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THE MOLTING SEQUENCE IN *APHONOPELMA CHALCODES* (ARANEAE: THERAPOSIDAE)

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ABSTRACT

The molting sequence of *Aphonopelma chalcodes* is broken into ten steps and each characterized. Feeding is delayed several days after a molt as the exoskeleton hardens. Under artificial conditions molting may occur at any time during the day, but apparently occurs on a seasonal cycle.

INTRODUCTION

While several authors have investigated molting in the tarantula, the actual molting sequence has received little attention. Passmore (1939) gave three stages and illustrated them by photographs. Baerg (1958) gave a time of four hours for a tarantula to remain on its dorsum before the carapace began to lift, and one hour and fifteen minutes for the actual molt. The purpose of this work is to give a detailed account of the molting sequence for the species *Aphonopelma chalcodes* Chamberlin, and to present evidence that this event is highly seasonal in its occurrence, but may take place at any time of day.

METHODS

Presumed adult female tarantulas were maintained in wide mouth gallon jars and were fed crickets or tenebrionid beetles on a weekly schedule. The temperature the tarantulas were maintained at varied from 24-27°C.

OBSERVATIONS

A total of twenty-five molts occurred over a two year period, four of which were observed in detail. For convenience, the entire sequence was divided into ten stages, which are summarized in Table 1.

First Stage: On dorsum to carapace splits. A spider was first noted as preparing to molt when on its dorsum, no specimen being observed to molt without first positioning itself so. Rau (1925) reported a tarantula molting in an upright position; however, the observations of McCook (1887), Passmore (1939), Gertsch (1949), and Baerg (1958) agreed with mine that this was an exception to normal behavior.

While on its dorsum the spider was motionless, with the legs and pedipalps arranged symmetrically. The motionless spider then suddenly began to twitch the legs and pedipalps, and the chelicerae were erected perpendicular to the long axis of the body. At this time the carapace became detached both laterally and anteriorly.

Second Stage: Carapace splits to wrinkled abdomen. During this time the pedipalps and legs continued to move, with the coxae, positioned at opposite ends of a diagonal across the sternum, seeming to pull in opposing directions. This created a stretch across the sternum.

Third Stage: Wrinkled abdomen to new coxae free. All legs and pedipalps flexed and extended in unison (four complete cycles per minute), with each cycle exposing more of the new appendages. During this time a lateral rip sometimes occurred on each side of the abdomen, exposing part of the anterior lateral region of the new abdominal exoskeleton.

Fourth Stage: Coxae free to paturons free (Fig. 1). The motion cycles of the legs and pedipalps continued to expose more of these appendages, so that the leg trochanters became completely visible. Also, if it did not occur earlier, the old abdominal exoskeleton tore in the lateral area exposing the fresh abdominal exoskeleton with a renewed urticating hair patch, even though the patch may have been only a bald spot on the old exoskeleton (Cooke et al., 1972).

Fifth Stage: Paturons free to leg femora free. During this stage the fangs, white in color, were freed completely. The legs and pedipalps continued to pulsate in unison, exposing the new leg femora.

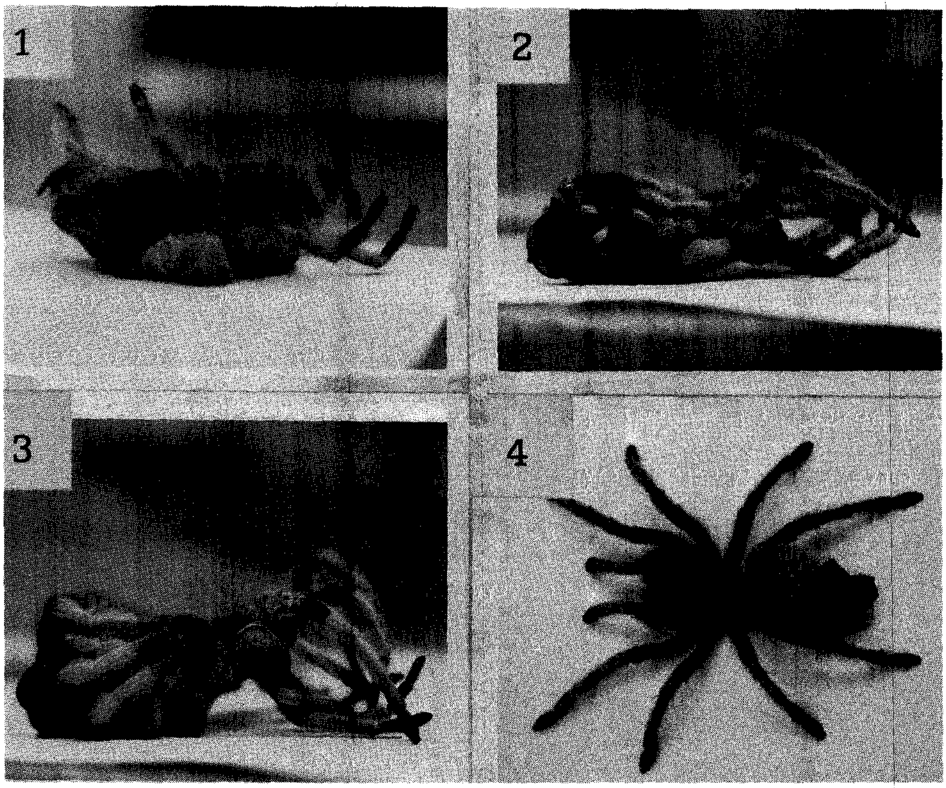
Sixth Stage: Leg femora free to leg patellae free. This was a fairly short phase, as the leg patellae are short segments. This act was accomplished by leg and pedipalpal pulsations.

Seventh Stage: Leg patellae free to leg tibiae free (Fig. 2). During this time the fang-tips became reddish brown. The pedipalps, which had been in advance of the legs throughout, were now completely free. There was one exception to this, in which the spider molted from the penultimate instar into an adult male. It is likely that the terminal bulb of the mature male pedipalp resulted in the observed delay in the removal of the pedipalp from the exuvium. Leg pulsations continued throughout this time, but the pedipalps began to move out of phase with the legs once they were completely free.

Eighth Stage: Leg tibiae free to metatarsi free. Along with the complete exposure of the metatarsi, the new spinnerettes became visible.

Table 1.–Summary of times (in minutes) spent in each molting stage by four specimens of *Aphonopelma chalcodes* in captivity.

STAGE	A	B	C	D
1. On dorsum to carapace splits	120	150	352	244-264
2. Carapace splits to wrinkled abdomen	10	30		6
3. Wrinkled abdomen to new coxae free	28			
4. Coxae free to paturons free	6			
5. Paturons free to leg femora free	10	9	10	26
6. Leg femora free to leg patellae free	7	1	6	
7. Leg patellae free to leg tibiae free	12		7	8
8. Leg tibiae free to metatarsi free	3			3
9. Metatarsi free to last leg free	15			8
10. Legs free to turns over to upright position	56	61	87	89
Total duration	267			



Figs. 1-4.–Molting in *Aphonopelma chalcodes*: 1, old carapace detached and new leg trochanters becoming visible; 2, new fangs and pedipalps free; 3, newly freed legs in flexed position alongside exuvium; 4, exuvium showing point of emergence from detached carapace.

Ninth Stage: Metatarsi free to last leg free. The legs and entire spider, became completely freed of the old exuvium. During this interval the fully formed male pedipalps were completely freed, with the bulb and embolus appearing white and resembling newly emerged fangs in color. During this stage leg pulsations were reduced in frequency to two complete cycles of motion per minute.

Tenth Stage: Complete extraction of legs from the exuvium to the spider righting itself (Fig. 3). During this time the legs were repeatedly flexed a number of times. Bristowe (1958) stated that these movements were vital to insure supple joints for the spider. Suddenly the spider righted itself over one side and was quiet, leaving the old exuvium behind (Fig. 4).

DISCUSSION

Passmore's (1939) first and third stages corresponded to my first and tenth stages, his second stage combined my second to ninth stages into one. Passmore observed the leg pulsations, but gave no rates nor mentioned the pedipalps. His single tarantula molted annually as did *A. chalcodes*.

Rau (1925) noted a fasting period of two weeks before a molt, and suggested the swallowing of air as a mechanism to cause the initial splitting off of the carapace. In

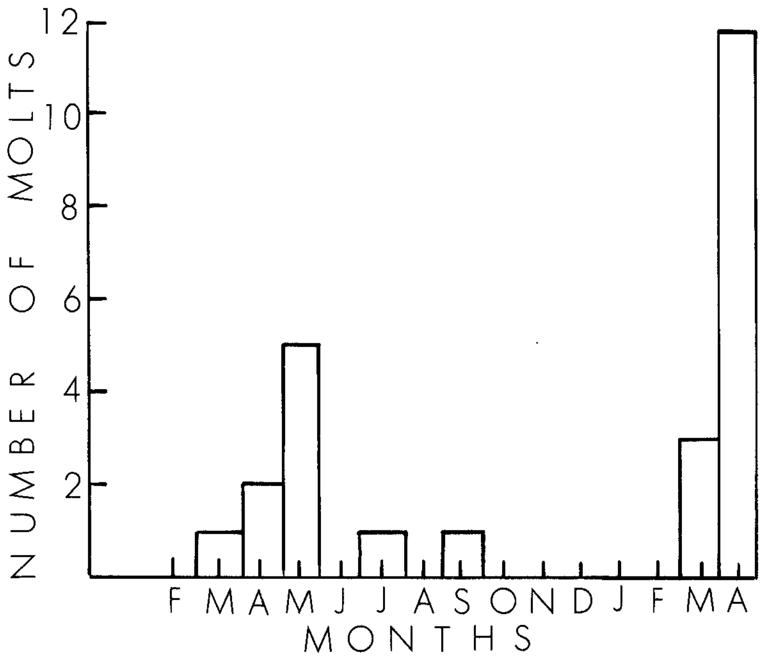


Fig. 5.–Frequency distribution of molts of presumed females by month (February 1975 to April 1976).

contrast, six *A. chalcodes* fasted prior to molting an average of twenty-nine days, ranging from seventeen to thirty-seven days.

McCook (1887) cited the unexplained death of a tarantula shortly after a molt. No mortality resulted from the twenty-five observed molts in *A. chalcodes*.

Gertsch (1949) stated that the tibial spur and palpal bulb indicative of the adult male were without a trace in the penultimate instar, in agreement with my own observations. The extraction of the pedipalps in adult males was delayed until the ninth stage. In presumed adult females this occurred during the seventh stage. Aside from this the molting sequence did not vary between the sexes.

In all cases but one the spider remained completely on its dorsum during the entire molting process, assuming this position five or six hours before the carapace split. In the single exception the spider was on its side while the legs were being extracted. This particular spider had been placed on a clean sheet of white paper to serve as a contrasting background for photographs, and since other spiders, in agreement with Gertsch (1949), were observed to rest on a thin sheet of web on soil substrate, I believe that this one case is an artifact resulting from an unnatural substrate. Further evidence for this interpretation comes from the observation that this specimen had difficulty in fully extracting the last leg from the old exuvium.

The next several days saw the new exoskeleton gradually harden. This was easily seen as the fangs darkened. One specimen caught and ate an adult cricket three days after its molt, and another four days after its molt.

Tarantulas seem capable of molting at any time of the day. Twenty-one of the twenty-five molts occurred either late at night or early in the morning and their sequence was not observed. The molts I observed spanned a period from 11:00am to 10:00pm. Thus, there seems to be no particular time of day to which molting is restricted under artificial conditions for this species.

There does, however, appear to be a seasonal correlation with molting. Figure 5 shows the number of molts and the months in which they occurred, showing that molts are concentrated around the last half of March and throughout April. Two individuals were maintained long enough to molt twice, and in both cases the period between molts was approximately one year. Baerg (1963) indicated that the frequency of molts depends not only on the species of spider, but also on the age. Young of *Eurypelma californica* Ausserer may molt up to four times during their first year, while older juveniles of this species possess an annual molt cycle (Baerg, 1938, 1945). Senility may first manifest itself by the disruption of the regular molt cycle in tarantulas (Baerg and Peck, 1970).

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LITERATURE CITED

Baerg, W. J. 1938. Tarantula Studies. J. New York Entomol. Soc. 46:31-43.

Baerg, W. J. 1945.The Black Widow and the Tarantula. Trans. Connecticut Acad. Arts Sci. 36:99-113.

Baerg, W. J. 1958. The Tarantula. University of Kansas Press, Lawrence, Kansas. 88p.

Baerg, W. J. 1963. Tarantula life history records. J. New York Entomol. Soc. 71:233-238.

Baerg, W. J. and W. B. Peck 1970. A note on the longevity and molt cycle of two tropical theraphosids. Bull. British Arachnol. Soc. 1:107-108.

Bristowe, W. S. 1958. The world of spiders. Collins, London. 304p.

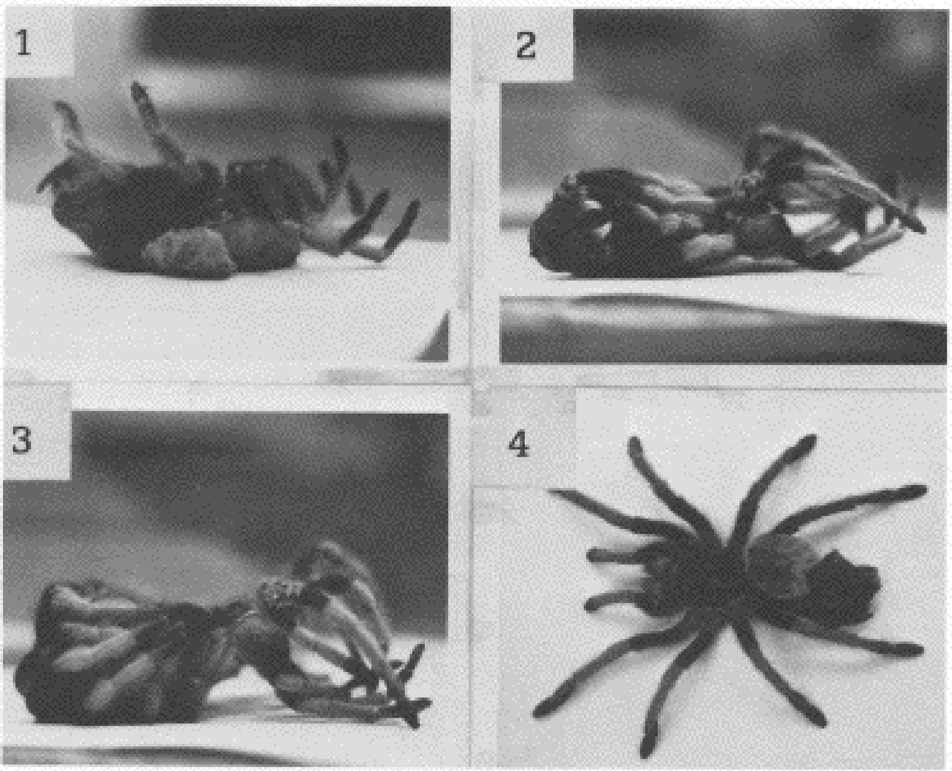
Cooke J. A. L., V. D. Roth, and F. H. Miller 1972. The urticating hairs of theraphosid spiders. Am Mus. Novit. 2498:1-43.

Gertsch, W. J. 1949. American spiders. D. van Nostrand, New York. 285 p.

McCook, H. C. 1887. Prolonged life of invertebrates: notes on the age and habits of the American tarantula. Proc. Acad. Nat. Sci. Philadelphia 1887:369-386.

Passmore, L. 1939. The Tarantula molts. Nature Mag. 32:151-152.

Rau, P. 1925. A note on the moulting of the tarantula, *Eurypelma hentzii*. Psyche J. Entomol. 32:1-3.



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