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## TMI stress: The long goodbye

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Just as physical difficulties continue to surround Three Mile Island more than a year after the nuclear plant's accident, an emotional residue lingers on among area residents. The latest measurable problem was discovered last week when traces of radiation were found in test wells drilled around the base of the reactor containment building.

Somewhat less dramatic but possibly more lasting are the psychological after-effects. While many of the "acute" reactions have dissipated along with the threat of impending, immediate danger, some other, subtle, effects appear to show few signs of disappearing, according to a research report for the U.S. Nuclear Regulatory Commission by Mountain West Research, Inc., with Social Impact Research, Inc.

"There is some evidence that stress has persisted since the emergency period," say researchers C.B. Flynn and J.A. Chalmers, who interviewed residents and studied a variety of statistics compiled since the accident. The results show that just slightly more than one quarter of the respondents perceive TMI as no threat to their safety, while one quarter still feel it is a very serious threat. Say the researchers: "... TMI has clearly become a substantially

greater source of stress" than it was prior to one year ago.

The survey results showed that some ill effects present during the emergency period were of short duration. They included demoralization, overeating, loss of appetite, sleep difficulties, shakiness, unclear thinking, irritability and extreme anger. "However," report Chalmers and Flynn, "the more somatic symptoms, such as rash, headache, stomach trouble, diarrhea, constipation, frequent urination, cramps and sweating spells continue to affect a small percentage of the population."

And though the day-to-day existence of most residents has returned to normal, there remains considerable concern about the ongoing status of the plant and of evacuation plans. "At present, there is no trustworthy source of information for laypersons about what happened in the past nor what is happening currently at TMI," states the report. "For some, this continuing lack of clear, unambiguous information contributes to continuing stress."

Such stress — both psychological and economic (SN: 4/5/80, p. 216)—prompted TMI's holding company, General Public Utilities Corp., to commission a study to decide what to do with the crippled plant. The study, released last month, showed that the nuclear plant could be converted to burn coal or natural gas at a cost of \$1.7 billion. □

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## Defoliant, cancer: Studies show link

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Five studies recently released by two members of Vietnam Veterans in Congress have the Veterans Administration under fire in the Agent Orange battle. The studies indicate that two components (2,4,5-T and 2,4-D) and a contaminant (dioxin) of the herbicide Orange — sprayed by the Department of Defense from 1965 to 1971 in Vietnam to defoliate enemy cover and to destroy food crops (SN: 3/17/79, p. 166)—probably cause cancer in humans. The results of the studies contradict VA statements that there is no evidence linking exposure to Agent Orange to cancer in humans (SN: 1/26/80, p. 55).

Two of the studies involved an analysis of the causes of death among Swedish railroad workers exposed to phenoxy acids (such as 2,4-D and 2,4,5-T) and among BASF (a major chemical industry in West Germany) employees exposed to dioxin. Results of the independently conducted studies show that the incidence of fatal stomach cancer among the exposed workers in Sweden and West Germany was slightly higher than the respective national mortality rates for that cancer.

Two other studies, reported by Lennart Hardell and colleagues of the University Hospital in Umeå, Sweden, investigated the possibility of phenoxy acid exposure in patients with a rarer cancer — soft-

tissue sarcoma. Hardell matched patients with that cancer with healthy controls and investigated their histories of exposure to phenoxy acid. He found more reports of exposure among the cancer patients. Moreover, because "a certain possibility exists that the [cancer] cases will have a greater interest in the questions than the healthy controls do," Hardell tested for possible distortions in his assessment of exposures and concluded it was insignificant in his study.

The results of the fifth study, also headed by Hardell, implicate phenoxy acid exposure as a risk factor in the incidence of cancer of the lymphatic system.

When congressional veterans David Bonior (D-Mich.) and Tom Daschle (D-S.D.) released the five studies they had obtained from the Environmental Protection Agency, they also sent a letter to VA Administrator Max Cleland. Cleland's failure to include the studies in a March 26 "Agent Orange packet" released by the VA "serves to create the impression that the VA makes available only studies which appear to reinforce a position that exposure to Agent Orange does not create adverse health effects," the congressmen wrote. VA spokesperson Marthena Cowart says that Cleland had not seen the studies prior to release of the VA packet. □

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## Mars: Radar hints at liquid water

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It is the essence of drought — a parched, planet-wide desert more arid than any on earth. Yet Mars is not without water — great icecaps at the poles, frost elsewhere on the surface, vapor in the atmosphere, water of hydration bound in the "soil" and perhaps frozen into permafrost. What has seemed missing is the liquid kind — with one possible, and highly controversial, exception. Centered about 25° south of the Martian equator is a region called Solis Lacus, where spectroscopy and other remote-sensing data have suggested to Robert Huguenin of the University of Massachusetts that unusual amounts of water vapor are periodically "outgassed" from beneath the surface. Possible links between the outgassing and Martian dust storms, as well as the fact that the area is the closest spot on the planet to the sun when Mars is at the most sunward point in its orbit (Solis Lacus means Lake of the Sun), have prompted Huguenin to describe the region as an "oasis" and "the wettest spot on the planet" (SN: 8/11/79, p. 108). He doesn't mean a real lake, or even a pond — just a little liquid water beneath the surface. But on dry, cold Mars, such a find would be notable. And at some of the meetings at which Huguenin has presented his interpretations, reactions have included some strong skepticism.

Now a similar interpretation from a different kind of data has been tossed into the fray, and its authors, though "convinced" of their conclusions, are wary of the flap that may result. The data, according to Stanley H. Zisk of Haystack Observatory in Westford, Mass., are fine. "It's the interpretation that worries me," he says. "I just can't believe in Santa Claus."

The data are radar scans of Mars, made in 1971 and 1973 with the Goldstone antennas in California's Mojave Desert by George Downs of Jet Propulsion Laboratory, who also reduced the data. Besides analyzing the planet's topography, Downs measured the variations in the dielectric constant — an indicator of radar reflectivity — and those in a quantity called the "c-factor," which essentially shows the smoothness of the surface or near-surface layer doing the reflecting. To Zisk and to Peter Mouginiis-Mark of Brown University, the interpretation seems virtually unavoidable.

First, they mapped the radar-covered parts of the planet for which the reflectivity was high (greater than 9 percent), which included Solis Lacus (or at least its northern portion — the radar coverage extended down only to about 22°S). High reflectivity could be due either to liquid water (ice is almost transparent to

the beam) or to solid rock. Then they sought areas with a high smoothness factor, and again Solis Lacus is on the map — except that its visible surface is pockmarked, cratered and in general anything but smooth, suggesting, says Zisk, a possible subsurface ice layer that has partially melted to provide the water. The final step was possible because the radar data included scans of Solis Lacus during different Martian seasons: Measured in mid-spring, late spring and early summer, the region's reflectivity was different, which it was not for most of the planet's other smooth, bright areas. This points further toward liquid water, the researchers maintain, since a seasonally variable solid rock surface seems highly unlikely compared to a water layer that changes as part of it is turned from ice to liquid by the sun's growing heat.

Zisk and Mougini-Mark, like Huguenin, discount the likelihood of an extensive, liquid-water surface. If there were one, it would show a much higher radar reflectivity than the maximum 16 percent that was seen. More likely alternatives, they told the recent Lunar and Planetary Science Conference in Houston, would include a thin layer of damp soil or a liquid layer that is visible only in patches, either because it is in fact patchy or because parts of it lie farther below the rock and dust of Mars.

The authors hope that others among the small community of planetary radar specialists will try their hand at interpreting the data, but there is more to the issue. Earth-based radar can "see" Mars only very poorly during the Martian winter (due to orbital positions), and Huguenin has speculated that salts may depress the freezing point of water on Mars to where Solis Lacus may be an "oasis" all year round. □

## Mars: Another Viking gone

The Viking 2 landing craft, which reached Mars on Sept. 3, 1976, has made its last scientific report. Officials at Jet Propulsion Laboratory in Pasadena believe that an unexpected current drain caused the craft's batteries to weaken past the point at which they automatically shut down the scientific instruments. Radioed instructions from earth could possibly reactivate some of the systems, but the lander must relay its earthward messages through the Viking 1 orbiter (the other orbiter ran out of control gas in July 1978), which will soon be sent to complete some high-resolution mapping out of the lander's view. The orbiter will not be back in range until September, and it is expected to run out of gas itself in June or July. After that, only Lander 1 will remain, programmed to take minimal but automatic readings and photos. It could run a decade or more. Lander 2, designed for a 90-day mission, lasted more than three and a half years. □

## Yin and yang of lobster posture

Whether a lobster tucks its tail or stretches it full length is both a matter of chemistry and of complex nerve cell connections. Scientists interested in how animals control their normal, precisely coordinated behaviors, such as walking and mating, have examined less subtle muscle interactions, such as stereotyped postures. They have learned that stimulation of a single nerve fiber can command an intricate pattern of muscle contraction and relaxation that adds up to a flexed or extended pose. In the April 4 *NATURE* scientists report that two related chemicals, naturally found in lobster, also trigger, and freeze, opposing postures.

Injections of the compound octopamine into their circulating fluid make lobsters and crayfish assume a rigid, hyperextended posture, say Margaret S. Livingstone, Ronald M. Harris-Warrick and Edward A. Kravitz of Harvard Medical School. The large claws are fully extended pointing forward and the tail is raised and extended to the back. This posture can last several hours, but if the animal is startled, it relaxes for several seconds and then again assumes its pose.

A quite different position results from an injection of a related chemical, serotonin. The lobster or crayfish opens its claws, stands high off the aquarium floor and tucks under its tail, loosely flexed.

The scientists have traced the opposing action of the chemicals to the lobster central nervous system. They find that octopamine and serotonin have opposite effects on the activity of nerve cells that control muscle activity as well as on the cells controlling opposing muscles — flexors and extensors.

The extreme postures the chemicals provoke are strikingly similar to the postures seen when special nerve fibers, called command fibers, are stimulated. Livingstone and co-workers suggest that the chemicals and command fiber system interact. Serotonin and octopamine might activate or modulate the command nerve cell. Each chemical might also serve as a signal throughout, so that the injected chemical floods a posture-controlling system, turning on all the cells.

The researchers caution, however, that they used large amounts of the chemicals, probably more than the animal's entire store. They suggest that normally the chemicals are active near the site where they are released, so a small amount of chemical could produce a strong effect. Alternatively, the postures might be an exaggerated manifestation of far more subtle posture control. Serotonin and octopamine have been detected in the circulating fluid of normal lobsters, so the researchers say it is likely that the chemicals function, at least in part, through re-



*Injections of chemicals make crayfish adopt rigid flexed (top) or extended poses.*

lease into that fluid.

In a variety of animals, amines — serotonin and related chemicals — appear somehow to moderate complex movements. When brain input is interrupted, for instance, one amine makes rats flex and another makes them hyperextend. The chemicals also have been implicated in the stereotyped walking behavior seen in cats lacking brain cortex. Livingstone and colleagues are intrigued by the possibility that throughout the animal kingdom pairs of amines regulate the activity of nerves going to opposing sets of muscles. □

## Brown fat and the fight against obesity

Most people overeat at one time or another, but the effect of the indulgence is not the same in all cases. Some overeaters gain weight rapidly; others never put on a pound although they take in the same number of calories. One explanation for this difference in weight gain may be a fat called BAT (brown adipose tissue). At a recent Endocrine Society seminar in New York George A. Bray of the University of California School of Medicine at Los Angeles described current research on the role of BAT in obesity.

To coax normal laboratory rats into gluttony, British researchers offered them four new foods every day, in a "cafeteria" feeding scheme. The animals, as they chose among such delicacies as cookies, bologna, ham, potato chips and chocolates, lost their natural ability to control caloric intake and rapidly put on weight. When the cafeteria was discontinued and the stock laboratory diet resumed, the rats, no doubt disappointed, returned to normal weight.

The weight gain of the rats could have been far worse. Nancy J. Rothwell and Michael J. Stock of St. George's Hospital Medical School in London reported in *NATURE* (vol. 281, p. 31) that animals fed cafeteria style gain 27 percent more weight than do control animals, but the cafeteria patrons consume 80 percent more calories. As the rats overeat, their