

BIOLOGY OF *MICROMEGISTUS BAKERI* TRÄGÅRDH, 1948
(ACARINA : PARANTENNULIDAE)
WITH DESCRIPTIONS OF IMMATURES AND REDESCRIPTION OF ADULTS ¹

BY

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and

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INTRODUCTION.

Prior to this study, knowledge of the host relationships of *Micromegistus bakeri* was limited to original work by TRÄGÅRDH (1948) who described the species from adults found on the carabid beetle, *Scarites subterraneus* Fabricius, collected in Mississippi. Although the mite has been collected by other workers, notably at the University of Kansas and at Ohio State University, there is no published information on its biology or immature stages. CAMIN and GORIROSSI (1955), who placed *Micromegistus* in its present family, judged TRÄGÅRDH's original description inaccurate and indicated the need for redescription.

MATERIALS AND METHODS.

Carabid beetles were collected in the vicinity of Manhattan, Kansas, from May 1966 through August 1968. Only live beetles were taken and specimens to be used for survey and host preference studies were placed separately into a clean, disposable plastic vial containing 70 % ethyl alcohol. Mites subsequently found were transferred to clean glass vials of 70 % alcohol until mounted.

For biological and behavioral studies, mites were obtained by collecting infested *Scarites subterraneus* and maintaining the beetles at room temperature in petri dishes or small glass jars with a maximum of 5 cm of moist soil. The beetles were fed daily with facefly pupae, Indian meal moth larvae or mealworms. Mites were marked on the dorsum with butyrate dope to

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facilitate observing individual development and activity. At night, red cellophane sometimes was placed over the light source in an attempt to detect behavioral differences by the mites between white and red light.

RESULTS AND DISCUSSION.

I. Host distribution and preference sites.

Micromegistus bakeri was found on three carabid species : *S. subterraneus*, *Evarthrus sodalis colossus* Le Comte and *Patrobis longicornis* (Say). The latter two constitute new host records.

Infestation rates and other survey data are recorded in Table 1. *S. subterraneus* apparently is the commonest host, as this carabid supported 96.7 % of the collected population and had a high (46.4 %) incidence of infestation.

TABLE 1 : Host distribution and infestation rates of *Micromegistus bakeri*.

Host	No. of beetles examined	No. of infested beetles	% infestation	No. of mites collected	Population preference ¹	Av. No. mites per infested beetle	No. of mites in maximal infestation
<i>Scarites subterraneus</i>	112	52	46.4	150	96.7	3.4	14
<i>Evarthrus sodalis colossus</i>	6	2	33.3	4	2.5	2.0	3
<i>Patrobis longicornis</i>	4	1	25.0	1	0.8	1.0	1

1. Represents the percent of population as measured by dividing the total number of mites collected on a host by the total number of mites from all hosts.

Morphological sites favored by the mite were the coxae, trochanters or femora of legs II. Other sites included (in decreasing preference) those same segments of different legs and the venter of the thorax near the prothoracic and mesothoracic junction. They were seldom seen on the elytra.

Collected mites included 30 % larvae, 10 % protonymphs, 10 % deutonymphs, 30 % females and 20 % males.

II. Biology and behavior.

The female is viviparous. Two large oval eggs, which together occupy more than one-half of the opisthosoma, develop almost simultaneously. Approximately 14 days elapse between the birth of two concurrently developing larvae and the birth of the next brood. The emergence of contemporary larvae is separated by about 24 hours.

Birth of one active larva was seen. This larva was already in the process of emerging through the mother's genital aperture when observation began. It escaped with its dorsum towards the substrate and gnathosoma towards the anterior of the female. Following emergence, the larva remained clinging to its mother's venter for three to five minutes and then moved to and around her dorsum for a similar period of time. Then it descended to the beetle and wandered

about for several minutes on the carabid's venter before settling near the junction of trochanter and femur II.

On one other occasion an amorphous ball was observed being extruded through a female's genital aperture. The object was saved and maintained at room temperature and with high humidity for several weeks in a clean glass vial. No change was noted. Our conjecture is that the mass was egg membrane and other embryonic remains being eliminated from the genital chamber.

All stages of the mite's life cycle occur on its host. The larval instar lasts 15 to 20 days, protonymph 12 to 15 days and the deutonymph 15 to 20 days. Individual adults have been maintained on their hosts for more than four months.

It is believed that the mites overwinter on the adult beetles (*S. subterraneus*) which normally survive the winter in their subterranean tunnels. Two such hosts were collected under boards in January, 1968, and each had one live female mite.

At all times the antenniform legs I are held aloft and are waved up and down and from side much like the antennae of insects. They are not used for ambulation.

Preening occurred with legs I and IV in the usual arachnid fashion and the ambulacra of legs II, III and IV were frequently brought forward and passed between the mouthparts.

Usually when a mite was brushed off by a beetle, it would move quickly about the soil while swiftly waving its antenniform legs I as previously described. Upon making contact with the beetle, the mite would remount and wander rapidly over the host's surface until it became situated at one of the usual sites mentioned above.

Occasionally adult mites were observed jumping back onto their hosts (sometimes from a distance of more than four times their own body length) after they had crawled off or had been brushed off by the beetle.

On one occasion a protonymph that had left its host was seen apparently ingesting water from a moistened clump of soil. It remained at this site for 60 to 90 seconds during which time its mouthparts were in contact with the soil and were constantly moving. The ambulacra also were frequently brought up to and passed between the chelicerae. Following this, the protonymph immediately remounted its host and became situated on femur II with little further activity.

Elimination was observed several times. Before deposition, the mite often backed up slightly, then dipped its opisthosoma and deposited a droplet of waste which evaporated to one-half its original volume within one minute. That left a soft mass of waste debris which, in heavy infestations, would build up on the anterior portion of the beetle's mesosternum and between coxae II (a common site of the adult mites).

No behavioral responses to light were noted in either white light or red light, nor when the light was switched off and on.

III. *Feeding and symbiotic relationship.*

Micromegistus bakeri was observed feeding on organic debris in the following ways : (1) Once a larva and protonymph were observed leaving the host and wandering over the soil surface until they came upon remains of a mealworm. The larva fed for only one or two minutes before remounting the beetle. The protonymph, however, entered the tubular remnants of the mealworm and stayed over a period of two to three hours. While the protonymph remained in the mealworm exoskeleton, it essentially was stationary, although the gnathosoma continually moved as the mite apparently was feeding. (2) Several times mites were observed on or near the host's

mouthparts where they procured particles of the beetle's food adhering there. (3) Mites occasionally were seen manipulating, with their chelicerae and pedipalps, organic particles clinging to the surface of the host and appeared to ingest them.

This mite evidently also feeds on the beetle's dermal secretions. HUGHES (1959) stated : " Members of the family Parantennulidae have chelicerae provided with numerous flap-like projections on the digits, and it is thought that these may be used in wiping secretions of the dermal glands from the host's surface. " Such flap-like projections occur on the chelicerae of *M. bakeri* (Fig. 6 a) and while mites were observed at their preferred sites, their mouthparts were in constant motion, with their chelicerae making lateral, wiping movements. Experiments were conducted in which five microliters of radioactive sodium acetate were injected intracoe-lomically into beetles. Mites were allowed to remain on injected and noninjected (control) beetles for seven and twelve days. Subsequently they were removed, washed with hexane, crushed on tissue paper and counted for radioactivity using a Beckman LS-100 liquid system scintillation counter. In both cases counts were low, but the mites from injected beetles had from 50 to 70 counts per hour more than the control mites. An additional experiment was conducted with radioactive sodium acetate applied by brush directly to the beetle's venter, and the mites replaced on the host for 24 hours. Other procedures remained as above. The results were nearly identical to those previously obtained. These preliminary experiments are not conclusive, but support the theory that the mites feed on the beetle's external secretions.

Micromegistus bakeri was neither seen feeding on or otherwise molesting anoetid hypopi that occasionally infested the beetle, nor was its chelicerae ever observed inserted into the host ; they do not appear suitably adapted for that purpose.

Literature regarding Parantennulidae often reports that they are parasitic. *Micromegistus bakeri*, however, as present information indicates, apparently is a commensal feeding on organic debris (particularly food remnants of the host) and its diet may be supplemented by feeding on the host's external secretions without measurable injury to the beetle.

IV. Description of *Micromegistus bakeri* Trägårdh, 1948.

1. Description of immatures.

LARVA (Figs. 1 and 2). Idiosoma 350 to 410 μ long, 290 to 330 μ wide ; color ivory-white ; shape almost circular, posterior one-half slightly wider than anterior one-half, with blunt anterior margin, posterior margin nearly semi-circular, body somewhat flattened dorso-ventrally ; peritreme and stigma absent. *Gnathosoma*. Conspicuous, with 3-tined corniculus situated on dorsal posterolateral margin of hypostome ; 2 pairs of hypostomal setae, the first larger than the second ; chelicerae weakly sclerotized, with long, narrow, edentate chela ; movable digit with 2 excrescences, both much longer than chela, one straight, membranous, and biramous forming 2 lanceolate projections with serrate margins, the other polydactylous with numerous filamentous processes ; fixed digit with slightly S-shaped membranous flap longer than chela and fringed with hair-like projections ; palpi 5 segmented, terminal segment tapering gradually to a blunt point and bearing numerous tactile setae, penultimate segment with 3-tined claw and numerous tactile setae. *Legs*. 3 pairs, long and strong, chaetotoxy as shown in Table 2 ; legs I with 6 segments, antenniform, more slender than other legs, tarsus obliquely cut off at the tip, claws and ambulacra lacking ; legs II and III with 7 segments, the tarsal segment divided into a metatarsus and tarsus, possessing well-developed claws and ambulacra. *Dorsum* (Fig. 2). Dorsal shield entire. Same general shape as body, anterior margin essentially truncate, lateral margins nearly straight, pos-

terior margin curved ; bearing 9 pairs of subequal setae, 6 pairs on podosomal region, 3 longest pairs on opisthosomal region ; 3 pairs of setae in membrane posterior to dorsal shield. *Venter* (Fig. 1). Tritosternum present, basal portion longer than wide and slightly wider at posterior, lacinae paired, not fused, pilose ; sternal shield nearly cordate, lateral edges thickened to ridges, posterolateral margins not united with rest of shield, bearing 3 pairs of setae ; metapodal shields

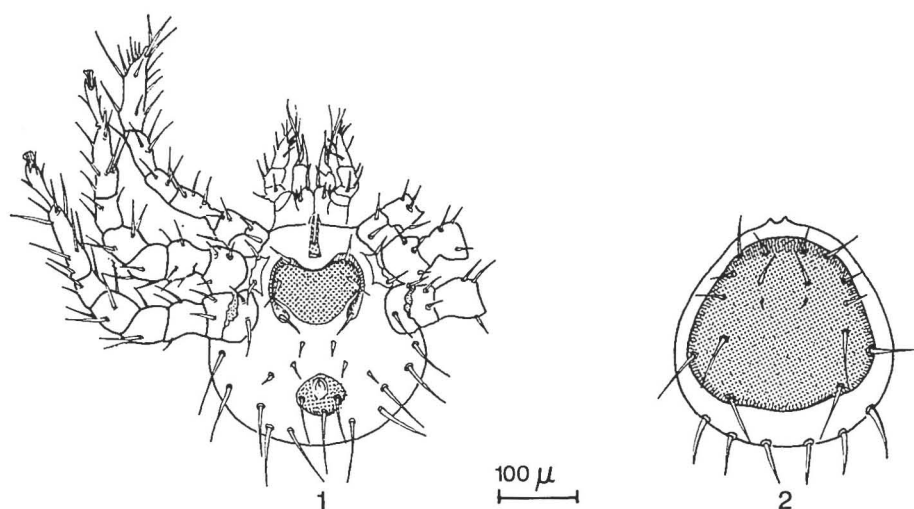


FIG. 1-2 : *Micromegistus bakeri* larva, ventral view (1) and dorsal view (2).

very weak ; anal shield quadrangular, with 3 setae ; 3 pairs of short setae in membranous area between sternal and anal plates ; 5 pairs long setae at lateral opisthosomal margin.

PROTONYMPH (Figs. 3 and 4). Idiosoma 440 to 465 μ long, 360 to 385 μ wide ; color pale white to very pale yellow ; shape ovate, posterior slightly wider than anterior, anterior margin blunt, other margins curved, body somewhat flattened dorso-ventrally ; stigmata open opposite leg IV ; peritreme short, about 38 μ long, sausage-shaped. *Gnathosoma*. Same as larva except as follows : with 3 pairs of hypostomal setae, the first greater than 2X width of remainder ; 1 pair of deutostomal setae ; chelicerae similar to larva ; palpi similar to larva. *Legs*. 4 pairs, long and strong, possess no specialized setae ; chaetotaxy as shown in Table 2 ; legs I with 6 segments, antenniform, resemble those of larva ; legs II-IV with 7 segments, claws and ambulacra well developed. *Dorsum* (Fig. 4). Dorsal shield entire, anterior margin truncate, lateral margins slightly curved, posterior margin almost semicircular ; bearing 11 pairs of equal-sized setae, 7 pairs on podosomal region, 4 pairs on opisthosomal region ; 9 pairs of setae in membrane adjacent to dorsal shield. *Venter* (Fig. 3). Tritosternum similar to larva ; sternal shield cordate with broad posterior lobe, anterolateral edges slightly thickened, bearing 3 pairs of setae ; metapodal and endopodal shields weak ; anal shield nearly triangular, with only 1 pair of setae ; 3 pairs of setae on membranous ventral region and 4 pairs forming a concave-shaped line posterolaterad to anal shield, all arising from small, circular plates ; 5 pairs setae on opisthosomal margin.

DEUTONYMPH (Fig. 5). Idiosoma 475 to 600 μ long, 460 to 580 μ wide ; color yellowish-tan to light brown ; shape same as protonymph ; stigmata same as protonymph, peritreme relatively short, about 66 μ long, sausage-shaped. *Gnathosoma*. Same as protonymph. *Legs*. Like protonymph, chaetoxxy as in Table 2. *Dorsum*. Dorsal shield like protonymph except bea-

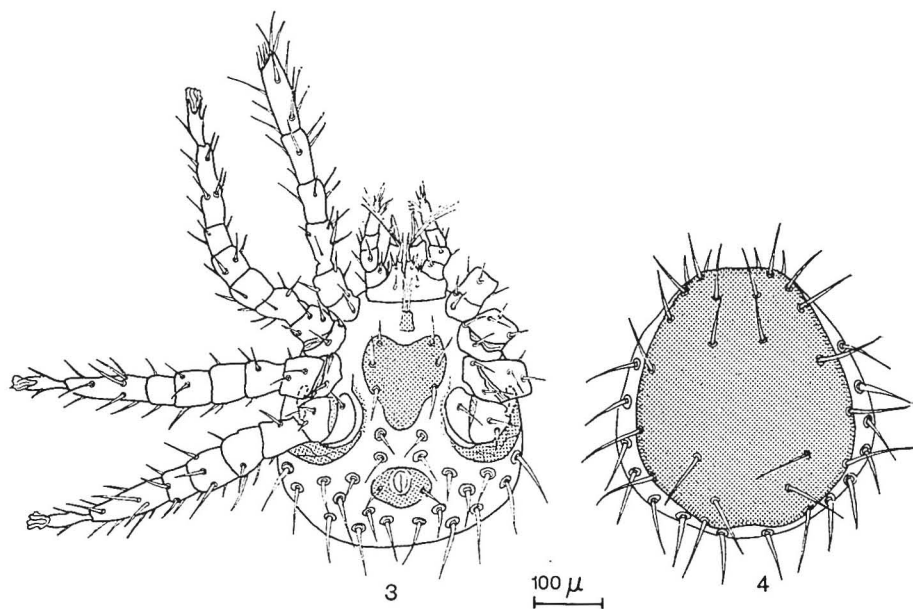


FIG. 3-4 : *Micromegistus bakeri* protonymph, ventral view (3) and dorsal view (4).

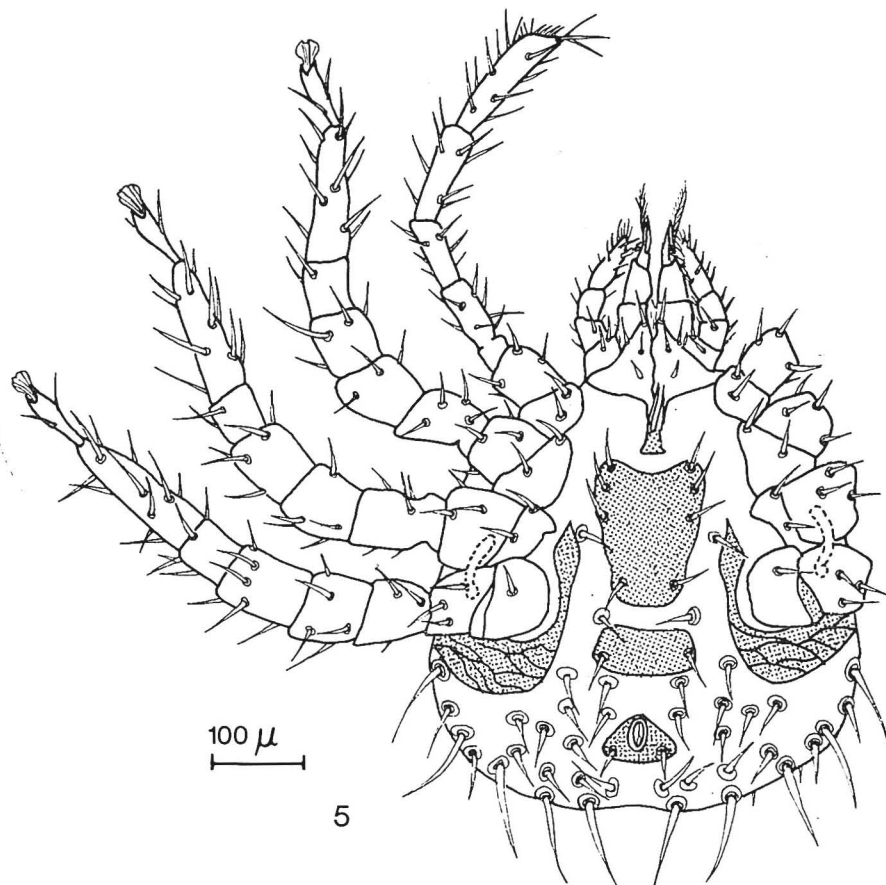


FIG. 5 : *Micromegistus bakeri* deutonymph, ventral view.

ring 12 pairs of equal-sized setae ; 8 pairs of setae in membrane of dorsal shield. *Venter*. Tritosternum as in previous instars ; sternal shield quadrangular, longer than wide, anterior half wider than posterior half, anterior margin concave, posterior margin truncate, bearing 4 pairs of setae ; metapodal and endopodal shields more developed than protonymph ; ventral shield present, nearly rectangular, wider than long, normally bearing 1 pair of setae ; 1 pair of setae in membrane slightly posterolaterad of third sternal setae, 1 pair between sternal shield and ventral shield and 1 pair on anal shield ; 7 pairs forming 2 transverse lines laterad or posterior to anal shield, all arising from small circular plates, 6 pairs of setae on opisthosomal margin.

2. Redescription of adults.

FEMALE (Figs. 7-9). Idiosoma 675 to 750 μ long, 635 to 700 μ wide ; color light tan to reddish brown ; dorsal shield shape ovate, posterior slightly wider than anterior, anterior end blunt, other margins curved ; body somewhat flattened dorsoventrally ; stigmata open opposite

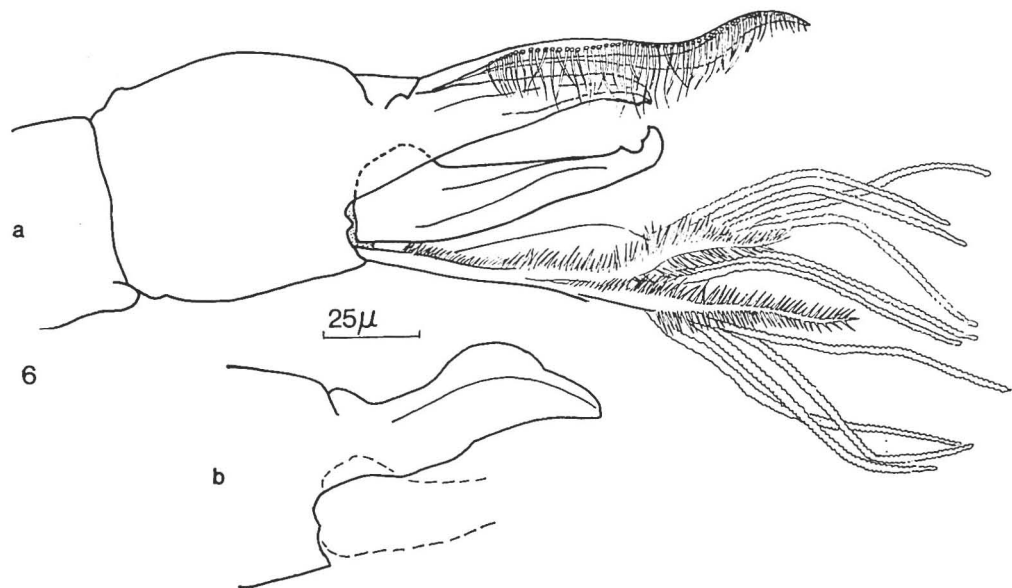


FIG. 6 : Chelicera of *Micromegistus bakeri* : a — of protonymph, b — of male.

leg IV ; peritreme relatively short, about 115 μ long, proximal half curved. *Gnathosoma*. Conspicuous, with 3-tined corniculi situated on dorsal posterolateral margins of hypostome ; 3 pairs of hypostomal setae, the first greater than 2X width of remainder, 1 pair of deutostomal setae ; chelicerae and palpi as described in larva ; tectum broad, anterior margin arcuate and smooth. *Legs*. Like protonymph in shape, chaetotaxy as shown in Table 2. *Dorsum* (Fig. 8). Dorsal shield like deutonymph except bearing 12 to 15 pairs of setae (varies with extent of sclerotization into shield). *Venter* (Fig. 7). Tritosternum as described in larva ; jugular shields fused, not distinct (seen only poorly with phase microscope), separate from sternogynial area, narrow, transverse, bearing sternal setae I at posterolateral margin, pores I not observed ; sternal setae II posteromesad to I and on triangular platelet ; sternal setae IV on endopodal plates lateral to II and posterad to sternals I ; area homologous to sternogynial shield moderately sclerotized, about 50 to 65 μ at maximal medial length and 115 μ wide, bearing sternal setae III on anterior margin ; latigynial shields indistinct, not hinged, membranous laterally with sclerotized triangular pla-

telet medially bearing 2 pairs of setae ; mesogynial shield hypertrophied, distinct, hinged to ventral shield, moderately sclerotized, 75 to 80 μ long and 120 to 135 μ wide, anterior margin usually arcuate, lateral and posterior margins nearly straight, bearing 2 pairs of setae, 1 pair at postero-lateral corners and 1 pair about 30 μ anterior to latter ; vaginal sclerites reduced, claviform, arms fused with bow-shaped basal portion ; ventral shield large, 150 to 175 μ at maximal medial length

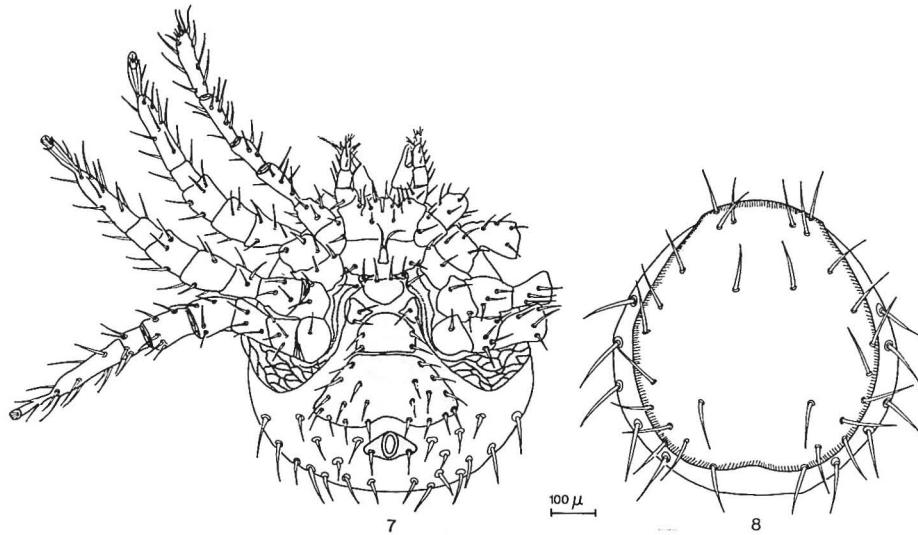


FIG. 7-8 : *Micromegistus bakeri* female, ventral view (7) and dorsal view (8).

and 330 to 400 μ wide at widest portion, separate but hinged to posterior margin of mesogynial shield, anterior and lateral margins straight, the latter gradually widening, posterior margin rounded but concave medially, bearing 8 to 10 pairs of setae ; anal shield triangular, about 63 μ long medially and 100 to 120 μ wide at widest portion, bearing 1 pair of setae.

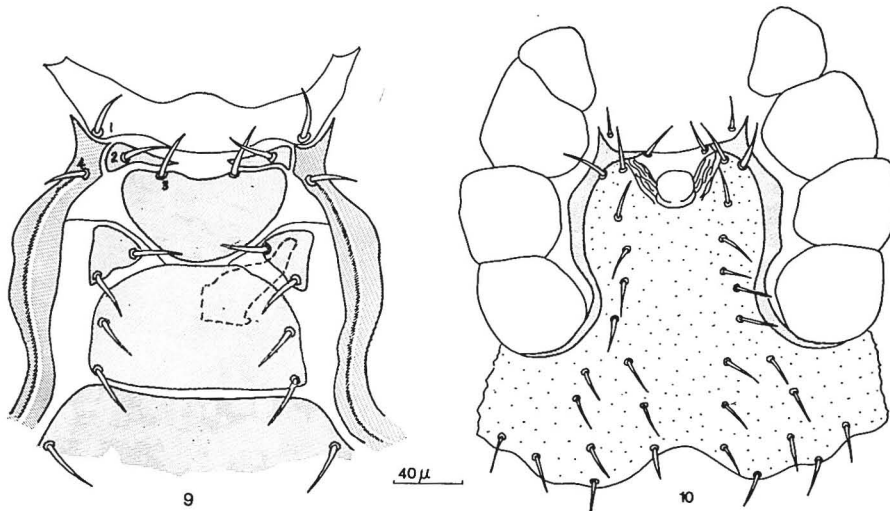


FIG. 9-10 : Sternogenital region of *Micromegistus bakeri* female (9) and male (10).
(9 — Redrawn and modified from Donald E. Johnston, An Atlas of Acari, 1968).

MALE. General shape and facies as in female. Size smaller and nearly as wide as long, idiosoma 610 to 625 μ long and 585 to 625 μ wide. *Gnathosoma*. Similar to female, sexual dimorphism, limited to hypostomal setae II being hooked at tip and shape of fixed digit of chelicerae (Fig. 6 b). *Legs*. As in female. *Dorsum*. As in female. *Venter*. Jugular shields nearly membranous as in female; all other ventral shields except anal fused into holoventral shield, anterolateral and lateral margins heavily sclerotized, posterior margin concave medially at area of anal shield, central portion of holoventral shield (Fig. 10) bearing 32 to 42 setae (number varies with amount of venter sclerotized posteriorly); genital aperture small, circular, with small posterior flange, situated submarginally at anterior of holoventral shield and at level between bases of coxae II and III; anal shield as in female.

Diagnosis. Dorsal shield entire. Jugular shields fused, very weakly sclerotized, narrow transversely. Chelicerae moderately sclerotized, edentate except for minute teeth at tips of chelae, movable digit with 2 large excrescences, fixed digit with large S-shaped excrescent. *Female*. Sternogynial area sclerotized, width greater than length; latigynial shields not distinct, membranous laterally, with sclerotized triangular plate medially bearing 2 pairs of setae; mesogynial shield hypertrophied, distinct, hinged, moderately sclerotized; ventral shield large, separate, widens posteriorly; anal shield small, separate, triangular. *Male*. Genital aperture near anterior margin of sternal shield, jugular and anal shields separate, all other ventral shields coalesced.

TABLE 2 : Leg chaetotaxy for *Micromegistus bakeri*.

Segment	Larva			Protonymph				Deutonymph				Adult female			
	I	II	III	I	II	III	IV	I	II	III	IV	I	II	III	IV
tarsus	28	11	11	30	12	12	13	34	14	15	15	34	14	15	15
metatarsus	—	4	4	—	4	4	6	—	4	4	6	—	4	4	6
tibia	8	7	7	8	7	7	7	12	10	10	11	12	10	10	11
genu	8	6	6	8	6	6	6	10	11	11	12	10	11	11	12
femur	10	7	5	10	7	5	4	10	10	7	8	11	10	7	8
trochanter	4	4	4	4	4	4	4	6	5	5	5	6	5	5	5
coxa	2	2	2	2	2	2	1	2	2	2	1	2	2	2	1

REMARKS. The above description of *Micromegistus bakeri* adults is based on 5 females and 4 males found on *Scarites subterraneus* collected in Manhattan, Kansas, and identified by Dr. Joseph H. CAMIN, the University of Kansas. They were significantly smaller by about 200 μ than originally described by TRÄGÅRDH, but are undoubtedly the same species.

M. bakeri differs from the only other known species of this genus, *M. gowrlayi* Womersley (1958), by having a much shorter mesogynial shield, larger sternogynial area and latigynial shields with 2 instead of 4 pairs of setae. Also, to date, *M. gowrlayi* has been reported only from New Zealand.

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