Sociotechnical analysis of Transgenic Foods by Stuart Shell

My premise is that transgenic food technology occurs in an arena animated by political, economic, and social forces. My primary question is about the meaning of transgenic food technology, i.e. what can it tell us about the world in which we live? After giving some definitions, I will consider four worldviews and how they construct transgenic technology. Due primarily to its high-tech nature, I suggest that for 'transgenic food technology' to be meaningful we need to question the action-oriented and material foundations of the anthropology of technology.

TRANSGENIC CROPS

Although some define the term more specifically, 'biotechnology' refers to "any process that uses living things or organisms to accomplish work or an outcome we desire" (Brown). Making cheese, breeding apples and splicing genes all fit this definition. Arends-Kuenning and Flora Makundi identify three types of what I call laboratory biotechnology: tissue culture, used to make identical seeds from a few plant cells; molecular markers, which help scientists track desired traits in the development of new varieties; and genetic engineering. Genetically engineered organisms, also referred to as genetically modified or transgenic, contain DNA that has been altered using either a plasmid method or a 'shotgun method' (Penn State). These methods, while requiring laboratory processes and equipment, are not precise. Scientists cannot control the insertion point for the DNA series containing the trait to be transferred. Tests must be performed to identify whether the trait has been transferred from the donor organism. Developing a plant with the desired trait takes about a decade, which is often half the time required by traditional cross-breading techniques.

Transgenic food technology is the process of creating transgenic organisms with qualities perceived to be beneficial for food producers, food marketers, food consumers or the ecosystem. This process involves action on test organisms facilitated by laboratory equipment and performed by knowledgeable technicians. Agrochemical companies that supplied hybrids and pesticides for the Green Revolution of the 1960's and 70's segued into the transgenic crops in the mid-90's. The first wave of transgenic crops has already claimed a significant share of food production, notably in soybeans, rice and corn. In the United States, about half of all soybeans are transgenic and by 2004, three-fourths of all corn production will be Bt corn (Hillyer). These first uses of genetic engineering produced varieties that increased yields and lowered pesticide use, aims termed 'agronomic' in that they primarily benefited producers and agricultural companies. Where government agencies played the primary role in the yield gains of the first agricultural revolution, the so-called 'life sciences' corporations are leading the second (genetic) revolution. Albert Sasson explains the recent past of agribusiness:

> The complexity of these technologies and the associated intellectual property-right issues account for the trend toward oligopoly with respect to patent ownership as well as for the mergers and acquisitions leading to the big life-sciences corporations. The size of the latter, their great research capacity and patent portfolio enable them to deal with the complexity of intellectual property rights and bring their products onto the market.

Bt corn was an early result of transgenic technology. A naturally occurring insecticide, Bacillius thuringiensis (Bt), was integrated into the plant's genome, allowing it to survive contact with the insect-killing bacterium. Use of Bt corn has reduced the amount of chemicals used by farmers and marginally increased yield. Roundup Ready soybeans, developed by Monsanto, is another widespread example of transgenic technology at work (Whalen, Penn State). Transgenic varieties that promise economic, ecological, flavor or nutritional benefit are likely to appear and spread in all sectors of agriculture.

FOUR WORLDVIEWS

The major players in transgenic food technology are agricultural companies, governments, conventional farmers, organic farmers, food manufacturers, consumers, environmental groups, scientists, and international organizations (Penn State). At work within these sectors are, as I see it, four basic worldviews that explain divergent meanings for transgenic food technology. For simplicity, I name these worldviews 'optimistic,' 'skeptical,' 'anti,' and 'anonymous.' These worldviews cut across sector, cultural, gender and ethnic divisions. Each worldview frames the food problems that our world (and 'world' is not common between worldviews either) confronts differently, and accordingly sees a different role for transgenic foods. Following Ellul, concepts that define what I am calling worldview, which serve to "check" technique, are morality, public opinion, social structure and the state.

The optimistic worldview is supported by Pfaffenberger's Standard View of technology. This view applauds the Green Revolution of the 1960's, which increased crop yields allegedly reduced hunger worldwide through the introduction of hybrid crops, monoculture, herbicides and pesticides. In this

view, consumers need crops that have improved taste, color and longevity. Poor farmers need to increase yields to increase profits, while being made to conserve the ecosystem. Transgenic crops promise to: generate solutions to growing crops in less-that-ideal soil conditions, provide more nutrition by adding zinc, iron and vitamin A to crop genomes, deliver vaccines, and reduce the use of chemicals. Some even foresee transgenic foods helping with the Western world's obesity. Two issues that proponents of this view stress are the need to ensure that poor farmers in developing countries have access to the varieties and the need to refine the property-rights structure relating to transgenic innovation. The technology will be developed and disseminated by corporations that, while they seek profit, also need to "maintain a credible public image" (Sasson). By this view, transgenic food technology will benefit all.

The skeptical worldview is not as certain of the promise of transgenic technology. This view, along with the optimistic view, claims analyticity as its ally (that is, proponents see their behavior as rational, practical and scientific), but recognizes the role that social and economic factors play in determining the effects of a technology. "Through experience with the Green Revolution, economists have learned that the social and economic environment people live in have more to do with who benefits from new technology that the specific characteristic of the technology itself" (Arends-Kuenning). Proponents of this view suggest that transgenic crops are not a blanket solution for poor farmers, but that they represent a significant technological innovation with applications that could empower poor farmers (Manning). They suggest that the technology may be useful in certain circumstances, focusing on who controls the genetic information (in production and reproduction). For honesty to the reader, my bias lies somewhere between this worldview and the anti view.

The anti worldview claims that the purveyors of transgenic technology can do no good for the world. (I have not investigated the work of those who view as morally wrong transgenic technologies, either on the basis of religious or Gaia-esque principles. This group would also view transgenic technology negatively.) Similar to the skeptical worldview, the anti worldview sees technology as a tool, as expressed by ecofeminist Vandana Shiva: "technology assessment and choice demands that technology be treated as what it is, a means and not an end in itself." The anti view is critical of the Green Revolution, which not only failed "to remedy unequal access to food and food-producing resources, it actually contributed to inequality" (Mittal and Rosset). Similarly, transgenic food technology is ironically being developed to benefit capitalists while claiming to help the hungry. From the anti perspective, transgenic technology poses an unprecedented risk to biodiversity. The spread of transgenic crops, and the genes that could be passed to other organisms are ecological wild cards of unprecedented scale. Proponents also observe that technologies are developed for mature consumer markets and corporate efficacy, not the needs of developing countries. "Small-scale ecological agriculture" is the most attractive future for the anti worldview (Mittal and Rosset). This view is exemplified by the Monsanto Quit India protest.

In much of the literature on transgenic technology, poor farmers in developing countries are said to want to retain their ethnic identity and ecological closeness, while avoiding dependence on international agribusiness corporations. Still in other versions, the farmers are aspiring entrepreneurs, with hopes of contributing to the global economy. In other cases, the poor farmers and starving landless persons are above having a moral stance on transgenic foods, because they are desperate for reliable crops. I quote one such example from Richard Manning at length:

> The villain in [the Indian researchers'] discussion is an insidious little worm, a pod borer, which makes its way unseen into the ripening chickpea pods and eats the peas. It comes every year, laying waste to some fields while sparing others. Subsistence farmers expecting a bumper crop instead find the fat pods hollow at harvest. Dozens will then kill themselves rather than face the looming hunger of their families. So while the battle wages over "frankenfood" in the well-fed countries of the world, here in this Pune lab the arguments quietly disappear.

A worldview where "arguments quietly disappear" is difficult to characterize. 'Biodiversity' and 'insect resistant' are conceptual devices, and as such, can conceivably disappear. I want to posit one last worldview on transgenic food technology: anonymous. These persons have no voice in the literature. I would suggest that they are apathetic to the concept of transgenic food technology. What I mean is that, in Leroi-Gourhan's terms, the anonymous internal milieu cannot currently accommodate the concept 'transgenic.' The anonymous worldview will not add much to my location of meaning for transgenic food technology, but I think it is nonetheless important. Those adherents of the anonymous view, wrongly and inevitably grouped together, are key players for the other three worldviews. Because we do not know how they would receive transgenic food technology (or as I suggest, they might not be capable of receiving it), a blank place should be left. This fissure might help

remind us academics that we don't know and cannot know completely what a technology is. For some groups, transgenic crops don't even exist (even though they might be growing them).

SOCIOTECHNICAL ANALYSIS

A method for dealing with technology in a social setting has been developed in a line of thought punctuated by Durkheim, Mauss, Leroi-Gourhan, Lemonnier and Dobres. I am calling this tradition *sociotechnical analysis*. Since I am only familiar with a small portion of this literature, I have modest expectations for applying these thinkers' concepts to transgenic food technology in a global setting. The main problem with submitting transgenic food technology (as I have defined the process) to sociotechnical analysis is that it is not clear how this technology impacts material culture. What transgenic technology means is largely a function of which worldview we pursue. For example, emerging from trade disputes between EU and US was the opinion (buttressed by the optimistic worldview) that transgenic crops are not significantly different from other crops (Victor and Runge). Following this line of thought, the crops represent an incremental step in the evolution of biotechnology, and they will have as much impact on material culture as the development of the navel orange did. So the crops will definitely affect material culture, but not in a concerning way (no one was too worried about the development of cheese). The anti worldview holds that "it's not the nature of genetic engineering itself that's the problem; it is the way genetic engineering has evolved" (Snell). The private sector's lead role in developing and controlling the technology is immeasurably more important than the technology itself. The technology appears to as a tool of oppression here, not an agricultural evolution, and as such has no impact on material culture. The wielder of the tool impacts material culture. The inability to agree on what transgenic technology is points to the difficulties that prohibit a clear sociotechnical analysis.

Lemonnier writes that a sociotechnical analysis requires that we ask how transgenic technology can express meaning –what are its social representations (unconscious, schema, symbol). Since few persons are involved with the operation of electron microscopes or the identification of molecular markers, which would require unconscious motor skills and refined scientific schemas, we should look to the world of symbols to understand how transgenic technology has meaning. My conclusion is that transgenic technology means something to persons (and not particularly social groups) because it represents some aspect of their worldview.

I approach transgenic food technology with the concept of worldview not because I think that worldviews possess agency (or even that they are real), but simply because I think they will be useful in understanding the space that technologies like genetic engineering inhabit in culture. The worldview concept, for me, is an attempt to establish some tenets that I intuitively think have a great deal of correlation -for example, that persons who see technology as unilinear and autonomous tend to see a unidirectional relationship between humans and the ecosphere (aspects of the optimistic worldview). Such a person would also be likely to harbor high hopes for transgenic technology. My classifications are not supposed to precisely delimit camps in our world, but rather to help animate the variegated appearance of some (high-tech) technologies.

A worldview-oriented theoretical structure is a different starting point than the concept of milieu. Milieu points to something that is actually at work in the world –a characterization of social agency. As such, milieu applies homogenously to a social or ethnic group. To me, the idea of milieu seems very promising (and has been, no doubt) for understanding ways that material culture interfaces with society. Generally, I feel persons studying techniques of material culture believe they are studying 'technology,' which makes sense, especially etymologically. However, attempts to circumscribe what we refer to as technology with a material culture component are unduly restrictive. Lemonnier insists "to be called 'technological,' an action needs to involve at least some physical intervention which leads to a real transformation of matter." Correspondingly, an important tool for Lemonnier (and Leroi-Gourhan) is the operational sequence, which maps out with video, diagrams or detailed time table how exactly a technique is executed. But when talking about aeronautics, which is certainly 'technological,' Lemonnier writes nothing about gestures. We need to understand how the actual (human) act of constructing an airplane in time and space impacts society. Of course, only a small segment of our society makes or flies airplanes. To what extent passengers are actors in the techniques of aeronautics is debatable. However, it seems like a stretch to say that airplanes are really part of our material culture, in the sense anthropologists intend when they talk about clothing or cooking (activities that all culture members participate in as an everyday part of life).

This problem with definitions gets worse with increasingly high-tech techniques. Coding computer software is socially important (at least for

affluent societies) but we rely on relatively few programmers to maintain Lemonnier's link between technical act (recording digital information) and social representation. I face the same dilemma with transgenic food technology. There are certainly social representations concerning the nature and desirableness of transgenic foods, but they do not correlate very well with material culture –in this case, the reality of the foods and their production.

Ridington summarizes a trend in affluent societies that leads to the problem I'm having with defining technology as action on matter. Because the forces of production have become largely disengaged from the social matrix, artifact has replaced artifice as the referent of technology. Ingold similarly questions why the "idea of 'technology' invariably leads us to think in the first place of objects rather than practices…." Specialization, automation, digitization and probably some complex financial structures have removed much of the human interface from material culture. Hence the limits of a definition that demands things technological to act on the material world and involve 'gestures.'

From what I interpret, the main problem with forces of production that are "disembedded from the social matrix" is that we lose our sense of ecological limitations. As much as anthropologists would like to build connections between ecology, society and technology, the condition of modernity stress these relations. It is critical that we move towards an understanding of how we live with technologies that have no clear relation to gestures and, therefore, ecology. I think this is what is ultimately behind Lemonnier's use of social representations as a way to construct a theory for both highly strategic and minimally strategic techniques (like rocking a child and investing money in oil companies). This is also why I suggest a less ecologically informed theory for high-tech techniques that would explicitly avoid a distinction between the physical and mental realms.

Anthropologists show the desire to include social, archeological, linguistic and technological considerations in their analysis of technique. The general desire to unify disparate fields characterizes modern times. Chomsky, in discussing the unification tendency in the fields of physics and chemistry, stipulates a future unification of neurophysiology and linguistics. Authors in the field of anthropology of technology are similarly struggling to build theoretical foundations to explain technological meaning in social terms. Chomsky's insight is that the unification of fields (the development of a framework for relating fundamental phenomena) has not helped *explain* the phenomena under scrutiny. His example, also relevant to our subject, is that Newton, in describing how masses accelerate, found it impossible to eschew "absurdities" like invisible forces and action-at-a-distance. His physics and ours are based on concepts that cannot be explained without recourse to god-like constructions such as forces and gravity. The mind-body conundrum dissolved with Newton, who showed that physical phenomena couldn't be explained any more than could the faculty of language –the bulwark of the soul. My point here is two-fold: a theory of societal techniques should be based on all types of things mental and physical (not necessarily involving physical, as in Lemonnier); and the unification of sociology with anthropology might not yield the nexus for meaningfulness anticipated.

I'll conclude with a comparison that illustrates the generality demanded of a theory uniting social agency and technique. The way Americans drive cars is easily understood within the material culture framework. Most would even agree on a description of the car-driving technique we use, regardless of how feelings differ regarding the 'sustainability' of the automobile. American car driving is a culturally homogenous technology that fits the schemas of anthropologists such as Lemonnier, gestures and all. But transgenic technology is not so easily reconciled to sociotechnical analysis. There are numerous understandings in America of what this technology is, and how we should react to its application to our food. There is no clear material component to transgenic technology as there is in car-driving technology. There is no way to limit the techniques or gestures involved in lobbying, developing, patenting, distributing, growing, processing, serving and eating foods that are genetically modified. One objection is that America is too geographically big for sociotechnical analysis. But listening to just a city or a town in America will quite disagreement about genetic engineering. Another option is to deny that genetic engineering is properly 'technological.' Barring that, we have to seek a theoretical approach that can handle intra-cultural heterogeneity and that is not resting on material or action-oriented foundations. Utilizing the worldview approach to delimit the definition of transgenic food technology seems like a promising start to the search for meaning.

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