AGRICULTURE

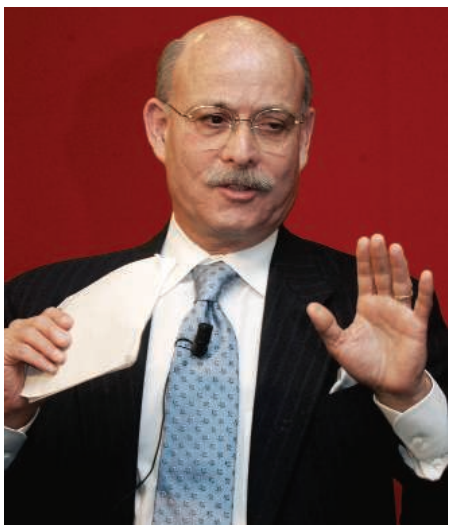
A Kinder, Gentler Jeremy Rifkin Endorses Biotech, or Does He?

For years, activist Jeremy Rifkin was the bête noire of biotechnology. Beginning in 1983, he filed several lawsuits to block field trials of genetically modified (GM) organisms and grabbed headlines around the world. Rifkin, an economist who runs the nonprofit Foundation on Economic Trends in Washington, D.C., said such actions were necessary to force an insulated research world to confront pressing ethical questions. To many in the scientific community, however, Rifkin was simply fanning irrational fears about biotechnology. A headline of a 1989 *Time* magazine profile called him "The Most Hated Man in Science" and captured the prevailing sentiment.

After a decade and a half of protests and campaigns to ban GM crops, Rifkin largely moved on to other topics, such as commerce, European politics, and hydrogen fuel. But now Rifkin, 61, is jumping back into agricultural biotech—this time, as a promoter. "This is an amazing twist for Jeremy Rifkin," says Susan McCouch, a rice geneticist at Cornell University. "I've never seen the man come out in favor of anything." But, like many others, she doubts his support will make much difference, as he is endorsing a biotech approach, known as marker-assisted selection (MAS), that is already well accepted.

In a white paper posted to his organization's Web site* this week, Rifkin says MAS offers all the advantages of new genomic science without what he calls the great risks to human health and the environment posed by GM crops. Instead of transferring genes from one species to another, MAS simply speeds and improves traditional plant breeding. Researchers search through maps of a plant's genome for sequence markers that are consistently associated with desired traits such as improved yield or disease resistance. Those markers can then be used to screen breeding stock and the progeny of traditional crosses even before they are grown or planted in the field.

Rifkin touts MAS as a path toward cheaper organic food and more sustainable agriculture. And to ensure that all reap its benefits, he advocates that MAS be used in a patent-free, or "open source," system in which the genetic information and techniques used to assist breeding are freely exchanged. "It's not enough to know what you're against. … This paper is my effort to try to frame an opportunity to move into a new age for agriculture," says Rifkin, whose immediate goal is to "open a conversation" with scientists, industry, and policymakers about the future of MAS.



Advocate. To some researchers' surprise, a new report by Jeremy Rifkin endorses genomics for crop breeding, as shown here with soybean DNA.

Greenpeace and other advocacy groups, which have already come out in favor of MAS, say they welcome the move. But many scientists suspect that Rifkin's newfound enthusiasm for MAS is just a subterfuge for another attack on transgenic modification of crops. "This tract is typical Rifkin material," says Alan McHughen of the University of California, Riverside. "He still twists information to fit his agenda." Rifkin does indeed argue that GM crops should be phased out. He claims that few crops have been improved by transgenic modification—"it's primitive science" he says—and, to make matters worse, contamination of wild relatives by transgenes may complicate the process of MAS, he warns.

As Rifkin describes it, his conversion was gradual. After following MAS for some time, he says he realized last year that it had eclipsed transgenic technology in its potential. MAS certainly has provided an enormous boost to breeders, and the pace has accelerated as ever more DNA is sequenced and as genetic screens have become cheaper and faster. Although scientists and companies share Rifkin's enthusiasm for MAS and predict it will become even more powerful, they disagree that transgenic technology has failed or that MAS has somehow rendered it obsolete. "To say that marker-assisted breeding will replace biotech is simply wrong," says Roger Beachy, who directs the Donald Danforth Plant Science Center in St. Louis, Missouri. That's because of the enormous task facing plant breeders, says Mike Gale, an emeritus cereal geneticist at the John Innes Centre in Norwich, U.K.: "If we are going to produce enough food to feed the world, we need every tool in the toolbox."

McCouch agrees that gene splicing remains a crude approach—like adjusting an intricate watch with a sledgehammer. Yet, she and others say, it is the only way forward in some cases—for instance, if a gene for a particular trait can't be found in a crop or its wild relatives. The classic example is Bt, a toxin from a soil bacterium that was added to corn to provide broad and powerful protection against lepidopteran insects. Now companies are working to add genes for omega-3 fatty acids into soybean, to make the oil more healthful. "Those genes don't exist in soybeans at all," says David Fischoff, head of technology strategy and development at the Monsanto Co. in St. Louis, Missouri.

Nor is transgenic technology inherently risky, scientists say. "It is the gene and the management of the crop that make the difference and not the technology used to develop them," says Les Firbank of the Centre for Ecology and Hydrology in Lancaster, U.K.

Rifkin's concerns aren't just biological. He couples his endorsement of MAS with a few caveats about policy, as well. He wants to be sure the technology is used in a way that meets his broader goals of sustainable agriculture and open-source technology—in other words, no patents. "We've seen too much how the patent system restricts the ▶

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* www.foet.org

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cooperative nature in science," he says. Charles Benbrook, a scientist with the Organic Center in Enterprise, Oregon, agrees that tight constraints on intellectual property are a concern, as ever more technology and markers are locked up in company labs. "I worry that marker-assisted breeding is not going to be able to deliver on its potential."

Although Rifkin stops short of calling for an overhaul of patent law, he predicts that genetic technology and genomic information will eventually make it so easy and cheap to produce germ plasm that companies will have to make profits by selling agroecological consulting to farmers. Rifkin says he plans to start actively hawking his message on the lecture circuit and in his advice to business leaders and governments. "This is what I'm going to hammer away on: MAS should be phased in on the condition of an agroecological approach and open source."

Rifkin's pleas aside, Monsanto and other agribusiness companies contacted by *Science* don't plan to drop their GM research or stop seeking patents. And several in the scientific community say they don't need Rifkin's help promoting a field that's already flourishing. "Having the endorsement of Jeremy Rifkin means nothing," says Martina Newell-McGloughlin, director of the University of California's Biotechnology Research and Education Program in Davis. She and others doubt that any conversation with Rifkin would be productive. "Let's just ignore the man," says Gale. "Let's get on with the job we have, which is to feed the world." But whether or not Rifkin succeeds in opening the conversation he desires, he no doubt will keep talking.

–ERIK STOKSTAD

PALEONTOLOGY

Fossil Embryos Hint at Early Start for Complex Development

Evidence of the earliest animals on Earth dates back about 700 million years. But the arrival time of more complex animals—those with mirror symmetry and digestive tracts, known as bilaterians—has remained a mystery.

Now, on page 1644, an international team of paleontologists says it has isolated hundreds of fossil embryos that resemble those of modern bilaterians such as annelids and mollusks. If they check out, it could mean that a wide array of complex animals existed tens of millions of years before the "Cambrian explosion"—the time when paleontologists think hard-bodied animals proliferated as their ecosystems took shape. Precambrian animals have been notoriously difficult to find and study because their fragile bodies likely did not fossilize well. "I'm delighted to see a paper like this because it suggests there's more to look for out there," says Rudolf Raff of Indiana University in Bloomington.

Two years ago, Jun-Yuan Chen of Nanjing University in China and colleagues described fossils with bilaterian features in *Science* (9 July 2004, p. 218). The find, uncovered in 580-million- to 600-million-year-old rocks in the Doushantuo deposit in China's Guizhou Province, drew fire from paleontologists who suggested that the small, almost featureless "fossils" were actually layers of minerals. The latest discovery comes from the same rocks, but this time Chen's team has unearthed what appear to be fossil embryos bearing hallmarks of bilaterian embryos. If they are bilaterians, says Jon Mallatt of Washington State University in Pullman, it would mean these complex animals existed 40 million years earlier than current evidence suggests.

Lumps of life. Lobed fossils removed from Precambrian rocks in China suggest that complex life forms evolved earlier than previously thought. (Scale bar: 250 micrometers.)

CREDITS: JUN-YUAN CHEN

The researchers say the fossil embryos sport so-called polar lobes, asymmetrical bulges that allow bilaterian embryos to form different tissues in adults. The fossil embryos appear to be in different stages of development: Some have three lobes and some five; some have lobes of equal shape, and some are more lopsided. Chen and colleagues isolated the fossils by dissolving away surrounding rock with acid, then examined them under a scanning electron microscope. The researchers say the relative volumes of the spherical lobes are too regular for the fossils to be unrelated embryos or inorganic lumps of rock stuck together.

Some scientists are reluctant to give the fossils their unequivocal endorsement. Nicholas Holland, an invertebrate zoologist at the University of California, San Diego, notes that the specimens show a few "slightly bothersome" differences from other bilaterian embryos. "A lot of critters that make polar lobes have reasonably small eggs, around 200 microns," says Holland, whereas many of the Doushantuo embryos are as much as five times bigger.

Douglas Erwin of the National Museum of Natural History in Washington, D.C., cautions that the embryos' small size makes it hard for scientists to tell organic structures from mineral deposits and other preservation-related artifacts. "If you have a dinosaur bone, it's easy to tell what's bone or what's not," he says. "The closer you look, the harder it is to tell what the original bone structure is." The fossils also lack some characteristics of known annelids and mollusks, Erwin says, although the embryos could represent an extinct lineage of bilaterian.

Just knowing that complex animals existed 580 million years ago would help scientists better understand biodiversity before the Cambrian Period, says Ronald Jenner of the University of Bath in the United Kingdom. If the bilaterians were there, then the "basic branches of the animal kingdom [had] already been established at this point," Jenner says, as indirect evidence from modern animals' genes has suggested.

–KATHERINE UNGER

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