FALSE SCORPIONS

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FALSE SCORPIONS

These small, harmless relatives of the true scorpions are surprisingly abundant in woodland regions. Their retiring way of life conceals some fascinating patterns of behavior.

by Theodore H. Savory

If a group of animals delights a naturalist—and the animals happen to be numerous, easy to observe and yet unfamiliar to most people—he feels compelled to share his pleasure with others. Such is my feeling about the false scorpions, harmless relatives of the venomous true scorpions that are well known and feared in hot countries. The false scorpions look like tiny tailless scorpions less than a quarter of an inch long. There are nearly 2,000 species of them, constituting an order in the class Arachnida (which includes the spiders, the harvestmen, or “daddy longlegs,” and the mites). False scorpions can be found in wooded regions throughout the world. The fact that many people never see one is due to the animals’ retiring way of life, not to their scarcity. In the woods or a subur-

FALSE SCORPION of the species Chelifer cancroides is enlarged some 30 diameters in this drawing. The nearly 2,000 species of false scorpion make up an order in the class Arachnida. The large pedipalpi that resemble a crab’s claws are used mainly as weapons in predation. The small organs between the pedipalpi, the chelicerae, contain extensions of the mouth that flood the prey with digestive juices and later imbibe it in dissolved form. The chelicerae also contain glands that secrete a silk similar to that of spiders.
PEDIPALP is used by the false scorpion as a pincer for attack and defense. The animal's two pincers are huge in proportion to its body; when extended, they about double its length. The long hairs on the pincers (and chelicerae) are thought to be sensitive organs of touch.

INNER VIEW

SPINNERET

EXTERNAL SERULLA

INTERNAL SERULLA

FLAGELLUM

DUCTS OF SILK GLANDS

OUTER VIEW

CHELICERA, one of two manipulative organs near the mouth, consists of a fixed finger (smaller extension) and a movable one. Ducts of the silk glands open onto the spinneret at the tip of movable finger; other ducts open onto the serulæ. Role of the flagellum is unknown.

CARAPACE

ROSTRUM

RETRACTOR MUSCLE

ESOPHAGUS

PHARYNGEAL PUMP

LAMINÆ

MOUTH

MOUTH PARTS of the cheliceræ include a set of grooves and channels through which digestive juices flow outward and food is imbiber. Arrows show route of intake. Retractor muscle and pharyngeal pump are part of sucking apparatus. Laminae are extensions of mouth.

ban backyard 100 or more specimens can be taken from an area of 10 square yards in a month if one knows their likely whereabouts.

The best way to get to know false scorpions for oneself is to go into a wooded area with a wide-mesh strainer and sift handfuls of fallen leaves in it so that any small animals in the leaves will shower down on a sheet of newspaper. If one is reasonably lucky, there will be one or two false scorpions among them. An aid to identification is provided by Robert Hooke's description of three centuries ago: a "crab-like insect" with 10 legs, two of which resemble crab's claws, and "other hands, very near placed to its mouth." At first, after falling onto the paper, the animals will have drawn in their legs and will be still, but after perhaps half a minute they will begin to move. They stretch out their legs, spread their large pedipalp (the crablike claws, or pincers) in front of them like the antennæ of an insect and begin to walk slowly across the paper with an oddly dignified air that distinguishes them at once from any other living creature. As soon as one sees them thus one cannot help being struck by their character: here are small animals displaying in their general bearing the equivalent of human personality.

Perhaps as the false scorpion proceeds across the paper it meets some other animal and touches it lightly with one of the long, hairlike bristles that cover its limbs. The reaction is immediate. The pincers are withdrawn and the scorpion darts backward with a speed that is astonishing compared with its earlier majestic progress. This rapid retreat is characteristic of false scorpions. Not many animals can go backward as easily as forward and very few can go backward much more rapidly.

After such an intriguing introduction false scorpions invite closer acquaintance. To bring them home alive and install them in suitable cages does not require elaborate arrangements. Laboratory zoologists often follow the soulless procedure of putting the false scorpion in a plain glass tube with a loose cotton plug and a slip of paper on which the animal can rest. I have had good results using a glass dish, such as a Petri dish, with moist filter paper on the bottom. If one plans to keep the animals for long periods, it is well to cover the bottom of the dish with small stones and on top of this to sprinkle a layer of white sand. The gravel can be kept moist (an essential condition) and the sand makes a light background against which the inhabitants can be seen clearly. A few
small stones will provide them with the shelter they seem to enjoy. The dish must be covered because the animals are able to climb the vertical sides.

In captivity false scorpions will live for weeks or months in apparent comfort. They must, of course, be fed. False scorpions, like true scorpions and like spiders and daddy longlegs, are predators that normally catch and kill their prey. Unlike daddy longlegs, however, they refuse to eat anything that is not alive, and so living things must be supplied to them. An obvious source of food for a false scorpion would be the small animals that fell through the strainer in its company. Among these may be daddy longlegs, tiny spiders, mites, flies, the wingless insects known as springtails and other false scorpions. I have seen false scorpions respond to each of these potential meals. The ones I have kept would neglect the mites, flies and daddy longlegs, and would back away from spiders. Once I swung a small spider on its thread into the jaws of a false scorpion. The spider was killed instantly, but no attempt was made to eat it. The springtails were seized with avidity; a dozen or more would vanish in an hour, leaving no trace. Occasionally false scorpions (as well as true ones) will make a meal of a wounded or ailing member of their own species, but this is rare if other food is available.

The way in which a false scorpion feeds is unusual, with the process of digestion beginning before the animal has taken its prey into its body. The victim is grasped by the pincers; then the chelicerae—the small organs Hooke described as hands located near the mouth—tear it open and are thrust into it. Glands in the chelicerae flood the prey with a saliva containing digestive ferments. These convert the victim into a nutrient solution that the false scorpion imbibes.

One of the surprising aspects of a false scorpion's feeding is the complete consumption of its food. Whereas spiders and daddy longlegs leave a debris of emptied legs and dried carapaces, false scorpions leave hardly any trace of their meal. In another respect, however, the feeding pattern of false scorpions is like that of other arachnids: they do not require frequent, regular meals and

BUILDING OF A COCOON in the open is depicted in four stages. The false scorpion surrounds itself with "bricks" of wood and stone (1). Brushing the bricks with its chelicerae to supply a silken mortar, it assembles them into a dome (2 and 3). Finishing the cocoon, which may be used for molting, hibernating or laying eggs, the animal rests (4). A cocoon in a crevice would be cylindrical.
INCUBATION CHAMBER of the mother false scorpion is secreted by glands in the walls of her oviduct and remains attached to her body (left). The eggs are fertilized as they descend into the chamber. The larvae come out of the individual egg membranes still attached by short beaks to the mother. After several days she forces yolk into their bodies, which become greatly infested. The incubation chamber swells, flattening the mother’s abdomen (right). For about two weeks the larvae absorb this meal; they then reach the first nymphal, or prespull, stage. At this point they break out of the chamber and leave the cocoon in which the process takes place.

seem indifferent to semistarvation. Zoologists who keep spiders know that they do not have to feed the animals often and that many a spider is overfed if given one fly a day. False scorpions may be fed daily, but Herbert W. Levi, who studied them at the University of Wisconsin, found that adults fed once a week seemed better off than those leading their natural lives in the woods.

At the start of a meal—often, in fact, when prey has only been sighted—a false scorpion begins to rub its chelicerae with its pincers. This procedure is not analogous to a man’s washing his hands, although it looks as if the animal were scraping or sucking dirt from its limbs. Actually the pincers are cleaning the mouth parts of the chelicerae, a complex arrangement of grooves and channels through which digestive juices flow outward and digested solutions are sucked inward. It is essential that the chelicerae be kept clear for this dual purpose. The pincers are fundamentally weapons of attack and defense and can remain soiled.

The chelicerae have yet another important function. They contain silk glands that secrete a viscous fluid that hardens into fine thread. The silk is probably similar to that of spiders (no biochemist has chosen to analyze it), but for false scorpions its use is limited. Spiders have so exploited the silk they produce that their lifelong behavior is dominated by it. False scorpions use their silk only on the occasions when they construct a cocoon-like shelter in which to pass the winter, lay their eggs and shed their skins.

False scorpions grow discontinuously by molting the hard outer skeleton that covers their body. They undertake this major operation in the safety of a cocoon built in one of two forms, depending on the physical surroundings. If a cocoon is to occupy a crevice, it will consist of a circular base or mat of silk with sides rising to the roof of the crevice and making a roughly cylindrical chamber. If the chamber is built in the open, it will resemble an igloo with a dome-shaped top [see illustration on preceding page].

Before construction begins the false scorpion can be seen wandering about as if it were searching for a suitable spot. Once this is found the animal starts to collect material such as small pieces of wood or bark, bits of stone and so on, which it arranges in a circle around itself. Joining the pieces with strands of silk, the animal lays foundations on which it places more wood and stone, brushing each addition to the rising wall with its chelicerae to provide a silken fixative. Soon it becomes necessary to go outside and collect more material. The false scorpion steps over the wall, picks up a splinter or two in its pincers, transfers the material to its chelicerae and carries it back. One is reminded of a bird flying back to its nest with straws in its beak.

As the wall rises and arches inward, the unfilled hole in the center gets smaller, yet the scorpion seems to have little difficulty forcing its way in and out. Finally the last brick is laid and the builder is imprisoned in the structure. This incarceration does not stop its activities; the animal continues to add silk to the wall of the cocoon, sweeping its chelicerae over the surface like a paintbrush. Silk threads emerge and coalesce, eventually to cover the entire inside with a continuous sheet of what may well be described as silk wallpaper. Several days may have passed before this last phase is complete.

Secure now from outside interference, the false scorpion will shed its skin. First it rests for a day or so with closed pincers and legs rigid and straight. Its abdomen, normally flattened, swells by becoming narrower and deeper. Suddenly the carapace breaks loose from the front part of the body, rising upward with an almost explosive force. Then the old skin begins to slide backward to the accompaniment of some twitching of the abdomen. The legs remain still. The whole affair, which is much more passive than the strenuous molting of a spider, may occupy the better part of a day. When it is over, the false scorpion moves its legs into their usual position and is able to walk about. It proceeds slowly for the first day or two; if it falls over, it will have some difficulty righting itself. In the course of their lives false scorpions, at least those that have been thoroughly observed, shed their skin four times.

Clearly the chelicerae of a false scorpion are organs of great value and versatility, although to the casual observer they are overshadowed by the enormous pincers. Each chelicera consists of two parts [see middle illustration on page 4]. There is a broad, flat “hand,” elongated at one point to form a fixed “finger.” Close to the fixed finger
there is a movable finger that forms a grasping organ. At the base of the fixed finger a group of spines forms a flagellum of uncertain function; on its inner edge is a comblike organ called the interior serrula. The fixed finger ends in a sharp point; at the tip of the movable one is a rounded spinneret onto which the ducts of the silk glands open; this spinneret takes a wide variety of forms in the different genera of false scorpions. A second comb, the exterior serrula, is found on the inner edge of the fixed finger. In addition to the silk and digestive glands there are two other glands in each chelicerae; one of them secretes through a single duct near the tip of each finger, the other through many ducts onto the combs.

Normally the chelicerae are held horizontally and pointing forward, but they can be moved and in fact are very active. They serve as jaws in feeding, cutting open the prey. They also pick up, hold, carry and distribute silk. The combs are used in cleaning the rostrum (a beaklike part of the mouth) and other mouth parts. They are lined with hairlike spines that probably serve as highly sensitive organs of touch. It is interesting to note that these spines are not scattered haphazardly over the surface; they occupy specific positions, and students can identify each one.

As I have indicated, false scorpions build cocoons for reasons other than molting. In the winter they build hibernation chambers (false scorpions may live for two or three years), which are shared by two or three individuals. Females build a variation of the cocoon, in the shelter of which they lay their eggs and bring up their young. The females also produce, as an extension of their bodies, an incubation chamber in which the eggs are actually laid. This chamber is made of a secretion from glands in the wall of the oviput; when the secretion is extruded, it takes the form of an inverted mushroom with the stem attached to the oviput opening [see illustration on opposite page]. The eggs are fertilized during their downward passage and about 20 fall one by one into the chamber. The chamber is not detached, as are most egg cocoons, but remains in position under the abdomen of the female. The eggs develop within it.

When the larvae break out of the egg membrane, they are still attached by short beaks to the body of the mother, absorbing a nourishment produced by the degeneration of her ovaries. A few days later a remarkable event takes place: the mother, by muscular contraction, forces yolk into the bodies of the young larvae. They become inflated to about three times their previous size; the incubation chamber is enlarged and pushes the shriveled abdomen of the female into an almost vertical position. For about two weeks thereafter the inflated larvae absorb their enormous meal and develop into the first nympha, or preadult, stage. This development involves the first molting of the false scorpion's life. In the first nympha, the larvae break out of the cocoon and begin to lead independent lives. They feed themselves and molt three more times before becoming adults about a year later.

Adulthood is defined by mating, a step preceded by a complicated courtship that marks the end of the false scorpion's retiring style of life. The courtship begins with a form of dance in which the male takes the initiative. He stops close to a female, shaking his abdomen and waving his pincers. The female is quiet with a significant still-
ness: if she moves, the male stops his maneuvers; if not, he draws closer until his forelegs almost touch her. At this point he suddenly lowers his body and on rising is seen to have left a viscous vertical thread, drawn from his genital opening. In a few seconds the thread has hardened into a tiny pillar known as a spermatophore. The male backs away, leaving a drop of seminal fluid on the pillar that stands between the two dancers. Signaled by a particular movement of the male’s pincers, the female moves forward in such a way that the spermatophore enters her body. The male then grasps her by the legs and shakes her vigorously so that the drop of fluid is detached and remains within her to fertilize the eggs when they are laid. The two false scorpions then part. If they meet again, they show no particular interest in each other.

Courtship of this kind, which is widespread among arachnids and other invertebrates, is easier to describe than to explain. It may have two functions: first, the mutual stimulation of the two participants, and second, the exact placing of the female so that the spermatophore will be oriented properly. Other interpretations have been suggested; it cannot be said that zoologists agree on the best explanation.

The false scorpions that live among the fallen leaves in woods are the easiest to find, but many others live in quite different kinds of surrounding. Some are almost always to be found under the loose bark of dead or dying trees, and others abound among stones and slates. A few species remain close to the sea; some live among rocks that are regularly covered by the tide. Others come into human habitations and may be found among books in the library or clothes in the closet. (A common name for the animal is “book scorpion.”) Some species live in ants’ nests, but this comes as no surprise; these habitats are popular with animals of almost every class and order. It is surprising, however, to find false scorpions in beehives. There is even some evidence that they eat the pollen from the bees’ legs.

Having a wide choice of possible habitats is a sign that an animal is a success in the evolutionary struggle. Insects and birds are obvious examples of successful types of animal life; so too are spiders and roundworms. The success of false scorpions involves their ability to adapt their bodies to various degrees of moisture in the surrounding air. Almost all invertebrates that live on land need some protection against the excessive loss of water. Indeed, the retention of water often determines their behavior and distribution. Some invertebrates, for example, may be active only after sunset; they lie in shelter during the day. It is therefore of considerable interest to learn that false scorpions can survive in wholly dry air for times varying from a few hours (for the species that frequent fallen leaves) to many days (for those that live in dry places such as houses).

As a conclusion to this brief account of the order of false scorpions, one of its unsolved mysteries should be men- tioned. It has long been known that false scorpions will at times cling to the legs of flies, daddy longlegs and other creatures so that they can be transported for relatively long distances with no expenditure of energy. False scorpions are not parasites, and there is no question of their having got into such a situation by accident. This mode of travel, known as phoresy, seems to be a response to specific conditions of the environment. Only a few species of false scorpion have been observed to use it, and they do so only at certain times of the year. In the periods when phoresy is employed, however, it seems to be the preferred means of transportation. In 1945 Max Vachon of the National Museum of Natural History in Paris recorded 78 false scorpions on the legs of 57 daddy longlegs in one week in August. The largest load carried by any one daddy longleg was eight individuals. All were of the same species and all but one were mature females.

The fact that the females were mature indicated that phoresy is not reserved for the dispersal of the young. Vachon found that all of his specimens had either recently mated or had just produced a brood of young. Since all were in need of food, he concluded that hunger had induced them to seize the legs of flies or daddy longlegs and thus travel to a neighborhood where prey might be more plentiful.

The study of false scorpions is enriched by the beauty and precision revealed when their bodies are examined in the microscope. The intricate design in the construction of their tiny frames is breathtaking. For example, the number and position of the spinelike hairs near the animal’s mouth change in a characteristic way during the various stages of its growth. The devout assure us with confidence that the number of hairs on our heads is ordained; in the same spirit the zoologist can state that the very hairs on a false scorpion’s jaws are arranged systematically.

Is it useful to know and record such facts? A professor of biology has recently written, “No merit attaches to the pursuit of useless knowledge,” adding that the amount of useless information awaiting pursuit is greater than the united ability of men to follow it. If it can be said that any knowledge is useless, his dictum might cause some reflection among those who follow false scorpions. Useful or not, however, the pursuit of some types of knowledge brings an enjoyment unique in itself and a satisfaction one does not want to forgo.
The Author

THEODORE H. SAVORY is vice-principal of Stafford House, a tutorial college in Kensington, England. Although he describes himself as having spent most of his adult years leading "the typical life of a British public school master," he is in fact one of the world's foremost authorities on arachnids, the group of animals that includes spiders, daddy longlegs and scorpions. His interest was kindled when he was 16 and "contemplating the idea of specializing in some sort of animal." One day he was reading outdoors when a spider dropped from an oak tree onto his book. Savory "said to companion, casually, 'What about spiders?' 'Why not?' replied he, and so it was." After graduating from the University of Cambridge in 1918, Savory spent 31 years teaching science at Malvern College and seven years as senior biology master at the Haberdashers' School in Hampstead. He took his present position in 1958. The article on false scorpions is his third in SCIENTIFIC AMERICAN; the others were "Spider Webs" in April, 1960, and "Daddy Longlegs" in October, 1962.

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