greater galaxy of structures that clearly are not biological." Bruce Runnegar, a colleague of Schopf's at UCLA, was never fully convinced by Schopf's original evidence. "They're suggestive" of life, he says, "but there's no absolutely distinctive morphology."

Whether the textbooks get rewritten will depend on an analysis of material from new sites, says Walter. "I doubt if it will be resolved by more clever work on these samples," he says. "It gets resolved by more work on more rocks. There are plenty more rocks out there." –RICHARD A. KERR

ASTRONOMY

Stellar Flares Illuminate Young Sun's Outbursts

A nursery of unruly stars in the Orion Nebula has yielded the best look yet at our sun's baby album. Based on data from NASA's orbiting Chandra X-ray Observatory, it appears that the sun threw more tantrums than expected, in the form of powerful x-ray flares that zapped the surrounding disk of gas and dust. These flares may have seeded the early solar system with fragile radioactive isotopes. However, it remains likely that some of the unstable compounds also drifted into our sun's domain from nearby exploding stars.

More than 4.5 billion years of evolution have erased all traces of the sun's youth, so astronomers dig into that past by studying similar stars elsewhere. X-ray satellites had spotted outbursts from a few very young sunlike stars, but it wasn't clear whether such flares were universal. Chandra has put those doubts to rest with images of what researchers call "the richest field of x-ray sources ever obtained."

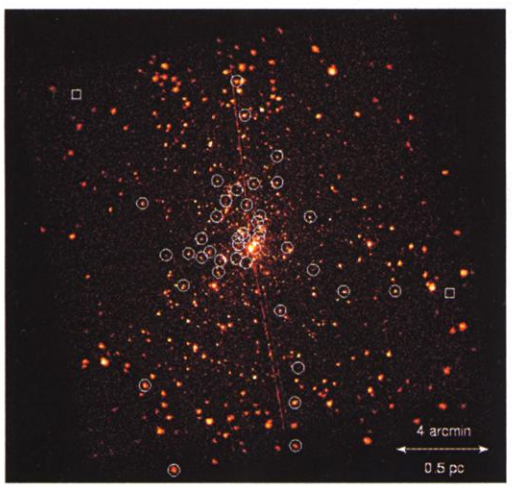
Chandra stared at a tight cluster of nearly 1100 x-ray blips at the heart of the Orion Nebula, the middle "star" in Orion's sword. Astronomer Eric Feigelson of Pennsylvania State University, University Park, and his colleagues identified 43 stars in this patch with masses between 0.7 and 1.4 times that of our sun and ages from 300,000 to 10 million years. Of those solar mimics, all but two actively emitted x-rays—and most of them flared during the 23-hour Chandra exposure.

The ferocity of the eruptions surprised Feigelson. The Orion flares were about 30 times more powerful and 300 times more frequent than the most intense flares unleashed by our sun today. The team's analysis will appear in *The Astrophysical Journal* and is posted on the astrophysics preprint server (xxx.lanl.gov/abs/astro-ph/0202046).

The study confirms that the sun was outrageously energetic as an infant, others say. "The statistics are overwhelming," says astrophysicist Donald Clayton of Clemson University in South Carolina. And, because x-ray flares boost protons and other particles to near the speed of light, Clayton notes, "the early sun was an intense accelerator of solar cosmic rays. We no longer have to postulate."

Indeed, Feigelson thinks the sun, in its first million years, seared the solar system with a flux of high-energy particles 100,000 times greater than today. "They were like machine-gun bullets," he says. "They would have created radioactive isotopes readily." The radiation blasted chunks of atomic nuclei from mineral grains wafting through space as the solar system condensed, he explains. Such nuclear reactions could have spawned calcium-41, aluminum-26, manganese-53, and other isotopes that decay in a million years or so. The offspring of those fleeting compounds are locked in the oldest meteorites; the new findings would help explain the puzzling timing of how the isotopes existed just as asteroids formed.

At a recent Chandra meeting,* Feigelson's team emphasized solar radiation as the main process over a rival theory that a nearby supernova fertilized the solar system's embryonic cloud with rare isotopes. However, the paper's primary reviewer insists that the story isn't so simple. Magnetic fields may have steered particles from the x-ray flares into space above and below the gas and dust in the chaotic early solar system, says astronomer Alastair Cameron of the University of Arizona in Tucson. Mineral grains probably grew quickly, he adds. If so, nuclear reactions were confined to the outer rinds, where they wouldn't have yielded much radioactive material. Moreover, Cameron notes, at least one isotope—iron-60—could not have arisen via the stripping action of cosmic rays, because it has more neutrons



CREDITS: (TOP TO BOTTOM) INTERNATIONAL FUND FOR ANIMAL WELFARE; NASA/E. FEIGELSON *ET AL.*/PENNSYLVANIA STATE UNIVERSITY

Hot flashes. X-ray flares from sunlike baby stars in Orion point to a fiery youth for our sun.

* "Two Years of Science with Chandra," 5–7 September 2001, Washington, D.C.

ScienceScope

Marine Research? Japan hasn't won many friends with its new plan to boost whale research. Government officials have told the International Whaling Commission (IWC) that Japan plans to kill 100 more whales this year under its controversial research whaling program, drawing protests from conservation groups.

Japan already kills 160 minke (below), Bryde's, and sperm whales annually in the North Pacific—and 400 minkes in the Antarctic—under a "research" exemption to a decades-old global ban on commercial whaling. It now wants to expand the Pacific hunt by 50 minke and 50 sei whales. The addition of the sei whales is particularly controversial, because the United States considers the species endangered. But the sei's status is based on outdated data, and fresh samples are needed to see if a growing population is competing with human fishers, argues Seiji Ohsumi, director general of the Institute of Cetacean Research in Tokyo.

Scientists are split over the value of such research, and many argue that there are nonlethal means of collecting the necessary data (*Science*, 29 September 2000, p. 2264). And the World Wildlife Fund says Japan should not be allowed to expand whaling "under the cynical guise of science." The IWC's Scientific Committee will review the plan in May, and Ohsumi says his institute will consider any recommendations before the hunt begins in June.

The Beat Goes On Mechanical heart makers got some good news this week. Advisers to the Food and Drug Administration (FDA) voted 8–2 in favor of a proposal from Thoratec in Pleasanton, California, to use its implanted heart pumps as a "destination therapy" for patients whose own hearts are failing. This could bring a long-sought change in FDA policy, which currently allows such pumps only as a "bridge to transplant" in the few patients lucky enough to be on the waiting list for a donated natural heart (*Science*, 8 February, p. 1000). If FDA agrees—and it usually goes along with advisory panels—it may grant Thoratec permission to sell its devices to some of the 100,000 U.S. patients with end-stage congestive heart failure. And the decision could open the way to other artificial hearts.

than stable nuclei of iron, rather than fewer.

Clayton allows that a star might have blown up in the right place at the right time, supplying key isotopes. Earlier generations of supernovae also may have added to the potpourri. "I think the pendulum has swung toward solar cosmic rays," he says. "But the real answer is likely to include parts of both."

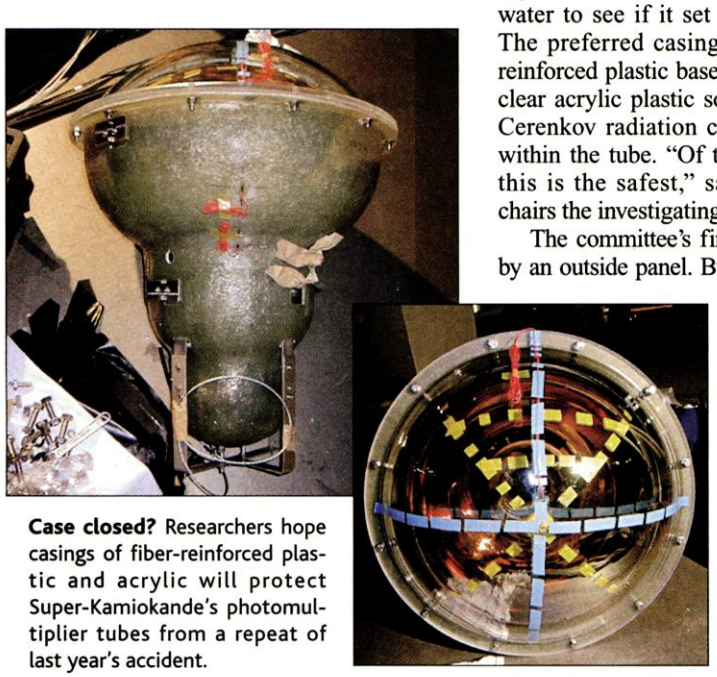
–ROBERT IRION

NEUTRINO DETECTION

Japan Hopes Casings Will Do the Trick

TOKYO—Since the devastating 12 November 2001 accident that shut down the $100 million Super-Kamiokande neutrino observatory, scientists there have been searching for a fail-safe strategy to prevent a recurrence—and get them back to work. Now they think they have one: a protective casing for each of the thousands of tubes that help them spot the elusive neutrinos. But they still need government funding for the repairs.

"I'm doing everything I can to win approval for restarting the experiment," says Motohiko Yoshimura, director of the University of Tokyo's Institute for Cosmic Ray Research, which runs Super-Kamiokande. According to Yoichiro Suzuki, head of the observatory's solar neutrino team, "this is the best solution [that can be] obtained in such a short time."



Case closed? Researchers hope casings of fiber-reinforced plastic and acrylic will protect Super-Kamiokande's photomultiplier tubes from a repeat of last year's accident.

CREDITS: ICRR

Super-Kamiokande is a massive water tank lined with light-detecting photomultiplier tubes that catch the glow of the Cerenkov radiation that results when neutrinos smash into atomic particles in the water. The facility has already earned a place in the science history books by producing the first convincing evidence that neutrinos have mass, a finding that overturned decades of theoretical predictions. But that research has been on hold since November, when a chain reaction of implosions destroyed about 7000 of the 11,000 photomultiplier tubes in the 39-meter-diameter, 41-meter-high tank. The tank was being refilled with water after some of its burned-out tubes had been replaced (*Science*, 23 November 2001, p. 1630).

In January, an investigating committee of scientists involved in the experiment, plus outside experts in fluid shock waves, concluded that workers standing on Styrofoam pads placed atop the tubes on the bottom of the tank probably caused microfractures in the neck of a single tube. Those fractures caused the tube to implode when the water pressure reached a critical limit, setting off the chain reaction throughout the tank (*Science*, 11 January, p. 247).

To prevent a recurrence of such an accident, the Super-Kamiokande team would like to nest each tube within a protective case. Researchers have tested numerous materials and configurations, including breaking one of the encased tubes in 40 meters of water to see if it set off a chain reaction. The preferred casing consists of a fiber-reinforced plastic base topped by a dome of clear acrylic plastic so that the light of the Cerenkov radiation can reach the sensors within the tube. "Of the various proposals, this is the safest," says Yoshimura, who chairs the investigating committee.

The committee's findings must be vetted by an outside panel. But an even bigger hurdle, says Yoshimura, is obtaining the necessary funding from the Ministry of Education, Culture, Sports, Science, and Technology. "The budget would possibly have to be increased" to cover the cost of the cases, he admits, although the price tag is not yet known. The ministry isn't expected to take up the matter before next month.

A green light would enable researchers to wrap the 5200 tubes now available—those that survived, plus a thousand or so spares—in protective cases and redeploy them throughout the tank. Although this arrangement provides reduced sensitivity, it's good enough to resume some research. Getting the facility back to full strength could take 5 years and between $15 million and $25 million.

–DENNIS NORMILE

ScienceScope

Mouse Pact Stanford researchers say they've sealed a knockout deal. The university confirmed earlier this month that it has signed a 3-year pact with Deltagen Inc. that gives its scientists access to the firm's catalog of genetically engineered knockout mice and extensive database of gene function information. In return, the company will get first dibs on discoveries with commercial potential. The deal could become a model for giving academics faster access to knockouts, in which a gene has been removed in a bid to understand its function.

Deltagen typically charges pharmaceutical firms up to $5 million a year for access to its database and up to 250 of its more than 1000 possible mouse models, says William Matthews, president of the Redwood City, California, company. But Stanford and Deltagen agreed to swap intellectual property instead of cash. Stanford cancer researcher Tony Oro says that, although the arrangement still needs road-testing, he is eager to comb through Deltagen's holdings. Creating and working with knockouts once was "like sipping water drop by drop," he says. "This is like opening a fire hydrant."

Rave Review The oft-maligned U.S. anthrax vaccine, suspected of causing everything from tinnitus to fatal anemia, received a vote of confidence this week from a panel at the Institute of Medicine (IOM). Headed by Brian Strom, chair of biostatistics and epidemiology at the University of Pennsylvania in Philadelphia, the panel found "no convincing evidence at this time" of serious negative health effects.

Addressing questions about efficacy, the panel noted that the anthrax bacterium is so dangerous that it would be unethical to test the potency of the vaccine in clinical trials. But the panel concluded that data from animal studies, combined with "reasonable assumptions," show that the vaccine is "effective" and can protect humans against "any known or plausible engineered strains of *Bacillus anthracis*." The vaccine does have faults, according to the report. The six required injections can create swelling and "nodules" at the injection site, fever and malaise, and, in some people, a period of "brief functional impairment." The IOM group urges the military to fund new studies of how the vaccine works, examine ways to reduce the number of injections, and increase its monitoring of possible long-term health effects.

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