

SCIENCE NEWS of the week

Chernobyl May Be Worst Nuclear Accident

What the Soviet government termed "a disaster" occurred this week at the Chernobyl Nuclear Power Plant 60 miles north of Kiev. The accident has resulted in a number of deaths and hundreds of casualties and has prompted an evacuation of perhaps thousands in the region, according to reports from wide-ranging sources, including TASS, the Soviet news agency. First official word of an accident — which some believe may have involved a partial "meltdown" of the affected reactor — came late Monday, April 28. By Tuesday, there were reports out of Moscow that an 18-mile-radius "security zone" had been set up around the four-reactor facility. Western scientists were speculating that this was perhaps the worst commercial nuclear accident ever.



Chernobyl plant area, as identified in February 1986 SOVIET LIFE magazine, appears to include large residential section.

At press time, details were sketchy. What was known is that the Soviet government had requested advice from the Swedish and West German governments on battling fires in graphite. That fueled speculation about the possibility of a fire in the affected reactor's graphite "moderator." It was also known that high levels of radiation were measured over Scandinavia on Monday and Tuesday — suggesting to many nuclear experts that the affected reactor probably was among the many Soviet plants lacking a "containment building" — a steel-reinforced concrete dome over the reactor to trap radioactive vapors that might otherwise be released into the environment during a major accident.

The Soviet accident apparently occurred in what is known as a "channel-type, light-water-cooled graphite-moderated reactor," according to Scott Peters of the Atomic Industrial Forum, a nuclear industry group based in Bethesda, Md. The U.S. industry does not build that type, he says. In fact, since the Soviet reactors were not covered by International Atomic Energy Agency safeguards, they have never been inspected by Western nuclear experts, according to Phil Kief, an Energy Department spokesperson.

Nevertheless, some U.S. experts are somewhat familiar with the Soviet design. According to nuclear engineer Weston Stacey, of Georgia Institute of Technology in Atlanta, the channel houses long cylindrical fuel rods. Water

flows through the channels, picking up and carrying away the heat produced by a fissioning of the fuel. Each fuel rod and channel arrangement is packed within a separate graphite boxlike arrangement, he says. (The graphite "moderator" is used to slow down fissioning neutrons to an energy level that makes them more conducive to contribute in another fission reaction.)

Stacey speculates that one possible scenario of what might have caused the accident is that the water coolant stopped flowing through one of the channels. Then, when heat was produced and not carried away, "the fuel could have increased in temperature until it melted." It is possible, he says, that the fuel "could have gotten hot enough to reach the combustion temperature of graphite," initiating a graphite fire. Stacey notes that depending on the type of graphite used, its burning point could have been near the melting point of the fuel.

Others believe no meltdown was involved. Nuclear physicists D. Allan Bromley of Yale University in New Haven, Conn., and William W. Havens of Columbia University in New York City suggest instead that a graphite fire may have been ignited during the attempted removal of "Wigner energy" — a phenomenon that occurs when neutrons, set free by nuclear fissions in the uranium oxide fuel, bounce off carbon atoms in the graphite. An accident may have occurred, they speculate, when workers tried to remove the Wigner energy — something that should be done once a



Photo published two months ago shows technicians working on what U.S. experts suggest is probably the Chernobyl reactor core; blocks within grid are probably graphite. Cooling water would circulate through channel holes visible in center of blocks. Inset: Chernobyl plant.

year — by heating the graphite until the displaced atoms return to their positions.

While Stacey says a meltdown may have occurred, he suggests that only a small number of the fuel rods actually melted.

Though containments were included in some Soviet reactors starting in about 1980, the fact that the Chernobyl reactors came on line in 1977, '78, '81 and '83 suggests to U.S. reactor experts that the four are among those still lacking this last line of defense against radioactive releases.

— J. Raloff with D. E. Thomsen

Bird fossil defended against hoax charge

There was a disturbing sense of *déjà vu* last year when the British Museum's *Archaeopteryx* fossil, long thought to be the earliest known bird, was branded as a hoax by several prominent scientists. Could this be another Piltown Man? researchers asked. Also housed in the British Museum, the Piltown Man was exposed as a fake in 1953. But a careful analysis of the *Archaeopteryx* fossil confirms that it is authentic, reports a team of paleontologists in the May 2 SCIENCE.

Alan J. Charig and his colleagues at the British Museum in London say that ultraviolet and microscopic photographs show that, contrary to allegations, the animal's flaring feathers could not have been pressed by a forger.

The 150-million-year-old *Archaeopteryx* specimen was discovered in 1861 in a Bavarian limestone quarry that has yielded five other fossil birds generally considered to be of the same species.



The controversial *Archaeopteryx* fossil.

The fossil is thought to be a prime example of evolution in action because it appears to represent a species in transition between reptiles and birds. Imprints on two pieces of a stone slab that formed a mold around the fossil outline a creature that had the teeth and many skeletal features of a reptile, most likely a small dinosaur, along with birdlike characteris-

tics such as feathers and fused collarbones.

But in 1985, British astrophysicist Fred Hoyle and other critics based at University College in Cardiff, Wales, claimed that a limestone paste was probably used to create the image of feathers around a genuine reptilian skeleton. Photographs of the fossil, said Hoyle, reveal a fine-grained substance under the feathers and distinctive blobs that could be remnants of a forger's cement. He and his colleagues also contended that elevated and depressed regions on one slab are not perfectly mirrored on the other.

The British Museum scientists used microscopes to examine the surface of the fossil and cross sections of the imprints. They found no evidence of an added cement layer or artificial feather impressions. The blobs cited by critics, maintain the investigators, are natural ir-

regularities created when the limestone was split to reveal the ancient bird. These and other irregularities, they add, often become slightly exaggerated after years of cleaning and examination.

Critics also have noted areas where the same feather appears to make two slightly displaced impressions, but the British Museum scientists say these "double strikes" are the likely result of two overlapping layers of feathers.

The most conclusive evidence that *Archaeopteryx* is genuine, however, is provided by hairline cracks running in various directions across the feathers and other parts of the impression. The cracks show up under ultraviolet photography, and those on the main slab correspond perfectly with those on the opposite face. It would be impossible, contend the researchers, to forge exactly matching crack patterns. — *B. Bower*

Sneaking in a therapeutic enzyme

The body's normal functions can work at cross purposes to a person's survival. Such is the case when the enzyme adenosine deaminase (ADA) is injected into babies born without the gene that produces it. The vital enzyme is quickly broken down, either by a knee-jerk immune system reaction to the foreign protein or by normal metabolic processes. Without ADA, the infants' immune systems eventually and fatally shut down.

So far, all attempts to directly replace the enzyme ultimately have failed, bone marrow transplantation of cells that make ADA is frequently not possible or successful, and gene therapy has yet to be used in humans.

Last month, researchers tried a new approach on an ADA-deficient infant using ADA studded with innocuous molecules that shield it from short-term destruction without disturbing the enzyme's active site. The treatment, claims Enzon, Inc., the South Plainfield, N.J., company that manufactures the altered enzyme, is simpler and safer than gene therapy.

Rebecca Buckley of Duke University in Durham, N.C., who is directing the human trial, says it is much too early to determine whether the treatment is effective. The patient had already received two bone marrow transplants, both of which failed.

ADA deficiency is one cause of severe combined immunodeficiency disease (SCID), sometimes known as the "bubble boy" disease, named for the Texas boy who lived most of his life in a sterile bubble. He died at age 12 after a bone marrow transplant (SN: 3/3/84, p. 133).

Bone marrow transplantation to graft in new cells that produce the enzyme is the only proven treatment for the rare

condition. But a matched donor is needed, and the therapy fails about as often as it succeeds.

Research in gene therapy — transferring ADA-producing genes into the patient's own marrow cells — is currently under investigation at Memorial Sloan-Kettering Cancer Center, the National Institutes of Health and Princeton University (SN: 8/24/85, p. 117). Researchers at the three institutions have used a virus to transfer the normal human gene for ADA into monkey marrow cells, transplanted the cells back into the monkeys, and detected a low but significant level of human ADA production, Richard O'Reilly of Sloan-Kettering in New York City told SCIENCE NEWS. In addition to getting government approval, many details have to be worked out before the procedure can be used therapeutically, he says.

In the new enzyme-replacement technique, polyethylene glycol (PEG) is hooked onto the ADA. The PEG "studs" effectively block out the large immune cells while the small molecules on which the enzyme acts can slip through to the active site, explains Abraham Abuchowski of Enzon.

Normally, the enzyme conducts its business within blood cells — adenosine from the blood plasma enters the cells and is broken down by intracellular ADA. With the protected PEG-ADA, the interaction is in the plasma. "It's totally unnecessary to get the enzyme into the cell," Abuchowski says.

Another PEG-coated enzyme is currently under evaluation in the United States and Europe for its activity against several types of leukemia. PEG-enzymes may also prove useful for some of the thousands of genetic diseases, Abuchowski says. — *J. Silberner*

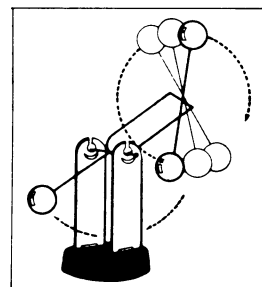
Toying with a touch of chaos

Gyrating like a stiff but daring gymnast, the Space Ball moves in mysterious ways. This simple toy's erratic oscillations recently attracted the attention of engineer Alan Wolf, who started to explore its movements for signs of chaos — motions that can be described by simple equations and yet are quite unpredictable (SN: 7/30/83, p. 76).

Most chaotic systems that people investigate are expensive to set up and rather complicated to study, says Wolf, who works at the Cooper Union School of Engineering in New York City. "This is a [low-priced] toy that generates high-quality chaos data," he says. "I can easily collect experimental data from it." Wolf presented his findings this week in Washington, D.C., at a meeting of the American Physical Society.

"A very hot issue is the attempt, in looking at experimental systems, to reconcile them with theory," says Wolf. "The theory is farther along than the experimental work." Simple models like the Space Ball and several other similar systems provide a useful way of testing competing theories and of learning how to define the amount of chaos present (SN: 5/26/84, p. 328).

The Space Ball is an electrically driven toy that can exhibit the erratic oscillations characteristic of chaos.



The Space Ball, which is made in Taiwan, runs on a 9-volt battery hidden in the toy's base. This activates an electromagnet that, in turn, "kicks" another electromagnet in the lower ball. "Basically, it's a very efficient electric motor," says Wolf.

For his experiments, Wolf removed the battery and added a power supply that can feed in anything from 0 to 40 volts. Wolf alters the Space Ball's motion by changing the voltage or the toy's starting position. "Sometimes, I get nothing," he says. "Sometimes, I can get it to come to rest. At other times, I can get it doing simple periodic motion [like a pendulum] or more complicated periodic motions. And I can get chaos.

"It'll do things like practically stop for a period of time, and you think it's ready to quit," Wolf says. "Then it starts spinning rapidly, then it slows down, then it spins rapidly but at a different rate. You can watch it for a week and there may be