Global Surveyor arrives at Mars

Last week, researchers who had spent a decade building detectors for the errant Mars Observer spacecraft finally scored a success. Duplicates of five of the seven instruments lost when that satellite vanished just 3 days before it was to have arrived at Mars in 1993 are revolving around the planet on the Mars Global Surveyor. On Sept. 11, Surveyor became the first U.S. craft to orbit the Red Planet in 21 years.

Designed to monitor the Martian climate and map the planet's surface at an unprecedented resolution of 1.4 meters, the craft faces a major hurdle before it even begins its 2-year mapping mission in mid-March. Surveyor must transform its initial, elliptical orbit, with a high point of 56,000 kilometers and a low point of 250 km, into a circle with an altitude of 378 km. To accomplish this feat, the craft is dipping into Mars' upper atmosphere, using air resistance to drop its height and speed over 4 months.

That maneuver, known as aerobraking, has been performed only once before, at the end of Magellan's mission to Venus, and it requires careful planning. If aerobraking occurs too rapidly, the craft could heat up dangerously. "Nobody really knows what to expect in terms of the actual [atmospheric] densities the craft will encounter," says Bruce M. Jakosky, a Surveyor researcher at the University of Colorado at Boulder. "These are things that have never been measured on Mars, so it's going to be a risky business."

Surveyor is the second in an armada of nine Mars-bound craft scheduled to be launched by NASA every 2 years through 2005. It will act as a scout for future landers, identifying sites whose mineral content or eroded terrain suggests that water once coursed through them.

The craft's thermal emission spectrometer is expected to examine the composition of the Martian surface; it is already providing data on the temperature of the atmosphere during aerobraking.

This week, Surveyor's magnetometer reported that Mars possesses a weak magnetic field, one eight-hundredth that of Earth's surface, says Mario H. Acuna of NASA's Goddard Space Flight Center in Greenbelt, Md. If the field were much stronger in the past, it could have shielded living material from the solar wind and cosmic rays, he adds.

In March, when Surveyor is slated to begin orbiting Mars once every 2 hours, its camera will record detailed black-and-white images as well as global color panoramas similar to weather maps of Earth. A laser altimeter will measure the heights of mountains and depths of canyons. *—R. Cowen*

Bright fish + dim light = diversity lost

Thirteen thousand years ago, Lake Victoria, now one of East Africa's great lakes, didn't exist. Since then, the basin has flooded first with water and then with an evolutionary flourish: the cichlids, a brightly colored family of perchlike fish that diversified to fill every nook in the Ireland-size pond.

As recently as 1978, researchers estimate, 500 cichlid species lived in Lake Victoria. About half are now extinct, the victims of overfishing, habitat loss, and annihilation by the Nile perch, an introduced fish whose numbers exploded in the 1980s.

A group of researchers from the University of Leiden in the Netherlands now has evidence of another toll on the cichlids' famed diversity. Turbidity in the lake is interfering with the ability of these strongly visual fish to find their preferred, bright mates. The result may be interbreeding of closely related species and loss of the more spectacularly colored forms.

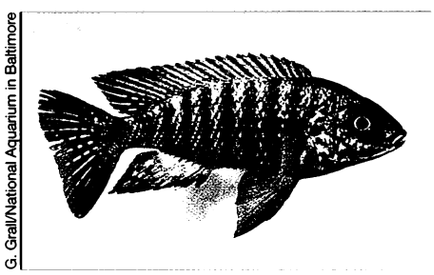
The analysis by Ole Seehausen and his colleagues in the Sept. 19 SCIENCE is a "beautiful piece of work," says Les Kaufman of the Boston University Marine Program.

The study grew from the observation that even cichlids in protected, rocky areas of the lake were disappearing. "Species disappeared not only in habitats that were affected by the Nile perch but . . . also in areas where we knew that Nile perch has basically zero impact," says Seehausen.

He and his colleagues measured the light and other environmental features in these areas, along with the brightness of the cichlids. They found the strongest correlation between bright male colors and clear, well-lit water. In recent laboratory experiments, females of two closely related species chose males of their own species in strong light but mated indiscriminately in limited light.

Lake Victoria—which is slated for ecological restoration—has been clouding up since at least the turn of the century, when forests were cut, researchers say. As Nile perch have preyed on algae-eating cichlids, the cloudiness has increased even more, aggravating the cichlids' perilous state. "It's as if they were painted into the last corner, and then that corner gets painted," says Kaufman.

For biologists, these extinctions have flipped the evolutionary value of the lake, he adds. For vertebrate evolution, "it's the keystone model for both sides of the coin: the origin of new forms and the destruction of forms." *—C. Mlot*



G. Grail/National Aquarium in Baltimore

Male cichlids range in color from red to blue, like this peacock cichlid from Lake Malawi. The diversity of colors seems to be diminishing in the murky waters of Lake Victoria, where females of some species can't spot their preferred mates.

A surprising role for Alzheimer proteins?

One fact about Down's syndrome, which stems from inheriting an extra copy of chromosome 21, has intrigued Huntington Potter for years. If the person lives long enough, "every Down's syndrome individual gets Alzheimer's disease," notes Potter, a geneticist at the Harvard Medical School in Boston.

That morsel of information, along with several other clues, has prompted Potter to suggest that some, perhaps many cases of Alzheimer's disease result from an abnormal accumulation of chromosome 21 in cells.

While probing cells for the homes of two proteins implicated in inherited forms of Alzheimer's disease, Potter appears to have found more support for his heretical proposal. The proteins reside in centrosomes, kinetochores, and nuclear membranes—structures involved in the dispersal of chromosomes in dividing cells—he and his coworkers report in the Sept. 5 CELL. "It's the first clear data in favor of the chromosome mis-segregation model," says Potter.

"It's a really interesting hypothesis. It's going to be somewhat controversial," predicts Bruce T. Lamb of Case Western Reserve University in Cleveland.

Potter's group studied two proteins called presenilin-1 and presenilin-2. If a person inherits two mutant copies of either presenilin-encoding gene, the abnormal proteins cause Alzheimer's disease to strike early, often before age 50 (SN: 3/2/96, p. 134).

Since that discovery, investigators have struggled to learn the normal cell functions of presenilins. For example, their structure suggests that they are embedded in one or more of the cell's various membranes, but which ones?

Several studies with antibodies that bind to the presenilins have indicated that they reside in the endoplasmic reticulum (ER), where the cell synthesizes

proteins, and in the Golgi complex, where proteins are often modified.

Yet Potter contends that those studies misled investigators because they typically involved cells forced to overproduce presenilins. In such cells, presenilins "tend to pile up in the ER and Golgi," he says.

When Potter and his colleagues, working with antibodies they created, studied cells that produce normal amounts of presenilins, they found that the proteins were part of the nuclear membrane, the sac that surrounds a cell's DNA. The scientists also detected presenilins in kinetochores, which are specialized protein complexes on chromosomes, and in centrosomes, structures found just outside the nuclear membrane.

Kinetochores and centrosomes play crucial roles in distributing identical sets of chromosomes within a dividing cell, says Potter. The two centrosomes organize filaments, called microtubules, along which the chromosomes travel to opposite sides of the cell. The kinetochores are the sites at which the chromosomes attach to the microtubules.

In a nondividing cell, suggests Potter, presenilins stud the inner surface of the nuclear membrane and hold onto chromosomes via kinetochores. If a cell begins to divide, presenilins may aid the process by releasing the chromosomes.

While Potter believes that his data provide strong evidence that presenilins participate in chromosome segregation, he notes that it remains unclear how their mutant versions cause Alzheimer's.

Some brain cells in Alzheimer's patients may accumulate abnormal numbers of chromosomes, including chromosome 21, ultimately causing them to die or otherwise falter, he says.

Alternatively, the presenilin mutations may induce cell death by stimulating neurons, brains cells that normally don't divide in adults, to try to divide, notes Peter Davies of Albert Einstein College of Medicine in New York. Davies published data last year hinting that brain cells in Alzheimer's patients may be attempting to split inappropriately.

Although Potter's data and interpretations are likely to be challenged, Davies welcomes the new work. "I love it. It generates a lot of testable ideas and new hypotheses that take us into ground we haven't covered," he says. —*J. Travis*

Anticancer agent sprouts up unexpectedly

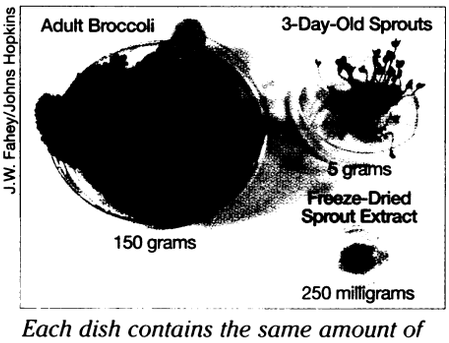
There's good news for George Bush and others who detest broccoli. Without ever downing another forkful of the green veggie, they can naturally enrich their diets with its most potent anticancer constituent. All they need to do is sprinkle a few tablespoons of sprouts on a salad—broccoli sprouts, that is.

Paul Talalay and his coworkers at Johns Hopkins Medical Institutions in Baltimore surprised cancer researchers in 1992 when they isolated sulforaphane, a compound in broccoli and its botanical kin that inhibits the development of cancer (SN: 3/21/92, p. 183). The compound works by turning on detoxifying phase-2 enzymes.

The hoopla over sulforaphane soon died down, however. Researchers realized that to get enough of the compound even from broccoli, its richest source, a diner would have to consume unrealistic amounts each week—about 2 pounds of the brassica, which some people find bitter (SN: 7/12/97, p. 24).

Undeterred, Talalay's team began testing broccoli throughout its life cycle to find how sulforaphane forms and when. "To our surprise," Talalay says, "we found that the seeds were extraordinarily high in [phase-2] enzyme activity." So were 3-day-old broccoli sprouts, which he says are considerably more edible than the seeds. "The sprouts aren't bitter and don't taste like broccoli," he says, though they do possess "a little zing."

Both seeds and sprouts contain a compound that is turned into sulforaphane when their cells are crushed during chewing. As the plants grow, this initial store of sulforaphane's precursor becomes diluted. Indeed, mature plants contain only 2 to 5 percent as much per gram as sprouts do. Even the sulforaphane precursor dramatically inhibits chemically induced cancers in rats, Talalay's team reports in the Sept. 16 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.



J.W. Fahey/Johns Hopkins

Each dish contains the same amount of anticancer compound.

Though diets rich in vegetables inhibit cancer development, Talalay's group is one of the few to execute "the very difficult, nitty-gritty studies" of the mechanisms, says Lee W. Wattenberg of the University of Minnesota in Minneapolis. Such work raises the prospect of mining broccoli for extracts that might be administered as cancer-fighting dietary supplements, he says.

Talalay is developing a center to certify that any sprouts ultimately marketed contain high quantities of the sulforaphane precursor. —*J. Raloff*

Glass film yields to a light touch

If an object moves in response to light, is it animal, vegetable, or mineral?

In at least one case, the answer is mineral. Researchers have found that a glassy material made of arsenic and selenium shrinks and expands when exposed to polarized light.

Eventually, the material could be used in nanometer-scale motors, switches, or actuators, says Stephen R. Elliott of the University of Cambridge in England. "The advantage is that no electrical connection is needed." He and his colleagues report their findings in the Sept. 19 SCIENCE.

The glass belongs to a class of materials called chalcogenides, compounds that contain elements of the group including sulfur, selenium, and tellurium. When exposed to polarized light, the glass takes on anisotropic optical properties—that is, it interacts differently with light depending on the lightwaves' direction.

Until now, scientists have explained the anisotropic traits through small-scale changes in the structure of the glass, but the new study shows that "there's some larger-scale, overall effect going on," says Ronald L. Cappelletti of Ohio University in Athens. The work may help scientists understand how the unusual properties arise, he adds.

The Cambridge researchers deposited a thin film of the glass onto a microscopic lever made of silicon nitride and shone a laser on the device. This initial treatment caused the glass to expand, preparing it for subsequent illumination by polarized light.

The researchers found that a laser whose electromagnetic waves are polarized along the length of the beam caused the glass to contract, thus bending the beam upward. Conversely, the glass expanded upon exposure to a laser polarized along the width of the beam, which bent the beam downward. The beam, 200 nanometers long, moved about 1 nm in each direction.

"It's quite a clever experiment," says Cappelletti, who studies the basic properties of chalcogenide glasses both in the lab and with computer modeling. Moreover, the effect could be reproduced reliably—another advantage for nanotechnology applications.

The Cambridge team plans to make more complex devices out of the glass and to look at other chalcogenides. The group also wants to tinker with the chemical composition of the glass to get rid of larger optical effects that accompany unpolarized light, Elliott says. That way, only the mechanical effects triggered by polarized light would remain. —*C. Wu*