GEOSCIENCE

Martian Field Test

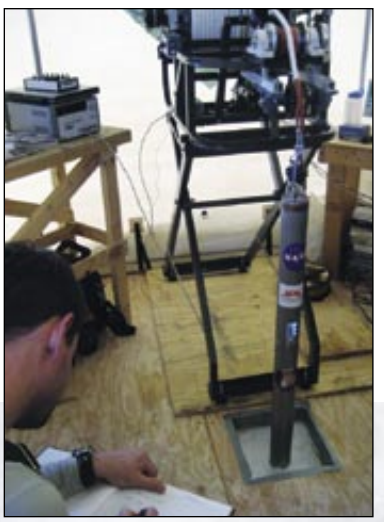
DRILLING IN GREENLAND TO PREPARE FOR MARS **BY CHRISTINA REED**

Summit Camp, Greenland—The guts of a thermal drill spilled out over a table and onto the wood-planked floor of a domed five-person tent. Five highly caffeinated planetary scientists from the Jet Propulsion Laboratory in Pasadena, Calif., continued updating the 122-centimeter-long, 7.6-centimeter-wide device with the software, firmware and hardware needed for its first field test. A square hole cut in the floor revealed the material that would serve as a Martian analogue.

The mission: to have the device, named Chronos, melt its way into Earth's ice sheet above the Arctic circle as a test of its worthiness for the coveted NASA mission to Mars in 2011. If chosen, Chronos would drill into our neighbor's northern ice cap. "Ice is probably the only accessible climate record on Mars; if there is a climate record, it is preserved in those ice caps" as variations in isotope abundance, explains lead engineer Greg Cardell.

Sitting on the accumulation of frozen precipitation at least 100,000 years old, Summit Camp reaches an elevation of 3.5 kilometers and provides an ideal location for testing ice drills. The team hoped to go 100 meters down, or about 200 years into the past. The goal for Mars is to drill 30 to 70 meters deep. Because of the Red Planet's thin, dry atmosphere, the ice on Mars has accumulated extremely slowly, so even 30 meters could date back thousands of years.

Chronos delivers power down a tether to heat a flat nose plate that pro-



MARS WORTHY: Ice drill named Chronos, operated inside a tent heated for human benefit (*left*), melted its way down about 50 meters. Blue LEDs illuminated the borehole (*below*).

CHRISTINA REED

STAYING WARM IN THE MARTIAN COLD

Researchers testing an ice-melting drill had to power down periodically to better mimic the frostier Martian climate. But toggling the heat also mimics the power conditions the drill would actually face. "On Mars we do not intend to melt continuously," explains task manager Miles Smith of the Jet Propulsion Laboratory. Instead solar cells will charge batteries at the surface that will in turn deliver electricity to the drill in short bursts of 200 to 400 watts. Aerogel insulation inside the tether will prevent the meltwater from refreezing on its journey back up. The spooling tether would be kept in a black box at the surface, where sunlight will keep it toasty during the summer months they plan to drill.

vides the only contact the drill has with the ice. A primary pump directs the meltwater from the borehole into the drill, and a secondary pump sends the meltwater up the tether to the surface for analysis. This keeps the borehole dry and prevents the hole from freezing over the drill. The side of the drill is also equipped with blue LEDs and a small camera to illuminate and document the ice along the way.

At 1:30 A.M. on July 19, Chronos began melting the ice at a rate of one centimeter a minute. But it quickly became clear that this Martian melt drill had some Earth hurdles to overcome. The field tent, usually heated for human benefit, was too warm even with the space heaters turned off. On Mars the drill will encounter temperatures that plunge to –110 degrees Celsius. At Summit Camp the air temperature was –15 degrees C and the ice –30 degrees C. To compensate, task manager Miles Smith and engineer Claus Mogensen programmed temperature controls to turn the drill heaters on and off remotely to relieve the overheating. "That fix is exactly the kind of software patch we could have done on Earth if this problem happened on Mars," Smith notes.

But Greenland has other ice properties unique to Earth: as deep as 70 meters, air bubbles create a porous ice layer called firn. Until water flowed through the tether, the team could not tell if the meltwater was draining into the firn or accumulating around the drill, which could freeze the borehole shut. Engineer Bob Kowalczyk added a temperature alarm to the outside of the drill that would signal them if the borehole rose above 0 degrees C. Still, the team remained tense until water flowed up for the first time, sending a collective cheer through the tent.

At that point, Mogensen started the laser-illuminated analyzer, which vaporized the incoming water and looked for variations in oxygen and hydrogen isotopes. "The mass spectrometer that used to take up an entire lab can now be done on a tabletop," he says.

Chronos went down almost 50 meters. "All and all a tremendous success," remarks Cardell, who stopped the mission when the drill hit a significant layer of mysterious dust that choked the filters on the last day. "We didn't prepare for coarse material, only fine particulates. It's a good lesson learned that we should prepare for the unexpected," Smith notes. "If Chronos hits a volcanic layer on Mars as thick as this, it would be front-page news. Of course, anything we get back from Chronos on Mars would be front-page news."

Christina Reed, based in Seattle, received permission from the National Science Foundation to travel with the NASA-sponsored JPL team.

PHARMACOLOGY

Not Imagining It

RESEARCH INTO HALLUCINOGENS CAUTIOUSLY RESUMES

BY DAVID BIELLO

Flashback: A middle-aged man enters a comfortably furnished room, sits on a couch and receives a pill. After swallowing the drug, his medical monitors place a mask over his eyes and headphones over his ears and encourage him to lie back. Soothing classical music plays, and during the next eight hours the self-identified religious man embarks on an inward journey occasioned by the drug: psilocybin, the active ingredient in magic mushrooms.

Thirty-six of these latter-day psy-