

Making Threats

Biofears and Environmental Anxieties

Edited by
Betsy Hartmann,
Banu Subramaniam, and Charles Zerner

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Decoding the Debate on “Frankenfood”

Hugh Gusterson

Since the development in the early 1990s of the world's first genetically modified (GM) crop (a pest-resistant tobacco plant in China), the industry for bio-engineered food has become big business. At the start of the new millennium 72 percent of the world's GM crops were grown in the United States, where sixty million acres—25 percent of all U.S. cropland—were planted with GM seeds. One-half of all the soy and one-third of all the corn and cotton grown in the United States are GM, and it is estimated that thirty thousand products, or about two-thirds of all processed foods in the United States, are GM. Since it costs between \$30 million and \$50 million to bring a GM crop to market, most GM crops have been developed primarily with Western markets in mind, rather than those of the less-lucrative Third World.¹ This has led Luiz Antonio Barreto de Castro, the head of Brazil's National Technical Committee on Biosafety, to remark ironically that “for the first time, populations of the First World will serve as the guinea pigs for the countries of the Third World.”²

First-generation GM crops have been bioengineered to produce their own pesticides, to have immunity from selected pesticides, to resist selected pests, to resist frost, to stay fresh longer, or to be sterile. These include strains of corn that produce within their own cells *Bacillus thuringiensis* (Bt), a “natural” pesticide sometimes used by organic gardeners to repel bollworms; strains of soy bean that are immune to particular pesticides (such as Monsanto's Roundup Ready soy bean, which is resistant to Monsanto's own Roundup pesticide); squashes designed to resist particular viruses; tomatoes and strawberries implanted with a cold-resistant gene from Arctic flounder so that they can be grown in colder climates than usual; Calgene's Flavr Savr tomato, in which the gene that activates rotting has been reversed; and Monsanto seeds equipped with a “terminator” gene to render them infertile.³

Second-generation GM crops may focus more on "value enhancement" of crops.⁴ There is already a strain of "golden rice" designed to boost metabolism of vitamin A, as well as "super" catfish and salmon that grow to maturity unusually quickly. Also in development are better-tasting, more-digestible soybeans and higher-oil strains of corn. And there are attempts underway to develop fruits and vegetables that would vaccinate those who eat them against particular viruses, thus obviating the need for cumbersome vaccination programs, which, in the Third World particularly, have proved difficult to mount. There is even a project to engineer a nonallergenic cat.⁵ The agricultural biotechnology industry and its allies claim that such developments constitute a new "Green Revolution" in the making that will improve the practice of agriculture and enable us to feed more people with less land. Saying that GM technology will be essential in the fight against global hunger, they argue that GM crops will enable us to achieve higher yields with less pesticide and less artificial fertilizer, to grow crops at times of year and in places where they would have failed before; to bring crops to maturity more quickly; and to amplify the nutritional and medicinal value of selected crops. With regard to vitamin A-enriched "golden rice," for example, they point out that one hundred million children under the age of five currently suffer from vitamin A deficiency, which is implicated in blindness, chronic diarrhea, and measles. Over three million children die of measles and diarrhea in the Third World each year.⁶

Such optimism notwithstanding, recent years have seen the emergence of a burgeoning social movement, first in Europe and more recently in the United States, of protest against GM foods.⁷ This movement includes major name-brand environmental organizations (Greenpeace, Friends of the Earth, and the Earth Island Institute); scientists' groups (the Union of Concerned Scientists and the Council for Responsible Genetics); and less-well-known organizations, such as the Native Forest Network, the Indigenous Peoples Council on Biocolonialism, the Organic Farmers Association, Genetix Snowball, Genetix Food Alert, the Rural Advancement Foundation, Food First, and the Foundation on Economic Trends. The Genetic Engineering Action Network has emerged as an umbrella group to coordinate the efforts of many of these groups. While activists in Britain and France have been conspicuously (often theatrically) militant, invading farmers' fields in white decontamination suits to rip up their GM crops and vandalizing McDonald's franchises, their American counterparts have tended to eschew such tactics in favor of street protests, conferences, and letter-writing campaigns.

Those opposed to GM crops make a number of arguments. They say that genetic engineering can introduce allergens into food that will be eaten by unsuspecting consumers.⁸ Citing the controversial research of the English scientist Arpad Pusztai, who was fired after going to the media with his claim that rats' digestive and immune systems were harmed by GM potatoes in his

experiments, they argue that GM foods may have harmful effects on human health.⁹ They maintain that the antibiotic-resistant "marker genes" used to determine whether gene transfers have been successful could hasten the development of antibiotic-resistant bacteria. They point out that Bt crops (crops that produce their own Bt) will accelerate the development of pest resistance to the organic Bt pesticide, while herbicide-tolerant crops will cross-pollinate with weeds, producing "superweeds" that cannot easily be destroyed by common pesticides. And they cite another controversial study, this one at Cornell, which found that feeding on pollen from Bt corn killed larvae of the monarch butterfly.¹⁰ Finally, pointing out that we already produce enough food for everyone on the planet, they argue that hunger is caused not by agricultural underproduction but by political and economic systems that deprive the hungry of access to food. The promise of an end to hunger, these critics say, is a rhetorical smokescreen that conceals the agrobiotech industry's real agenda: increased profits and control over farmers.¹¹

Such arguments against GM foods have made more headway in Europe than in the United States. (Indeed, studies show that most Americans are surprised to learn that they are already eating GM foods, and many believe that tomatoes do not contain genes at all until they have been genetically modified.)¹² In Europe, although GM crop trials continue, under pressure from the European public, the European Union instituted a moratorium on GM food imports from 1999 to 2004. At the time of writing, the European Union has only licensed one GM food for import (a pest-resistant corn developed by Syngenta) since the termination of the moratorium and, unlike the United States, it mandates strict labeling of all GM foods.¹³ Many mainstream European supermarkets now refuse to stock any GM food. In the United Kingdom, for example, Sainsbury's, Tesco's, Safeway, the Co-op, and Marks and Spencer's are all GM-free. This European resistance to GM crops has in turn hurt the U.S. GM crop industry, since American farmers cannot sell GM food to the European market and must incur the additional expense of separating GM from non-GM food when exporting to Europe. This has led the United States to file a World Trade Organization complaint against the European Union for illegal restraint of trade.

While the debate about GM food has received extensive media coverage, relatively little has been written about it by sociologists, anthropologists, or practitioners of science studies.¹⁴ In thinking how to analyze this debate as an anthropologist of science, I have taken as my starting point Ann Murcott's plea for a "considered sociology" of the GM food debate that, "rather than taking sides . . . requires concentrating on how the sides came to be the way they are."¹⁵ Such an analysis asks, "What are the knowledges of GM food? How is knowledge of GM food declared? On what claims is knowing based?"

In this chapter, I map and analyze the discursive formations that have grown up around the GM food debate. In the next section, I map the

discourse of anti-GM activists, using material culled from anti-GM flyers, talks, and articles in the media. Next, I sketch the contours of pro-GM discourse, drawing on pro-GM commentary in the media and on material provided to me by Monsanto. Then, in the more detailed analysis that follows this exercise in discursive mapping, I select two themes from this field of discourse for more detailed discussion: I ask how we are to understand the fact that critics of GM foods are so concerned about the pollution of something they call "nature," and I ask what it means that those who defend GM crops are so concerned about the authority of something they call "science." Finally, by way of conclusion, I assess the benefits and limitations of discourses that rely so heavily on, respectively, an idealized view of nature and an idealized view of science, and ask whether it would be possible to discuss risk in a different way.

In mapping the discourses that have arisen to contest and defend GM foods, I am interested in the way claimed facts and arguments are made meaningful by recurrent metaphors, symbols, and narrative themes. In his work on narratological tropes in policy analysis, Emory Roe has argued that "stories commonly used in describing and analyzing policy issues are a force in themselves, and must be considered explicitly in assessing policy options."¹⁶ What makes factual claims about, for example, global warming plausible, Roe argues, is the broader narrative about the world within which they are embedded. As Carol Cohn and Emily Martin have shown in their work on the discourse of defense intellectuals and biologists, respectively,¹⁷ it is particularly important in undertaking this kind of discourse analysis to pay attention to metaphors, to the subject position from which a story is told, and to strategies for presenting a contested position as obvious or natural.¹⁸ Finally, I assume here that a field of discourse must be seen as a whole and that the discourses of those for and against a particular technology cannot properly be understood in isolation from the other. Anthropologists have traditionally sought, when doing fieldwork abroad, to make the strange familiar and, when doing fieldwork at home, to make the familiar strange. For the anthropologist seeking to make the familiar strange in domestic debates about science, the juxtaposition of opposed discourses in policy debates offers a particularly effective strategy for relativizing and dramatizing the cultural construction of policy positions that claim simply to represent the world as it is. Of course, the price that must be paid here is that the relativizing effect of this strategy makes itself felt as much upon political positions with which one is inclined to sympathize as upon those one may dislike.

Discourse analysis does have its limits as an analytical tool. It tends to abstract speech from other kinds of practices and to reframe power struggles as debating contests. As Martin Teitel writes in his own commentary on GM food, "we are not faced with 'two sides' of an issue who are having a debate but, rather, an industry with a product to sell and huge sums of money at

stake seeking to impose its views on the public."¹⁹ Nevertheless, discourse analysis is a powerful tool for revealing the overarching structure and foundational assumptions of a political controversy and, in making assumptions visible, it may make it easier to transcend them and move debate forward.

THE DISCOURSE AGAINST GM CROPS

The discourse that is crystallizing in opposition to GM foods on both sides of the Atlantic emphasizes the undemocratic way in which GM products have been introduced into our food supply, the greed and unaccountability of agricultural biotechnology companies, images of irreversible contamination, and the destruction of "nature." Although it is often portrayed by its opponents as an "antiscience" movement, the movement against GM foods does draw for its authority on the pronouncements of scientific experts.

Democracy and Corporate Greed

Jose Bove, the charismatic leader of the "Confederation Paysanne" in France, on trial for destroying a shipment of Bt corn, turned the tables on the court, saying, "When were farmers and consumers asked what they think about this? Never. The decisions have been taken at the level of the [World Trade Organization]... GM maize is... the symbol of a system of agriculture and a type of society that I refuse to accept.... Political choices are swept aside by the power of money."²⁰

It is a recurrent theme in the anti-GM literature that citizens in a democracy, and consumers in a capitalist economy, should have a "right to choose" that has been taken away from them because "quietly and with very little media attention, giant 'biotechnology' corporations have rapidly introduced genetically engineered foods into our food supply."²¹ The invisibility of modified genes in foodstuffs on the shelves of supermarkets compounds the problem: "By looking at these tomatoes you have no way of knowing that they may include the DNA of flounder or North Atlantic shellfish," says one flyer.²² In the United States, this sense of injury is magnified by the government's refusal to mandate the labeling of GM foods.

Anti-GM activists have called for citizens to organize and demand the labeling of GM foods and for consumers to stage boycotts of stores that refuse to disclose whether or not they stock GM foods.²³ Their target is what one publication refers to as "a powerful, profit-driven industry, comprised largely of the same companies that have made their fortunes in chemical pesticides," and is now effecting "corporate capture of the food chain."²⁴ One flyer states that "biotechnology promotes a view of living beings with no greater value than as industrial product."²⁵ "If the trend is not stopped," says another

broadsheet, "the patenting of transgenic plants and food-producing animals will soon lead to universal 'biosefdom' in which farmers will lease their plants and animals from biotech conglomerates such as Monsanto and pay royalties on seeds and offspring."²⁶

Pollution

The companies that seek to commodify nature in this way are frequently identified in this literature with pollution. The fact that they also manufacture pesticides is emphasized repeatedly. One flyer, for example, describes Monsanto as "the company that brought us Agent Orange and PCBs."²⁷

The anti-GM discourse is full of metaphors and images of mutation and contamination. Anti-GM flyers are often decorated with pictures of corn stuck with syringes or potatoes and tomatoes that look mutant and abused, some sporting stitched Frankenstein-like scars on what have been turned into faces in the images. At street protests, some demonstrators even dress up as mutant vegetables. Meanwhile the discourse is full of references to "frankenfood," "frankenfish," and "frankencorn" and to the mutant "superbugs" and "superweeds" that these products are expected to produce in time. In keeping with the Frankenstein theme, when British prime minister Tony Blair boasted that he eats GM foods, he was promptly rechristened the "Prime Monster."²⁸

Anti-GM literature also talks about "contaminated DNA," "genetic pollution," the intrusion into our food of "alien genes" and "foreign genes," and the need for farmers to segregate GM from non-GM corn. Greenpeace has described raids on GM crops in British farmers' fields as "decontamination" exercises, and those participating often dramatize the point by wearing white decontamination suits of the kind worn by those responding to toxic spills of chemicals.²⁹

The comparison with more familiar kinds of pollution is recurrent. A full-page advertisement in the *New York Times* speaks of the biotechnology industry's plans to "dump" plants and animals into the environment—"dump" being a word more commonly associated with toxic waste than living organisms.³⁰ A newsletter quotes Jeremy Rifkin, a prominent critic of the biotechnology industry, as saying that "genetic pollution will loom as significantly on the political agenda of the twenty-first century as chemical and nuclear pollution have in the twentieth."³¹ Another flyer says that, in the hands of the biotechnology industry, food becomes a form of toxic waste, and it points out that, in the case of Bt corn, consumers are confronted with a "food that is itself a pesticide registered with the EPA."³² The association of transgenic food with allergies in anti-GM discourse only compounds this sense that there is something inherently toxic about the food.

Finally, the pollution inherent in GM foods is presented in terms of a transgressive confusion of categories that may arouse disgust. The following quo-

tion even goes so far as to identify the practice of eating GM foods with the most disgusting practice of all—cannibalism:

Vegetarians may not wish to eat vegetables that have been engineered to contain animal genes. Jewish people who keep kosher may not wish to eat products that have been engineered with pig genes. Many consumers may not wish to consume foods containing human genes.³³

The Assault on "Nature"

The confusion of categories that genetic engineering involves is, above all, presented as "unnatural." Calling genetic engineering a "highly unnatural technology," one flyer says, "For the first time, humans are able to manipulate the very fabric of life, shuffling the genetic deck that controls every aspect of every living organism in ways that nature never intended."³⁴ Another flyer says that "genetic engineering is a radical departure from traditional plant and animal breeding. . . . Genetic engineering breaks down natural barriers between humans, animals, and plants."³⁵

But nothing in anti-GM discourse quite symbolizes the propensity of GM technology to violate the integrity of nature as powerfully as Monsanto's "terminator" gene: "The terminator gene, which renders corporate seeds sterile . . . is an unconscionable technology because it destroys life."³⁶ Here transgenic biotechnology is presented not as a way to reshape life but as the means toward a sacrilegious assault on the fertility of the natural world and on the essence of life itself: the will to reproduce. Where pro-GM discourse valorizes genetic engineering as the means to creating unprecedented abundance, a superfertile natural world, anti-GM discourse associates transgenic technology with death and sterility—stressing the prospect of species extinctions, plagues of superpests, and plants programmed like the androids of *Blade Runner* to die at their appointed hour without reproducing.

The Appeal to Science

The sociologist Phil Sutton observes that "established environmental organizations such as Greenpeace and Friends of the Earth have over time become increasingly professionalized and dependent on rational modes of argumentation which rely heavily on scientific knowledge as a way of gaining credibility and respectability."³⁷ One might add that, in the debate about genetically modified organisms (GMOs), even the less-mainstream environmental organizations lean heavily on the authority of science, at least when it suits them. Thus, in anti-GM discourse, although it is science that is said to be destroying the natural world through GM technology, it is also scientists who speak for nature about the dangers of what is being done: "Mounting

scientific evidence suggests that genetically engineered foods may present serious hazards for human health and the environment. The British Medical Association has called for a ban on genetically engineered foods."³⁸ "In one survey 100 environmental scientists in the United States warned that genetic engineering's 'imprudent or careless use . . . could lead to irreversible, devastating damage to the ecology of the planet.'"³⁹

THE DISCOURSE IN DEFENSE OF GM CROPS

Those who support GM crops argue that the technology of genetic modification merely renders more targeted and deliberate a practice that humans have practiced for generations—the improvement of crops. They argue that GM technology promises to save the lives and improve the diets of the poor in the Third World and that we therefore have a moral responsibility to move forward with it. They also accuse those who oppose GM crops of being impervious to scientific evidence, maybe even opposed to science itself or, if they are scientists, of practicing "junk science."

Genetic Technology as the Embellishment of Tradition

One of the principal arguments used by those defending the genetic engineering of crops is that, while the precise technique used in the laboratories of agribusiness might be novel, the enterprise of experimentation to improve plant genetics is as old as farming itself, giving us crops today that never existed in "nature." For example, Prince Philip of England told a reporter, "Do not let us forget that we have had genetically modified animals and plants ever since people started selective breeding. People are worried about genetically modified organisms getting into the environment. What people forget is that the introduction of exotic species—like for example the introduction of the grey squirrel into this country—is going to, or has done, far more damage than a genetically modified piece of potato."⁴⁰ Writing in the *London Times*, another commentator said, "The only time and place where there were no GM plants was in the Garden of Eden. . . . Ever since then nature and husbandry have been creating hybrids by genetic engineering. . . . These single-issue Green zealots cause as much harm as the Luddites of the Cap-tain Swing riots 170 years ago."⁴¹

James Watson, one of the discoverers of DNA and a fierce defender of GM food technology, points out that it is not new for plants to contain insecticides either. Arguing that biotechnologists are simply taking over where the invisible hand of evolution left off, he says, "Seeds have always been bred to be bug-resistant by natural selection. Plants that didn't have these compounds died out. Plants are naturally full of a variety of components which kill insects, that's their protection against being eaten."⁴²

Hunger

Florence Wambugu is director of the International Service for the acquisition of Agri-Biotech Applications in Nairobi. The journalist Madeline Nash, writing in *Time* magazine, says,

For Wambugu, the flap in the U.S. and Europe over genetically modified crops seems almost ludicrous. In Africa, she notes, nearly half the fruit and vegetable harvest is lost because it rots on the way to market. "If we had a transgenic banana that ripened more slowly," she says, "we could have 40% more bananas than now." Wambugu also dreams of getting access to herbicide-resistant crops. Says she: "we could liberate so many of our people if our crops were resistant to herbicides that we could spray on the surrounding weeds. Weeding enslaves Africans; it keeps children from school."⁴³

Some commentators point to crops such as the new vitamin A-enriched "golden rice" and argue that anti-GM activists' espousal of the "precautionary principle" is irresponsible, even immoral. (According to the precautionary principle, new plants should not be introduced until the consequences of their introduction are fully understood, in order to ensure that ecological systems do not sustain irreversible damage). "Turning our back on life-saving bioengineered products would irresponsibly condemn millions of people to unnecessary suffering and early deaths," said one commentator, arguing that it is more appropriate to evaluate the balance of probabilities in a GM and a non-GM world than to demand impossible guarantees of perfect safety as the precautionary principle does.⁴⁴

Pro-GM commentators also often accuse their opponents of a hypocritical elitism that condemns the poor to suffer and starve in the service of First World environmental correctness. "I shuddered recently," says former Senator George McGovern, "when I read that a prosperous chef of a chic Manhattan restaurant denounced this lifesaving technology."⁴⁵ Hassan Adamu, saying that "starving people . . . want food and nourishment, not lectures" and that "it is wrong and dangerous for a privileged people to presume they know what is best for everyone," calls this willingness to deny biotechnology to the poor "colonialist."⁴⁶ This is an interesting inversion of anti-GM activists' repeated claim that companies such as Monsanto are engaged in economic neocolonialism by turning Third World farmers into "bioserfs" dependent on such companies for expensive seeds.

Science

Above all, pro-GM discourse presents the safety of GM crops as scientifically validated and represents its critics as irrational and even hostile to the entire enterprise of science.

While anti-GM discourse often presents humans as "guinea pigs" being forced to eat GM foods in a massive uncontrolled global experiment, it tends

to be taken for granted in pro-GM discourse that the safety of GM foods has already been scientifically established.⁴⁷ Thus, pro-GM commentators often say, in passing usually, that GM foods have been tested and their safety scientifically validated—"as safe as every test by the FDA, the Agriculture Department and the EPA has shown these foods to be," begins one sentence in a *Boston Globe* editorial.⁴⁸ Similarly, Paul Krugman, in one of his regular opinion columns in the *New York Times*, refers to the safety of GM crops as "extensively tested."⁴⁹ These matter-of-fact presumptions in the opinion pages of two of the most prestigious newspapers in the United States that GM foods have been tested and found safe are interesting not least because they are quite untrue. U.S. regulatory agencies decided in the early 1990s to exempt GM foods from mandatory safety testing, and "food companies are on their own to test and verify the safety of their own products."⁵⁰

Those who oppose GM crops are often presented as ignorant, superstitious, and unscientific. The same editorial in the *Boston Globe*, for example, says, "This page supports the genetic modification of crops as a service to mankind and believes that most of the protest against it is unscientific and wrong."⁵¹ On the other side of the Atlantic, writing in the *London Times*, Mick Hume avers,

In scientific terms, the anti-GM panic remains, literally, a lot of fuss about nothing. Nobody is known to have suffered so much as an upset stomach as a result of eating GM foods, and there is still no hard evidence of any environmental damage caused by growing GM crops. . . . Unaccountable little influence groups lare[ly] puffing their influence by reinforcing a climate of irrational fear. In private, many politicians will admit that they are appalled by the growth of superstition and anti-experimental prejudices, so evident over the GM food issue. Yet none of them seems prepared to stand up to the new forces of darkness.⁵²

An editorial in the *Minneapolis Star Tribune* characterizes a local protest against GM food as "a muddled Luddite yawp."⁵³

Where those arguing that GM crops are unsafe are themselves scientists, they are often accused of practicing "junk science" or politicized science. Paul Krugman, writing in the *New York Times*, dismisses the Pusztai study, suggesting that GM potatoes harmed rats, with a reference to "supposed independent scientists who were actually political activists."⁵⁴ James Watson dismissed the same study by saying simply, without elaboration, "These were bad experiments."⁵⁵ The Nobel Prize-winning biologist and "father of the Green Revolution," Norman Borlaug, compared anti-GM scientists to the infamous Soviet biologist Trofim Lysenko, who insisted in the face of contradicting empirical evidence that plant biology conformed to the principles of Marxist dogma. The consequences were disastrous for Soviet biology and agriculture.⁵⁶

Elsewhere Borlaug has accused the opponents of GM crops of being opposed to science itself, referring to "small, well-financed, vociferous, anti-

science groups."⁵⁷ Despite the fact that anti-GM groups often cite scientists in their literature, this characterization of the movement against transgenic crops as "anti-science" is quite common. The columnist Debra Saunders refers to them as "anti-technology groups."⁵⁸ Another commentator, a professor of agriculture, responds to Prince Charles's observation that use of antibiotics and pesticides creates problems of pest and bacterial resistance by saying, "Yes, they do lead to problems of resistance. But would the Prince abandon antibiotics and return to bloodletting? Nature did not provide smallpox vaccinations, electricity, flight or contraception. However, all of these aids to living required expanding our knowledge of nature."⁵⁹ This broad claim, that the critics of GM food are opposed not just to transgenic crops but to science itself, has a special resonance at a moment when the mainstream press has presented science as an institution under attack by an unholy alliance of postmodernists and New Agers in the context of the so-called science wars of the 1990s. By framing the debate as one between "science" and its opponents, commentators also efface the fact that a number of the critics of transgenic crops are themselves scientists who have published in peer-reviewed scientific journals.⁶⁰

A European Disease

Finally, a number of American commentators identify hostility to GM crops as a form of superstition that is particularly likely to afflict Europeans. Speaking in a congressional debate, U.S. Representative Kenny Hulshof (R-MO) said, "I find it ironic that today as world scientists are heralding the breakthroughs and mapping human genetics that the EU remains in the dark ages regarding advancements in plant science."⁶¹ Describing what it is like to be on the receiving end of such judgments, the technical manager of a British frozen-food chain, Iceland, recalled what an American biotechnology company executive said upon hearing that the manager planned to buy GM-free foods for his customers: "You are a backward European who doesn't like change. You should accept that this is good for your customers."⁶²

American commentators have found various reasons for this European backwardness. Warren Hoge, writing for the *New York Times*, attributes it to a failure in European government institutions, saying, "There is no government agency in Europe of the regulatory rigor of the United States Food and Drug Administration to build consumer confidence."⁶³ (There is a certain pathos to this judgment in view of recent revelations that the FDA endangered public health by ignoring evidence that the drugs Vioxx and Celebrex increase the risk of heart attack.) U.S. Representative Roy Blunt (R-MO) sees more sinister reasons: saying that "the Europeans are clearly trying to protect their farmers from superior products that we can send into that market," he calls for the WTO to take action against European protectionism

masquerading as environmental concern.⁶⁴ Many other commentators see in European unease with GM crops an irrational displacement onto GM foods of anxieties produced by the eruption of "mad cow disease" in Britain in the mid-1990s—a calamity that has made the British in particular paranoid about the safety of the foods they eat.

CONSTRUCTING "NATURE"

Although the discourses for and against GM foods evince a number of themes, there are two that I want to highlight in the remainder of this chapter. At the center of gravity of anti-GM discourse lie claims about contamination, confusions of categories, and disruptions of the balance of "nature." At the heart of pro-GM discourse is the claim that critics of transgenic crops are unscientific, if not hostile to science itself. Let's begin by looking at anti-GM claims that GM crops pollute "nature."

The environmental movement against GM foods is vitally concerned with purity.⁶⁵ While defenders of genetic engineering argue that scientists in their laboratories are only doing more efficiently what farmers have been doing for centuries—cross-breeding to produce improved crop strains—those who oppose transgenic crops point out that farmers and plant breeders never did, indeed could not, mate a tomato with a flounder or a soy bean with a Brazil nut. Their language of "foreign" and "alien" genes and "genetic contamination" highlights the "unnaturalness" of such couplings.⁶⁶ The hybrid entities created by genetic engineering are what anthropologists have called "liminal objects."⁶⁷ They are, to use Victor Turner's famous phrase, "betwixt and between," or, more colloquially and more to the point perhaps, "neither fish nor fowl." In her now classic analysis of liminal objects—objects such as the fish without scales prohibited for eating in Leviticus—Mary Douglas argues that notions of pollution and taboo are our responses to liminal or hybrid objects whose ambiguity disrupts our categorical systems. She says, "Ideas about separating, purifying, demarcating and punishing transgressions have as their main function to impose system on an inherently untidy experience. It is only by exaggerating the difference between within and without, above and below, male and female, with and against, that a semblance of order is created."⁶⁸ Calling dirt "matter out of place," she argues, "Where there is dirt there is system. Dirt is the by-product of a systematic ordering and classification of matter."⁶⁹

Stephen Crook, noting the obvious relevance of Douglas's work for the debate on GM foods, argues that the liminal qualities of transgenic foods makes them "culturally risky."

Pollution threats arise when boundaries that define a sociocultural order are breached: when non-food species are eaten, when the milk is mixed with the

meat. This conception of pollution connects with the principle that sociocultural order is built from basic binary oppositions: nature-culture, male-female, raw-cooked. Biotechnology is a culturally risky threat to order because it breaches boundaries between "natural" and "cultural/artificial" that have served as ordering principles in Western cultures.⁷⁰

From this perspective, the technology of genetic modification is "culturally risky" because it breaks down the very distinction between animal and vegetable or between formerly distinct plant species. Thus the anti-GM impulse to taboo transgenic foods represents an attempt to reaffirm the categorical system threatened by hybrid objects. Seen in this light, anti-GM activists are not so much progressive defenders of the environment against the depredations of greedy corporations (though they may still be that) as they are reactionary defenders of an established order that is threatened by the uncensored border crossings of migrant genes.

No one has seen this irony more clearly than the poststructuralist social theorist Donna Haraway, whose writing establishes numerous cross-cutting, often elusive, connections between discourses on biotechnology and discourses on race, class, and gender in Western society.⁷¹ Although politically predisposed to sympathize with the environmental movement, she also finds herself "especially drawn by such engaging beings as the tomato with a gene from a cold-sea-bottom-living flounder" and "the potato with a gene from a giant silk-moth."⁷² As George Myerson puts it, "She is intuitively sympathetic to all campaigns against the global powers. Yet her work also suggests a reservation about any demand for a return to lost purity."⁷³ Haraway's thought is built around the central figure of the cyborg, which she deploys as an ambiguously utopian figure that dramatizes the dangers and possibilities of life in a globalizing technoscientific age. Espousing a deconstructive feminism that challenges established categories in the name of liberation, Haraway embraces the hybrid figure of the cyborg as her icon and, to use her own word, as her "kin." For her, a cyborg is not just a combination of human and machine but, more elusively, any hybrid entity that rewrites our sense of the possible, by reworking relationships between any combination of animal, human, vegetable, microbe, and machine. For Haraway, "cyborgs are beings in whose presence the categories themselves break down."⁷⁴

It is in the context of this postmodern political vision celebrating miscegenation, hybridity, and border-crossing that Haraway has expressed reservations about the rhetoric of anti-GMO activists—a rhetoric of endangered purity and genetic contamination that is haunted by histories of eugenics, segregation, and genocide in the West. "It is a mistake," she says, "to forget that anxiety over the pollution of lineages is at the origin of racist discourse in European cultures." She adds, "I cannot help but hear in the biotechnology debates the unintended tones of fear of the alien and suspicion of the

mixed."⁷⁵ Perhaps this explains why the anti-GM movement in Britain has found support not only on the left but also from the right-wing, anti-European tabloids the *Daily Mail* and the *Daily Express* and from such prominent members of the inbred classes as Prince Charles.

Haraway's work reminds us that animals, humans, and plants have for centuries constituted a complex web whose components and relationships have constantly shifted and evolved, partly through chance, partly through conscious experimentation and design. Indeed, as Richard Lewontin points out, activists' evidence of the dangers of invasive species and pest-resistant hybrids all comes from the pre-GM past they figure as "natural" in their discourse.⁷⁶

It is in this context that we should be suspicious of noisy calls to defend "the natural." For, as Henry Miller asks, "what does 'natural' mean? The mutant peach we call a nectarine? The tangerine-grapefruit hybrid we call a tangelo?"⁷⁷ Humans are constantly modifying the natural world and forgetting that they have done so, making national parks and looking there for pristine nature, breeding wolves into dozens of species of dog and treating the pooodle as if it came from the Garden of Eden. The "natural," then, is a fiction, a word that freezes the world around us, unnaturally, at a moment in time, after—or maybe before—the last set of changes we made, a way of erasing the traces of our own agency in our environment. If we are to use the term *nature*, it can only be to denote something that is constantly shifting rather than an idealized reification of a set of relations presumed to embody an immutable teleological wisdom.⁷⁸

DEFENDING THE AUTHORITY OF "SCIENCE"

Scientists tend to construe public discussions of technological risks in terms of a "deficit model" of understanding: lay people lack the rigorous and objective understanding that scientists themselves have of the risks associated with, for example, nuclear reactor technology, and the role of scientists is therefore to educate the public. Stephen Crook has observed that "irritation at the ignorance and irrationality of those who cannot grasp the logic of risk assessment is widespread among risk specialists and promoters of new technologies."⁷⁹ The promoters of GM crops are no exception here. However, we might ask whether their rhetorical insistence that the opponents of GM crops are superstitiously opposed to science itself does not suggest, by implication, that at stake in their own stance is an anxious, quasi-religious faith in the authority of science and the project of technological progress at a moment when these are, to some degree, in crisis—a crisis manifested in such heterogeneous symptoms as the "science wars," the rise of alternative medicine in the West, the appearance of social movements opposed to nuclear energy and

genetic engineering, the eruption of "mad cow disease" in the United Kingdom, the loss of two space shuttles in the United States, and the cancellation of such big-ticket science projects as the Superconducting Supercollider.

Behind the statements of those who deride GM technology's critics as "irrational," "unscientific," and "Luddite" is an assumption, which is part of the common sense of contemporary Western society, that "science" is a reliable means for producing objective, consensual facts about the world. However, this assumption is particularly problematic in the context of the debate over GM food. While the proponents of GM food like to speak as if all of science is ranged on one side of the scales against the irrational forces of darkness on the other, the truth is that there are scientists on both sides of the debate—an arrangement of forces that is, of course, profoundly at odds with science's idealized presentation of self as an efficient machinery for the production of consensus through the application of reason to empirical facts. This puts scientists in the awkward position of speaking in the name of a consensus that does not, in fact, exist.

In one of the foundational texts in science studies, Bruno Latour suggests that, rather than take a science-textbook view of scientific knowledge as the unproblematic accumulation of proven facts, those seeking to understand science as a social practice should focus more closely on the conduct of scientific disputes and on the process by which these disputes are brought to a close, when they are, and facts established.⁸⁰ Latour describes these disputes as "trials of strength" between contending scientists attempting to turn their own facts and theories into black boxes whose contents, everyone agrees, can be accepted without further debate. The double helix structure of DNA is an example of something that has been black boxed; the safety of cultivating GM crops is not.

According to the popular view of science, disputes are often clearly resolved by experiments or by measurements that clearly validate one theory over its rival. The problem with this view is that, in reality, the reliability and meaning of experiments and measurements can themselves be open to dispute—sometimes protracted dispute, which Collins and Pinch refer to as "the experimenter's regress."⁸¹ Collins and Pinch give the almost comical example of two scientists, James McConnell and Georges Ungar, who spent the best part of their professional lives defending claims that worms and rats that ate the brains of other worms and rats that were trained in a skill showed greater mastery of the skill than did those of a control group. They believed that knowledge stored biochemically in the brain could be transmitted through ingestion. The two scientists spent years debating critics who failed to replicate their experiments over whether their theories were disproved (as the critics claimed) or whether the critics were not handling the animal subjects and administering tests properly. Numerous rounds of experimentation failed to bring about surrender by either party.

In the case of the debate over GM crops, one clearly sees the "experimenter's regress" in operation. For example, some scientists claim that, in his study of rats that were fed GM potatoes, Arpad Pusztai was rigorous neither in his design of the experiment nor in his analysis of the data. Although the *Lancet*, Britain's most prestigious medical journal, did publish the study, its peer reviewers were divided in their evaluation of its scientific rigor, and some later complained that it should never have been published. Similarly, environmentalists said that John Losey's laboratory data on Bt pollen's ability to kill monarch butterfly larvae in the laboratory clearly showed that the widespread planting of Bt corn in the Midwest threatened the monarch butterfly with calamity; however, those on the other side of the debate wondered whether the Bt in GM corn might not obviate the need to use pesticides that are even more damaging to the monarch butterfly, and they questioned the relationship between the events witnessed in a laboratory at Cornell and those of the "real world." One such person said acidly, "The well-publicized experiments with the Monarch butterfly show that under laboratory conditions caterpillars force-fed pollen are damaged."⁸² There were complaints that *Nature* should not have published the study.

One might argue that the debate on the safety of GM crops, like so many scientific debates in the past, is currently passing through a normal phase in the genesis of scientific knowledge in which debate and disagreement between scientists precedes the eventual closing of the black box. The debate about GM crops may, however, present special difficulties for those seeking to close the black box, because scientific discussion of the safety of GM crops is complicated by open-ended questions about the relationship between controlled laboratory experiments and "natural" environments; because the debate is so dependent on modeling; and because ecological systems embody chaotic and nondeterministic feedback loops quite different in character from the more regular behaviors charted by earlier bodies of scientific theory (the orbits of the planets, chemical reactions, and so on). I have argued elsewhere that, where the conduct of scientific disputes is heavily dependent on modeling—for example, in contemporary debates over global warming and the reliability of nuclear weapons in the absence of nuclear testing—facts, theories, and predictions get sucked into a vortex of "hyperconstructibility."⁸³ The debate on GM crops offers another example of hyperconstructible science. Putting the same idea a little differently, George Myerson writes,

The Facts have become more complicated. They have changed their nature. A fact about Flavr Savr is just not the same kind of thing as a fact about oak trees, or rubber, or the moon. It has more in common with facts about, say, Black Holes, or programming "languages." These are 'mutated' facts—full of theories, full of uncertainties and ambiguities. You have to grasp these new facts as much with your imagination as with your calculator.⁸⁴

For scientists seeking to convince the public of the authority of scientific pronouncements on such matters as GM crops—an authority predicated on the special ability of scientists to speak with one voice—the current situation presents a dilemma. One option is to reassert the unanimity of science by communicating those with whom one disagrees. In this case, if one supports GM crops, one calls their work "junk science" or "ideological science"; if one opposes them, one says their science has been bought and corrupted by biotechnology corporations.⁸⁵

Such strategies carry their own cost in exacerbating the very unease among the public about the authority of science that the strategy is supposed to help reestablish. And that unease is already bad enough since, in the words of one British journalist, "We have had three decades of assurances by scientists about the safety of the nuclear industry—something no one can believe now. Then there is the BSE fiasco [bovine spongiform encephalopathy, or "mad cow disease"]. It is not surprising that people view the assurances of scientists with great skepticism."⁸⁶ Ulrich Beck spoke for many when he said that science is increasingly perceived as "the protector of global contamination of people and nature. . . . The sciences have squandered until further notice their historic reputation for rationality."⁸⁷ After Love Canal, after Chernobyl, after Three Mile Island, after Bhopal, after BSE, and after an epidemic of cancer in Utah and in the Pacific caused by nuclear tests that scientists at the time insisted were safe, we can say that, if members of the public are sometimes unduly afraid of new technologies, it is also the case that scientists—especially those employed by state military-industrial complexes and corporations—are sometimes unduly sanguine about new technologies, making pronouncements that they are clearly safe that later become embarrassments to the reputation of science.

CONCLUSION: A DEBATE WITHOUT "SCIENCE" OR "NATURE"?

At the beginning of this chapter, I speak of the way that arguments about public policy become persuasive as they embed themselves in narratives of the world. The opponents of GM foods have created a narrative centered on the greed of biotechnology corporations, the unnaturalness of genetic couplings effected in Dr. Frankenstein's laboratory, and the danger to "nature" of unleashing new hybrids into our fragile and complex ecological environments. This narrative has tremendous appeal among some segments of the modern Western public and has succeeded in mobilizing and unifying a new social movement against GM foods, especially in Europe, where public opinion about the risks of science had already been softened up by the BSE crisis. On the other side, the proponents of GM foods have created a narrative centered on the power of modern technoscience to ameliorate social

problems such as hunger and on the primitive irrationality of Luddites and quaint aristocrats who question the authority of science, the ultimate institution for the production of truth in modern society. This narrative has been effective in staunching the damage inflicted by anti-GM commentators and in ensuring continued public consent for transgenic experimentation, especially in the United States, where techno-utopian discourses have always had more resonance than on the other side of the Atlantic.

While both of these narratives have been effective in generating partial public support for their exponents' positions, neither has been able to defeat the other, and both the narrative of "nature" and the narrative of "science" embody flawed accounts of the world. Jean-Francois Lyotard has argued that it is the essence of the "postmodern condition" that metanarratives—narratives that seek to ground themselves as totalizing and objective accounts of the world—are doomed to fail, imploding upon themselves or colliding painfully with the ambitions of rival metanarratives that they cannot finally defeat.⁸⁸ That certainly seems to be the case with regard to the two rival narratives of risk in the transgenic age that I have anatomized here. But if attempts to ground authority in appeals to "nature" or to "science" are only partially persuasive in the transgenic age, can we speak about risk in this context without invoking the authorization of an essentialized nature or science? What would a policy debate look like that did not invoke these categories? Would it be intelligible or compelling? Can we find a way of talking about the unintended, sometimes disastrous, consequences of introducing new agents into ecological systems without speaking as if those systems embody a frozen teleological wisdom? Can we find a way of taking seriously the learning and expertise of scientists without compounding unrealistic and, frankly, superstitious expectations that scientists are capable of oracular foresight and should always agree?

A more nuanced and productive debate about GM foods would be one that, first of all, disaggregated the category of GM food itself, acknowledging that rice with enhanced nutritional content may not carry the same risks as, for example, corn that synthesizes pesticides in its own cells or soy designed to withstand the strongest pesticides yet developed. Thus we might decide that we like some GM products but not others. Second, if we stopped speaking in the name of fairy-tale versions of "nature" and "science," we could ask not whether a GM product will despoil a mythological nature but whether it poses risks beyond the fluctuations that have proved tolerable, even beneficial, in the past; not whether the product's critics threaten the foundations of modernity but whether the science in support of the product is robust enough that we can be sure it is not like the science that claimed Vioxx as a new wonder drug with no harmful effects. Finally, a more productive and insightful debate about GM food would be one that foregrounded some of the political economic issues that have been submerged by the appeals to "sci-

ence" and "nature." The debate about GM food is partly a debate about whether we want to live in a society where food production is dominated by a few large corporations and whether the solution to global hunger is (as the supporters of GM food maintain) a technical fix in the biology lab or whether it is (as the critics of GM food maintain) a distributional fix that empowers the poor to buy food that already exists in sufficient quantity to feed all the world's citizens. To raise such political economic issues is to put questions about values and power at the center of the debate on GM food, which is properly where they should be.

NOTES

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1. Fred Buttel, "Agricultural Biotechnology: Its Recent Evolution and Implications for Agrofood Political Economy," *Sociological Research Online* 4, no. 3 (1999), www.socresonline.org.uk/4/3/buttel.html (accessed February 2, 2005). John Grogan and Cheryl Long, "The Problem with Genetic Engineering," *Organic Gardening* (January/February 2000): 42–47. Mac Marshall, "An MAQ Innovation: Editorial," *Medical Anthropology Quarterly* 15, no. 1 (2001): 3–8.

2. Mark Strauss, "When Malthus Meets Mendel," *Foreign Policy* 119 (June 29, 2000): 105–12.

3. While Monsanto defended its "terminator" seeds by saying that the terminator gene would prevent genetic modifications in its GM crops from moving through cross-pollination into the genome of wild plant life or that of crops owned by farmers who had not chosen to grow GM foods, the terminator gene also had the commercially beneficial consequence that it would force farmers to buy new seeds from Monsanto every year.

4. Buttel, "Agricultural Biotechnology."

5. Jeff Hecht, "More Doubts over Plan for Allergen-Free Cats," *NewsScientist.com*, October 29, 2004, www.newscientist.com/article.ns?id=dn6594 (accessed May 9, 2005).

6. On "golden rice," see J. Madeline Nash, "Grains of Hope," *Time*, July 31, 2000; Debra Saunders, "A Golden Opportunity for Planet," *San Francisco Chronicle*, December 19, 2000, 31A; and Saunders, "Food for Thought," *San Francisco Chronicle*, May 7, 2000, 9. Critics argue that the nutritional benefit of golden rice has been oversold by boosters who do not point out that the rice does not contain vitamin A but a precursor, beta carotene, that cannot be converted into vitamin A by the malnourished. Richard Lewontin, "Genes in the Food!" *New York Review of Books* 48, no. 10

(June 21, 2001). Nina Schlapp and Quirin Schiermeier, "Critics Claim 'Sight-Saving' Rice is Over-rated," *Nature* 410 (March 29, 2001): 503.

7. One study found that 2 percent of American consumers consider GM issues when making consumer purchases, versus 20 percent of British consumers. Mark Henderson, "America Is Given GM Food for Thought," *London Times*, April 28, 2000, www.lexis-nexis.com.

8. In 1996 a group of Nebraska researchers who were splicing a Brazil nut gene into soybeans discovered through casual testing in the laboratory that it could trigger reactions among those allergic to nuts. Plans to commercialize this transgenic soy were promptly shelved. Marion Nestle, "Allergies to Transgenic Foods—Questions of Policy," *New England Journal of Medicine* 334, no. 11 (March 14, 1996): 726–28; Julie A. Nordlee, "Identification of a Brazil Nut Allergen in Transgenic Soybeans," *New England Journal of Medicine* 334, no. 11 (March 14, 1996): 688–92.

9. See Stanley W. B. Ewen and Arpad Pusztai, "Effects of Diets Containing Genetically Modified Potatoes Expressing Galanthus Nivalis Lectin on Rat Small Intestine," *Lancet* 354, no. 9187 (1999): 1353–54; and Sheldon Rampton and John Stauber, *Toxic Us, We're Experts!* (New York: Putnam Books, 2001), 152–94. More information on Pusztai's verified research can be found at www.ris.sari.ac.uk/gmo/alp.htm (accessed May 9, 2005); see also, *The Hindu*, "Call for Detailed Studies on Genetically Modified Foods," September 27, 2000.

10. See John Losey et al., "Transgenic Pollen Harms Monarch Butterfly," *Nature* 399, no. 6733 (May 20, 1999): 214. Critics of the Cornell study have questioned whether results from the laboratory where monarch larvae were compelled to eat Bt pollen can be extrapolated to the wild, and they point out that monarch larvae are also killed by the pesticides whose use Bt crops are intended to diminish. Meanwhile, subsequent studies suggest that it was not the pollen itself but parts of the plant not usually eaten by caterpillars that caused the monarch larvae to die. See Paul Brown, "Sowing Seeds of Doubt: U.S. Public Opinion on GM Crops Is Rattled by New Research," *Guardian*, August 9, 2000, 7; George Myerson, *Donna Haraway and GM Foods* (Cambridge, U.K.: Icon Books, 1999), 43; and Andrew Pollack, "New Research Fuels the Debate over Genetic Food Altering," *New York Times*, September 9, 2001, 28A. Losey himself has said that the laboratory experiment was only intended to be suggestive and that the jury is still out on the real-life consequences for the monarch of Bt crop planting. See also Nash, "Grains of Hope."

11. See Douglas Boucher, ed., *Paradox of Plenty: Hunger in a Bountiful World* (Oakland, Calif.: Food First, 1999); Mike Davis, *Late Victorian Holocausts: El Niño Famines and the Making of the Third World* (New York: Verso, 2002); and Amartya Sen, *Poverty and Famines: An Essay on Entitlement and Deprivation* (New York: Oxford University Press, 1984).

12. See Brenda Derby, "Consumer Perceptions of GM Food Labelling Issues in the U.S.: A Focus Group Study" (paper presented at the conference of the Society for the Social Study of Science, Vienna, September 30, 2000); and John Palfreman, *Harvest of Fear* (PBS film, Nova/Frontline, 2001). Derby also reports that the U.S. public is more concerned by the genetic modification of animals than that of plants, that men are more supportive of GM crops than are women, and that those who know the least about GM technology focus on its health effects while those who know the most focus more on its environmental consequences.

13. *Economist.com*, "Another Gene Genie out of the Bottle," May 19, 2004, www.economist.com/displaystory.cfm?story_id=2685115 (accessed May 9, 2005).

14. Exceptions include Barbara Adam, "The Temporal Gaze: The Challenge for Social Theory in the Context of GM Food," *British Journal of Sociology* 51, no. 1 (2000): 125–42; Stephen Crook, "Biotechnology, Risk, and Sociocultural (Dis)order," in *Altered Genes: Reconstructing Nature*, ed. Richard Hindmarsh, Geoffrey Lawrence, and Janet Norton (St. Leonards, Austral.: Allen and Unwin, 1998), 132–46; Crook, "Length Matters: A Note from the GM Debate," *Anthropology Today* 16, no. 1 (2000): 8–11; Arturo Escobar and Chela Heller, "From Pure Genes to GMOs: Transnationalized Gene Landscapes in the Biodiversity and Transgenic Food Networks," in *Genetic Nature/Culture*, ed. Alan Goodman, Deborah Heath, and Susan Lindee (Berkeley: University of California Press, 2003); Claire Maris, "Between Consensus and Citizens," *Science Studies* 12, no. 2 (1996): 3–32; Mac Marshall, "An MAQ Innovation: Editorial," *Medical Anthropology Quarterly* 15, no. 1 (2001): 3–8; Ann Murcott, "Not Science but PR: GM Food and the Makings of a 'Considered Sociology,'" *Sociological Research Online* 4, no. 3 (1999), www.socresonline.org.uk/4/3/murcott.html (accessed February 4, 2005); Murcott, "Public Beliefs about GM Foods: More on the Makings of a Considered Sociology," *Medical Anthropology Quarterly* 15, no. 1 (2001): 9–19; Myerson, *Donna Haraway and GM Foods*; Janet Norton, "Throwing Up Concerns about Novel Foods," in Hindmarsh, Lawrence, and Norton, *Altered Genes*, 173–85; Bob Phelps, "Genetic Engineering: The Campaign Frontier," in Hindmarsh, Lawrence, and Norton, *Altered Genes*, 186–198; Glenn Davis Stone, "Both Sides Now: Fallacies in the Genetic-Modification Wars, Implications for Developing Countries, and Anthropological Perspectives," *Current Anthropology* 43, no. 40 (2002): 611–19 (and replies in special issues of *Current Anthropology* 43, no. 4 [2002]; *Sociological Research Online* 4, no. 3 [1999], www.socresonline.org.uk/4/3/gmfood.html (accessed May 9, 2005); and *Medical Anthropology Quarterly* 15, no. 1 [2001]).

15. Murcott, "Not Science but PR."

16. Emory Roe, *Narrative Policy Analysis: Theory and Practice* (Durham, N.C.: Duke University Press, 1994), 2.

17. Carol Cohn, "Sex and Death in the Rational World of Defense Intellectuals," *Signs* 12, no. 4 (1987): 687–718; Emily Martin, "Toward an Anthropology of Immunology: The Body as Nation-State," *Medical Anthropology Quarterly* 4, no. 4 (1990): 410–26; and Martin, "The Drama of the Egg and the Sperm: How Science has Constructed a Romance Based on Stereotypical Male-Female Roles," *Signs* 16, no. 3 (1991): 485–501.

18. On the importance of metaphors and narratives in policy debates, see George Lakoff and Mark Johnson, *Metaphors We Live By* (Chicago: University of Chicago Press, 1980); and Lakoff, *Don't Think of an Elephant: Know Your Values and Frame the Debate* (White River Junction, Vt.: Chelsea Green, 2004). See also, Louise Wells Bedsworth, Michal Lowenthal, and William Kastenberg, "Uncertainty and Regulation: The Rhetoric of Risk in the California Low-Level Radioactive Waste Debate," *Science, Technology, and Human Values* 29, no. 3 (2004): 406–27; Hugh Gusterson, "Endless Escalation: The Cold War as Postmodern Narrative," *Tikkun* 6, no. 5 (1991): 45, 92; Gusterson, *Nuclear Rites: A Weapons Laboratory at the End of the Cold War* (Berkeley: University of California Press, 1996); Gusterson, "The Virtual Nuclear Weapons Laboratory in the New World Order," *American Ethnologist* 28, no. 1 (2001): 417–37;

Gusterson, *People of the Bomb: An Anthropologist Explores America's Nuclear Complex* (Minneapolis: University of Minnesota Press, 2004); and Alexandra Von Meier, Jennifer Lynn Miller, and Ann Keller, "The Disposition of Excess Weapons Plutonium: A Comparison of Three Narrative Contexts," *Nonproliferation Review* (Winter 1998): 20-31.

19. Martin Teitel, "Public Beliefs about GM Foods: Anne Murcott's Contribution," *Medical Anthropology Quarterly* 15, no. 1 (2001): 20-21.

20. Maria Margaronis, "The Politics of Food," *The Nation* 269, no. 22 (December 27, 1999): 11-16.

21. Quote from "The Next Endangered Species?" Flyer put out by the Campaign to Label Genetically Engineered Foods.

22. Bay Area Resistance against Genetic Engineering (BayRAGE), "Value Your Family's Health" (flyer).

23. See Ulrike Felt, "On Rhetorics of Choice: Presenting GM Food to the Austrian Public" (paper presented at the conference of the Society for the Social Study of Science, Vienna, September 29, 2000); Les Goffon and Erica Haimes, "Necessary Evils? Offering up Closings in Sociology and Biotechnology," *Sociological Research Online* 4, no. 3 (1999), www.socresonline.org.uk/4/3/goffon.html (February 4, 2005); and Brian Wynne, "Discursive Construction of Ethical Issues on GMOs: Deleting Public Voices on Science" (paper presented at the conference of the Society for the Social Study of Science, Vienna, September 30, 2000). These authors offer interesting critiques of the movement for the labeling of GM foods. Felt argues that, in practice, it is hard to sustain the option for individual consumers to opt out of GM food consumption since, once the societal infrastructure for growing and distributing GM crops has been built, it commits the entire society and overwhelms individuals who may have to strive inordinately to live GM-free. Goffon and Haimes argue that most consumers do not have time to study labels and, in the absence of a concerted public debate on GM food, have difficulty knowing whether to purchase it anyway. "A belief in 'organic' or 'natural' products may be a response to this information overload by returning to the past: food's version of postmodern nostalgia," they argue. Wynne argues that the principal issue with regard to genetically modified organisms is not that of protecting the individual's right not to consume them but that of evaluating the risk they represent to an entire ecological system.

24. Grogran and Long, "Problem with Genetic Engineering"; and George Monbiot, "Just Say No to Biotech Business" (editorial), *Guardian*, March 2, 1999, 22.

25. Bay Area Resistance against Genetic Engineering (BayRAGE), "Fact Sheet on the Risks of Genetically Engineered Food."

26. Ronnie Cummins, "Length Matters: A Note on the GM Debate," *Anthropology Today* 16, no. 1 (2000): 8-11.

27. BayRAGE, "Value Your Family's Health." PCB (polychlorinated biphenyl) products were developed to be used as coolants and lubricants in electrical equipment. Carcinogenic in animals and neurotoxic for children, they have been banned in the United States since 1977, though they remain in the environment.

28. Eleanor Mills, "Slaying the GM Bogyman," *Vancouver Sun*, March 31, 2000, 17A.

29. Warren Hoge, "Britons Skirmish over Genetically Modified Crops," *New York Times*, August 23, 1999, 3A.

30. *New York Times*, October 26, 1999, 15A.

31. The Marketplace, *Organics Today* (newsletter, Santa Fe, N.M., March 2000).

32. Grogran and Long, "Problem with Genetic Engineering"; Michael Pollan, "Desire: Control/Plant: The Potato," in *The Botany of Desire: A Plant's-Eye View of the World*, ed. Michael Pollan (New York: Random House, 2001), 181-238.

33. Council for Responsible Genetics, "Frequently Asked Questions about Genetically Engineered Food" (flyer, Cambridge, Mass., Summer 1999).

34. Grogran and Long, "Problem with Genetic Engineering."

35. BayRAGE, "Fact Sheet."

36. "What Many Farmers Have Found about Genetic Engineering," source unknown.

37. Phil Sutton, "Genetics and the Future of Nature Politics," *Sociological Research Online* 4, no. 3 (1999), www.socresonline.org.uk/4/3/sutton.html (accessed May 9, 2005).

38. Organic Consumers Association, "Consumer Warning" (flyer).

39. BayRAGE, "Fact Sheet."

40. James Melke, "Duke Challenges Skeptics over GM Food," *The Guardian*, June 7, 2000, 7.

41. Philip Howard, "The Only Place Where There Were No GM Plants Was the Garden of Eden," *Times*, March 31, 2000, www.lexis-nexis.com.

42. Mills, "Slaying the GM Bogyman," 17A. A number of pro-GM authors argue that genetic engineering may be safer than the techniques it supersedes because it is a more precisely targeted way of changing a plant's genome than repeated trial-and-error cross-breeding of different species, though questions have been raised about the possible disruption of gene regulation, as exogenous DNA is shot into the genome of a plant or animal. See Lewontin, "Genes in the Food!"

43. Nash, "Grains of Hope."

44. H. Sterling Burnett, "Destructive Precaution," *National Post*, November 20, 2000, 15C.

45. George McGovern, "The Wonder of Fighting Famine with Biotechnology," *Minneapolis Star Tribune*, November 6, 2000, 13A.

46. Hassan Adamu, "World's Starving People Need Food, Not Lectures," *Houston Chronicle*, September 27, 2000, 25A.

47. One flyer, for example, says that "life sciences' corporations . . . [are] using us as unwitting test subjects and contaminating the planet, in the largest global research project since the first atomic bomb mushroomed its radioactive particles above our state." La Montanita Co-op, "Avoiding Genetically Engineered Food: A Consumer's Guide" (Albuquerque, N.M.).

48. "Labeling GM Foods" (editorial), *Boston Globe*, March 28, 2000, 12A.

49. Paul Krugman, "Natural Born Killers," *New York Times*, March 22, 2000, 27A.

50. *Minneapolis Star Tribune*, "Biotech Foods: A Belated Effort to Reassure Consumers," May 7, 2000, 22A.

51. "Labeling GM Foods," 12A.

52. Mick Hume, untitled column, *Times*, February 28, 2000, www.lexis-nexis.com.

53. *Minneapolis Star Tribune*, "Biotech Protest: Under the Chanting, Some Worthy Points" (editorial), July 30, 2000, 24A.

54. Krugman, "Natural Born Killers," 27A.

55. Mills, "Slaying the GM Bogyman," 17A.
56. Norman Borlaug, "We Need Biotech to Feed the World," *Wall Street Journal*, December 6, 2000.
57. Quoted in McGovern, "Wonder of Fighting Famine," 13A.
58. Debra Saunders, "A Golden Opportunity for Planet," *San Francisco Chronicle*, December 19, 2000, A31.
59. Douglas Powell, "Junk Science Week," *National Post*, June 24, 2000, 11D.
60. I am referring here in particular to the work of Losey et al., "Transgenic Pollen", and Ewen and Puszta, "Effects of Diets," 1353.
61. U.S. representative Hushof (R-MO), *Congressional Record* (June 26, 2000).
62. Maria Margaritis, "The Politics of Food," *The Nation*, December 27, 1999, 11-16.
63. Hoge, "Britons Skirmish," *New York Times*.
64. Blunt, *Congressional Record*, June 26, 2000.
65. One of the key websites for the movement, for example, is www.purefoods.org.
66. Against this, Mark Harvey has argued, "As objects of transformation, plants ... are subject to natural laws, and whatever modifications are made of them, the modifications are of organisms subject to those laws, rather than modifications of those laws. Thus, if genetic modification can be said to be historically the most radical form of cultivation, nonetheless it cannot produce non-natural entities." Harvey, "Cultivation and Comprehension: How Genetic Modification Irreversibly Alters the Human Engagement with Nature," *Sociological Research Online* 4, no. 3 (2000), www.socresonline.org.uk/4/3/harvey.html (accessed May 9, 2005).
67. On liminality, see especially Mary Douglas, *Purity and Danger: Analysis of the Concepts of Pollution and Taboo* (New York: Ark, 1984); Stanley Tambiah, "Animals Are Good to Think and Good to Prohibit," *Ethnology* 8, no. 4 (1969): 423-59; Sherry Turkle, *The Second Self: The Human Spirit in a Computer Culture* (New York: Simon and Schuster, 1984); Victor Turner, *The Ritual Process: Structure and Anti-structure* (Chicago: Aldine, 1969); and Turner, *Dramas, Fields, and Metaphors: Symbolic Action in Human Society* (Ithaca, N.Y.: Cornell University Press, 1974).
68. Douglas, *Purity and Danger*, 4.
69. Douglas, *Purity and Danger*, 35.
70. Crook, "Biotechnology," 135.
71. Donna Haraway, *Simians, Cyborgs, and Women: The Reinvention of Nature* (New York: Routledge, 1991), and Haraway, *Modest_Witness@Second_Millennium_FemaleMan_Meets_Oncomouse: Feminism and Technology* (New York: Routledge, 1997).
72. Haraway, *Modest_Witness*, 88.
73. Myerson, *Donna Haraway and GM Foods*, 32.
74. Myerson, *Donna Haraway and GM Foods*, 21.
75. Haraway, *Modest_Witness*, 60-62.
76. Lewontin, "Genes in the Food!"
77. Henry I. Miller, "Biotech Food Labelling Is Regulatory Overkill," *Los Angeles Times*, October 27, 1996, 9B.

78. William Cronon, *Changes in the Land: Indians, Colonists, and the Ecology of New England* (New York: Hill and Wang, 2003).
79. Crook, "Biotechnology," 137.
80. Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Cambridge, Mass.: Harvard University Press, 1987).
81. Harry Collins and Trevor Pinch, *The Golem* (Cambridge: Cambridge University Press, 1998).
82. Burke, quoted in Myerson, *Donna Haraway and GM Foods*, 43.
83. See Gusterson, *People of the Bomb* chapter 9.
84. Myerson, *Donna Haraway and GM Foods*, 49.
85. For example, Peter Riley of the Friends of the Earth says, "The public will not be hoodwinked into accepting so-called independent advice from scientists who are being paid by the industry to say GM Foods are harmless." Quoted in Jeremy Watson, "Ministers Face GM Conference Protests," *The Scotsman*, February 27, 2000, 3.
86. John Hancox, "Scientist Should Not Be Blamed in Theory," *Glasgow Herald*, May 26 2000, 22, www.lexis-nexis.com.
87. Ulrich Beck, *The Risk Society: Towards a New Modernity* (Thousand Oaks, Calif.: Sage, 1992).
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