NASA Ames Research Center in Moffett Field, California. "We're seeing things that nobody had an inkling existed," adds Bruce Jakosky, a geologist at the University of Colorado, Boulder. "In a sense we're seeing the planet for the first time."

The new map was made by bouncing laser light off the martian surface and using its roundtrip time to determine distance. The map reveals a dramatic landscape of higher highs and lower lows than previously appreciated, with a total range in elevation of 30 kilometers (km), compared to just 20 km for Earth. The data confirm that the southern hemisphere is higher than the northern hemisphere—6 km higher, to be exact. That means that on Mars, "downhill is north," and if the planet had flowing water, the northern lowlands would drain a watershed comprising three-quarters of the planet, says co-author Sean Solomon of the Carnegie Institution of Washington, D.C.

This MOLA-eye view of Mars may also help resolve the genesis of its split geologic personality. Planetary scientists have long realized that Mars is lopsided—thin-crusted, low, and smooth in the north, and thick-crusted, high, and crater-scarred in the south. Conflicting explanations for the mismatched hemispheres include a huge asteroid impact that blew apart and thinned the crust in the north, or internal processes, such as Earth-like plate tectonics or a huge plume of molten rock rising from the interior that melted northern crust.

MOLA's data point in one direction. "We favor internal processes," says Maria Zuber, a co-author of the topographic analysis and a geophysicist at the Massachusetts Institute of Technology in Cambridge. Although MOLA found no direct evidence of plate tectonics such as mountain belts or earthquake faults, several features suggest an unprecedented amount of past volcanic activity, signaling a hot interior. For example, the Tharsis rise, a 4000-km-across bulging plateau that straddles the equator, appears to consist of two volcanic domes rather than one. And Olympus Mons, the biggest volcano in the solar system, is not a part of Tharsis as scientists believed, but rises off its western edge. "This argues for a broader mantle heat source for Tharsis than was previously thought," says Zuber. Added to the magnetic stripes recently spotted on Mars's surface (*Science*, 30 April, pp. 719, 790, and 794)—a possible sign of plate tectonics—the new evidence suggests that an internal, heat-driven process shaped Mars's spectacular topography, says Zuber.

MOLA's data also tend to refute the idea of a northern impact. The maps show no sign of a giant northern crater, and the north-south boundary is too irregular to be a circular crater wall. Instead, MOLA's team concludes that the boundary is a mosaic of regional effects, shaped by such factors as erosion, volcanism, and debris flung up from a southern impact.

Indeed, when it comes to impacts, "we've been looking in the wrong hemisphere," says Zuber. MOLA has discovered that the south's Hellas basin, 9 km deep and 2300 km wide, is surrounded by a giant ring of topography 2 km high that stretches 4000 km from the basin's center (see image). These highlands were likely raised by rock blasted out by the impact.

Other researchers aren't ready to discard the idea that an impact gouged out the north. "It's too soon to jump on a bandwagon," because either an internal mechanism or a megaimpact could produce planetary-scale changes in topograpy, says planetary geologist George McGill of the University of Massachusetts, Amherst. He adds that traces of even a massive impact could have been obliterated over billions of years.

But McGill and others say they are impressed with the data, which reveal a host of other details, including the size of the polar ice caps. The northern ice cap turned out to be smaller than expected, but MOLA found that the southern polar cap is surprisingly large, because although the visible cap is small, the topography suggests vast layered deposits of ice and dust. Assuming both caps are chiefly water ice, the MOLA team estimated a maximum ice volume of 4.7 million km^3—about one-third less than the previous best estimate—suggesting that much of Mars's water has either escaped to space or been sequestered underground.

MOLA will continue to collect 900,000 elevation measurements daily for the next 2 years, and researchers are now signing up to use the data for questions ranging from the location of ancient water reservoirs to the best places to land spacecraft. "I just can't wait until people have the opportunity to use this map," Zuber says.

–BERNICE WUETHRICH

Bernice Wuethrich is an exhibit writer at the Smithsonian's National Museum of Natural History.

CREDIT: MOLA SCIENCE TEAM

High and lows. An impact punched out Mars's giant Hellas basin, but the ejected material raised the surrounding highlands, as shown in this MOLA image (verticle scale exaggerated).

GENETICALLY MODIFIED FOOD

Britain Struggles to Turn Anti-GM Tide

For the past year, debate has raged in the British media, on an almost daily basis, about whether genetically modified (GM) crops will harm the environment or if food made from them will harm the people who eat it. Clouding the issue were fears that U.K. regulations weren't adequate to protect the public, should those hazards be real. Now, in a move intended to restore public confidence in Britain's ability to regulate GM foods and crop planting, the government last week announced the creation of two new commissions to advise politicians on the long-term impact of genetic technologies on human health, agriculture, and the environment. To back up the pro-GM position it has maintained throughout the debate, the government at the same time released a report from its chief scientific adviser and chief medical officer, which examined the theoretical risks to public health from first principles and concluded that there was no "current evidence to suggest that the GM technologies used to produce food are inherently harmful." They did call, however, for a public health surveillance network that will quickly flag any problems that may arise among people eating GM foods, such as allergic reactions.

The tactics seem not to have worked, however. Newspapers reacted with headlines such as "GM measures scorned." Environmental groups were similarly scathing. While welcoming the greater openness the new commissions would produce, Friends of the Earth called the report "miserably inadequate." According to spokesperson Adrian Bebb, "We don't need another layer of committees. That will not solve anything."

Despite a small number of GM food products having been available in shops for several years, the issue didn't explode into the public consciousness until last summer's reports of the now-discredited research suggesting that GM potatoes stunted growth and suppressed the immune system in rats (*Science*, 21 May, p. 1247). At the time, the inept handling by previous governments of the crisis surrounding the apparent spread of bovine spongiform encephalopathy, or "mad cow disease," from infected animals to humans had already made the British public doubt the government's ability to protect consumers from potentially hazardous products.

Bean dump. Anti-GM activists deposit GM soya outside Tony Blair's Downing Street home.

CREDIT: GREENPEACE

Keen not to see the British biotechnology industry undermined by the barrage of negative coverage, Prime Minister Tony Blair set up a ministerial committee on biotechnology policy headed by Jack Cunningham, minister for the Cabinet Office. The ministerial committee ordered a review of the country's regulatory framework in December, and last week's announcement was the outcome of that review. Addressing the House of Commons, Cunningham said the new commissions would strengthen the existing regulatory system.

At the moment, any applications to plant experimental GM crops or sell GM foods are examined by the Advisory Committee on Releases to the Environment (ACRE) and the Advisory Committee on Novel Foods and Processes, which make their decisions on the basis of science only. Critics have long said that the case-by-case approach of these committees did not provide a strategic, long-term outlook for dealing with the issue of GM crops and food. The new commissions—to be called the Human Genetics Commission and the Agriculture and Environment Biotechnology Commission—are designed to plug that gap. The precise role of the commissions has not been revealed, but they will identify gaps in regulation and advise government on policy: the Human Genetics Commission focusing on the long-term implications of genetic technologies for human health; the agriculture commission on the impact of GM crops on farming and biodiversity. Government strategy on the introduction of GM foods will fall under the purview of the new Food Standards Agency, created last year.

Jenny Maplestone, technical liaison officer of the British Plant Breeders Society—a trade association—welcomed the new commissions. "There is a huge amount of emotion and little fact," she says. "The commissions can put the debate on a sound scientific footing." Sandy Thomas, director of the Nuffield Council on Bioethics, agrees that the commissions may well act as a focus for debate, but she is not convinced they will restore public confidence. "These commissions need to be seen to be as independent as possible, but already there have been editorials saying that they are just another quango ["quango" suggests a committee in the government's pocket]," she says. But John Berringer, dean of science at the University of Bristol and chair of ACRE, welcomes the agriculture commission, saying it should fill the gap between science and public policy. "Such a body has been needed for a long time." But he adds, "it is not clear how it will work."

What's more, even as government ministers were preparing to release their recommendations, the British Medical Association (BMA) published its own decidedly anti-GM report. The BMA, concerned about health issues such as allergenicity, called for a moratorium on planting GM crops until there is a scientific consensus on the long-term effects of GM products. In its report, the BMA also said that if GM foodstuffs, such as soya, are sold to the public, they should be separated from non-GM foods and clearly labeled.

John Durant, professor of the public understanding of science at Imperial College London, believes that giving consumers the choice of whether to eat GM foods is one

ScienceScope

Jacques in the Box Jacques Crozemarie, once one of France's most powerful biomedical science funders, is fighting to stay out of prison.

This week, the former president of the Association for Cancer Research (ARC), a charity based near Paris, went on trial for forgery and other charges stemming from allegations that Crozemarie siphoned off millions of dollars in ARC funds via sweetheart contracts with suppliers (*Science*, 18 October 1996, p. 336). He and 25 other defendants have pleaded innocent. If found guilty, Crozemarie and some other defendants could get up to 5 years in prison and be ordered to pay as much as $800,000 in fines.

The trial has been eagerly awaited by current ARC president Michel Lucas, the investigator who exposed alleged irregularities in the charity's books, then took over after Crozemarie's arrest in June 1996. As part of his campaign to restore ARC's credibility, Lucas is making sure potential donors can follow the trial's every twist: The organization has set up a toll-free hotline that will regularly update callers on the proceedings, which are expected to last into July.

Lab-Bench Diplomacy Scientists from India and the United States are working to ease tensions between the countries since India's nuclear tests last summer.

Last week, two dozen researchers from both nations gathered behind closed doors in Bangalore, India, to discuss hot topics such as weapons monitoring and disarmament. The 3-day summit was organized by the Committee on International Security and Arms Control (CISAC) of the National Academy of Sciences in Washington and the National Institute of Advanced Studies in Bangalore. Although CISAC has sponsored similar meetings of the minds in Russia and China, this was its first in India.

Participants wouldn't discuss details, but the "free, frank discussions helped both sides better understand each other's positions," says CISAC chair John Holdren of Harvard University. Both sides hailed the rap session as a "second track" of diplomacy that complements ongoing government talks. Organizers plan to hold a second get-together within a year.

Contributors: Eliot Marshall, David Malakoff, Dennis Normile, Michael Balter, Pallava Bagla

of the keys to quelling the debate. "While GM foods were discrete and labeled, such as the tomato paste made from GM tomatoes, there was little problem," he notes. It is also crucial for the biotech industry to produce a product in which consumers can see some benefit. The current generation of GM products offers no obvious benefit to the consumer, he says, "but if consumers could buy low-fat crisps, say, made from potatoes genetically engineered to absorb less fat, you'd start to get a real test of what the consumer thinks of genetically modified products." **–HELEN GAVAGHAN**

Helen Gavaghan is a writer in Hebden Bridge, U.K.

ELECTRICAL ENGINEERING

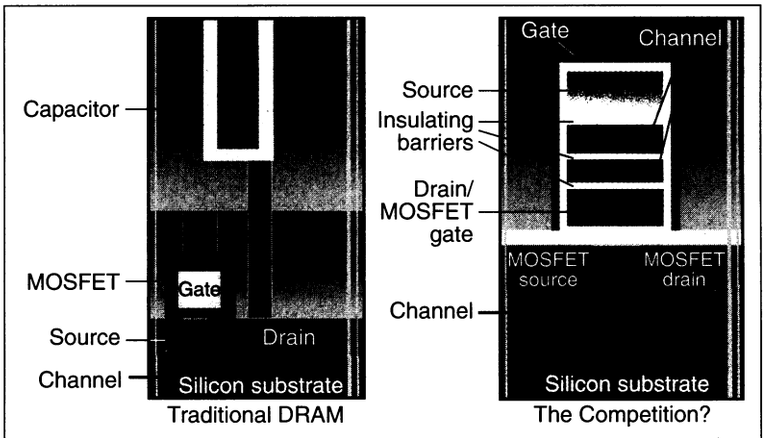
New Memory Cell Could Boost Computer Speeds

In its relentless pursuit of faster machines with more memory, the computer industry has found ways to squeeze ever more transistors and capacitors onto a silicon chip, like carving up a big building into smaller and smaller apartments. But apartments—and capacitors—can become only so cramped. By 2005, companies expect to have reached the size limit for capacitors, the memory storage cells vital to the "working" memory used to store data temporarily as a computer runs programs. Now, however, scientists present a bold new strategy that may break the size barrier: reinventing the capacitor.

In the 13 May issue of *Electronics Letters*, researchers from Cambridge University and the Japanese electronics giant Hitachi describe a new chip architecture that does away with traditional capacitors, slashing the real estate of each memory cell by more than half. The capacitor's job is taken over by a novel type of transistor, recast as a data storage bin. The new design should prove easy to integrate with number-crunching processor chips and should retain working memory even when a computer is off—advantages lacking in the current chip architecture, called dynamic random access memory (DRAM). Such chips could allow computer users to begin work instantly after turning on a machine, rather than waiting for it to call up information from the magnetic hard disk.

The new approach is "excellent work," says Stephen Chou, an electrical engineer at Princeton University in New Jersey. Hitachi is so enamored with the early results that it has already begun pushing the experimental design into commercial development.

Although upstart architectures have tried to unseat DRAMs before, drawbacks—such as being bulky or slow—have curtailed their takeover prospects. Starting from scratch, the Cambridge-Hitachi team, a collaboration underwritten by the company, sought to figure out how to duplicate the ability of DRAMs to store data as 1's and 0's, but in less space. In standard DRAM chips, capacitors are coupled with metal oxide semiconductor field-effect transistors, or MOSFETs, which act like doorways that open when writing and reading data. The open-sesame moment happens when a voltage is applied to a gate electrode, which increases electrical conductivity between two other electrodes, the "source" and the "drain." In a DRAM, the capacitor is wired to the drain: When data are written, electrons stream from source to drain, onto the capacitor. When data are read, electrons flow the reverse route, back to the source. A state-of-the-art DRAM has 256 million capacitor-MOSFET pairs that are constantly shuffling electrons during calculations.



Packing more punch. A new design for a working memory chip (right), featuring transistors posing as capacitors, could potentially shrink memory chips and make computers boot up and run faster.

Transistors can shuttle single electrons, so their size presents no obstacle to shrinking a chip. To tackle the real problem—space-hogging capacitors—the researchers had to devise a novel way to store charge. What they came up with would make the International House of Pancakes proud: a stack of four silicon pads. The top and bottom pads, doped with phosphorus to conduct like a metal, are the source and drain. The undoped pads in the middle act as a channel for electrons. To further coax the transistor to act like a capacitor, the channel contains insulating layers of silicon nitride between each of the pancakes in the stack, to prevent current from slowly leaking to the drain, as happens in conventional transistors. Surrounding the stack is a gate electrode; the entire array is positioned atop a MOSFET that detects charge in the bottom pancake, or storage bin.

In their new setup, the researchers write data by applying a voltage to the gate. The current rearranges electrons in the undoped pads, effectively increasing the channel's positive charge. This, in turn, draws electrons from the source through the stack to the drain. "The drain gets charged up," says Cambridge team leader Haroon Ahmed. "That's the memory node." Charge pooling in the drain tickles the MOSFET, but not enough to trigger the gate to open.

To read the data, a second, smaller voltage is applied to the gate. If the drain is empty (the off, or 0, state), the voltage blip has no effect. But if the drain is charged (the on, or 1, state), the voltage gives a big enough nudge to overcome the MOSFET's gate threshold, triggering a flood of electrons to cascade from the MOSFET's source to drain.

The new setup can read and write data in billionths of a second, as fast as DRAM—one of the traditional architecture's greatest strengths. It also could eliminate some of DRAM's shortcomings. For one, DRAM capacitors are wired to metal contacts that siphon off charge, even when the MOSFET doorway is closed. Thus when a computer is on, DRAM capacitors must be recharged continually, and when it is off, all their stored data are lost. The new memory cell, in theory, can hang onto charge for 10 years or more, allowing it to retain memory with the power off, says Hitachi team member David Williams. Also unlike DRAMs, he says, the new technology contains components of a similar size to those on logic chips, the computer's brains, meaning that it should be possible to better integrate memory and logic chips and boost processing speeds.

For now, Williams says, there appear to be no showstoppers in scaling up for commercial use. If all goes well, he says, the new chips could be on the market for personal computers within a few years. **–ROBERT F. SERVICE**

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