

IT'S ALL IN SELF-DEFENSE—A bombardier beetle that looks delicious to a hungry toad protects itself by emitting a chlorine-like spray that burns its enemy's tongue. Defeated, the toad retreats. (A-C). A whip scorpion, antagonized when one of its appendages is pinched with a forceps, aims its acid spray in the direction of its attacker. (D). Millipedes also protect themselves by secreting chemicals. A midbody section sagittally dissected shows round reservoirs filled with dark brown quinonoid secretions. (E). The *Eleodes* beetle stands on its head when upset and sprays repellent quinone from the tip of its abdomen. (F).

ENTOMOLOGY

## Insects Speak in Chemicals

A vast array of chemicals are produced by insects and other animals that serve as odorous messages of defense or alarms of approaching danger—By Barbara Tufty

### See Front Cover

► THE VOCABULARY of chemical signals used by insects and other animals to protect themselves may be one of the "richest in the entire world of life."

There is a vast array of chemicals produced by these animals that serve for messages, reported Drs. Thomas Eisner and Jerrold Meinwald of Cornell University, Ithaca, N.Y.

In fact, "all living things—animals, plants and microorganisms alike—are probably involved at one time or another in their existence with the emission or reception of extraspecific chemical messages," the two scientists pointed out in *Science*, 153: 1341, 1966.

A whip scorpion discharges an acid spray when disturbed. A millipede secretes a poison from its segmentally arranged glands. An arctiid moth emits froth from its cervical glands. These chemical defenses of the tiny animals are comparable to the rather forceful message written in the stench of a skunk's spray.

The chemical secretion, often strongly odorous and discharged in substantial amounts, is stored in glands that are so variable in number, distribution and structure that there can be no doubt they have evolved independently of each other. Some animals such as millipedes secrete the chemicals by oozing them over their body surface, while others, such as beetles "air" the chemicals. The caterpillar shown on the

cover, being pinched with forceps, responds by everting its two-pronged postcephalic gland.

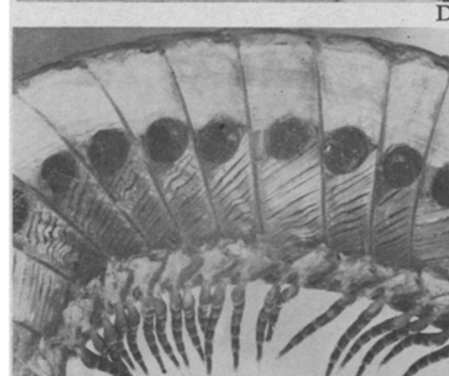
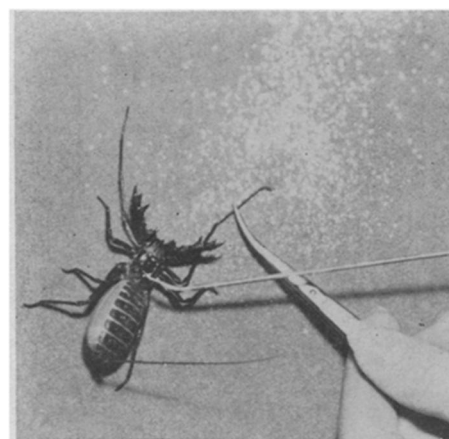
Most of the chemicals that have been identified belong to a number of common classes, such as the acids, aldehydes, ketones, esters, hydrocarbons and phenols.

These substances can be aimed at encroaching predators with extraordinary effectiveness, the scientists reported. The secretions, aimed at sensitive areas of the face, act as irritants and cause the predators to cease the attack and "perform more or less vigorous cleansing activities." Mice wipe their eyes and snouts with their front feet; birds ruffle their plumage and rub their heads against the feathers of their bodies; frogs and toads, which are sensitive over their entire body surface, scratch affected regions with their feet. The predators often recover in a matter of seconds or minutes—and may have learned enough to remain aloof from the insect in the future.

Sometimes these secretions serve another purpose, such as sending out alarms of approaching danger to members of the same species. The ant, *Acanthomyops claviger*, produces a secretion that serves both for defense and as an alarm signal.

Another set of important substances is produced by animals to exchange messages of courtship and other social activities.

(Cover photographs by Dr. Eisner.)



Dr. Thomas Eisner