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PRIMITIVE CRYPTOSTIGMATID MITES FROM THE CHIHUAHUAN DESERT OF NEW MEXICO

by Bernardette KAMILL, John A. WALLWORK and Miranda MACQUITTY *

TAXONOMY SUMMARY: Thirteen species of Oribatei Inferiores, two of which are considered to be new, are described from arid soils in the Chihuahuan Desert of New Mexico.

INTRODUCTION

This report forms part of a series on the soil and litter-dwelling Acari collected by WALLWORK in 1979 and three years later by KAMILL, in the northern part of the Chihuahuan Desert of New Mexico (see WALLWORK & WEEMS, 1984; WALLWORK et al., 1984; KAMILL et al., 1985). In spite of the evergrowing interest into the biology of desert microarthropods and their responses to extremes of temperature and moisture, very little attention has been paid to their taxonomy. So far as the Acari are concerned, WALLWORK (1972) has recorded seven species of Cryptostigmata, five of which were considered to be new, from the Joshua Tree National Monument in California: Aphelacarus acarinus (Berlese), Haplochthonius variabilis Wallwork, Oppia clavipectinata (Michael), Joshuaella striata Wallwork, Eremaeus magniporus Wallwork, Passalozetes californicus Wallwork and Zygoribatula heteroporosa Wallwork.

The present paper is concerned with the taxonomy of the Oribatei Inferiores from a number of localities on the New Mexico State University Experimental Range, 40 km north-north east of Las Cruces, Dona Ana County, New Mexico. Details of the localities examined are given in KAMILL et al. (1985) but for the purposes of the present paper it is sufficient to note that soil and litter from the following localities was studied: a large area of creosotebush (Larrea tridentata) on the lower slopes of the bajada (valley); thicketts of hackberry (Celtis reticulata), desert willow (Chilopsis linearis), Apache plume (Fallugia paradoxa) and mesquite (Prosopis glandulosa) on the margins of an arroyo (outwash channel); scattered areas of juniper (Juniperus monosperma), desert oak (Quercus grisea), and black grama grass (Bouteloua eriopoda) on the higher slopes of the bajada. In addition, litter samples were taken beneath an area of saltbush (Atriplex) in White Sands National Monument, approximately

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150 km to the east of the Experimental Range. The "higher" Cryptostigmata from all these localities will be dealt with in later papers. The present account is being written with the non-specialist as well as the specialist in mind. Therefore, a short, somewhat general introductory account of the basic external morphology of the Cryptostigmata has been included before the detailed taxonomic descriptions. The setal nomenclature used in the later works of GRANDJEAN has been followed throughout the descriptions.

EXTERNAL MORPHOLOGY

The majority of adult Cryptostigmata have a well-defined sejugal furrow dividing the body (idiosoma) into two major regions, the proterosoma bearing the first two pairs of legs and covered by a dorsal shield, the aspis or prodorsum (Pr), and the posterior hysterosoma bearing the hind two pairs of legs and covered by the notogaster (Ng) (Fig. 4). The venter of the idiosoma can be divided into two regions, an anterior podosoma (Pd) or leg-bearing region, and a posterior opisthosoma (Opis) in which the anal and genital apertures are located (Fig. 18). The region of the podosoma between the legs is occupied by a number of scleritized plates, the epimera or coxisterna (Fig. 18), regarded as having been formed by the fusion of coxal and sternal elements. The genital and anal apertures, protected by paired valves, the genital and anal shields, may either be long and contiguous and flanked by two more pairs of shields, the aggenitals and adanals which may be fused into aggenito-adanal shields or shorten and well separated in a large ventral shield.

Within the Cryptostigmata, a group of "higher" families can be distinguished characterized by a circular ecdysial split, a protero-hysterosomal articulation (with the exception of the Nothroidea) and leg genua and tibiae which are more or less equal in length. The legs are generally robust and in some families they can be tucked in close against the notogaster which provides a protective shield. In those "lower" groups with a protero-hysterosomal articulation, a continuous band of soft cuticle (sejugal membrane) extends from the dorso-sejugal region (DS) separating the prodorsum and notogaster (Fig. 4) to the ventro-sejugal region (VS) between the second and third pairs of epimera (Fig. 18).

DESCRIPTION OF SPECIES

The following thirteen species of "lower" Cryptostigmata were recorded in the desert samples. Two of these, namely Cosmochthonius juvenalis and Brachychochthonius americanus are considered to be new.

Gilarovella demetrii Lange
Aphelacarus acarinus (Berlese)
Hoplophorella cf. cucullata floridaea Jacot
Rhyotria ardua (C. L. Koch)
Sphaerochthonius splendidus (Berlese)
Haplochthonius variabilis Wallwork
Cosmochthonius plumatus Berlese
Cosmochthonius juvenalis sp. nov.
Cosmochthonius emmae Berlese
Liochthonius cf. lapponicus (Trägårdh)
Brachychochthonius americanus sp. nov.
Camisia cf. horrida Hermann
Trhypochthonius tectorum (Berlese)

Family CTENACARIDAE Grandjean, 1954

Gilarovella demetrii Lange


This species is only known from its type locality Badhüz, Turkmenia, Soviet Union. Four specimens were found in creosotebush litter (Larrea tri-
dentata) collected from the Jornada Experimental Range. As BALOGH and MAHUNKA (1983) pointed out this species is similar to Neoctenaca rus hastilis Moritz and both genera are monotypic. G. demetrii differs by having: five pairs of anal setae, nine pairs of genital setae, two bifurcate eupathidia on the palpal tarsus, a large extent of striated cuticle between the prodorsum and notogaster, and a naso on which the rostral setae are inserted. New Mexican specimens measured 260-280 μm in overall length and agree well with LANGE's (1974) figures.

Family APHELACARIDAE Grandjean, 1954

*Aphelacarus acarinus* (Berlese)


The type locality is Palermo, Sicily. GRANDJEAN (1954) collected most of his material at Mongaillard, France and considered the species to be a "domestic" one since many specimens were found inside buildings, rather like the astigmatid mite, *Glycyphagus*. On the Jornada, large numbers of *A. acarinus*, agreeing well with GRANDJEAN's redescriptions, were recorded in creosote-bush litter.

**EUPTYCTIMA** Grandjean, 1967

In this group of mites the sejugal membrane is relatively wide, the individual epimera are separate and moveable, and the legs can be retracted into a space beneath the notogaster which is completely covered, "or closed", by the aspis.

The Euptyctima were very poorly represented in the desert samples. In all only three specimens were collected representing two species, one of which (*Hoplophorella cf. cucullata floridae*) is a member of the Phthiracaroidea and the other (*Rhysotritia ardua*) a member of the Euphthiracaroidea. Members of the two superfamilies can be easily distinguished by differences in the shape of the ano-genital region and in the arrangement of the covering shields. In the Euphthiracaroidea the idiosoma is compressed laterally and the ano-genital region is narrow and covered by a series of contiguous elongated shields. By contrast, the idiosoma of the Phthiracaroidea is not compressed laterally while the ano-genital region is broad and covered by four shields.

Family EUPHTHIRACARIDAE Jacot, 1930

*Rhysotritia ardua* (Koch)

*Hoplophora ardua* KOCH, 1841 : Fasc. 32, t. 15. Regensburg [type series lost].

*Pseudotritia loricata* FEIDER & SUCLI, 1957 : 40.


In comparison with topotypic material from VAN DER HAMMEN's Regensburg collection (BMNH), the New Mexican specimen is smaller and less heavily sclerotized. Thus the aspal length in the specimen from New Mexico was 175 μm while in the topotypes examined the length of the aspis ranged from 215 to 250 μm. No other morphological differences could be detected. A single specimen was recorded in creosotebush litter.

Family PHTHIRACARIDAE Perty, 1841

*Hoplophorella cf. cucullata floridae* Jacot (Figs 1-3)

*Hoplophorella cucullata floridae* JACOT, 1933 : 250. Gainesville, Florida ["cotypes" presumed lost].

ADULT (Fig. 1) : The aspis bears three pairs of short, rather stout and procumbent setae dorsally. There is a prominent median keel in front of the in-la setae and posteriorly the prodorsal integu-
ment is raised into a number of weakly developed longitudinal ridges. The sensilli, 75 µm in length, are slightly membranous and serrated distally, while the basal portion is smooth, slender and distinctly elbowed (Fig. 3). The prodorsal integument is coarsely punctate. The notogaster is approximately 300 µm in length along a line through c₁-ps₁. All 15 pairs of setae are short (less than the distance c₁,d₁), spatulate and smooth (Fig. 2). Anteriorly there is a weakly developed hood bearing setae c₁₋₃. The fissures lps and ips are apparently absent while vestigial f₁₋₃ could not be discerned in either of the two specimens available. The notogastral integument is coarsely punctate. The ano-genital region comprises a pair of ano-adelal plates and a pair of genito-agenital plates. There are three pairs of marginal anal setae and two pairs of adanalals located submarginally. The anal setae are all moderately stout, smooth and more or less equal in length. The anterior pair of adanal setae are short and fine while the posterior pair, approximately 50 µm in length, are rather stout, taper to a point, and are weakly serrated. In lateral aspect the paraxial margins of the anal plates are strongly convex and prominent. There are nine pairs of genital setae located marginally and a single pair of aggenitals located antiaxially. All the genital setae are short. The integument of the ano-genital region is coarsely punctate. The leg chaetotaxy closely resembles that found in other species of the genus and in the rest of the Phthiracaroidea (see Parry, 1979).

OTHER STAGES: Unknown.

MATERIAL: Two specimens only were collected, both under Quercus.

REMARKS: Species currently classified in Hoplophorella (type Phthiracarus (Hoploph.) cucullatus (Ewing)) are distinguished from those of Stegana-
carus and Tropacarus by the chaetotactic pattern of the anal setae (three subsequally placed setae on median edge). However, while SHEALS' (1969) numerical analysis of the Phthiracaroidea suggests that Hoplophorella is neither a very "natural" nor a distinctive genus, BALOGH and MAHUNKA (1983) fail to recognize the genus, placing cucullata in Steganacarus.

It would appear that the specimens from New Mexico bear a form of notogastral seta (smooth and spatulate) and integumental ornamentation (coarsely punctate) which is common to cucullata and its three subspecies, cucullata obsoletior Berlese, cucullata cuculoides Jacot and cucullata floridae Jacot. However, while a prominent hood is present in the nominate form and in cuculoides, a hood is absent entirely in obsoletior and only weakly developed in floridae.

Although JACOT'S (1933) original figure of cucullata floridae from specimens collected in leaf litter, Gainesville, Florida, is extremely superficial, his description refers to the characteristic features of the species: smooth, spatulate notogastral setae; notogaster "stipple punctate"; weakly developed anterolateral hood on notogaster. While the New Mexican material agrees reasonably well with JACOT'S description of cucullata floridae, in comparison with JACOT'S specimens (notogastral length 336-426 μm) the material from New Mexico is somewhat larger (notogastral length 500 μm).

ENARTHRONOTA Grandjean, 1946

The Enarthronota are well represented in the desert where members of the Sphaerochthoniidae, Brachychthoniidae, Cosmochthoniidae and Haplochthoniidae were recorded.

In this group of "lower" Cryptostigmata the notogastral shield is subdivided both longitudinally and transversely. A pair of longitudinal bands of soft cuticle divide the notogaster into a dorsal notaspis which is flanked on either side by a lateral pleuraspis (Fig. 5). The notaspis is itself subdivided into two (Sphaerochthoniidae), three Brachychthoniidae, or four shields (Cosmochthoniidae and Haplochthoniidae) by one or three bands of soft cuticle, and the pleuraspis may also be subdivided. All the members of the Enarthronota are small (less than 500 μm in length) and weakly sclerotized.

Family SPHAEROCHTHONIIDAE Grandjean, 1947

*Sphaerochthonius splendidus* (Berlese)

(Figs. 4-8 ; 29-30 ; 33)


The true identity of BERLESE's *splendidus* now appears to be certain (VAN DER HAMMEN, 1959). The convex notogaster bears a single suture while tarsi I-IV are tridactylous with a strong median claw flanked by two fine lateral claws. As VAN DER HAMMEN (1959) has pointed out, BERLESE was in error when he described the tarsi as being monodactylous. The species can be easily recognized by the "T-shaped" notogastral setae and also by the delicate "lace-like" appearance of the integument which is sculptured with a polygonal network. The redescriptions of *S. splendidus* given below is based on material collected in Fallugia litter.

**ADULT** (Figs. 4-5 ; 29-30 ; 33) : Rather small, weakly sclerotized and strongly convex. The species ranges in length from 255-325 μm. The prodorsum bears six pairs of setae and, with the exception of the sensilli, all are voluminous, procumbent and "T-shaped" (see VAN DER HAMMEN, 1959). Each of the two setal arms is more or less equal in length, covered with whorls of spicules and born on a short, thick stem. Setae (*in*) are located just anterior to the bothridium and are less than half as long as setae (*la*). The sensillus, 30 to 40 μm, is broadly clavate and densely serrated distally with a smooth, slender basal
portion (Fig. 30). The exobothridial setae are short and their bases difficult to discern owing to the convexity of the prodorsum — it would appear that the anterior pair (ex,) are "T-shaped" while the posterior pair (ex,) are uniramous. The voluminous appearance of all the setae is due to their dense secretion of tubercles. Scanning electron micrographs show that the outer surfaces of the tubercles are deeply sculptured (Fig. 33). The prodorsal integument is ornamented with an irregular reticulate pattern and is also invested with a sparse covering of tubercles. The latter are most numerous around the raised margins of the depressions. At the level of the lamellars the cuticle is thickened to form a distinct carina. The notaspis, almost spherical in dorsal aspect, is divided by a single suture into two separate plates, the pronotaspis and the pygidium. The latter bears two faint carinas (see Grandjean, 1932b), one at the level of the d setae and another at the level of the e setae. The anterior carina is often difficult to discern since it is partially covered by the posterior border of the pronotaspis. Ventrolaterally, the pleuraspis (Pl) is divided into four plates, two laterals and two inguino-scapular plates. Of the 16 pairs of setae, c1-3 and cp are located on the pronotaspis and d1-2, e1-2, f1-2, h1-3, and ps1 on the pygidium. The remaining notogastral setae (ps2-3) are borne on the inguino-scapular plate. Difficulty was experienced in discerning setae h1-2 and it is possible that Grandjean (1932b) experienced similar difficulty since he
described a *Sphaerochthonius* species with 14 pairs of setae. He later, however (Grandjean, 1949), described the adult as being holotrichous. All 16 pairs of setae are of a similar length and all are aligned antero-posteriorly, those in the c series being the most prominent. Unlike the prodorsal setae, the notogastras are rather fine and composed of two equal arms, a short anterior arm and a longer one directed posteriorly. A dense covering of tubercles partially obliterates the whorls of the spicules and gives each seta an extremely "bulky" appearance in surface view. The six notogastral plates differ somewhat in their integumental sculpturing — the two dorsal plates bear a reticulate pattern (the raised margins of the depressions forming a regular polygonal network), the laterals have a longitudinal-reticulate appearance, while the ornamentation of the inguino-scapulars is rather striking and may be described as reticulate-coriaceous. The notogastral integument is invested with a covering of tubercles similar to that of the prodorsum. The ano-genital region is shown in Fig. 5. The anal and adanal plates are distinct while the genital and aggenital plates are fused. The preanal plate is triangular in ventral aspect. On each anal plate there are four, short, simple setae located submarginally. The four pairs of marginal adanal setae are bira-mous and covered with whorls of spicules — both arms are short and more or less equal in length. On each genito-agenital plate there are six short, simple genital setae. There are no aggenital setae. The ornamentation of the ano-genital region is reticulate and the integument is invested with a sparse covering of tubercles. There are three pairs of genital papillae, the posterior pair being rather small.

**DEUTONYMPH** (Figs. 6–7): Approximately 160 μm in length. The form and arrangement of setae on the prodorsum is essentially the same as in the adult — the exobothridial setae are, however, extremely difficult to discern, especially the posterior pair. At the level of the lamellars and at the level of the bothridia, a thickened carina is visible. The integument of both the prodorsum and the notogaster is reticulate and tuberculate although the tubercles are less numerous than in the adult (Fig. 6). In the specimen figured only six pairs of notogastral setae appeared to be present although Grandjean (1949) described both nymphs, and the adult, as being holotrichous. The eight setae in the c series resemble those in the adult, both from the point of view of shape and alignment while the two other pairs of setae are uniramous. All the setae bear whorls of spicules and a covering of tubercles. A single suture separates the pronotaspis from the pygidium. The pygidium bears two faint carinas, the anterior of which is more clearly visible than in the adult as, at this stage, the pronotaspis has not as yet grown down to cover it completely. Ventrally, there are apparently no setae, either on the pleuraspis or, in the anal or adanal series (Fig. 7). A longitudinal band of soft cuticle separates the lateral from the inguino-scapular plate. All the tarsi are monodactylous.

**TRITONYMPH** (Fig. 8): 250 to 275 μm in length. With the exception of setae d-r2 which are minute and barely visible, and setae e-r2 and f-r2 which are orientated transversely, the disposition as well as the number of dorsal setae, are similar to those of the adult. The suture on which the d setae are located is deeply indented and there is also a second suture at the level of the e setae. In comparison to the adult, setae f-r2 and h-r2 are more easily discernible since f-r2 are located dorsally and h-r2 posteriorly. Ventrally, the ano-genital region is similar to that of the adult although at this stage there are apparently only two pairs of genital setae present. The integument of the prodorsum, notogaster and ano-genital region is reticulate and tuberculate. The tarsi are monodactylous.

**OTHER STAGES**: Unknown.

**MATERIAL**: *S. splendidus* was uncommon in the desert samples and was found in only two species of litter, namely, *Fallugia* and *Atriplex*. In all about 20 specimens were collected of which one was a deutonymph, two were tritonymphs and the remainder were adults.
Figs. 6-8: *Sphaerochthonius splendidus*: (6) deutonymph, dorsal; (7) deutonymph, ventral; (8) tritonymph, dorsal.
Family HAPLOCHTHONIIDAE van der Hammen

Haplochthonius variabilis Wallwork


One adult (275 μm in length) agreeing well with Wallwork's description was collected under juniper. In comparison with the Califor­nier material however, the New Mexican specimen has rather stouter and more lanceolate notogastral setae.

Family COSMOCHTHONIIDAE Grandjean, 1947

Cosmochthonius plumatus Berlese

(Figs. 9-10; 32)

Cosmochthonius plumatus Berlese, 1910: 221. Holotype, Monte Giovi, Italy (ISZA, Florence, no. 80/7); Grandjean, 1950: 78.

The New Mexican material compares reasonably well with Berlese's figure of the species. Tarsi I are bidactylyous while tarsi II to IV are tridactylous, the lateral claws being very slender. The notogastral setae, (ε₁–2) and (f₁–2) are long, slender and barbed. The redes­cription given below is based on specimens collected under Atriplex.

ADULT (Figs. 9-10; 32): Small and weakly sclerotized. The species ranges in length from 240 to 290 μm. Of the six pairs of setae on the prodorsum (in), (la), (ro) and (ex₁) are large and prominent. Each seta is strongly curved and carries numerous long, slender spines. Setae (ex₂) are tiny and bear whorls of spicules. The sensil­lus, 50 to 60 μm, is distinctly elbowed ; the basal portion is smooth and slender while towards the elbow the sensillus thickens and carries many whorls of long, delicate spicules. Scanning electron micrographs show that the prodorsal integu­ment is finely striated. The notasps is somewhat elongate in dorsal aspect and is subdivided into four separate plates by three transverse bands of soft cuticle (Fig. 32). The most anterior plate in the dorsal series is the pronotaspis (NA) and the most posterior, the pygidium (PY). Two other plates, the first and second median notasps (NM₁ and NM₂), are interposed between the pro­notaspis and the pygidium (Fig. 9). Longitudinal intercalary sclerites arranged between NM₁ and NM₂, and between NM₂ and PY, protect the transverse bands of soft cuticle. There is a broad, apparently unprotected band of soft cuticle between NA and NM₁ which allows for some flexibility between the two most anterior plates. Sixteen pairs of setae are present in the notogastral series. The setae in the c series arise from the pronotaspis and those in the d series from the furrow between NA and NM₁. Setae c₁–3 and cp, and d₁–2 are relatively short and barbed, setae c₁ being particularly prominent. The very long setae (ε₁–2) and (f₁–2), are about equal in length (25-30 μm), each seta arising from a longitudinal sclerite (see Grandjean, 1962). All the e and f setae bear two rows of very long barbs. Setae h₁–3 and ps₁–3 are short, somewhat broad and den­sely barbed. Setae h₁–3 are located dorsally while setae ps₁–3 are inserted ventro-laterally on the pleuraspis. The notogastral integument is weakly striated (cf. Balogh and Mahunka, 1983). The ano-genital region is shown in Fig. 10. The genital and aggenital plates are fused while the anal and adanal plates are distinct. On each anal plate there are four barbed setae, the anterior pair being rather short. The four pairs of adanal setae are more or less equal in length and located submarginally. On each genito-aggenital plate there are ten pairs of setae. There are no aggeni­tal setae. The integument is densely punctate.

OTHER STAGES: Unknown.

MATERIAL: This species, the type material of which was collected from moss and humus is Central Italy (Berlese, 1910), appears to be rather rare (Van der Hammen, 1959). It occurred in
Figs. 9-10: *Cosmochthonius plumatus*: (9) adult, dorsal; (10) adult, ventral.
very small numbers in the Chihuahuan Desert, five specimens only were recorded under *Atriplex* and three under juniper.

**REMARKS**: VAN DER HAMMEN (1959) suggests that MARIE HAMMER’s subspecies, *suramericanus*, described from the Argentine (HAMMER, 1958), is perhaps a nymph of *plumatus*. In comparison with the species (240-290 μm in length), the subspecies is somewhat smaller (220 μm in length). HAMMER noted that the *d* setae on *NM₁* were further apart than in *plumatus*, while the *e* and *f* setae were somewhat thinner. Unfortunately, HAMMER did not figure or describe the tarsi.

**Cosmochthonius juvenalis** sp. nov.  
(Figs. 11-13)

The smallest of the 17 described species of *Cosmochthonius*, *C. juvenalis* (overall length 160 μm) is somewhat unusual in relation to the form of the setae on *NM₂* and on the pygidium. Each seta is rather short and lanceolate with a central

![Diagram of Cosmochthonius juvenalis](image)
midrib and a highly ciliated margin. Although a central midrib extends the length of each seta in *C. emmae* and in other closely related species, these *e* and *f* setae are very long, broad and leaf-like. The tarsal claw formula in *C. juvenalis* resembles the condition found in *C. plumatus*, namely, 2-3-3-3. The holotype is deposited in the collections of the Acarology Laboratory of the Ohio State University.

**ADULT** (Figs. 11-13): Very small, weakly sclerotised and almost transparent. The species is 160-165 μm in length. The prodorsal setae (*la*) and (*ro*) are biramous, each of the two setal arms being more or less equal in length and covered with whorls of spicules. Setae (*in*) and (*ex*), are minute and carry very few spines — setae (*ex*) could not be discerned in the two available specimens. The sensillus, approximately 35 μm, is densely serrated in the distal two-thirds with a smooth, slender basal portion (Fig. 13). The prodorsal integument is apparently smooth. The notaspis is ovoid in dorsal aspect and divided by three sutures into four separate plates, three of which (*NA, NM*, and *PY*) are more less equal in depth while *NM* is considerably more shallow (Fig. 11). A pair of lateral apophyses are located on the pronotaspis. Setae *c*₁,₃ and *cp* are located on *NA* while setae *d*₁,₂ are on *NM*. The *c* and *d* series setae are very short and carry few spines while the longer setae, (*e*₁,₂) and (*f*₁,₂), are more or less equal in length (35 μm), each seta arising from a longitudinal sclerite. All the *e* and *f* setae are slender and lanceolate with a central midrib and a densely ciliated margin. Setae *h*₁,₃ and *ps*₁,₃ are short and barbed. The notaspal integument is distinctly granular. The ano-genital region is shown in Fig. 12. The anal and adanal plates are distinct while the genital and aggenital plates are fused. On each anal plate there are four short, barbed setae and on each adanal plate a further three barbed setae. On each genito-aggenital plate there are eight barbed setae, five of which are located marginally and three submarginally. There are apparently only two pairs of genital papillae.

**OTHER STAGES**: Unknown.

**TYPES**: Holotype, and one paratype, reg. no. AL-2917, from creosotebush litter (*Larrea tridentata*), Jornada Experimental Range, New Mexico. The material was collected by D. C. WEEMS, July, 1983.

**REMARKS**: In relation to the general depths of the notaspal shields and the lengths of the gastronotal setae, *C. juvenalis* is atypical of the genus. Moreover, while the number of tarsal claws resembles the condition found in *C. plumatus*, the form of the *e* and *f* setae is reminiscent of *C. emmae*. It is interesting that two "species groups" can be recognized within the genus *Cosmochthonius*, based on the tarsal claw formula and on the form of the "long" setae. The tarsal claws may number 2-3-3-3 as in *plumatus* or, 2-2-2-3 as in *emmae*, while setae (*e*) and (*f*) may be slender and barbed (*plumatus*) or foliate with a central rib and marginal serrations (*emmae*). *C. juvenalis* shows affinities with both of these groupings.

*Cosmochthonius emmae* Berlese

(Figs. 14-16)


**ADULT**: The only European species of the genus *Cosmochthonius* with the tarsal claw formula 2-2-2-3 (see GORDEEVA, 1978 ; 1980). *C. emmae* can be identified from the figure and description given by BERLESE (1910) and can be easily recognized by the remarkable development of foliate setae in the *e* and *f* series (Fig. 14) on the second median notaspis and on the pygidium respectively. Both *e* and *f* setae bear a thick, central rib and easily discernible transverse vena- tion. Through the courtesy of Dr. F. PEGAZ- ZANO (ISZA), the material from New Mexico has
Figs. 14-16: *Cosmochthonius emmae*: (14) adult, dorsal; (15) adult, ano-genital region; (16) tritonymph, notogaster, dorsal.
been compared with BERLESE’s type specimen (slide no. 69/19) in Florence. The form of the notaspal setae in the New Mexican material agrees well with the holotype, although there are minor differences. For example, in the Italian specimen the margins of the foliate setae bear similar spine-like serrations, while in the American material setae e₁₋₂ bear numerous delicate marginal hairs and setae f₁₋₂ bear fewer, more spine-like serrations. Although BERLESE (1910) described the margins of both the e and f setae as being barbed, he was in error when he figured these setae with smooth margins. MAHUNKA (1977), in his redescription of emmae based on specimens collected in Indonesia, distinguished two forms of setal margin in the e and f series (ciliated and serrated) but failed to indicate which form of margin was characteristic of the e, and which of the f series. GORDEEVA (1980), working with material from the Soviet Union, figured a specimen of emmae in which both the e and f setae carried similar marginal serrations.

Other characteristic features of the species are the biramous rostral and lamellar setae, and the simple barbed setae (e₁₋₃, cp, d₁₋₂) on the two anterior notaspal shields. The general arrangement of the plates on the venter is characteristic of the genus (Fig. 15). Each genito-aggenital plate bears 10 setae, while both the anal and the adanal plates bear four setae. All the setae in the ano-genital region are strongly barbed.

TRITONYMPH : A single, somewhat damaged specimen was recorded. The number and disposition of the dorsal setae are essentially similar to those of the adult, except setae (e₁₋₂) and (f₁₋₂) which, unlike the foliate expansions seen in the adult, are long, thickened and bear whorls of strong spines (Fig. 16).

OTHER STAGES : Unknown.

MATERIAL : The type locality is Pisa. C. emmae appears to be rather rare in Europe (VAN DER HAM-MEN, 1959) although MAHUNKA (1977) recorded this species from a number of habitats in Indonesia. In New Mexico only two specimens were recorded in creosotebush litter.

REMARKS : Based on a study of 11 species, GORDEEVA (1978) separated those species with “four dorsal sutures”, foliate e and f setae, and with 2-2-2-3 tarsal claws, from Cosmochthoniinus (three dorsal sutures, slender e and f setae, tarsal claws 2-3-3-3) and placed them in the genus Phylozetes Gordee Ya, 1978 (type, C. emmae). In the original figure of the species (BERLESE, 1910), the notaspis is shown to be divided by three sutures into four separate plates — the apparent division of the pronotaspis shown in the figure is almost certainly due to the exposure of the soft cuticular band between NA and NM₁ (see Fig. 32, C. plumatus). Although it has not been possible to study any of the species determined by GORDEEVA as emmae, Dr. PEGAZANO has confirmed that the type specimen bears only three dorsal sutures. Moreover, Dr. PEGAZANO has compared the New Mexican material with BERLESE’s specimens and was unable to determine any morphological differences.

The evidence suggests, therefore, that while morphological differences, particularly in the form of the e and f setae, could provide a useful basis for dividing this genus into two species groupings, the number of dorsal sutures is not a feature which could be used. Moreover, as noted earlier, C. juvenalis shows affinities with both of these groupings. Another species (Cosmochthoniinus bengalensis Chakrabarti et al., 1972), described from West Bengal, India, falls into neither grouping since all four tarsi are bidactylous.

Family BRACHYCHTHONIIDAE Thor

Liochthonius cf. lapponicus (Trägårdh)
(Figs. 17-19)

FIGS. 17-19: Liochthonius cf. lapponicus: (17) adult, dorsal; (18) adult, ventral; (19) sensillus.

Although rather larger (220 μm compared to 180 μm) the New Mexican specimens agree reasonably well with TRÅGÅRDH’s description. However, in his revision of the Brachychthoniidae based on topotypic specimens collected by TRÅGÅRDH, MORITZ (1976) recorded an overall body length of 200 μm. Moreover, MORITZ has shown that in addition to the pattern of roundish areas (three pairs) between the bothridia, the Lappland material bears additional weakly patterned areas on the pro- and median notaspis and on the pygidium. The notogastral integument of the North American material was apparently unpatterned.

*L. cf. lapponicus* resembles *Liochthonius breviseta* described by HAMMER (1958) from moist Umbelliferae growing along the Arroyo El Oscuro in the Argentine. However, an examination of the type of *breviseta* (UZM, no. 241) revealed that the notogastral setae are very much more spine-like than those of *L. lapponicus* while the sensillus is lanceolate (see Fig. 19). Another difference can be seen in the form of certain of the setae on the pygidium. In *breviseta*, setae \( (f_i) = (c_i) \) and \( (h_i) = (c_i) \) each arises from a tuberculate-like swelling of the integument (= "low hill"), while in *lapponicus* these setae emerge directly from the pygidial integument.

MATERIAL: Twenty adults of *L. cf. lapponicus* were collected, all under juniper.
Brachychochthonius americanus sp. nov.
(Figs. 20-23)

ADULT (Figs. 20-23): Overall length 174-190 μm. Sculpturing on the prodorsum is not strongly defined but 16 plates are normally discernable (Fig. 20). Rostral setae inserted just above the scalloped anterior edge of the prodorsum and are the longest of the prodorsal setae. Lamellar seta inserted on a transverse ridge and are strongly serrated. The interlamellar setae are similar to the lamellar setae both in size and shape. Anterior exobothridial setae (ex₁) inserted on small lateral tubercles; only alveoli of posterior exobothridial setae (ex₂) present (Fig. 23). Distal part of sensillum fusiform, bearing sharply pointed spines. Pronotaspis (NA) has two ring spots which are partly surrounded by plates, those lateral to the spots undivided. Anterior plate has weak transverse divisions. Lateral plates on pygidium (PY)
are well defined but vary slightly in shape. Notogastral setae are deeply serrate, e, appears to be the longest in the dorsal series (Fig. 22). In lateral view (Fig. 23), the suprapleural plates C, E and F can be seen as can the lyrifissures ia, im, ip, ih and ips. The medial seta on coxa I is situated on a separate plate (Fig. 21). There are seven pairs of genital setae. Adanal setae ad1 and ad2 are clearly blade-like.

Characters of the gnathosoma including those of the palp and chelicerae are similar to those described for B. lydiae by REEVES and MARSHALL (1971). Leg chaetotaxy is also similar to that of B. lydiae except that tarsus II appears to have 13 setae and one solenidion compared with 14 setae and one solenidion. The posterior lateral setae appears to be missing.

TRITONYMPH: Overall body length 154-166 \( \mu \)m. Dorsum has weak sculpturing but shape of dorsal setae similar to the adult. Only six pairs of genital setae present.

DEUTONYMPH: Overall body length 154 \( \mu \)m. Similar to tritonymph except that there are only three pairs of genital setae and the coxisternal setal formula is 3-1-3-3.

OTHER STAGES: Unknown.

TYPES: Holotype and paratypes (8 adults, 4 tritonymphs, 1 deutonymph), reg. no. AL-3040. From creosotebush litter (Larrea tridentata), Jornada Experimental Range, New Mexico. Collected in most monthly samples throughout 1983 and 1984. Deposited in the collections of the Acarology laboratory of Ohio State University.

REMARKS: There are few Brachychochthonius species with serrated notogastral setae. B. americanus differs from all of these species in the pattern of the sculpturing on the notogaster, the shape of the notogastral setae and sensillus. B. hauserorum Mahunka is the most similar species but can be distinguished by radiating lines lateral to the ring spots on NA, indistinct lateral plates on PY, more slender and less deeply serrated setae on the dorsum and by many small serrations on the sensillus.

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Fig. 23: Brachychochthonius americanus: (23) adult, lateral.
Family CAMISIIDAE Oudemans, 1900

Camisia cf. horrida (Hermann)

Notaspis horridus HERMANN, 1804: 90.
Notthus horridus: BERLESE, 1885: fasc. 17 (1).
Camisia horrida: GRANDJEAN, 1936: 51.

The description and figure of this species given by BERLESE (1885) are adequate for its identification.

MATERIAL: Two specimens (970 μm in length) which have been found to fall within the size range given by GRANDJEAN (1936) for horrida (850-1030 μm) were recorded under juniper.

Family TRHYPOCHTHONIIDAE Willmann, 1931

Trhypochthonius tectorum (Berlese)
(Figs. 24-25; 26-28; 31; 34)

Hypochthonius tectorum BERLESE, 1896: Fasc. 78 (8).

BERLESE's (1896) description and figure of this species based on specimens collected from moss on roofs in Florence, are adequate for its identification. The characteristic features of tectorum are the deeply serrated, narrowly spatulate, notogastral setae and the reticulate ornamentation of the notogastral integument. The specimens from New Mexico, although rather smaller (545-605 μm in length) than the Italian material (750 μm in length), are probably referable to this species. WILLMANN (1931) records an overall body length of 660-690 μm, VAN DER HAMMEN (1956) 775 μm for tectorum. Specimens from Holstein in the STRENZKE Collection (BMNH 1953, 5. 16. 3) are 730-750 μm and two British specimens from Dunegen are 580-655 μm in length. BALOGH and MAHUNKA (1983) state that the rostral setae are shorter than all of the other prodorsal setae and this is the case in the Holstein specimens. In the New Mexican material, the lamellar setae are the shortest (Fig. 24), while the British specimens are not consistent in this regard. Fig. 31 shows the structure of the sensillus and Fig. 34 that of the notogastral integument. There are fewer genital setae in the specimens from New Mexico, 6-7 pairs compared 9-11 pairs recorded for European specimens by GRANDJEAN (1949) and VAN DER HAMMEN (1956). We have examined specimens of T. tectorum from PEARCE'S Sikkim-Himalaya collection (BMNH) (PEARCE, 1906), and found them to be somewhat larger (615-640 μm in length), more heavily sclerotized and having more pointed posterior notogastral margins than the New Mexican material.

T. tectorum bears some resemblance to a North American species, namely T. americanus (Ewing, 1908). However, the latter differs from tectorum in having a tuberculate-like swelling at the posterior tip of the notogaster, by having slender, barbed setae (cf. Fig. 24) and also in the overall body length (533 μm, see WOOLLEY, 1956). VAN DER HAMMEN (1956) has suggested that the posterior swelling in T. americanus could be attributable to coverslip pressure, but WOOLLEY (1956) has recorded a posterior swelling in seven specimens of americanus collected in Colorado.

We have also been able to examine material of Trypochthonius tectorum longipes (Warburton, 1912) recorded from the island of Mahé in the Seychelles. Warburton's collection was found to contain one slide (BMNH reg. no. 1984, 2. 23. 1) bearing two specimens mounted in BERLESE's fluid. Both of the specimens are in good condition and are conspecific. After comparison with the nominate form, we consider longipes to be very close to, but not identical to, the former (see VAN DER HAMMEN (1956)). In Warburton's subspecies, the legs are considerably than in the typical tectorum, the sensillus is rather long, slender and serrated, and the notogastral integument is raised reticulate. GRANDJEAN (1940) described a subspecies tectorum congregator from France, based principally on the size and location of the
soledinions on tarsus I. In _congregator_ solenidion ω₃ is elongated and inserted close to ω₂. New Mexican material belongs to the typical form in having a short ω₃ which does not reach ω₂. MARSHALL (1968) gives the distribution of _tectorum_, in addition to the areas mentioned above, as Iceland, Faroes, Peru, Alaska and Canada.

GRANDJEAN (1934, 1949) records the epimeral, genital and anal chaetotaxies for all stages of _tectorum_. There are several differences that we observed in the New Mexican material and these are described below. The tritonymph has been figured by TABERLY (1952), but the other juvenile stages have been treated only briefly by WILLMANN (1928) and VAN DER HAMMEN (1956). More detailed descriptions of the immature stages are given below based on material collected from juniper litter.

TRITONYMPH: Overall body length 400-490 μm, width 245-275 μm. European specimens 525 μm in length, 300 μm in width (WILLMANN, 1928), and British specimens 450-525 μm in length, 225-300 μm in width. The notogaster is divided into two parts by a line of dehiscence, the anterior part is roughly striated and the posterior part reticulate. The notogastral chaetotaxy is unideficient (15 pairs) and includes three pairs of pseudoanal setae. The form of the setae is similar to that of

Figs. 24-25: Trhypochthonius tectorum: (24) adult, dorsal; (25) protonymph, dorsal.
the adult (Fig. 24). The epimeral setal formula is 3-1-3-3, identical to that recorded by Grandjean (1934). New Mexican specimens have 5-6 pairs of genital setae, Grandjean (1949) recorded 6-8 pairs. There are three pairs of anal and one pair of anal setae. All legs are monodactylyous.

Deutonymph: Overall body length 375-400 μm, width 180-225 μm. Similar to the tritonymph except for the following: epimeral chaetotaxy is 3-1-2-3 and identical to that given by Grandjean (1934). These are 3-4 pairs of genital setae (Grandjean 1949) recorded four pairs. The anal setae are absent.

Protonymph (Figs. 25-26): Overall body length 275 μm, width 170 μm. Similar to the deutonymph except: setae f2 are small and setiform, epimeral chaetotaxy is not clear but Grandjean (1934) gives 3-1-2-1, a single pair of genital setae.

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Figs. 26-28: Trhypochthonius tectorum: (26) protonymph, ventral; (27) larva, ventral; (28) larva, dorsal.
LARVA (Figs. 27-28) : Overall body length 200-245 μm, width 100-180 μm. The sensillus is reduced and a pair of exobothridial setae are present. The notogastral setae are deficient in respect of all the other stages, Grandjean (1949) recorded 11 pairs (excluding the two pairs of pseudoanal setae). The $f_i$ setae are absent and in the New Mexican material only two pairs of $h$ setae are visible (Fig. 27). The epimeral chaetotaxy is 2-1-2.

MATERIAL : T. tectorum was common under juniper but was not found under any of other plants sampled. In all about 200 adults were collected together with small number of larvae, proto-, deuto- and tritonymphs.

END NOTE

The description of C. juvenalis sp. nov. was prepared by B. S. K. and the correct designation is Cosmochthonius juvenalis Kamill. M. M. prepared the description of B. americanus sp. nov. and the correct designation is Brachychochthonius americanus MacQuitty.

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