Random Walk

Benzer Wins Crafoord Prize

Seymour Benzer, the Boswell Professor of Neuroscience, Emeritus, shares this year's Crafoord Prize with William Hamilton of Oxford University. The Crafoord Prize is given annually by the Royal Swedish Academy of Sciences—the same outfit that administers the Nobel Prizes in chemistry and physics—to recognize work done in fields ignored by Alfred Nobel. In Benzer's case, that work was the laying of much of the foundations of modern neurogenetics.

Benzer did so by studying that experimental animal par excellence, *Drosophila melanogaster*, known to the rest of us as the fruit fly. Fruit flies have been beloved of geneticists since Thomas Hunt Morgan for their short life span (less than two weeks), incredible fecundity (hundreds or even thousands of offspring from one pair of fertile flies), low-maintenance lifestyle (they live in glass bottles on a diet of rotting banana mash), and ease of mutability (just zap 'em with a low dose of X rays or a chemical mutagen). To discover the genetic underpinnings of fruit fly behavior, Benzer used the time-honored technique of creating mutant flies, cataloging the mutations, and determining which genes had been mutated.

Benzer's breakthrough was in realizing that an organism as apparently unsophisticated as the fruit fly did, in fact, have a panoply of behavior worth studying. It does, and since the fruit fly is such a simple organism, its behavior is all hard-wired. The fly's brain is much too tiny to actually *think* about such complex things as finding food or a mate, or even about simple things like avoiding a looming shadow that might be a flyswatter, so the fly's responses to its environment have to be built in—genetically determined.

Benzer's group started with fairly simple behavior, even by fly standards. Normal fruit flies fly toward a light source, so the group built an experimental chamber lit on only one side. The group soon found mutants that flew either faster or more slowly than normal flies, and others that flew away from the light instead of toward it. Other experiments explored the genetic drivers of muscular coordination, the 24-hour cycle of sleep and wakefulness, courtship and sex (a remarkably elaborate ritual, even among flies), and even the rudiments of learning (by teaching the flies to avoid a stimulus linked to an electric shock). The trick, of course, was to relate an abnormal behavior pattern to a specific neurological defect, and then to trace that defect to a mutated gene involved in guiding the development of the fly's nervous system.

Benzer's work took on a whole new dimension with the discovery that flies and humans share many genes. Thus the study of these peculiar flies, and the genes that created them, helps illuminate the genetic aspects of neurological development and disease in humans.

Benzer is Caltech's second Crafoord laureate, the first being Jerry Wasserburg, the MacArthur Professor of Geology and Geophysics, who was similarly honored in 1986.

Honors and Awards

Roger Blandford, Tolman Professor of Theoretical Astrophysics, and Ahmed Zewail, Pauling Professor of Chemical Physics, have been elected to the American Academy of Arts and Sciences. Blandford has done research on the properties of black holes, which may power the extraordinarily bright, active nuclei of some galaxies; and on the behavior of pulsars, the small, rapidly spinning remnants of exploded supernovas. Zewail is widely known for developing the new field of femtochemistry—chemistry on the time scale of femtoseconds, or millionths of a billionth of a second.

John Brady, professor of chemical engineering, will receive the Curtis W. McGraw Research Award at the June meeting of the American Society for Engineering Education. The award recognizes outstanding early achievements by a young researcher at an engineering college. Brady specializes in fluid mechanics and transport processes.

Julia Kornfield, assistant professor of chemical engineering, will receive the 1993 Recognition Award for Emerging Scholars from the American Association of University Women. The award is given in recognition of Kornfield's exceptional achievements in chemical engineering to date, and of her promise for future accomplishments. The AAUW is a nationwide grassroots organization of 130,000 college graduates dedicated to promoting equity and education for women and girls.

Professor of Political Science Richard McKelvey was elected in May to the National Academy of Sciences, becoming the first member of Caltech's social science faculty to receive what has long been considered one of the highest honors that can befall a U.S. scientist or engineer.

David Stevenson, professor of planetary science and chair of the Division of Geological and Planetary Sciences, has been elected a fellow of Britain's Royal Society for his studies of the chemistry and physics of planetary interiors, where his studies of brown dwarf stars have developed a link between stellar and planetary physics.

Hugh Taylor, Sharp Professor of Geology, has been named the 1993 recipient of the Geological Society of America's Arthur L. Day Medal, for his "outstanding contribution to geologic knowledge through the application of physics and chemistry to the solution of geologic problems."

Still Boldly Going...

Both Voyager spacecraft appear to have picked up the first sign of the heliopause—the outer limit of our planetary system, where the solar wind no longer blows. The solar wind—actually a stream of ionized particles, or plasma—is continuously boiling off the sun in all directions, forming a bubble of plasma, called the heliosphere, that permeates and surrounds the solar system. The bubble's surface, the heliopause, is that point where the outward pressure of the solar wind is exactly counterbalanced by the flow of the interstellar plasma beyond. Although the heliopause has long been assumed to exist on purely theoretical grounds, there has been much speculation as to its actual location, and thus the dimensions of the solar system.

Not that the Voyagers have actually crossed the heliopause—far from it. Last August, however, they began picking up intense, ultra-low-frequency radio waves. Voyager scientists have now concluded that these waves were generated when strong gusts of solar wind, emitted during particularly violent solar flares last May and June, finally reached the heliopause and slammed into the interstellar plasma. Since the dates of the flares are known, the distance to the heliopause can be calculated by measuring the time it took the solar wind from those flares to reach the heliopause and generate a radio signal that then returned to the spacecraft. The solar wind's speed in the boondocks beyond the Voyagers is unknown, so the scientists, led by Don Gurnett of the University of Iowa, can't place the heliopause more precisely than somewhere between 82 to 130 astronomical units. An astronomical unit (AU) is the average distance between Earth and the sun—93 million miles. By contrast, distant Pluto is roughly 39 AU from the sun. Voyager 1 is 52 AU and Voyager 2 is 40 AU from the sun, so, assuming that the heliopause is actually 100 AU out, Voyager 1 should cross it in about 15 years. Scientists at Caltech's Jet Propulsion Laboratory, which flies both Voyager spacecraft for NASA, have every hope that the Voyagers will still be alive and well and transmitting data when they finally cross that great divide into interstellar space—and even well beyond.

What a Drag!

In other news from JPL, the Magellan spacecraft finished its fourth 243-day cycle of mapping cloud-enshrouded Venus on May 25, and fired its maneuvering thrusters to begin dipping the low point of its orbit into Venus's atmosphere. Thus begins the first-ever attempt to "aerobrake" an interplanetary spacecraft—using atmospheric drag to slow the spacecraft down and hence lower its orbit. Magellan's current orbit is egg-shaped, with its high point about 5,300 miles and its low point only 100 miles above the planet's surface. In mid August, when the aerobraking maneuver is complete, the orbit will be a nearly circular 375 by 125 miles. The experience gained may help areobraking become a standard maneuver, enabling future spacecraft to be built without the large thrusters now needed to enter planetary orbits.

Magellan's first three orbital cycles used radar to map 98 percent of Venus's surface, much of it in stereo views. The fourth cycle began the collection of gravitational data. The new orbit will enable Magellan's scientists to make a much more accurate map of Venus's gravitational field, which will in turn tell them what lies beneath the planet's surface. Hotter mantle material is less dense than cooler mantle material, and thus the spacecraft experiences a slightly weaker gravitational tug as it passes overhead. This causes the spacecraft to slow down very slightly, and the resulting Doppler effect creates a measurable difference in the frequency of a continuous radio signal that the spacecraft will be sending to Earth. By correlating Venus's mantle densities to its surface features, project scientists hope to discover what processes are creating the strange landscapes the radar mapper has revealed. Similar measurements of Earth's gravitational field helped uncover the nature of plate tectonics, Earth's fundamental geologic process.

Ricky, Don't Lose That Number

For your comfort and convenience, Caltech's telephone prefix will change from 356 (for the campus) and 397 (for the Beckman Institute) to 395, effective July 1. The four-digit extension numbers will remain the same. Data lines, fax numbers, and private phones not having the 356 or 397 prefix will not be affected. Besides consolidating Caltech and the Beckman Institute into one prefix, this change will provide enough new phone numbers to accommodate future growth.