Food and Agricultural Biotechnology: Incorporating Ethical Considerations

Prepared for

The Canadian Biotechnology Advisory Committee
Project Steering Committee on the Regulation of Genetically Modified Foods

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October 2000

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Aussi disponible en français sous le titre *Intégration de facteurs d'éthique à la biotechnologie alimentaire et agricole*.

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Executive Summary

Many of the expressed concerns about food and agricultural biotechnology are described as >ethical=. Decision leaders should interpret the expression of ethical concerns as a demand for competing visions of nature and the public good to be expressed in public dialog about food and agricultural biotechnology, for those who feel that their values have been neglected to have an adequate opportunity to express their concerns in their own words, and for their voices to be heard. This White Paper provides a framework for understanding the force of these concerns and a summary overview of them, but it should not be interpreted as a substitute for actual public dialog on ethical concerns.

Those who call for attention to ethical issues appeal to many diverse values. Their concerns can be classified into two broad categories. On the one hand, some see the very act of using genetic technology to raise ethical issues that would not apply to other applications of food and agricultural technology. On the other hand, some believe that specific applications of biotechnology raise ethical issues that are not being adequately addressed, even if these issues may be raised in connection to other, more conventional types of agricultural technology, as well.

Special Arguments Pertaining to the Use of rDNA Technology. There are several types of concern noted by those who question whether the use of biotechnology may be intrinsically questionable.

- **Genes and Essences.** Longstanding religious and cultural traditions associate the idea of a particular Aessence@ with different species of living organisms, and specify an obligation for human beings to respect these essences. Some may associate the modern notion of genes with this traditional notion of essence.
- **Species Boundaries and Natural Kinds.** The idea that there is a specified Aorder of nature@ may involve the belief that the species of plants and animals we find around us represent natural kinds. Some may fear that biotechnology disturbs this order and thereby violates absolute limits on what human beings are ethically permitted to do.
- **Religious Arguments.** Many religious traditions prohibit acts that involve transpecies reproduction, or ban the consumption of some species groups for food, and the mixing of foods from different groups. Biotechnology may be interpreted as contrary to some of these religious traditions.
- **Emotional Repugnance.** Cultural traditions dictate that some potentially consumable substances (e.g. species such as cat and dog, or particular parts of plants and animals) are

not suitable for use as food. Western food systems currently respect the repugnance that people feel toward these substances as a sufficient ground for policies that help people avoid consuming them. Some individuals may feel a similar repugnance toward bioengineered foods.

General Technological Ethics. There are a number of ethical questions that can be raised with respect virtually any new food or agricultural technology. As they are raised in connection with biotechnology, these questions suggest the following types of ethical concern:

- **Environmental Ethics.** Technology raises environmental issues when there are environmental exposures that pose risk to humans, wildlife or to ecosystem integrity. It has been alleged that agricultural biotechnology may pose risks to wildlife in or near farm fields. There are also issues associated with the question of whether agricultural ecosystems can themselves to exhibit features of ecological integrity.
- **Food Safety.** Many of the issues associated with the safety of eating bioengineered foods are technical, but the question of whether regulators should make this decision based on an assessment of the risks, or whether individual consumers should be placed in a position to make the choice themselves is an ethical one.
- **Moral Status of Animals.** If genetic engineering of livestock would compromise animal welfare, there are ethical questions that can be raised. There are also ethical questions about whether it would be ethical to use biotechnology to make animals more tolerant of production settings that are currently regarded as inimical to animal welfare.
- **Impact on Farming Communities.** Some critics of agricultural biotechnology have alleged that it will contribute to farm bankruptcies and the depletion of farming population in rural communities. There has been a longstanding ethical debate as to whether technology or policy that has these effects on farming communities can be ethically justified in virtue of offsetting benefits in the form of efficient production and lower food prices. The concern is particularly relevant to the impact of biotechnology in developing regions where many farm at the subsistence level.
- **Shifting Power Relations.** Related to the concern on farming communities, some have argued that biotechnology will help a few well-capitalized firms control decision making in agriculture (including future research), and limit farmers= ability to choose from an array of production possibilities. This concern is related to a general ethical concern with the distribution of economic power and wealth in democratic societies.

Responses to These Issues. This section of the paper discusses several approaches that have been discussed as a possible response to these various ethical issues.

- **Uncertainty and the Precautionary Principle.** Many of these ethical issues involve uncertainty about the risks or outcomes associated with biotechnology. The Precautionary Principle has been suggested as the appropriate decision rule to utilize in response to such situations. It suggests that decision makers should not permit technological innovations to go forward simply because alleged harms have not been proven to exist. However, it is not clear how the Precautionary Principle should be applied in the case of food and agricultural biotechnology.

- **Consent, Labels and Consumer Choice.** Various proposals for labeling products of biotechnology have been discussed. On the one hand, these proposals are supported by an informed-consent approach to issues in food safety, and may be the most satisfactory response to concerns based on religious values, emotional repugnance and other intrinsic objections to biotechnology. Labels might give individuals who have these concerns an opportunity of exit, to opt out of a food system that causes them anxiety or concern. On the other hand, labels may stigmatize bioengineered foods, and may not provide information that would be useful for consumers trying to make choices on the basis of nutrition and food safety.
- **Methods in Applied Ethics.** How do methods in ethics suggest a response to these concerns. One approach suggests that common ethical principles can be applied to provide definitive answers to the questions raised above. A more promising approach suggests that only open public discussion of these issues can produce an adequate basis for responding to the questions that critics of biotechnology raise.

Trust and Public Confidence. As debates over food and agricultural biotechnology become politicized, with activist organizations opposing both industry and governmental spokespersons, there is a growing tendency for public discourse on biotechnology to reflect the strategic interests of industry and activists. There is a grave risk that as science becomes deployed in these debates, scientists themselves will be come so tainted by the strategic character of debate that the public will begin to lose confidence in the objectivity and judgment of scientists. Scientific spokespersons thus have an ethical responsibility to develop a capacity to participate in ethically-charged public discussions of biotechnology without either denigrating the values of others by characterizing them as irrational, or presuming uncritically that their science-based perspectives are the ethically proper approach to take.

Conclusion: Ethical issues associated with food and agricultural biotechnology must be regarded as open-ended and in great need of more structured and serious dialog. The issues sketched in this White Paper are only an overview. Both specialists and members of the public should be encouraged to articulate their concerns, and to respond to the views of others in a considered and respectful manner.

Food and Agricultural Biotechnology: Incorporating Ethical Considerations

This paper provides a framework for understanding the range of ethical concerns and for appreciating the value judgments that underlie conflicting opinions on the ethical responsibilities associated with food and agricultural biotechnology. The range of ethical concerns that have been or might be raised in connection with food and agricultural biotechnology displays considerable complexity. It is impossible to do full justice to this range in a paper of this length. The goal is rather to provide readers with a way of appreciating the multiple bases of ethical concern, and to sketch the types of argument that would be deployed in interpreting and developing each area of concern more fully.

Three broad types of concern can be distinguished. First, it is possible that the use of gene technology is itself the basis of concern, that there is something about the manipulation of living matter at the genetic level that is of ethical concern. Second, it is possible that gene technology is of ethical concern because it poses risks to animal, environmental and human interests, including not only individual health and safety, but also economic and social considerations. One would expect that concerns in the first category would not arise in connection with conventional chemical, mechanical and breeding technologies used in food and agriculture, while concerns arising in the second category would be generally applicable. Finally, there are ethical concerns that relate less to the products or processes of food and agricultural biotechnology than to the social institutions that develop, promote and regulate these technologies. It has been suggested that these institutions are suffering from a deficit of public trust. The final section of the paper discusses the ethical dimensions of this problem.

Because other papers in the Industry Canada initiative will address environmental and food safety risk, as well as intellectual property, this paper does not include any technical, legal or regulatory discussion of these issues. These issues are discussed solely in light of the ethical concerns that are raised in connection with them. The analysis and opinion expressed in this paper is solely the responsibility of the author. The paper includes a summary of analysis published in the author=s 1997 book, *Food Biotechnology in Ethical Perspective*, and substantial discussion and interpretation of events and concerns that have come to light since that work was completed.

1. The Nature of Ethical Concerns

The term >ethics= applies broadly to the normative bases for human action, for judgments about the acceptability, advisability and justifiability of practices, and for criteria of responsibility and justice. Normative bases stipulate ideals, values or standards that ought to be reflected in human conduct, and may be distinguished from matters of fact that may also form a

component of the basis for action or judgment in a particular case. The term ›ethics‹ is itself open to conflicting interpretations. On the one hand, ethics deals with almost universally recognized norms that are both implicit within everyday social interaction and explicitly articulated in public sources such as legal or professional codes of practice, religious texts, folktales, literature and philosophy. On the other hand, the ethical dimension of conduct and reflection is often characterized as inherently personal, introspective and inherently unsuited to public discourse.

Given this range of interpretation, ethical concerns associated with food and agricultural biotechnology can be expected to comprise highly idiosyncratic personal reactions of individuals, identifiable traditions and values of particular social groups, and broadly shared social norms. Although the number and kind of potential ethical concerns given this diversity is overwhelming, the need to coexist within society has established several key procedures for systematizing ethical values and coping with ethical diversity in pluralistic societies. Above all, pluralistic societies are tolerant of divergent individual values and idiosyncrasies, particularly when personal ethical values do not give rise to social conflict.

Citizens of pluralistic societies are seldom placed in the position of articulating personal values explicitly or of defending them publicly. As they are unpracticed in expressing ethical concerns, their statements of ethical concern are often broad or obscure. For example, statements to the effect that food and agricultural biotechnology is unnatural convey a judgment of disapproval, but do little to articulate the basis for that judgment. In one sense, all of agriculture is an unnatural activity, but we should not infer that all of agriculture is therefore of ethical concern. Without further explanation it is difficult to understand how such a broad judgment of disapproval could be used to distinguish an ethically unacceptable practice from any other. This paper develops a framework for interpreting such concerns with a greater degree of specificity, and for understanding how they might be applied in rendering a judgment, favorable or unfavorable, with respect to food and agricultural biotechnology.

The framework of analysis being proposed in this paper reflects a particular way of interpreting ethics. *Discourse ethics* is a program in philosophy that prescribes a general approach for understanding ethical issues (see Habermas, 1990). According to this program, when one is presented with an ethical objection to an opinion or course of action, one has a responsibility to ensure that one has first understood the force of that objection. Second, one must either alter the opinion or course of action to accommodate the objection, or offer a response that explains why the objection has been rejected. This means that those who offer an ethical objection are owed a reply. The reply should restate the objection in terms that the person who offered the original objection can accept. If the terms are not accepted, one must conclude that one has not understood the objection, and try again. If the reply to an objection involves a rejection of it, one owes the person who offered the objection an opportunity to make another reply, which of course may occasion further objections and replies. Obviously, this is a process that can go on at some length, so we must regard discourse ethics as an idealization, and we must recognize that time and resource constraints limit the extent to which ideal discourse can be realized in practice.

Discourse ethics has several advantages for understanding the nature of ethical concerns regarding food and agricultural biotechnology. It provides a framework for understanding and respecting diversity of opinion about ethical issues, but it does not suggest that ethical issues are *merely* matters of opinion, or that they are wholly subjective judgments that are inherently undecidable in a public forum. It also provides a way of understanding how the expressed perceptions and concerns of the public can be developed into statements that are more clearly applicable to the real decisions that must be made regarding science and public policy (see Kettner, 1993). The average member of the lay public is especially constrained by resources and is unpracticed in extending ethical viewpoints beyond their initial expression. Advocates, scholars and participants of special forums and committees can take the process of discourse ethics a number of steps beyond the initial expressions of approval or disapproval. We may interpret this as *practical ethical discourse*. While falling short of the unrealizable ideal case in which all objections are fully answered, practical discourse attempts to treat ethical issues with the seriousness that they demand.

Many of the ethical issues that been raised in connection to food and agricultural biotechnology might as easily have been raised in connection with virtually any agricultural or food system technology. As such it is useful to begin by breaking the issue into two large categories. First, what considerations that might lead someone to attribute special significance to the use of genetic technology and gene transformation? Second, what are the general issues of technological ethics, issues that pertain to genetically based technologies, though not uniquely. Within this second category, attention will be given to four broad subcategories: consumer issues, environmental impacts, animal ethics and social consequences. Finally, it is important to examine why issues in the first category might have led many in the public to be particularly sensitive to general issues in technological ethics, and to examine the particular imperatives for achieving public trust in biotechnology.

2. Special Arguments Pertaining to the Use of rDNA Technology

The most sweeping ethical argument against food and agricultural biotechnology would be one that derives its force from the judgment that the manipulation of genes or cells is either categorically forbidden or presumptively wrong, so that compelling arguments would need to be adduced in its favor. Fable and myth provide a basis for the idea that certain forms of knowledge or technology may be subjected to such proscription (see Shattuck, 1997). It is not clear whether members of the lay public who express ethical reservations about gene technology have such a view in mind, but it is reasonable to presume that some do. There are many ways in which such a claim might be stated, though on further analysis most formulations of the view that there is something inherently problematic about gene technology fail. For example, empirical research indicates that many members of the lay public who find food or agricultural biotechnology ethically objectionable base their judgment on the view that it is unnatural. But why is something that is unnatural also unethical?

Straughan (1995) and Comstock (1998) review a series of ways to extend the claim that gene technology is unnatural into a more substantive ethical argument for regulating or restricting crop biotechnology. The general problem is that while, in one sense, all forms of modern technology are unnatural, no one has succeeded in articulating a principled way of stating why the unnaturalness associated with the manipulation of DNA is unethical, while ordinary plant and animal breeding, computers and modern transport are not. More persuasive extensions of the claim that gene technology is unnatural cite environmental risks, but with this argument there is no need to attribute special *ethical* significance to the fact that DNA has been manipulated. Any technology can be evaluated ethically with respect to its environmental risks. Manipulation of DNA may or may not create unique opportunities for environmental impacts, but that is an empirical, not an ethical, question. The ethical significance of environmental risks will be discussed below.

2.1 Genes and essences.

Since antiquity, people have thought of living things as having Aessences@ that constitute their essential being. One view of biotechnology may see it as Atampering@ with these Aessences@. Criticisms voiced by Rifkin (1985, 1995) suggest such a judgment, and it is particularly associated with those who have suggested that genetic engineering violates a species= *telos*. (See Fox 1990, 1992, 1999; Verhoog, 1992, 1993). The term >telos= is derived from the philosophy of Aristotle, where it was used to indicate a thing=s guiding or final purpose, realized in the case of living organisms through the processes of growth, development and reproduction that are characteristic of their species. It is associated with *teleology*, a philosophy of nature that seeks to explain biological processes in terms of function, purpose and design. Although teleology does not necessarily prescribe particular ethical norms, versions of teleology that find a predetermined design in nature, often the work of a supernatural intelligence, move quickly to the ethical judgment that humans deviate from the preordained purposes of this plan at their physical and spiritual peril.

Nelkin and Lindee (1995) note a general cultural tendency to interpret genes as bearers of the traditional notions of essence and purpose that would achieve moral significance in some teleological conceptions of nature. Gifford (2000) has shown how this conception of the gene as cultural icon fails to correspond with the conception of genes that is operative in contemporary molecular biology. Scientific authors do not characterize the processes of cloning or genetic transformation in terms that would support the judgment that essences and *telos* are being affected. As such, there is a gap between the ethical understanding of nature implicit in philosophies that attribute essential or teleological significance to genes or gene processes, and the dominant scientific interpretation of the practices that constitute food and agricultural biotechnology.

It is not clear who bears the burden of proof with respect to further development of this line of ethical concern. On the one hand, those who believe that genes have the ethical status of essence or *telos* have not shown how the idea of genes as sequences of DNA can be made compatible with traditional notions of essence or *telos*. One might argue that this line of criticism has reached a dead end until such an argument is forthcoming. On the other hand, one might

argue that scientists and practitioners of biotechnology bear the burden of explaining how modern biology departs from traditional notions of purpose and essence that may still be very active in the worldview of non-scientists. In fact, it seems more likely that this line of thinking will devolve into a more straightforward environmental concern, or into one of the other expressions of concern discussed immediately below.

2.2 Species boundaries and natural kinds.

Human cultures display a remarkable constancy with respect to the way that species boundaries are taken to reflect a kind of natural order, reflected in the linguistic tendency to build the system of meanings around natural kinds. Plants and animals visible to human senses and important for human purposes are described as kinds, rather than as particular things not amenable to classification. Although different cultures parse the world around them in different ways, human languages tend to have equivalent kind-terms for ›dog‹ ›cat‹ ›tree‹ or ›flower‹. Verhoog (1993) suggests that this tendency is evidence for an underlying system of purposes such as those discussed immediately above. He also makes the separate argument that biologists lack any special authority to redefine these terms to more faithfully reflect the scientific construal of kinds as interbreeding populations. The force of this second argument is that modern biology is challenging the most basic way in which human beings have made sense of the world since antiquity—and so much the worse for modern biology.

This is not an argument form that has widespread appeal, though it is one way of making sense out of the claims made by some of biotechnology's most vehement opponents. It deserves consideration if only as a possible way of explaining why biotechnology and molecular biology seem to cause such a profound sense of anxiety. It is not clear whether the next move should be a stronger statement of the reason why the need to preserve the basic categories of human language (and perhaps, by extension, of humanity's collective intelligence) entails any specific proscriptions or norms with respect to food and agricultural biotechnology. Alternatively, a need for better public education in biology might follow, on the assumption that the real problem is the underlying anxiety and disorder associated with shifting worldviews. Better practical ethical discourse on food and agricultural biotechnology might even be a means to resolving the tension felt by those who feel that modern molecular biology threatens the most basic categories that human beings use to make sense of the world.

2.3 Religious arguments.

Many people clearly attach religious significance to species boundaries and question the wisdom of genetic engineering. Furthermore, many of the world's religions endorse specific injunctions against crossing species boundaries, interfering in reproductive processes, and consuming proscribed foods. As noted already, some of the most plausible ways of understanding the view that biotechnology is unnatural or that it tampers with the natural order against the demands of morality involve appeals to divine authority. Furthermore, worldviews that construe nature as bearing specific forms of moral significance may also be considered as resting on religious foundations, especially when they involve beliefs that are not amenable to scientific characterization and measurement.

The ethical significance of these facts can be pursued in two distinct ways. First, one may examine the theological or doctrinal basis for this judgment, given the sacred texts, sectarian juridical processes and doctrinal traditions of specific religions. Second, one may simply acknowledge that the principle of religious tolerance affords people with wide latitude for deriving faith-based opinions on food and agricultural biotechnology, and inquire how these intrinsically personal ethical judgments entail social norms. Worldviews and normative beliefs about nature and natural order must be regarded as protected by principles of religious tolerance even if they do not derive from recognized religious traditions, churches or theological traditions, and even if they do not involve belief in a supernatural power. Arguably, the second approach converts the significance of religious beliefs about gene technology into a problem of consumer and social policy. The norms that guide action are based on a secular principle of religious tolerance, rather than (or in addition to) norms that make specific appeal to religious inspiration or doctrine. Tolerance implies that religious believers should be able to act on their beliefs, but these issues will be taken up in section 4.2.

In societies with established churches or strong religious majorities the first of these approaches may be an important source of practical ethical discourse itself. In such circumstances, the result of a religiously oriented examination of food and agricultural biotechnology may accurately reflect the society=s consensus moral judgment of its acceptability. Even in religiously pluralistic societies, deliberations by established religious authorities represent an important contribution to public moral discourse, as these deliberations often constitute precisely the sort of reflective and critical thinking that practical ethical discourse demands. Clearly, religious deliberations represent an important source of insight with respect to the application of cloning, genetic engineering and other forms of gene technology to human beings (see Nelson, 1994; Peters, 1997).

Prior to the announcement of successful adult cell nuclear transfer cloning of a sheep in February 1997, churches and denominational organizations have made few public statements about food and agricultural biotechnology. Those that have been made (both before and since Dolly) suggest that gene technologies have special ethical significance when applied to human beings, but that the ethical issues associated with food and agricultural applications can be adequately conceptualized under the framework of technological ethics, discussed below (see also Thompson, 1997). Unless more specific religiously based claims about food and agricultural biotechnology are made, it is reasonable to assume that it is the consumer, environmental, animal welfare and social consequences of these technologies that are ethically significant, and not the fact that rDNA is being used as an instrument of practice.

This is not to suggest that individuals and specific religious groups do not or will not have faith based objections to the use of food and agricultural biotechnology. Indeed, it seems likely that some of those who find the technology unnatural are working from conceptions of nature that are so inconsistent with those of contemporary biology that we must regard them as Afaith-based@ even if they make no specific appeal to God or recognized religion. However, one of the main implications of calling these views faith-based is that the individuals who hold these views are regarded having a right to hold and act on these views irrespective of modern science or of the rational give and take that constitutes practical ethical discourse. The fact that people

have these views does not provide a public basis for constraining or regulating the practice of food and agricultural biotechnology. Rather this fact establishes a prima facie obligation [1] to respect these beliefs and to accommodate a believer=s desire to act on faith-based beliefs in their daily life. Any form of technology that compromised people=s ability to hold and act on faith-based beliefs would raise ethical concern, so the ethical issue that is raised here is a general concern of technological ethics, rather than a special concern associated with gene technology.

2.4 Emotional repugnance.

Genetic modification of foods causes an immediate reaction of repugnance among many. The most sophisticated philosophical statement of the ethical significance that should be associated with that reaction was made in brief article by Kass (1997), commenting on the announcement of Dolly, the sheep cloned by the Roslyn Institute in 1997. Kass=s central argument is that mammalian cloning elicits a repulsive reaction from many, and that this repugnance is sufficient ground to regard cloning as intrinsically wrong. In making this case, Kass relies on a conservative tradition in ethics that harks back to the philosophical writings of David Hume, Adam Smith and Edmund Burke. These philosophers believed that morality was based on sentiments of sympathy with others, and that emotional attachments were a key component in any moral judgement. Although they lived and wrote in a pre-Darwinian culture, they also believed that emotional reactions like repugnance reflect a deep-seated and culturally ingrained wisdom. Societal stability is the result of respecting these emotional reactions, and departure from them entails the risk of upheaval and dissolution.

Several points should be noted in reply. First, arguments from repugnance been abused to support discriminatory practices against women and minorities. They have been almost entirely discredited in the mind of some. Second Kass=s argument is focused primarily at *human* cloning, though he finds many instances of animal cloning repugnant, as well. It is not implausible to extend the general argument to cover reactions to a wide array of food and agricultural biotechnologies. However, if there are morally compelling applications of cloning and genetic engineering, this may be sufficient to overcome immediate reactions of revulsion. Finally, more than any other of the above issues, repugnance would appear to be amenable to public discussion and practical ethical discourse. If a public informed about the technology and its likely applications still found it repugnant, it would strengthen Kass=s argument. There is no reason, however, to think that this would be the result of an extensive program of education and debate.

3. General Technological Ethics

The 20th century was a time of unsurpassed technological progress, but it was also a time in which humanity learned that technological changes bring unintended social and

[1] A prima facie right or obligation is one that we should recognize as having moral force, and as binding when countervailing considerations are not present. But prima facie claims may be overridden by other considerations that are regarded as more compelling in particular cases.

environmental consequences. The German philosopher Hans Jonas is generally credited with first recognizing the need for a systematic method of anticipating and evaluating technology. Jonas (1984) understood that this would depart from traditional ethics in that technology has impacts that extend indefinitely in space and time. Jonas argued that technological ethics must integrate science-based attempts to understand the systematic and temporally distant effects of technology with ethical concepts attuned to the fact that many of the people who will be affected by technology will not be known to those who plan and execute a technological practice. Today, the central problems in technological ethics can be understood as problems of anticipating and managing the unintended consequences of technical change. Risk analysis is one of the main social responses. Risk analysis is often characterized as a multi-stage process comprising risk identification, risk measurement, risk evaluation, and risk management. The last two stages have always been understood to incorporate value judgments. The most obvious type of value judgment concerns the attribution of value to certain predicted outcome. Financial gains and losses are easily expressed in terms of monetary values, but the comparative measurement of injury, loss of life, and psychological harm are more difficult. When impacts borne by future generations, by society as a whole, by non-human animals or even by inanimate entities such as natural ecosystems are thrown into the mix, the philosophical and methodological problems of placing a value on predicted outcomes becomes both complex and contentious. From the standpoint of management, ethics weighs in on whether people must be informed and their consent obtained before they can become bearers of risk, and on how trade-offs between risk and benefit are to be evaluated.

In some of the early approaches to technological risk analysis, the stages of risk identification and risk measurement are characterized as wholly objective. On this model, ethics comes in only when it is time to compare the risks and benefits of different technological options, or to accept or reject a technological practice based on its predicted risk (see Rowe, 1977, Lewis, 1990). However it is now generally recognized that value judgments are implicit in any attempt to identify or decide which consequences are relevant, or to determine which of the myriad of actual possible courses of action should be selected as the Aoptions@ that will be subjected to modeling and analysis. Furthermore, it is recognized that measurement of risk requires value judgments about how to treat uncertainties in data and modeling, and how to derive and integrate statistical and subjective probabilities. As such, it is possible to see all phases of risk analysis as involving ethical issues (see Shrader-Frechette, 1991; Brunk, Haworth and Lee, 1991).

Even this short statement suggests that there are many ethical issues that can be raised in connection with risk analysis, and most of them arise to some degree in applying this general framework to food and agricultural biotechnology. Some of the most difficult problems arise simply in organizing the issues. In the literature that has already been generated on agricultural biotechnology, there are five general categories in which the products and processes of rDNA have been alleged to have impact: 1) impact on the environment; 2) impact on humans (including food safety); 3) impact on non-human animals; 4) impact on farming communities in the developed and developing world; and 5) shifting power relations (e.g. the rising importance of

commercial interests and multinationals). After discussing each of these topics in this section, I will discuss three general ethical issues or responses to the problems in the succeeding section.

3.1 Ethical significance of the environment.

What counts as an ethically significant environmental impact? One useful approach to this question is to see environmental issues in general as raising three different kinds of ethical concern. First are human health effects accruing from environmental exposure, such as air or water borne pathogens (as opposed to ingestion through food). Second are catastrophic impacts that would disrupt ecosystem processes in ways that threaten to destabilize human society. This includes dwindling energy supplies, human population growth and global warming. Finally there are effects that are felt less by humans than by the broader environment. These may be classified as eco-centric (or non-anthropocentric) impacts. Each of these types of environmental impact raise somewhat different ethical issues.

Environmental impacts in the first category manifest themselves as human disease. They include cancer induced by chemical pollution, emphysema and lung diseases from air pollution, poisonings and non-fatal diseases such as allergies and reduced fertility speculatively associated with hormone disrupting chemicals in the environment. Although the scientific and legal issues that arise in establishing the connection between cause and effect are tortuous, the ethical imperative to limit these risks is very clear. Ethical and quasi-ethical issues arise because it is not clear how to resolve uncertainties that arise in assigning a probability to the unwanted impact, and because there are different ways to think about the acceptability of environmental exposure to disease risks. Although it is certainly possible that food and agricultural biotechnology could pose such risks, products currently under development have not been linked to any known human diseases that would be contracted by environmental exposure. As such, the ethical issue that arises with respect to the possibility of disease risk is uncertainty, and this is an issue that is associated with virtually every kind of consequence discussed throughout this section. What responsibilities follow from the possibility that there is something we have not thought of?

For many years, the environmental risks associated with agricultural biotechnology were thought to fall primarily in the middle category of potentially catastrophic ecological consequences. Ecologists raised the possibility of widespread disruption of atmospheric processes associated with ice-nucleating bacteria early in the development of agricultural biotechnology (see Thompson, 1987 for an overview). The speculation that biotechnology would contribute to a narrowing of the genetic diversity in major food crops was also an early concern (see Doyle, 1985). During the 1990=s the potential environmental impacts foreseen were less sweeping. Particular attention has been given to the potential for escape of herbicide tolerant genes into weedy relatives of crop plants, and to the possibility that insect pests will acquire resistance to *bacillus thuringiensis* (bt) (Rissler and Mellon, 1996; Krimsky and Wrubel, 1996) . Though such events are not in themselves catastrophic, their ethical significance derives from interpreting them as contributing to a broad destabilization of the global food system. The upshot is that agricultural biotechnology is associated with possible consequences that are potentially catastrophic in impact, though in comparison to risks of global climate

change or human population growth the probability of catastrophic environmental impact accruing from agricultural biotechnology must be regarded as comparatively low.

Environmental concerns that do not bear directly on immediate human health risks or on preservation of wild nature remain comparatively undeveloped as ethical issues in Canada and the United States. Early on, environmental philosophers noted two general categories for ethical debate: duties to posterity and the basis for eco-centric ethical values (Hanson, 1986). The potential for ecologically based decline of the global food system would, on the face of it, appear to be an issue that relates to the first of these concerns. Yet for whatever reason, issues of this sort are often treated as economic or political matters having little ethical significance within the North American context.[2] The situation is arguably quite different in the rest of the world.

For reasons that are difficult to discern, ecological impacts of agricultural biotechnology elicit more ethical concern globally than in North America (see Durant, Bauer and Gaskel, 1998). Some Canadians may see themselves as quite different from Americans in this respect, due in part to Canadian leadership on a number of global ecology study teams and a greater willingness on the part of the Canadian Government to participate in international environmental agreements. Nevertheless, public opinion surveys suggest that Canadians and Americans have not historically associated ecological risks of agricultural biotechnology with *ethical* concern, though there may be a greater tendency to do so in recent years (Einseidel, 2000; Priest, 2000). This does not, of course, prove anything about the ethical significance of possible ecological consequences, but it does indicate that this may be an area in which attitudes are changing.

North American approaches to environmental ethics have laid greatest stress on the third category, that is, non-anthropocentric effects. Preservation of wilderness and endangered species has been of particular importance in Canada and the United States. In part, this emphasis derives from the fact that environmentalists in Canada and the U.S. have sought persuasive rationales for setting aside the relatively large tracts of undeveloped land that exist in these countries. Industrial, scenic and recreational uses provide a baseline for valuing wild ecosystems in economic terms. The main philosophical tasks have been understood in terms of developing a rationale for valuing and preserving wild ecosystems, including keystone species, irrespective of their economic value. Given this orientation, one would expect that products such as transgenic salmon, which could affect wild salmon populations, would be among the most contentious applications of biotechnology from the perspective of ecocentric environmental ethics.

In addition, agriculture is sometimes viewed as antithetical to environmental values in the North American context. Agricultural technologies are potential polluters, contributing to human health risks, and agricultural land use competes with wilderness preservation. For example,

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[2] Author's Note: Some reviewers of the white paper disputed this judgment. There are certainly philosophers and environmental activists in North America who have devoted great energy to these issues. Indeed, I am just such an individual myself. Nevertheless, it is my judgment that unless they involve impact on wild or protected areas, ecological consequences are not likely to be thought of as *ethically* significant in Canada and the United States.

Canadian environmental ethicist Laura Westra argues that farmlands cannot possess Aecological integrity@. She sees farming as environmentally valuable only as a buffer that protects wild areas from the impact of human civilization (Westra, 1997). Given this orientation, one might think that agricultural biotechnology would not be of interest to on ecocentric environmental grounds. A contrasting view, which may be more prevalent in northern Europe, implicitly sees preservation of nature as preservation of farmland. Preservationist goals are articulated in terms of keeping land in fairly traditional forms of farming, and farming is seen as wholly compatible with preservation of habitat.

Prior to 1999, crop biotechnology was not widely associated with environmental impacts on wilderness or endangered species. In that year news reports that Bt-crops could affect monarch butterflies enlivened the prospect of unintended impact on nontarget species for the first time. This has awakened public recognition of the way that agricultural biotechnology could have an impact on wild species, and provides an example of how eco-centric environmental impacts could be brought about by genetic agricultural technologies. In Canada, genetically engineered canola could outcross with wild rape. Research on genetically engineered fish have long been associated with the potential for negative impact on wild populations. There are also less well known products, such as recombinant vaccines, that could also have negative impact on wild habitat. Since those who argue most strongly for an eco-centric approach to environment generally reject the idea that benefits to humans could compensate for harmful impacts on wild species and ecosystems, the potential for this type of impact raises the possibility of a new kind of argument against agricultural biotechnology.

Attentiveness to potentially catastrophic risk and to preservation of farmland has created a groundswell of environmentally based concern about agricultural biotechnology in Europe. It is not clear that this concern is grounded on a particularly well-informed appreciation of the likely consequences of adopting genetically engineered crops. Nevertheless, the cultural difference between Europeans and North Americans is striking, and Europeans do appear to have an ethically coherent set of concerns in mind. They question whether global society is sufficiently committed to addressing the challenges of catastrophic risk, and they value traditional rural areas and farming practices as components of nature preservation. It is possible that the strength of European environmental concerns will stimulate new levels of environmental concern in North America.

3.2 Food Safety.

Critics of food and agricultural biotechnology may link the need for ethics with a concern for food safety. This is, on the one hand, quite understandable, since if one already believes that eating so-called GMOs**C**the acronym is short for Agenetically modified organisms,@ or the products of food and agricultural biotechnology**C**could be dangerous, one is also very likely to believe that it is unethical to put people in a position where they might eat them, especially without their knowledge. On the other hand, those who advocate on behalf of agricultural biotechnology take great offense at this characterization of ethics, since it implies that they are exposing the unwitting public to grave dangers without their knowledge. In fact, what is at issue between critics and advocates of biotechnology is not really a question of ethics. Both

would agree that it would be very unethical to expose people to food borne hazards without their knowledge. The source of their disagreement is whether there *are* hazards associated with the human consumption GMOs, or if harms are theoretically possible, the likelihood that any potential hazards will actually manifest themselves in the form of an injury to human health.

The philosophical, statistical and scientific issues that arise in any attempt to sort out the grounds for such disagreements go well beyond the scope of the present paper. Readers are encouraged to consult the CBAC paper on food safety. Nevertheless, there are some ethical issues that can be associated with food safety. One ethical issue concerns the question of what a company or government food safety regulator should do when there are disagreements of the sort just mentioned. One possible answer is that the decision should be based on the best available science. The ethical rationale for this approach presumes that GMOs have benefits of some sort, if only the potential to increase the cost-efficiency of crop production and build wealth for farmers and seed companies. If so, it would be ethically wrong to prohibit GMOs without some sort of evidence that they pose a hazard to human health. If one allowed baseless concerns to stifle innovation, the result would be technological and economic stultification that is not in the public interest. This approach does require criteria for deciding when an alleged hazard is baseless, and Athe best available science@ is supposed to provide a risk based approach (discussed below in Section 4.1) to this problem.

Philosophers of science have long recognized that science is not value-free, and Brunk, Haworth and Lee (1991) have shown how values permeate risk analysis as it is developed to support criteria for the evaluation of potential hazards. As already noted, this is not an appropriate context to delve into these issues. Even a cursory discussion of them would tax the patience of the most committed lay reader, though it is certainly important for the scientists who must make these judgments to be well versed in the value dimensions of risk analysis. The practical implication is that if companies and government agencies are to adopt a risk based approach, it is essential that the public be able to place their trust in science. That is the topic of Section 5 in this report, and the connection between food safety and trust in science is one reason why public confidence in science is relevant to the ethics of agricultural biotechnology.

Even under the best circumstances of strong scientific consensus on hazards, this approach to food safety suffers from some of the problems often associated with the utilitarian or consequentialist form of ethical reasoning with which it is closely allied (see the discussion in Section 4.2 below). Any approach to ethics that rationalizes some chance of a hazardous outcome in terms of benefit to the general public will be vulnerable to criticisms that stress individual rights. The widely discussed risk of allergenicity associated with GMO=s is an instance of this problem. Since genes make proteins and proteins are potential allergens, one cannot exclude the possibility that genetic engineering of foods may introduce proteins into foods that will cause sensitivities and allergic reactions in some portion of the population. Since food allergies are not well understood, and since they may affect very small percentages of the population, it may not be practical to anticipate or characterize the likelihood of allergic reactions before GMOs are released for public consumption. Thus, there may be a few people who would be harmed by eating a GMO, and the approach to food safety described above

seems to rationalize a small probability of serious health affects on these few in terms of economic benefits to the many.

One may be inclined to think that individuals have an inviolable right not be harmed by inadvertently consuming a protein that they could not have known they were allergic to, and that this right is violated even when the risk is purely hypothetical. One way to characterize this type of thinking is to say the rights of the few outweigh less vital interests of the many. Some opponents of biotechnology may wish to take this position. The most obvious alternative is to place each individual in a position to look after their own interests where food safety is concerned. This approach follows the ethical logic of informed consent: people should be free to take whatever risks they choose, but they should not be put in a position of risk without adequate notification and an opportunity to choose otherwise. This sort of reasoning has led many to demand labels for GMOs, a response that will be discussed in more detail in section 4.2 below.

However, the informed consent approach to food safety has drawbacks, as well. For one, empirical research demonstrates that few people make effective use of detailed food information, nor do people generally desire such information. It may be impossible to provide the information that allows one person to make an informed choice without simultaneously putting another person in a position where they will make an uninformed choice. As such, some argue that governments should be judicious and sparing in the information that they require to be supplied to consumers, and this argument effectively brings us back to the Abest scientific evidence@ perspective described already.

3.3 Moral status of animals.

Genetic transformation and cloning of livestock is currently in the experimental stage. However, survey research indicates that animal biotechnology is strongly associated with ethical concern among members of the public. There are also a number of authors associated with social movements to protect animals who have decried food and agricultural biotechnology (see Fox, 1990, 1992, 1999; Linzey, 1995; Ryder, 1995). However, other authors who have argued strongly for recognition of animal interests have not found gene technology to be especially problematic (see Rollin, 1995; 1996; Varner, 2000). Clearly some of those who find animal genetic engineering problematic are among those who see gene technology as intrinsically wrong. This area of ethical concern has been discussed above. There are two additional issues associated with gene technology applied to animals. The first is that gene technologies have the potential to produce suffering in animals. The second is whether or not it is acceptable to reduce an animal=s capacity to suffer as a means to reduce suffering.

Some of the first genetically engineered animals were very dysfunctional (see Rollin, 1995), and there continue to be questions about the health of cloned animals (though the evidence currently suggests that they do not have abnormal health problems). Animals have not always and everywhere been thought to have moral standing that would make their suffering a matter of ethical concern. Nevertheless, few in Western industrial democracies would deny that animals are capable of feeling pain, and few would deny that humans have a responsibility to

ensure that animals do not suffer gratuitously. The ethical issue here is thus whether the purposes to which animals are being put justifies any pain and suffering they experience.

Although this is an ethical issue of general interest and importance, its bearing on the ethical acceptability of food and agricultural biotechnology should not be overstated. No genetic transformation that would result in genetically engineered or cloned animals enduring greater suffering than ordinary livestock is being proposed. Rollin (1995) has argued for an ethical principle that would proscribe any such application of biotechnology. To the extent that existing practices within livestock production are ethically acceptable with respect to their impact on farm animals, practices associated with food and agricultural biotechnology should also be acceptable.

Of course, existing practices are the subject of intense criticism by animal advocates, and arguments that follow the principle stated in the preceding paragraph have already been controversial. For example, recombinant bovine somatotropin (rBST), a product of genetically engineered bacteria that stimulates dairy production, has been controversial because cows with higher rates of milk production are also at a higher risk for health problems. The U.S. Food and Drug Administration chose to interpret the animal health risk from use of rBST as consistent with that of existing practices, since there are other legal ways for boosting milk production. Critics chose to interpret the same data as evidence that rBST increases the risk of health problems in animals on which it is used (see Powell and Leiss, 1997 for a discussion of the Canadian debate on rBST). There is thus a real prospect that animal advocates will interpret the animal health risks associated with gene technology as having greater ethical significance than that of existing technology.

The second set of ethical issues associated with animal biotechnology were first clearly stated when Rollin suggested that genetic engineering should be used to render animals being used in medical experiments Adecerebrate@Cphysically incapable of experiencing pain (1995). This general approach could be applied in a less drastic fashion to livestock. Gene technology could be used to produce animals that are more tolerant of the crowding and confinement that create welfare problems in existing animal production systems.[3] If animal suffering is the predominant ethical concern, it would seem that there is a compelling ethical argument for doing this. Many animal advocates find this to be an abhorrent suggestion, though it has proved difficult to articulate reasons that do not revert back to the kind of animal telos arguments that were noted in section 1.1.

3.4 Impact on Farming Communities

[3] It is, in fact, possible to do this through conventional animal breeding. This is not a consequence that should be seen as uniquely associated with genetic transformations

The way that biotechnology interacts with social justice revolves around the way that specific products affect economies of scale in farming or food distribution, and the control that different actors[4] maintain with respect to the overall food system. Certainly any technology has these effects, including not only such obviously agricultural technologies as plant breeding or chemical pesticides, but also information technologies such as the internet and basic infrastructure such as roads and transport. How do technological changes pose challenges of social justice with respect to farming communities? Perhaps more than any of the other ethical concerns discussed in this paper, food and agricultural biotechnology represent nothing more than a case study for this general question.

From one point of view, it is either mistaken or unfair to focus attention on food and agricultural biotechnology=s consequences for farming communities. This focus might be mistaken in that other technologies may be making a larger contribution to the social changes of concern to critics of biotechnology (see Thompson, 2000). It might also be unfair in that it exploits concern about safety and environmental issues to promote an ethical and political agenda that the broader public does not support. Social critics respond to these points by noting that the actors promoting agricultural biotechnology are well-financed, enjoy considerable political power and are capable of moving the technology forward without addressing issues of social justice to farming communities (see Jamieson, 2000). There is no element in the debate that is uncontested.

Those who have raised issues of justice for farmers and farming communities have based their concerns on many different ethical claims. Some of the arguments have a history that extend back to the origins of the industrial revolution; others exemplify social concerns uniquely characteristic of the late twentieth century. In assessing long-running historical arguments, it will be useful to trace the way that agricultural technologies have played a key role throughout history. It is plausible to see late twentieth-century themes that link opposition to science and technology and movements of social liberation as building on these long running historical arguments.

Some of the foundational arguments for contemporary discussions of social justice achieved some of the most influential formulations during 17th and 18th century debates over agricultural land reform. Developments in transport technology and infrastructure made it feasible for farmers and landowners to seek competitive prices for grain. This practice sparked additional innovations (such as enclosure and increased use of draft animals) that increased yields. It also disrupted the system of tithes and shares that had been the foundation of feudal and village economies. On one side of the political dispute that emerged from this technological change were those who developed a two-stranded argument. A) People who invest labor in the production of goods have the right to seek the most favorable price for their goods; and B) the increased efficiency of technological innovation served all in the long run**C**technological innovations promote the greatest good for the greatest number. On the other side were those who argued that these transformations destroyed the integrity of village communities. They argued that the older system of exchange, in which every person in the village was entitled to a

[4] The term >actors= will be used to indicate individuals, corporations, government agencies and non-profit, non-governmental organizations including public interest groups, universities and scientific societies.

share of the local crop, better satisfied the ethical demands of social justice (see Thompson, 1971; Montmarquet, 1987).

The ethical issues associated with early transformation of rural areas in Europe were generalized and evolved into general views on social justice during the 19th and 20th centuries. Arguments that favored agricultural technology eventual took shape as the neo-liberal principles endorsing the social efficiency of unregulated markets, on the one hand, and the sanctity of private property, on the other. Arguments opposing technological improvement of agricultural production and rural infrastructure evolved into socialist and communitarian conceptions of social justice. The anti-technology dimension of these arguments was gradually muted, particularly in strong leftist and Marxist interpretations of social justice. Marx believed strongly in the power of technological development as a force of liberation. There is thus a sense in which some of the broadest concepts of social justice have their roots in disputes over agricultural technology. Disputes over agriculture and rural development continued throughout the 20th century, but participants in these debates were not particularly mindful of their historical origins. It is useful to isolate three themes.

First, new agricultural technology had its greatest effect on rural communities in industrial societies during the 20th century and especially after World War II. This created a century long debate over the ethical and political wisdom of allowing industrial principles to shape agricultural production, vs. policies and technological investments that would strengthen family ownership structures and rural communities (see Kirkendall, 1984). The debate involves layers of dispute over facts, social theory and policy potential. The ethical dimension consists in the claim on one side that technological innovations adopted by profit seeking farmers, processors and food retailers reduce overall food costs, resulting in consumer benefits that outweigh the financial and psychological costs of those who suffer economic reverses. On the other side it is claimed that the economic opportunity represented by family farms and the small businesses that arise to support them is the essential component of social justice. Furthermore it is claimed that small-scale rural communities promote participatory local governance and are therefore most consistent with the ethical principle that social justice depends upon consent of the governed. It was virtually inevitable that any new agricultural technology developed in the last quarter of the twentieth century would be subsumed by this debate. Some of the first social science publications on food and agricultural biotechnology framed it in precisely the terms of the century long debate over the structure of agriculture and the ethical importance of the family farm.[5]

A second strand of ethical concern over social justice examined the impact of food and agricultural biotechnology in developing countries. Here, too, there was an ongoing debate over the AGreen Revolution@ agricultural development policies being pursued by organizations such as the World Bank, FAO, the Consultative Group on International Agricultural Research, the Rockefeller Foundation and the international development agencies of industrialized nations.

[5] Principle works in this literature include Kloppenburg, 1984, and Kalter, 1985. See Thompson 1997 for a discussion of this literature on biotechnology in the context of ethical issues involving social justice. Also see Schor, 1994 for a history of the early thinking on the social significance of biotechnology, especially in the United States.

Here, too, it was inevitable that biotechnology would be subsumed by the existing debate. [6] On the part of those who support the actions of the official development organizations, it is argued that developing countries must follow the lead of the developed world in adopting yield enhancing agricultural technology. As above it is argued that the benefits of increased food production outweigh any short run reverses suffered by individual farmers. Indeed, given the threat of famine, it is argued that the social demand for more food production is compelling.

[6] The Report of the Nufield Council on Bioethics (1999) provides an excellent and concise review of the social science dimensions of the debate.

Those holding an opposing view raise factual questions about the success of the Green Revolution. The ethical dimension of their viewpoint notes that the infusion of technology and capital into peasant economies and traditional agricultural production systems causes an upheaval in the existing social relations. In addition to claiming that this upheaval destroys the culture and way of life in traditional societies, critics of Green Revolution-style development note that the poorest of the poor are the most vulnerable when such massive transformations of social structure occur. They counter the argument that food needs in the developing world override concern for cultural integrity with an argument that appeals to the basic rights of individuals whose lands, jobs and way of life are destroyed in the wake of development projects. The rights argument claims that it can never be acceptable to treat individual rights as a social cost that must be paid in order to achieve benefits for the majority.[7]

A third strain of argument also focuses on issues relating to international development, and is closely related to the previous one. Much of world=s most valuable plant genetic resources lie in the territory of developing countries, and much of it is found in land-races. Land races are crop varieties that have been grown by indigenous farmers who have selected for valuable traits by a process of trial and error. Developed country plant breeders have made many advances by extracting these valuable traits from the seeds of land races. In the past, neither the indigenous farmers who grow land races nor the governments of their countries have been compensated for the use of these genetic resources. Critics have claimed that a double form of injustice occurs when these genetic resources are first taken without compensation, then sold back to developing countries in the form of seeds protected by patents or under plant breeders rights.[8]

3.5 Shifting Power Relations

[7] See Brown and Shue (1977) or Aiken and LaFollette (1993) for selections of articles that represent the various philosophical perspectives on international agricultural development. See Persley 1990 for a balanced yet optimistic portrayal of the prospects for using biotechnology in agricultural development. See Peritore and Galve-Peritore, 1995 for a selection of authors with a less optimistic assessment.

[8] This has become a central point in the dispute over biotechnology and intellectual property**C**a topic that falls outside the bounds of this white paper. See Juma 1988.

In addition to the above noted affects on farming communities, there have been several other concerns that have been associated with the dominance of hierarchical decision making styles and linked to the growing power of multinational companies. Critics of food and agricultural biotechnology claim that policy making has been dominated by men who exhibit a decision making style that has been the target of the feminist social movement. They note the prevalence of a viewpoint that characterizes critical attitudes as emotional or irrational, and equates rational decision-making with an emphasis on economics and cost-benefit style comparison of decision options. They also believe that decision-makers see nature as an object of human domination. Consistent with much of the literature in feminism, they see the domination of nature and the domination of women as themes with a common historical, intellectual and cultural origin. Hence they argue that opposition to biotechnology and the overthrow of the existing decision-making elite for biotechnology follows from an ethical commitment to feminist philosophies of social justice. Vandana Shiva is particularly known for linking feminist ethics to the second and third conceptions of social justice noted above.[9]

A more general set of concerns have been raised in connection with industry=s impact on publicly funded science. *Biotechnology=s Bitter Harvest* (Goldberg and coauthors, 1990) was one of the most influential publications to make a forceful ethical critique of food and biotechnology in a clear way. Although the report included a critique of biotechnology on environmental grounds, it=s primary argument was that U.S. land grant universities were abandoning an ethical commitment to serve farmers, turning instead to the development of technology that would primarily benefit agribusiness and agricultural input firms. This argument can be seen as a direct outgrowth of the issues concerning farming communities discussed above in Section 3.4. Yet in directing the brunt of its criticism at the planning and conduct of publicly funded agricultural research, the authors of this report made claims with a substantially different ethical importance. Their argument connects with that of social critics who have been expressing concerns that commercial interests were having a growing influence on the conduct of science (see Krimsky, 1991; Press and Washburn, 2000).

The ethical issues associated with the planning and conduct of science should be seen as distinct from concerns about the impact of technical change on farming communities. Someone who holds values that generally favor pursuit of food and agricultural biotechnology (in the belief that it will help address world hunger, perhaps) could still find fault with the way that the science agenda is being established in the era of biotechnology. The concern at the grossest level is that receipt of funding from industry might influence the results of research intended to review the safety of products. The concern that industry funding affects the public=s confidence in research results, even if it does not unduly influence scientist=s conduct, is closely related. However, a more subtle set of ethical issues is probably more crucial to the future of food and agricultural biotechnology.

University scientists like to think of themselves as motivated by a quest for truth and understanding of natural processes. They often balk at the suggestion that questions of ethics or social utility should influence their choice of research topics (see Grinnell, 1992). Nevertheless it

[9] The essays collected in Mies and Shiva, 1993 and Shiva and Moser, 1995 are characteristic of this line of criticism.

is clear that scientists cannot conduct research without significant sources of funding beyond that of the salaries they receive for teaching. One of the persistent criticisms of food and agricultural biotechnology has been that funds to examine the environmental consequences and ecological context of biotechnology have been relatively scarce, while funds that would serve the development of commercializable products have been plentiful. There is the further concern that, like so-called orphan drugs, agricultural technologies that have little profit potential receive little research support, despite their potential for social benefit. Since government and foundation funding is explicitly committed to goals of public benefit, there is a legitimate ethical concern that funds may be diverted to leverage industry funding or toward patentable research that will provide universities with continued sources of financial support (see Busch and coauthors, 1991).

4. Responses to the Problems of Technological Ethics

This section delves a bit more deeply into philosophical ethics to examine three responses that cut across the five impact areas discussed above. The first discusses the Precautionary Principle, an idea that has been introduced to deal with questions of scientific uncertainty. The second section is a discussion of labels and consumer choice issues. The third section is a brief discussion of the philosophical distinction between consequentialist and non-consequentialist approaches in applied ethics. In each of these areas, the author has ventured further in offering critical opinion and analysis than in preceding sections of the paper.

4.1 Uncertainty and the Precautionary Principle

As noted above, there is always uncertainty about the consequences of technology. Here, the term ›uncertainty= is used to indicate the possibility of unknown and possibly unknowable consequences. This is different from the case in which it is possible to estimate the probability that a particular consequence will occur, or to measure how frequently a consequence will occur during a number of opportunities. The latter approach is used to estimate morbidity and mortality associated with pesticide use, for example. These estimates are frequently treated as a Acost@ of pesticide use, which may be judged ethically acceptable when offset by economic benefits. This kind of cost-benefit offsetting is ethically controversial in its own right, but the issues raised by uncertainty are quite different.

It may be useful to attack the problem of uncertainty by breaking it down. First, there is a form of statistically measurable uncertainty associated with estimates derived from scientific data. In general scientific research, scientists who are trying to establish that a substance causes a particular effect require that data support the causal link with 95% confidence. They would regard an alleged causal link shown with 80% confidence as uncertain, or unproven. This practice means that scientists are very conservative about allowing a result to viewed as ›known=. However, some have argued that in matters of human health it is ethically more important to be conservative in the opposite direction. That is, one should not allow people to be exposed to the substance in air, water or food unless one is 95% confident that the substance *does not* cause morbidity or mortality. Second, no matter what the area of human

endeavor, there is always the possibility that there is something that people have not thought of. With any novel activity, our relative lack of experience opens the possibility that there will be some novel way in which the practice can cause harm. Here, a conservative approach might weigh in against anything new. Yet a third set of circumstances exist when there is scientific controversy about the possible consequences of a practice, or the likelihood of those consequences. In this case, it may be difficult to say exactly what precaution demands, depending on the nature of the dispute and the larger ethical problems that it concerns.

All three of these circumstances can be said to involve uncertainty. The Precautionary Principle is less a single principle or decision rule than a general philosophy which dictates toward the most conservative response in each of the three cases. The Precautionary Principle is also often used as a reason to reject practices that have consequences that would be impossible or difficult to reverse or mitigate. In debates over agricultural biotechnology, the Precautionary Principle is often placed in opposition to Arisk based decision making.@ The broad idea behind risk based decision making is that in some circumstances the public good is advanced by accepting some degree of known risk or uncertainty. There are, in fact, many ways in which both the Precautionary Principle and risk based decision making are described, so much so that the conflict over definitions threatens to overshadow the underlying philosophical issues.

For example, critics of the Precautionary Principle portray it as a decision rule that allows perception of hazard to override documented evidence for hazard in regulation and enforcement of international agreements (see Gray, 1993). Some authors describe the Precautionary Principle simply as a preference for statistical and evidential burdens of proof that favor public and environmental health interests over commercial and industrial interests in cases where there is little scientific consensus on the levels of risk associated with a practice (see Cranor, 1999; Ozonoff, 1999). Others identify it with the integration of ethical concerns into regulatory decision making (see O=Riordan and Jordan, 1995; Bernstein 1999). Following this line of thinking, others argue that a precautionary approach to uncertainty requires broader public participation in regulatory decision making (Carr and Levidow, 2000).[10] Given the array of opinion on the very meaning of the Precautionary Principle, it is probably best to understand it as a label for an ongoing philosophical discussion. On this interpretation, the Aprecautionary approach@ is a search for the appropriate response to the uncertainty and indeterminacy that pervades science-based characterizations of risk, rather than a well defined position or principle.

There are at least three distinct ethical concerns that are interwoven in debates over the precautionary approach. One is the claim that there is a need to anticipate harm to persons and the environment in advance, and to take action that will forestall this harm. This is a theme that recurs frequently in statements of the Precautionary Principle, but it is not, in fact, a view that would be contested by advocates of the opposing Arisk based@ approach. The risk based approach can be strongly committed to anticipatory action when the evidence warrants. A second concern notes that powerful commercial and industrial interests can influence the assumptions that are deployed in conducting scientific risk assessments. This, too, is a concern

[10] This theme is discussed in Sections 3.5 and in Section 5, below.

that has been voiced repeatedly by those who call not for an abandonment of risk assessment, but for a more objective implementation of risk based decision making (see Graham, Green and Roberts, 1988; Mayo, 1991; Brunk, Haworth and Lee, 1991). It is thus likely that at least some of the alleged incompatibility between a Arisk based@ and a Aprecautionary@ approach is terminological and rhetorical. This is not to minimize the importance of these two ethical concerns; indeed, the fact that they have long been a part of the attempt to develop an adequate approach to technological risk assessment only underscores their importance.

A third concern arises specifically in applying the precautionary approach to food and agricultural biotechnology. Some of the most convincing applications of the Precautionary Principle involve situations where it is fairly clear that human activity is affecting ecosystem process that would function reliably in the absence of impact from human beings. Straightforward cases of chemical pollution of air and water fit this model, as do cases where marine ecology is affected by fishing or industrial activity. Here, the default option of Ano human activity@ genuinely seems to embody a precautionary approach. However, it is not clear how to extend this model to agriculture, where the default option to adoption of biotechnology is an array of farming practices in which humans are already having extensive impact on ecological processes.

The claim that biotechnology threatens to destabilize an ecologically sustainable food system in agriculture can be disputed. Industrial practices in agriculture already utilize chemical inputs, mechanized cultivation, harvesting and irrigation, fossil fuel consumption, and large-scale transport of nutrients and genetic resources. Though the point is contested, it is not at all clear that the existing industrial system is ecologically sustainable, that it ought to be preserved, or that agricultural biotechnology would lead to further destabilization of the system. It thus appears that applying the Precautionary Principle to agriculture may also require a more complex discussion of the feasibility and desirability of alternative approaches to food production that reduce chemical, energy and mechanical inputs, but do not utilize biotechnology (see Kirschenmann, 1999).

The Precautionary Principle has also entered public discourse on food and agricultural biotechnology in connection with the use of putative human, animal and plant health protection as de facto trade barriers. The paradigm case has been a trade action fought between the United States and several European countries. From a U. S. perspective, the issue has been European refusal of American beef on the ground that the safety of hormones used in animal feeds remains in question. The technical scientific and legal details of this case are complex, and this presentation of the dispute oversimplifies the scientific and legal issues. What matters from an ethics perspective is that U.S. beef producers felt that European insistence on hormone free beef was an unfair trade practice designed to shield European producers from competitive forces. U.S. trade officials representing the perspective of U.S. producers have persistently argued that the existence of a food safety rationale for hormone free beef must be demonstrated by scientific studies. This is an example of theA risk based@ view described above. The opposing viewCassociated with the Precautionary PrincipleCis that the burden of proof should not fall on those who oppose the use of hormones. Rather, U.S. producers should be required to prove the use of hormones is safe.

Much of the public debate over food and agricultural biotechnology has been shaped by the expectation that the pattern of controversy that arose in connection with the use of hormones in animal feed would repeat itself with respect to GMOs. In early 2000 at a meeting in Montreal, U.S. trade negotiators reluctantly accepted a European proposal to utilize the Precautionary Principle in evaluating GMOs. The ethics component of this complex scientific, legal and economic dispute concerns the norms that should be applied in using scientific studies to support regulatory decisions. This includes not only decisions that relate to environmental risk, but also decisions about how to interpret the claim that a novel food is Asubstantially equivalent@ to an existing food, hence not requiring regulatory review for food safety purposes.

The fact that the Precautionary Principle has become a critical point in trade negotiations has certainly complicated practical ethical discourse on the issues that arise in comparing precautionary and risk based decision making. Government officials and representatives of commercial interests seem to be positioning themselves to benefit strategically from the debate, without regard to the underlying issues or even the meaning of the terms. In the U.S., representatives of the biotechnology industry and many university scientists are taking an Aanti-Precautionary Principle@ stance with little regard for the positions that are actually being advocated. Meanwhile, those with economic interests that are contrary to U.S. industry and food exporters seem willing to use precautionary rhetoric opportunistically. There are, however, difficult and important ethical problems involved, and at this juncture it seems appropriate to call for more discussion and debate on the precautionary principle simply as a way to better clarify what is actually at stake.

4.2 Consent, Labels and Consumer Choice.

As noted above in Section 3.2, one of the key points of dispute over GMOs involves the appropriate role of labeling and consumer choice. The issue of choice is broader than safety, however, since consumers may desire an alternative to GMOs for reasons that derive from repugnance or religious views (Sections 2.3 and 2.4), or to express their moral views about animals, ecology, globalization or family farms (Sections 3.1, 3.3, 3.4 and 3.5). Some argue that individual consumers must not be put in a position where they are unable to apply their own values in choosing whether to eat the products of biotechnology. Others argue that the matter of whether genetic transformation has been used is immaterial to the underlying values (espcecially safety and healthfulness) that are the basis of consumer choice. They argue that the very act of informing consumers about GMO foods would mislead consumers into making choices that are not consistent with the underlying purposes that are sought through the purchase and consumption of food.

This is an ethical issue rather than a simple dispute over facts about the safety of food and agricultural biotechnology because one viewpoint stresses individual autonomy and consent, while the other stresses rational optimization. The tension between these two ways of stating the most basic norms of decision making has been endemic to some of the most protracted ethical debates of the last 200 years. The utilitarian school of philosophical ethics has argued that choice that produces the best consequences is always the best one, while followers of Kant have argued that rational conduct requires respect for the autonomy of others, even when this may not lead to the best consequences, all things considered. While it is not plausible to suggest

that ordinary people make systematic commitments to either utilitarian or autonomy-based ethical theory, paying attention to these two competing philosophies can usefully illuminate the issues of consumer choice. The ethical issues here are also probably some of the least well understood by scientists and key decision makers responsible for biotechnology policy. The persistent misinterpretation of the ethical issues involved with consumer consent is arguably the source of some the most difficult lingering problems associated with food and agricultural biotechnology.[11]

The problem is that those who are implicitly committed to the ethics of rational optimization (or utilitarianism) interpret consumer choice in a manner that distorts the basic ethical position of those who stress autonomy and consent. According to utilitarian ethical theory, rational individuals seek to maximize personal satisfaction through choice by selecting the course of action that has the best chance of producing an outcome consistent with their personal preferences. The preferences that might lead consumers to prefer GMO-free foods include non-rational emotional reactions, as well as aversion to hazards associated with the potential for allergens or unresolved questions of food safety. However, it is important for individuals to have the options (e.g. choices) that allow them to act on their preferences, whatever their origin. If some individuals would prefer so-called GMO-free products (products free of ingredients in which food and agricultural biotechnology have been used), a food system in which this option is available will better serve consumer preferences than one in which this choice is unavailable (see Sherlock and Kawar, 1990; Nestle, 1998).

This analysis of consumer choice provides a rationale for labeling that would permit consumers who want GMO-free foods to express their preferences, but it also puts this preference on an equal footing with other consumer preferences, such as the desire for inexpensive or tasty foods. Indeed, it is possible to argue on these grounds that a food system that did not allow those who wanted to eat GMO foods to act on this preference would be as problematic from an ethics perspective as one that denies the choice of GMO free. It is also possible that the confusion that would be produced by a complex system of labels and consumer information would substantially reduce consumers= ability to satisfy their preferences. Furthermore, if labels that described a product as GMO-free tended to be interpreted as conveying a safety warning, this, too, might lead consumers to make less rational choices than they would if no label were present. Thus, the utilitarian approach to the issue of choice and labeling requires a complex weighing of the costs and benefits that would be associated with labeling.

This is a distorted picture of the ethical issues from the perspective of autonomy and consumer consent. Here, the underlying issue is that people should not be placed in a position where they are unable to act on basic values that are central to their personal identity and worldview. It is crucial to this position that beliefs about the appropriateness or naturalness of food are a component of individual belief systems that are protected by principles of religious tolerance (see section 2.3 above). A system of choice that constrained a person=s ability to act

[11] The Parliamentary Office Science and Technology (1998) report, the U. S. Congressional Research Service Report (Vogt, 1999) and the Nuffield Council on Bioethics Report (1999) are examples of recent documents that discuss choice issues, but fail to make a clear statement of the argument from autonomy.

on the basis of religious or metaphysical beliefs would compromise the principle of autonomy in way that a system that denied opportunities for inexpensive or tasty food choices presumably would not.

The analysis of choice from the perspective of autonomy and consent demands an argument demonstrating that food choices do indeed represent values that are of deep importance to individuals—importance rising to the level of a value that is protected by liberties of conscience. Given the prevalence of food beliefs throughout religion and culture, this is not a difficult argument to make. Of course individuals often deviate from religious or culturally determined food beliefs. A utilitarian might interpret this behavior as evidence that these are weak preferences. The opposing view is that individuals must be free to follow or deviate from values fundamental to their personal and cultural identity. It is one thing for individuals to freely violate such beliefs and something entirely different for society to develop a system of practices that forces them to do so (see Thompson, 1997; Chadwick, 2000, Rippe, 2000, Zwart, 2000).

It is of course a matter of contention as to which of these two philosophical approaches—utilitarian rational optimizing or respect for autonomy and consent—ought to have the upper hand with respect to issues of market structure, labeling and consumer choice. However, the fact that autonomy and consent issues continue to be misrepresented even by those who are attempting to provide a balanced overview of social and ethical issues associated with agricultural biotechnology suggests a further concern. An unreflective (and probably unintentional) tendency to frame issues in utilitarian terms may itself be a source of ethical concern with respect to food and agricultural biotechnology. If this is the case, it would suggest that not only issues involving consumer consent, but also issues associated with social justice, environment and even animal ethics are being addressed with a utilitarian bias to frame ethical issues solely in terms of utilitarian, cost-benefit kind of thinking. If so, there is a kind of unfairness or perhaps ethical blindness that pervades thinking on biotechnology. The possibility of such a problem leads directly into the problem of trust, discussed in Section 5.

4.3 Methods and Approaches in Applied Ethics

Many philosophers, theologians and bioethicsts would want to expand the kind of analysis given immediately above in section 4.2 to serve as a comprehensive framework for addressing ethical issues in biotechnology. This is a theoretical question that is likely to be of more interest to professional ethicists, decision theorists and policy analysts than to the general public or even to scientists and government officials. The logical rigor and clarity that is attained by introducing a more rigorous theoretical framework may be considerably offset by the added difficulty that readers not already familiar with philosophical terminology will encounter. The ideas discussed throughout this white paper are difficult enough already. Nevertheless, it may be useful to make a few brief remarks on applied ethics, if only to prepare those readers who interested in further to reading for some of the issues that will be found in the literature of bioethics and risk.

Human beings have been debating ethical issues for thousands of years and scholars have developed a framework for classifying the kinds of argument that are most typical in these debates. Two patterns of argument are particularly striking. *Consequentialist* arguments determine the ethically correct action in terms of the consequences or outcomes that the action

brings about. The utilitarian approach described above in section 4.2 is the most common form of consequentialist argument, but there are others.[12] *Neo-Kantian* (or sometimes ›deontological‹) arguments determine the ethically correct action by seeing whether it is consistent with laws or rules that are derived from an abstract or conceptual analysis of what it means to act morally. These latter arguments often place much greater emphasis on the attitude or intentions of the person who acts. They also tend to generate a rationale for absolute adherence to certain moral rules, whatever consequences may follow.

Many philosophers and theologians trained in ethical theory adopt a theoretical commitment to one or the other of these general approaches, and a great deal of the academic work in ethics then comes to involve a full articulation and close examination of each approach. Applied ethics then comes to be understood as the application of one of these approaches to real-world ethical problems. So if the problem is ›How should we respond to the risks associated with agricultural biotechnology?‹, a consequentialist philosopher will develop arguments that emphasize prediction and evaluation of the possible consequences. A neo-Kantian philosopher will develop approaches that stress individual rights or rules such as informed consent. When the two get together, they will criticize each other's approaches and defend their own approach against weaknesses that the other has found.

This kind of debate between advocates of a particular philosophical approach can be a very useful way to bring issues to the surface and to clarify what is ethically important about a practice that is being contemplated. As professional philosophers and theologians become personally invested in one approach or another, they become expert in deploying the principles and patterns of logic found in that approach. Consequentialism and Neo-Kantian advocates have been particularly good at surfacing and articulating some of the key ethical issues associated with medical care and research. Readers of this paper who follow the debate into the professional literature of genetics will see ample evidence of these two approaches.

But as university departments of philosophy, theology and bioethics have come to be dominated by people committed to these two approaches, a tendency to force issues into the consequentialist/neo-Kantian dichotomy has also arisen. Although the consequentialism/neo-Kantianism dichotomy runs through many of the issues discussed in this paper, emphasizing these two philosophical approaches may not promote a full understanding of issues involving the environment, the transformation of nature, changes in farming communities, and trust in science. Other approaches are available, notably those that stress concepts of virtuous conduct and community solidarity. Furthermore, as already noted, individuals invested in one or the other of these approaches tend to develop elaborate theoretical languages that effectively exclude non-professionals from discourse. The approach of discourse ethics described in Section 1 provides

[12] One of the reviewers for this report notes that Canadian philosophers prefer the term ›consequentialist‹ over ›utilitarian‹. I have persisted in using the term ›utilitarian‹ for two reasons. One is that it is more accessible to non-specialists, though it may also be more likely to be misunderstood. The other is that the main problems that are discussed in the paper relate to welfare maximizing decision rules that are particularly characteristic of utilitarian forms of consequentialist ethics. See Sen (1987) at 39 for a discussion.

an alternative to consequentialist and neo-Kantian applied ethics that recognizes the value of both consequentialist and neo-Kantian types of argument.

Discourse ethics is not without both real and perceived limitations. Clearly any attempt to engage in practical ethical discourse will be limited not only by time and resources, but also by the imagination and sensitivity of those who participate in it. This is not a problem unique to discourse ethics, however, and it will occur in any attempt to do applied ethics. Discourse ethics is sometimes criticized unfairly as excluding the interests of minorities and other groups who find themselves on the margins of a society=s political life, or as ignoring the interests of those who cannot speak, such as non-human animals, nature or future generations. However, discourse ethics makes no presumption that the participants in discourse represent only their own interests. On the contrary, the claim that interests of parties who are not actual participants of a discourse have been adversely affected is precisely the sort of claim that must be taken very seriously by anyone who advocates practical ethical discourse. However, practical ethical discourse ethics *can* be disproportionately influenced by the fact that scholars and professionals may not represent the actual concerns of absent parties, nor, indeed, of the broader public. Reliance on advocates introduces the further problem that the back and forth process of objection and reply can itself be deployed not in pursuit of seriousness, mutual respect and pursuit of understanding, but as a delaying tactic in pursuit of a self-interested or strategic end.

While these limitations must be acknowledged, one must also bear in mind the fact that the viewpoint of anyone, including a member of the lay public, will sharpen and change as a result of participating in discussions that approximate the ideal of discourse ethics. A more serious criticism lies in the fact that discourse ethics itself does not really provide much guidance into the source or derivation of norms and values. For present purposes, we may assume that participants in practical ethical discourse derive their inspiration and initial moral feelings from many diverse sources, including religion, experience, and family life, as well as consequentialist or neo-Kantian philosophical approaches to ethical theory. Discourse ethics is not offered as a substitute, but as a framework for proceeding beyond these starting points in an open, public manner.[13]

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[13] When possible, this paper cites characterizations of ethical concern have been drawn from published sources where authors can be assumed to have believed that they were participating in a practical ethical discourse. Citations and references are provided not to provide an aura of academic respectability and authority, but to allow readers to retrace the reasoning, dialog and practical discourse on biotechnology that

5. Trust and Confidence in Science

Although there is no doubt that the issues already covered come foremost in the public mind, the debate over food and agricultural biotechnology has also involved ethical issues about the conduct of scientists and scientific administrators that should not be neglected. Indeed, these concerns may be of far reaching consequence, as they bear not only on the further development of food and agricultural biotechnology, but on other large scale technological enterprises such as nanotechnology and the internet. Furthermore, the way that scientists do or do not respond to the ethical issues noted above (or to reports such as this) is itself an ethical issue that bears heavily on the public=s willingness to accept that biotechnology is being managed in an ethically responsible manner.

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has already occurred. There are a few sections in this white paper where relatively undeveloped statements of ethical concern have been extended and interpreted so as to provide more pointed and compelling statements of the underlying basis for concern. Whether these extensions and interpretations of ethical concern accurately represent the opinions and feelings of anyone in the lay public is speculative, though it would be possible to conduct empirical research to determine the level of resonance that they inspire. However, it is not essential that any given ethical concern reflect actual opinions of a substantial portion of the public. Developed statements of ethical concern establish burdens of proof that anyone responsible for practice or oversight with respect to food and agricultural biotechnology should feel compelled to address. The overarching goal is not simply responsiveness to the public=s concern (though responsiveness to public concern is one component of responsible practice), but considered responsiveness to the legitimate issues. History furnishes many examples of situations in which the broader public was inattentive to the most compelling ethical concerns.

Since 1989, the National Agricultural Biotechnology Council, a consortium of Canadian and U. S. non-profit institutions conducting research on food and agricultural biotechnology, have conducted annual meetings on the issues needing attention. Every report from those meetings has noted a need for building public confidence in the technology.[14] The reports have stressed better communication with the public and educational programs in the recognition that those with a poor understanding of biotechnology would have every reason to be suspicious about its introduction into the food system. Indeed, many authors have noted that public attitudes and distrust of biotechnology or of science in general is the greatest single obstacle to its market acceptance and commercial success (see Boulter, 1997; Rubial-Mendieta and Lints, 1998; von Wartburg and Liew, 1999).

The social science literature on public trust in science builds upon points that have been discussed throughout the earlier sections of this white paperCenvironmental impact, uncertainty, animal issues, social justice and consumer consent. It suggests that the public does not trust the actors that promote food and agricultural biotechnology because they have exhibited ethical failings with respect to one or more of the issues noted (see Frewer and coauthors, 1997, Brom, 2000). Commercial influence on the conduct of science is a frequently noted concern (see Martin, 2000). To some, this suggests the need for a public relations campaign designed to sway citizens in the mainstream to a point of view more consistent with acceptance of food and agricultural biotechnology. Such a campaign is likely to eschew serious discussion of issues, choosing instead to associate a product or person with favorable images, or to associate opponents with unfavorable images. In such campaigns, the issue that has given rise to public concern is handled strategically, and the term *strategic discourse* can be used for any form of communication or public education that tries to bolster public support for an objective (or mute public opposition) in an effective and efficient manner. Characteristically, a form of communication is strategic whenever the alteration or manipulation of audience attitudes and behavior is the dominant criterion for success.

As debates over food and agricultural biotechnology become politicized, with activist organizations opposing both industry and governmental spokespersons, there is a growing tendency for public discourse on biotechnology to take on a strategic character. Campaigns launched to sway opinion in favor of biotechnology are not the only form of strategic discourse. Opponents of biotechnology have utilized strategic approaches as well. Whoever initiates them, communications designed simply to sway public opinion may use rhetorical ploys to induce unwarranted inferences from readers, and they may also include direct misstatements of fact. All parties are associating their messages with imagery (negative or positive) in a manner that elicits emotional responses without communicating substantive information.

Although the word Aethics@ almost never fails to be mentioned when the subject of public trust arises, the connection between trust and ethics is neither simple nor straightforward. It seems likely that a number of cultural and psychological factors play a significant role in

[14] For information or copies of these reports, contact NABC at nabc@cornell.edu

determining when and whether science will be trusted, and most social science research on trust is understandably quite attentive to these factors. The appropriate question for ethics is somewhat different. Does biotechnology, understood not merely as the lab techniques or the products themselves, but as the consortium of industry and academic researchers, government regulators and research administrators that has shepherded recombinant DNA techniques from basic research through product launch, merit the public=s trust? The issue for ethics is to keep the focus on whether the conduct of actors associated with food and agricultural biotechnology is trustworthy, not on whether they are trusted in fact.

One point merits explicit note despite its obviousness: strategic discourse is never an adequate response to an ethical issue. None of the ethical issues discussed in sections 2 and 3 above depend on active political opposition to biotechnology for their definition or significance. Each would be an ethical issue even if virtually no one was sufficiently concerned about agricultural biotechnology to carry placards, write angry letters or construct web pages that espouse a given analysis of each issue, while recruiting fellow travelers. An issue does not become Aethical@ simply in virtue of its popularity, but because deep and systematic differences in values and interpretations open up the possibility for incompatible prescriptions for action. Throughout human history, it has often been the case that a small minority, sometimes a single individual, seizes on a vital difference and opposes a strong majority point of view. These minority viewpoints need not, and historically often have not, represented anything even remotely like widespread public doubt or opposition to the mainstream point of view. One should not equate a response to ethical issues and a response to public concerns. In having too little concern with mutual understanding, strategic discourse disrespects those with differing values and differing points of view. As noted in section 1 above, the approach taken in this white paper presumes that *practical ethical discourse* is the appropriate response to ethical concerns.

However, it is possible to explore the relationship between ethics and trust a bit further. Strategic and practical discourse are analogous to criteria we rely upon when we determine whether an individual person is trustworthy. Trustworthy people display thoughtfulness of purpose and a clear capacity to be mindful of the interests of those by whom they are trusted. We do not trust people who seem to be making reference to their own immediate goals and self-interest at every moment (see Baier, 1994). If these criteria are extended to actors responsible for the development of food and agricultural biotechnology, those who always seem to be engaged in strategic discourse, and never in serious practical discourse are not trustworthy. This is not a judgment that reflects on the moral character of the individuals involved. People who are virtuous in their own right may well be involved in groups or associations that are untrustworthy in virtue of the fact that serious discourse about ethical issues occurs infrequently.

This suggests that strategic communications from those who speak on behalf of science are more problematic than strategic communications by activist and industry groups. Industry groups have an obvious interest in promoting their products, and there is a growing recognition that activist groups depend upon media visibility for their causes (and membership). There is thus a general expectation that activist groups and industry interests will offer communications that portray issues in the most favorable light, that they are prone to exaggeration, and that their

communications should be regarded with skepticism.[15] If activist and industry groups are expected to address issues strategically, scientific and governmental forums should be the locus for non-strategic discourse focused not only on factual issues associated with environmental and public health risk, but also value judgments. As discussed above, value judgments are intrinsic to the definition of key options, the treatment of uncertainty, the relative ranking of outcomes (including non-human animal and social consequences) and to the development of risk management strategies. It is impossible to exclude discussion of value judgments without also introducing strategic elements (elements that suggest a point of view without arguing for it) into the discussion of risk.

A lack of willingness or capacity to engage in practical ethical discourse on the value issues surrounding risk may itself be the overriding ethical concern associated with the public's trust in science. Concerns about the undue influence of commercial interests arise in connection with willingness to engage in practical ethical discourse. The concern is that forums nominally committed to non-strategic discourse are actually influenced by strategic considerations. However, lack of capacity for discourse on values may be a more insidious problem. A number of authors (including myself, Thompson 1997) have suggested that the lack of capacity for practical ethical discourse is particularly evident in the conceptualization of rational responses to risk. People naturally and rationally discount the quality and accuracy of strategic communications. Without clear communication channels that distinguish strategic and ethical discourse, efforts to educate the public about biotechnology may backfire. The tendency to discount strategic communications promoting the safety of biotechnology may lead people to conclude that it is instead quite risky.

Concerns about the one-sidedness and utilitarian bias of claims that have been produced to defend or promote biotechnology also arise in this connection. Even those committed to the belief that issues should be addressed from the perspective of weighing the trade-offs between risk and benefit that are associated with biotechnology should recognize that an alternative approach to risk issues exists. This alternative that sees the issues in terms of securing individual consent, negotiating social consensus, and curtailing the power of elite groups (including scientists) to shape culture and policy (see von Schomberg, 1995; Brom 2000; Mepham, 2000). Failure to acknowledge the full range of ethical perspectives can create the impression that communications are promoting a utilitarian trade-off approach to ethical decision making. This impression does not serve the goal of a fair and open hearing for all ethically motivated points of view.

6. Conclusion

[15] Social science research indicates high variability in the confidence accorded to the messages of activist groups. Some surveys indicate that non-governmental organizations or NGO's are among the most trusted sources of information for certain sub-populations. See Durant, Bauer and Gaskell, 1998.

Discussion of the appropriate policy or other responses to the ethical concerns described above has not been in the purview of this white paper. It seems likely that some of the ethical concerns that have been raised in connection with food and agricultural biotechnology will turn out to have been misplaced. We would expect that opposition to biotechnology based on such concerns will subside when matters are clarified and adequate communications are established. It seems likely that compromise, regulatory oversight or other policy measures could accommodate other concerns, particularly those relating to environment and consumer choice. Other concerns will turn out to reflect deep and enduring philosophical differences that are reflected in the political divisions that are endemic to democratic society, and we should expect disagreements to persist. It is difficult to discern how still other concerns, such as those pertaining to uncertainty and precaution, should be addressed. They must be regarded as open-ended and in great need of more structured and serious dialog.

However, it is worth noting that all these possibilities presuppose that resources**C**time, money and willingness to engage in dialog**C**are devoted to furthering understanding and practical ethical discourse on the issues involved. Concerns raised with respect to the public=s confidence in the institutions that promote the science and governance of food and agricultural biotechnology point toward a comprehensive need to develop more effective approaches to the ethical issues raised throughout the body of the paper. The responsibility to address ethical issues in a serious and systematic way is itself the overriding ethical concern for food and agricultural biotechnology.

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