

## Another controversy over nuclear waste site

Geoscientists working for the State of Nevada are questioning the accuracy of federal studies looking at the geologic stability of Yucca Mountain, Nev. — the proposed site for the nation's first high-level nuclear waste dump (SN: 2/27/88, p.139).

Plans for the repository call for placing radioactive waste into sealed rooms 1,000 feet below the surface of the mountain, a remote ridge of volcanic rock expected to keep the waste from leaking into the environment for thousands of years. The Department of Energy is collecting information to assess whether this site, 100 miles northwest of Las Vegas, is suitable for the repository. In order to make this decision, federal officials will require assurance that future earthquakes, volcanic eruptions or climate changes will not threaten the repository.

At the meeting of the Geological Society of America in Denver this week, Ronald Dorn of Arizona State University in Tempe and colleagues from the University of Nevada in Reno said their work, conducted separately from the Energy Department research, shows the federal scientists may be analyzing their data in a way that could underestimate hazards in the Yucca Mountain area.

The controversy between the two investigations centers on a relatively new technique called varnish dating. When a geologic event such as a landslide or an earthquake exposes rocks to air, it can

cause dust and bacterial residue to collect on the newly uncovered surfaces, creating a thin black varnish. Over time, air and water leach elements from this coating. By analyzing the ratio of the remaining elements and then matching these ratios against a standard, researchers can date the varnish and thus the geologic event.

Dorn, who helped develop this technique in the early 1980s, says the problem with the federal studies lies in the way they calibrate the elemental ratios against a standard. "The ages they are getting for the varnish have a reasonably strong possibility of being too old and hence of minimizing the hazard," he says.

Researchers studying a certain fault may use a varnish date to determine when the fault began to move. If the varnish date is too old, investigators would underestimate the recent activity of the fault, possibly leading to false calculations of the stability of Yucca Mountain, says Dorn, who advocates a different calibration technique.

Charles D. Harrington from the Los Alamos (N.M.) National Laboratory, one of the researchers performing rock varnish work for the Energy Department studies, acknowledges that "calibration techniques are a problem." Yet, he says, it will take much more research to tell whether either of the controversial calibration methods yields inaccurate results.

— R. Monastersky

## Spotlighting the power of crystal light

The unexpected happens when you shine laser light into a crystal of barium titanate. At first, the beam passes right through the material. But within seconds, a second beam emerges from the crystal, heading straight back into the incoming beam and rapidly growing in strength.

This curious property is one mark of a remarkable group of materials known as photorefractive crystals. Long considered little more than a physics novelty, photorefractive crystals are starting to find their way into a variety of sensors and instruments. In one instance, they play a role in detecting minute vibrations; in another, they're used for tracking and reproducing the motion of a robot arm. These applications are among several reported this week in Santa Clara, Calif., at the Optical Society of America annual meeting.

"The field is wide open," says Jack Feinberg of the University of Southern California in Los Angeles. "In the beginning, we were concentrating on the physics of what was going on. Now people are starting to let their minds roam a little."

The photorefractive effect is caused by traces of impurities and minor crystal

defects, which supply the crystal with extra electrical charges trapped within the material. Laser light dislodges charges, forcing them to drift and then become trapped again. This electrical rearrangement warps the crystal lattice, distorting and scattering the light beam. When the illuminating light is turned off, the charges stay put, in effect "remembering" the light pattern.

Photorefractive crystals provide a way of storing holographic images without the bother and delay associated with photographic plates. An image-bearing beam and a reference beam illuminate the crystal. The two beams interfere, canceling each other in some areas and reinforcing each other elsewhere, to create a complicated intensity pattern. Another beam can then "read" the stored pattern, recreating the original image. If set up correctly, the system even compensates for the distorting effects of any medium through which the light beam travels, cleaning up the image.

Feinberg and his colleagues have used this holographic effect for detecting tiny vibrations of rough surfaces. Unlike shiny mirrors, rough surfaces generally scatter

## Better body, better heart

Considerable research links obesity with heart disease. Now scientists report that either of two weight-loss schemes — diet and exercise — can independently boost blood levels of high-density lipoprotein (HDL), the "good" cholesterol associated with lower risk of heart attacks. "Weight loss by diet or by exercise can improve one's lipid risk factors for heart disease," says Richard B. Terry of Stanford University.

A group of 155 men who were 20 to 60 percent over ideal body weight participated in the study, described by Terry, Peter D. Wood and their colleagues in the Nov. 3 *NEW ENGLAND JOURNAL OF MEDICINE*. The men were separated into three groups: dieters, exercisers and controls. Dieters were put on individualized plans to reduce body fat by one-third over a nine-month period. Exercisers got tailor-made fitness regimens, starting off slowly with warm-ups and gradually working up to 40- or 50-minute jogs. Controls followed their usual diet and exercise patterns during the one-year study.

Blood samples taken at seven months and one year showed a significant increase in plasma concentrations of HDL cholesterol in diet and exercise groups compared with controls. High levels of HDL cholesterol are regarded as beneficial because HDL acts as a scavenger, picking up fat deposits that can build up on vessel walls. Both diet and exercise groups showed comparable improvement in their "risk ratio," a clinical measure that predicts heart trouble.

The researchers believe their results may encourage doctors to prescribe moderate exercise, as well as dietary changes, for patients at risk of coronary heart disease. At the same time, Terry sounds a note of caution: To avoid injury, overweight patients should ask for a gradual fitness program. □

light in all directions. By using a barium titanate crystal, Feinberg can holographically process the scattered light to produce a clean signal and dramatically improve the chances of optically detecting surface deflections of less than an angstrom.

Dana Z. Anderson and his collaborators at the University of Colorado in Boulder use holographic encoding to record a mechanical arm's movements. Light shining through an optical fiber attached to a robot arm generates a characteristic speckle pattern depending on the arm's position. A lithium niobate photorefractive crystal records the speckle patterns associated with a sequence of movements. Reading the stored patterns allows the arm to repeat its movements.

— I. Peterson