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BIRTH ACTIVITIES OF SOME NORTH AMERICAN SCORPIONS

By

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ABSTRACT: The birth and post-birth behaviors of 14 species of North American scorpions belonging to four families are discussed. Birth occurred at all hours of the 24-hour cycle, but was restricted to a limited season of the year. The birth season was longer for some species than others. Birth of an entire litter took up to 7½ hours and consisted of several steps insuring that the young would escape from their birth membrane and ascend to the mother's back without touching the ground. Post-birth associations of the first- and second-instar nymphs with the mother is described.

INTRODUCTION

Mating and other reproductive activities of terrestrial arthropods are often highly specialized and frequently reflect adaptation to a specific mode of life in occupied regions of the environment. The behavior of scorpions in regard to reproductive processes is no less specialized and distinctive. However, scorpions have long eluded investigators in regard to these processes because of their long and secretive life cycles, the difficulty of rearing the complete life cycle under laboratory conditions, and because of the uniqueness of the group.

In recent years, however, considerable interest has been shown in the reproductive processes of scorpions. Courtship and mating studies have been reported by Maccary (1810), Fabre (1923), Serfat and Vachon (1950), Baerg (1954, 1961), Southcott (1955), Alexander (1955, 1957, 1959, 1962), Angermann (1955), Bucherl (1958), Shulov (1958), Shulov and Amitai (1959), Matthiesen (1960), Savory (1964), McAlister (1965), and Stahnke (1966).

Studies on the embryology of scorpions have been reported by Mathew (1959). Observations on parturition were reported by Shulov and others (1960). Post-birth growth and development have been discussed by Smith (1927), Schultze (1927), McAlister (1960), and Baerg (1961). Much interest has centered around scorpion meiosis and various aspects of gametogenesis in recent years: Lal Sareen (1961, 1962), Venkatanarasimhaiah and Rajasekarasetty (1964), Srivastava and Agrawal (1961), Sharma and others (1959, 1962), and Bedi (1962, 1963).

The purpose of this paper is to describe behaviors and processes observed in the birth of some North American scorpions. The data presented here are the results of intermittent studies in western North America over the last 5 years. Observations were made on as wide a representation of the scorpion fauna as was reasonably possible. Reproductive data on 14 species belonging to seven genera and four families is here presented to permit the study to be as comparative as possible. The data on some species such as *Vejovis spinigerus* (Wood), *Vejovis vorhiesi* Stahnke, *Uroctonus mordax* Thorell, and *Centruroides sculpturatus* Ewing are much more extensive and based on numerous observations, while the data on other species are sometimes incomplete and may be based on single observations.

Most of the research reported in this study was carried out in the field or in the laboratory facilities provided by the Department of Zoology of Arizona State University. This study was partially supported by a National Science Foundation Summer Fellowship. Special thanks to Mont A. Cazier of Arizona State University for suggestions and encouragement, to W. L. Minckley and Loren Honetschlager of Arizona State University for donation of some specimens yielding valuable information to the study. Thanks also to Charlene F. Williams for clerical assistance and to Gregory Fernald for field assistance.

Results

Time of parturition. Parturition was observed in a number of North American species belonging to the following taxonomic categories:

Family Buthidae:
- *Centruroides gertschi* Stahnke
- *Centruroides sculpturatus* Ewing

Family Chactidae
- *Broteas alleni* (Wood)

Family Diplocentridae
- *Diplocentrus whitei* (Gervais)

Family Vejovidae
- *Anuroctonus phaeodactylus* (Wood)
- *Hadrurus arizonensis* Ewing

Uroctonus mordax Thorell
Vejovis confusus Stahnke
Vejovis mesaensis (Stahnke)
Vejovis minimus Kraepelin
Vejovis spinigerus (Wood)
Vejovis vorhiesi Stahnke

Female scorpions were observed delivering young in the field and laboratory at various times throughout the day and night. No pattern of preferred time of parturition was evident. Since these observations were made on a wide variety of species, is seems likely that most North American species deliver young during no specific portion of the 24-hour cycle.

The length of time spent in parturition varied greatly among individuals of the same species and among members of different species. In general, the length of time spent in parturition seemed to depend upon the number of young delivered, size of the young, and occurrence of complications interfering with the process. The shortest recorded parturition was that of a *H. arizonensis* which delivered 10 young in one hour. The longest recorded case was that of a *V. spinigerus* which delivered 69 young in 7½ hours.

Scorpion birth occurred in the laboratory from early June through late November. Field observations indicated a similar but shorter birth season. This observed time interval of scorpion birth appears synchronized with the warmer seasons in temperate North America. Some species, such as *C. sculpturatus*, gave birth during a broader interval of time (June through September). Other species, such as *V. vorhiesi* and *H. arizonensis*, appear to deliver one litter during the year, this event occurring during a very restricted period of the season. As an example, during mid-July, 50 mature females of *V. vorhiesi* were collected in Portal, Arizona. Two weeks later they began delivering young (all were born in the same stage of development), the entire colony giving birth within a two-week period. No other birth activity was observed during the remainder of the season. A restricted parturition season was deduced for *H. arizonensis* by the observation that second instars were only observed in the field during a period of about 4 weeks during the summer season.

THE BIRTH PROCESS. The birth of scorpions was strikingly similar in all the taxa observed. For this reason the birth process of scorpions can perhaps be best understood by examination of the following typical birth observation. In this case, a 1.27-gram *Vejovis spinigerus* female gave birth to 69 young in 7½ hours. Birth began at 11:30 AM (MST) on 27 July, 1967.

Prior to delivery, the mother raised her body as high as possible above the substrate by stilting on her last two pairs of walking legs. The first two pairs of walking legs had no contact with the substrate, and were held beneath the genital operculum with distal segments parallel to the under surface of the body. In this stilting posture the anterior end of the body was held distinctly higher than the

Figure 1. Stilting posture assumed by scorpions prior to giving birth. This posture is maintained until the young have ascended to the back and is characterized by metasoma on substrate and anterior part of body raised high. Photograph of *Vejovis spinigerus,* 27 July 1965.

posterior of the body, resulting in a unique posture (fig. 1), which was maintained throughout birth. In approximately one hour, the genital operculum opened and the babies began passing through the genital aperature, head first, and in a somewhat anterior direction (fig. 2). Each of the newly emerged young was tightly encased in a thin transparent birth membrane (fig. 3). They emerged continuously, one by one, and dropped into a "birth basket" formed by the distal segments of the first two pairs of walking legs which were held medially, parallel to the substrate and inferior to the genital opening (fig. 2).

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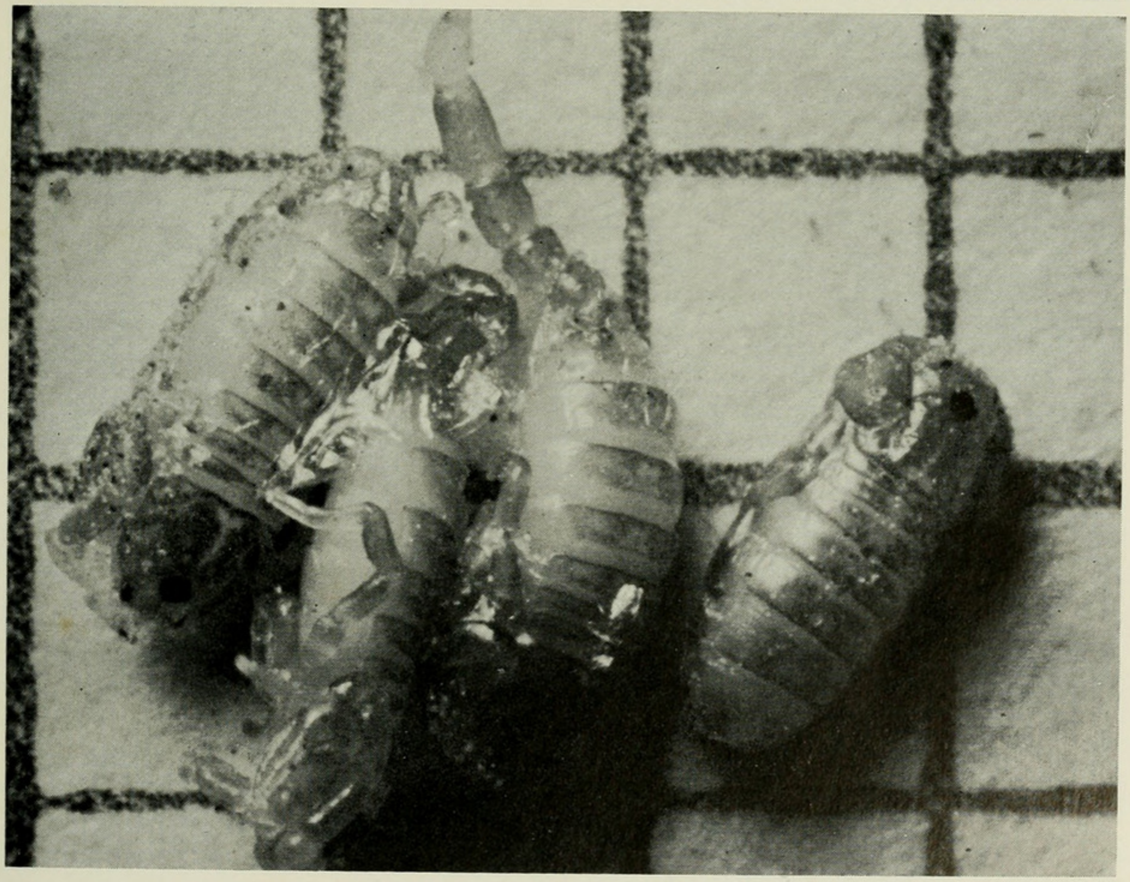
Figure 2. Scorpion parturition. A scorpion is now passing through the genital aperature and is being caught in the "birth basket." The newly born escape from their birth membrane and climb the mother's leg to ascend the back. During this process the female catches the young with her forelegs, the new born never touching the ground. The shed birth membranes are held in the "birth basket" and form a landing platform for other new born. Photograph of *Vejovis spinigerus,* 27 July 1965.

Figure 3. Newly emerged scorpions still encased in their birth membranes. Second scorpion from the left is about half free of its membrane. Wrapped in these moist membranes the scorpions pass quickly through the genital aperture of the mother with a minimum of birth complication. Photograph of *Vejovis vorhiesi,* 17 August 1965.



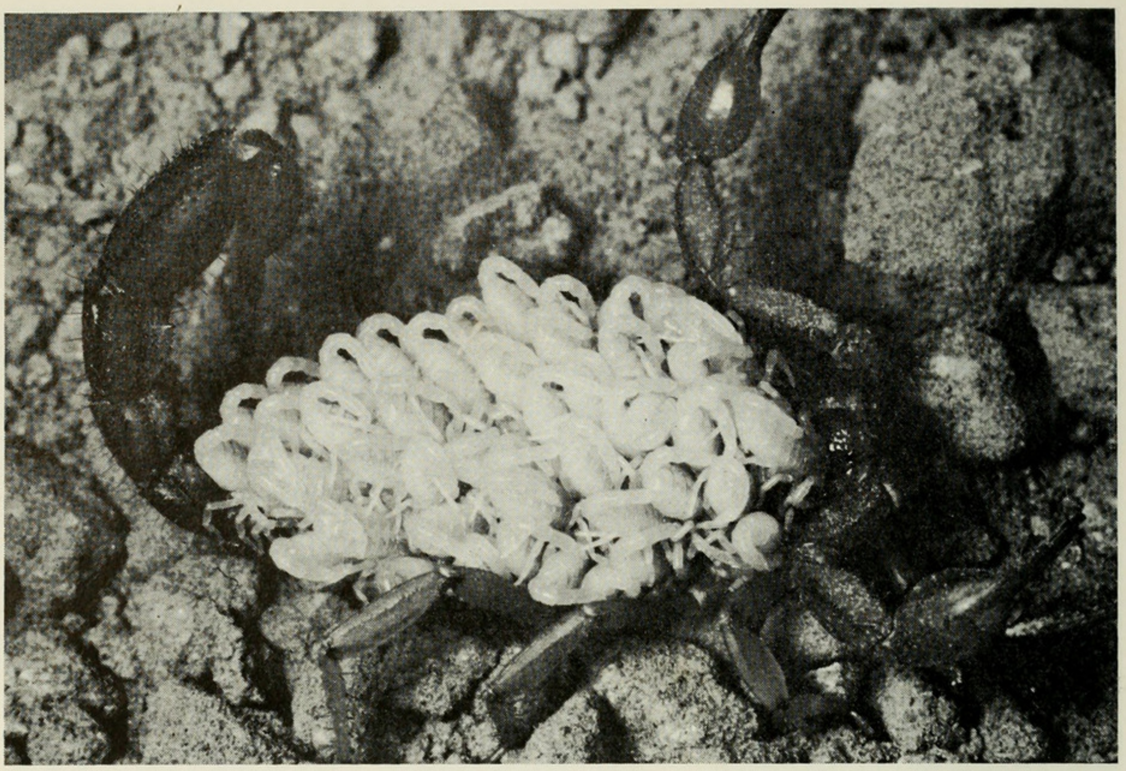


Figure 4. First instar orientation of *Vejovis spinigerus*. The entire litter has been born and all members ascended to the mother's back without complication. Notice the distinctive pattern of orientation of the young in relation to each other and the mother. Photograph taken 2 August 1965, five days after birth.

The young, never touching the substrate, became active within 5 to 15 minutes after birth. At this time the anterior end of the membrane split open and the newly born scorpion struggled free. After a pause of a minute or two, each baby then climbed up one of the mother's walking legs to ascend the back (fig. 2), where they at first assumed a random orientation. However, as more and more new born reached this destination, they gradually assumed a definite non-random spatial orientation in regard to the mother and each other (figs. 4, 5). At this point, each baby faced anteriorly with prosoma down and metasoma curled so that the aculeus pointed toward the mother's back. Newly ascended young crawled over the already oriented young until an available space was found. At this time they positioned themselves on the mother's back in accord with the orientation of the other young (fig. 6).

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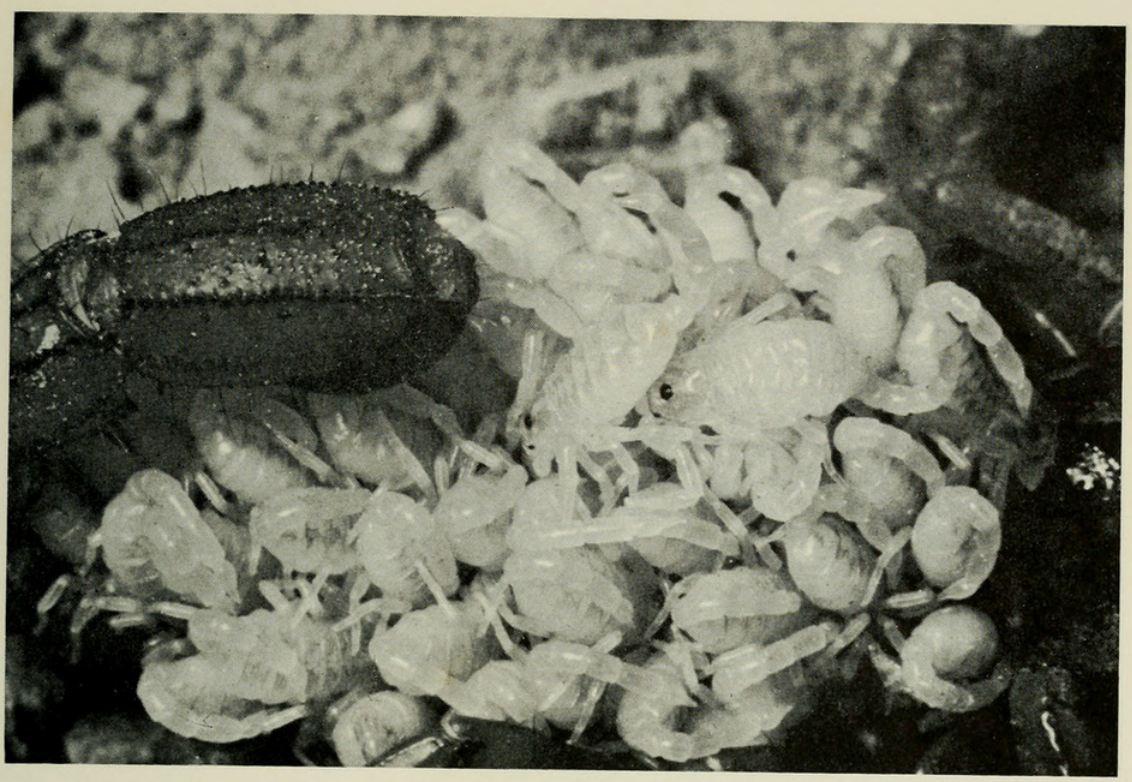
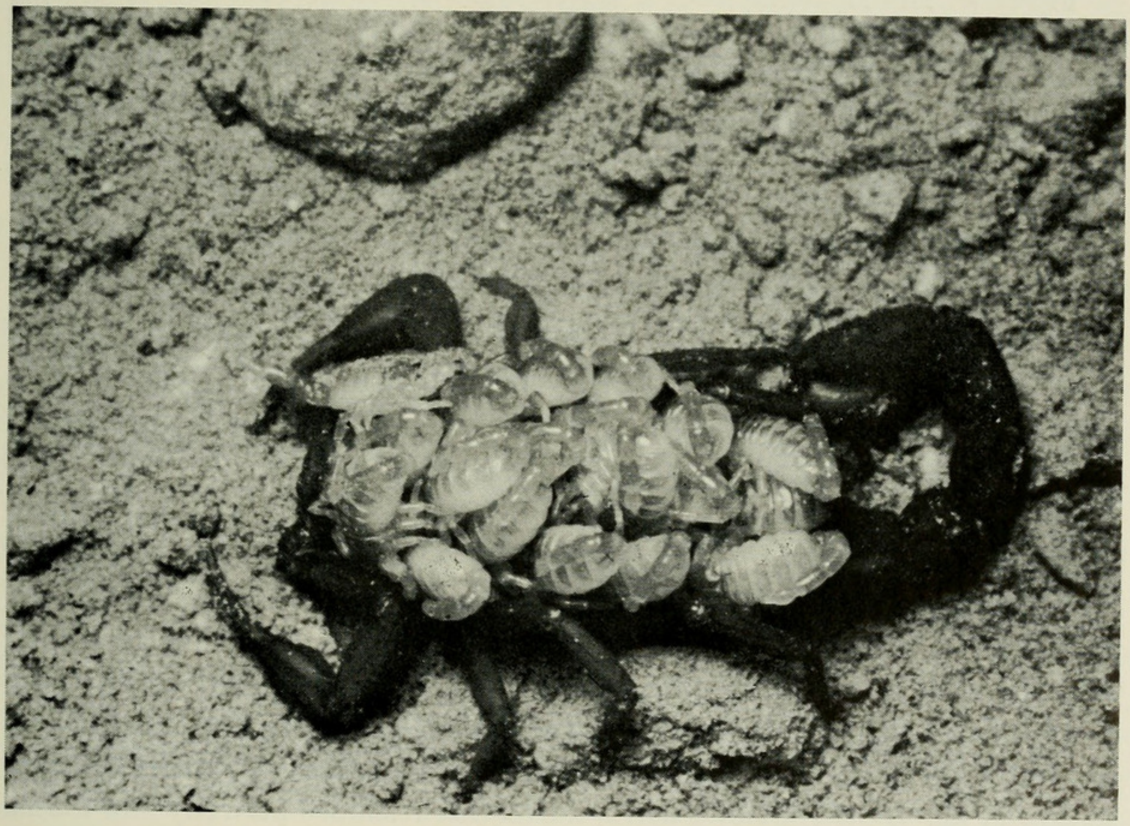
Figure 5. Newly ascended *Vejovis spinigerus* in the process of orienting themselves on the mother's back. Once orientation is assumed, the young do not move until after the first molt. Photograph taken 27 July 1965.

Figure 6. First instar orientation of *Vejovis vorhiesi*. Note the distinctive vejovid orientation of the young. Photograph taken 7 August 1965.





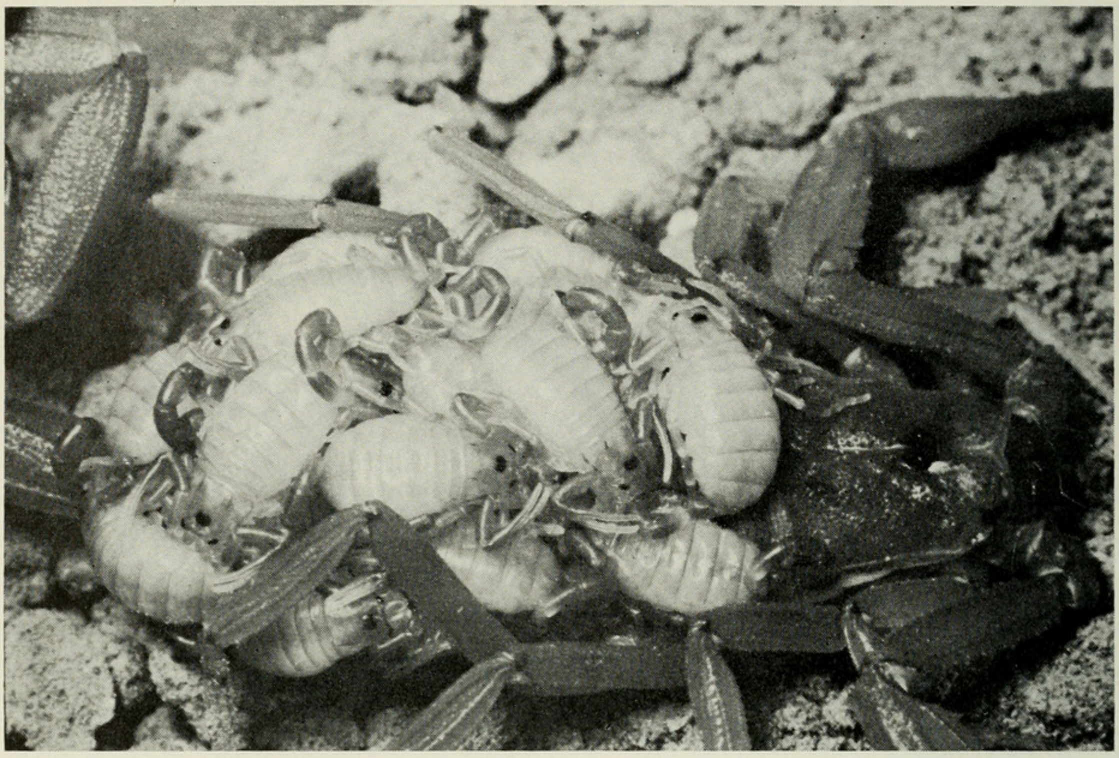


Figure 7. First instar orientation of *Centruroides sculpturatus*. The first instar nymphs are randomly positioned on the mother's back. Note the lack of positional orientation characteristic of the species of *Vejovis*. Note also the circular curling of the metasoma in contrast to the "U-shaped" metasoma of the vejovids. Photograph taken 6 August 1965.

This orientation was in general characteristic of the Vejovidae, in contrast to that of the Buthidae which showed no first instar orientation. In this family, the young of the first instar were roughly parallel to the mother's back and piled up randomly in layers sometimes three to four individuals deep (fig. 7). No conclusions could be made regarding first instar orientation in *H. arizonensis* or *A. phaeodactylus* as only one birth was observed for each species, and during these the first instar young never ascended. This lack of ascent was probably due to unfavorable laboratory conditions at time of birth.

Four mechanisms aided the young in mounting the mother's back without touching the ground. First was "birth basket" formation. Second was a sticky substance on the outside of the birth membrane which caused the newly emerged young to stick together in the "birth basket" until they were able to shed their membrane and thus gain some degree of control over their movement (fig. 8). Third, the shed birth membranes remained in the "birth basket," thus forming a sticky platform which received the newly emerged babies and minimized accidental fall to the ground. Fourth, the mother remained perfectly still during the entire delivery process and afterward until long after the last baby had ascended.

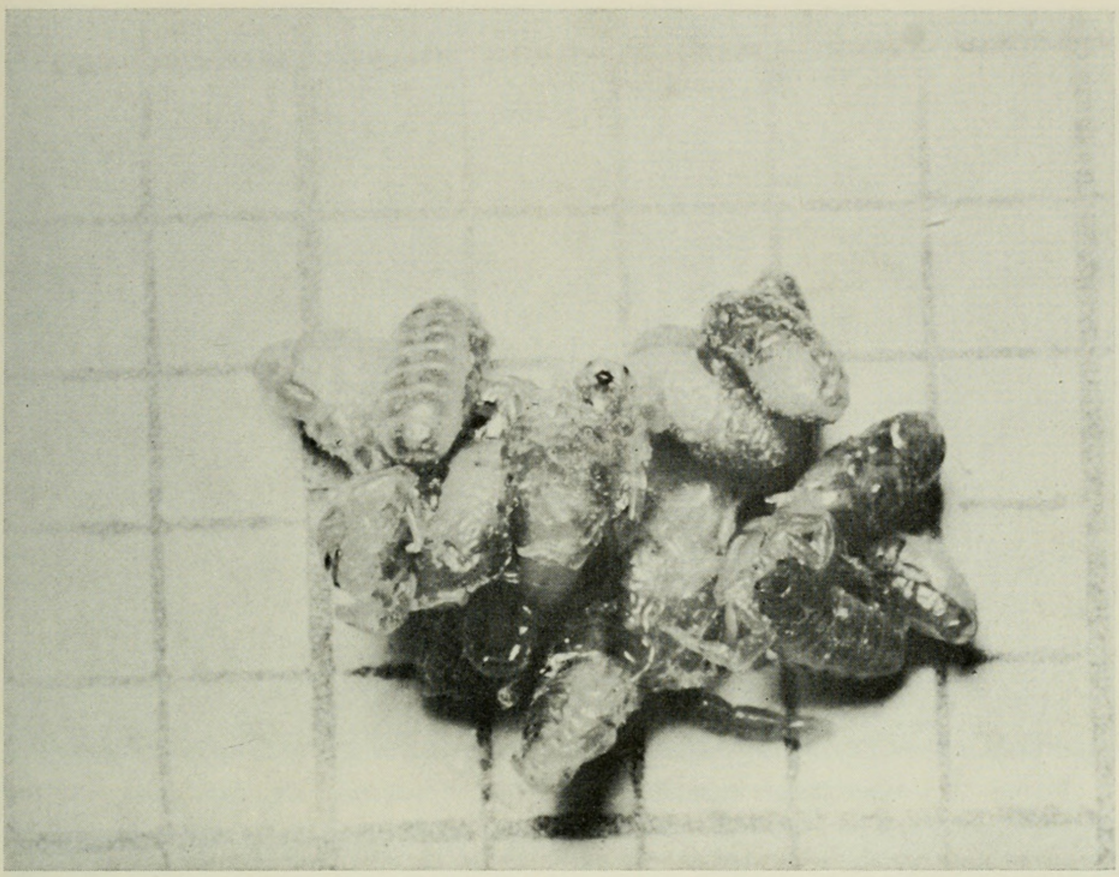


Figure 8. Newly born young clinging together by their sticky surfaces before emergence from their birth membranes. This mass of newly emerged scorpions was removed from the "birth basket" of the mother during birth. Photograph of *Vejovis vorhiesi,* 7 August 1965.

The two greatest obstacles to the survival of the newly born were being unable to escape from the birth membrane and accidental fall to the ground.

Post birth association of young with mother. Within 45 minutes following parturition the first instar nymphs found their way to the mother's back, where they secured a firm hold and remained during the first few weeks of post-birth life. The first stadium of all species lasted for one to two weeks, at the end of which time all members of a litter molt simultaneously on the mother's back within a period of 24 hours. The first instar nymphs never left the back, nor was movement readily accomplished. Even upon accidental fall to the substrate they seldom regained their position.

With the onset of the second stadium, distinct changes in the appearance of the litter occurred. Each of the young became distinctly more elongate (not accompanied by increase in body weight), thus causing the mother's back to appear much more crowded and disorganized. Even the vejovids lost their distinct first instar positional orientation during this stadium (figs. 9, 10, 11).

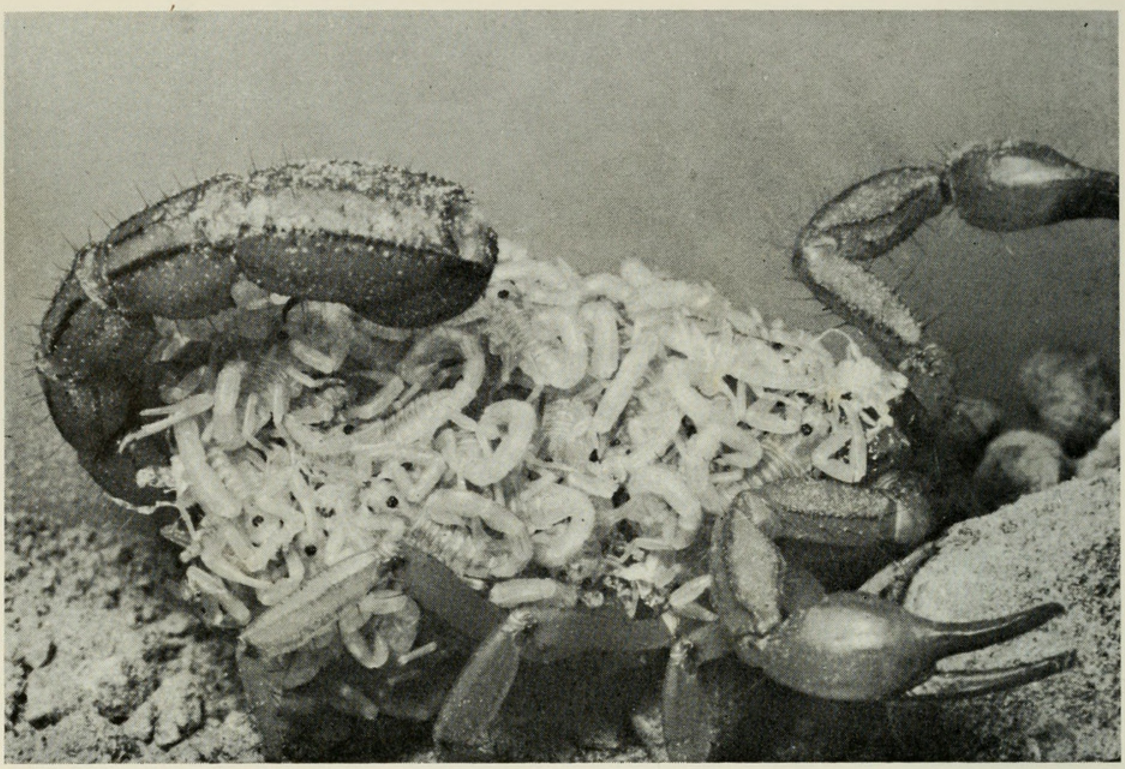


FIGURE 9. Second instar orientation of *Vejovis spinigerus*. Compare this with the photograph of the same litter while in the first instar stage (fig. 4). The young have abandoned their distinctive first instar orientation and have assumed a random positioning. The cast first-instar exuviae are still on the mother's back and visible along the edges of the litter. Photograph taken 17 August 1965, 21 days after birth.

At first, the second instar nymphs showed little or no movement. Gradually more and more movement occurred, until in about two weeks they began dropping off the mother's back one by one. At this time the fallen young departed from the mother and assumed an independent existence.

The second instar nymphs of burrowers such as *A. phaeodactylus, V. spinigerus,* and *H. arizonensis* at first sought shelter under rocks and other surface objects. Soon they began their burrowing activities by the excavation of simple cells under these shelters (fig. 12). The second instar young of all

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FIGURE 10. Second instar orientation of *Vejovis vorhiesi*. The young have abandoned their distinctive first-instar orientation and have assumed random positioning. Compare with figure 6. Note that figures 6 and 10 are not photographs of the same litter. First instar exuviae are visible on the periphery of litter. Photograph taken 17 August 1965.

FIGURE 11. Second instar orientation of *Centruroides sculpturatus*. The young are randomly positioned on the mother's back. First-instar exuviae are visible on the periphery of litter. Photograph taken 7 August 1965.

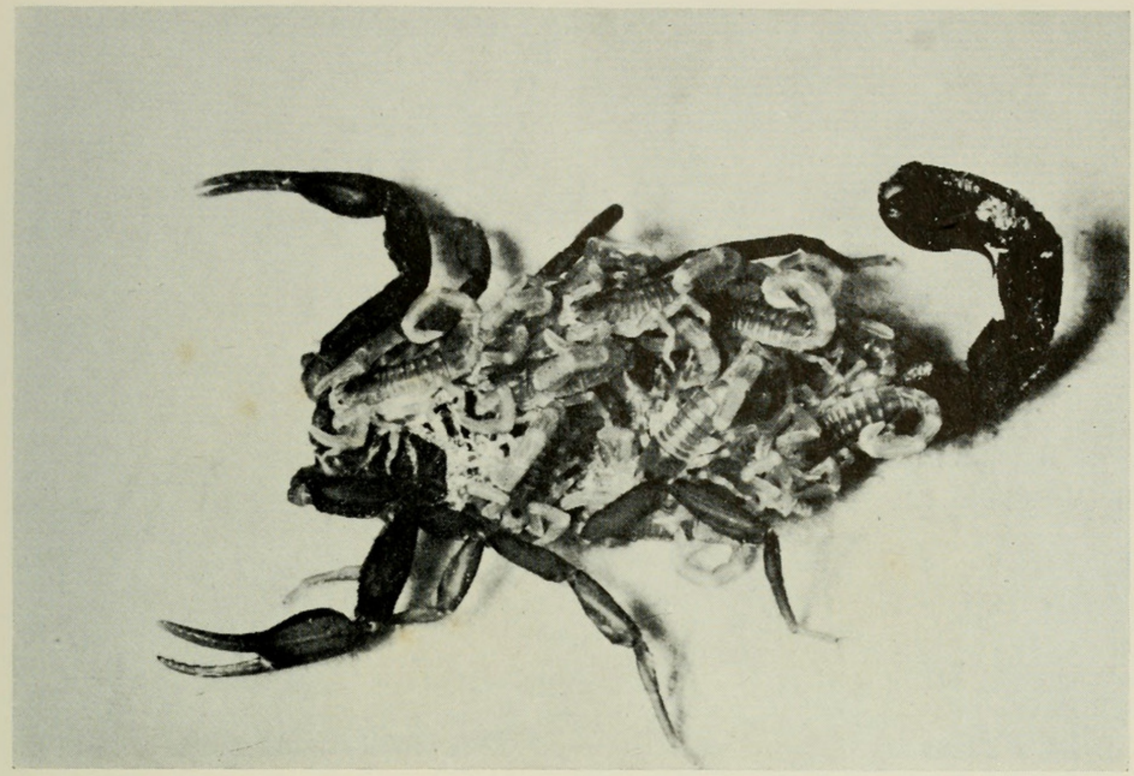

FIGURE 12. Second-instar nymph of *Vejovis spinigerus* excavating its first burrow. Photograph taken Fall, 1965.

observed species showed aggressive predatory tendencies and fed readily on small insects (*Drosophila* in the laboratory).

That early instar offspring are carried on their mother's back would tend to insure that they are always located among environmental conditions favorable for survival, growth, and development. In no case was a mother seen to devour the young on her back. On some occasions, however, females did eat unfortunate young which had fallen from the back. It was also clearly established that the first instar nymphs do not feed, much less show cannibalism toward each other or the mother. There is a superstition that young scorpions derive nourishment by eating the mother, but this was clearly not the case in the species observed in this study as the mother's integument was intact and undisturbed after the babies had departed (fig. 13).

During the first month or so of life, which was spent on the mother's back, the babies never ate or drank. The time spent in the first instar form was interpreted as an extension of the developmental process which had previously been going on inside the ovarian tube. The time spent on the mother's back in the second instar state was interpreted not only as necessary for carrying out general phases of development, but for furnishing protection and transportation for the babies until their cuticle had sufficiently hardened to make self-locomotion and independent life possible.

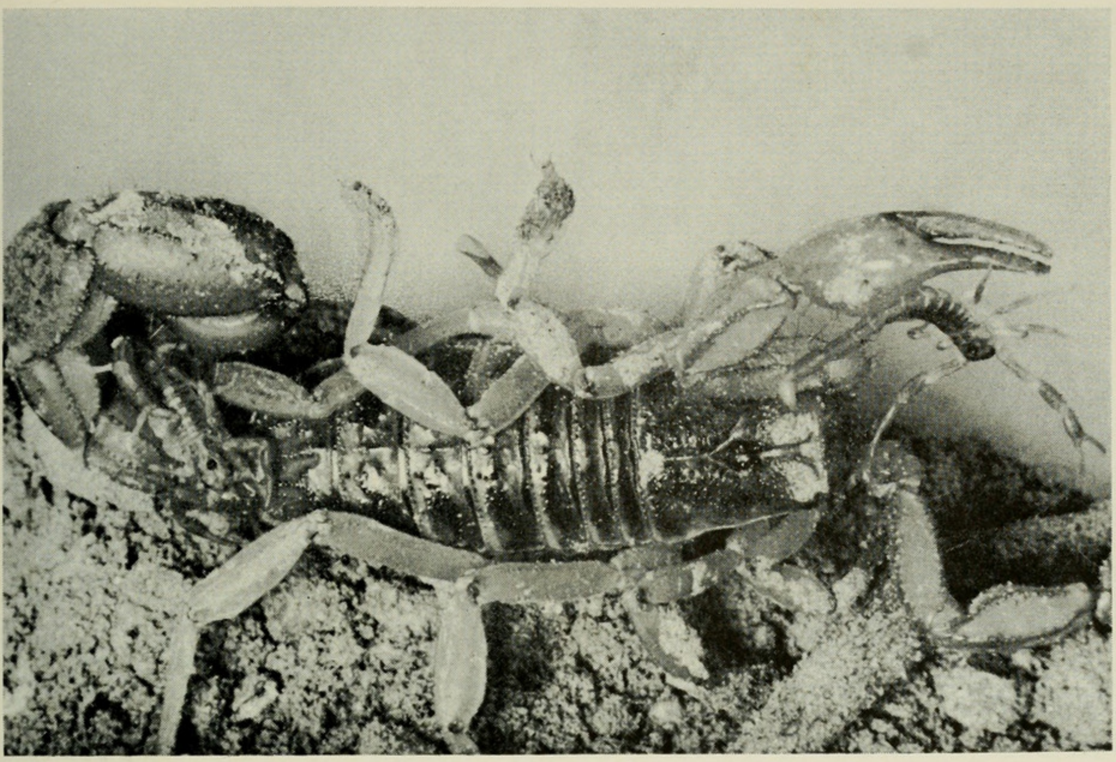

Figure 13. Mother *Vejovis spinigerus* and her last second instar offspring. This is the same mother shown in figures 1, 4, and 9. The back, vacated by the departing second-instar nymphs, is smooth, shiny, and with no signs of cannibalism by the young. Photograph taken in late August, 1965.

Description of first and second instars. Early instars belonging to the following taxonomic categories were studied:

Family Buthidae
- *Centruroides gertschi* Stahnke
- *Centruroides exilicauda* (Wood)
- *Centruroides sculpturatus* Ewing
- *Centruroides vittatus* (Say)

Family Chactidae
- *Broteas alleni* (Wood)

Family Diplocentridae
- *Diplocentrus whitei* (Gervais)

Family Vejovidae
- *Anuroctonus phaeodactylus* (Wood)
- *Hadrurus arizonensis* Ewing
- *Uroctonus mordax* Thorell
- *Vejovis confusus* Stahnke
- *Vejovis mesaensis* (Stahnke)
- *Vejovis minimus* Kraepelin

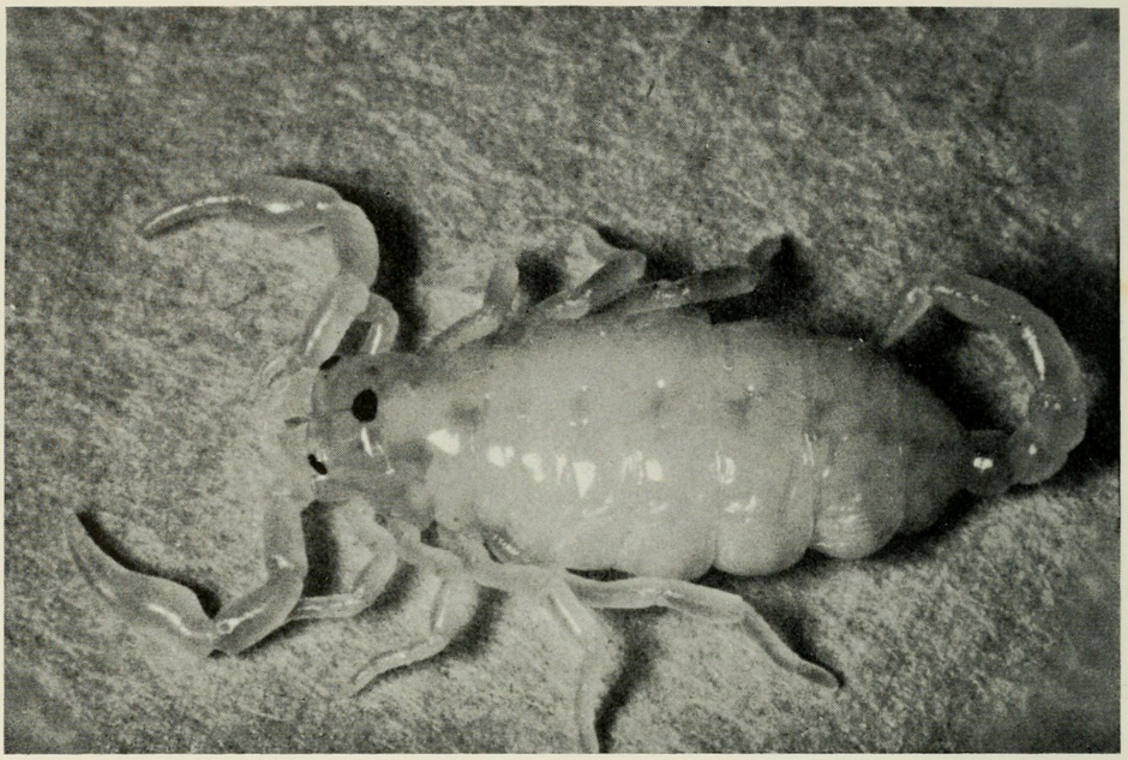

Figure 14. First instar of *Anuroctonus phaeodactylus*. Older instars develop a very dark cuticle pigmentation which is absent in the first instar. The body is very plump and filled with reserve nutrient. Young of this genus although very large in size are born not as fully developed as those of *Vejovis* and *Centruroides*. Photograph taken in September, 1965.

Vejovis spinigerus (Wood)
Vejovis vorhiesi Stahnke

The first instar of each species observed demonstrated a unique color and morphology which differentiated it from all other instars. The body of this instar was soft and whitish throughout the duration of this stadium since the cuticle, although firm, never attained a significant degree of hardening or pigmentation.

First instars of even the darkest species, such as the black diplocentrids, were whitish. Some of the vejovids did, however, have a slight trace of dusky pigmentation during this stage, while some of the centrurids were light orangish-white in general coloration.

First-instar weight and length measurements varied only slightly within any litter. These measurements varied slightly more when different litters of the same species were compared. The first instar nymphs of different species showed the greatest differences when average measurements were compared.

The first instar telson of all species was unique in that the aculeus was blunt and not fully developed. Likewise, the distal ends of the walking legs were blunt and lacked the pretarsal claws characteristic of all older instars (figs. 14, 15, 16).

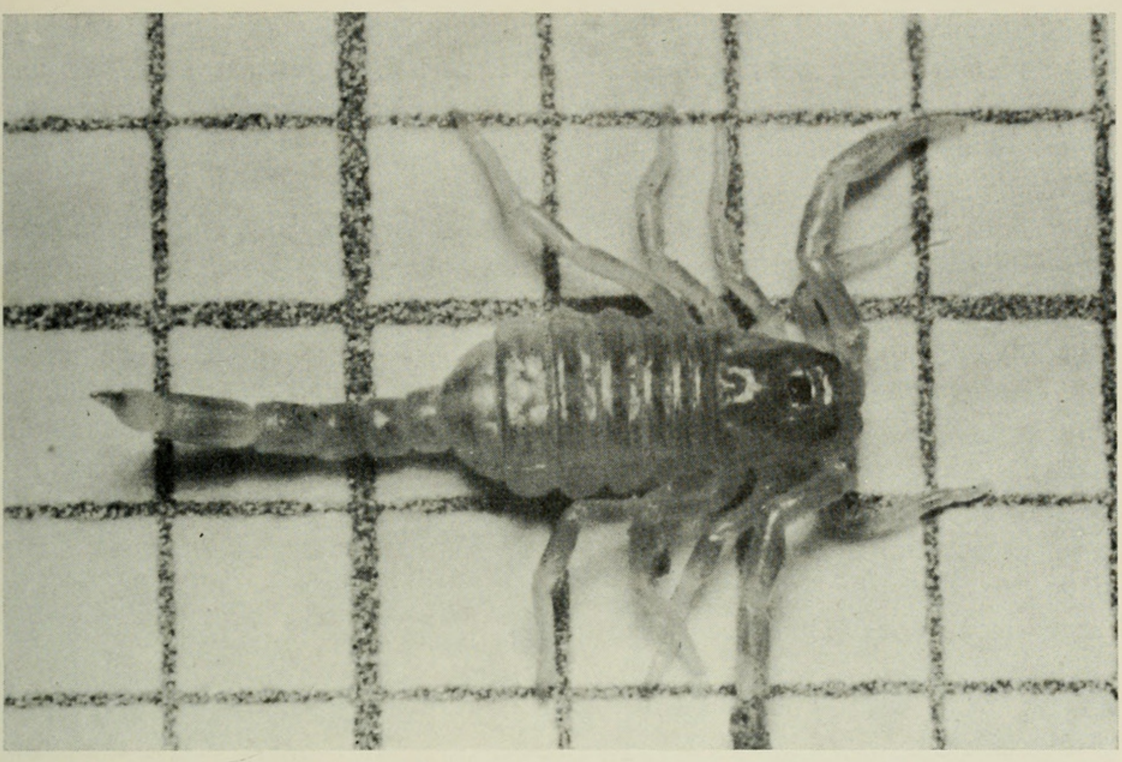

Figure 15. First-instar nymph of *Vejovis spinigerus*. Photograph taken 6 August 1965 on millimeter grid paper.

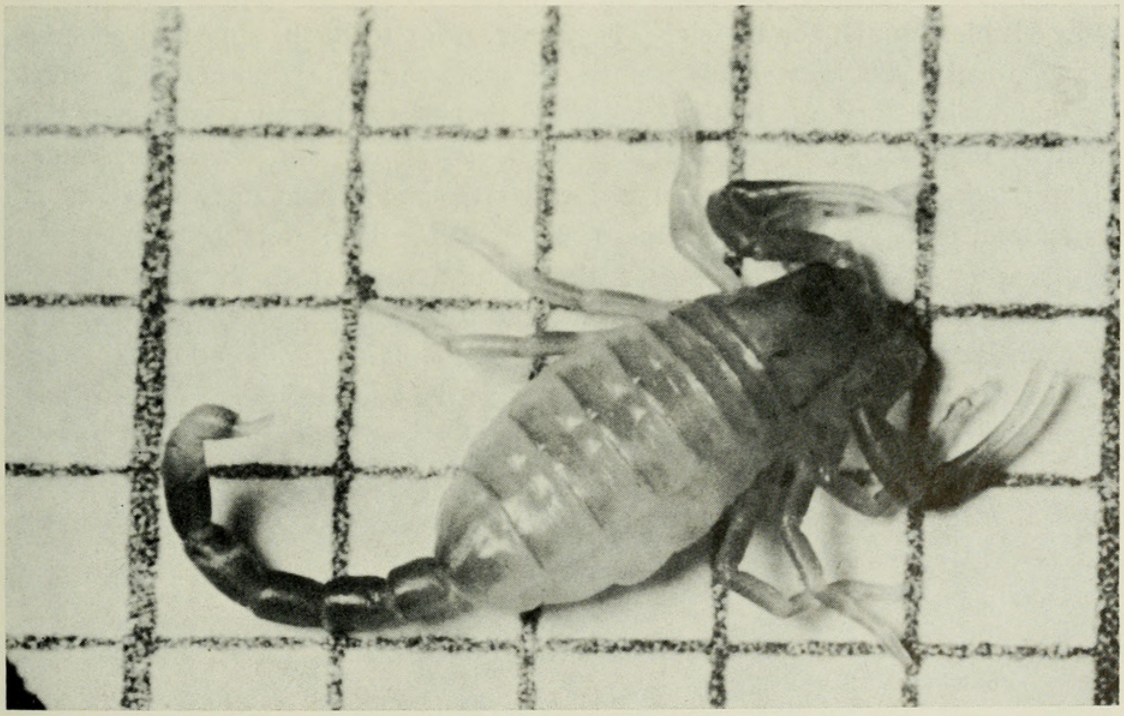

Figure 16. First-instar nymph of *Centruroides sculpturatus*. Photograph taken 6 August 1965, on millimeter grid paper.

Immediately following the first molt, the second instar young were still soft and pale, but gradually, over a 2-week period, the cuticle hardened and took on the characteristic color and color pattern of the species. The pretarsi were now distinct and possessed the characteristic claws while the aculeus was also distinct in shape and proportion (figs. 17, 18).

The first instars of all species looked remarkably similar. They all showed incomplete development of the external morphology and lacked the ability to move, feed, defend themselves, or burrow. These instars, of different species, generally differed only vaguely in color hue, size, and weight.

The nymphs were born very plump, the extra body volume was occupied with large amounts of stored nutrients needed for support of normal metabolic activities and growth until feeding could begin. During the first and second instars, prior to the initiation of feeding, the weight gradually and slowly decreased until the onset of feeding when weight again began to increase. After the onset of feeding, the weight fluctuated noticeably because of the periodic, predatory, engorgement type of food procurement.

Discussion and Conclusion

Most temperate North American species appeared to mate before the onset of winter; the females then overwintered. With the coming of spring, the mated females became active again and their bodies gradually became swollen in size with the developing young (fig. 19). During the summer the mesosoma of the females became greatly distended and a number of the developing embryos became visible through the cuticle. The young, prior to birth, appeared as small, whitish, oval bodies with distinct black eye spots within the mother's mesosoma. Field and laboratory observations indicated that probably only one litter is born annually in each of the species of *Vejovis*, *Anuroctonus*, and *Hadrurus* studied. Members of these species gave birth during late summer and early fall (August, September, and October). Specimens reared in the laboratory sometimes gave birth earlier or later in the season than apparently occurs in the field.

Individuals of some species, such as *Centruroides sculpturatus,* possibly gave birth to more than one litter during the summer and fall seasons. This species was observed in the field with young on the back from late May through late October. Females with litters on the back were also frequently observed to engage in the courtship dance with a nearby male. A specimen of the more tropical species *Centruroides gracilis* gave birth to two litters during the year.

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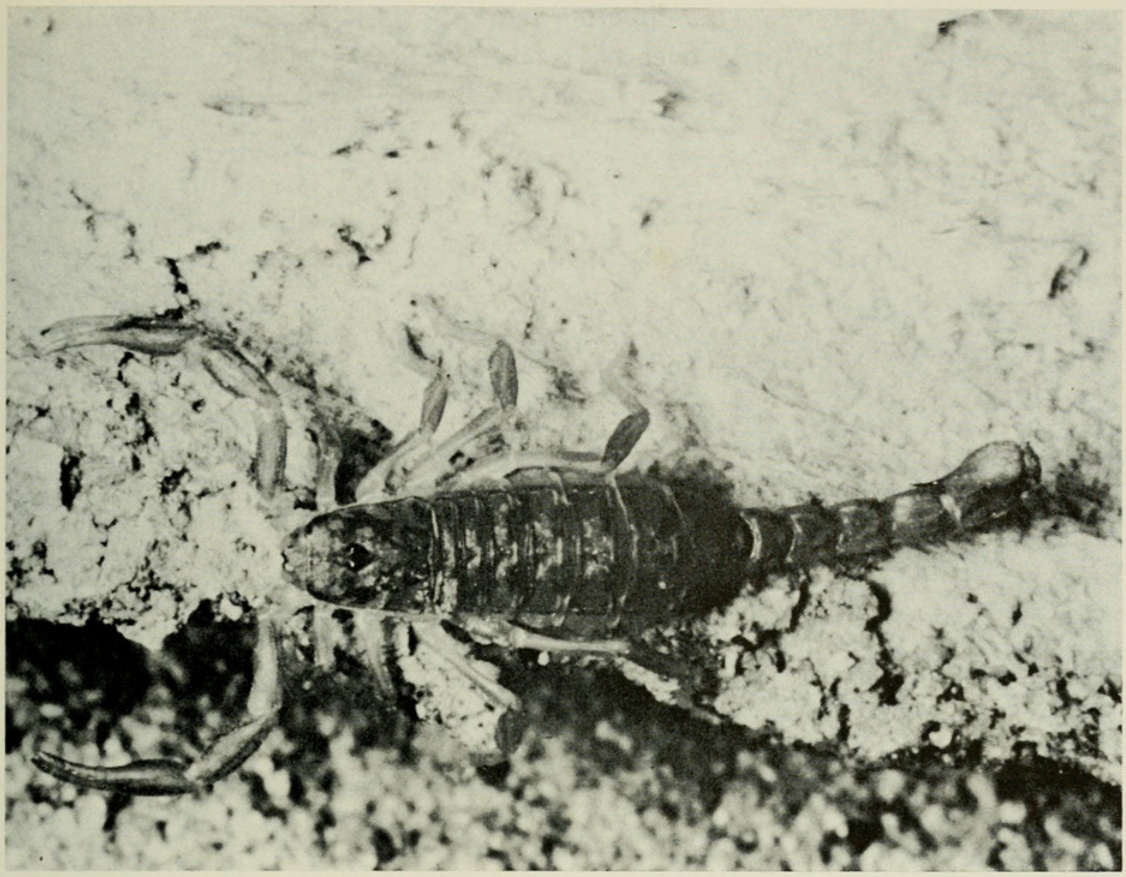
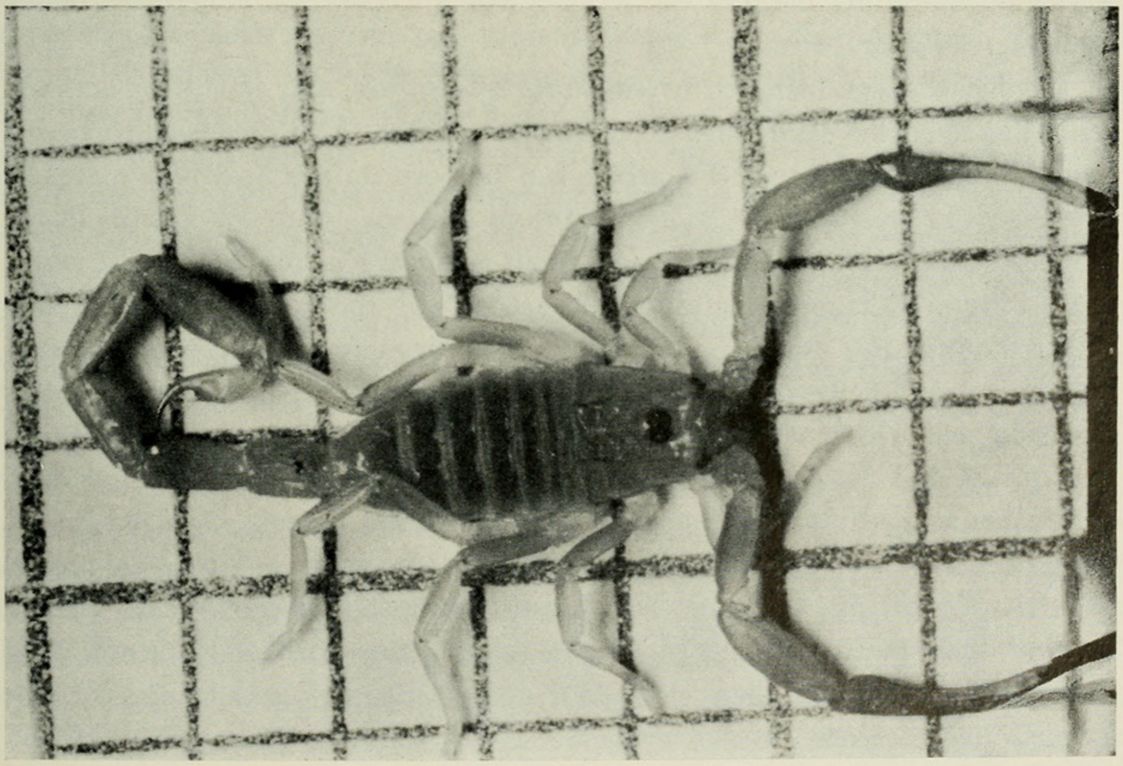
Figure 17. Second-instar nymph of *Vejovis spinigerus* soon after departing from mother. Photograph taken Fall, 1965.

Figure 18. Second-instar nymph of *Centruroides sculpturatus* at time of departure from mother. Photograph taken 2 August 1965 on millimeter grid.





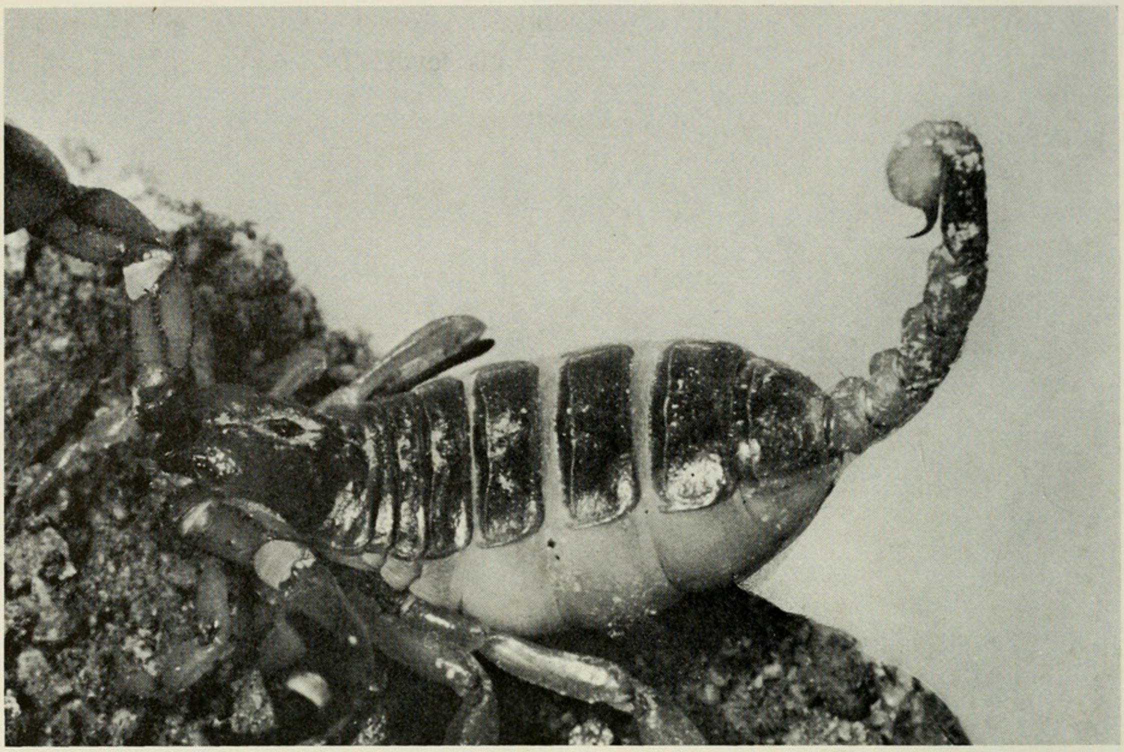


FIGURE 19. Female of *Anuroctonus phaeodactylus* with mesosoma swollen by internally developing young. The necessary increase in body volume is provided for by expansion of the pleural membranes and backward telescoping of the mesosomal tergites.

This was interesting because the mother had no opportunity to mate before delivering the second litter.

Embryonic development in temperate species probably varies in duration depending upon the environmental conditions present. This development occurs at a rate that insures that the babies will be born during a favorable season. Gestation was estimated by Baerg (1954) to be from 4½ to 7½ months in the Jamaican *Centruroides insulanus* and about 8 months in the Arkansas *Centruroides vittatus*. These estimates were in accord with the minimal gestation data gathered during this study. Gestation probably varies among the species depending on size and number of young born and depending upon the general climatic conditions endured by the population. It seems reasonable that a high-altitude species such as *V. vorhiesi* would have different reproductive and developmental cycles than low altitude species such as *V. spinigerus*. *Vejovis vorhiesi* is active for a much shorter time during the year because of the increased period of annual inactivity caused by the longer cold season of the higher mountains. *Vejovis vorhiesi,* then, must go through its entire reproductive and developmental cycle in a much shorter time than is the case with species living in habitats with a longer activity season.

In each species, the birth process appeared to commence when the young reached a certain level of development. This level of development, however, was not necessarily the same for all species.

Under natural conditions, scorpions appeared to deliver their young in protected situations such as under rocks, under bark of trees, in burrows. In the last 5 years some 75,000 scorpions have been observed in western North America and none were seen delivering young on the ground surface or in places lacking good shelter. Observation of birth in burrowing species, such as the members of the Vejovidae, were rare in natural field situations. Only on rare occasions was a female to be seen giving birth in a simple cell constructed under a rock or log. These species presumably gave birth in the seclusion of the burrows which they normally occupy. In the laboratory, members of the Vejovidae (most notably *Anuroctonus* and *Hadrurus*) exhibited conspicuous burrowing behavior for several days prior to birth. Individuals belonging to species of *Centruroides* were more frequently observed giving birth in the field because their preferred shelters (under logs and bark) were more readily accessible for observation.

All newly born young were very weak and not sufficiently developed to live independently. The period of time spent on the mother's back as first instar nymphs permitted extension of development until the young were sufficiently developed for independent life. Following the molt from first to second instar stage, the time spent on the mother's back allowed the second instar cuticle to harden and develop pigmentation. When the second instar body was strong and hard enough for adequate locomotion, the young left the back. Such a premature birth, followed by instinctive association with the mother, is not common in invertebrates. In a way this situation is analogous to the premature birth of marsupials followed by instinctive migration to the mother's pouch. Scorpions, however, have no analogous pouch, nor do the young require food while associated with the mother. Schultze (1927) reported that the young of the Philippine scorpion *Palamnaeus longimanus* left the mother in the third instars and that food was procurred for the litter by the mother. This seeming exception may not really be an exception. Probably the mother and young were kept in confined quarters which prevented the young from completely leaving the mother's association. These young then may have fed on the remains of prey left after the mother's feeding, since food of suitable nature could have been lacking due to the caged conditions.

The birth process and post-birth association of the young was surprisingly uniform among the species of the four families observed. The families, however, diverge in respect to post-birth orientation of the first instars. The Buthidae demonstrated a random positioning of first instar nymphs on the mother's back, while in the Vejovidae the first instar individuals demonstrated a highly organized and characteristic orientation in relation to each other and to the mother. The vejovid orientation allowed more young to be efficiently carried per unit space on the mother's back as well as allowing a firmer positioning of each member of the litter. This orientation perhaps minimized accidental fall to the ground and thus insured greater probability of reaching the second instar stage. Orientation of first instar young of the Diplocentridae and Chactidae could not be adequately studied because of lack of sufficient data.

An interesting difference between the observed vejovids and buthids occurred in relation to the behavior of mothers with young on their backs. In the field, *Centruroides* females were frequently seen on the ground surface while carrying young on their backs. They demonstrated little or no reduction in locomotory activity, frequently accepted food, and even participated in the courtship dance. In contrast, it was a rare occurrence to find a female vejovid on the ground surface at night while carrying a litter. In the laboratory, members of this family showed significant reduction of locomotor movement and feeding and no courtship was observed while litters were being carried. It was, therefore, concluded that the vejovids usually remained in their burrows or other shelters while carrying young on their backs.

The parturition and post-parturition activities of the scorpions reported by Shulov and others (1960) in the old world were strikingly similar to those observed here in North America. Comparison of birth activities of individuals in different families (Vejovidae, Diplocentridae, Scorpionidae, Buthidae, and Chactidae) indicated that this aspect of scorpion biology must have been a well established and successful plan early in the evolutionary history of the order. Since the now existing families are believed to have begun their divergence in the Carboniferous (Birula, 1917), it seems reasonable that the basic pattern of gestation, parturition, and post-parturition parental association must have been well established at this time.

It is interesting to note, however, that some interesting differences do occur between the Old World species reported by Shulov and the North American species observed. First is that the Old World species (*Nebo hierochonticus, Orthochirus innesi, Leiurus quinquestriatus,* and *Compsobuthus acutecarinatus*) were reported to deposit their young directly on the ground. These young apparently were born in a somewhat precocious condition and were able to leave the ground and ascend the mother's back to continue their initial development. The mothers (of at least *O. innesi*) aided the ascent by lowering their bodies close to the ground after parturition, and in holding the first pairs of walking legs on the ground under the genital aperture. The New World scorpions (*Uroctonus mordax* and species of *Vejovis* and *Centruroides*) all delivered their young in what appears to be a much earlier state of development. These were wrapped in a sticky birth membrane and were caught by the first and second pairs of walking legs before they touched the ground. These young were then held by the mother until they escaped from their membranes and began their ascent to the mother's back, never touching the ground.

The more precocious young of the Old World species took longer to pass through the genital aperture than the New World species. Each of the young of *N. hierochonticus* and *O. innesi* required a parturition time approximating 10 and 4 minutes respectively while parturition times in species of *Vejovis* and *Centruroides* were seldom over one minute.

Species such as *N. hierochonticus* (Diplocentridae) and *Scorpio maurus* (Scorpionidae) apparently retained their young within the mother's body until a more advanced stage of development (based on data reported by Shulov and others, 1960). In these two species, each of the young had apparently already escaped from their "birth membrane" before parturition. They were capable of considerable locomotor action at time of birth and did not molt for some 10 days after parturition.

Other species had apparently not attained this level of development at parturition time. The young of *O. innesi, L. quinquestriatus,* and *C. acutecarinatus* (all Buthidae) were born still contained in the birth membrane. The young showed no movement immediately after parturition, but escaped from their membrane within several minutes of birth. Within 8 to 10 minutes of birth, individuals of these species went through their first molt (before ascending to the mother's back).

All the species of *Vejovis* (Vejovidae) and *Centruroides* (Buthidae) observed and apparently *Euscorpius italicus* (Chactidae) (based on data reported by Angermann, 1957) delivered young in what seems to be an even earlier stage of development. This group of scorpions delivered young still encased in the "birth membrane." These young, after escape from this membrane, then ascended the mother's back and underwent their first molt several days to over a week later.

The available observations on scorpion birth indicate three types of young are born: those in an early state of development, those in a precocious state of development, and those in an intermediate group. The level of development at birth seems to be characteristic of the species and perhaps similar within related genera and families. Observations of more species will probably show that no three definite developmental groups occur, but that a continuous spectrum of development levels occur at time of birth within the order. For this reason, the terms viviparous, ovoviviparous, and oviparous may not be appropriate here.

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