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BIOLOGICAL AND BEHAVIORAL ASPECTS
OF THE LIZARD MITE \textit{PTERYGOSOMA MUTABILIS} JACK, 1961
(ACARINA: PTERYGOSOMIDAE)

BY

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ABSTRACT

The biology and mating behavior of the pterygosomid mite, \textit{Pterygosoma mutabilis} Jack (1961), was studied. Mite colonies were maintained on the lizard host in the laboratory. The active stages (larva, nymph and adults) fed on the host’s blood. All developing stages, including quiescent ones, spent their entire life beneath the scales of the host; however, the commonest and longest-lasting stage was larva. Distribution on host body was indiscriminate. Nevertheless, immature stages preferred the venter, while adults favored the dorsum. Eggs were deposited singly and were found at random on the sand of the cage. Duration of stages at 80-90°F: Egg 7-9 days; larva 19-21 days; larval chrysalis 10-12 days; nymph 7-12 days (including nymphochrysalis); adult female 25-30 days. Males lack a nymphal stage; their life span was not determined. A complete generation lasted 68-84 days. The mating behavior of a mature male and female was observed in the laboratory. The male uses a spermatophore in fertilizing the female.

RéSUMÉ

La biologie et le comportement sexuel du Pterygosomidé \textit{Pterygosoma mutabilis} Jack (1961) ont été étudiés. Les colonies de l’Acarien sont maintenues au laboratoire sur le lézard hôte. Les stases actives (larve, nymphe et adultes) se nourrissent du sang de l’hôte. Toutes les stases, y compris les stases inactives, passent toute leur vie sous les écaillles de l’hôte ; la stase larvaire est la plus commune et celle qui dure le plus longtemps. La distribution sur le corps de l’hôte se fait sans distinction. Toutefois, les stases inactives préfèrent la région ventrale et les adultes le dos. Les œufs sont déposés un par un au hasard sur le sable de la cage. Durée des stases à 80-90°F : œufs, 7-9 jours ; larve, 19-21 jours ; pupa larvaire, 10-12 jours ; nymphe, 7-12 jours (y compris la pupa nymphale) ; femelle adulte, 25-30 jours. Une stase nymphale manque chez les mâles. Leur durée de vie n’a pas été déterminée. Une génération complète dure de 68 à 84 jours. Le comportement sexuel d’un mâle mûr et d’une femelle a été observé au laboratoire. Le mâle utilise un spermatophore pour fertiliser la femelle.

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INTRODUCTION

In studying parasitic mites of Egyptian reptiles a number of lizards, captured from nature, were maintained for long periods of time in the laboratory. Infestations of previously mite-free lizards and the obvious increase in density of mites on reptiles in captivity suggest that the mite *Pterygosoma mutabilis* Jack (1961) is able to reproduce in the laboratory.

Describing the stages of two species of *Pterygosoma* from preserved specimens in a museum, Jack (1958) mentioned the existence of a deutonymphal stage which differs from the adult female only in body proportions. Apparently his deutonymph was actually an unengorged female. In the same paper, Jack briefly cited the occurrence of a nymphochrysalis in the species *Pterygosoma bicolor* Lawrence. In another paper (1961) he showed the morphological distinctions between developing stages of *Pterygosoma caucasic* Jack (1961). However, in 1962 Jack mentioned only a single nymphal stage for *P. agamae* Peters (1849).

The ambiguity of information on the biology of members of the mite genus *Pterygosoma* is regrettable because of the possibility that certain species of pterygosomid mites (e.g. Genera: *Pimeliaphilus* and *Hirstiella*) may transmit viral, rickettsial and protozoan diseases (Newell and Ryckman, 1964). The present investigations were undertaken to shed light on the biology of the mite *Pterygosoma mutabilis*; hopefully the findings will aid in future epidemiological studies.

METHODS.

The mites used in this work were naturally infesting the agamid lizard (*Agama mutabilis*) of the Egyptian western desert. All stages, except eggs, were observed on the host's body. The commonest and longest-lasting stage was the larva. Individual mites were scattered over the host body, particularly on the venter, limbs, and basic parts of the tail and ears. The venter seemed the most preferred site for immature stages, while adults favored the dorsum.

First observations were of the eggs. A number of eggs (75-100) from a mass newly-laid by several females that were naturally infesting the agamid host, were divided into five equal groups; each group of 15-20 was confined in a clear polyethylene tube 60 mm long and 10 mm diameter and the tubes were closed by a piece of fine cotton. The tubes were kept in an incubator at 75% RH and 80°F (25°). After hatching, the larvae were offered mite-free lizards. Other eggs from the mass were kept in a petri dish under laboratory conditions at room temperature (80-90°F) the dish and the original host both being kept within a large glass jar 8 in. height and 8 in. in diameter; about an inch of clean sand covered the bottom of the jar and it was covered over with a screened cap. After hatching, these larvae reinfested the original host.

The laboratory infested lizards were examined for developing stages, and observations of the parasite on the host were accomplished with the aid of a dissecting microscope. A dissecting needle was used to raise host scales and to manipulate mites.

The active and resting stages were sometimes isolated and confined in tubes (mentioned above), each stage having a separate tube. A fine-hair brush was used to transfer mites from host to tube.

During the development of mite stages on the host, laboratory temperatures ranged between 80-90°F.
RESULTS AND DISCUSSION.

All stages of the mite, except eggs, spend their entire lives on the lizard host. They were observed feeding and resting beneath the body scales. Their broad and somewhat flattened shape, with all legs directed anteriorly, is probably an evolutionary adaptation for living secure beneath host body scales. The active stages feed on the blood of the host, and all mite stages, eggs included, are red. It is believed that blood feeding is necessary for completing the development of immature stages and for oviposition by fertilized females. The mites do not leave their hosts soon after the latter's death, but are still to be found in position a week later. In fact, this particular mite will starve to death on its specific host, even though it is provided with another agamid lizard (e.g. Agama stellio).

EGGS.

Eggs are deposited singly and indiscriminately on sand, surfaces of a petri dish, a polyethylene tube or the dorsum of the host lizard (but not under the scales). They are elliptical, smooth, bright red; in the process of embryonic development the color darkens slightly. The new-laid egg is shiny and covered with a sticky substance that adheres to any object. However, this substance soon evaporates and the egg rolls free in the container if slightly disturbed. Hatching occurs after 7-9 days under conditions of constant temperature and humidity (75% RH and 80°F) as well as at room temperature of 80-90°F. The egg splits open at one end and the emerging larva starts backing out of the egg shell; front legs are the last to emerge. Often the larva has difficulty freeing the front legs from the shell. After hatching, the empty shells appear transparent. If an embryo fails to complete development, the egg retains the red color but becomes dry and shriveled.

LARVAE.

Small, six-legged, bright red creatures. They are active soon after emergence, constantly and quickly moving. If a host is available, the larva will immediately climb aboard and race randomly over its body in search of a resting and feeding station under a scale. In a few moments it secures itself under a scale, with its legs and mouth parts at the base of the scale. When the larva finds no available host, it can survive for 3-4 weeks without access to food. Goodwin (1954) reported that the larvae of Geckobiella texana (Banks) 1904, are able to survive for 21-40 days without feeding.

Quite unlike the larva of the pterygosomid Pimeliaphilus gloriosus Newell and Ryckmann (1966) of the kissing bug, which fully repletes and detaches in 2-4 hours, these larvae spend their entire lives under host scales. If they are purposely disturbed or removed, they actively and immediately search out new scales to hide beneath, usually the tightly overlapping scales of the lizard’s abdomen and tail, where they are unlikely to be brushed off. In heavy larval infestations, they form transverse strands under the consecutive rows of the host’s body scales. Sometimes two larvae have been observed under a single scale.

The active life span of the larva is about 19-21 days in the summer under room temperature. Before moulting into the next active stage, the larva enters a quiescent stage; its appendages turn translucent. This larval chrysalis remains under a scale for 10-12 days. The moulting of larval chrysalis (like that of all stages) occurs at the original feeding site of the preceding stage.
The cuticle of the chrysalis splits along nearly the entire periphery of the body, resulting in transparent upper and lower halves hooked together anteriorly. Then the newly emerged stage starts pushing its posterior end out of the exuvia. It immediately searches for another attachment site. The moulted cuticle remains in place until it completely dries and falls off the lizard body; it is composed of two definite transparent layers that can be manipulated separately under a dissecting microscope with a fine needle.

**NYMPH.**

Newly emerged nymphs are slightly larger than larvae; their bodies are flattened and wider than long; they have four pairs of legs. Young nymphs find a feeding site and secure under a scale in the same way as the larvae do. However, the nymph must feed within 24 hours or it will die. Nymphs of *Geckobiella texana*, according to Goodwin 1954, are unable to survive over four days without feeding. The nymph resembles the adult female, but is much smaller and lacks well developed genital lobes. When the nymph reaches full development, it becomes quiescent and a nymphochrysalis is formed inside the nymphal integument. Attempts to measure the nymphochrysalis duration were unsuccessful. However, the nymphal life span is 7-12 days from emergence to the appearance of the adult female.

**ADULT FEMALE.**

The adult females resemble the nymphs in general body form and color. However, they are much larger and slower, especially when engorged. Copulation takes place immediately after emergence of the adult female and at the site of the imagochrysalis, when a mature male has been waiting (copulation details are discussed later in this paper). In 2-3 days the newly-emerged female moves to another site on the host and continues engorging, leaving the moulted integument behind. At this time the female starts laying her first eggs. Oviposition extends over a great period of time, probably the entire life span of the female. An adult female produced 35 offspring in the first fifteen days of her life on the host. The engorged female will lay 4-7 eggs per day, depending on her age and degree of engorgement. Although longevity of the female was not precisely determined, some lived for 25-30 days, laying 90-100 eggs. The female will continue depositing her eggs for as long as she remains attached to its host. Females that were detached from their hosts laid eggs only for the first 24 hours, after which oviposition ceased; if kept from hosts for 2-3 days, the females died apparently from starvation. Females of *Geckobiella texana* survived for 17 days without feeding (Goodwin, 1954).

However, if returned to the host before three days had elapsed, they quickly fix their mouthparts to an available soft area of the skin, for example the neck foldings, and resume feeding and oviposition. It is probable that adult females need a blood meal before depositing eggs. Also, attachment to the host seems necessary for life continuity.

**ADULT MALE.**

Much smaller than the female; about the same size as newly emerged or unengorged nymph. The male genito-anal field located on mid-dorsum, rather than on the most posterior margin
of the body as in the other stages of this mite. Males are very active, and, if disturbed, wander very quickly over the host's body. Adult males develop directly from larvae without passing through the nymphal stage. After emergence, the male secures himself under a scale, usually near an imagochrysalis female about to moult into adulthood. The male matures quickly and in three days it copulates with the available female. Apparently males feed frequently, taking small quantities of blood, and their bodies never enlarge like those of nymphs and adult females. Like the females, the adult males must be in close contact with their host to survive. Male life span is much shorter than the female, probably copulation ends the process.

**Mating behavior.**

The naturally occurring mating process has never been seen by the author; however, an artificially induced copulation between an adult male and female was carefully observed on the host's body with the aid of a dissecting microscope. While experimenting to see if disturbed mites would relocate themselves easily, an adult male was found resting under a scale and was disturbed with a fine needle. The disturbed male started wandering around and began ejecting a transparent, elongated sac (a spermatophore herein discovered for the first time in members of genus *Pterygosoma*, previously recorded in literature as an aedeagus (JACK 1958, 1961 and 1962 a, b)) from its dorsal genitalia. The spermatophore was very obvious, carried on top and upward of the male genitalia and manipulated by the genital processes. The male wandered about, its spermatophore sticking out on dorsum, apparently trying to find a female to copulate with. The spermatophore is elongated and the thicker end had a darkened area. Believing the male ready to copulate, I oriented him towards a nearby mature female. Then the male mite himself discovered the female resting nearby. He felt the body of the female, using his front legs, and walked over the hind part of her body. After a few moments the male took a standing position behind the female, his front end directly behind the genitalia of the female; he simultaneously lowered his anterior end and raised his back up. Then, using his genital appendages, he manoeuvred the spermatophore forward and down towards the female genital opening with the dark end approaching first.

Perhaps this female had been fertilized previously, because she did not in any way respond. After the male had failed for approximately 1/2 hour to evoke response from the female — she refusing to open her genital opening — he walked away and finally came to rest about two scales distant from the female. Then he apparently tried to retain his spermatophore back again into his genital pouch. The male was using his genital appendages (clearly visible under the microscope) to manipulate the spermatophore, trying to make it lay flat horizontally on top of the male genitalia in order to reinsert it into the male genital pouch. On the following day this male was observed concealed completely under the same scale and resting in the usual way.

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