SCIENCE NEWS of the week

Fusion Claims Multiply, Strengthen

A Brigham Young University physicist told a standing-room-only colloquium audience at Columbia University that he and his co-workers had devised a simple laboratory process for fusing small atomic nuclei into larger ones with an accompanying release of energy. His March 31 announcement — and sketchier fusion reports by scientists in Hungary and at Brookhaven National Laboratory in Upton, N.Y. — added fuel to the worldwide research wildfire ignited on March 23 by two chemists reporting a similar achievement (SN: 4/1/89, p.196).

"I'm not sure we're there yet, but I think we have a new way to fusion," said Steven E. Jones, speaking for his colleagues at Brigham Young University in Provo, Utah, and the University of Arizona at Tucson. Fusing pairs of atoms contained in just 1 ounce of deuterium — the double-heavy isotope of hydrogen abundantly available in ocean water — would release as much energy as about 70,000 gallons of gasoline, he calculated. In a press conference following the colloquium, Jones ventured it could be "20 years to never" before the new, bench-top brand of fusion became practical for generating power.

Other researchers' observations of fusion products such as tritium (an even heavier hydrogen isotope) in volcanic eruptions and helium in diamond led Jones and his associates to think that a so-called "piezonuclear fusion" (from the Greek word meaning to squeeze) process might be occurring within the Earth's crust and that perhaps they could duplicate this process in a lab.

Like B. Stanley Pons of the University of Utah in Salt Lake City and Martin Fleischmann of the University of Southampton in England, who had described their results just eight days earlier, Jones reported evidence of fusion reactions occurring in electrolysis cells created with a jar of heavy water, chemicals that make the water more conductive, and two metal electrodes. An electrochemical current between the electrodes split the heavy water into its deuterium and oxygen components. Jones' team used metals such as palladium and titanium for the negatively charged cathode. The group theorizes that as huge numbers of positively charged deuterium nuclei jam into the microvoids of the electrode's crystal lattice, a tiny but noticeable fraction of them fuse.

Jones and his colleagues spent years developing an extremely sensitive detector for measuring even tiny numbers of fusion-produced neutrons, an effort many observers say greatly strengthens their claim of fusion. "It looks like they made a very careful set of measurements," remarks physicist Gerald A. Navratil of Columbia University.

Less encouraging is the fact that their detector found so few neutrons spraying from the electrolysis cell and only for several-hour periods. The measurements correspond to mere whispers of fusion-generated power — about 10 trillion times less than what Pons and Fleischmann calculate they are getting in some of their experiments. Although this discrepancy demands caution in claiming that the coveted age of fusion nears, Jones and his colleagues remain optimistic. "While the fusion rates observed so far are small, the discovery of cold nuclear fusion in condensed matter opens the possibility at least of a new path to fusion energy," they write in a manuscript now under review by NATURE.

Despite failures to quickly replicate the fusion experiments, numerous physicists and chemists told SCIENCE NEWS that the successive announcements by the two independent groups bolster each group's individual conclusion that it has indeed discovered a new route to fusion.

Whether the research can lead to fusion-driven power plants remains an open question. Pons' and Fleischmann's observations of enigmatically large amounts of power — sometimes more than 4 watts of heat put out for 1 watt of electricity spent to run the cell — hint at a good prognosis. But their evidence for actually achieving fusion has weak points, some scientists say.

Particularly troubling is the indirect means they used for detecting neutrons of specific energies, an observation that physicists say would provide the strongest evidence for the occurrence of deuterium nuclei fusions. Also, the number of neutrons they claim to detect cannot explain the amount of heat they measure. In a paper accepted by the JOURNAL OF ELECTROANALYTICAL CHEMISTRY AND INTERFACIAL ELECTROCHEMISTRY, Pons and Fleischmann acknowledge "that the bulk of the energy release is due to an hitherto unknown nuclear process or processes. . . ."

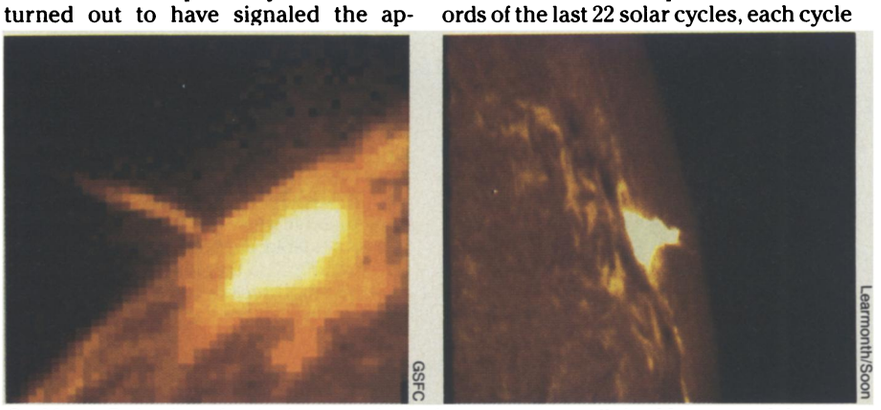
Fraying some of the excitement, says Navratil, are ugly consequences that could emerge if the new electrochemical fusion technology matures. "The one that annoys me the most is the [potential] impact of this process on nuclear proliferation," he told SCIENCE NEWS. By using uranium as a target for the legions of hurling neutrons expected from larger-scale fusion of deuterium nuclei, people would find it relatively easy to start breeding plutonium, an essential ingredient in nuclear weapons, he says. No research group, however, has seen numerous neutrons in its experiments. Navratil and others agree it is too early to judge what, if anything, will develop from the newly discovered and poorly understood prospect for achieving fusion.

— *I. Amato*

Fantastic fortnight of active region 5395

Scientists at first thought the huge solar flare detected on March 6 was "merely" one of the largest in the last decade. In subsequent days, however, it turned out to have signaled the appearance of a spectacular active region on the solar disk, setting records at every turn.

Scientists have compiled detailed records of the last 22 solar cycles, each cycle



On March 7, the day after it photographed a huge solar flare, Solar Max spotted this loop of ultraviolet emissions (left) expanding away from the flare's original location on the sun. The loop's curvature, says Stephen A. Drake of NASA Goddard, suggests it is one of the sun's magnetic field lines, outlined in hot plasma as a result of the flare. Twelve days later, with the same active region having moved across the sun, an Earth-based photo (right) shows the erupting plasma of another major flare.

lasting 11 years. "I've been living this cycle just about from beginning to end, and it's sort of an inspirational experience," says Patrick S. McIntosh of the National Oceanic and Atmospheric Administration's Space Environment Laboratory in Boulder, Colo. The previous two solar cycles, according to McIntosh, appear feeble by comparison. "I've compiled the levels of solar activity since we've been keeping satellite records, and [the present active region, designated AR 5395 and the source of the big flare] is off the top of the scale."

The flare, spotted by an X-ray instrument aboard the Solar Maximum Mission satellite, was "one of the largest X-ray events ever recorded," says Judith J. Nelson of ST Systems Corp. in Lanham, Md. In fact, she adds, it was "the largest ever observed by [Solar Max]." Nelson is in charge of forecasting solar conditions for Solar Max scientists at the NASA Goddard Space Flight Center in Greenbelt, Md.

Richard Schwartz, also of ST Systems, notes that between March 6 and 19 – the time required for the active region to cross the sun – the satellite's Hard X-Ray Burst Spectrometer recorded 447 hard X-ray flares, a rate of about 32 per day. This exceeded the previous high by 50 percent. During one five-day span within that stretch, the instrument detected more than 250 flares, also a record. Schwartz says the active region also produced the most intense "single-spike event" of X-rays ever measured by the device. Furthermore, it identified three flares that were turning out X-rays faster than all but 10 other flares in the history of the satellite's mission, which began in 1979.

Besides the X-rays, Nelson says, radio telescopes observed radio events unprecedented both in intensity and in duration. Moreover, active region 5395 triggered major disturbances of Earth's magnetic field. On March 13, an index of geomagnetic activity known as the AFR reached a level of 248, the highest it had been since Nov. 13, 1960. The effects showed up at an unusually low latitude, where such disturbances are produced only by intense solar activity. Auroras were reported at the time in night skies as far south as the Bahamas, Nelson says.

Ironically, the tumult also hastened the demise of Solar Max, notes Chris St. Cyr at Goddard. The increase in solar activity has heated and thus raised the height of Earth's atmosphere, increasing the drag on the satellite. So during the two weeks when the active region was crossing the sun, the low point of the satellite's altitude dropped about 3 miles, says project scientist Joseph B. Gurman of Goddard. Goddard's Flight Dynamics Branch now predicts Solar Max will be impossible to control from the ground after Aug. 3, and that by Oct. 9 it will reenter the atmosphere and burn up. – *J. Eberhart*

Breast cancer risk linked to dense tissue

Women with a higher percentage of dense breast tissue face a greater risk of developing breast cancer than women with primarily fatty breasts, according to new research presented this week at the American Cancer Society's 31st Science Writers' Seminar held in Irvine, Calif. The research team developed and tested a technique that measures the amount of dense tissue picked up by mammograms, X-ray pictures of the breast.

The method may provide doctors with a simple, accurate way to identify women with a higher-than-average threat of breast cancer, a disease that will strike about 142,000 women in the United States this year.

"We believe that the measurement of percent densities is a promising technique that could enhance the physician's ability to identify high-risk groups of women," says Audrey F. Saftlas, an epidemiologist at the Centers for Disease Control in Atlanta. Saftlas, John N. Wolfe at the Hutzel Hospital in Detroit and colleagues began their work with the theory that cancer occurs more often in women whose breasts contain proportionally more dense-type tissues, such as epithelial and connective tissue, because breast cancers occur most often in these cells.

To test their idea, they studied 567 women enrolled in the Breast Cancer Detection and Demonstration Project, a nationwide, five-year screening program sponsored by the American Cancer Society and the National Cancer Institute. Wolfe used an instrument called a planimeter to determine the percentage of dense tissue highlighted by each woman's initial mammogram. The researchers found that the 266 women diagnosed with breast cancer during the project's fifth year were more likely to have more dense breast tissue than 301 women who showed no signs of breast cancer during the study period.

"We found that breast cancer risk increased steadily with increasing breast density," Saftlas reports. Women whose mammograms showed over 65 percent dense tissue developed breast cancer at a rate more than 400 percent higher than that of women with densities of less than 5 percent. Women with densities of 5 to 25 percent developed the disease at a 70 percent higher rate compared with the same group, Saftlas says.

Women with a family history of breast cancer faced an even greater threat: Those who reported breast cancer in a mother, daughter or sister and who showed mammographic densities of 45 percent or more developed breast cancer at a rate 700 percent higher than that of women with no family history and a mammographic density of less than 5 percent, Saftlas says.

The study is important because doctors need a more accurate method of spotting women at high risk of breast cancer to provide early detection, says Benjamin F. Byrd Jr., clinical professor of surgery at Vanderbilt University in Nashville, Tenn. Still, the new technique's accuracy must be verified, Byrd adds. Saftlas agrees, but expects further research will confirm the new findings. "The percentage of the breast containing mammographic densities is a *bona fide* risk factor for breast cancer that is at least as important as family history," she says.

– *K.A. Fackelmann*

What killed the chickens?

The deaths of 16 embryonic chickens that rode into orbit with the space shuttle Discovery last month have raised questions that could bear on the development of living creatures whose lives begin in reduced gravity, such as aboard a space station. The experiment, devised by John Vellinger, now a student at Purdue University in West Lafayette, Ind., sought to determine whether chickens from eggs that spent five days aboard the shuttle would develop any differently from a control batch of fertilized eggs kept on the ground.

Sixteen eggs were fertilized nine days before Discovery's March 13 launch, and another 16 only two days before the mission began. The older chickens hatched and were still alive and well this week, but half the younger ones were found dead when their eggs were opened just after landing. The rest were placed in an incubator, but they, too, have failed to hatch, says veterinary anatomist Ronald L. Hullinger of Purdue, who is Vellinger's faculty adviser.

"We don't know why the embryos stopped developing," Vellinger says, "but it happened sometime after the launch." According to Hullinger, there is a possibility that one egg the researchers opened early may not have been fertilized. Some of the embryos appeared as though they might have been viable when placed in the incubator, he adds, but additional study will be required to make sure.

Factors that might have played a role in the deaths include how long each egg spent in the hen's reproductive tract and how long after laying each egg was collected. But Hullinger says the effects of reduced gravity in orbit really do seem to be what counted. The embryos that died, he notes, were all in the first trimester of their 21-day development, while the older ones orbited during their second trimester. Future studies, says Hullinger, ought to focus on when the survival difference occurs. □