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 irregularities 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.

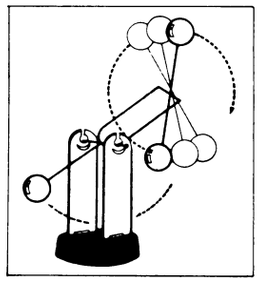
Another PEG-coated enzyme is currently under evaluation in the United States and Europe for its activity against several types of leukemia. PEG-enzymes may also prove useful for some of the thousands of genetic diseases, Abuchowski says. — *J. Silberner*

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

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