from an impact, a single sample of lunar soil can carry records of many different impacts.

Delano plans to analyze the chemical composition of several hundred glass beads, to be certain they did not pick up impurities after they formed, then send them to Paul Renne at the Berkeley Geochronology Center for argon-argon dating. For now, he says, "Origin-of-life investigators should be reluctant to cede the interval of 4.4 billion to 3.9 billion years ago as having been too hostile for sustainable life." Says James Kasting, a geoscientist at Pennsylvania State University, State College, "It's hard to prove [the timing of impacts] from a small collection of moon rocks from 6 or 7 locations. If Delano has a better way to look at the data concerning bombardment, that would be very interesting."

Mimicking Metabolism

Anyone who has taken Biology 101 has become painfully familiar with the Krebs or citric acid cycle (CAC). This complex loop of reactions is part of aerobic respiration, which extracts energy from glucose far more efficiently than do alternative pathways that do not require oxygen. To biochemists pondering early life, aerobic respiration poses the same problem as RNA polymerization: How could this sophisticated chemistry have gotten started?

Maybe sunlight helped set the CAC, or parts of it, in motion, says Tom Waddell, an organic chemist at the University of Tennessee, Chattanooga. At the meeting, Waddell described experiments he did with undergraduates Tod Miller, Barry Henderson, and Sunil Geevarghese. To recreate parts of the CAC, they placed appropriate chemical intermediates from the cycle on a sunny rooftop. "We set up a simple experiment, watched what happened, and let nature teach us," Waddell said. They found that, in some cases, solar energy drove chemical reactions that produced further intermediates of the cycle. For example, oxaloacetic acid, a compound at the cycle's "end," broke down in sunlight, releasing citric acid, the compound that starts the cycle anew.

The findings mesh with analyses of the Murchison meteorite, found in Australia in 1969. In 1974, J. G. Lawless and co-workers at the Ames Research Center, in Moffett Field, California, identified a zoo of organic molecules in the 100-kilogram meteorite, including amino acids, nucleotides, and CAC intermediates. Solar radiation might have driven CAC-like reactions in space, Waddell thinks. His rooftop experiments show that these sun-inspired reactions could have occurred on Earth as well, perhaps in the chemical systems that were precursors to life.

Although Waddell has reproduced only a few steps of the citric acid cycle, he can't help imagining how the pieces might fit into a bigger picture. "Perhaps evolving cells [relied on] photochemical reactions that were the ancestors of the modern CAC," he says. Eventually, as enzymes evolved that could harness chemical energy to drive the CAC, organisms no longer had to rely on the sun to keep their metabolisms churning. "It is certainly a reasonable proposal," says James Ferris of Rensselaer Polytechnic Institute in Troy, New York.

–Ricki Lewis

Ricki Lewis is the author of Life, *published by McGraw-Hill College Publishers.*

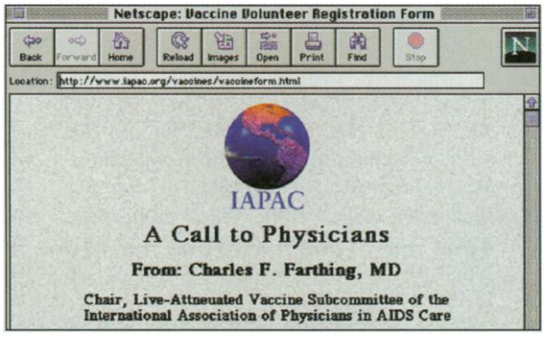
AIDS RESEARCH

Novel Campaign to Test Live HIV Vaccine

An AIDS vaccine that, hands down, has had more success in monkey experiments than any other approach has never been tested in humans. The reason: many researchers believe the vaccine, based on a weakened, or attenuated, live virus, would be too risky. Now, the little-known International Association of Physicians in AIDS Care (IAPAC), convinced that the potential benefits outweigh the risks, is conducting an unusual campaign to recruit "a few hundred" volunteers for a safety study of this approach that the group hopes to organize by the year 2000.

Heading the drive to sign up volunteers is AIDS clinician Charles Farthing, one of IAPAC's 5500 members and medical director of the AIDS Healthcare Foundation in Los Angeles, California. Farthing says he has been "progressively irritated" by the lack of movement toward clinical trials of an attenuated HIV vaccine—an approach that has worked wonders against diseases such as smallpox and polio. The Chicago–based IAPAC made the call for a live, attenuated HIV trial in the August issue of its journal; the editor, Gordon Nary, announced that he would be among the volunteers. IAPAC also has posted a registration form for the trial on its Internet site (http://www.iapac.org), and says more than a dozen people already have stepped forward.

Ronald Desrosiers of the New England Regional Primate Research Center in Southborough, Massachusetts, first showed the power of the live, attenuated approach in a monkey study published in *Science* nearly 5 years ago (18 December 1992, p. 1938). Monkeys given the vaccine did not become infected later, when given a lethal strain of SIV, the simian cousin of HIV. Desrosiers, who has worked with Therion Biologics of Cambridge, Massachusetts, to develop a potential product, has spent the past several years deleting various genes from SIV and HIV to find a weakened form that is as safe as possible, yet still able to protect animals from disease-causing isolates of the virus.



Internet appeal. IAPAC's call for volunteers.

A live, attenuated AIDS vaccine would have three potential pitfalls, however. The weakened virus would still be able to replicate and might cause AIDS after, say, 30 years. It's also possible the virus could mutate into a virulent form, although Desrosiers thinks this risk can be all but eliminated by deleting enough genes. Finally, the weakened HIV would still integrate with a host cell's DNA, which theoretically could trigger cancer by a process known as insertional mutagenesis.

Farthing says he hopes the safety trial will show after a year or two that people, like the monkeys, can control replication of the vaccine virus and not suffer any immunological damage. Still, AIDS experts say the trial won't answer some of the biggest safety questions. "We're really concerned with what happens when you vaccinate 20 million people and 10 years later, 5% or 10% get lymphoma," says Anthony Fauci, head of the National Institute of Allergy and Infectious Diseases. "You're not going to know that from [IAPAC's proposed test]."

Farthing recognizes the risks, and acknowledges that regulatory agencies such as the Food and Drug Administration may never approve his proposed test. But "if you just assume everybody's going to say no, you don't do anything," he says. Margaret Johnston, head scientist for the International AIDS Vaccine Initiative, a group started by the Rockefeller Foundation to speed the search, thinks the safety issue are paramount, but says IAPAC's efforts might help. IAPAC's move, says Johnston, "will stimulate debate, which I do think is sorely needed."

–Jon Cohen