

Has the biosphere done a flip-flop?

Today, plants depend on carbon dioxide and water to survive. In turn, they produce organic matter, which settles on the ground or in a body of water, and oxygen, which floats into the atmosphere. Animals consume some of the plants and give off their own by-products — and the closed cycle of photosynthesis and respiration continues.

However, during the Archean age more than 2.5 billion years ago, the biosphere lacked oxygen and was replaced in the cycle by dissolved iron, proposes James C.G. Walker, a University of Michigan atmospheric scientist, in the Oct. 22 NATURE. The presence of dissolved iron caused the Archean biosphere to be a total flip-flop of today's, he says. If accepted, this picture could change how geologists classify Archean fossils and how scientists view human evolution.

According to Walker, the oxygen-replacing dissolved iron, which is denser than organic matter, settled in sediments or stagnant pools, while volatile carbon and gaseous hydrocarbons scattered in the atmosphere and oceans. "My suggestion will profoundly change, if not turn

upside down, how we look at the Archean environment," Walker told SCIENCE NEWS.

The prevailing thought has been that yesterday's "animals," or single-celled organisms, either fermented organic matter or consumed dissolved sulfate. The organisms then released organic matter or sulfide that settled on the ground or in the sea. According to this view, these substances would be plentiful in areas where life was flourishing.

Geologists have maintained that fossils found in Archean sediments rich in either carbon or sulfide are the remains of organisms that lived in productive areas. But according to Walker, a fossilized organism found in iron-rich and carbon-poor or sulfide-poor rock lived in a very productive area. Walker defends his theory by maintaining that iron was more plentiful than sulfur during the Archean.

"The Archean world has few fossils," Walker says. "Maybe that's why no one has really thought about it. [But] it's important to figure out who was eating whom and what properties in the environment they were exploiting."

Donald Lowe, an authority on early sedimentary rocks at Louisiana State University at Baton Rouge, says, "Right or wrong, [Walker's theory] will . . . make people think about the system in ways they haven't before." — S. Eisenberg

Cosmos 1402's uranium remains

When a Soviet satellite called Cosmos 1402 was launched into orbit around the earth on Aug. 30, 1982, it carried a nuclear reactor containing up to 50 kilograms of uranium-235. After the satellite had finished its job, the reactor — used to power an ocean-reconnaissance radar system — was supposed to be separated from it and boosted to a higher orbit, where its radioactive core would presumably stay aloft for centuries. However, a malfunction prevented the orbit from being raised, and on Feb. 7, 1983, the reactor reentered the atmosphere.

But what happened to it then? The consensus was that the device had burned up from atmospheric friction high above the South Atlantic Ocean. This would have reduced its radioactive heart to dust-like particles that would circle on the winds for months or years before settling out, rather than coming down as solid pieces of debris. But at the time, according to a group of U.S. researchers whose report appears in the Oct. 23 SCIENCE, "there was no direct evidence that this occurred."

Both scenarios have occurred before and both have the potential for being harmful. Heavier chunks represent greater concentrations of radioactivity, while fine particles can cover far more terrain by the time they finally do fall, depending on the winds, the altitude of burn-up and other factors.

Now the scientists' analysis, based on samples collected in paper filters by high-altitude balloons before and after the satellite's reentry, has indicated that most or all of the reactor's uranium-235 "dust" was indeed still present in the upper atmosphere more than a year later.

The technique involved using mass spectrometry to measure variations in the exposed filters' relative amounts of uranium-235 and -238, both of which exist in tiny amounts in the atmosphere and even in the unexposed filter paper. The uranium-238 showed similar concentrations in the samples from both before and after Cosmos 1402's reentry, as well as in several unused filters, according to Robert Leifer of the Department of Energy's Environmental Measurements Laboratory in New York City, together with colleagues from that lab and from the National Measurements Laboratory of the National Bureau of Standards in Gaithersburg, Md. A clearly measurable excess of uranium-235 was found, however, in one of the three post-reentry filters.

The timing of the balloon launches to give them the best chance of detecting radioactive fallout from Cosmos 1402 was based on measurements that had been made after the 1964 reentry of a plu-

How effective are bulimia treatments?

Results of a preliminary study to track the responses of young bulimic women to psychiatric treatment over an extended period are not encouraging, particularly for teenagers, according to a report presented last week at the annual meeting of the American Academy of Child and Adolescent Psychiatry in Washington, D.C.

After 18 months of treatment that included both psychotherapy and the use of antidepressant drugs, eight of 18 teenage bulimics were unimproved, reports David B. Herzog of Massachusetts General Hospital in Boston. The remaining 10 improved significantly for at least two months, he says, but by the end of the study, five had again developed symptoms of bulimia.

Bulimia is characterized by episodes of binge eating accompanied by feelings that the binges are abnormal and cannot be controlled. Depression and anguish, as well as induced vomiting, often follow a binge. Some bulimics employ extreme diets, constant exercise or laxatives to lose weight.

Several studies have used prior medical records and self-reports to estimate the long-term effectiveness of bulimia treatments among women in their 20s. Treatments and diagnostic criteria in the studies varied, as did estimates of symptom recurrence. Herzog and his

co-workers used current psychiatric standards for bulimia and assigned each patient her own treatment plan, which included individual, group and family psychotherapy, antidepressant medication and nutritional counseling. Four follow-up interviews were conducted during the 18-month study.

In addition to the poor outcomes of the 18 bulimics between the ages of 15 and 19, the researchers found that four of 12 bulimic women in their 20s did not significantly improve for at least two months during the study. In contrast, notes Herzog, it is estimated that 22 percent of severely depressed, hospitalized patients do not improve after 18 months of psychiatric treatment.

About half of the bulimic women were also diagnosed as suffering from severe depression or milder mood disturbances. But there was no clear link between the two disorders, says Herzog. Significant improvement during the study, for example, was the same for bulimics with mood disorders and those without them.

A clearer picture will emerge from a larger sample, says Herzog. He and his co-workers recently received funding from the National Institute of Mental Health to conduct a similar study of 225 women with eating disorders, including 125 bulimics, over five years. — B. Bower

onium-powered system called SNAP-9A aboard a U.S. satellite that had failed to get into orbit. A particularly widely reported reentry was that of the Soviet Cosmos 954 satellite in 1978, which deposited radioactive debris over a large area of northwestern Canada.

One concern that has been raised about the possible reentry of satellite nuclear material is that of contamination by more toxic fission products such as strontium-90 or cesium-137. In Cosmos 1402's case, notes Leifer, "we could not detect any fission products in the samples." On the other hand, says Steven Aftergood of the Los Angeles-based Committee to Bridge the Gap, the administration's Strategic Defense Initiative is funding the development of much higher-powered space-borne reactors, "despite President Reagan's pledge that [SDI] would offer a non-nuclear defense."

— J. Eberhart

NRC to vote on new evacuation rule

The Nuclear Regulatory Commission (NRC) is poised to approve a rule change that would allow the licensing of nuclear power plants without state or local input into emergency planning. After reviewing more than 50,000 comments from concerned citizens — most of them opposed to the rule change — the staff of the NRC recommended at an Oct. 22 briefing that the full commission approve the proposal. A final vote is expected this week.

Operating licenses for the completed Shoreham nuclear power plant on Long Island and the Seabrook plant in New Hampshire have not been issued because state and local authorities are refusing to submit the emergency evacuation plans currently required by the NRC (SN: 3/7/87, p.150). The rule change would allow utility companies to submit their own emergency plans for NRC approval, and would formalize NRC's so-called "realism doctrine." That doctrine assumes that in a real emergency, local and state governments would in fact assist in implementing an evacuation.

"Obviously, state and local participation in off-site emergency planning is very important," said William C. Parler, general counsel for the NRC. However, he asserted, the commission has the legal authority to bypass local input when utility companies can provide "reasonable assurance" that the public health and safety will not be endangered.

According to federal law, no operating license may be issued for a nuclear power plant unless there is "reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency."

Several commissioners and staff people suggested at the briefing that it would

Hologram: New dimension for X-rays

With the electron microscope, scientists can see the hairs on a housefly's feet and uncover other marvels of the microscopic universe. But the world imaged in electron micrographs is largely a dead and unnatural one because samples must be chemically fixed, thinly sliced, dehydrated or altered in other ways. Biologists have hoped for X-ray microscopes, which, while using a longer wavelength and hence having a lower resolution than their electron counterparts, would enable scientists to study unaltered, living samples in detail.

In the last few years, researchers have made significant strides toward this goal, and some X-ray microscopes that produce two-dimensional images are attracting biological customers. Now two research teams report in the Oct. 23 SCIENCE that they have passed important milestones in X-ray holography, the main microscopy technique for producing three-dimensional images. One group, using the National Synchrotron Light Source (NSLS), has produced a hologram of unprecedented resolution; the other has made the first X-ray-laser hologram.

The synchrotron group, led by Malcolm Howells at the Lawrence Berkeley (Calif.) Laboratory, made holograms of rat pancreas granules. The smallest resolvable feature in these holograms is 400 angstroms, 25 times smaller than the best previous holograms and equal to the resolution of the best X-ray microscopes. Howells attributes this increased resolution in part to an improved X-ray source: NSLS last year added an undulator — a series of magnets that deflect synchrotron electrons side to side, creating a brighter, more coherent X-ray beam. The improved resolution is also due to the group's use of high-resolution resist, rather than film, for recording the hologram.

"The key step preventing X-ray holography from being a useful technique was the inability to record the hologram," says Howells, "and now we've accomplished that step with the undu-

lator and resist."

At the moment, however, their holograms appear two-dimensional because the depth of focus is about the same as the thickness of their sample. They hope to achieve three-dimensionality by pushing the resolution down to 100 angstroms. One potential difficulty is the technique's long exposure time — 80 minutes in their recent work. To avoid blurred images from moving samples, says Howells, "we definitely have to find a way to hold the sample still."

In contrast, the X-ray laser that James E. Trebes and his colleagues at Lawrence Livermore (Calif.) National Laboratory used to make holograms is so bright and coherent that hologram exposures on film take less than a nanosecond. In principle, this will enable researchers to freeze the action of a moving sample without blurring the image. So far, Trebes's group has demonstrated the feasibility of X-ray laser holography by making, again, two-dimensional-appearing holograms of a gold bar and carbon fibers, with a resolution of a few microns.

The researchers plan to develop a laser source that will image biological samples at much higher resolutions, which will, among other things, help achieve three-dimensionality. "That's the nice thing about Howells's work," says Trebes. "He's shown that you can really make a high-resolution hologram. This was in some doubt before."

One of the key ingredients in the system devised by Trebes's group is a multilayered X-ray mirror that can separate X-rays from other wavelengths made in the lasing process and is flat enough to maintain the beam's coherence. Another critical part is the X-ray laser, which is produced when Livermore's Nova laser zaps selenium foil, creating a plasma that produces X-rays.

"For the last three years, X-ray lasers have been a lab curiosity, a research topic in themselves," says Trebes. "This paper announces that X-ray lasers have arrived and it's time to start using them [for imaging]." — S. Weisburd

be difficult — but not impossible — for a utility to make an adequate emergency plan without the assistance of state and local authorities. But neither was it Congress's intention, they said, to give state or local authorities veto power over the licensing of nuclear plants. One commissioner expressed concern that even if local agencies ultimately cooperated in an emergency, the lack of any coordinated exercises in advance might render emergency measures less effective.

An earlier version of the proposal's environmental impact statement had

stated that "the public in the vicinity of the few affected plants would be placed at a somewhat greater risk relative to what would be the case if either the governments cooperated or the NRC adhered to its current emergency planning rules."

In fact, Parler said at the latest briefing, the new rule as it stands does not require any comparison between emergency plans with or without government cooperation. However, the "reasonable assurance" standard of public protection would be unchanged under the new rule, he said. — R. Weiss