ECOLOGY

Biosphere 2 Gets New Lease On Life From Research Plan

Can Biosphere 2, the 3-acre, glass-enclosed ecosystem in the Arizona desert, shed its troubled past and finally come into its own as a scientific enterprise? Outside researchers might have good reason to be skeptical, as science has generally taken a back seat to New Age theatrics in the past. But this time around, the signals are much more positive. New management is in charge, outside institutions have a role in running the venture, and a new scientific committee has just put together an ambitious research plan for the coming year—the first major step toward exploring the true scientific utility of the $150 million facility.

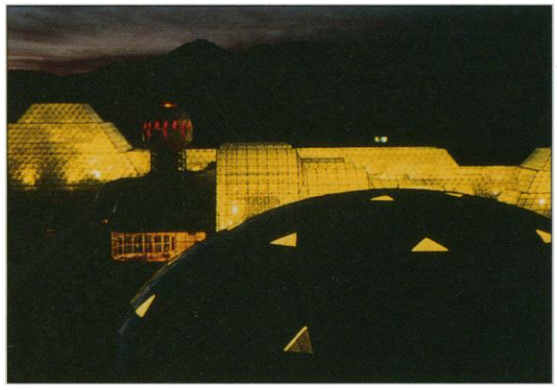
The committee wholeheartedly endorsed the idea of a year-long study aimed at producing an in-depth understanding of how the existing, unperturbed ecosystem behaves. Obtaining such a baseline picture, says geochemist Wallace Broecker of Columbia University's Lamont-Doherty Earth Observatory, is "simply the most logical thing to do" if researchers are to churn out good science in Biosphere 2.

Once this baseline understanding is established, the committee, which is co-chaired by Harvard University's Michael McElroy, an atmospheric scientist, and Stanford University's Harold Mooney, an environmental biologist, suggests they will then be ready to assess how Biosphere 2's ecosystem responds to changes in variables such as atmospheric gas concentrations, humidity, and temperature. In this way, say members of the science committee, Biosphere 2 can be used to gain valuable information that may help answer global change questions. "What Biosphere 2 does," says committee member François Morel, a Princeton geologist, "is give you a huge enclosed system in which you can account for all reservoirs and all fluxes of every element you chose to study. You can also manipulate some of these parameters, which happens to be very hard to do on the Earth itself."

The new plans for Biosphere 2 represent a major departure from the facility's previous operations. From its opening in late 1991 until the end of 1993, it was inhabited full-time by a crew of eight biospherians who were supposed to glean new insights into the workings of planet Earth. But their work was plagued by technical glitches and criticized for producing little of scientific value (*Science*, 11 March 1994, p. 1368).

The turning point came in late March, when Ed Bass, the Texas billionaire who built Biosphere, ousted the previous management. To replace it, in August he established the Biosphere 2 Research Group, a consortium of major universities, research institutes, and national labs, and also created a joint venture with Lamont-Doherty to generate a long-term scientific plan. The Biosphere 2 facility, Bass promised, would now be dedicated to the pursuit of hardcore science.

One step toward accomplishing this goal was the establishment of the 20-member committee to participate in Biosphere 2's research plans. Since last August, the committee members have been hard at work drafting more than a dozen white papers on the facility's research potential, which they presented at a meeting last month. Based on those presentations, the committee came to an overwhelming consensus about what to do first, says John Mutter, director of Lamont-Doherty.



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Looking ahead. Biosphere 2's ecosystem will be thoroughly studied as a prelude to tackling global change questions.

The plan of attack is to spend at least the next year getting to know every aspect of the biosphere ecosystem. Most of the work will be done by the 15 members of the Biosphere 2 research group, which is led by the new director of science and research for Biosphere 2, biogeochemist Bruno Marino, formerly of Harvard. The researchers will, for example, measure the concentrations and fluctuations of gases such as carbon dioxide, analyze soils, and take inventories of plant, animal, and micro-organism populations. By the end of 1995, they hope to understand the ecosystem of Biosphere 2 on a level that could never be achieved in the outside world. "We should be able to completely piece together the biological system of Biosphere 2," says Marino. "Most of us are used to working with global budgets of gases with very sparse data sets. In comparison, Biosphere 2 is a very knowable place."

The next year will also be spent honing the engineering of Biosphere 2's control apparatus so that once the researchers decide they're ready to begin perturbing the environment of the ecosystem, they're capable of doing it scientifically. "We have an enormous amount of work to do," says Marino, "just to make sure we can operate the facility at a given level."

Once the baseline ecosystem is thoroughly understood and the engineering complete, then the researchers hope, in Marino's words, to begin to "layer experimentation upon it." Already, says Broecker, they have tentative plans to design and construct roll-down partitions, so that Biosphere can be run as a single unit or partitioned into separate regions. Such partitions would allow researchers to run controlled experiments—for instance, keeping the carbon dioxide at background levels in one region while raising it in another to see how this affects plant growth, temperatures, or whatever.

One thing that apparently won't happen again at Biosphere 2, however, is long-term inhabitation. The new scientific team will work inside the Biosphere 2, but not for extended stays. Indeed, Robert Russell, an expert in metabolic studies at the Tufts University New England Medical Center who was asked to prepare a white paper on the research that might be accomplished during an extended stay, says his fellow committee members made a telling response to his presentation. "They all looked on it as a kind of side show," he says, "to the main show of ecology and the carbon dioxide cycle, the things that Biosphere 2 is really uniquely set up to do." And that may not be such a bad thing, as his main conclusion was that little would be gained by keeping researchers in the facility for long periods.

No one involved with the project was willing to reveal what the budget of Biosphere 2 is likely to be. But for now, the work will continue to be funded by the facility's parent company, Space Biospheres Ventures, which is owned by Bass.

Whether useful science will finally come out of Biosphere 2 still remains to be seen, however. As Mutter points out, the conditions in the facility do not exactly mimic those on Earth. It has an atmosphere, for example, but no stratosphere, and its ratio of water to land mass is the reverse of that on Earth. "It's an analogy of the real Earth, but an incomplete analogy," Mutter notes. Nevertheless, he adds, "that doesn't mean it's not valuable. It's still vastly better than anything you can get in a lab in a university."

–Gary Taubes