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REDEFINITION OF MOCHLORIBATULA (ACARI: MOCHLOZETIDAE), WITH NEW SPECIES, RECOMBINATIONS, AND NOTES ON PLANT ASSOCIATIONS

BY Roy A. NORTON*

SYSTEMATICS OF MOCHLORIBATULA PLANT-INHABITANTS

ABSTRACT: The oribatid mite genus Mochloribatula is discussed and its placement in the family Mochlozetidae is supported. Like other members of the family they are primarily plant-inhabitants. Two new species are proposed: *M. bahamensis* from halophilic shrubs in the Bahama Islands and *M. metzi* from *Spartina alterniflora* in North Carolina. *Eremaeus floridanus, Notaspis depilis* and *N. texana* are included in *Mochloribatula* and the ontogeny of *M. texana* is described in part.

SYSTÉMATIQUE DU GENRE MOCHLORIBATULA HABITANTS DES PLANTES


The oribatid mite genus *Mochloribatula* was proposed by MAHUNKA (1978) to include two newly discovered species from soil and litter in the Dominican Republic. While briefly suggesting tentative placement in the Mochlozetidae, he noted discrepancies in two characters, the absence of notogastral pteromorphs and the presence of five pairs of genital setae; all previously described mochlozetid taxa have distinct pteromorphs and six pairs of genital setae. The first objective of the present study is to examine *Mochloribatula* and the family diagnosis proposed by GRANDJEAN (1963) from the standpoint of shared derived character states. A new generic diagnosis is then presented following GRANDJEAN's format for other genera of the family. A proposed new species (*M. bahamensis*) will be described in detail, with subsequent new and newly recombined species given brief diagnoses; characters not mentioned are similar to those of *M. bahamensis*. Observations on ontogeny in one species are also offered.

The genus actually has a wide distribution in South, Central and North America, and its species

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appear to be primarily associated with living plants, rather than litter. In addition to the distributional records noted below, I studied representatives of *Mochloribatula* from Mexico, Colombia and Brazil, which will be treated in a later publication. Also a damaged female specimen from Columbia, Missouri and two damaged males from apple trees in Moore County, North Carolina were examined.

I. FAMILY PLACEMENT OF *MOCHLORIBATULA*

The family Mochlozetidae, when originally proposed by Grandjean (1960), encompassed the four genera *Mochlozetes* Grandjean, *Dynatozetes* Grandjean, *Terrazetes* Jacot and *Unguizetes* Selnick. Only the first three were known well enough to be used in formulating his diagnosis, which was considered provisional at that time. The subsequent inclusion of *Podoribates* Berlese (= *Sphaerobates* Selnick) necessitated a modification (Grandjean, 1963).

Prior to the proposal of *Mochloribatula*, three other genera have been relegated to this family (*Nesiotizetes* Jacot, *Rykella* Balogh and *Urobates* Hammer), and it is likely that numerous supraspecific taxa remain unknown, especially in the neotropics.

The thirty diagnostic family character states listed by Grandjean (1963) are mostly found in *Mochloribatula*. Of greatest significance is the sharing of the following derived states. 1) The notogaster is fused to the prodorsum between the dorsophragmatic apophyses, without a trace of a dividing suture. This fusion has apparently occurred independently in several lineages of the Excentrosclerosae. 2) There is a ventral subterminal tooth on each lateral claw of the leg tarsi. This is thought to increase grasping efficiency of mochlozetic mites, which are primarily plant-inhabitants. This is shared with some or all members of other arboreal or saxicolous Excentrosclerosae genera, such as *Drymobates*, *Drymobatoides*, *Dometorina*, *Oribatula*, *Phauloppia* and *Lucoppia* (Grandjean, 1959b, 1960; Travé, 1961). 3) Legs II-IV have "pretarsi" in the sense of Grandjean (1959b); distinct tarsal sclerotization ends proximally to the insertion of the proral setae, enhancing tarsal flexibility. This is found also in *Sellnickia* (Sellnikiidae) (Grandjean, 1958) and certain other isolated Brachypyllina, but the distribution of this character state is not well known. 4) A distinct notch is present in the antiaxial margin of the chelicera (see Grandjean, 1959b, fig. 2E), which probably allows the chelicerae to maneuver at greater than normal angles. It is also found in *Sellnickia*. 5) A marginoventral series of porose areas are present peripherally on the ventral plate. This is known outside the Mochlozetidae only in *Drymobates*. 6) Tarsi I and II have a dorsal porose area. This is shared by *Sellnickia*, the arboreal oribatulid genera *Phauloppia* and *Lucoppia* (Grandjean, 1948), and some species of *Oribatula*. 7) The notogastral porose areas are accentuated by the combination of thin porose cuticle and internally thickened borders. This is found also in *Sellnickia*.

In addition there is an unusual tendency within the Mochlozetidae (which Grandjean did not list in his familial diagnosis but is implied in his discussions) toward elongation and multiplication of porose areas on the notogaster. Areas *A*₂ and *A*₃ are especially subject to modifications, forming a circumdorsal series complementary to those of the marginoventral series. Both of these series presumably provide respiratory surface related to the dorsoventral musculature (Grandjean, 1959a).

The various species of *Mochloribatula* all show some modification of the usual notogastral porose areas.

However, there are certain characters or states cited by Grandjean (1963) as diagnostic of the Mochlozetidae which members of *Mochloribatula* lack: non-hinged pteromorphs; a sixth pair of genital setae (five pairs in *Mochloribatula*); a

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1. Balogh (1972) has included the Mochlozetidae in the superfamily Ceratozetoidae. It is clear from studies of the immatures that this is inappropriate. The closest relatives of the Mochlozetidae can be found in the Oribatuloidea (Grandjean; 1960), and perhaps include the genera *Sellnickia* and *Drymobates*.
tutorium⁴; and tibia I solenidion φ₂ inserted distad of φ₁ (inserted paraxiad of φ₁ in Mochloribatula). The first three can be explained as regressions within the family. MAHUNKA (1978), for example, has implied that absence of pteromorphs in Mochloribatula might represent the end of a regressive transformation series, of which the small pteromorphs of Mochlozetes may represent an intermediate step. Pteromorphs are involved in protection or coaptation of retracted legs, and it is a common pattern that poronotic oribatid mites which lack well developed pteromorphs also have other leg-protecting structures poorly developed, compared to near relatives with large pteromorphs. The absence in Mochloribatula of a tutorium, and the poor development of the sublamella are consistent with this pattern, since both are involved in leg coaptation.

The five pairs of genital setae found in Mochloribatula may also represent a derived regressive state. Occasional specimens have five genital setae on one valve, six on the other. According to GRANDJEAN's concepts, such aleatory presence usually precedes complete loss of a given seta, and indicates ongoing regression.

The significance and polarity of the position of solenidion φ₂ is unclear at present. Both states, and intermediate ones, seem to be present in a variety of Excentrosclerosae, including the genera Scheloribates and Oribatula. However, in lieu of a detailed cladistic study of phylogeny in the Mochlozetidae and closely related taxa (such as Selnickia, Drymobates, and Drymobatoides) I suggest that the association of Mochloribatula with this family is correct, based on the seven derived states noted earlier, especially 4, 5 and 7. If this is accepted, GRANDJEAN's (1963) diagnosis of the family must be modified to indicate presence or absence of a tutorium, pteromorphs, sixth genital seta and distally displaced φ₂.

II. DIAGNOSIS OF MOCHLORIBATULA

This new diagnosis follows, for the most part, the format of GRANDJEAN (1960) and pertains only to adult mites. Characters of ontogeny are not included due to insufficient comparative knowledge of other genera, but the nature of gastronomic setae and sclerites, as well as leg setal ontogeny, may eventually prove to be of diagnostic value.

Mochloribatula Mahunka, 1978. Type species: M. multiporosa Mahunka, 1978. Mochlozetidae with; 1) interlamellar setae large, erect; 2) lamella distant from lateral margin of prodorsum in dorsal aspect; 3) translamella a narrow carina; 4) sublamella poorly developed; 5) tutorium absent; 6) posterior cirumpedal carina confluent with discidial carina; 7) custodium absent; 8) five pairs of genital setae; 9) dorsosejugal porose area small, circular or slightly elliptical; 10) an additional small circular or slightly elongated porose area (Ax) between seta la and lyrifissure im; 11) circumdorsal porose areas A₂ and A₃ (posteriad of gla) of diverse form, greatly elongated or subdivided, exhibiting marked sexual dimorphism; 12) notogastral setae (usually 10 pairs) present, but small, simple; 13) no distinct, projecting pteromorph; 14) dorsal porose area present on tarsi I and II; 15) femora I and II with distinct crispin (basal retrotectum); 16) trochanter IV without dorsodistal apophysis; 17) solenidion φ₂ of tibia I inserted paraxiad of φ₁.

III. Mochloribatula bahamensis N. SP.

SIZE. The mean total length of 10 males was 548 μm (range 530-559 μm); mean total length of 10 females was 578 μm (range 549-607 μm).

INTEGUMENT. The color, except for teneral adults, is light to medium brown. The integu-

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2. MAHUNKA (1978) mentioned a tutorium (at the end of which seta ro is inserted) in his description of Mochloribatula multiporosa. This may be a misconception based on observation in dorsal, rather than lateral aspect. The tubercle on which ro is inserted appears like a small tutorial cusp when viewed from above.
ment is moderately smooth and shiny in reflected light at low magnification, but at high magnification the prodorsum and peripheral regions of the ventral plate exhibit minute granulation. The granules are much larger in the lateral region of the podosoma but they are hidden under a thin cerotegument which is restricted to this area and is itself granular in nature (Figs. 5A, C). On the notogaster the integumental granules are mostly replaced by minute vermiform ridges, 2-3 \( \mu \text{m} \) long, the orientation of which is generally longitudinal in the middle of the notogaster and parallel to the notogastral border in peripheral regions. Larger (5-10 \( \mu \text{m} \) or greater), well defined surface striations are present on the external surface of pedotectum I and the lateral surface of the prosdorsum in the region usually occupied by the tutorium (Figs. 5B, C).

PRODORSUM. The rostrum is entire, with a conical shape in dorsal aspect (Fig. 1A); the laterorostral carina is present. The lamellae are narrow and essentially cariniform; in dorsal aspect under transmitted light they appear broader due to the projection of internal surfaces (cf. Figs. 1A and 5C). A lamellar cusp is not well developed. The somewhat enlarged distal end of the lamella is free anterolaterally but fused to the prodorsum anteromedially. The translamella is a complete, but very narrow ridge. Although a tutorium is entirely absent, the lateral region of surface striations mentioned above is slightly convex and forms part of the apparent contour of the prodorsum in dorsal aspect.

The interlamellar (in) and lamellar (le) setae are large, acuminate, and strongly barbed; they are drawn somewhat depressed in Fig. 1A to show their form. Setae in are divergent; le are almost parallel and inserted in depressions at the tip of the lamellae, barely anteriad of level of translamella. The rostral setae (ro) are smaller and slightly more attenuate. The exobothridial setae (ex) are straight, taper only near their tip, and are very densely barbed. The sensillus is sub-capitate, with small barbs on the head, and a thin stalk of moderate length which curves dorsad after emerging from the bothridium. The opening of the bothridium is barely hidden in dorsal aspect, with its upper surface confluent with the lamella (Figs. 5A, C). The small sublamellar porose area forms approximately an equilateral triangle with the bothridium and the insertion of seta ex.

NOTOGASTER. In transmitted light there is no indication of a division between notogaster and prodorsum between the dorsophragmatic apophyses of cleared specimens. Only slight surface irregularities mark the anterior margin. The general shape is that of a broad ellipse. The border is reflexed strongly in the humeral region (Fig. 5A) but hardly at all posteriorly.

The dorsosejugal porose area (Ad) is small, nearly circular when viewed perpendicularly, and located posteriad of seta in and anterolaterad of the dorsophragmatic apophysis (hy). There is distinct sexual dimorphism with regard to certain of the porose areas. The adalar porose area is elongated in the female (Fig. 1A, Aa) but even longer (by about 50%) in the male. Area Ax is small, circular or elliptical. The greatest dimorphism is found in the series located concentrically between setal row h and the circumdorsal muscle insertions. On the female notogaster there are five (usually) or six small, rounded to moderately elongated porose areas, of which the one just posteriad of seta h3 is the longest; there are none mediad of seta p1. The male pattern is quite different, with the arrangement of the four to six areas variable in detail, especially posteriad of seta h2 (Figs. 1B, C, D). The general male pattern is for the most posterior porose area to curve ventrad between setal pair p1.

The normal complement of five lyrifissures is present and in the usual locations. The opening of the opisthosomal gland (gia) is small, circular and located on a slight surface convexity; the duct widens just inside the exoskeleton and has a well-sclerotized wall. The gland itself is large, flattened in dorsal aspect, and has an unsclerotized wall. Muscle and tendon insertions are similar to those of Mochlozetes penetrabilis as described by Grandjean (1959 b). The ten pairs of notogastral setae are fine, smooth and easily
overlooked if directed at the observer; setae of row \( p \) are about 15 \( \mu m \) long, the others half as long.

The terminations, or caecae, of the hysterosomal tracheae, visible through the notogaster, are moderately bulbous. They have a distinctly sclerotized wall which is strongly rugose on the side in contact with the body contents.

**ANOGENITAL REGION.** As is typical of poronotic oribatid mites, there is a single pair of aggenital setae, two pairs of anal setae, and three pairs of adanal setae; no variations were noted. Setae \( ad_3 \) are slightly anteriad of the anal plates and somewhat laterally displaced. Lyrifissure \( iad \) is adjacent to, and usually aligned with, the lateral margin of the anal cavity, approximately at the level of the anterior anal seta; \( ian \) is not evident. The genital plates each usually bear five setae, but exhibit minor variations; rarely six and more rarely four setae have been observed unilaterally. The ovipositor, male organ and preanal organ are similar to those described for *Mochlozetes penetrabilis*, including the well-developed porose area of the latter (Grandjean, 1959b).

The marginoventral series consists in the female of about 50 small, but variably sized porose areas just ventrad of the attachment of the soft cuticle which connects the notogaster. This series begins near the posterosilateral extremity of the circumpedal carina and completely encircles the ventral plate. In the male, those posterior areas between the levels of setal pair \( p_2 \) are elongated, like a ribbon broken in several places.

**LATERAL REGION OF PODOSOMA.** The most conspicuous surface feature in ventral aspect, under reflected light is the circumpedal carina (\( cir \)) which merges with the discidial carina (\( dis \)) ventrad of acetabulum III (Fig. 5B). Anteriorly, \( dis \) merges with the ventral edge of pedotectum II (without forming a custodium); the later is itself prolonged as ridge extending onto the ventral surface of pedotectum I. Originating on the anteroventral wall of acetabulum IV, another carina is directed anterodorsad to the posterior wall of acetabulum III. This latter carina has the same point of origin as \( dis \); the two carinae form approximately a 60° angle when viewed perpendicular to the integument and epimeral seta \( 4c \) is inserted at their junction. The supracoxal gland opening \( (z) \) and groove-like vestibule of the sejugal stigmata \( (st) \) can be seen in Fig. 5A. A parietal tectum is present anteriad of acetabulum I. A humerosejugal porose area is well-developed, but no separate subhumeral porose area is present.

**COXISTERNAL REGION.** Apodeme II is short, reaching only about half-way to the sagittal plane; it is an arched apodeme (Grandjean, 1952) with the antiaxial fenestration occupying about two-thirds its length. The sejugal apodeme is virtually complete and joins the anterolateral corner of the genital border; it is also antiaxially fenestrated, but only for about one-fourth its length. Apodeme III is similar in length to apodeme II, but much more shallow and without fenestration. Apodeme IV is absent. The coxisternal setation is normal (3-1-3-3), but because of the nature of the sejugal apodemes, seta \( 3a \) inserts on what appears to be epimer II, giving an apparent formula of 3-2-2-3. Epimeral setae are more densely barbed than those of the anogenital region.

**GNATHOSOMA.** The chelicerae are similar to those of *Mochlozetes penetrabilis* (Grandjean, 1959b, Fig. 2E) except that the antiaxial notch is not quite as deep. Otherwise the mouthparts are not distinctive. The palp, with its normal setation, is shown in Fig. 1E.

**LEGS (Fig. 2).** All trochanter-femur and tibiatarsus articulations are at least partially covered by tecta. The paraxial retrotecta ("crispins") near the proximal end of femora I and II are similar to those of *Dynatozetes* (Grandjean, 1960, Fig. 4B, C). The protecta ("manchettes") of trochanters III and IV take the form of ventrodistal scales, best developed on the paraxial side. The usual dorsal protecta of the tibiae, which form distinct partial sockets for the insertion of the tarsi, are better developed in *Mochloribatula,*
and other Mochlozetidae, than in most poronotic oribatid mites. Femora III and IV are flattened, somewhat rectangular in lateral aspect, and have small, but distinct ventral blades, which are distally rounded. Femora I and II have a short proximal stalk and lack ventral blades. The integument of the femora has a microsculpture of fine, doroventrally oriented, streak-like lines, which are generally restricted to the distal quarter on the antiaxial surface, but are more extensively distributed on the paraxial surface. The paraxial porose areas (po π) of all femora and trochanters III and IV are large, well-marked, and usually shaped as indicated in the figures. There is an elongated ventral porose area near the distal end of all tibiae. In addition to the dorsal porose areas of tarsi I and II, there are two ventral areas at the proximal end of all tarsi; rarely these merge to form a single area.

The nature and distribution of leg setae and
solenidia are indicated in the figures. The setal formulae (trochanter to tarsus; famulus included) are: I (1-5-3-4-20); II (1-5-3-4-15); III (2-3-1-3-15); IV (1-2-2-3-12). The solenidial formulae are normal for poronotic oribatid mites: I (1-2-2) ; II (1-1-2) ; III (1-1-0) ; IV (0-1-0). For leg III (Fig. 2C) only those additional setae not also present on leg IV are labeled. Both I and II have the usual single seta (v') on the trochanters, which are not illustrated. The setal homologies of leg II are similar to those of leg I, except for the absence of setae e, pl', p1", v', and l" from tarsus II, along with solenidion v'h." The single v' seta of femur II is antiaxial (v"), but that of femur I is clearly on the paraxial surface, and is given the designation v'; a similar distribution is present on the femora of Mochlozetes penetrabilis and Dynatozetes species (Grandjean, 1959 b, 1960), and is not uncommon elsewhere in the Excentrosclerosae. There is no trace of seta d associated with any of the genual or tibial solenidia, but a second canal, much narrower than the principal canal, can be discerned leading from the alveolus of the tibial solenidia on legs III and IV (fig. 2F, cv), similar to that of tarsus I of Dynatozetes obesus described by Grandjean (1960). This is possibly a vestige of the alveolar canal of seta d.

All claws have barbs along the dorsal surface. The subterminal notches of the lateral claws are small, but distinct on all legs.

**Material Examined.** The type series (14 specimens) was collected from the pubescent form of Borrichia arborescens (L.) D.C. (Asteraceae) on July 1, 1979, in the Bahama Islands, at George-town (Ichi Cay). They were collected by Richard E. Wetzler, whom I thank for the specimens and collection information. The holotype male and one paratype female will be deposited in the Field Museum of Natural History (Chicago, Illinois). Additional paratypes will be deposited in the Yale Peabody Museum (New Haven, Connecticut), the Canadian National Collection (Ottawa, Ontario), and the Hungarian National Museum (Budapest).

Additional specimens were collected from Rachicallis americana (Jacq.) Hitch. (Rubiaceae) at the type location. Both plants are shrubby coastal halophytes which are common throughout the limestone cays of the Bahama Islands and are often exposed to salt-spray.

**IV. Mochloribatula metzi** 3 N. SP.

**ADULT.** Total length of one male 700 µm. Lamellae and cusps relatively large for the genus; cusps with length and width approximately equal in dorsal aspect (Fig. 3A); seta le inserted well anteriad of translamella. Sensillus clavate, gradually expanding distally, minutely barbed. Notogastral setae mostly 7-10 µm long; p1 about 20 µm. Porose area Aa very long, curved anteriodorsad; its length in both sexes greater than half the distance between setae c and la; area Ax reniform or oval; area A, comma-shaped, divided into two parts on one side of female paratype. Modified areas A1 + A2 of male (Fig. 3A, B) composed of two long ribbon-like areas which may be broken distally, and a vertically oriented terminal pair. The latter (Fig. 3C) bordered by raised lateral rims; a narrow central carina present between terminal porose areas, which does not protrude from the cavity formed by the lateral rims. Female with A2 + A3 modified into one small area anteriad of seta h3 and two elongate areas positioned between setae h2-h3 and h1-h2, respectively. Female marginoventral series of porose areas as in M. bahamensis; those of male fused into continuous ribbon between level of setal pair p2, broken into small areas anteriad of p2.

**Material Examined.** The type series (2 males, 1 female) is from a salt marsh at Southport, Brunswick County, North Carolina, collected by

3. This species is named for Dr. Louis J. Metz, who brought the specimens to my attention. He has aided my work in numerous ways during the past several years, for which I am deeply grateful.
Fig. 3: *Mochloribatula metzi* n. sp.: A. — Adult male dorsal aspect. B. — Variation of posterior porose areas of male.
H. — Posterior portion of notogaster of male, dorsal aspect. I. — Posterior aspect of terminal modification of male.
A, B, E-H to same scale.
L. Hobbs by sweeping cord grass (*Spartina alterniflora* Loisel) at the site of Carolina Power & Light Company’s nuclear reactor (date unknown). The holotype male (in alcohol) will be deposited in the Field Museum of Natural History, the two paratypes (on slides) will be retained by the author.

V. *Mochloribatula floridana* (Banks)

*Eremaeus floridanus*: Banks, 1904, p. 145.

**Adult.** Mean total length of 12 males, 655 μm (range 620-680 μm); 10 females 725 μm (range 660-770 μm). Prodorsum similar to that of *M. metzi*; seta *le* inserted well anteriad of translamella on distinct lamellar cusps (Fig. 5D). Sensillus clavate (Fig. 3D). Notogaster finely punctate, somewhat more distinctly foveate than that of *M. metzi*. Notogastral setae short, mostly 6-10 μm; *P₁* about 20 μm. Porose area *Aa* long, curved anterodorsad; its length in both sexes greater than half the distance between setae *c* and *la* (Fig. 3E); in the male it may reach posteriad to level *la*. Area *Ax* circular to oval; *A₁* oval, elliptical or slightly elongated. Area *A₂* + *A₃* of female usually similar to those of *M. metzi*; variations such as those of Figs. 3F, G are less common. Males with terminal modification similar to that of *M. metzi*, but with paired porose areas closer together (Fig. 3H, I) and central carina very robust in all specimens (Fig. 5C), protruding beyond raised rim in lateral aspect. Other portions of *A₂* + *A₃* highly variable, either similar to female or showing patterns similar to those of *M. metzi* males. Marginoventral porose areas as in *M. metzi*.

**Material examined.** The holotype female (slightly broken) was collected at Punta Gorda, Charlotte County, Florida in April (no year or habitat given) and is preserved in alcohol at the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts. Typical of his early work with oribatid mites, Banks did not include with the label any indication of type-status, but the single specimen bears the correct data and undoubtedly can be considered the holotype. Banks’ measurement of the holotype (0.6 mm) was underestimated; it is 720 μm long. Also, his Fig. 18 exaggerates the length of setae *in* and *le*, and does not include the lamellar cusps.

Forty-eight additional specimens were examined, collected from Orange County Florida, 8 km southwest of Orlando by L. Watus. They were extracted from litter at the base of cattails (*Typha* sp., Typhaceae) at the edge of a pond.

VI. *Mochloribatula texana* (Ewing)

*N*. comb.


**Adult.** Mean total length of 12 males, 595 μm (range 559-617 μm); 7 females, 640 μm (range 598-675 μm). Lamellar cusps poorly developed (Figs. 4A, 5H), similar to those of *M. bahamensis*. Rostrum somewhat shorter than in other species 4 (cf. Figs. 5C, E, G). Sensillus subcapitate (Fig. 4B). Notogastral and anogenital region distinctly foveate, superimposed on a very finely granulate integument. Notogastral setae mostly 8-12 μm; *P₁* about 20 μm. Porose area *Aa* of male (Fig. 4A) less than or approximately equal to half the distance between setae *c* and *la*; that of the female about one-fourth this distance. Porose areas *Ax* and *A₁* subcircular to slightly elliptical. Modified areas *A₂* + *A₃* often in form of continuous ribbon which runs posteriad to near midline before curving abruptly ventrad between setal pair *p₁* (Fig. 4C); between *p₁* porose area is usually slightly elevated from rest of integument. Usually a separate small area present anteroven­tral of *h₅*, but this may be fused with rest of rib­bon. Male variations shown in Figs. 4D, E. Marginoventral porose areas as in *M. metzi*.

4. The relative distance between the translamella and the distal end of the rostrum can appear to vary a great deal in dorsal aspect, depending on the angle made by the frontal plane of the specimen and the plane of observation.
although those of the male may be occasionally broken between the levels of setal pair \( p_2 \). Variations of female \( A_2 + A_3 \) shown in Fig. 4 F-H.

**Material examined.** Three cotype specimens, collected from grass on Padre Island, Texas (28 June, 1908) by C. A. Hart, are in the collection of the U.S. National Museum of Natural History, presently in Beltsville, Maryland. All were originally mounted in glycerine jelly and are badly crushed. One (a male) was remounted into Hoyer’s medium for study. Total length was impossible to measure, but length of genital and anal plates, the distance between the interlamellar setae, and other measurements were compared to those of specimens mentioned below. Based on these comparisons, the original length was probably about 600 \( \mu m \); Ewing’s single measurement of 0.67 mm was apparently based on a female.

A series of 14 males, 9 females (and immatures noted below) was provided by, P. L. Whittaker, who collected them from partially hollow twigs of mistletoe (Phoradendron tomeritosum, Loranthaceae), 1 June 1981, at the Chaparral Wildlife Management Area, La Salle County, Texas. Voucher specimens will be deposited in the collections of the Cornell University Department of Entomology.

**VII. Mochloribatula depilis (Ewing)**


*Zygoribatula depilis* (Ewing); Woolley, 1961, p. 11.

Ewing (1909) proposed *Notaspis depilis* based on “several specimens” found “on peaches infested with *Curculio*” at Metropolis, Illinois (L. M. Smith, col.). None of these, including the male figured by Woolley (1961, Fig. 12, 13) could be found in the U.S. National Museum collections after extensive searching, so a diagnosis is not presented here.

*Mochloribatula depilis* and *M. texana* are possibly synonyms, and Woolley’s figures could easily represent a male *M. texana*. Ewing mentioned the following three differences between the two species. 1) The body of *M. texanus* is supposedly larger (0.67 mm) than that of *M. depilis* (0.53 mm). However, Woolley’s measurement of a cotype (undoubtedly a male) was 566 \( \mu m \), well within the range for males of *M. texana*, and it seems likely that no significant size differences exist between the two taxa. 2) The lamellae are supposedly longer in *M. texana*. Assuming that Ewing referred to a relative, rather than absolute difference, I compared measurements of lamellar length relative to fixed structures (genital and anal plates). No differences were found between the relative lamellar lengths as expressed in Woolley’s figures and available specimens of *M. texana* (including the cotype male). 3) The legs of *M. texana*, according to Ewing, are longer than those of *M. depilis*. Unfortunately, Woolley did not illustrate the legs of the latter, so relative measurements cannot be made, but I have seen no apparent differences in leg:body proportions in any of the species discussed previously.

**VIII. ONTOGENY OF Mochloribatula texana**

(Ewing)

Descriptions of immature instars of mochlozetid mites are available only for *Mochlozetes penetrabilis* (deutonymph and tritonymph; Grandjean, 1959 b) and *Podoribates gratus* (all instars, Grandjean, 1963). The following comments on the ontogeny of *Mochloribatula texana* are based on the series collected by P. L. Whittaker, as mentioned above. A single nymph of *Mochloribatula floridana* from the Orange Co., Florida material was superficially examined, but lost before detailed comparisons could be made. The general facies of this specimen (e.g., shape of body and setae, nature of the opisthosomal gland) were the same as indicated below for the nymphs of *M. texana*, and these are probably characteristic of the genus.

**Size, Color.** The total length (mean and range) of five specimens of each nymphal instar are: protonymph, 328 \( \mu m \) (308-347 \( \mu m \)); deu-
tonymph, 416 μm (405-424 μm); tritonymph, 528 μm (501-569 μm). The body is light, yellowish brown in the deutonymph, almost colorless in the protonymph. The region of the opisthosomal gland is conspicuous with its dark brown, almost black coloration; this is due both to pigment in the plicate walls of the gland itself and to a porose, leathery, more darkly pigmented area of the overlying integument. The latter is conspicuous even on nymphal exuviae. Transformation to the unpigmented, flattened gland of the adult is abrupt.

GASTRONOTIC REGION. The nymphs appear rather angular in dorsoventral aspect (Fig. 41); they are widest at the level of the opisthosomal gland, behind which the body outline tapers strongly. The tritonymph has three pairs of setae which are especially obvious in this orientation even at low magnification; c₁ is long (ca. 110 μm) and projects laterad from the humeral region; p₁ is even longer (ca. 160 μm) and curved posterolaterad from the end of the body; h₂ is only half the length of p₁, but also projects from the body outline. Setae c₁ and the dorsocentral series (da, dm, dp) are all similar in size to h₂, but are almost erect, slightly angled media (those of Fig. 41 are depressed to indicate their shape). Other gastronomic setae are small and less conspicuous; lm is about 25 μm; p₂, p₃, h₁, h₃, c₂, la and lp are half that length or less. All are barbed to some degree. All have porose eccentric sclerites at their base, typical of the Excentrosclerosae, but only those of c₂, la, lp and h₃ are large and conspicuous.

The setation is similar in overall appearance in the younger nymphs, except for rows h and p. Seta p₁ of the protonymph is positioned ventrally and is small, inconspicuous; it abruptly becomes long in the deutonymph, proportionally even somewhat longer than that of the tritonymph. The facies seen in Fig. 41 is maintained in the protonymph, however, because h₂ has a position and appearance comparable to that of p₁, of older nymphs; in the deutonymph and tritonymph h₃ becomes successively shorter and more laterally positioned. Seta h₁ of the protonymph has a position and appearance similar to that of tritonymphal h₁. Seta h₁ of both protonymph and deutonymph is proportionally intermediate between lm and the dorsocentral setae; both h₁ and h₃ become abruptly smaller in the tritonymph. The general pattern is consistent with Grandjean’s (1964) concept of anhomologous tautergy: a similar facies is maintained during ontogeny, but with non-homologous structures.

PRODORSUM, VENTRAL REGIONS. The prodorsal setation of all nymphs is similar to that of the adult. The development of coxisternal formulae is as follows: protonymph (3-1-2-1); deutonymph (3-1-2-2); tritonymph (3-1-3-3). Both protonymph and deutonymph have glabrous paraprocts, but inconspicuous setal vestiges are present. Otherwise, ontogeny of the anal region is normal. Distinct, porose eccentric sclerites are present at the bases of setae ad₂ and ad₃ (but not ad₁) in the deutono- and tritonymph. The single aggenital seta is deutonymphal.

The ontogeny of genital setation (1-2-4, proto-tritonymph) is interesting. It adds evidence to Grandjean’s (1961) hypothesis that genital setae are usually eustasic, since it is apparent that development is not simply arrested at the tritonymphal number to form the adult complement of five setae. Arrested development would be indicated by a nymphal formula like that of Podoribates gratus (1-3-5), which has the usual mochlozetid adult number of six genital setae.

LEGS. The ventral porose areas of leg tarsi are very distinct in all nymphs; the dorsal porose areas of tarsi I and II and the subtibial areas are not evident until the tritonymph. The paraxial porose areas of the femora are, as usual, much more extensive than in the adult and cover much of the ventral surface; they are distinct in the deutono- and tritonymph, but very weakly developed in the protonymph.

Setal ontogeny is indicated in Table 1; no variations were noted. Unless this species is unusual, the larval leg setation (I-III) should be identical to that of the protonymph; this is the case in Podoribates gratus (Grandjean, 1963).
and probably most poronotic oribatid mites. Only solenidion $\omega_2$ of tarsus I is typically added in the protonymph. Solenidial ontogeny is normal; $\omega_2$ of tarsus II, $\omega$ of tarsus IV, and $\varphi_2$ of tibia I are all formed in the deutonymph. Eupathidial development is also normal on tarsus I; proral setae are eupathidic in all instars examined and the subunguinal seta becomes eupathidic in the adult.

**Comparative Setal Ontogeny.** Although the adult leg setation of *M. texanus* differs from that of *Mochloribatula texana* only by the presence of seta $\ell'$ on genu III, there are several ontogenetic differences. Seta $\ell''$ of femora I and II is tritonymphal in *M. texanus* but is present in the deutonymph of *M. penetrabilis*. Seta $\ell'$ of tibia IV, formed in the adult of *M. texanus*, is tritonymphal in *M. penetrabilis*. More interestingly, Grandjean (1959 b) suggested that in *M. penetrabilis* trochanter III setae $\nu'$ and $\nu''$ have a reverse ontogeny, compared to the usual order (which is exhibited by *M. texanus*); that is, $\nu'$ appears before $\nu''$ in the former species.

The leg setation of *Podoribates gratus* is identical to that of *M. texanus* in the adult instar, except that the anteroventral seta of femur I is antiaxial ($\nu''$) rather than paraxial. Developmentally, *P. gratus* differs from *M. texanus* in the following ways: seta $\ell''$ forms in the adult on femora I and II; $\ell'$ appears in the tritonymph on femur II and the adult on femur III; $\nu'$ forms in the adult on genua I and II; $\nu''$ forms in the adult on tibiae I and II; $\ell'$ and $\nu''$ form in the adult on tibia III. All these differences involve retardation of appearance by one instar, compared to *M. texanus*.

**IX. Relationships with Plants**

Although representatives of many oribatid mite genera are primarily or exclusively plant associates, such relationships are rarely characteristic...
of whole families. The Cymbaeremaeidae and Micreremaeidae are exceptions among pycnontic oribatid mites, and the Oripodidae and Mochlozetidae seem to be poronotic exceptions. This does not mean that representatives of these groups are never found in soil or leaf litter; such occurrences apparently result from accidental dislodgement from living vegetation, from dispersal behavior, or from vertical migrations of a daily or seasonal periodicity. The chance of encountering such mites in leaf litter may thus vary temporarily. Grandjean (1960) failed to discover specimens of Dynatozetes amplus or D. obesus in leaf litter below the tree branches and aerial roots which they normally inhabit, but I have seen representatives of both species in Berlese-funnel residues extracted from litter. Podoribates gratus, which lives primarily on grass plants, can occasionally be encountered in soil or litter (Grandjean, 1963). In fact, a majority of the known species of Podoribates have been described by soil biologists, from adult specimens extracted in low numbers from soil or litter; it is probable that their true microhabitats remain undiscovered.

Of the four Mochloribatula species discussed above, only M. floridana was collected from organic litter, and this was at the base of living cat-tails. The latter may have been the principal substrate of the mite, but were not sampled. The two species described by Mahunka (1978) are known from litter, but again, this was the only substrate sampled. It seems likely that Mochloribatula, like other genera in the family are for the most part plant-inhabitants.

Although we know little of their host-plant distribution, species of Mochlozetidae probably do not exhibit much specificity. One reason is that the plants themselves do not appear to serve as direct sources of nutrition. Although representatives of Dynatozetes obesus and Terrazetes mauritius ingest material of higher plant origin (Grandjean, 1960), most mochlozetid mites appear to feed primarily on fungal spores and hyphae. I have found a wide variety of pigment-ed and hyaline spores in Mochloribatula guts, but hyphal fragments were rarely encountered. It seems more likely that general habitat and plant growth form will prove to be principal determinants of mohlozetid mite distribution, but even growth form may not be critical in some species. Mochlozetes penetrabilis, for example, has been collected from both trees and herbaceous vegetation (Grandjean, 1959 b). It appears that Mochloribatula texana, originally collected from grasses but now known from mistletoe twigs, may be similarly euryecious.

**LITERATURE CITED**

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