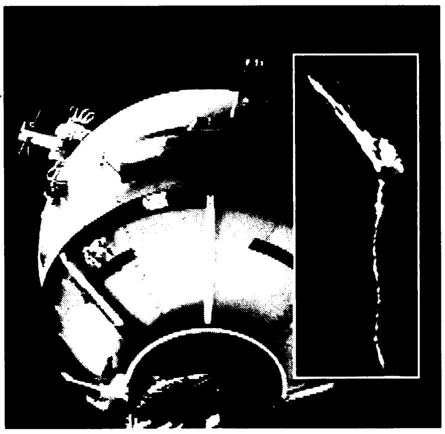
The unkindest cut: Tethered satellite lost

This time, it was supposed to work.

And for just under 5 hours, as the crew of the shuttle Columbia reeled out a satellite on the end of a 20-kilometer-long umbilical cord, the experiment in space went like clockwork. Designed to probe Earth's ionosphere and to test an innovative way of generating electricity, the conducting tether swept through our planet's magnetic field at 8 km per second. The motion created an electric potential as great as 3,500 volts between the shuttle and the satellite. At times, when the satellite, the shuttle, and the ionosphere formed a complete circuit, the tether generated as much as half an ampere of current.



Johnson Space Center

The satellite before the break; inset shows the frayed end of the snapped tether.

Late on Feb. 25, the crew had unreeled the shoelace-thin cord to 19.7 km, nearly its full length. Suddenly, the cord snapped near the top of a launching boom in Columbia's cargo bay, and the $440 million Italian-built satellite floated away like a lost balloon.

Tether scientist Brian Gilchrist of the University of Michigan in Ann Arbor says that the experiment had collected intriguing data before the cord broke. Notably, the cord had generated a larger current than expected. But, he added, "clearly, we did not meet the key objectives" of the mission, a joint enterprise of NASA, the European Space Agency, and the Italian Space Agency.

The crew had planned to retrieve the satellite 2 days after deployment. Instead, after only hours, they reeled in about 10 meters of frayed cord—minus the satellite, now destined to burn up in Earth's atmosphere within a month.

A 1992 experiment, the only other shuttle mission to deploy a tether, had also failed. During that mission, the reel jammed, and the shuttle crew could play out only a few hundred meters of the tether.

With the reel redesigned and three other test flights—using smaller or nonconducting tethers—succeeding in the interim, researchers had hoped this second shuttle flight would go well. "This was a real weirdy," says William J. Webster Jr. of NASA's Goddard Space Flight Center in Greenbelt, Md. "We were caught by surprise."

The tether wasn't taut when it broke, making it seem unlikely that the fault stemmed from a mechanical problem, says Webster. "We [may have] been hit by an unusual electrical effect," he conjectures. Discoloration of the severed cord also suggests an electrical malfunction. Inspection of the cord when the shuttle returns to Earth should determine the culprit, Webster adds. — *R. Cowen*

Element 112 debuts in fusion of lead, zinc

Researchers have added a chemical element to the periodic table.

So far unnamed, this new atom has a nucleus consisting of 112 protons and 165 neutrons, giving it an atomic mass of 277. It's the heaviest nucleus yet created in the laboratory.

The detection of a single nucleus of element 112 is the latest in a series of discoveries at GSI, the center for heavy ion studies in Darmstadt, Germany. In late 1994, a GSI team produced elements 110 and 111 (SN: 1/7/95, p. 5).

This sequence of experiments brings nuclear physicists tantalizingly close to creating element 114. Theorists have long predicted that a combination of 114 protons and about 184 neutrons would be more long-lived than other superheavy atoms in the periodic table. Uranium, with atomic number 92, is the heaviest naturally occurring element.

Sigurd Hofmann of GSI and his collaborators announced their discovery of element 112 last week in a paper submitted to ZEITSCHRIFT FÜR PHYSIK A.

The researchers made element 112 by accelerating zinc ions to high energies, then slamming them into a lead target. Very rarely, when a zinc ion had just the right energy, it would fuse with a lead nucleus to create a new element.

Collecting data for several weeks earlier this year, the GSI group ended up detecting a single nucleus of element 112. It decayed after less than a millisecond by emitting an alpha particle, which consists of two protons and two neutrons, to create an isotope of element 110 with an atomic mass of 273. That isotope, in turn, decayed by emitting an alpha particle to form a new isotope of element 108, and so on.

The pattern of the isotope lifetimes helps establish that nuclei with about 162 neutrons hold together more strongly than nuclei with a smaller or larger number of neutrons (SN: 9/24/94, p. 206). Theories of nuclear structure assume that neutrons and protons are arranged in layers, or shells, and predict that certain numbers of these particles lead to particularly stable configurations.

Recent calculations suggest that a narrow "peninsula" of relatively stable isotopes, including element 112, may link the known superheavy elements to the putative "island" of stability at atomic number 114, says Yuri A. Lazarev of the Joint Institute for Nuclear Research in Dubna, Russia. He and his coworkers have confirmed this picture in recent experiments that produced the heaviest known isotopes of elements 104, 106, 108, and 110.

At GSI, researchers are now preparing experiments involving even heavier projectiles than zinc to produce elements 113 and 114. The results may answer questions about the maximum size and weight that atomic nuclei can attain—a fundamental issue in understanding the structure of matter in the universe. — *I. Peterson*

Gene variants link Alzheimer's forms

The mysteries of Alzheimer's disease have proved as tough to unravel as the characteristic nerve tangles in sufferers' brains. In fact, doctors do not know for certain whether Alzheimer's is one, two, or several similar diseases.

Now, scientists have found genetic evidence in 208 patients that the two main forms of Alzheimer's—one emerging early in life and another after age 65—may actually be versions of the same illness.

The "unifying" puzzle piece is the *presenilin-1* gene, says geneticist John Hardy of the University of South Florida in Tampa. This gene is one of three whose variants can trigger early-onset Alzheimer's—a rare freefall into dementia in people under the age of 65 (SN: 8/19/95, p. 118).

A different variant of *presenilin-1* can increase a person's risk of the late-onset disease. An individual with two copies of this variant, one from each parent, is twice as likely to develop late-onset Alzheimer's as a person with just one copy, report Hardy and his colleagues at South Florida and Washington University in St. Louis in the Feb. 24 LANCET. "The disease mechanisms are similar to each other, whatever the age of the patient," he says.

Researchers believe a cascade of genetic and environmental events produces late-onset Alzheimer's, which accounts for most cases. Yet scientists have nailed down just one genetic risk for late-onset disease—the gene for apo E-IV, a protein that ushers cholesterol through the bloodstream. In 1993, a team of researchers at Duke University Medical Center in Durham, N.C., implicated that gene in half of the late-onset cases they studied (SN: 8/14/93, p. 108). Hardy says *presenilin-1* may figure in 20 percent of the late-onset cases.

Duke's Margaret A. Pericak-Vance, who reported the initial link with the *apo E-IV* gene, says, "If it's true, it's intriguing." She adds that the study must be replicated by others to make certain the association doesn't occur by chance. Pericak-Vance and a coworker found no link between the gene and late Alzheimer's in an unpublished study of 300 patients and some family clusters.

Hardy argues that the *presenilin-1* variation he and his colleagues have identified does not cause late-onset Alzheimer's. The variation lies on a portion of the gene that does not code for protein. He suggests that another section of the gene triggers the disease.

The variation does, however, provide a distinctive, readily identifiable pattern that researchers can track through successive generations, as well as locate in individual patients. This predictable association between Alzheimer's disease and the variation indicates that it lies close to the gene segment that causes the disease.

"What we're looking at is a marker," Hardy says. "There's something else that's biologically relevant that we need to find." *— S. Sternberg*

Artificial materials imitate nature's own

Nature has a knack for making materials. Bones and teeth, for instance, display extraordinary properties—high strength, light weight, and unusual molecular architecture—that scientists find hard to replicate. Even more remarkable is the ability of biological processes to assemble these complex composites from inorganic materials.

Using a process of molecular self-assembly inspired by the way bones form, chemists Peter T. Tanev and Thomas J. Pinnavaia of Michigan State University in East Lansing have managed to coax a silicon compound into forming tiny onionlike beads, called vesicles, that are layered in concentric shells.

"We're aiming to mimic the way nature puts together organic and inorganic components, as in teeth and bones," says Pinnavaia.

"By using a biological type of assembly, we've been able to make a new type of porous material."

The newly fabricated material resembles zeolites, naturally occurring mineral compounds that serve as catalysts for a wide range of reactions. Scientists want to customize such materials, tailoring the size and shape of their pores to specific chemical purposes.

"Materials that have holes as part of their structure, such as zeolites, play an important role in commercial processes, particularly in refining petroleum and in reducing industrial pollutants," Pinnavaia says. "The chemistry of assembly of these porous silica vesicles resembles what goes on during biomineralization."

The new vesicles—which form clusters resembling a bunch of grapes—measure between one-millionth and one-billionth of a meter in diameter, the chemists report in the March 1 SCIENCE.

Tests show that this silica remains stable at a wide range of temperatures, has a large surface area and pore volume, and can be produced using methods that are environmentally benign, the chemists say.

"The ability to make complex self-assembled materials like this is a significant advance," says Thomas Bein, a chemist at Purdue University in West Lafayette, Ind.

"This is one of the first examples of an organized, porous material with a vesicle structure," says Galen D. Stucky, a chemist at the University of California, Santa Barbara. "That's an important contribution."

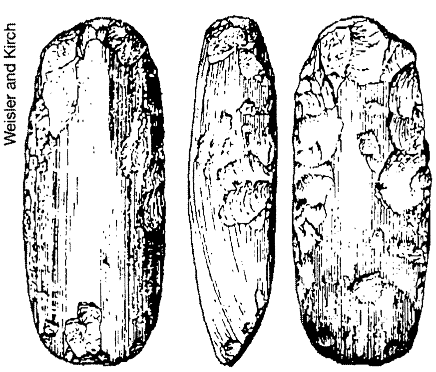
With further development, such biomimetic materials hold the promise of spawning improved building materials, novel protective coatings, and components for automobiles and microelectronics. *— R. Lipkin*

Polynesian tools tout ancient travels

Archaeologists have long assumed that prehistoric inhabitants of Polynesia, an approximately 3,000-mile-long swath of islands in the South Pacific, rarely traveled far from their tropical homes. In particular, cultural traditions and languages diverge sharply between western and eastern Polynesia, denoting a long-standing isolation of these regions from one another, many investigators argue.

A new study, however, indicates that prehistoric Polynesians made long-distance voyages across the west-east barrier in order to obtain a fine-grained basalt suitable for tool production. Polynesian settlers of various island groups, or archipelagos, regularly navigated vessels to and from faraway sources of this volcanic rock, contend Marshall I. Weisler of the University of Otago in Dunedin, New Zealand, and Patrick V. Kirch of the University of California, Berkeley.

"This is one of several projects starting to find evidence of such interarchipelago contacts," asserts Barry V. Rolett of the University of Hawaii in Honolulu. "It's one of the most exciting developments in the study of Polynesian prehistory in the last 20 years."



Weisler and Kirch

Front, side, and back views (left to right) of a basalt tool from Ofu Island.

Ancient Polynesians transported fine-grained basalt from a rich quarry on the western island of what is now American Samoa to islands situated 60 to 1,000 miles east, Weisler and Kirch contend in the Feb. 19 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES. This activity began between 2,000 and 3,000 years ago, the scientists estimate.

They analyzed the chemical composition of sharpened basalt tools found on American Samoa, on nearby Ofu Island, and on Mangaia Island in eastern Polynesia. Each artifact was placed under special X-ray equipment that delivered a nondestructive radioactive beam, enabling the researchers to calculate the amounts of certain trace elements in the basalt.

Fine-grained chopping and slicing basalt tools from American Samoa have a different chemical signature from those of the coarse-grained basalt artifacts found on Ofu and Mangaia Islands, Weisler and Kirch hold. Moreover, fine-grained basalt implements excavated on the latter two islands display the elemental insignia of basalt from American Samoa, they found.

Radiocarbon dates indicate that Polynesians imported basalt from distant archipelagos in the west for about 3,000 years, up until around A.D. 330, according to Weisler and Kirch.

Ongoing work in the Marquesas Islands, on the eastern fringe of Polynesia, is also uncovering chemical evidence of ancient basalt imports, says Rolett, who directs that project.

Long-distance expeditions probably occurred regularly in prehistoric Polynesia, although more evidence will be needed to convince traditionalists to give up the theory of largely isolated islanders, remarks Thomas J. Riley of the University of Illinois at Urbana-Champaign.

— B. Bower