

MIMICRY OF VELVET ANTS (HYMENOPTERA: MUTILLIDAE) BY JUMPING SPIDERS (ARANEAE: SALTICIDAE). G. B. Edwards

Many animals are known to use mimicry in a number of ways (Tickler 1968). Although numerous spiders have cryptic coloration and resemble inanimate objects or part of the substrate they inhabit (Patton 1948), few are known to specifically mimic other organisms. A few salticids mimic beetles (Kaston 1948), especially of the family Chrysomelidae. Members of at least 8 spider families mimic ants (Reiskind and Levi 1967); especially numerous in this respect are members of the families Clubionidae and Salticidae. Males of the mygalomorph family Atypidae appear to mimic ants or wasps (Gertsch & Platnick 1980). No specific spider mimics of velvet ants (Mutillidae) have been reported, although Reiskind (1969) implicated some species of Castianeira (Clubionidae). Mutillid females would seem to be ideal models with their potent sting and aposematic coloration. Here I present evidence that certain species of *Phidippus*, perhaps most of the species in the genus, mimic mutillid wasps. The spider stage most often implicated as a mimic is the adult male, although juveniles and females appear also to be mimics in some species.

A preliminary experiment to test the value of aposematic coloration in *Phidippus apacheanus* was conducted with two lizard species, *Anolis carolinensis* Voight and *Sceloporus undulatus* (Latreille). The lizards were of mixed age groups, but all except one *Sceloporus* male were either juvenile or young adult.

A wooden frame box 25 x 31 x 40 cm with 5 hardware cloth sides was used. Three lizards were placed in the box (2 *A. carolinensis*, 1 *S. undulatus*) in one of three test situations. The lizards fed freely on cabbage loopers (*Trichoplusia ni*) under such conditions; it was therefore concluded that testing of multiple individuals simultaneously in one cage was a valid procedure. The lizards used for each test were

different individuals, and there was only one replicate of each test. The 3 groups of lizards were offered one of the following: a female *Dasymutilla mutata* (Blake), a penultimate male *Phidippus apacheanus*, or both simultaneously. I made periodic observations of encounters. Each test lasted 24 hours, after which the prospective prey was removed and the lizards released.

No predation occurred on any of the test arthropods. The lizards largely remained stationary on the sides of the cage. The mutillid would alternate between walking around the bottom of the cage and not moving. The spider would walk anywhere in the cage or remain still in an edge or corner.

The lizards would sometimes watch the moving mutillid, but made no attempt to approach it. Sometimes the lizards would approach the spider, but they made no attempt to capture it, even when the spider assumed a defensive stance, thus betraying its identity as a non-mutillid.

Perhaps the lizards already had experience with mutillids, although mostly young individuals were used to reduce the chance of this possibility. If they were inexperienced with mutillids, then either the test situation affected their behavior or they have an innate aversion to aposematically-colored arthropods.

The lizards were chosen because of their abundance and availability, and also because they represented some of the most likely vertebrate predators of *Phidippus* species. There is at least one record of a *Sceloporus* preying on a *Phidippus* (Gertsch & Woodbury 1930). Another reason for using these particular lizard species is that *A. carolinensis* is primarily arboreal, whereas *S. undulatus* is more terrestrial. A close relative of the latter species, *S. woodi* (Stejneger), is almost exclusively terrestrial (Carr 1940). In Florida, *S. woodi* occurs where *P. apacheanus* is most abundant, in sand pine scrub areas.

I have never seen a *Phidippus* individual of any age or size make a silken bridge-line from one plant to another, and only once observed an individual use a bridge-line made by another spider. This may be due in part to the relatively large size of these spiders as adults, not necessarily because of their weight (which the silk could support), but because of the exposure to predators such a maneuver would allow. More than likely, the foraging behavior of the spiders and the relative spacing of plants in the preferred habitats have also been factors in selection against bridge-making. Most herb-shrub zone inhabiting species of *Phidippus* hunt primarily up and down the main stem of a plant, and in order for the spider to move from one plant to another, a second plant must either be touching or within jumping range, or the spider has to walk across the ground. Since most species live in semi-xeric to xeric habitats and the relative density of plants is low, traversing from plant to plant involves a considerable amount of travel on the ground. This has been observed for *P. audax* (Tessler 1979) in old fields and probably occurs often in the xeric sand hill and sand pine habitats in Florida. It is in the early successional stages of the latter habitat that *P. apacheanus* is most abundant in Florida. This habitat most resembles the conditions of its desert habitat in the southwestern U. S., where a number of congeneric apparent mutillid mimics occur.

The color pattern of adult *P. apacheanus* most resembles that of the western mutillid *Dasymutilla flammifera* Mickel; both model and mimic are solid red dorsally with black appendages. The large *D. occidentalis* (L.) of the eastern U.S. may be the model for eastern populations of *P. apacheanus*. Most of the western species of *Phidippus* alleged to mimic mutillids are red only on the dorsum of the abdomen and black elsewhere, as are the sympatric *Dasymutilla magnifica* Mickel and *D. nogalensis* Mickel. Both sexes of the western *Phidippus octopunctatus* (Peckham & Peckham) are gray dorsally, as are the sympatric *D. magna* (Cresson) and *D. nocturna* Mickel.

The above-mentioned mutillids, medium to large in size (15-20 mm average), are about 5-10 mm longer than their alleged mimics. However, in life, mutillids run with their heads down, somewhat hidden by the thorax. The truncate anterior edge of the mutillid thorax becomes effectively the front of the animal, which is matched in shape by the front of the spider. The tucked head of the mutillid also makes the mutillid appear shorter, thus more similar to the mimic in size.

The fact that lizards (assuming they are among the most important vertebrate predators) have limited home ranges is important to the development of mimicry in *Phidippus*. It seems necessary that the predator, model, and mimic all occur together in order for the mimic to maximize its potential for success. In this case, the mutillids would presumably teach the lizards about the painful effects of trying to eat a velvet ant, the lizards would retain a visual image of the aposematic coloration of the mutillid, and would refrain from attempting to eat anything with a similar color pattern. This is particularly significant for *P. apacheanus*, since all except the first free-living instar have a red and black color pattern. Although the spiders are primarily arboreal, some of the smaller species of *Dasymutilla* are also partly arboreal; therefore, a broader base of potential predators can learn about mutillids (hence the testing of both arboreal and terrestrial lizards).

I found that in the Florida State Collection of Arthropods, collections of local mutillids revealed that the smaller species of *Dasymutilla* were present from May through August, the same time as immatures of *P. apacheanus*, whereas the large *D. occidentalis* was present from May through October, the latter month when *P. apacheanus* matures. This synchronization of different stages of the mimic with different models has been taken to an even higher specialization by some ant mimics (Reiskind 1970).

Although *P. apacheanus* seems adapted to being a mutillid mimic throughout most of its life cycle, the same cannot be said of its sympatric congener, *P. cardinalis*. Only the adult male of *P. cardinalis* (sometimes also adult females) resembles a mutillid, and these mature the same time and in the same habitats as *P. apacheanus*. The immature stages of *P. cardinalis* are pale yellow and blend well with dead stems and grasses in the xeric habitat. In the subadult stages they turn orange and finally red as adults.

Males of *P. cardinalis* average smaller than those of *P. apacheanus*, which are only about half the size of the supposed model, *D. occidentalis*; the mutillid itself is uncommon in October. Perhaps size is unimportant relative to the similarity of the mimics' color patterns to mutillids, which may be sufficient to discourage predators. However, another possibility is that the predators have already learned about mutillids during the summer when *P. apacheanus* is a mimic as a juvenile, and this protection carries into the adult stage, where it is

further amplified by the peculiar mutillid walk, which is mimicked by the adult males of both *Phidippus* species. But the question of what *P. cardinalis* is mimicking must be asked. Since *P. cardinalis* did not have a mimic stage during the hypothetical learning period of the predator when mutillids were relatively abundant, it could not have been synchronically mimicking the velvet ants (barring the possibility that males mimic the few remaining and much larger *D. occidentalis*). The primary advantage to *P. cardinalis* males would seem to be their resemblance to the memory of a velvet ant retained by a lizard!

Obviously, a considerable amount of additional research is needed on the relationships of the biologies of various species of *Phidippus* to species of mutillids. One final observation: I recently have noticed that color patterns of such neotropical salticid genera as *Freya*, *Frigga*, *Nycerella*, and *Phiale* are remarkably similar to such neotropical mutillid genera as *Atillum*, *Cephalomutilla*, *Darditilla*, *Hoplocrates*, *Hoplognathoca*, *Hoplomutilla*, and *Traumatomutilla*. Further research may show that mutillid mimicry may be at least as common as ant mimicry within the Salticidae.

REFERENCES

- Carr, A. F., Jr. 1940. A contribution to the herpetology of Florida. Univ. Florida Publ., Biol. Sci. Ser. 3: 1-118.
- Gertsch, W. J. and N. I. Platnick 1980. A revision of the American spiders of the family Atypidae (Araneae, Mygalomorphae). Amer. Mus. Novit. 2704: 1-39.
- Gertsch, W. J. and L. A. Woodbury 1930. Spiders found in the stomachs of *Sceloporus graciosus graciosus* (B. & G.) (Araneina). Ent. News 41: 318.
- Kaston, B. J. 1948. Spiders of Connecticut. Connecticut St. Geol. Natur. Hist. Bull. 70: 1-874.
- Reiskind, J. 1969. The spider subfamily Castianeirinae of North and Central America (Araneae, Clubionidae). Bull. Mus. Comp. Zool. 138: 163-325.
- _____. 1970. Multiple mimetic forms in an ant-mimicking clubionid spider. Science 169: 587-588.
- Reiskind, J. and H. W. Levi 1967. *Anatea*, an ant-mimicking theridiid spider from New Caledonia (Araneae: Theridiidae). Psyche 74: 20-23.
- Wickler, W. 1968. Mimicry in plants and animals. World Univ. Libr., McGraw-Hill Book Co., New York. 253 p.