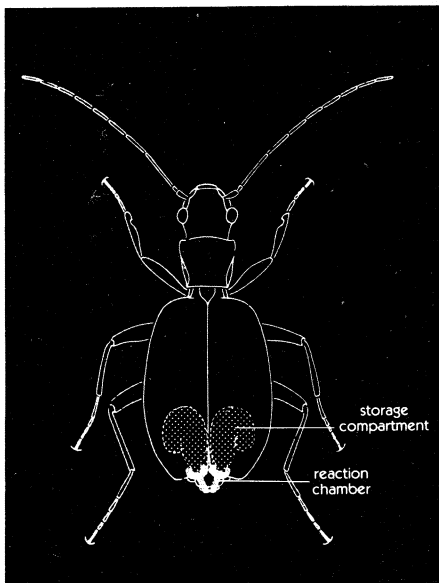


# A SKUNK OF A BEETLE

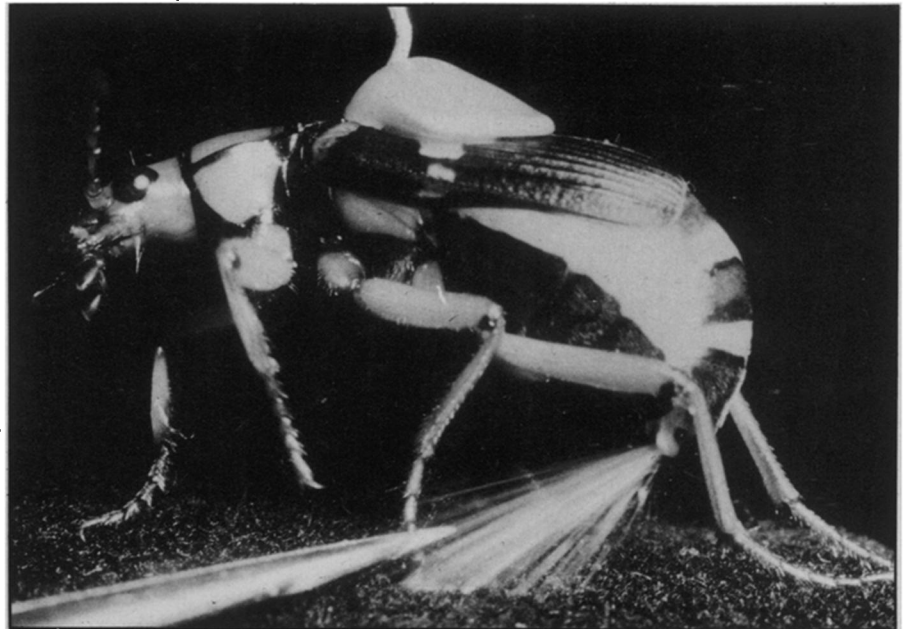
The defensive spray of a bombardier beetle is more than odorous and irritating— it is boiling hot and pulses like rapid machine gun fire

BY JULIE ANN MILLER

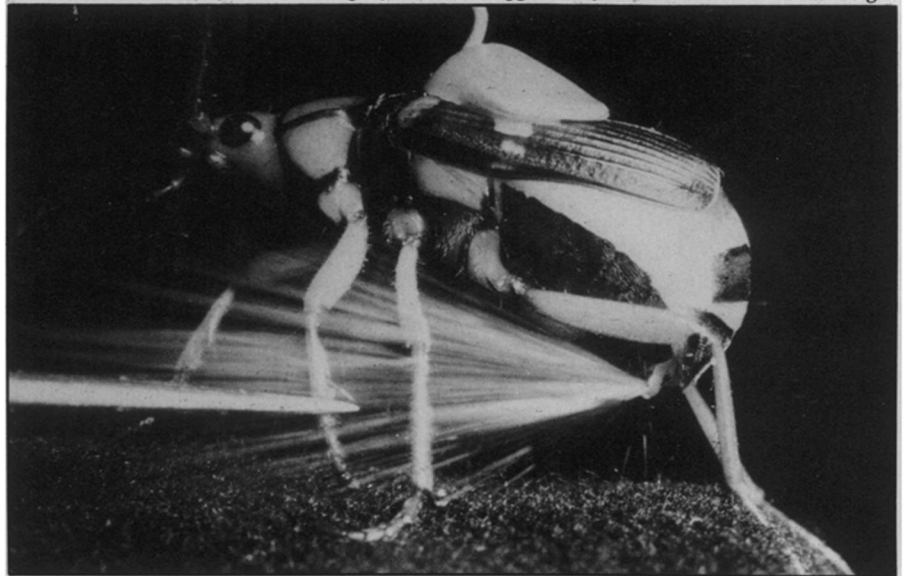


after David Alsop

T. Eisner and D. Aneshansley



Beetle aims its noxious spray at forceps, demonstrating ability to hit ants full blast no matter where they bite. Photographs were triggered by sound of beetle's discharge.



The audible “pop” of explosion triggers an electronic flash. Snap — a bombardier beetle caught in action on film. Thomas Eisner and Daniel Aneshansley of Cornell University have documented photographically an amazing defense mechanism.

Beetles of several species fend off potential predators by squirting noxious chemicals from their abdomens. No matter how an attacker approaches or which leg an ant chooses to nibble, the bombardier beetle can revolve its abdominal tip to accurately aim the discharge. The defense is effective against ants, preying mantids, wolf spiders, frogs and mice (unless a bee-

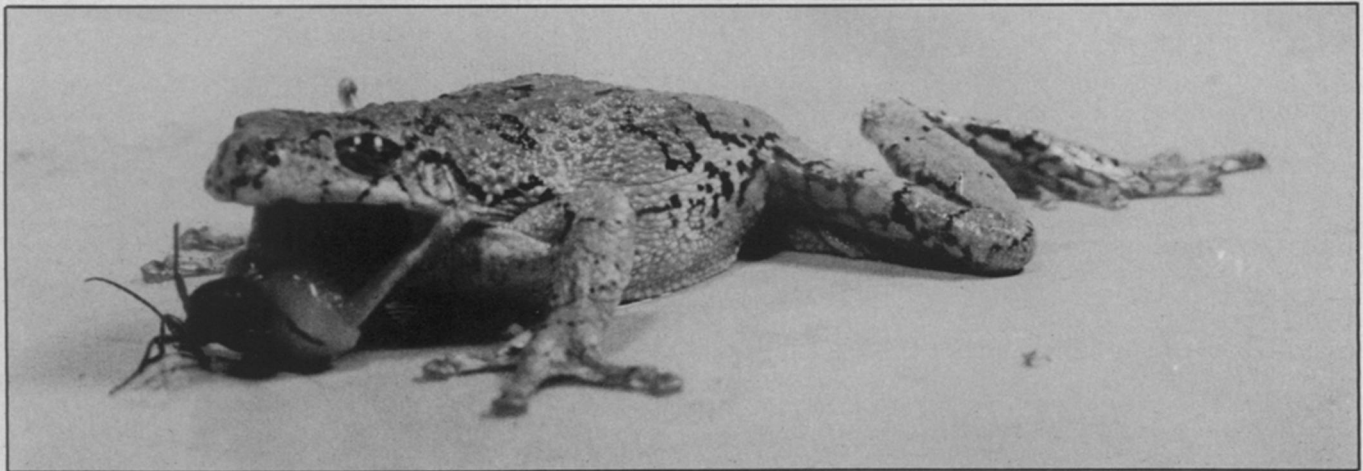
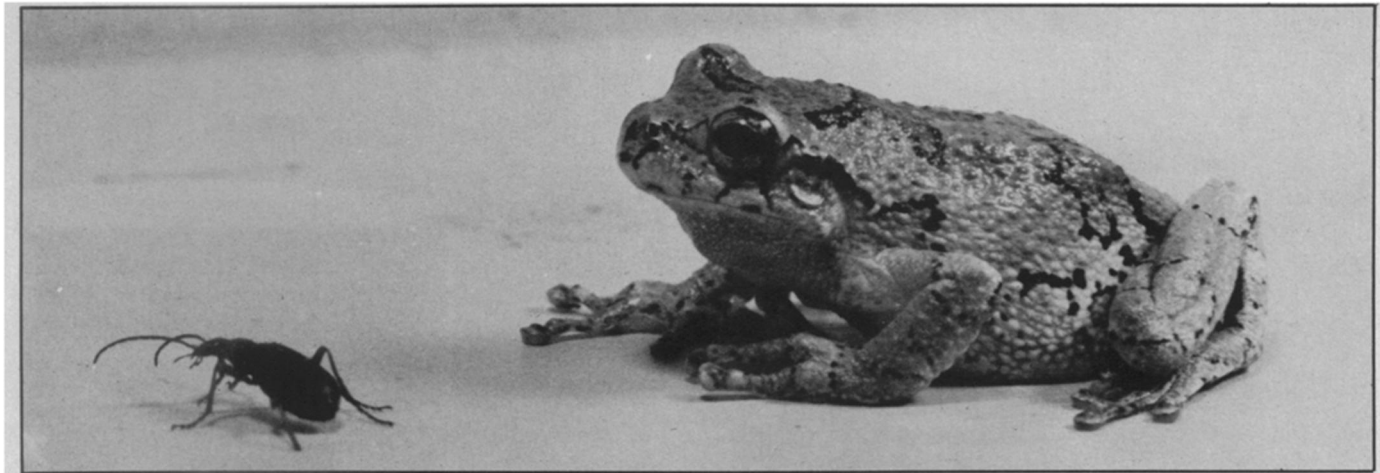
tle's ammunition is depleted).

Only the gentle imprisonment of certain orb-weaving spiders can evade the beetles' guard. When a beetle flies into a web, the spider can wrap its prey in silk so lightly that the beetle is not induced to fire. By the time the captive fires, as the spider bears down with deadly fangs, its abdomen is too bound in silk to aim adequately. In that case its defense is futile.

Bombardier beetles are widespread in the United States and around the world. These blue and orange insects are found near ponds and streams, usually under logs and rocks. In Madagascar and in the

Amazon Basin, a giant type of bombardier beetle reaches almost an inch in length.

German investigators a few years ago analyzed the beetles' defensive chemistry. Bombardier beetles were found to have glands that store hydrogen peroxide and chemicals called hydroquinones. When a beetle is disturbed, muscular compression forces those chemicals into a “reaction chamber” containing enzymes that catalyze hydroquinones' oxidation. The reaction products are benzoquinones — odorous and irritating substances — and gaseous oxygen — which propels the spray out of the beetle's abdominal tip.



T. Eisner and Charles Wojcick

*A small frog gets an unpleasant surprise when it attacks a bombardier beetle. The beetle's spray can deter most predators.*

Eisner and Aneshansley suspected that such an explosive reaction might involve considerable heat. They enlisted Cornell chemists Joanne Widom and Benjamin Widom to make thermodynamic calculations. The conclusion was that the heat liberated by the reaction should be sufficient to make the reaction mixture boil. By setting small thermistor beads in a beetle's firing trajectory, the researchers directly measured spray temperatures of approximately 100°C. The measurements confirmed reports of travelers that the spray of giant beetles is noticeably hot and also the scientists' own observation that

smaller beetles' sprays feel hot to the tongue.

Films, as well as still photography, now have captured the beetles' defensive act. Harold Edgerton at Massachusetts Institute of Technology helped make a movie to document action too rapid to be apparent to an unaided observer. The film, taken at almost 3,000 frames per second, shows that a beetle's spray is actually a series of pulses, as from a "water pick," the scientists say in the quarterly *NEW YORK'S FOOD AND LIFE SCIENCES*. Analyses of the sound of discharges had previously shown a discontinuity, like the report of a rapidly firing

machine gun, with the interval between pulses approximately 0.001 second. The pulsation may be due to a cooling effect from intermittent addition of fresh chemicals to the reaction chamber, the scientists speculate.

Eisner and Aneshansley recount a story in which British biologist J.B.S. Haldane was asked what organic evolution had revealed about God's design. "An inordinate fondness for beetles," was the purported reply. Thus, the modern biologists infer, there must have been a special fondness for the remarkable bombardier beetles, with their unique defense. □