Readers express displeasure that nuclear power was not covered in a recent special "Energy" issue. They also comment on the cover image for that issue: "Becalmed windmills are the perfect symbol for our politically correct energy program....[but] Don Quixote should have been shown attacking them." The debate over genetically altered foods continues, and an editorial writer's alleged ties to industry are questioned and disclosed. And academics are warned that private postdoctoral fellowship agencies are sending critiques of applications to applicants.

Energy Options

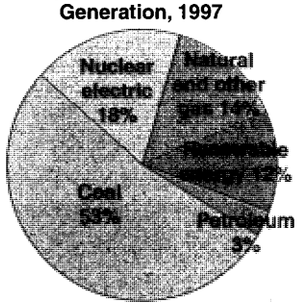
In the 30 July "Energy" issue, Richard Stone and Phil Szuromi ("Powering the next century," p. 677) do not take a global perspective when they write that others have "missed the mark by heralding new eras of nuclear and alternative energy." They do not discuss the fact that the use of nuclear power has enormously increased on an international level.

In the 10 years from 1987 to 1997, nuclear power use grew by 70% in Japan and 50% in France (*1*). Nuclear power plants now generate a majority of France's electrical power. Since 1983, the use of nuclear power in Organization for European Cooperation and Development (OECD) countries has more than doubled. There have also been steady growths of wind and solar power.

Although nuclear power may not be a big political success in the United States, it has and continues to be a major, in some cases the largest, factor in electrical energy production in some other countries. Since nuclear power does not produce carbon dioxide in its primary energy-producing process, it should be part of any reasonable energy policy discussion.

Erik Philipp
1 Shady Lane, Scarsdale, NY 10583, USA. E-mail: philipp@westnet.com

U.S. Electric Power Generation, 1997



SOURCE: U.S. ENERGY INFORMATION ADMINISTRATION

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In the special "Energy" issue, solar energy is strongly supported. In general, however, solar energy analyses do not take into account the full cost of storage backup for a system that substantially depends on solar energy.

Consider the consequences of depending on solar energy after a major volcanic eruption, such as that of Krakatoa. Krakatoa's eruptions began in May 1883 and continued until 27 August 1883, when a cataclysmic explosion blew the island apart with the force of a 100-megaton bomb (the Hiroshima bomb was about 20 kilotons). Ash from the explosion rose 50 miles into the stratosphere, where it affected weather patterns for the next year. In the following "year without a summer," there were extensive crop failures and related deaths and devastation. Since the 1970s, solar energy analysis has consistently not recognized the "potential," much less the actual experience, of such interruptions in solar radiation.

The next Krakatoa, or worse, could occur in your grandchildren's solar energy–dependent world, with a likely population of 10 billion people and a dozen megacities with more than 20 million people. Economies could collapse, and food and water could be lost. This might be "the maximum credible accident" for solar energy.

Those who promulgate reliance on solar energy, beyond an appropriate and potentially significant role with backup capabilities, to displace fossil fuels are putting the world at such a risk.

Jim Muckerheide*
Co-Director, Center for Nuclear Technology and Society, Worcester Polytechnic Institute, Worcester, MA 01609, USA, and Massachusetts Emergency Management Agency. Framingham, MA 01701, USA. E-mail: jmuckerheide@delphi.com

*Chair, Low Level Radiation Health Effects Committee, American Nuclear Society, and President, Radiation, Science, and Health, Inc. Board of Management, Eagle Alliance.

The "Energy" issue cover shows a group of "Blue Max" turbines, probably in about 1986. This is an unfortunate choice, unless it was intended to show how far wind turbine design has advanced in 15 years; if so, it should have said so. These machines had aluminum blades that quickly fatigued, cracked, and broke, and an inadequate braking system that allowed the turbine to "run away" and destroy itself. Fortunately, the fine feature articles in the "Energy" issue exonerate this unfortunate beginning.

William C. Leighty
Alaska Applied Sciences, Inc., Box 20993, Juneau, AK 99802–0993, USA. E-mail: bill@eagle.ptialaska.net

The "Energy" issue cover was almost perfect. Becalmed windmills are the perfect symbol for our politically correct energy program. But for those who might not get the joke, Don Quixote should have been shown attacking them.

Thomas R. Freeman
121 Lame Horse Drive, Columbia, SC 29223, USA. E-mail: bov@mindspring.com

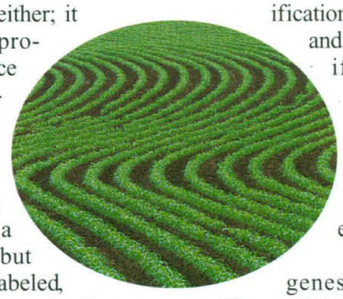
Redesigning Evolution?

Roger N. Beachy (Editorial, 16 July, p. 335) bewails the "hysteria" and "mistrust" that have led many Europeans to disbelieve U.S. official findings that genetically altered foods are safe for both eaters and ecosystems. A simpler explanation would be the widespread and justifiable perception that key committees, agencies, and policy positions have been captured or compromised by commercial interests.

Ex-regulators reviewing their own past decisions, and consultants to or former employees of the industries being scrutinized, do not look independent. Neither do studies performed or sponsored by those industries, especially if unpublished. Old, narrow, superseded science and lack of relevant disciplinary backgrounds may make findings unconvincing. Revolving-door appointments tarnish the appearance of integrity in policy advice. Such conditions, widespread in U.S. and for that matter U.N. food regulation, rationally explain weak public confidence. Beachy regrettably contributes to this problem by failing to note that a leading transgenics company is a cofounder and major funder of his institution, whose genuine independence, despite its university and nonprofit partners, remains to be established.

The "comprehensive scientific reviews" that Beachy says ensure food safety look very different to readers of a recent report (*1*) that the U.S. Department of Agriculture (USDA), the U.S. Environmental Protection Agency (EPA), and the U.S. Food and Drug Administration (FDA) all lack jurisdiction to test and certify the safety of genetically modified foods. The FDA, for example, does not test the safety of genetically altered potatoes because the EPA regulates the *Bacillus thuringiensis* (*Bt*) insecticide they produce. (Companies can opt out of FDA regulation

of other transgenic foods simply by saying they are safe.) The EPA does not follow the FDA's food standard, "reasonable certainty of no harm," but sets human tolerances subject to risk-benefit analyses. But the EPA does not test the potatoes either; it merely feeds separately produced *Bt* insecticide to mice and assumes that the potatoes are otherwise identical [an assumption now coming into question for soybeans (*2*)]. Purchased, the insecticide comes with a long EPA warning label, but eaten in potatoes, it is unlabeled, because the FDA, which controls plant-food labels, is barred by law from including on them any pesticide information. Nonetheless, the potato vendor's spokesman is quoted as saying that his firm "should not have to vouchsafe the safety of biotech food. Our interest is in selling as much of it as possible. Assuring its safety is the F.D.A.'s job." (*1*). Why should this runaround inspire public confidence either? And who, if anyone, ensures ecological safety, which may be an even greater concern (*3*)?



CREDIT: LARRY LEFEVER/ GRANT HEILMAN

Genetically altered crops are being rejected by many leading international buyers and trade at a discount (*4*), doubtless because of fear and risk-aversion. But fear is not always irrational, especially when so many of the surprises have been bad ones. Beachy is right that the basis of concern needs scientific clarification. However, both transgenics and science will lose legitimacy if cheerleading replaces thoughtful and rigorous discussion of food and ecosystem safety, especially from the commonly missing perspectives of ecology and evolutionary biology.

For example, is importing genes from remote taxa really like traditional breeding? Might transgenics let pathogens jump the species barrier? Do transgenes speed horizontal gene flow? Why? How safe are antibiotic-resistance markers and viral carriers? How certain and permanent is "substantial equivalence" of gene-altered foods? Does evolution occur in the genomic "nanoecosystem"? Are so-called "junk genes" its vital biodiversity? What comes of ignoring genomic and environmental contexts that influence expression in the phenotype or of injecting alien genes into random genomic sites?

And now for the tough, fundamental questions: What would be the long-term ecological implications of success in creating the properties being sought? Is redesigning evolution to work not at its biological pace but at that of quarterly earnings reports—and to align not with biological fitness but with economic profitability (survival not of the fittest but of the fattest)—really a good idea? Can it still foresee and forestall? Can novel life forms with unexpected consequences be reliably recalled? Is transgenics, as someone said of nuclear fission, "a fit technology for a wise, farseeing, and incorruptible people"? And is transgenics really essential to avoid starvation—or is it, as nuclear power proved to be, just a distraction from available, superior, but systematically suppressed and overlooked alternatives (*5*)?

Amory B. Lovins
Co-Chief Executive Officer (Research), Rocky Mountain Institute, 1739 Snowmass Creek Road, Snowmass, Colorado 81654–9199, USA

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Editorial writer Beachy is identified as president of the Donald Danforth Plant Science Center in St. Louis, Missouri. But he does not inform us that for many years he has collaborated with, and been financed by, the Monsanto Corporation (*1*), a leader in corporate plant biotechnology and the subject of much criticism in this area (*2*). The Monsanto Corporation is a founding partner of the Donald Danforth Plant Science Center (*3*). In addition, Beachy chairs the Scientific Advisory Board of Xyris, another agricultural biotechnology firm (*4*). These significant corporate involvements and their consequent biases cannot be inferred from his stated affiliation.

As Beachy notes, plantings of genetically modified crops have increased dramatically over the past few years. He asserts that the commercial use of such crops followed "comprehensive scientific reviews." Others refute this statement. Beachy's pro-Monsanto biases are revealed by his not acknowledging the arguments of reputable scientists and biotechnology policy analysts that the "reviews" have in fact been minimal, short-term, and conducted by industry (and largely unpublished, rather than public and peer reviewed) and that they have not addressed the full range of risks posed by these novel organisms (*5*). Differing views about the risks of genetically modified crops are thus matters of scientific debate (*6*). However, by posing the issue in terms of "hysteria" and "fear of biotechnology," Beachy uses his position as editorialist to obstruct essential technical and public discourse.

As a matter of policy, *Science* should follow the practice of other scientific society–sponsored journals (*7*) by requiring that all authors and editorialists fully disclose financial interests in their subject matter. Only then can readers knowledgeably evaluate the writer's statements and potential biases.

Claire Nader Chair, Board of Directors, Council for Responsible Genetics, 5 Upland Road, Cambridge, MA 02140, USA. Email: crg@gene-watch.org; **Martha R. Herbert**, Massachusetts General Hospital, Boston, MA 02129, USA; **Paul R. Billings**, Veterans Health Administration, Grand Prairie, TX 75050, USA; **Philip L. Bereano**, University of Washington, Seattle, WA 98195, USA; **Ruth Hubbard**, Harvard University, Cambridge, MA 02138, USA; **Jonathan King**, Massachusetts Institute of Technology, Cambridge, MA 02139, USA; **Sheldon Krimsky**, Tufts University, Medford, MA 02155, USA; **Stuart A. Newman**, New York Medical College, Valhalla, NY 10595, USA; **Doreen Stabinsky**, Sacramento State University, Sacramento, CA 95819, USA*

*The signers of this letters are all board members of the Council for Responsible Genetics.

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Response

Lovins questions the conclusion that current regulatory mechanisms are sufficient to oversee foods developed through genetic modification. The fact is that the FDA has absolute legal right over the foods developed by any process. New varieties produced by means of biotechnology must be shown to possess chemical equivalence with the parent materials; such proof is provided by the company making application. After review (generally requiring 12 to 18 months), the FDA rules to accept or reject; it also holds the right to remove any food product at a later date. The EPA evaluates the environmental safety of any new pesticidal product (such as the *Bt* protein), and sets daily allowances of residues of the protein and/or its derivatives in the food or in the environment. The USDA determines whether the new variety does or does not have impacts on the ecology of the environment in which it is planted and, accordingly, determines acceptability. These processes together can require up to 6 years to gain approval of a new variety developed by genetic transformation. Such requirements are not required of varieties produced by chemical or radiation mutagenesis, or by other techniques used in plant breeding.

Lovins and board members of the Council for Responsible Genetics question the independence of the Donald Danforth Plant Science Center. Legal documents that establish the Center are open to the public and confirm the independence from Monsanto Company and other companies. I would not have accepted the position as president and director of the center under other conditions. Like the authors of the letters, I, too, believe in full disclosure. I am currently a member of the Science Advisory Board of Akkadix, in San Diego, a newly established corporation, and Advisor for Biotechnology for the Rohm and Haas Corporation, in Philadelphia. I have not received support for sponsored research from the Monsanto Company since 1991 and have served only as an ad hoc consultant. I have served as an ad hoc consultant and advisor for a variety of other biotechnology companies since 1982.

I respect the right of others to disagree and expect all reputable scientists to present accurate information and honest conclusions. Regardless of the differences of opinions expressed in these letters, I believe that all can agree that the more scientists learn about plants, both within or outside of agriculture, the greater the likelihood that we will develop sustainable methods to meet the challenges of a growing population.

Roger N. Beachy

Donald Danforth Plant Science Center, St. Louis, MO 63105, USA

Common Courtesy

My colleagues should know that some private postdoctoral fellowship agencies now send critiques of applications to applicants. Persons who write letters of reference for applicants are not notified in advance that these letters may be quoted explicitly in the critiques. It is not difficult to match explicit quotations with specific individuals who have been asked to write letters of reference. Such a practice on behalf of the agencies destroys confidentiality and, at the very least, if it is not illegal, it lacks common courtesy.

Sidney Altman

Department of Molecular, Cellular and Developmental Biology, Yale University, New Haven, CT 06520–8103, USA

Credit Due

In the News of the Week article "Keeping bone marrow grafts in check" by Michael Hagmann (16 July, p. 310), which accompanied the report by W. D. Shlomchik *et al.* in the same issue (p. 412), the first au-