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LETTERS

Gaia in *Science*

The description of Doug Zook's enthusiastic and competent leadership in "hands-on science" for teachers and students by John Travis ("Reading, writing, arithmetic . . . and microbes?", News & Comment, 20 Nov., p. 1299) is very welcome in this day of "rote memorization" and overuse of the "lecture method." The need to overcome our cultural "microphobia" at all levels is obvious. Peer review that reflected this microbe-hunting attitude even seems to have led *Science* to reject my article making this same point of respect for microbial metabolic virtuosities and extraordinary sexuality. The paper, "Biodiversity: molecular biological domains, symbiosis and kingdom origins," was published in a recent issue of *BioSystems* (*1*). About 400 reprint requests have been received so far. In that article I detailed an appropriate evolutionary classification for the microorganisms—one that escapes the dimwitted "plant versus animal" dichotomy. The article expresses the views of various investigators and educators in support of Zook's statement, "If the earth could speak directly to us, its language would be microbial."

However, Travis misrepresents James E. Lovelock's Gaia theory when he says that I am "best known as a fervent proponent of the controversial Gaia hypothesis, which sees the whole planet as a single organism. . . ." Because no single organism ever supports its growth solely by eating its own waste and entirely cycling the carbon, hydrogen, sulfur, and so forth needed for its body, I have always clearly maintained that "the Earth is a single live organism" is *not* the Gaia idea. It is a misstatement that encourages critics and cranks to flourish and prevents the job, begun by Lovelock, of integration of Earth system science data. L. Joseph in his book *Gaia: The Growth of an Idea* (*2*) and Phil Shannon in his recent *Skeptical Inquirer* article "Gaia without mysticism" (*3*) both make this abundantly clear. A far more accurate short statement of Gaia, discussed in chapter 12 of my recent book (*4*), is that

> the surface temperature, chemistry of the reactive gaseous components, the oxidation-reduction state and the acidity-alkalinity of the Earth's atmosphere and surface sediments are actively (homeorrhetically) maintained by the metabolism, behavior, growth and reproduction of organisms (organized into communities) on its surface. Gaia is not an individual, it is an ecosystem.

When, by letter, I accused *Science* of misquotation and misrepresentation in Charles Mann's article "Lynn Margulis: Science's unruly Earth mother" (Profile, 19 Apr. 1991, p. 378), neither a retraction nor my complaints were published. Rather, shortly afterward, for the fourth time, a scientific paper, the one referred to above, was rejected. When I complained, editor Daniel E. Koshland, Jr., said mine, like all papers received by *Science* of course had gone through the standard procedures of peer review. To his credit, Koshland did publish Lovelock's letter of defense of our long-standing collaboration (14 June 1991, p. 1472), as well as write me a personal letter claiming that I was an "interesting, flamboyant, and controversial scientist."

In spite of Travis' misstatement, my "fervent" support centers less on Gaia and much more on symbiosis as a mechanism of evolutionary innovation. Indeed my involvement with Gaia theory derives from my conviction that Lovelock's is entirely the correct approach. As atmospheric chemist, independent scientist, and brilliant inventor, Lovelock deserves strong collaboration with knowledgeable biologists and ecological model-makers aware of the effects of population growth and gas exchange on the Earth's surface, rather than distortions like those of Travis and Mann.

Genuine coverage of the fruitful Gaia concept must be based not on personalities but on recent reviewed work, including Lovelock's paper on a numerical model for biodiversity (*5*) and the report of the unique American Geophysical Union meeting in 1988 (*6*).

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