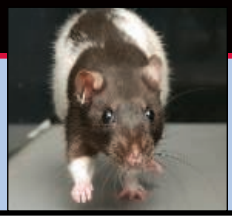
This Week

PAGE 333
Upheaval at Pasteur



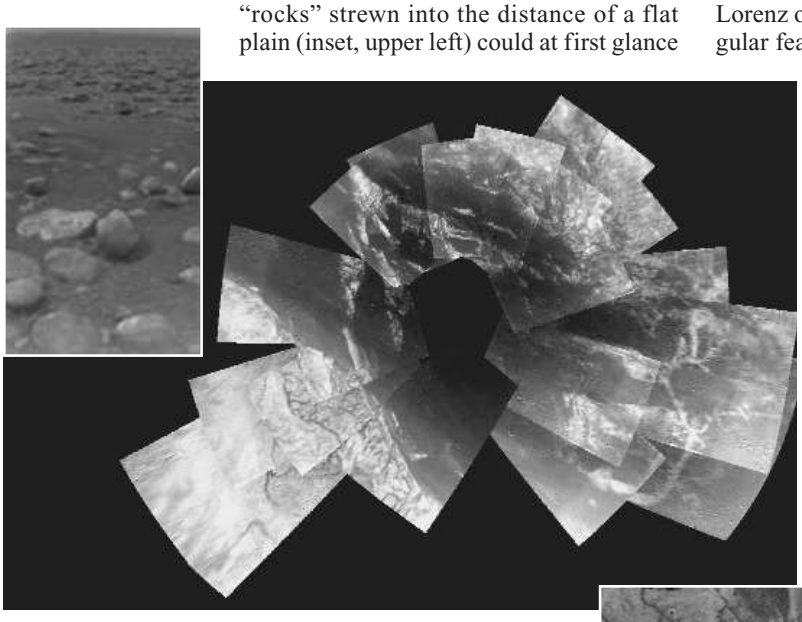
334
Active rats, strong hearts

PLANETARY SCIENCE

Titan, Once a World Apart, Becomes Eerily Familiar

The praise was polyglot, but the sense of it was clear enough: incredible, magnificent, astonishing. The European probe Huygens had blazed into the upper atmosphere of Saturn's big moon Titan, floated down by parachute for two-and-a-half hours—as it snapped pictures, sniffed the air, and checked the weather—and almost miraculously survived a hard landing to taste the surface and return a "wish you were here" view of a truly alien world.

The mission was more than simply a brilliant engineering success. "I was blown away by what I saw," said European Space Agency (ESA) science director David Southwood. "I had wanted to know that there was complexity down there." And complexity he got. What had frustratingly remained an unrecognizable world of broad smears of light and dark, veiled even from the passing Cassini spacecraft by Titan's hazy atmosphere, exploded into sharp details of canyons, riverbeds, plains, rocks, mud, and possible lakes and seas.



A blur no longer. The Huygens probe revealed new detail on Titan (center, 60 kilometers across), including drainage channels (inset, lower right) and surface rocks (inset, upper left).

Perhaps most astonishing was how familiar it all looked. "I was struck by how similar it looks to what we've seen on a variety of planets," said Huygens descent imager principal investigator Martin Tomasko of the University of Arizona (UA) in Tucson. In particular, this moon of rock-hard ice, organic goo, and liquefied natural gas bears a striking resemblance to deserts like the Mojave and to Mars.

The shock of the familiar crept up on icy-satellite geologist Robert Pappalardo of the University of Colorado, Boulder. "When I first saw the image from the surface," he recalls, "I scrolled right by it because I thought it was Mars. I was amazed." The rusty orange color later added by the imager team is the cast that sunlight gives the surface as it leaks through Titan's hazy atmosphere; Mars, on the other hand, takes its color from the yellow-brown of oxidized iron. But the "rocks" strewn into the distance of a flat plain (inset, upper left) could at first glance easily be taken for martian. In fact, they are probably water ice, as suggested by spectra taken by Huygens. The 10- to 30-centimeter cobbles are well rounded, as if they've been tumbled in a streambed, and are scattered across the scene as if a powerful current had debouched nearby, spread across a broad valley floor, and dropped the rocks where they're now found. On Earth geologists call that a playa.

Huygens's view of the surface on its way down made it plain that powerful currents have indeed carved the surface of Titan. With 20 times the resolution of Cassini and a view from beneath the obscuring haze, the Huygens descent imager returned a picture (inset, lower right) that screams fluid flow. The view from 16 kilometers up "looks very much like drainage channels," said Tomasko, with signs of seepage from canyon walls familiar from both Earth and Mars. Collected fluids would run down the dark-floored channels "out to what looks very much like a shoreline" of a dark sea. This and other Huygens images now add credibility to earlier Cassini observations. "We saw what we called 'dark meandering lines' " in Cassini images, says imaging team member Alfred McEwen of UA, but "we weren't ready to call them channels." And Huygens radar team member Ralph Lorenz of UA had pointed out bright, triangular features in the radar images and suggested—boldly at the time—that they could be rough, bouldery fans of debris dumped where channeled flows opened onto valley floors.

With so many signs of erosion, "the big question is, are the liquids there now?" McEwen asks. Theoreticians had invoked liquid methane—liquefied natural gas—on the surface to explain the presence of methane in the atmosphere. But Cassini observations had failed to reveal any clear sign of a dark methane ocean, sea, or even lake (*Science*, 3 December 2004, p. 1676). As much as the canyon-riddled highland draining to a dark, "shore"-lined plain suggested a sea, Huygens found no obvious sign of standing fluids either. It landed in a generally dark area, said Tomasko, that turns out to be a flat plain.

Even so, Huygens may have found the predicted reservoir of liquid methane. Atmospheric chemist Sushil Atreya of the University of Michigan, Ann Arbor, and the gas chromatograph/mass spectrometer team reported that when they gently heated their instrument's sampling inlet after it was driven into the surface on landing, methane was released. And John Zarnecki of the University of Kent, U.K., principal investigator of the surface science package, said that the penetrometer encountered a thin crust before passing through 15 cen-

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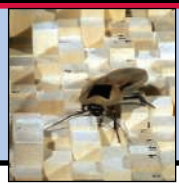
338 Rough sailing for U.S. researchers

345 Watching for epidemics



346 How cockroaches elude you

timeters of something the consistency of wet sand or clay. His most colorful analogy was a crème brûlée.

Methane seas may yet turn up, but Titan already would seem to have all the parts of a "methylogical cycle" that is analogous—in sometimes strange ways—to the hydrologic cycles of Earth and ancient Mars. Titan's atmosphere contains methane and photochemically produced ethane—analogous to Earth's water vapor—that condense into hydrocarbon clouds. Some clouds must rain onto the surface to erode the channels, although just how hydrocarbons would erode the highly insoluble water ice remains to be worked out. The rain would presumably also pick up the many meters of dark photochemical goo that settles from the haze layer over the eons. That would explain the dark stain on canyon floors and outwash plains. Once the hydrocarbon rivers spread across the wide, flat plains, they would drop any heavy sediment in fans. If the fluids mostly evaporated away to complete the cycle, they would leave their load of organic goo the way water leaves its dissolved salts on a salt flat. Some fluid would likely soak into the plain to become "ground hydrocarbons."

All this sounds to Pappalardo like a desert environment on Earth. It doesn't rain often in deserts, but when it does, the rain can be torrential. That could well be the case on Titan, notes Jonathan Lunine of UA, a Huygens interdisciplinary scientist. Cassini has found few if any clouds outside the south pole region, but ground-based astronomers have seen one cloud outburst at mid latitudes in recent years. That level of activity could be all that's needed to shape a familiar-looking world.

–RICHARD A. KERR

DISASTER PREPAREDNESS

Global Tsunami Warning System Takes Shape

The Bush Administration last week announced a new plan to protect American citizens from tsunamis, bolstering efforts both in wave detection and public readiness.

Unveiling of the proposed $37.5 million effort came a day after Koichiro Matsuura, director-general of the United Nations Educational, Scientific, and Cultural Organization (UNESCO), announced that his organization would build a global tsunami warning system, starting with a $30 million network in the Indian Ocean. White House science adviser John Marburger, speaking at a press conference on 14 January, said the enlarged U.S. network could be part of the worldwide UNESCO effort.

The Administration is proposing to expand the number of wave detectors in the Pacific from six to about 24 and to deploy another seven in the Atlantic and Caribbean. U.S. Geological Survey seismometers are also set for an upgrade. "It's [the] initial straw man plan," said oceanographer Eddie Bernard, director of the National Oceanic and Atmospheric Administration's (NOAA's) Pacific Marine Environmental Laboratory in Seattle, Washington. In the coming months, tsunami experts at NOAA will work with volcano and landslide specialists to finalize the proposal.

The current network of six American wave detectors, which measure water pressure on the sea floor, warns officials on the West Coast and Hawaii of long-ranging tsunamis heading south from Alaska. Ringing Pacific coasts on both sides of the ocean with some 18 new detectors will dramatically improve the network's capabilities. It will also provide crucial early warning to Asian and South American nations.

More warning. NOAA's Conrad Lautenbacher says extending the Pacific tsunami network will make "a significant contribution to a global system."

The expanded detection system would be part of the American-led Global Earth Observation System of Systems (GEOSS), a linking of existing networks for global studies, which is set for formal approval in Brussels on 16 February. Asked if the proposed U.N. and U.S. systems were connected, Marburger noted that UNESCO's Intergovernmental Oceanographic Commission has endorsed GEOSS. And officials hope to coordinate the placement of wave and seismic gauges in international waters. "We want to work it out with our global partners," said NOAA administrator Navy Vice Admiral Conrad Lautenbacher.

Even the upgraded network would give little time to alert coastal communities if a massive earthquake were to strike just offshore. To prepare the public for that, the plan calls for an expansion of the Tsunami Ready program, which prepares local communities to seek higher ground after tremors, among other things. "It's not just a question of putting some buoys out there," Marburger said.

Bolstering defenses—especially for Atlantic shores—only became a priority after the destruction in South Asia. "Even though we haven't experienced an earthquake-tsunami off the East Coast doesn't mean it can't happen," said Bernard, noting that although Atlantic coasts face lower risks from earthquakes, tsunamis can be caused by rare events such as landslides above ground or under water, as well as meteor strikes.

The White House is pressing Congress to approve much of the funds for the new program as part of a supplemental tsunami-relief funding measure for this fiscal year. The House science committee will review the new plan in a hearing 26 January.

–ELI KINTISCH

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