpha
pv', pv", (pv)	=	primiventral setae of leg segments
r1, r2, r3	=	notogastral setae
ro	=	rostral hairs
s	=	subunginal seta (legs)
sa, s1, s2, s3	=	sacculi
sul	=	subultimal seta (pedipalp)
sup	=	superior seta (pedipalp)
sr	=	sublamellar ridge
ss	=	sensillus
S	=	sublamella (prodorsum)
ta	=	notogastral seta
tc	=	tectal seta (leg segments)
te	=	notogastral seta
Tg	=	organ of Tragardh
ti	=	notogastral seta
tr	=	transverse ridge (prodorsum)
tu	=	tutorium (prodorsum)
TA	=	tarsus
T1	=	tibia
TR, (T)	=	trochanter
tY		transverse ridge

u	=	unginnal setae (leg segments)
ul	=	ultimal setae (pedipalp)
v	=	ventral setae (leg segments)
w, w1, w2	=	solenidion of leg and pelpal segments
1a, 1b, 1c, 1k 2a, 2b, 3a, 3b, 3c 4a, 4b, 4c	=	epimeral setae
φ', φ"	=	solenidion of tibia
6	=	solenidion of genu
ε	=	famulus of tarsus

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EXPLANATION OF FIGURES

Figure 1. Map of Rajasthan State showing different climatic zones and the localities surveyed.

Figure 1b. Modified Tullegren apparatus.

General External Morphology

Figure 2. Somatic divisions of a typical oribatid mite

Figure 3. Dorsum of a typical Oribatei inferiores showing setal terminology of prodorsum and notogaster.

Figure 4. Dorsum of Scheloribates chauhani Baker (Oribatei superiores), showing the presence of Sacculi.

Figure 5. Dorsum of a typical Oribatei superiores (Galumna tessellata) showing setal terminology of prodorsum and notogaster.

Figure 6. Venter of oribatid mite (Scheloribates chauhani Baker) showing epimeral and anogenital regions and setal nomenclature.

Figure 7. Gnathosoma (chelicerae and pedipalp removed).

Figure 8. Pedipalp.

Figure 9. Chelicerae.

Figures 10-13 Chaetotaxy of legs I-IV.

Systematics

Brachychthonius cristatus sp.nov.

Figure 14. Dorsum of female.

Figure 14a. Rostral tectum.

Figure 14b. Notogastral seta (e1).

Figure 14c. Notogastral seta (f1).

Figure 15. Venter of female.

Brachychthonius semiornatus rajasthanicus subsp.nov.

Figure 16. Dorsum of female.

Figure 16a. Trichobothrium.

Figure 17. Venter of female.

Haplochthonius nudatus sp.nov.

Figure 18. Dorsum of female.

Figure 19. Venter of female.

Figure 20. Gnathosoma (chelicerae and pedipalp removed)

Figure 20a. Chelicerae.

Figure 20b. Pedipalp.

Cosmochthonius areolatus sp.nov.

Figure 21. Dorsum of female.

Figure 22. Venter of female.

Figure 22a. Leg I.

Dichthonius lanceolatus gen.nov.,sp.nov.

Figure 23. Dorsum of female.

Figure 23a. Rostral tectum.

Figure 23b. Rostral hair.

Figure 23c. Lamellar hair.

Figure 23d. Trichobothrium.

Figure 23e. Notogastral hair (e1).

Figure 24. Venter of female.

Figure 25. Pedipalp.

Figure 26. Chelicerae.

Figure 27. Leg I.

Figure 28. Leg II.

Figure 29. Leg IV.

Figure 30. Tritonymph.

Hoplophthiracarus hardingii sp.nov.

Figure 31. Lateral view of female.

Figure 31a. Notogastral setae (cp).

Figure 31b. Notogastral seta (ps1).

Figure 31c. Notogastral seta (d1).

Figure 32. Dorsal view of Aspis (prodorsum).

Annectacarus asymmetricus sp.nov.

Figure 33. Dorsum of mite (sex not known).

Figure 34. Venter of mite.

Figure 35. Gnathosoma (chelicerae and pedipalp removed).

Figure 35a. Chelicerae.

Figure 36. Leg IV.

Haplacarus (Porocarus) semifoliatus subgen.nov., sp.nov.

Figure 37. Dorsum of female.

Figure 37a. Dorso-lateral region of prodorsum.

Figure 38. Venter of female.

Figure 39. Leg I.

Papillacarus khandavallensis sp.nov.

Figure 40. Dorsum of female.

Figure 41. Venter of female.

Figure 42. Gnathosoma (chelicerae and pedipalp removed).

Figure 43. Leg I.

Papillacarus naraharensis sp.nov.

Figure 44. Dorsum of female.

Figure 45. Venter of female.

Allonothrus jodhpurensis sp.nov.

Figure 46. Dorsum of female

Figure 47. Venter of female.

Figure 48. Tibia and tarsus of leg I.

Trimalaconothrus chittorensis sp.nov.

Figure 49. Dorsum of mite (sex not known).

Figure 50. Venter of mite.

Figure 50a. Tibia and tarsus of leg I.

Pedrocortesella indiana sp.nov.

Figure 51. Dorsum of female.

Figure 52. Venter of female.

Figure 53. Chelicerae.

Figure 54. Pedipalp.

Xenillus umaensis sp.nov.

Figure 55. Dorsum of female.

Figure 56. Venter of female.

Figure 57. Leg I.

Oppia abuensis sp.nov.

Figure 58. Dorsum of female.

Figure 58a. Sensillus.

Figure 59. Venter of female.

Oppia yodai Aoki

Figure 60. Dorsum of female.

Figure 61. Venter of female.

Striatoppia aokii sp.nov.

Figure 62. Dorsum of mite (sex not known).

Figure 62a. Trichobothrium.

Figure 63. Venter of mite.

Figure 64. Lateral view of prodorsum.

Figure 65. Leg I.

Scapheremaeus mathurensis sp.nov.

Figure 66. Dorsum of female.

Figure 66a. Trichobothrium.

Figure 66b. Dorsal sculpture of the posterior region of notogaster.

Figure 66c. Dorsal sculpture of the median region of notogaster.

Figure 67. Venter of female.

Figure 67a. Sculpture of the epimeral region.

Chaunoproctus alveolata sp.nov.

Figure 68. Dorsum of female.

Figure 69. Venter of female.

Figure 70. Chelicerae.

Figures 71-73 Tibia and tarsus of leg I, II and IV.

Chaunoproctus longisetosus sp.nov.

Figure 75. Dorsum of female.

Figure 75a. Trichobothrium.

Figure 76. Venter of female.

Figure 77. Leg I.

Chaunoproctus pilanica sp.nov.

Figure 78. Dorsum of female.

Figure 79. Venter of female.

Figure 79a. Gnathosoma (pedipalp and chelicerae removed)

Figure 79b. Chelicerae.

Figure 79c. Pedipalp.

Figure 80 a-d Legs I-IV.

Pynoribates indicus gen.nov., sp.nov.

Figure 81. Dorsum of female.

Figure 82. Pteromorpha.

Figure 83. Venter of female.

Figure 84. Gnathosoma (chelicerae and pedipalp removed).

Figure 84a. Chelicerae.

Figure 84b. Pedipalp.

Figure 85. Tibia and tarsus of Leg I.

PLATES

Plate I

A. Showing the sculpture on rostral tectum - *Cosmochthonius areolatus* sp.nov. (× 600).

B. Showing sculpture on rostral tectum - *Dichthonius lanceolatus* sp.nov. (× 600).

Plate II.

Showing lateral ridges on prodorsum - *Allonothrus jodhpurensis* sp.nov. (× 400).

Plate III.

A. Showing sculpture on prodorsum - *Pedrocortesella indiana* sp.nov. (× 600).

B. Showing sculpture on notogastral plate - *Pedrocortesella indiana* sp.nov. (× 400).

C. Showing polygonal areolation on a part of ventral plate - *Pedrocortesella indiana* sp.nov. (× 600).

Plate IV.

Showing sculpture on dorsum of *Scapheremaeus mathurensis* sp.nov. (× 400).

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