

orated. Regarding the anatase crystal sizes, she concurs with Towe but says many other inks contain titanium and should be researched further to see what sizes are present. She adds that the presence of copper, zinc, aluminum and gold in the map's ink are also consistent with medieval manufacturing.

Historian Kirsten A. Seaver, a fellow of the Royal Geographical Society in London, states that the map's writing contains historical anachronisms such as mention of Bishop Eirik of Greenland of the early 12th century reporting to superiors, although he would have had none, because Greenland had not yet become

part of the Church hierarchy. "This map absolutely screams 'fake,'" Seaver remarks. In fact, she believes she has found the culprit—a German Jesuit priest, Father Josef Fischer, a specialist in mid-15th-century world maps. Her theory is that Fischer created the map in the 1930s to tease the Nazis, playing on their claims of early Norse dominion of the Americas and on their loathing of Roman Catholic Church authority. The map, she supposes, vanished during postwar looting. Seaver's book on her search will appear this June.

Charles Choi is based in New York City.

GEOMAGNETICS

Storm Spotting

A STEP CLOSER TO FORECASTING DISRUPTIVE SOLAR ACTIVITY BY KRISTA WEST

On **October 19, 2003**, a large solar flare erupted from the surface of the sun, drawing scientists' attention to three massive sunspot groups that, over the next two weeks, produced a total of 124 flares. Three of them were the biggest flares ever

recorded. Along with these bursts of electromagnetic radiation came enormous clouds of plasma mixed with magnetic fields. Known as coronal mass ejections (CMEs), these unpredictable clouds consist of billions of tons of energetic protons and electrons. When directed earthward, CMEs can create problems. At last count, the fall's flares and CMEs affected more than 20 satellites and spacecraft (not including classified military instruments), prompted the Federal Aviation Administration to issue a first-ever alert of excessive radiation exposure for air travelers, and temporarily knocked out power grids in Sweden.

Historically, CMEs have struck the earth with little or vague warning. If they could be forecast accurately, like tomorrow's weather, then agencies would have time to prepare expensive instruments in orbit and on the ground for the correct size and moment of impact. Such precise predictions could soon emerge: last December researchers announced the early success of a forecasting instrument, called the Solar Mass Ejection Imager (SMEI), that can track CMEs through space and time.

Launched in January 2003 on a three-year test run, SMEI (affectionately known as "schmee") orbits the planet over the poles, along the earth's terminator, once every 101 minutes. On each orbit, three cameras capture

BRIGHT LIGHTS, BIG PROBLEMS

Autumn 2003 saw two weeks of intense solar activity. The most serious disruptions of the earth's electronics systems stem from coronal mass ejections (CMEs).

October 19

Three massive sunspots rotate to face the earth.

October 22–23

First geomagnetic storm, triggered by a CME, strikes the earth.

October 28

The second-largest flare ever recorded erupts from the sun.

October 28–30

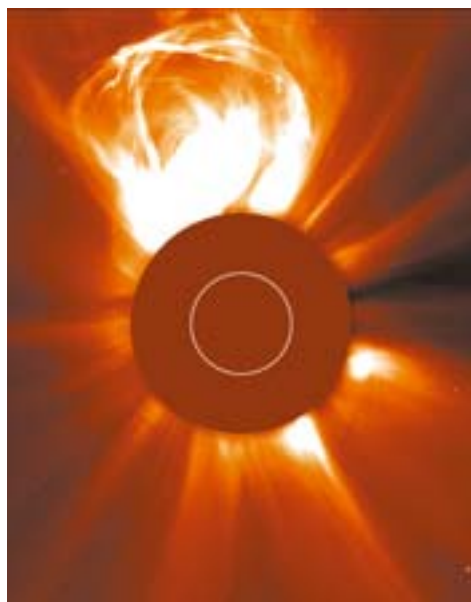
First-ever radiation alert goes out to air travelers above 25,000 feet.

October 29

Second CME-triggered geomagnetic storm hits the earth.

November 4

The biggest solar flare ever recorded erupts; fortunately, the sun has rotated enough so that no disruptive radiation strikes the earth.



SUN BURPS UP a bulb-shaped cloud called a coronal mass ejection, as seen in February 2000 by the sun-watching satellite SOHO. The mask blots out direct sunlight; the white circle denotes the sun.

images that, when pieced together, provide a view of the entire sky with the sun in the middle. The scattering plasma electrons of CMEs appear on SMEI images as bright clouds.

Other sun-watching instruments can image CMEs, but they work like still cameras, taking single pictures of the sun. NASA's Solar and Heliospheric Observatory (SOHO), for example, can "see" CMEs erupting from the sun quickly but is soon blind to the path of the clouds. SOHO came in handy last fall when it caught two large CMEs headed for the earth, but it could not follow the ejecta nor provide an accurate impact time.

Instead of a SOHO-style snapshot camera, SMEI works more like a 24-hour surveillance system, constantly scanning and tracking. SMEI begins looking about 18 to 20 degrees from the sun and continues imaging beyond the earth. SMEI can determine the speed, path and size of a CME, allowing for refined and reliable impact forecasts. Such information is particularly useful, scientists say, in predicting small CME events. Such ejections can take anywhere from one to five days to reach our planet. Since its

launch, SMEI has detected about 70 CMEs.

During last fall's solar storms, SMEI had its first big chance to prove worthy of its estimated \$10-million price tag. Managed primarily by the Air Force Research Laboratory at Hanscom Air Force Base in Massachusetts, about 20 air force and university scientists have been developing SMEI over the past 20 years. At the December 2003 American Geophysical Union meeting in San Francisco, Janet Johnston, SMEI's program manager, proudly announced that SMEI had successfully detected two of the autumn's largest CMEs about 21 and 10 hours, respectively, before they struck the earth.

Unfortunately, scientists didn't know of the detection and tracking potential until after the storms hit the earth. Right now it takes about 24 hours for SMEI data to reach Hanscom because they travel through multiple ground-tracking stations. According to David F. Webb, a physicist at Boston College who is part of the SMEI team, precise forecasting demands a reduction in data-transmitting time from 24 to six hours. Such a reduction will require more researchers at



Glenfiddich
SINGLE MALT
SCOTCH WHISKY

The
independent
spirit.

Distilled by an independent family company.
Bottled as Glenfiddich, which means "valley of the deer." Matured at its own Highland distillery for a full 15 years — our Solera Reserve single malt features delicious notes of oak, honey, vanilla spice, fruit and sherry.



AGED 15 YEARS

ground-tracking stations to move information along and to inspect SMEI's output.

SMEI's data gathering may also need perfecting. Lead forecaster Christopher Balch of the Space Environment Center in Boulder, Colo., emphasizes that the CME signal must stand out better against other background

light. Once improved, SMEI "could potentially fill a gap in our observations," Balch says, by allowing scientists to track CMEs precisely, thereby making "real-time" forecasts possible.

Krista West is based in Las Cruces, N.M.

TOOLS

Cryogenic Cutting

LIQUID-NITROGEN JET SLICES AND SCOURS ALMOST ANYTHING BY STEVEN ASHLEY



LIKE A KNIFE through warm butter, a high-pressure jet of liquid nitrogen hews through hard materials, then disappears into thin air.

Late-night television was once awash in a commercial hawking the "amazing Ginsu knife" that never needed sharpening. In the infamous ad, the blade carved through tin cans with ease and then deftly cut paper-thin slices of tomato. Engineers have recently produced an innovative industrial cutting device with Ginsu knife-like capabilities that uses a supersonic stream of high-pressure liquid nitrogen. The so-called Nitrojet slices through just about anything—steel girders, concrete slabs, stacks of fabric, meat carcasses—and never gets dull.

Nitrojet technology was originally developed in the 1990s by scientists at the Idaho National Engineering Laboratory (INEL) as a nonthermal method to cut open barrels of combustible waste. Ron Warnecke, president of TRUtech, an Idaho Falls-based firm that handles decontamination and decommissioning efforts for nuclear weapons facilities, stumbled on the still developmental system in the late 1990s when he was searching for an environmentally safe way to clean and cut up plutonium-processing equipment. TRUtech later licensed the technology and developed INEL's prototype into a salable product. Warnecke has since set up a new company, NitroCision, to market the device.

The supercooled nitrogen jet, which emerges from special nozzles fitted to a handheld or robotically positioned wand, seems to cleave materials so well because the dense liquefied gas enters a solid's cracks and crevices and then expands rapidly, breaking it up from the inside. The effectiveness of the process for various applications depends on the pressure (6,000 to 60,000 pounds per square inch), temperature (300 to -290 degrees Fahrenheit)

and distance to the workpiece chosen by the user. Lower pressures enable the nozzle stream to strip tough-to-remove coatings off even delicate surfaces better than almost any other cleaning process.

Moreover, the cryogenic jet does not create secondary waste or cross-contamination; as the nontoxic, supercooled "blade" warms, it simply vanishes into the air. Hazardous refuse created by stripping or cutting can be vacuumed up at the point of impact.

NASA technicians are now employing a Nitrojet system at the Kennedy Space Center to precisely peel thermal-protection coatings off the inside surfaces of the space shuttle's solid-rocket boosters. Water-jet or similar abrasive-blasting methods would have required the entire internal surface to be processed, Warnecke reports. The U.S. Navy meanwhile has contracted to use Nitrojet units to remove anticorrosion coatings from ship decks and hulls, antennas and radomes. Others testing the technology include aerospace firms Boeing and Northrop Grumman, semiconductor manufacturers Semitool and Rogers, paint producer Sherwin-Williams, Merrimac Industries (makers of polyurethane parts) and meat packers Hormel and ConAgra.

Nitrojet systems, which come on skids measuring four feet by four feet by eight feet, start from \$200,000 to \$300,000 for a low-pressure unit and go to \$450,000 for a full system. These figures represent a considerable premium over the \$150,000-plus price tag for a conventional water-jet unit, but advocates of the technology say its unique capabilities are worth the extra cost. But don't expect it to appear on late-night infomercials, no matter how many easy payments are offered.