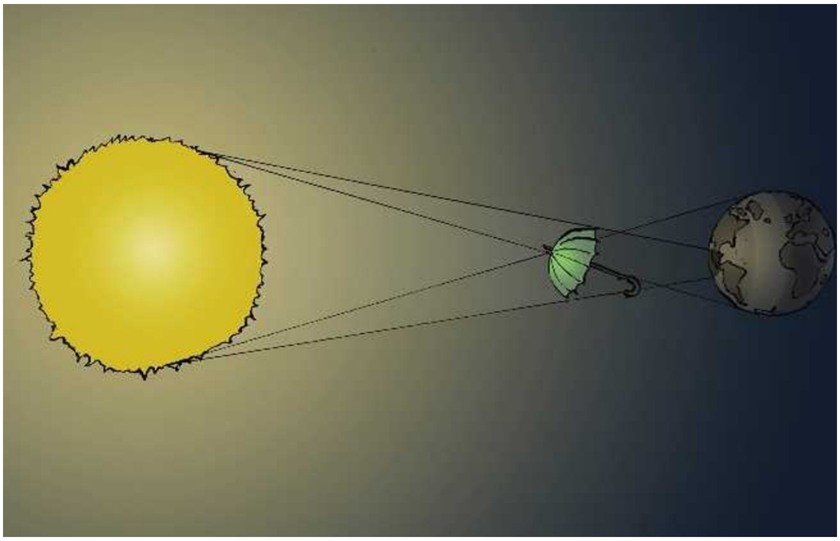
Whole Earth comes into focus

To understand how our planet uses energy, we must integrate genetic data from microbial studies with satellite views of our planet.

Stewart Brand



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Two vastly different but complementary projects could transform our understanding of Earth. The long-standing mystery of how microbes run the world is closer to being solved, thanks to metagenomics — the DNA sequencing of whole populations of microbial life. And if a project to record fluctuations in the solar energy that reaches Earth gets back on track, we could begin to predict, and even manipulate, ecological changes on the planetary scale.

In 1966, I promoted the idea of photographing the 'whole Earth' from space, hoping that it would stimulate humanity's interest in its mega-habitat. The concept of the whole-Earth photo expanded profoundly in 1998 when the then US vice-president, Al Gore, envisaged a video camera in space permanently broadcasting a high-resolution real-time image of the sunlit side of our planet. The camera would reside at Lagrange-1, the point between the Sun and Earth where the gravitational pull is neutral. At this point in space, 1.5 million kilometres from Earth, an object orbits the Sun in synchrony with us. Gore's scheme was modified and eventually named the Deep Space Climate Observatory (DSCOVR). This project won approval from the US National Academy of Sciences and $100 million from the US Congress, and the satellite was built.

DSCOVR's positioning, between the Sun and Earth, was to make it perfect for monitoring the planet's albedo, the amount of light Earth reflects. This information is crucial for improving climate models. The satellite was also to gauge Earth's total heat budget, measuring and guiding our progress in heading off global warming. It was also to provide much-needed calibration of the temperature readings from low Earth-orbiting satellites. And everyone with a computer screen would have been able to contemplate the bracingly real 'big here right now' image of our planet. Sadly, the satellite languishes in a warehouse outside Washington DC. The Bush administration mothballed the project in January 2001, and cancelled hopes for its launch in 2006.

Whether or not DSCOVR makes it to Lagrange-1, something similar surely must, and soon. We need to answer some crucial questions. Where exactly does solar energy go when it hits Earth? How much of it is absorbed by biological organisms? And how does biological life affect the physical energy flows in the atmosphere and oceans that in turn drive climate dynamics?

When DSCOVR, or better, gets installed, the most important global activity it can monitor will take place at the scale of a bacterial gene. Metagenomics is giving us detailed access to the genes and gene communities of bacteria and archaea, 99% of which can't be cultured in the lab. For instance, analysis is revealing whole new metabolic pathways for oxygen and carbon production by the ocean's microbes.

These pathways must be understood, because their effects work on the planetary scale and could be harnessed as new energy sources. For example, the carbon tightly bound in lignin is broken down largely in the microbial soup of termite hindguts. Half of the world's oxygen is produced by ocean microbes, and they fix an unknown, but presumably enormous, amount of atmospheric carbon. Once ecologists open microbial black boxes such as the soil and gut, and when they understand the prolific transfer of genes between prokaryotes and viruses, we will begin to comprehend the extremely local interactions that take place within a biological neighbourhood. With the kind of close monitoring that metagenomics offers, predictability of ecology should improve.

This, perhaps, could be followed by engineering. To control global warming, we may one day resort to palliatives, such as a variable sunshade for Earth located at Lagrange-1 or increasing the activity of phytoplankton with deep-water nutrients or iron.

Both routes offer the ability to manipulate energy at the planetary scale, and each should be investigated incrementally. Solar uptake by microbes can be probed locally with ocean experiments and then scaled up. And a sun-shield disk that can expand to a diameter of 2 kilometres would allow heat-budget changes to be studied with precision.

DSCOVR equipped with a variable sunshade could even act as a planetary thermostat, making fine adjustments in the amount of solar energy reaching Earth so that a stable climate regime is maintained. This vision requires much better understanding of temporal and regional energy budgets and their interplay with microbial life on Earth.

A unifying body of data, ideas, models and images of the whole-Earth system could inspire the public and may shift scientific thinking. In studying the energy dynamics of the Earth–Sun system while learning how our microbial partners manage to keep this planet comfortably terraformed for life, we would begin to step up to the full meaning of Earth stewardship. ■

Stewart Brand founded and edited the Whole Earth Catalog. He is president of the Long Now Foundation, co-founder of Global Business Network. His next book, *Whole Earth Discipline: An Ecopragmatist Manifesto*, will be published in late 2008 by Viking-Penguin.

FURTHER READING
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