Voracious turtle grabs a quick bite

Turtles, not usually known as speed demons, can strike fast when the mood strikes them. A new high-speed video system reveals that a chicken turtle takes only 50 milliseconds – one-twentieth of a second – to grab a goldfish, helping to disprove the notion that turtles feed by sucking in prey.

The turtle moves "so fast that it looks to your eye as though his head stays still and the fish goes away," says Stephen M. Reilly of the University of California, Irvine, who took part in the discovery.

The Japanese-developed video system, when used with electrodes implanted in an animal's muscles, allows researchers to forgo dissection and instead study animals moving naturally, says Irvine colleague George V. Lauder. The system also lets scientists examine their results immediately and analyze the images by computer.

The video images can serve as a window on development and evolution, Reilly says, citing salamanders as a case in point. During their aquatic larval stage, salamanders suck in water and small prey, but after they metamorphose into land-bound adults, they catch dinner by flicking out their tongues. Although the transformation radically changes the animals' anatomy and behavior, the high-speed video and muscle recordings reveal that the muscles of adults contract in almost exactly the same sequence as those of larvae, Reilly says. This pattern may mimic the evolutionary events that transformed some fish into land creatures, and also shows that movements can change dramatically without much change in the brain, he says. *– A. McKenzie*

Explaining and exploiting a winter worry

Every spring, farmers in frigid climes reap an irksome harvest of rocks in their fields. Driven up by ice and water, once-buried boulders emerge during winter with enough force to crack roads and foundations, dismaying engineers and homeowners as well.

Though researchers have proposed many theories to explain this "frost heave," the mechanism has remained unclear. Now, a physicist has come up with seven brief equations that strongly support one explanation, suggesting ways to both limit the damage and harness the underlying force.

Every frozen substance has a thin coating of melted liquid, even when the surrounding temperature is below its melting point, notes J. Gregory Dash of the University of Washington in Seattle. His calculations, described in the Dec. 22 SCIENCE, indicate that when one part of an ice chunk is colder than another, the temperature difference sets up a suction, drawing the liquid toward the colder region.

If the ice lies within a wet, spongy environment such as soil, the suction pulls in outlying liquid as well. If the ice also lies under a rock, the drawn-in water takes up enough space that it forces the rock upward to make room, Dash calculates.

The new equations apply to any pure, frozen substance and thus appear to rule out the notion that frost heave results from water's unusual habit of expanding as it freezes, Dash says. He adds that geologists have observed water flowing toward ice in frozen ground and have found that the force pushing the rock up increases with the size of the temperature difference – just as he calculates.

"This is a link between the condensed-matter physicists and the earth scientists," comments geologist Bernard Hallet of the University of Washington's Quaternary Research Center. While noting that Dash's calculations involve pure materials rather than the complicated mixtures of real soils and water, he says the theory makes specific predictions that experimenters can now test under various conditions in the laboratory and in the field. "It provides a new framework to view this phenomenon," Hallet says.

Since the calculations indicate that frost heave produces more thrust when it occurs in coarser substances, Hallet suggests using finer-grained concrete to build heave-resistant foundations. And Dash has an idea for exploiting the phenomenon in underground repositories of chemical and nuclear wastes. Buried refrigerator units, he says, could attract contaminated groundwater and prevent toxic wastes from leaching out.

– A. McKenzie

A perilous passage through volcanic ash

Despite a new warning system designed to prevent such encounters, several planes last week made potentially disastrous trips through ash from an erupting Alaskan volcano. The incidents leave many wondering what went wrong.

In the most serious event, a Boeing 747 operated by KLM Royal Dutch Airlines lost power in all four engines on Dec. 15 when it flew through an ash cloud at 37,000 feet about 75 miles northwest of Anchorage. The plane plunged more than 13,000 feet before pilots restarted its engines, says Ivy Moore of the Federal Aviation Administration (FAA) in Anchorage.

The incident occurred the day after FAA issued its first of several airline advisories concerning the hazards from several eruptions of the Redoubt volcano, says FAA's Richard Stafford in Washington, D.C. The advisories are part of a volcano watch system set up early this year, which uses satellite information to spot ash clouds and notifies airlines about the danger. Redoubt provided the system's first real test.

"The information was out there. The advisories and the warnings were out there. I'm just curious why the plane went into the ash cloud," says Michael Matson, who helped design the system at the National Oceanic and Atmospheric Administration (NOAA) in Washington, D.C.

The Redoubt volcano has erupted sporadically since Dec. 14, producing several ash plumes that reached 30,000 to 40,000 feet. Its last eruption series occurred between 1966 and 1968.

The NOAA team analyzing the satellite data first spotted a volcanic cloud from Redoubt on Dec. 14, one day after the U.S. Geological Survey notified them that earthquake activity under the volcano had stepped up dramatically. The NOAA experts use infrared- and visible-light images from four satellites to identify volcanic clouds. Image analyzers spotted Redoubt's initial ash cloud because it was higher, and thus colder, than normal weather clouds. But in the hours before the KLM encounter, high weather clouds nearby prevented NOAA from tracking plume movement, says NOAA's Otto Karst.

As federal authorities investigate the incident, participants in each level of the volcano watch program will review the system to see what, if anything, they can improve.

FAA's Nicholas Krull, who helped set up the program, says the system functioned according to design, notifying carriers and leaving them to decide whether or not to fly through the area. He adds that it may not be possible to avoid all such encounters. *– R. Monastersky*