BIOLOGY

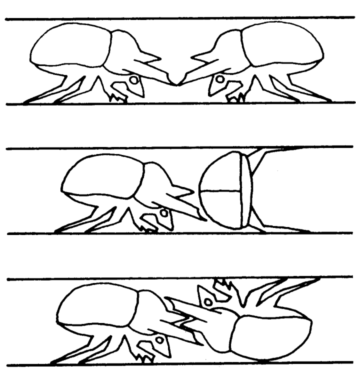
Deep croak: A frog love story

Animals have various ways of assessing an opponent's strength wihout resorting to a costly battle. The pitch of a toad's call appears to provide such a signal. British biologists N. B. Davies and T. R. Halliday report in the Aug. 17 NATURE experimental evidence that a deep croak discourages toad challengers.

Size is an important determinant of the outcome of a toad contest. During mating, the male toad clasps onto the female, piggyback, and rides there for days until she deposits her eggs. When there is an abundance of males, they frequently tussle for the possession of a female. Davies and Halliday report that in half the cases large males successfully displace small males, but they never saw a small toad succeed in replacing a larger one.

The researchers used tape-recorded croaks to test the hypothesis that calls give an attacker reliable information as to the size of his adversary. Larger toads have larger larynxes and thus are able to croak more deeply. Male frogs clinging to the backs of females were silenced by a rubber band through their mouths. A second male was introduced into the cage and, when it touched the paired frogs, the researchers played a 5-second croak. A deep croak inhibited attacks against small male defenders, but a high croak did not induce a male to persistently attack a larger toad. Thus other cues still prevent a costly mistake.

Beetle bouts: Why a horn?


Palmer/Nature

The elaborate armature of rhinoceros and dung beetles is a subject of dispute. Are the horns and similar appendages actually used as weapons? T. J. Palmer of the Imperial College Field Station in England reports that the horns in a burrowing beetle are not only used for fighting, but seem specifically designed for that purpose.

Palmer observed beetles *(Typhoeus typhoeus)* in mesh- or glass-sided burrows and watched a male beetle defend his burrow against an invader. At first the beetles clash with head-on upward jerks (top drawing), but, if pressed, the defending male turns on his side and wedges himself across the burrow (center drawing). In that position he is invulnerable to direct pushes, but can be dislodged if the attacking beetle uses his horns as a lever. To be successful, the attacker's horns must be long enough to reach under his opponent. In another type of contest, the beetles meet head-on, one flips on his back, they engage horns and jerk against one another (lower drawing). There may be several bouts, but the heavier beetle was always observed to win. Palmer concludes in the Aug. 10 NATURE that the horns have evolved to facilitate a trial of strength using powerful burrowing muscles in the confines of a burrow and as a counter-measure to an otherwise impregnable position, the defensive block.

Of ants and hemlock

The painful sting of Peruvian fire ants is related to the poison that killed Socrates. Recently identified toxins in the fire ant venom are similar to those of hemlock, report Murray S. Blum of the University of Georgia, Henry M. Fales of the National Institutes of Health and James W. Wheeler of Howard University. The researchers, who were aboard the *Alpha-Helix* research ship on the Amazon River in Peru, were examining plants and animals as potential sources for new pharmaceuticals.

EARTH SCIENCES

Measuring volcanic particle production

The particles and gases spewed into the atmosphere by volcanoes have been shown to have significant global effects on weather. However, little data exist on the amount and nature of such emissions or on how they compare with human particle sources. Based primarily on ground studies, global estimates of volcanic particle production vary widely from 4 to 150 trillion grams per year.

More accurate estimates will come from airborne studies such as one reported by University of Washington researchers in the Aug. 20 JOURNAL OF GEOPHYSICAL RESEARCH. Crisscrossing the plumes of six volcanoes in Alaska and Washington, Jeffrey L. Stith and co-workers mapped the extent of the clouds and measured emission rates of SO_2, H_2S, water vapor and particles and the size of particles produced during all phases of activity.

As expected, more violent, explosive eruptions had higher particle emission rates than less violent events. Saint Augustine in Alaska, for example, produced 4×10^5 kilograms of particles per second during violent eruptions and 3×10^2 kg per second and 4×10^1 kg per second during less active events. However, the study showed that the emissions that follow violent eruptions and the steady fuming emissions of less active phases are the most significant sources of smaller, weather-affecting particles and gases. Based on their estimates, the researchers calculate that Saint Augustine emitted about 2.5×10^{11} grams of persistent particles into the air from 1976 to 1977.

Estimates of yearly gaseous sulfur production for Saint Augustine — as much as a "moderate-sized smelter" Stith said — indicate that worldwide estimates for volcanic sulfur production may be low. In addition, the data show volcanoes to be an "important source of H_2S," collectively injecting about 1 trillion grams into the atmosphere each year.

Rechecking geomagnetic field changes

In addition to recording the strength and direction of the earth's magnetic field at the time they were formed, rocks will pick up an artificially induced magnetic field. When this tendency is measured throughout the rock, it is found to be stronger in some directions than in others. The measurement of this property (called anisotropy of magnetic susceptibility or AMS) reveals the orientation of the magnetic grains within a rock or sediment. For example, in a normally deposited sediment, all the magnetic grains will usually display a uniform orientation — similar magnetic susceptibility in similar directions. In a sediment disrupted by slumping or redeposited by currents, AMS will show unusual orientations of the magnetic grains.

According to Brooks Ellwood of the University of Georgia, AMS has been used to plot the location and orientation of coal seams, to determine the flow direction of volcanic rock and to find the direction and magnitude of ocean bottom current motion. In addition, Ellwood and R. J. Marino of Ohio State University report in the Aug. 10 NATURE that AMS of sediment believed to record short-term changes in the earth's magnetic field can determine if the sediment has been distorted, changing the orientation of magnetic grains and producing misleading results.

Using samples from the same core, the researchers compared the AMS for normal sediments and sediments thought to record a geomagnetic field change. The samples from normal sediments showed uniform orientation, but the other samples showed the random orientation characteristic of a disrupted sediment. Ellwood stresses that the method cannot verify that a sediment represents a geomagnetic field change; it can only tell whether or not the sediment is suspect. However, he says, because such field changes serve as time markers in sediment analysis, AMS is a valuable objective tool to test their validity.