Fritjof Capra

Widely acclaimed author Fritjof Capra is ideologically opposed to global capitalism, but a fervent supporter of systems approaches. Is he a friend or foe of biotech?

Fritjof Capra has been railing against the evils of the global economy for decades since leaving his chosen field of high-energy physics to become an author and activist. Now he has turned his attention to the biotech industry. In his most recent book, *The Hidden Connections*, Capra singles out biotech as an example of an industry corrupted by the profit motive. With its intentionally oversimplified notions of biology, the biotech industry, in Capra's view, is clearly on the wrong path to achieve its goals, whether they be curing disease or improving agricultural practices. "As long as this overriding value exists, it's difficult to imagine a responsible biotechnology," he says. In his view it has "invaded the very sanctity of life."

Given biotech's increasing problems with public perception, could an author as prominent and acclaimed as Capra, who has written nine books (including four international best sellers and a screenplay for the 1990 movie, *Mindwalk*) and founded two environmental organizations, seriously damage the industry's public image? Certainly, Capra has more credibility than other more traditional biotech critics, such as Jeremy Rifkin of the Foundation of Economic Trends (Washington, DC). Dan Evamian, Vice President for Communications at the industry's trade organization, (Biotechnology Industry Organization, Washington, DC), feels it is important for people to question and debate how new technologies will be used. However, since the industry is small—95% of biotechnology companies have yet to produce a product—he feels that it doesn't have money to spend on advertising campaigns to counter some of the negative claims.

Born and educated in Austria, he practiced high-energy physics for 20 years. Reading Werner Heisenberg's book, *Physics and Philosophy*, was a pivotal event for him. As Capra recalls, Heisenberg describes how a handful of scientists discovered a very surprising and different reality when they did atomic experiments. "It influenced me very much and I kept an interest in this conceptual revolution implied by the new physics."

While promoting his first book (*The Tao of Physics*, published in 1975), he met scientists of various stripes, and found that similar things were happening in their fields. However, fields other than physics, he found, dealt more with life in all its manifestations—economy, social life and ecology—which led him to broaden his thinking and develop a framework he called the systems view of life; systems thinking and ecology became his focus, and he left physics altogether.

Capra sees another revolution in thinking emerging this time in the life sciences, centered around complexity theory. Though not new (it has been around for decades), this is providing new tools for dealing with complex systems—attractors, fractals, bifurcation diagrams—and is increasingly finding its way into biological applications, particularly as systems biology approaches take hold. "Now, whenever scientists seriously study nonlinear systems, they have the tools to talk about them, and they do so when they are serious about their studies," says Capra.

Despite this realization, Capra says that every day he sees the industry and even scientists and their students embarking on the same well-trodden path of genetic determinism (genes beget behavior, with a few steps in between). "They know that brings in the money, but it's basically dishonest." Former geneticist David Suzuki agrees. "We all practice the way we were brought up. Most molecular biologists are reductionists. There will be a realization, albeit too late, that the simple-minded reductionist models that underlie most of the biotech manipulations are far too limited, and indeed they will be dangerous," says Suzuki. Dangerous because they presume an understanding of complex systems that is not there yet. In the past, the rush to apply knowledge led to such ecological disasters as DDT, Suzuki points out. David Altshuler, a geneticist at Broad Institute (Cambridge, MA, USA) feels that this casting is out of date. "No one believes in genetic determinism anymore," he says. "[Using this argument] is setting up a straw man."

"As long as this overriding value [on making money] exists, it's difficult to imagine a responsible biotechnology."


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Is Capra's view of science going to shake up the biotech industry? Not likely, says Roger Brent, director of another Berkeley institution, the Molecular Sciences Institute (see Commentary by Brent on p 1211). Complexity theory is the "old bad babble with next to no explanatory powers," he explains. Until it is shown to have some predictive value, biotech and pharma will go on the way it has been going—which Brent points out has had some considerable successes, even when targeting single elements of complex pathways, as all effective HIV drugs do. But, Brent argues, "To get where they need to go, they can't just say things, they have to show [the systems approach] behaves in useful ways, which means they have to get down and dirty in the details."

One wonders whether biotech has more to gain from systems approaches than simply improving its success rate in predicting outcomes in genetic engineering or disease treatment. If it could convince authors like Capra it was embracing modeling strategies, perhaps there would be more commendations, than condemnations of its efforts. That would not be a bad thing for the industry's image.

Laura DeFrancesco, San Francisco