

Appendix E: Ethical Evaluation of Recombinant DNA Research

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The rapid technological developments of the 20th century provided humanity with more tools while intensifying moral and ethical concern about how those tools might be used. The leading example of this intensification is nuclear weapons technology, which occurred in dire circumstances prompting even scientists fearful of its social consequences to urge its development. However, several other industrial technologies have been shown to have sufficient social or environmental consequences to inspire demands that pursuit of new scientific knowledge and development of new technologies based on it be subject to ethical scrutiny as well as technical and economic analysis.

Recombinant DNA (rDNA) research, and its applications in genetic modification (“genetic engineering”) and gene tracing for medical purposes or investigations of crimes have inspired considerable concern since advances in genetic science opened the possibility of altering the deoxyribonucleic acid (DNA) that holds the genes which shape the characteristics of each living thing in the mid 1970s. Genetic modification involves producing a new form of DNA not found in nature – recombinant DNA (rDNA) – by “splicing” genes that trigger emergence of some desired trait (such as ability to produce particular nutrient or increased resistance to a particular disease) present in the DNA of one organism into the DNA of another to produce a new DNA sequence that will yield a plant or organism of the latter type that also has the desired trait. Since its introduction genetic modification has been touted as a major – even revolutionary – advance over earlier methods of carrying out several activities. In medical science, one of the earliest applications, it promised ways of synthesizing and hence increasing the supply of previously-rare curative substances like human insulin and the anti-infection agent interferon. While application of gene tracing has the potential for understanding the causes or progress of certain diseases and congenital conditions through comparison of disease rates in persons having and not having particular genes or mutation of genes, rDNA techniques suggest that it may be possible to correct those defects or else develop medications that compensate for them. In plant and animal breeding, it promises improvements over traditional methods of creating new varieties through cross-breeding or hybridization because it allows much more specific selection of traits. It is also seen as revolutionary because it is a “deeper” technology: hybridization works at the level of whole organisms; GM operates at the more basic level of individual genes.

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Even before rDNA research began in the early 1970s, both the basic research and the potential applications inspired all the main forms of ethical concern that arise with new ways of handling physical objects: about impacts on the natural environment, about impacts on human health and physical well-being, about distributional consequences, about processes of decision-making regarding whether and if so when to use the technology.

Today rDNA research is too well-established to be stopped entirely, but continuing objections to applications of genetic modification (GM) technologies draw on the same ethical principles. The objections can be divided into four main types. Objections of the first type are what ethicists call “intrinsic objections;” they raise claims that developing and using a particular technology is inherently wrong regardless of the results of developing it or the uses to which it is put. The other three types are “extrinsic objections;” they do not reject the technology as inherently wrong, but do claim that developing and using the technology is wrong when it is used in ways that cause or contribute to morally unacceptable situations or outcomes. Each of the four types of objection has been expressed in a number of ways:

1. Intrinsic objections based on conceptions of the divine order or of nature as independent of humans and valuable in itself:¹
 - a) GM technology is fundamentally unnatural and hence contrary to ecological sustainability because it substitutes highly error-prone human manipulation for the natural working of life processes.
 - b) GM technology constitutes a fundamental assault on nature by disrespecting the inherent character and intrinsic worth of nature as it is.
 - c) GM technology constitutes a sacrilegious effort to redesign nature (natural varieties of life) to fit human convenience or preferences that substitutes human judgment for divine benevolence and divine guidance of the workings of the universe.
 - d) GM technology violates the sanctity or intrinsic character of life by
 - i. reducing life to genome sequences;
 - ii. destroying naturally-established species barriers;
 - iii. promoting the treatment of living things as commodities to be owned, traded, and redesigned at will.
2. Extrinsic objections based on level of risk to human physical well-being
 - a) GM technology poses unacceptable risk of causing severe and irremediable ecological harm that will reduce ecosystem ability to sustain all life, including that of humans. Critics have identified at least five sources of such risk:

¹ Gary Comstock, *Vexing Nature? On the Ethical Case against Agricultural Biotechnology* (Dordrecht: Kluwer, 2000) outlines the first three objections; Jeremy Rifkin, *Algeny: A New Word, a New World* (New York: Viking, 1983) raises the fourth.

- i. accidental creation of "super pathogens," infectious organisms that are more virulent or infect a wider range of other organisms;
 - ii. accidental creation of "superweeds" as GM plants in close proximity with natural ones exchange pollen with natural varieties of plants in nearby open fields and the offspring thus produced cause severe harm to human or animal health or disrupt ecosystems;
 - iii. aggressive spreading of artificially-created plants that crowd out naturally-occurring ones and reduces species diversity to a point the ecosystem cannot function effectively;
 - iv. creation of large populations of genetically identical plants or animals proving susceptible to some unanticipated disease or pest that wipes out whole herds or crops, reducing food supplies and – in the plant scenarios – resulting in mass starvation;
 - v. acquisition by pathogens of traits increasing resistance to antibiotics, weakening their effectiveness;
 - vi. multiplication of pests with genetic traits making them robust enough to overcome plants with GM modifications for insect resistance through the normal operation of evolutionary gene mutations, which will require using larger amounts of pesticide or increasingly strong pesticides causing more harm to soils;
 - vii. creation of crops with traits that decrease soil quality more severely than native or even traditionally-bred plants, requiring greater use of chemical fertilizers that harm ecosystems and/or leading to enough decrease in agricultural productivity to require taking over additional land for farming and hence further reducing wilderness habitat.²
- b) GM technology is another manifestation of the human hubris that led to massive environmental degradation; its development and use encourages continued under-estimation of the potential for human action to create ecological harm and continued over-estimation of human ability to develop a "fix" for environmental harms already sustained.³
- c) GM technology promotes "industrial farming" – monoculture of similar plants in large fields relying on repeated applications of chemical fertilizers, pesticides, and herbicides – that harms ecosystems by contributing to species loss, soil depletion, soil erosion, loss of nutritional value in foods and feeds, pollution of aquifers, streams, rivers, and lakes, and the emergence of chemical-resistant insects and weeds.⁴

² Noted in Norman Ellstrand, "When transgenes wander, should we worry?" in Micheal Ruse and David Castle, editors, *Genetically Modified Foods: Debating Biotechnology* (Amherst NY: Prometheus Books, 2002), pp. 325-330.

³ E.g., Bill McKibbin, *The End of Nature* (New York: Anchor Books, 1999), part 2; Eric Katz, "The Big Lie: The Human Restoration of Nature," in William Throop, editor, *Environmental Restoration* (Amherst NY: Humanity Books, 2002), pp. 85-86.

⁴E.g., Marc Lappe and Britt Bailey, "Biotechnology's negative impact on world agriculture," in Gregory Pences, editor, *The Ethics of Food* (Lanham, MD: Rowman and Littlefield, 2002), pp. 156-167.

3. Extrinsic objections based on considerations of equity, fairness, or justice
 - a) Risks from use of GM technologies are borne mainly by persons exposed to them involuntarily – those living near places where rDNA research or development of GM plants or other product proceeds, those consuming foods made from or with GM ingredients or derived from animals or plants raised on GM nutrition sources, those in societies where GM products comprise a large part of the total food and feed supply.
 - b) GM technologies disproportionately benefit the relatively small groups who monopolize sources through patents or other forms of intellectual property rights: the companies (usually large ones) developing GM organisms, the companies selling the seeds, rootstocks, fertilized eggs, or other source of GM plants or animals (often the same company as the developer).
 - c) The marginal benefits provided by GM organisms to consumers create a situation in which benefit is enjoyed without risk, and risk is shouldered without benefit whereas in a more just world benefits and risks would both fall on the same persons.
 - d) GM technology increases economic inequality within countries because the size of organization needed to develop GM medicines or plants, and the size of farm needed to benefit most from planting GM crops favors large multinational farms and large industrial-type farms over small farms and farmers.⁵
 - e) GM technology increases economic inequality between countries by imposing on developing countries' agricultural techniques that are inappropriate to their climates and social circumstances; the effect is worse if a foreign-based company has been able to engage in "biopiracy" – patent a GM organism consisting wholly or partly of a variety traditionally used in a developing country's traditional agriculture.⁶
 - f) Decisions about when and how to use GM technology are driven by the individual interests of developers, distributors, and users, not by considerations of public good or general welfare.
4. Extrinsic objections based on considerations of transparency and accountability in decision-making.
 - a) With GM technology, as with any other, the scientific expertise needed to develop and assess the potential physical risks and benefits of the technology, and the economic expertise needed to determine whether use of the technology offers efficiency advantages

⁵Jack Ralph Kloppenburg, Jr. *First the Seed: The Political Economy of Plant Biotechnology* (Cambridge: Cambridge University Press, 1998); Britt Bailey and Marc Lappe, *Against the Grain: Biotechnology and the Corporate Takeover of Your Food* (Monroe, ME: Common Courage Press, 1998).

⁶ E.g., Vandana Shiva, "Genetic engineering and food security," Gregory Pences, editor, *The Ethics of Food* (Lanham, MD: Rowman and Littlefield,), pp. 130-147 and Vandana Shiva, *Biopiracy: The Plunder of Nature and Knowledge* (Boston: South End Press, 1998).

over alternate ways of performing the same task are necessary but insufficient for determining whether all or some uses of the technology are “safe,” are in the public interest, and are ethically or morally acceptable. Therefore, decisions about whether and how to use GM should be made through processes permitting extensive input from various stakeholders.

- b) GM technology, like any other technology likely to have large-scale effects, should be subject to public scrutiny and widespread consideration before placed into use.

Impacts of GM Technologies

Most ethicists would agree with Ronald Sandler’s view that the proper goal of technology use is “to promote human welfare in just and sustainable ways, within appropriate moral boundaries.”⁷ Deep ecologists would object to the emphasis on human welfare, and insist on at least equal consideration for the environment and/or other forms of life. Yet those who focus more on human welfare often come to similar judgments as those considering all of life on particular questions if they regard environmental degradation as a cause of harm to human physical and mental well-being.

However, ethicists who agree on substantive issues make their evaluations in different ways depending on the ethical system that they apply. While there are certain aspects of conduct on which all or nearly all ethicists can agree about what should be encouraged or permitted, and discouraged or prohibited, there is as yet no global consensus on the underlying principles and logics that should guide ethical thinking. Thus, the nearly global consensus that human cloning is bad and should be prohibited is not matched by a consensus on why human cloning is so bad. When dealing with technology, different ethical arguments may come to the fore when people are considering different uses of the technology. Recombinant DNA research opened up possibilities for developing a family of related technologies, some geared to identifying and treating diseases or conditions and others to breeding new types of organisms, plants, and animals.

Discussion of the medical uses of rDNA technologies – identification of relationships between particular genes or mutations of genes and the likelihood of experiencing a disease or condition, gene therapy to compensate for a genetic predisposition, use of genetic modification to develop new drugs – inspire drawing on bioethical reasoning. Beauchamp and Childress advocate principlism, a form of ethical reasoning that starts from certain basic, though abstract, principles and under which ethical reasoning is guided by four basic injunctions: beneficence, nonmaleficence, respect for autonomy, and justice. Beneficence requires doing things that are good for the persons being treated. Nonmaleficence requires avoiding doing harm to the persons being treated; it is a one-word reminder of the physicians’ maxim, “first, do no harm.” Respect for autonomy has several elements, including privacy, respecting the patient’s choices and ensuring that the patient (or the patient’s guardian) has freely consented to the treatment after receiving explanations of its benefits and risks both in itself and in comparison with alternate courses of action available. Justice involves ensuring that benefits and risks are distributed equitably and that social disparities in access to treatment are minimized.⁸

⁷ Ronald Sandler, “GM Food and Nanotechnology,” in A.M. Cutter and B. Gordjin, editors, *In Pursuit of Nanoethics: Transatlantic Reflections on Nanotechnology* (Springer, 2009), p. 7.

⁸Tom Beauchamp and James Childress, *Principles of Biomedical Ethics*, 4th Edition. (New York: Oxford University Press, 1994).

The tradition of virtue ethics provides a different way to consider ethical questions. Virtue ethics evaluates choices and actions by determining whether they would accord to what a virtuous person would do in the situation at hand. Thus the primary concepts applied in virtue ethics are notions of the human virtues – such as courage, honesty, humility, or compassion – and the human vices – such as cowardice, dishonesty, arrogance, or cruelty. Virtue ethics emphasizes the connections between the dispositions (character traits) that guide action and the impact of undertaking a particular action on development of the doer's future dispositions (or character traits). Virtue ethicists first ask what virtues are relevant to the situation at hand. They next consider what dispositions would be present in a person having the virtue or virtues relevant to the situation. When more than one virtue is relevant, they also consider which virtue or virtues should be subordinated to other virtues in that particular situation, so they can identify which of the several dispositions that might apply should guide the choice or action.

The focus on human virtues and vices appears at first glance to cut off any consideration of nature, and some deep ecologists have criticized virtue ethics on that basis, but any form of virtue ethics that regards "external goods" – material things and social relations that permit experiencing a better quality of life than would be attained in their absence – as a component of the good life can easily incorporate concern for nature and the viability of ecosystems into ethical reasoning.

A virtue ethicist would approach the question of whether to use GM technology for breeding plants and animals by asking first whether its use would enhance or inhibit the ability of natural and agriculturally-modified environments to produce the external goods "nature" has traditionally provided. A virtue ethicist of a deep green hue would define these to include not simply the clean air and water, healthy soils, and raw materials that most directly affect humans, but also the range of habitat conditions for other forms of life. This broader definition might lead the deep green virtue ethicist to see a particular technology as posing more danger to external goods than does a pale green virtue ethicist. Virtue ethicists who regard all sentient life forms as proper recipients of compassion can incorporate nature and ecosystems into ethical reasoning via the impact of environmental degradation on other species. Yet however, an individual virtue ethicist justifies paying attention to the condition of nature, they would all oppose using GM technology if, as some of its critics content, its use would harm nature significantly and irreversibly reduce its capacity to produce external goods. Here virtue ethicists would be expressing an intrinsic objection.

A virtue ethicist concluding that use of GM technology would not irreversibly reduce nature's capacity to produce external goods then proceeds to a second question about nature, whether use would be contrary to any of the human virtues that apply to human interaction with nature. Virtue ethicists disagree about which virtues are relevant in these interactions because they, like others, disagree on the broader question of how humans should relate to nature and divide into "conservationist" (at least maintain and if possible increase the value of nature for humans) and "respect-based" (value nature in and for itself) camps.⁹ The respect-based approach is likely to be more restrictive of GM technology. This is particularly clear with transgenic rDNA, which creates a gene sequence that could not arise without human involvement; cisgenic rDNA, which selected genes to be "spliced" only from organisms that can cross-fertilize in nature is, at least in its promoters' eyes, more consistent with nature and much less likely to create severe ecological damage or harm to living organisms. The question of whether some use of GM technology is contrary to the virtues

⁹ Gifford Pinchot, *The Training of a Forester* (Boston: J.B. Lippencott, 1937) is the classic exposition of the conservationist approach; Paul Taylor, *Respect for Nature: A Theory of Environmental Ethics* (Princeton: Princeton University Press, 1986) exemplifies the respect-based approach.

that should guide humans' relations with nature can also be answered "yes" or "no." If the answer is yes, an intrinsic reason to avoid GM technology exists and a virtuous person will not use it.

Virtue ethicists concluding that GM technology does not violate rules of conduct towards nature that a virtuous person would follow, then proceed to a third question: does use of the technology serve virtuous human-related ends without violating any virtue-based reasons counseling against their use? Here, the objections shift onto extrinsic grounds. Sandler regards compassion and justice as the virtuous ends most relevant to decisions about use of GM technology to produce new agricultural crop varieties. Compassion is the attitude of attention to and concern for the situation of others; justice is a broad term covering considerations of equity and fairness among people. While insisting that each use of GM technology has to be evaluated separately because different genetically modified plants have different impacts on nature and different implications for human social relations, Sandler concludes that most uses of GM technology should not be encouraged. Though doubting GM technology will have the ecosystem-collapsing effects that some opponents claim, Sandler believes that it usually does violate the ethics that should guide human interaction with nature relation because of its impact on human attitudes. He regards GM technology as fostering the human hubris and tendency to regard nature as a something to be manipulated rather than respected and accommodated that has caused most of today's environmental harm. While he also believes that most commercial applications of GM technology violate the requirements of justice, he notes that a virtue ethicist would raise that objection only when the particular use of GM technology does not violate the standards of virtuous behavior toward nature, because the GM plant involved has been developed mindful of likely effects on nature and is designed to have low impact. In the end, Sandler supports those uses of GM technology serving a virtuous goal without violating a virtue-based prohibition. This, he argues, is the case with "golden rice," a variety of rice with genes inserted to increase its ability to produce beta-carotene (a good source of Vitamin A). It is respectful of nature in that it was developed to enhance vitamin synthesis rather than resistance to diseases, pesticides or herbicides so has low potential to spread or dominate other varieties of plants. It will also serve justice because its developers at the Swiss Federal Institute of Technology intend to cross breed it with local varieties of rice in developing countries where Vitamin A deficiency is widespread and provide it inexpensively to local farmers.¹⁰

Peter Singer, best known for his work on animal rights, and Jim Mason adopt a partly rights-based and partly circumstantial form of ethical reasoning raising extrinsic objections to use of GM technology in foods and animal feeds. They suggest starting from five ethical principles "we think most people will share" when considering food choices:¹¹

1. Transparency: each person has a right to know how any food or food product is produced. This covers production processes, and the impact of production processes on the environment, as well as ingredients. In their view this not only shows respect for others but also serves as a safeguard against bad practices by permitting consumers to use production information as part of their purchasing choice.

¹⁰ Ronald Sandler, "A virtue ethics perspective on genetically modified crops," in Micheal Ruse and David Castle, editors, *Genetically Modified Foods: Debating Biotechnology* (Amherst NY: Prometheus Books, 2002), pp. 222-23.

¹¹ Peter Singer and Jim Mason, *The Way We Eat: Why our Food Choices Matter* (Emmaus, PA: Rodale, 2006), pp. 270-1.

2. Fairness: food production should not impose the sort of costs economists call “negative externalities” on neighbors or the environment. Thus “factory farms” that smell bad and attract lots of insects because animals are overcrowded impose externalities on their neighbors. Prices of food should reflect full costs of production. Non-environmentally sustainable methods of food production fail this test because they pass costs on to future generations
3. Humanity (Humaneness): inflicting significant suffering on animals for minor reasons is wrong. Taken to its full logic, this principle endorses a vegan diet above all others. Singer and Mason acknowledge, however, that not everyone can adopt such a diet; in some parts of the world conditions for growing plants are not sufficiently favorable while some people have metabolic conditions that prevent their absorbing full protein from plant sources. They also acknowledge that many people differentiate between wild and domesticated animals, and regard the latter as legitimate food. For meat-eaters, humaneness requires choosing meats produced in ways that keep animal discomfort and suffering to a minimum.
4. Social responsibility: workers have rights to safe working conditions, fair workplace practices (no forced labor, no discrimination in employment), and rights to form unions and bargain collectively. While many of these same conclusions could be drawn from Principle 2, having a separate principle covers aspects of decent working conditions that do not increase costs of production or distribution.
5. Needs before desires: actions preserving life and health are more justified than those merely advancing pleasure. Within and between countries this principle suggests ensuring that everyone has a nutritional minimum. Singer and Mason also use it to argue that overeating and poor food choices leading to obesity should be condemned not only for their effects on the individual but also because of the higher health care costs imposed on others wherever health care is financed through taxes or private insurance funds.

Considering use of GM technology in food and feeds specifically, Singer has argued that complaints GM organisms are not “natural” are beside the point. As he put it in a recent interview, “It is a mistake to place any moral value on what is natural. I mean many things are natural, including racism, sexism, war, and all sorts of diseases that we try to fight all the time. So the argument about GM food being unnatural and therefore wrong oversimplifies this debate.”¹² He adds that each proposed GM organism has to be examined separately to determine whether the potential gains from its use (better nutritional value, greater drought resistance, better adaptation to particular soil conditions) outweigh the potential dangers (GM crops cross-pollinating with other farmed or wild plants and creating new environmental problems, producing foods with more allergens than previous varieties, producing varieties that interfere with other aspects of human or animal metabolism or hormone systems).

Singer also estimates the distributional consequences of GM seeds differently than many commentators. Though expressing some preference for development through what he calls “public benefit organizations” (non-profit institutes or NGOs), he argues that “It’s offering new seeds. If they’re better, people will grow them; if they’re not better, people won’t grow them.” In his view “terminator technology” (engineering the

¹² Peter Singer, “Genetically modified food and foreign aid: An interview with Krishna Chokshi,” *Brown Journal of World Affairs* 14/1 (Fall/Winter 2007), pp. 135-143.

GM plant so that seeds taken from the first year's crop cannot be used to start the next year's crop) is self-limiting because farmers who want to be able to grow from saved seed will avoid seeds known to incorporate terminator features.¹³

Though some anti-GMO activists hold to intrinsic objections, there has been enough use of GM technology to shift debate onto extrinsic grounds. Those focused on equity, fairness, and justice have inspired the most heated debates. Critics contend that the strengthening of intellectual property rights in the 1980s and 1990s has created a situation in which a few large corporations dominate the field and use their patent monopolies to exploit farmers and worsen gaps between prosperous and impoverished farmers in both rich and poor countries, but more sharply in the latter.

Today, most of the debate about use of genetic modification technology in developing countries focuses on the distributional consequences. Vandana Shiva is the most globally famous of Third World critics making these points.¹⁴ Yet developing country government decisions to limit use of GM crops often fail because farmers aware of GM varieties find ways to get the seeds anyway regardless of government or patent-holder views on the matter.¹⁵ However, most GM varieties are designed for farmers in temperate zones and crops used mainly in industrial countries. Until more attention is given to plants or characteristics (like drought-resistance) more relevant to developing countries, local growth of GM varieties will be limited.¹⁶

Decisions about GM Technologies

In contemporary debates about how to design decision-making processes, the alternatives available are often presented in binary terms involving either an "elite" or a "democratic" processes. In these debates the term "elite" extends to people other than political leaders and corporate executives holding the authority to commit governments and firms to particular courses of action; "the elite" also includes persons with scientific, technical, and economic expertise relevant to determining the basic physical possibility of using some technology, the relative feasibility of use as compared to other technologies serving the same broad purpose, and the relative benefit/cost ratio of using different technologies or using the same technology at

¹³ Singer 2007, p. 139. This has proven true; vociferous objections led developers to decide against commercializing the technology in 1998-2000. Yet as Ronald J. Herring. 2007. "The genomics revolution and development studies: science, poverty, and politics," *Journal of Development Studies* 43 (1): 1-30, p. 8 noted, terminator technology is the only sure way to prevent emergence of unexpected hybrids between GM varieties and other plants.

¹⁴ E.g., Vandana Shiva. 2000. *Stolen Harvest: The Hijacking of the Global Food Supply* (Boston, MA: South End Press; Vandana Shiva, Afsar H. Jafri, Ashok Emani, and Mandish Pande. 2002). *Seeds of Suicide: The Ecological and Human Costs of Globalisation of Agriculture* (New Delhi: Research Foundation for Science, Technology, and Ecology).

¹⁵ Ronald J. Herring. 2007. "Stealth seeds: Bioproperty, biosafety, biopolitics" *Journal of Development Studies* 43 (1) 130-157; Sakiko Fukuda-Parr. 2007. "Institutional changes in Argentina, Brazil, China, India, and South Africa: in Sakiko Fukuda-Parr, ed., *The Gene Revolution: GM Crops and Unequal Development* (London: Earthscan Publications), 199-221; Devparna Roy, Ronald J. Herring, and Charles C. Geisler. 2007. "Naturalising transgenics: Official seeds, loose seeds, and risk in the decision matrix of Gujarati cotton farmers," *Journal of Development Studies* 43 (1): 158-176 (noting that the state of Gujarat ignored the Indian government's demands that it enforce the national rules banning GM cotton).

¹⁶ This would pose a dilemma for critics with intrinsic objections to GM technologies because development of lower-cost GM seeds, say by the international research institutes affiliated with the Consultative Group on International Agricultural Research (CGIAR), that reduced the fairness and distributional objections would reduce the number of critics with extrinsic objections and thereby weaken anti-GM movements.

different scales or in different conditions. Thus decisions confined to corporate offices and government agencies register as “elite” even if technical experts as well as CEOs and other top executives, political leaders and agency heads participate. In an elite process, a few people participate in the process of assessing the technology and deciding whether and when to use it. In a democratic process, not only does government or corporate assessment occur in a publicly-visible way, the choice whether or when to use is set after input from a wide variety of participants including developers, providers, intermediate users (persons who use the technology to produce a good or service ultimately bought by others), final users, and members of the general public.

Advocates of democratic governance maintain that decisions about whether and how to use a technology – or at least those technologies expected to bring major changes to the way tasks are accomplished or likely to have significant impact on human health or the environment – should be made in public through political processes affording wide participation.¹⁷ In their view, knowledge of the scientific or engineering feasibility and the economic efficiency of using a technology are not sufficient for determining what action ought, may, or ought not be undertaken. Social values are equally relevant and technical experts have no special insight into the ethical dimensions of a technology. Though competitive markets decentralize technology decisions among numerous firms, and thus provide multiple separate looks at a technology, strong democrats regard market-organized processes as insufficient for two reasons. First, choices about technology are made within firms, which are typically hierarchical organizations in which a few top executives make the major decisions. Second, the dynamics of competition among firms for market share are likely to push the spread of a technology before its full implications are understood as firms seek advantages by being the first to market with new products or services.

This aspect of the deep democratic view goes against the grain of many ethical traditions. In most places at most times in human history certain individuals – often the leaders of religious congregations, but also philosophers, shamans, hermits, and others believed to have particularly strong connection to sources of wisdom – are regarded as better able to make ethical judgments than individual “ordinary folk” or even a whole community considering a matter together. Deep democrats object to relying on a small circle of moral guides not because their wisdom is weak (though they may find a particular moral guide’s ideas dubious) but because relying on them is another type of closed process all too likely to be skewed to elite advantage.

Yet strong democrats are aware that groups as well as individuals can get caught up in emotional, psychological, or group dynamics that inhibit clear thinking. In recent years they have been paying more

¹⁷ Such as John S. Dryzek, *Discursive Democracy: Politics, Policy, and Political Science* (Cambridge: Cambridge University Press, 1990); Bent Flyvbjerg, *Rationality and Power: Democracy in Practice* (Chicago, IL: University of Chicago Press, 1998); E.g., Amy Gutmann and Dennis Thompson. 2004. *Why Deliberative Democracy?* (Princeton, NJ: Princeton University Press); Matt Leighninger, 2006. *The Next Form of Democracy: How Expert Rule is Giving Way to Shared Governance – and Politics will never be the Same* (Nashville, TN: Vanderbilt University Press); James S. Fishkin. 2010. *When the People Speak: Deliberative Democracy and Public Consultation*. Manuals suggesting methods of promoting deliberation include John Gastil and Peter Levine, eds. 2005. *The Deliberative Democracy Handbook: Strategies for Effective Civic Engagement in the Twenty-First Century* (San Francisco: Jossey-Bass) James L. Creighton. 2005. *The Public Participation Handbook: Making better Decisions through Citizen Involvement* (San Francisco: Jossey-Bass); and James Fishkin’s Deliberative Polling process, described at <http://cdd.stanford.edu/polls/docs/summary/> (accessed 21 June 2010).

attention to the conditions under which such dynamics can be kept from dominating the outcome.¹⁸ Meanwhile, the debate about how to strike a good balance among technical, economic, and social aspects of technology choice continues.

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¹⁸Such as Cass R. Sunstein. 2009. *Going to Extremes: How Like Minds Unite and Divide* (New York: Oxford University Press); Farhad Manjoo. 2008. *True Enough: Learning to Live in a Post-Fact Society* (New York: Wiley).