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MACROCHELES RODRIGUEZI, A NEW SPECIES OF MITE FROM KANSAS (ACARINA: MACROCHELIDAE) WITH NOTES ON ITS LIFE CYCLE AND BEHAVIOR

BY

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Although macrochelid mites are extremely common in the United States, until recently little attention has been devoted to their study. In England, Evans (1956) published an excellent study of the classification of the Macrochelidae and Evans and Browning (1956) published a comprehensive study of the British mites of the Macrochelinae. While the taxonomy of the family is far from settled, the bionomics of the family are even less well known. The present investigation deals with the description, life cycle and behavior of a new predatory species of macrochelid mite.

Macrocheles rodriguezi n. sp.

FEMALE (Figs. 1-4).

Length of idiosoma averages 904 μ, with a range of 822-963 μ; width of idiosoma at posterior level of coxae II averages 562 μ, with a range of 535-611 μ. Dorsal shield strongly sculptured with punctate-reticulate pattern, lateral and posterior margins irregular; with twenty-eight pairs of dorsal shield setae, of which all but setae D7, M3, and M4 are plumose or weakly pectinate distally; vertical setae plumose and inserted adjacent to one another; setae M1 short and weakly pectinate, inserted anterior to setae D6; setae D8 rarely plumose distally and inserted slightly anterior to the insertions of setae M5-6.

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4. References to setae are derived from a nomenclatorial system used by Evans and Browning (1956).
Sternal shield with a strong reticulate pattern similar to that of the dorsal shield; with three pairs of simple sternal setae, with sternal setae II lying in nearly a straight line with sternals I and III. Metasternal setae simple, inserted on small ovoid metasternal shields which lie posterolateral of sternal setae III. Epigynial shield punctate-reticulate and with a pair of simple setae at the posterolateral angles; lateral accessory sclerites distinct. Ventrianal shield peltate, somewhat wider than epigynial shield but not extending laterally beyond coxae IV; with a strong punctate-reticulate pattern and three pairs of preanal setae arranged as illustrated of which only preanals II are distally plumose; adanal setae longer than preanals and weakly plumose distally, postanal seta short, simple. Metapodal shields elongate, lying behind coxae IV. Integumental pattern striate and weakly aciculate in ventrianal-metapodal region. Stigmata opening laterad of a point between coxae III-IV; peritremes extending anteriorly beyond coxae II and dorsally to a point anterior to setae M1. Hypostome with the usual three pairs of setae, of which the internal rostrals are the longest; with five rows of deutosternal teeth and a pair of simple deutosternal setae. Tectum tripartite, with the central element divided distally. Palpí five-segmented and with a strong three-tined claw on the palptarsus. Digitus mobilis of chelicera with two small teeth and a large and a small setal brush basally; fixed digit with a single crenulate tooth and a
short pilus dentilis, seta on fixed digit simple. *Legs* with strong patterns of grooves and ridges; setae on legs plumose distally.

**MALE (Figs. 5 & 6).**

Length of idiosoma averages 634 μ, with a range of 597–728 μ; width of idiosoma at posterior level of coxae II averages 407 μ, with a range of 376–470 μ. Similar to female except in the following respects: ventrally with fused sternal-

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ventral elements (sterniti-genital shield) which is ornamented as illustrated; with five pairs of simple setae and three pairs of pores. Ventrianal shield similar to that of female, except that the adanal setae apparently are simple. Sperm transfer organ on digitus mobilis of chelicera distinctly longer than the digit. Femur II with a large apically-rounded ventral spur; genu and tibia II, and trochanter and femur IV, each with a small spur.
TYPE SPECIMENS.

The type specimens were taken from a laboratory colony started from mites collected at Lawrence, Kansas, in January, 1958. The holotype female and allotype male will be deposited in the collection at the U. S. National Museum, Washington, D. C. Paratype specimens will be placed in the collections of the Snow Museum, University of Kansas, Lawrence, Kansas, Oregon State University, Corvallis, Oregon, and the British Museum (Natural History), London, England.

M. rodriguezi is named in honor of Dr. J. G. Rodriguez, University of Kentucky.

Materials and methods: The stock colony of Macrocheles rodriguezi was started with mites obtained under a board in Lawrence, Kansas during January 1958 by Robert Sluss. A colony of acarid mites was also started at this time as a possible food source for the macrochelids. Each species was reared separately in glass containers (stender dishes and jars). The bottoms of the containers were overlaid with a layer of plaster-of-paris containing activated charcoal. This mixture provided a substrate which held moisture well and allowed a high relative humidity to be maintained. The relative humidity in the containers was probably more than 95 percent most of the time, according to experiments conducted by Huber (1958). A few drops of water were added each week. This kept the humidity high but did not cause free water to accumulate. The ambient temperature of the room in which the mites were kept ranged from 23° to 28° C. but usually remained approximately 25° C. A few chips of wood were added to the colony containers in order to provide the mites with hiding places. The acarids were fed Fleischmann's dry yeast granules. This apparently was an excellent nutritional source because the population of mites was constantly at a high level.

The food of M. rodriguezi consisted of acarid mites in all stages of development. Critical observations were made on mites that had been removed from the stock colonies. They were placed individually in containers similar to the ones described above, differing only by being smaller.

Results and discussion: There is an egg, larval, protonymphal, deutonymphal, adult male and adult female stage. The female lays one egg at each oviposition and was never observed to oviposit more than one egg per day. The time interval between successive ovipositions varied from 1 to 8 days. Sixty-seven percent of the eggs were laid on consecutive or alternate days and the remaining 33 percent of the eggs were laid 3, 4, 5, 6 and 8 days apart. The percentages were based on 34 progeny from 5 females. It should be mentioned that the interval of time between ovipositions could be in error due to the possibility of the female eating her eggs or larvae before they were observed. Cannibalism occurs in this species when other prey are not available and an adult female was observed to feed on a first instar nymph even though there were acarid mites present. If
this happens frequently, it is possible that the females oviposit more often than indicated here. After deposition the eggs were covered with substrate materials by the female, making it most difficult to ascertain the location of the oviposition site.

Although the authors did not find any eggs under the chips of wood which were placed in the containers, nor in the open cracks of the substrate, it is still possible that some may have been laid in these secretive areas. At first it was thought that the mites were ovoviviparous because larvae were appearing in the culture although no eggs were found.

The viable eggs hatched in 8 to 24 hours. The larval stadium was also short, lasting at least 8 but less than 24 hours. One mite was observed to pass through both the egg and larval stage in less than 36 hours, although the exact duration of each stage was not determined. The duration of the protonymphal instar was less than 48 hours in all mites observed except one which lasted 6 days. Most of the mites remained in this stadium from 12 to 24 hours. The second nymphal stage lasted for a longer period (48 to 72 hours). The adult female was able to oviposit at the age of 21 days (inclusive of the time in the immature stages). The apparent greater variation in the duration of the nymphal stages when compared to that of the egg and larval stages may be due, in part, to nutritional deficiencies. The amount of food offered was not always uniform in all the rearing dishes.

All motile stages of this mite except the larvae, which are relatively sluggish, feed readily on acarid mites. The larva has not been observed to feed and usually is found in a dark crevice or in some other hiding place. The nymphs and adults appear to move in a random pattern. Mites in all stages tended to prefer the dark and to be beneath some object. This behavior suggests that they probably are photonegative, thigmotactic or both.

Parthenogenetic and bisexual reproduction occurs in this species. Mites produced parthenogenetically showed the same developmental pattern as offspring originating from mated females. All of the parthenogenetic progeny that were examined developed into males and, therefore, arrhenotoky is strongly suspected. *Pereira and de Castro* (1947), *Wade and Rodriguez* (1961) and *Axtell* (1961) reported that arrhenotoky occurs in *Macrocheles muscaedomesticae* and *Filipponi* (1957) reported it in *Macrocheles subbadius*. Although the progeny produced by virgin females and male offspring of the mated females are probably haploid, one should refrain from stating that the males are haploid unless the chromosomes have been studied. One of us (J. H. O.) has evidence (unpublished) that the males of *M. muscaedomesticae* are indeed haploid.

*Macrocheles rodriguezi* feeds by sucking the juices from the body of acarid mites. After extracting most of the fluid from the body it then drops their crumpled bodies on the substrate. The maximum number of acarids that they will consume during one feeding period varies, depending on the stage and how long the predator has been starved. All stages of *M. rodriguezi* have voracious appetites and it was not uncommon to see an adult female suck 5 acarids dry in rapid suc-
cession and then search for more. It is not known if they will feed on anything else, but mites belonging to the family Anoetidae were exposed and were not attacked. From this, however, one could not state that M. rodriguezi, if they became starved, would not feed on anoetids. No other type of food was offered to the macrochelids.

The post embryonic development of all the mites examined appeared to fall into a common pattern. If they did show a drastic difference they usually died while immature or as young adults. However, one mite showed a most unusual developmental cycle and remained in each of 2 nymphal stages for 6 days. This was a female and was especially large in all stages of development. She reached adulthood and apparently was normal in other respects. Her treatment and environment was similar to the other members of the colony. Unfortunately she escaped before she was old enough to produce offspring and thus further experiments and critical morphological examination were not possible.

No courtship behavior was observed by either sex prior to mating. Apparently they find each other by random movement and may actually pass each other closely and show no sign that they recognize the presence of the opposite sex. When they do encounter each other they stop locomotor movement and begin moving the first pair of legs rapidly, often touching each other with these legs. After this they either ignore each other or proceed with mating. If the latter alternative occurs, the male immediately crawls onto the dorsum of the female and then quickly moves beneath her so that their venters are adjacent to each other. The male does not line up parallel to the female but is off to one side and tends to line up with the long axis of her body at approximately a 45° angle. While the male and female are in this position there are periods when one can observe vigorous movements of the gnathosoma of the male. It is assumed that he is placing spermatophores into the genital opening of the female at this time although this has not been actually observed. Frequently they may separate for 30 to 60 seconds and then embrace again. The duration of the mating process is variable. It may be as long as 17 minutes and as brief as 5 minutes, including the time they may be separated, but usually it is completed in approximately 6 minutes. In one instance, the male and female remained embraced for 17 minutes without separation. After mating is over they resume their typical random movement and ignore each other even when they encounter one another directly.

The sexual appetite of one male was tested by allowing him to mate with a female and, upon completion, transferring him to another dish containing a second female. He readily mated with her and then was transferred to a third dish containing another female. He crawled over the female but made no attempt to get beneath her and mate.

The longevity of Macrocheles rodriguezi has not been determined but some adult females were observed to live more than 30 days. When senescence occurs it is evident, being accompanied by lethargy and a distended or bloated body.
When the mites are in this condition they have a great deal of difficulty in righting
themselves if they are turned upside down. In addition, old adults usually have
more debris stuck to them than do the young ones.

Summary: *Macrocheles rodriquezi* n. sp. is figured and described. This species
was observed in the laboratory for a period of 53 days. During these observa-
tions the relative humidity was extremely high (probably 95 percent or more)
and the temperature ranged from 23° to 28° C but was usually approximately 25° C.
The life stages consisted of an egg, larva, protonymph, deutonymph, adult
male and female. It was not uncommon for the mites to pass through all the
immature stages in 5 days. The approximate duration of each stage was 8 to
24 hours as an egg, the same as a larva, 24 hours as a protonymph and 48 to
72 hours as a deutonymph. The adult female was able to oviposit at the age of
21 days, inclusive of the immature stages. The eggs were laid at intervals of 1 to
8 days. Parthenogenesis and bisexual reproduction occurred.

The regular diet of *Macrocheles rodriquezi* in the laboratory consisted of living
acarid mites. Cannibalism was observed between an adult female and her first
instar nymph in the presence of numerous acarids.

There appears to be no courtship display prior to mating. During mating
the male and female may remain embraced for as long as 17 minutes, but usually
mating is completed in approximately 6 minutes.

Senescence is accompanied by a bloated appearance and the mite becomes
lethargic.

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