The Wenner-Gren Foundation
For Anthropological Research, Inc.

Embedding Ethics

Shifting Boundaries of the Anthropological Profession

Edited by

Lynn Meskell and Peter Pels

BERG
Oxford • New York

English edition
First published in 2005 by
Berg
Editorial offices:
1st Floor, Angel Court, St Clements Street, Oxford, OX4 1AW, UK
175 Fifth Avenue, New York, NY 10010, USA

Berg is the imprint of Oxford International Publishers Ltd.

Library of Congress Cataloging-in-Publication Data

A catalogue record for this book is available from the Library of Congress.

British Library Cataloguing-in-Publication Data

A catalogue record for this book is available from the British Library.

ISBN 1 84520 046 2 (hardback)
1 84520 047 0 (paperback)

Typeset by JS Typesetting Ltd, Wellingborough, Northants.
Printed in the United Kingdom by Biddles Ltd, King's Lynn.

www.bergpublishers.com

Contents

eight

A Science of the Gray: Malthus, Marx, and the Ethics of Studying Crop Biotechnology

Glenn Davis Stone

"Crop biotechnology" encompasses a wide range of technologies, but most of the vexing ethical issues concern the technology of genetic modification (genetic engineering, recombinant DNA). In genetic modification the scientist usually isolates and removes genes from one or more organisms (virus, bacterium, plant, or animal), recombines them in a gene construct, and then introduces them into a target organism. The target organism is then a genetically modified organism.

My first engagement with genetically modified agriculture was when I bought a Flavr Savr tomato—the first genetically modified organism marketed in the United States—at a Manhattan greengrocer's in 1995. The connection between this tomato (engineered to rot slowly) and my research activity (then focused on conflict, population, and agricultural change in Nigeria) seemed remote. Yet by 2000 I was not only conducting field research on genetically modified crops but taking a leave from university teaching to participate in the modification of crops. This change in research focus confronted me with a set of ethical problems I had never faced in my previous work on the social aspects of nonindustrial agricultural systems. In fact, it was partly stimulated by ethical issues: as much as anything else, it was the biotech industry's ethical self-justifications that led me to take up this research. Crop biotechnology took a remarkable turn in the late 1990s, when the collapse of its market in the United Kingdom and continental Europe was followed by a corporate media campaign claiming an ethical high ground by promising to feed the Third World. Claims by anti–genetic modification activists also gravitated toward ethical grounds for blocking the technology from the Third World (and elsewhere, for that matter). As an anthropologist who studied food production in the Third World, I recognized that both sides suffered from a studiously blinkered perspective on the topic. Whatever weaknesses anthropology may have as a discipline, one of its strengths is the holistic perspective it can offer on such topics, and, given the importance of the biotechnology debate, I had difficulty justifying remaining on the sidelines. Yet entering this arena as an anthropological researcher posed its own set of ethical questions, which I conceive as a case of contested *ethical platforms*.

Crop biotechnology lies at the intersection of a remarkably wide set of important concerns, and it can be (and is being) condoned or condemned on widely varying grounds. Biotech discourse is aptly described as "a patch quilt of neighborly and competing factions" (Visvanathan and Parmar 2002:2715). But from the jungle of arguments, claims, and predictions emerge a few key positions that we may call ethical platforms—rationales for prioritizing or privileging concerns, "big-picture" meta-arguments that often appeal to high-level implicit propositions. My concern in this chapter is with the interplay among ethical platforms: the proponents' case, based on neo-Malthusian claims by industry and allies, an opposing case, based on issues in political economy (best developed by Marxist writers), and the responsibilities of an anthropologist entering such contested terrain.

The Proponents' Ethical Platform: Biotech Neo-Malthusianism

Pioneering experiments in genetic modification began in the early 1970s, and by 1983 plants were being genetically modified (Lurquin 2001; Charles 2001). The first commercial genetically modified product sold in the United States was the tomato mentioned above, and by 1996 genetically modified cotton, soy, and maize seed had begun to penetrate American farming while genetically modified ingredients were spreading throughout the American food supply. Soon after this, genetically modified crops encountered disastrous opposition in Europe and particularly in Britain. The main resistance was triggered not by the first genetically modified food in British stores (tomato paste, clearly labeled, which sold well) but by the arrival of American genetically modified soya, which went into countless processed food products. Various reasons for the subsequent British aversion to genetic modification have been cited, including different attitudes toward government regulation, a stronger and more mainstream green movement, and exquisitely bad timing in relation to the mad cow disease scandal. It did not help that the corporation behind the soya (and also the world leader in crop biotechnology) was Monsanto, a bête noire of the European green movement. In 1997 the smoldering opposition to genetically modified products burst into flame, and by 1998 British grocery chains were removing genetically modified products from their shelves (Purdue 2000; Lambrecht 2001; Charles 2001; Levidow 1999; Stone 2002a).

The closing of European markets did much more than hurt U.S. exports. The European backlash also provided—and continues to provide—inspiration and support to the opposition to genetically modified organisms worldwide. The collapse of the European market put Monsanto and the biotechnology industry on notice about the precariousness of the entire enterprise and the urgency of winning over a suspicious and potentially hostile public. Monsanto reacted with a didactic media campaign in Britain, the spectacular failure of which left the company's director of communications out of work and its CEO apologizing to a Greenpeace convention.

One of the themes of Monsanto's "Let The Harvest Begin" campaign was the need for crop biotechnology to feed the hungry in developing countries. In 2000 Monsanto and six other biotech firms jointly formed the Council for Biotechnology Information (CBI), a public relations consortium with an initial war chest of $250 million (Lambrecht 2001:9) for TV and newspaper ads, web sites, and even coloring books. From the outset, the driving theme was the promise of and need for genetically modified crops in developing countries. This was hardly an obvious issue to campaign on, since over 99 percent of the acreage devoted to genetically modified crops were in the United States, Canada, and Argentina as of 1999 (and the number is still over 95 percent).[1] But it was an issue that the CBI partners could agree on (whereas insecticide reduction was not—some of the biotech companies were still in that business), and it seemed to resonate reasonably well with the American public (if somewhat less so with the Europeans).

Genetic engineers were interested in the developing world not only for its rhetorical value. By 1999, genetically modified crops were available to farmers in China, Mexico, and South Africa, test plots were growing in India, and *Science* published an article entitled "Crop Engineering Goes South" (Moffat 1999). Actually, the crop leading genetic modification into the south was not a subsistence crop but cotton, and while cotton farmers did offer interesting fodder for the public relations mill (Stone 2002b), the industry campaign focused mainly on the malnourished masses.

The CBI campaign was also provided with a very timely poster child in the form of "Golden Rice," which appeared on the cover of *Time* in July 2000 as a plant that "could save a million kids a year." Developed as part of the Rockefeller Foundation's Asia Rice Initiative, Golden Rice was a prototype that contained genes for producing beta carotene in the endosperm. Its aim was to mitigate vitamin-A-deficiency blindness in poor children on rice-based diets. The CBI soon flooded the U.S. television and print media with ads touting Golden Rice.[2] Although the corporate sector had refused to fund development of Golden Rice (Potrykus 2000), it was not long before the industry had apparently spent more advertising it than Rockefeller had spent developing it (much to Rockefeller's dissatisfaction [see Brown 2001]).

This rhetorical move south was a response to an increasingly polarized public debate in which negative biotech coverage was just reaching its peak in the United Kingdom (Gaskell et al. 2003). Its intent was to establish for the biotech debate an ethical platform based on a neo-Malthusian dogma tailored to the situation (Kleinman and Kloppenburg 1991). Variants on Malthus's doctrine have had a long history of surges in Western popular and intellectual culture; these neo-Malthusianisms have differed through the years, reflecting their times and often having major impacts on public opinion and policy (Ross 1998). The particular variety of neo-Malthusianism holding sway at the time (particularly in North America) did not suit biotechnology's public relations problem: it focused on environmental security problems rather than hunger. Filling the political space left by the collapse of the Soviet Union and the cold war paradigm, "environmental security neo-Malthusianism" emphasized conflicts and societal breakdown as results of resource scarcity ultimately driven by overpopulation (Peluso and Watts 2001)[2] The biotechnology industry and its academic allies, backed by a media budget such as no previous neo-Malthusianism had enjoyed, refocused attention on the crude balance between mouths and mouthfuls, much as had Paul Ehrlich's (1968) neo-Malthusianism of the late 1960s and 1970s. However, this "biotech neo-Malthusianism" parted with Ehrlich's in touting agricultural technology as a solution. It has come to assume a dominant role in the debate and has become a predictable mantra at the opening of presentations advocating genetically modified crops. It can be decomposed into several dogmas, concerning demography, agriculture, and investment (for a different analysis specifically of Monsanto's discourse, see Kleinman and Kloppenburg 1991).

1. *Demography*. The primary dogma is that the various problems posed by biotechnology are trumped by the specter of population outstripping food supply. This follows Malthus's explicit argument that unchecked population increases geometrically while subsistence increases arithmetically ([1798] 1959:5).[3] Prominent biotechnologists have claimed demographic trends to be heading toward "Malthus's worst predictions" (Martina McGloughlin, in *Hotwired* 1997). Yet in some ways Malthusian doctrine has been turned on its head. Malthus's primary concern with the British poor is replaced by the focus on hunger in an overpopulated Third World; there is no mention of the class distinctions that preoccupied Malthus and certainly no mention of the thirty-five million food-insecure people in the United States, the world's leading producer of genetically modified crops (Nord, Andrews, and Carlson 2003).

Biotech neo-Malthusianism routinely presents assured projections of future population levels, reflecting popular notions sufficiently entrenched that no plus-or-minus factor or source seems to be needed. Indeed, the causal link between population and famine often goes unstated: trained to perceive the world as a place of food shortages rather than surpluses, the public readily makes the causal link between population growth and malnourishment when provided with numbers of hungry.

2. *Agricultural growth***.** Biotech neo-Malthusianism depicts existing agriculture as already maximized, with further increases generally being impossible without biotechnology. This is a remarkable reversion to Malthus's late-eighteenth-century understanding of agricultural inelasticity. Malthus was writing before the era of rapid technological change in agriculture and before any comparative research on means of raising output by increasing labor and material inputs. He offered only this rudimentary acknowledgment of what today we would call agricultural intensification and raising of producer prices ([1798] 1959:33):

> Premiums might be given for turning up fresh land, and if possible encouragements held out to agriculture above manufactures, and to tillage above grazing. Every endeavour should be used to weaken and destroy all those institutions relating to corporations, apprenticeships, etc., which cause the labours of agriculture to be worse paid than the labours of trade and manufactures.

However, he saw such steps only as "palliatives" because of the absolute impossibility, from the fixed laws of our nature, of removing the pressure of want from the lower classes of society (25–35). Biotech neo-Malthusianism also stresses agricultural inelasticity, but not as an inevitability: it depicts production as expandable by (and only by) technological means. For instance, in "Without Biotechnology, We'll Starve," the director of an industry-supported university biotechnology program warned that "the human population continues to grow, while arable land is a finite quantity. So unless we will accept starvation or placing parks and the Amazon Basin under the plow, there really is no alternative to applying biotechnology to agriculture" (McGloughlin 1999:164). This position resonates well enough with popular notions that Senator Christopher Bond read it into the *Congressional Record*, in remarks immediately republished on Monsanto's web site.

These two dogmas are combined in the claim that only through biotechnology can starvation be averted in less developed countries (Thomson 2000):

> The recent debate over biotechnology foods is a luxury well-fed people of the industrialized world can afford. But in developing nations, where the population is soaring while the supply of farmland shrinks, people are grappling with a much thornier—and higher-stakes—dilemma. Unless they can grow more food on less land they will starve. . . . Biotechnology crops are safe and nutritious and offer perhaps the only hope for producing enough food for a growing world population.

3. *Incentives to capital*. A key feature in biotech neo-Malthusianism is the explicitly capitalist veneer it adds to the model of overcoming overpopulation through technology. It holds that corporate investment is vital to the scientific and technological advances needed for agricultural growth; strong incentives to capital are needed to feed the poor. This argument has featured in other struggles over proprietary rights in agriculture, such as the disputes surrounding the 1970 Plant Variety Protection Act (Kloppenburg 1988:131). Malthus would never have made such an argument, not just because it militated against the feeding of the poor but because his writing predated the expansion of agrarian capitalism (Wood 2000). But stressing the need for agricultural investment to feed developing countries is important because of the high levels of investment required by biotechnology and because industry has been put on the defensive by publicity surrounding gene-use restriction technologies (GURTs): nicknamed "Terminator" by genetic modification opponents, these are technologies for creating sterile seeds.[4] Although reviled by various parties that support and even practice genetic modification for developing countries (including the

Rockefeller Foundation and the network of international agricultural research labs), it is staunchly defended by biotech neo-Malthusians (Weiss 1999):

> Supporters see in Terminator a possible solution to Third World hunger and poverty, which could become more widespread in coming years as populations expand and farmlands are lost. "The rhetoric has been extremely alarmist without looking at the whole situation," [the U.S. Department of Agriculture (USDA) developer of the technology, Mel Oliver] said. Henry Shands, assistant administrator for gene resources at the USDA's ARS [Agricultural Research Service], said foreign farmers need to recognize that biotech companies are not going to export their best-engineered varieties to parts of the world where patent protection is weak unless they can be assured farmers won't resell or replant harvested seeds. GURTs, he and others said, will give poor farmers access to better seeds.

4. *Asserting ethical priorities.* In the 1970s, Paul Ehrlich used to cut off critics who sought to raise other issues in response to his demographic catastrophism by saying, "There are other problems, but if you don't solve this one you won't be around to solve the others." Biotech neo-Malthusianism is used in the same way: to put the biotechnology issue on an emergency footing that diminishes objections based on longer-range and more synthetic criteria. For instance, the head of an industry-backed foundation recently lashed out at genetic modification critics: "To turn a blind eye to 40,000 people starving to death every day is a moral outrage. . . . We have an ethical commitment not to lose time in implementing transgenic technology" (Macilwain 1999:342).

Senator Bond, from biotech-heavy Missouri, exemplifies how neo-Malthusian ethics can be used to demean critics (2000:S61):

> Let me emphasize this critical point. The issue of risk is not one-dimensional. Yes, we must understand and evaluate the relative risk to a Monarch Butterfly larvae. . . . But there is another risk. That risk is that naysayers and the protectionists succeed in their goals to kill biotechnology and condemn the world's children to unnecessary blindness, malnutrition, sickness and environmental degradation.

Similarly, the Washington Legal Foundation (2002) writes, "So why is it that so many professional activist groups and special interest radicals have no appetite for genetically enhanced foods? How can they attack dramatic technological advances that could end world hunger?"

The theme is sounded most indignantly by the Kenyan biotechnologist Florence Wambugu, who asserts: "The biggest risk in Africa is doing nothing. I appreciate ethical concerns, but anything that doesn't help feed our children is unethical" (Butler 1999). The academic biotechnologist C. S. Prakash (2000) writes that "anti-technology activists accuse corporations of 'playing God' by genetically improving crops, but it is these so-called environmentalists who are really playing God, not with genes but with the lives of poor and hungry people." Critical opposition is even branded as crime. One biotech executive said, "We're talking about the food security of the world. . . . When people talk about crimes against humanity—wouldn't it be a crime if political narcissism delayed things to the point where there were major food shortages in the Third World?" (Raymond Rodriguez, quoted in Charles 2001:262). Ingo Potrykus (Golden Rice's lead developer) announced at the 2000 World Food Prize conference that Golden Rice critics were potentially guilty of murder.

The primary target of this invective may be professional activists, but the relevance to social science research on genetically modified crops is obvious. This ethical platform demands that objections to the central role of corporations in developing the technology be outweighed by considerations of raising food output in the Third World and, indeed, that that role be embraced.

Biotech neo-Malthusianism is, of course, by no means the only rationale for promoting genetically modified crops (cases are also made on the basis of free trade and environmental advantages, for instance). I have isolated it here because it offers the most developed and influential ethical argument for crop genetic modification and because it directly concerns issues that an agrarian anthropologist may be obliged to confront. In now turning to the biotechnology opposition, one finds a welter of perspectives, including several that are based in part on ethics. However, given my starting point—the agrarian anthropologist's ethical position entering this arena—I will examine only the position that offers a well-developed ethical platform, which is, moreover, a platform that directly contradicts the tenets of biotech neo-Malthusianism.

An Opposing Ethical Platform: Political Economy of Agriculture

There is in social science an important and diametrically opposed ethical platform based on issues in political economy. Its application specifically to biotechnology may be less developed, but its underlying logic is well known. It maintains that considerations of raising food output in the Third World are trumped by considerations of the central role of biotechnology in expanding the role of corporations. It is not necessarily Marxist, although the relevant ideas have been best developed within the Marxist tradition. This began with Marx himself in discussions of agricultural technology as a mechanism of capitalist penetration ([1858]:527–528):

> If agriculture rests on scientific activities—if it requires machinery, chemical fertilizer acquired through exchange, seeds from distant countries, etc., and if rural, patriarchal manufacture has already vanished . . . then the [products of external trade] appear as *needs* of agriculture. . . . Agriculture no longer finds the natural conditions of its own production within itself, naturally, arisen, spontaneous, and ready-to-hand, but these exist as an industry separate from it. . . . This pulling away of natural ground from the foundations of every industry . . . is the tendency of capital.

Agriculture has long posed difficulties to this capitalist penetration (Mann and Dickinson 1978), and the "pulling away of natural ground" has occurred only in grudging stages. A key step in the process was the advent of nonreplantable hybrid seeds (Kloppenburg 1988; Lewontin and Berlan 1986); another was the flood of cheap nitrogen fertilizer following World War II that ended integrated crop-stock production (Foster and Magdoff 2000). Today, as biotechnology firms use genetic modification to render seeds sterile and make natural properties dependent on chemical inputs (the so-called Terminator and Traitor technologies), Marx's general point remains highly relevant, indeed prescient.

Given the vituperativeness of the debates, I should note that my concern here is with arguments for opposing genetically modified crops, not on their advocates' political leanings. The political inspirations of the various opponents vary widely. Moreover, charges of "Marxist " are used in North America to discredit genetic modification opponents. Vandana Shiva is attacked as Marxist by various conservative groups in the United States (for example, Georgetown College Republicans 2002); Greenpeace founder Patrick Moore, who later switched allegiances, disparages Greenpeace as having filled up with pro-Soviet Marxists after the end of the cold war (Elvin 1997).

Whatever the opponents' politics, the theory that crop genetic modification is driven not by food supply, environment, or farmers but by the needs of capital to commodify the "natural ground" of agricultural production fits some of the history of this technology well. Soon after the first experiments in recombinant DNA, it began to emerge that this technology would open the door to capital's claiming proprietary rights over the basic productive force of genes.[5] Despite the profound economic, political, and ethical questions involved, the United States saw little debate on or public appreciation of the advent of gene patenting. Remarkably, it was never formally decided that genes should be patentable in the United States; it was a latent result of decisions on other matters made before any plant had been genetically modified. Yet genetic modification was pivotal in the advent of gene patenting, and this warrants a closer look because of its relevance to the ethical platform being considered.

"Products of nature" are ineligible for utility patents by long-established principle in American law, but exceptions have been allowed for "artificially purified forms."[6] As early as an 1873 case involving Louis Pasteur, the patent office granted a patent on "yeast, free from organic germs of disease, as an article of manufacture," and in 1910–11 patents were granted on purified forms of adrenaline, aspirin, and calcium carbide (Gipstein 2003). This would seem, however, to have little to do with ownership of plants or genes. Such purified variants of natural substances were patentable only if the difference in purity rendered the product "for every practical purpose a new thing" (Golden 2001:125). Even the 1952 Patent Act, which famously declared "anything under the sun that is made by man" to be patentable, would seem to leave natural genes immune.

Proprietary rights over breeder-developed plants came not from utility patents but from plant patents (provided by the Plant Protection Act of 1930) and certificates (from the Plant Variety Protection Act of 1970); these rights pertained to whole plants that had not existed previously in nature, and they had various limitations that utility patents lacked (Hamilton 1993). But with genetic modification came the need to rethink what an invented organism was. In the early 1970s the General Electric biologist Ananda Chakrabarty used early methods of genetic modification to transform a bacterium so that it would degrade crude oil. The patent office allowed the claim on his method of transferring genes but not his claim on the bacterium itself, which was deemed to be a product of nature. In 1980 this was overturned in *Diamond v. Chakrabarty*.[7] Burger's (1980:2208) majority opinion (in a five-to-four decision) held that the genetically modified microorganism was patentable because it "is not a hitherto unknown natural phenomenon, but a nonnaturally occurring manufacture or composition of matter—a product of human ingenuity."

This ruling took on particular significance because the "purification exception" had just been extended to biological products. In the 1979 *Bergy* decision, the Court of Customs and Patent Appeals held that a particular pure bacterial culture was a "product of a microbiologist" rather than a product of nature (Golden 2001). This made into law the position of the patent office first expressed in the Pasteur patent, and it did so just in time for the law to be applied to DNA sequences. The combined result of the *Bergy* and *Chakrabarty* rulings was to render the "product of nature" doctrine "effectively toothless, because biotechnology by nature involves isolating and replicating biological materials to produce 'unnatural' levels of purity" (Golden 2001:127). Before a DNA gene can be transferred or altered, it must be isolated and cloned, which leaves it in an artificially purified form eligible for patenting. As Golden (2001:127–128) puts it, "with respect to biotechnology, the century-old 'purification exception' tends to swallow the rule."

This established the right to exclusive control over a fundamental productive force, and biotech corporations promptly began a period of explosive growth and frenzied patenting of genes. In some cases, genes were actually invented—examples are the Flavr-Savr antisense PG gene and Monsanto's synthesized Bt gene (Martineau 2001; Charles 2001)—but most patented genes were merely located and purified. The process has been likened to the gold rush (Rai 2000) or the Oklahoma Land Run, as in this description by Jerry Caulder, who left Monsanto to form Mycogen (Charles 2001:48):

> Like the early U.S. railroads, which made their profits selling land rather than by carrying passengers or freight, Caulder decided the near-term profits in agricultural biotechnology lay in intellectual real estate. "My strategy was simple," Caulder says. "Let's find as many genes as we can and patent them. We'd jump ahead and build intellectual property." Caulder saw the early competition in biotechnology as a kind of Oklahoma Land Run, a race for property rights.

Yet the analogy between genes and plots is deceptive. Plots of land are unique, and ownership of one does not keep a different buyer from owning another; a forty-niner gained exclusive rights only to gold on his claim, not to gold on other similar land or to gold itself. In contrast, U.S. patent #5,352,605 applies to the biotechnological use of every CaVM 35S promoter in every strand of DNA in every country where the patent is recognized. In sum (Golden 2001:130–131):

> what might have seemed to be entrenched doctrines of patent law prior to 1980 have shown remarkable flexibility in the face of the biotechnology industry's craving for expansive intellectual property rights. The patentability of most basic biotechnological products is now well established, and supposedly central requirements such as utility and nonobviousness have often merely nibbled at the margins of patentability's broad realm.

Gene patenting in the United States was quickly followed by a push to internationalize such proprietary rights. In the 1994 Uruguay Round of the General Agreement on Tariffs and Trade, which established the World Trade Organization, 137 countries agreed to move toward harmonizing intellectual property rights by adopting patent or other sui generis protection for plants. Signers included India and several other developing countries that were to become crucial in the debate on biotechnology.

This ethical platform, then, argues that the package of genetic modification and privatized gene rights is the latest stage in the capitalist penetration of agriculture, an enormously transformative stage that is being exported to the Third World (Kloppenburg 1988; Lappé and Bailey 1998; Lewontin 2000). It further recognizes the devastating effects of capitalization of agriculture in industrialized countries, including the elimination of most farmers; indeed, Hobsbawm marks the disappearance of peasantries as the signal social transformation of the past half-century (1994:289). Large numbers of peasant farmers may still be on the land in the Third World, but the continuation of peasantries would be threatened by the specter of U.S.-style farm concentration (Magdoff, Foster, and Buttel 2000). If one accepts these threats to farmers as more credible than famine from absolute food shortages, could this not impel one to prioritize the impeding of the technology over a quixotically "objective" research agenda that could generate fodder for the biotech media machine? After all, the lead item in the American Anthropological Association's Code of Ethics is "Anthropological researchers have primary ethical obligations to the people, species, and materials they study and to the people with whom they work. These obligations can supersede the goal of seeking new knowledge."

The problem is that it is only after seeking objective knowledge that the anthropologist can even begin an informed assessment of the relative threats of the courses of action recommended by the competing ethical platforms. What the two ethical platforms appear to have in common is an overriding commitment to an ethical black-and-white. Both are intended to delegitimate an examination of the grays.

Prejudicial, Your Honor

The two ethical platforms do more than simply make a case for or against biotech; they inveigh against detailed scrutiny of biotechnology's various potential impacts on the grounds that such considerations would threaten larger ethical imperatives with ultimately trivial impediments. Each challenges the validity of an objective-as-possible investigation of the effects of genetically modified crops in developing countries: research findings, even if "accurate," may have broader harmful effects that outweigh the value of the information made public. For example, the ecologist Allison Snow has suffered withering criticism from the biotech neo-Malthusian perspective for finding that outcrossing transgenes could confer adaptive advantage on wild sunflowers: "it is unknown how many [Africans] starved to death" as a result of her work, fumed biologist Neal Stewart in a major biotechnology journal (2003:353).[8] Again, Altieri has criticized my attempt to analyze fallacies on both sides of the biotech debate, arguing that anthropologists should know that "technical choices are simultaneously political choices," that they should criticize technologies "pursued without concern for the environment or social displacement," and that "as long as researchers attempt to maintain political 'neutrality' their research will always serve those who are in a position to dictate the research agenda"; he goes on to link production of knowledge in international agricultural research to the demise of struggles over land and water (2002:619).

I agree with the premise of both ethical platforms that there may be information or lines of inquiry that are like the evidence that is excluded from a trial as prejudicial: they should be avoided because their probative value is exceeded by the potential damage to an analysis of larger issues. The problem here is how one knows a priori what environmental or social effects genetic modification in general or any particular use of it will have. Genetic modification is a highly variable and rapidly evolving technology, and an ethical platform would have to be overpoweringly compelling to justify overriding an attempt at a "neutral" analysis. My assessment, as I became involved in the issue, was that neither platform was compelling to this extent and, indeed, that both were seriously flawed.

Biotech neo-Malthusianism's first dogma (population outstripping food supply) has been a very poor fit in a world where famine is commonplace and absolute food shortages are rare. Although this has been argued by numerous writers (Sen 1981, 1993; Lappé, Collins, and Rosset 1998; Altieri, Rosset, and Thrupp 1998; Altieri and Rosset 1999; among others), it makes biotech neo-Malthusians apoplectic (Prakash 2000):

> Critics of biotechnology invoke the trite argument that the shortage of food is caused by unequal distribution. There's plenty of food, they declare; we just need to distribute it evenly. That's like saying there is plenty of money in the world so let's just solve the problem of poverty in Ethiopia by redistributing the wealth of Switzerland (or maybe the United Kingdom, where the heir to the throne is particularly opposed to companies "playing God" with biotechnology).

Yet the surplus is not only in wealthy Switzerland or Britain but also in Prakash's native India, which is home to a plurality of the world's hungry and also tens of millions of tons of grain above the desired level in the national buffer stocks (Stone 2002a). We might consider that what is a moral outrage is not depriving the hungry of genetic modification technology but using the hungry in the corporate media to justify genetically modified products *without specifically addressing how genetic modification will feed them*. India reminds us that simply boosting production, however beneficial to corporations selling the inputs and seed, may be less than beneficial to the hungry.

The second dogma, that the Third World needs to avert famine through new technology, is largely inconsistent with my own experience with Third World agricultural systems. The heavily subsidized search for ever-increasing yields is better suited to industrial agribusiness interests than to the Third World. It gives little weight to the needs of producers where inputs are unreliable, since the market dependably provides purchased inputs (and credit to buy them) and the government provides lavish relief payments when rains fail. Richards (1997), for example, shows that the more "advanced" breeding of the Green Revolution has much less to offer African rice farmers than "Farmer First" conventional breeding oriented toward reliability under actual field conditions.

The third dogma is likewise dubious in the context of the Third World; indeed, there is ample reason to believe that the intersection of institutional interests and the patenting regime will stultify pro-poor public research. The 1980 Bayh-Dole Act allowed government-funded research results to be patented and commercialized. Thus government-funded discoveries with promise for developing countries are patented and licensed to corporations rather than becoming public goods. Genetic modification always involves multiple patented technologies, and this promotes corporate consolidation to develop patent portfolios (DeVries and Toenniessen 2001). Since public-sector research has no such portfolio, this has disastrous consequences for the same malnourished populations used as an ethical justification for biotechnology (De Vries and Toenniessen 2001:73):

> Leading academic researchers are interested in research competitiveness. They readily sign research MTA's[9] to keep competitive but are then restricted from further transferring their research products. Their universities now have "technology transfer offices" where the incentives are to maximize [intellectual property (IP)] royalty income, often by granting exclusive licenses. The net result is that improved plant materials produced by academic scientist-inventors are highly IP-encumbered and commercially useful only to a big company having an IP portfolio large enough to cover most of the IP constraints. The international agricultural research system does not have such an IP portfolio and as a consequence the traditional flow of materials through the system is breaking down, particularly at the point where useful new technologies and improved plant materials flow from public sector researchers in developed countries to international centres and national crop improvement programmes in developing countries. Africa, in particular, is being short changed of the benefits of biotechnology.

But the anti-biotech ethical platform sketched above has its own problems in the real world, and just as its strongest theoretical rationale comes from Marxist writing, it also inherits serious problems from the Marxist programs for action. Marx maintained that capitalism, along with its attendant social makeups, governmental forms, and ideologies, should and would change; the whole package, integrally related, would decompose, perhaps even without intervention. Early Marxists bifurcated into camps of critical Marxists, who aimed to mobilize a proletarian revolution, and scientific Marxists, who took the evolution of political forms to be preordained (Gouldner 1980). The evolutionary Zeitgeist left little room in either camp for serious consideration of mitigating the effects of capitalism; indeed, some writers looked forward to a worsening of conditions for the working classes to precipitate the systemic overhaul Marx had predicted.

Marx's analysis of capitalism may have been right on the money, but his model of political-economic evolution has fared poorly. Since the failure of the envisioned evolution beyond capitalism, his writings have lost relevance as a program for changing the world.[10] Like capitalism, crop genetic modification is not going away: it is very big business, it has become a fundamental tool in biological research, and it is taught in all major research universities in the United States and practiced in virtually every country with a developed scientific infrastructure. There is little chance of killing it. As an activist against genetic modification per se, a researcher sacrifices not only the ability to investigate the range of effects it may have but also the ability to influence how it is developed. This is the key problem running through the uncomfortable overlap between scholarship and activism; witness the interchange in *Hungry for Profit* (Magdoff, Foster, and Buttel 2000), an analysis of the capitalist transformation of food production, which includes an upbeat survey of sustainable alternatives to corporate farming (Henderson 2000). This chapter evoked an editors' italicized afterword suggesting that such activities might be no more than a "minor irritant to corporate dominance of the food system" because actual reform would require "complete transformation of society."

The implication that sustainable agricultural programs are a waste of time echoes the scientific Marxist position that social improvements are mere palliatives. This is an odd corner for researchers ethically committed to the welfare of Third World farmers to have painted themselves into—opposing potentially beneficial agricultural strategies or technologies because they might impede a complete transformation of the agricultural system. If the complete transformation never comes, one has relinquished the ability to mitigate the excesses of the extant system. And since the complete transformation of crop biotechnology (putting the genie back in the bottle) seems impossible, I see my ethical obligation to Third World farmers (and also my professional obligation as a researcher) as investigating how various plant transformations and institutional arrangements might actually affect Third World agriculture and society without predisposing the research toward supporting or opposing biotechnology. This approach, explicitly designed to counter the assigning of black-and-white ethical values to biotechnology itself, is a science of the gray.

Science of the Gray

A principal aim of an anthropologist's study of the gray of biotechnology is to probe the enormous diversity within the biotechnology project. My analysis of fallacies in both sides of the debate has highlighted the illusion of biotechnology as a unified project by biotechnology's most strident proponents and opponents alike (Stone 2002a). Both sides employ a strategy of blurring distinctions between corporate and public biotechnology: industry wants to take credit for pro-poor technologies from nonprofit labs, and opponents want to tar all biotechnology with the "corporate takeover" brush. It is true that the borders of the two sectors overlap, but there remain differences that are crucial to the Third World. This is why I spent the fall of 2000 on leave from teaching, working as an apprentice (and participant-observing) at the International Laboratory for Tropical Agricultural Biotechnology (ILTAB), a public-sector biotechnology lab engaged in genetic modification of crops for the Third World poor housed in the Donald Danforth Plant Science Center in St. Louis. My training and participant-observation were sponsored by a National Science Foundation Scholar's Award for Methodological Training in Cultural Anthropology. They combined hands-on experience in genetic modification of crops with observations of the interaction between considerations of biology, intellectual property, and Third World agriculture.

An analysis of ILTAB's work is a classic gray subject. ILTAB is part of a center that, while legally nonprofit, is very much part of the American biotechnology establishment. It is located across the street from Monsanto, receives support from Monsanto, affords Monsanto opportunities for image-burnishing announcements, and potentially provides genetic modification technologies that Monsanto may commercialize. It also patents and profits from the licensing of biotechnologies. At the same time, my involvement at ILTAB has convinced me that its work stands a very good chance of benefiting farmers in some situations in the Third World. I arrived at this position only after considering likely broader impacts of specific crop modifications. I have described the two examples of nutritionally enhanced cassava and apomixis, specifically addressing the question why these interventions, in contrast to most genetically modified crops now available, may actually improve food security (Stone 2002a). These crop modifications are, however, still years off, and ILTAB is further along with another genetically modified cassava that may offer dramatic advantages to African farmers. A rapidly spreading gemini virus is devastating East African cassava, and whereas conventional breeding has been incapable of providing resistant strains, ILTAB has achieved viral resistance through genetic modification. The cassava is (as of this writing) being tested in Kenya. From an anthropological perspective, the matter goes far beyond the agronomy; it includes the nature of local economies (cassava can be used both for sale and subsistence), labor scheduling (cassava is particularly flexible vis-à-vis labor demands), and control over means of production (cassava is vegetatively propagated and so not amenable to corporate control).

Although success for ILTAB's genetically modified cassava would predictably be used as proof of biotech neo-Malthusianism, particularly its first two dogmas, this misses the point. This would not be a case of population outpacing food supply but one of a problem of declining production that happens to be solvable by genetic modification. Regarding the third dogma, it would be more accurate to say that the cassava has been developed in spite of corporate control over biotechnologies, since ILTAB has had to avoid incorporating some technologies into crops because of (usually corporate) patent encumbrances.

Gray issues have also been instrumental in my choice of field research sites. My principal ethnographic focus in biotechnology research is now in Warangal District of Andhra Pradesh, India. India is the most hotly contested battleground for genetically modified crops in the Third World, and Warangal in particular was the site of an epidemic of suicides by cotton farmers in 1998 (Reddy and Rao 1998). The suicides coincided with field trials of India's first genetically modified crop, a cotton, and galvanized a resistance movement that destroyed many of the plots. Both the biotech firms (Monsanto and Mahyco) and green critics (in particular Vandana Shiva) used the suicides in their rhetoric (Stone 2002b). The two sides offered a stark choice of causes for the suicides: American bollworms, in Monsanto's view, or multinational-driven globalization, according to Shiva. Equally stark was the contrast in their views of the likely results of selling genetically modified cotton: Monsanto claimed that it would prevent suicides, Shiva that it would cause more.

Of course, specifying causality in the complex affairs of society is an exercise in holding variables constant. Suicides are "caused" not just by either American bollworms or globalization but by a dozen insect pests, by pesticide resistance and the high cost of pesticides, by the ready availability of means for suicide (the pesticides themselves), by vendors' usurious lending practices and their draconian collection tactics, by unscrupulous seed salesmen and a weak regulatory system that fails to protect farmers from bogus seed, by the boom in the cotton market and government campaigns enticing farmers into risky practices, by the large number of small and marginal farmers, by the dropping water tables combined with the preponderance of thirsty cotton varieties, by the cost and unpredictability of hitting water in a bore well, by government payments to suicides' families, by alcohol abuse, and by a long list of other general and specific factors. Rather than championing a cause that serves one's own interests at the expense of a richer understanding of the situation at hand, my ethnographic science of the gray reaches for a more systemic and synthetic analysis of the sociocultural context into which genetically modified crops are being introduced.

This has led, so far, to an analysis of "agricultural deskilling" among cotton farmers in Warangal (Stone 2004). Deskilling is a concept from the Marxist literature (Braverman 1974); it originally referred to factories, but activists in Andhra Pradesh have charged that farmers would be deskilled by genetically modified cotton (Harwick 2000). In contrast, the biotech companies involved and other biotech proponents who have taken an interest in the Indian case have argued that the region's severe agricultural insect problems need to be solved by the latest market-driven technology. Agricultural skilling and deskilling are partly social processes, and they offer a good example of the need for the sort of synthetic perspective that is anthropology's strength. In this case, my analysis showed how and why farmers have already been partly "deskilled" in cotton (but not rice) cultivation. However, the first two years of Bt cotton planting have already brought qualitatively new disruptions in the skilling process and left farmers increasingly susceptible to paid lobbying by both green and industry sources.

The science of the gray is emphatically not an attempt to forge a middle ground in the biotech debate. Indeed, it has tended to arrive at a ground quite apart from industry of green orthodoxy (Stone 2002a). It has also attracted vigorous criticism from both sides on ethical grounds. It often seems a fairly lonely enterprise; there are few anthropologists asking discriminating questions from the perspective of Third World farmers (one other is Tripp [2001]). At the same time, it can also seem to place one in the company of farmers whose lives may undergo significant and subtle changes with new technologies and who would surely want to know that questions have been asked before they were answered.

Acknowledgments

For insights into topics discussed in this chapter I am grateful to Richard Fox, Charles McManis, and Nigel Taylor, although any errors in fact or interpretation are mine alone. Laboratory training in crop biotechnology was supported by the National Science Foundation under Grant No. 0078396 (Scholar's Award for Methodological Training in Cultural Anthropology); research on biotechnology and agriculture in Andhra Pradesh is supported by the National Science Foundation under. Grant No. 0314404.]

Notes

1. Data are from the International Service for the Acquisition of Agri-Biotech Applications (ISAAA) (James 2000). The ISAAA categorizes Argentina as a "developing" rather than an "industrialized" country, which is potentially misleading given that Argentina's transgenic crops are herbicide-resistant soybeans on mega-farms averaging 500 ha in size (Qaim and Traxler 2004).

2. The lead popularizer of this school of thought was the journalist Robert Kaplan,whose lurid essay "The Coming Anarchy" (1994) quickly found its way onto high government officials' desks; the leading academic proponent was Thomas Homer-Dixon (1994).

3. The demographic argument was in part theoretical, drawing on Malthus's consideration of the "passion between the sexes" ([1798] 1959:4); it was also empirical, the demography of colonial America providing the main case study. In all social classes growth may be slowed somewhat by anti-natalist "preventive checks," but "the lowest orders of society" (25) are characterized by "positive checks" of misery and vice, since "the lower classes . . . are disabled from giving the proper food and attention to their children" (22). . . . "The positive check to population, by which I mean the check that represses an increase which is already begun, is confined chiefly, though not perhaps solely, to the lowest orders of society" (25).

4. In 1998 the U.S. Department of Agriculture (USDA) was awarded a joint patent with the cotton seed company Delta Pine & Land for the first GURT. A GURT would oblige farmers to rebuy seed each year rather then replanting. In some crops, the nonreplantability that the seed industry craves is built in. The classic example is hybrid maize, which is produced by crossing inbred lines of this normally outbreeding plant; segregation causes a drop in yield in the F2 generation. Several other crops, notably soybeans, are not sold as hybrids, and genetically modified seeds could be replanted; biotech companies have to combat this through contracts with farmers. The "Terminator" patent was a public relations windfall for genetic modification opponents and was used to direct international attention to its threat to Third World farmers (Steinbrecher and Mooney 1998). Industry (and the USDA) avowed that the technology would actually benefit less developed countries by attracting investment into crop development, but the issue was enough of a public relations problem that Monsanto promised not to use the technology and never acquired Delta Pine & Land as it had intended. (Although media attention continues to be focused on this one patent, 14 have been issued, and some have been field-tested [RAFI 2001]).

5. The industry seeking to control this force has, perhaps not surprisingly, offered misdirection on this point. In 2000 Monsanto's director of public affairs

wrote that "a quarter of a century ago, Monsanto Co. scientists presented their senior managers with a dilemma: We could continue to discover new chemicals to be sprayed on crops . . . or we could chart the then-unknown waters of biotechnology and potentially help farmers grow healthy, safe food for more people and better protect the environment. . . . To travel [the biotechnology] path would be an enormous shift for Monsanto. . . . We made some choices at Monsanto 25 years ago based on information that led us to believe that biotechnology held the promise for a better way of growing food" (Foster 2000). The year 1975, mentioned three times in short piece, coincides with key advances in the laboratory, but it actually was in 1980 that Monsanto began building its biotechnology division (see Charles 2001). This was the time that gene patenting was established.

6. The "products of nature" doctrine is a part of the Supreme Court's long struggle to distinguish between an "invention" and a mere "discovery"—a distinction made necessary by the fact that the U.S. Constitution creates an ambiguous power in Congress to secure to "Inventors" the exclusive right to their "Discoveries." In case law the classic statement of this principal came in a 1889 case in which a patent was denied on a plant fiber that "nature had intended to be equally for the use of all men" (Ex parte Latimer, 1889 Dec. Comm'r Pat. 123, Comm'r Patents 1889). The principle was reaffirmed in 1948, when the Supreme Court invalidated a patent for a mixed bacterial culture on the grounds that the invention amounted to "no more than the discovery of some of the handiwork of nature . . . part of the storehouse of knowledge of all men" (*Funk Brothers Seed Co. v. Kalo Inoculant Co.*, 333 U.S. 127 (1948)). Even the Supreme Court's 1980 *Chakrabarty* decision affirmed that the "laws of nature, physical phenomena, and abstract ideas" are unpatentable, as is "a new plant found in the wild" (Burger 1980:xxx).

7. Diamond was the commissioner of patents.

8. Strictly speaking, Stewart's criticism concerned Snow's having allowed "premature release" of her findings on gene flow, but this was patently not the real issue; in fact, Stewart himself had just allowed the "premature release" of his own results, which reflected positively on genetically modified crops (Adam 2003), and Snow's research was already in press in a major scientific journal (Snow et al. 2003).

9. A material transfer agreement is a contract permitting a researcher to use a patented technology under specific conditions, which invariably include the researcher's not having the right to sell or distribute any inventions arising from that use.

10. "Overthrow capitalism and replace it with something nice," read a plaintive sign at the 2001 May Day demonstration at King's Cross in London.