ROBOTICS

Dante Goes Into the Volcano

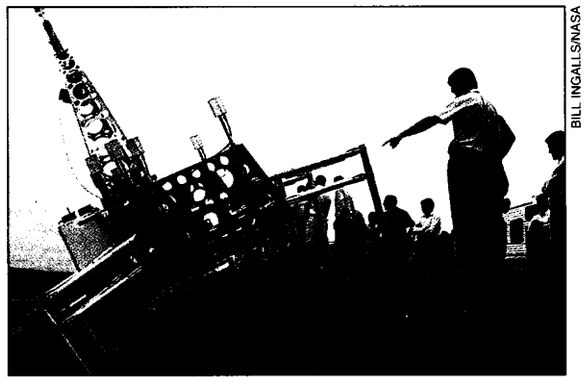
Like a giant spider, an eight-legged, 10-foot-tall robot named Dante II crept more than 600 feet down into the inferno at the core of a smoldering Alaskan volcano—sometimes picking its own route and proving that big robots can boldly go where no humans have gone before. The descent into Mount Spurr, the robot's second try at a volcano crater and its first success, sets the stage for robotic explorers to traverse the terrain of distant planets.

As the robot inched down the steep, icy slopes of the volcano, trudged over deep snow and thick mud, and maneuvered around boulders the size of Volkswagens, its progress was visible to scientists in a control room in a trailer 80 miles away in Anchorage, who were delighted. "I'm on top of the world," said William L. "Red" Whittaker, head of the team that built the robot at the Robotics Institute at Carnegie Mellon University (CMU) in Pittsburgh. "We're in some fairly exotic terrain, but it's going better than I expected." The performance could be a forerunner of a future robot's mission to Mars or the moon, which might include components first tested on Dante.

The mission was also of intense interest to volcanologists, who hope to use information about the gases at the bottom of the crater to understand the volcano and, eventually, predict its activity. By the time Dante had reached a misty fumerole field on the crater floor on Monday, it was clear that the robot had proven its worth from a robotics perspective. In addition to unprecedented success at semi-autonomous navigation, the communications/telemetry system was working exceptionally well, making it possible for scientists as far away as Anchorage and the National Aeronautics and Space Administration (NASA) Ames Research Center in Mountain View, California, to operate the robot in real time. Dave Lavery, manager of the telerobotics program at NASA, chief sponsor of the $1.8-million Alaskan mission, called what Dante has achieved already a "significant leap forward in robotics technology....It's demonstrated the capability for a robot to explore planets with remote human control."

Dante's descent into Mount Spurr is a vast improvement over its performance on New Year's Day, 1993, when an earlier version of the robot tried to clamber down into the crater of Mount Erebus in Antarctica. The mission was called off after the robot had descended only 28 feet because a fiber-optic communications cable had broken.

After Erebus, the team of Carnegie Mellon scientists and students built "a whole new machine," says John Bares, Dante's project manager. Among other things, they strengthened the communications cable and winch, and designed the cable to lead to a satellite dish at the crater's rim, where the communications data were beamed by satellite to a control room (previously the cable tied the robot directly to the control room a few kilometers away). Then they tackled Mount Spurr.



BILL INGALLS/NASA

Mission to the Inferno. The robot Dante prepares for its descent into an active volcano.

After 39 years of quiet, the volcano had erupted three times in 1992—making it impossible for volcanologists to explore the crater. Dante II's eight video cameras and one digital high-resolution still-frame camera, however, make impressive remote sensors. The robot also took the temperature of the air and tested for two gases—hydrogen sulfide and sulfur dioxide—that have been indicators of volcanic activity. Neither gas was found.

While volcanologists were waiting for those measurements, scientists around the world were watching Dante II's progress in images broadcast over the Internet. The most dramatic, however, were not posted on the Internet: pictures of falling boulders as big as the robot, including one that slipped under its communications cable on Sunday.

What most impressed one observer—Rodney Brooks, associate director of the artificial intelligence lab at the Massachusetts Institute of Technology—was that Dante was operating autonomously (at least part of the time), selecting its own course as it created three-dimensional models of the surrounding terrain. Says Brooks: "I think they're doing a great job. Here's a vehicle that's able to navigate terrain that is pretty rough—and able to do large parts of that autonomously. That's going to be important for Mars." But for Dante's scientists, the success in Alaska was already out of this world.

–Ann Gibbons

Ann Gibbons, a contributing correspondent for Science, *also teaches science writing at CMU.*

U.S. SCIENCE POLICY

White House Lauds Basic Research

For 18 months the academic research community has fretted that the Clinton Administration doesn't care about its issues. This week the Administration sought to soothe those bruised feelings, issuing a 31-page policy paper that glows with warmth toward basic research.

On 3 August, Vice President Al Gore unveiled "Science in the National Interest," a document that makes the case for the value of fundamental science and suggests that a $25-billion-a-year increase in the nation's investment in basic research (now hovering at $160 billion) may be needed to maintain the country's status as an international industrial power. Gore also urged scientists to "step up" to the challenge of increasing the country's level of technical literacy. Scientific leaders welcomed the Administration's therapeutic rhetoric, but many said they're still waiting for evidence—next year's proposed budget, for example—that the words will be backed by deeds.

Calling science the "fuel" that powers the economy's technological engine, the policy paper says the nation should boost spending on research by both the public and private sector to 3% of the country's gross domestic product, from a current level of 2.6%—an increase reflecting science's "growing importance to society." It also calls on Congress to provide sufficient funds for new buildings, state-of-the-art instruments, and human resources to help researchers in the lab and to develop a scientifically literate public. It pledges to keep the country strong in all major scientific fields, saying this is the best way

Five Goals for Science

In its new white paper on research, the Clinton Administration has set the following goals for its "stewardship of science":

- **Maintaining leadership across the frontiers of scientific knowledge;**
- **Enhancing connections between fundamental research and national goals;**
- **Stimulating partnerships that promote investments in fundamental science and engineering and effective use of physical, human, and financial resources;**
- **Producing the finest scientists and engineers for the 21st century; and**
- **Raising the level of scientific and technological literacy of all Americans.**

to respond quickly and decisively to new discoveries with commercial potential. And it sets out five goals for making sure science will pay off (see table).

Researchers who have read advance copies applaud the paper's tone and content. "It should reassure the scientific and medical communities that this Administration cares about research," says Robert White, president of the National Academy of Engineering. "And that will be very welcome," White adds, because "it could have been otherwise."

Indeed, the policy paper, crafted by the Office of Science and Technology Policy under the direction of associate director M. R. C. Greenwood, is widely seen as an opportunity for the White House to mend fences. One month after taking office, President Clinton issued a 36-page policy paper on the importance of technology in fostering economic growth. Although research—specifically, world leadership in basic science and engineering—was listed as one of three technology goals, it was a meager six-paragraph footnote to the overall policy statement, which served as rationale for a proposed $17-billion investment package (*Science*, 26 February 1993, p. 1244). Academic researchers were upset by what they perceived as an emphasis on technology at the expense of basic research. Their fears were heightened by congressional pressure on the National Science Foundation (NSF) to pursue more "strategic research."

To counter that perception, Greenwood organized a national forum last winter (*Science*, 4 February, p. 604), which was attended by 250 prominent researchers and science administrators. The views they expressed at the meeting are sprinkled throughout this week's document, which also incorporates parts of recent reports on the need for a new federal policy toward science from the National Academy of Sciences and the National Science Board, which oversees NSF. The report also offers nine one-page vignettes, covering subjects ranging from the life cycle of cells to galactic black holes, all of which make the point that fundamental research can have unexpected practical results. "I don't think that it's possible to oversell the value of fundamental research," says Greenwood about the underlying message of the short descriptions of science in action. "We want people to understand that the nation needs science more than ever."

The job of transforming this philosophy toward science into policy goes to the new National Science and Technology Council (NSTC), which is also charged with evaluating how the nation ranks internationally in every major scientific field. The document is silent on where to obtain additional funding, saying only that "this modest increment should be shared by the federal government and the private sector." But the lack of detail doesn't bother Roland Schmitt, president emeritus of Rensselaer Polytechnic Institute in Troy, New York, who has just completed 12 years on the science board. "You don't solve problems in this town by trying to hit a home run," says Schmitt. "This gives us a place to start, and the NSTC offers a mechanism for getting things done."

–Jeffrey Mervis

ROCKEFELLER UNIVERSITY

Death Threats and Trial by Tabloid

It may not be Rockefeller University's worst nightmare, but it must be high on the list. First, a series of bizarre and threatening incidents plagues a prestigious molecular biology laboratory, and the police are called in to investigate. Then 6 weeks later the story leaks out, and the tabloids have a field day. The question, as far as Rockefeller administrators are concerned, is which was worse.

The incidents occurred in the 15th-floor laboratory of Robert Roeder, who has done pioneering work on the mechanisms of gene transcription in mammalian cells. They began on 6 June, when a dozen researchers became sick, first with diarrhea and then nausea and vomiting. The researchers wrote it off as food poisoning and discarded the coffee, sugar, and sweeteners that seemed to have been the common link. Later that day, however, several Bunsen burners were discovered with their valves opened, filling the laboratory with flammable gases. Two days later, towels were found burning in a supply closet. And finally, letters addressed to two female scientists turned up in a women's bathroom saying the women would be killed if they did not quit the laboratory. The anonymous letters also identified the poison that had caused the stomach ailments as "S.F.," or sodium fluoride, which is lethal in large doses.

By that time the New York City police had been called in, as well as university security and an outside private detective. Members of the 40-person lab volunteered to take polygraph tests and give blood for DNA analysis, apparently for comparison with DNA from traces left on the death-threat letters. University officials tightened security and hoped to solve the case internally. "We had obviously hoped that this should be solved quietly," said Nobel Prize–winning biologist and Rockefeller president Torsten Wiesel, in an interview with *Science*. "We were working from the position that whoever was to blame was obviously under great stress and needed help." Wiesel added that when no incidents occurred after the first week, he had become optimistic. "I had hoped that somehow it would resolve itself in a dignified way."

"[W]hoever was to blame was obviously under great stress and needed help."

—Torsten Wiesel

Rockefeller was not so lucky, however. The story was leaked to *The Wall Street Journal*, which ran it on page 1 on 26 July as a variation on an Agatha Christie novel: "Who's Trying to Kill the Great Biologists of Rockefeller U.?" What followed, says Doron Weber, director of public affairs at the University, was a "circus." Rockefeller was flooded by calls from the press, including such tabloid television news shows as "A Current Affair" and "Unsolved Mysteries." The day after the *Journal* story ran, the police handling the investigation held a press conference. John Hill, chief of Manhattan detectives, announced that the police had a suspect—a "peer" of the women scientists—but not enough evidence yet to make an arrest. Meanwhile, an unnamed police source blamed a "mad scientist."

The next morning the New York tabloids gave the story their least dignified treatment. The *Daily News* front-page headline trumpeted the coming of "Weird Science" at Rockefeller and dubbed the incidents "the Case of the Mad Scientist and the Green-Eyed Monster." *Daily News* columnist Mike McAlary managed to get in the seemingly obligatory reference to the O. J. Simpson case by noting that Roeder's biologists are among "the class of scientific investigators who will wind up testing blood in the O. J. Simpson case." The *New York Post* settled for a headline announcing "Mad Scientist Breeding Terror in Cancer Lab."

Rockefeller administrators still refuse to comment publicly on the details of the case, although Wiesel said he was saddened that the press didn't at least put the story in a compassionate context: "that the stress in science is great, the competition is enormous, and it's not surprising something like this would happen." On the brighter side, Weisel added, the papers did mention that DNA was found to be the genetic material at Rockefeller. "That's more publicity for the DNA discovery than we've had so far," he said.

–Gary Taubes