



LETTERS TO THE EDITOR

Biosphere 2 Was

Science, Not a Stunt

BD **BILL DEMPSTER**
Jun 24 2017, 7:00am

“Statements about 'failure' and things 'going wrong' inevitably follow based on the incorrect statement of purpose.”

Image: Daniel Oberhaus/Motherboard

On June 10, I published an article about the decades-long quest to recreate Earth in miniature. This journey has exposed the fragility of Earth's ecosystems and how little we truly know about the complicated way terrestrial systems interact with one another. At the center of this story was the Biosphere 2, the largest closed-system experiment in history. The story of the Biosphere 2 has often been sensationalized in popular media following a series of experiments in the early 1990s, which saw human crews inhabit the Biosphere for several months at a stretch.

Although I attempted to curb this sensationalism in my own reporting, two of the Biosphere's architects felt as though I hadn't gone far enough and reached out to correct the record. The criticisms in the letters warrant our attention and are a welcome addendum to the original article.

Motherboard has decided to publish these letters in full. The first, published here, is by Bill Dempster, the Biosphere 2 Director of Systems Engineering, who served in this position from the inception of the project until 1994. The second letter is by Mark Nelson, the chairman of the Institute of Ecotechnics and a member of the 1991-1993 Biosphere 2 crew.
-Daniel Oberhaus

Your article about Biosphere 2, "A 21st Century 'Operating Manual for Spaceship Earth,'" is critically pertinent to the increasing predicament that human society is damaging our own life support system which is Earth itself. I was Director of Systems Engineering for the

project for 10 years and wish to correct the record and misunderstandings about Biosphere 2 and its creators.

Innumerable media articles have started, as does this one, by misstating the purpose of Biosphere 2. Statements about "failure" and things "going wrong" inevitably follow based on the incorrect statement of purpose.

Yet, your article does contain the central purpose of Biosphere 2, but almost hidden by unfortunate placement in the article. I refer to two statements. From Buckminster Fuller, "...it is impossible to understand a given system only by considering its parts in isolation," and your quote from John Adams: "It's really humbling when you begin to see the sensitivities of Earth systems and realize how little we truly understand those systems."



Biosphere 2. Image: Daniel Oberhaus/Motherboard

It was precisely because John Allen understood how little we understand the biosphere of planet Earth and because he also understood the need to study the whole system that he

began decades ago to build a team to comprehensively study not only our biosphere but also the role of human society as part of the biosphere. Mr. Allen also recognized that governmentally organized or supported studies became seriously limited by the inevitable strings that are attached due to the use of public funds, so he organized a private enterprise to develop Biosphere 2. These were profound insights, but led to unfounded and entirely false attacks suggesting motives of secrecy or deception.

The purpose of Biosphere 2 was to build a system including enough aspects of earth's biosphere so that the major processes of respiration, photosynthesis, water cycling, nutrient cycling, development of ecosystems within themselves and in interaction with each other, survival and extinction of species while in competition could all be studied within one containment so that the essential elements are traceable. Study would include measurements, detailed observations of the evolutionary trajectory of the system plus management to limit changes that would lead to grossly different conditions from the Earth-like initial approximation.

This effort included 1000 sensors recording conditions every 15 minutes to an ever-growing digital record, observation notes of every wilderness plant, regular taking of soil samples, water and atmospheric analyses, detailed medical studies of the crew, coral reef and fish studies, etc. It was never intended to just "let the system go" no matter what happens. That would be next to useless scientifically and practically. What is much more interesting and applicable to our situation on Earth is to observe, measure and document tendencies of the system to change and to record the type and level of intervention necessary to stay roughly within the conditions that represent each biome. So, for example, carbon dioxide scrubbing and the oxygen injections were all carefully measured and documented, even if they were initially unanticipated, and were perfectly reasonable interventions. It is notable that data suggested these were both transitory phenomena that might resolve in a decade or so. I attach the peer-reviewed publication "[Oxygen Loss in Biosphere 2](#)", one of the most valuable results from the two-year closure.

It did not "[violate] the purpose of the experiment" to inject oxygen. The experiment was not "to prove that [Biosphere 2] was capable of sustaining a closed ecological system." The

purpose was not to prove anything. Biosphere 2 was not "to be a proof of concept that it was...possible to create a closed and self-sustaining ecosystem." It was to begin a long program of research how biospheric systems operate. Building and operating Biosphere 2 was an extremely effective way to do this.

This program would continue for decades, the facility was intended to operate for a century, while we (and our successors) documented the evolution of all the biomes and the system as a whole as they progressed from infancy to maturity and beyond.

The only "failure" that might occur would be if the whole structure leaked so badly that unknown amounts of atmosphere or water unaccountably left the system or there were invasions of species from the outside or if equipment broke down so that temperature / humidity could not be controlled or water could not be circulated. Nothing like that occurred. In fact, Biosphere 2 is recognized as being more tightly sealed and including vastly more complexity than any system ever built for similar purposes. It was and is a giant step forward in understanding how Earth's biosphere operates.

The media has treated Biosphere 2 as a stunt and decries it as a "failure" for not meeting expectations of a stunt. This is all the more ironic because the media also accuses Biosphere 2 of being a stunt, not science. To insist that Jane Poynter stay inside instead of getting medical treatment for her cut-off finger tip is to demand a stunt. To say that she could not take some experimental equipment back in with her is to demand a stunt. To say the biospherians must not eat some of the stored seed stock is to demand a stunt. To insist that Biosphere 2 be a perfect self-sustaining ecosystem is to demand a stunt. What would any of those stunts have to do with science? Nothing.

This article starts right off saying the "primary goal was to test the feasibility of using biospheres as living spaces for long duration space missions." I hope it is clear by now that was *not* the purpose of Biosphere 2. Of course, Biosphere 2 will provide (has already provided) important data that can be used toward design and planning for future habitats in space or on another planet. That is such a monumental goal that Biosphere 2 is only a drop in the bucket of everything that must be understood, but Biosphere 2 is a very

important drop in that bucket. Yes, as you say, "we would have to figure out a way to create sustainable habitats," but that was not *the* idea of Biosphere 2. Some very important fundamental experience and data have come out of Biosphere 2 that will contribute to the incredibly difficult goal of building a habitat beyond Earth, but it is wrong to say that was *the* idea as if it were the only, or even the primary, idea.

Humanity is showing extreme arrogance and hubris in the way we treat Earth with abandon while Earth is our only life support system. An indefinitely self-sustaining and recycling life support system is not only a miracle in the universe (Earth is the only known one), it is a delicate balance which we are now disturbing. To imagine that the creators of Biosphere 2 knew how to build a perfectly balanced system from the beginning and to expect that Biosphere 2 be that system right from the get-go (like a stunt) is entirely wrong.



The ocean biome in the Biosphere 2. Image: Daniel Oberhaus/Motherboard

A very effective way to study such systems would be to build and operate one, probably stumbling sometimes, making changes and developing understanding. I quote Dr. Howard Odum, widely regarded as the founder of ecosystem science, commenting on Biosphere 2: "The management process during 1992-1993 using data to develop theory, test it with simulation, and apply corrective actions was in the best scientific tradition. Yet some journalists crucified the management in the public press, treating the project as if it was an Olympic contest to see how much could be done without opening the doors."

Other parts of the article also reflect basic misunderstanding. For example, suggesting factions in the crew as being a failure. It is well understood, scientifically, that isolated groups (even for only a few weeks, not to mention 2 years) almost inevitably split into factions with tensions. This is not some sort of scandal, it is a fundamental human tendency. The important issue is that they remain operational and put their task above personality. Jane Poynter's comment in her book simply does not reflect understanding of this dynamic. The following is from Mark Nelson's peer-reviewed publication on the subject: "Despite the feelings of some of the biospherians that the stress from the internal discord made them depressed, objectively this was not the case. Strikingly, the MMPI psychological test administered to both the first and second closure crews showed low scores for depression. The women and men tested very similarly, and there was a high correlation between the test results of the entire crew and a group of astronaut candidates. Overall, test results indicated an 'adventurer' profile, a personality well-suited to challenge and stress."

Characterization of the project's organizational history and finances as if it were all a personal dynamic between John Allen and Ed Bass is a distortion. Space Biospheres Ventures was a joint venture between companies, each with a board of directors. The article reads as if the management team running the project were employees of Ed Bass that he replaced. Not true. They were 50-50 partners as corporate entities. Overall planning and financial decisions were approved by the boards of both companies. Some knowledgeable visitors to the project commented that it looked like a \$1B project. The actual about \$150M was a tightly and well managed cost. "Overspending" has no basis in fact. After the takeover, expenditure levels under Steve Bannon's management continued

at the same level.

The Institute of Ecotechnics is a different entity. Mr. Bass had been *a* director, never *the* director. IE projects aim to operate on their own economic basis while preserving or enhancing the local ecology. There is nothing radical about that unless you mean how different that is from business as usual which aims to maximize profits. In the 1970s, Synergia Ranch was not a retreat for visitors, it was an intentional community that grew some of its own food in organic gardens, not as experiments, and engaged in theater as part of a balanced lifestyle. The media has used the theater aspect as if a person in theater cannot be anything other than an actor and as if that disqualifies them as anything else. Part of knowing how society operates and humanity's role in the global ecosystem is understanding motives and attitudes. Theater gives great insights into both. Buddhism was not part of Synergia Ranch.

Free association brainstorming is a well recognized technique for complex projects. If someone mentioned a refuge after a nuclear war, it never became even a hint in the planning. It would be absurd anyway. Biosphere 2 was fully dependent on a reliable external infrastructure for energy and operational support. No one would build a huge glazed above-ground enclosure as a nuclear shelter. This is just a sensationalist comment and was not an ideological notion of anyone involved in the project.

The two members of the first mission who flew back to warn the second crew, weren't concerned about cost cutting, they were concerned about direct incompetence of bankers who had forcibly taken over from the skilled management team and the danger that posed. The five "panels of glass" they broke were not part of the Biosphere 2 glazing, they were small glass panes, designed to be broken, somewhat similar to the small glass pane that you might break when pulling a fire alarm handle. The media has often characterized the incident as if it were vandalism. In a subsequent civil court case, the two biospherians won a judgement for abuse of process for the attempt to prosecute them.

I ask you and Motherboard / Vice to publish this letter in full. There is so much misunderstanding about Biosphere 2, repeated in so many, often sensationalistic, media accounts, that it damages not only the reputation of the project, but deprives the global public from knowing about the huge gap between what we know about Earth and what could be known by a robust scientific program to build and operate such facilities. We are in serious trouble on this planet. Biosphere 2 represents a real step toward developing the understanding we desperately need, but do not pursue because of complacency and/or arguing about trivialities.

M

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