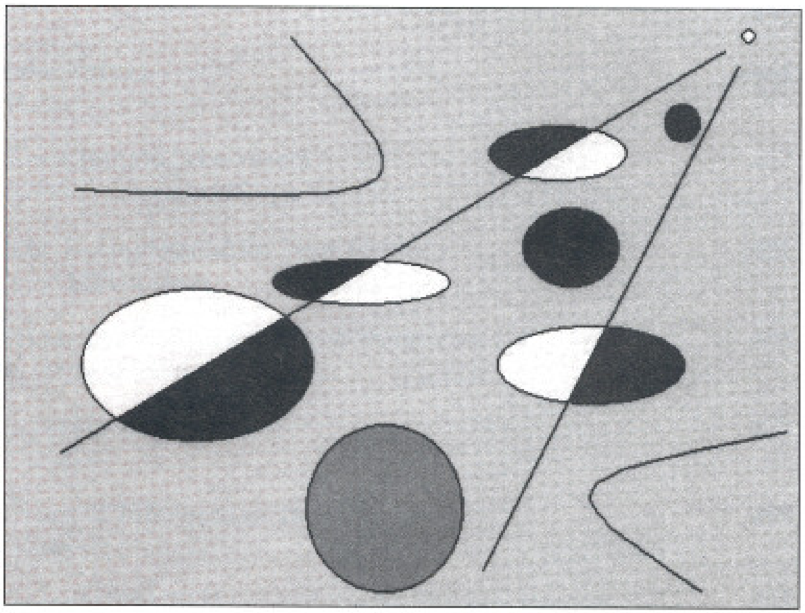
PART

I

Ethics and Technology

A Paul Klee Look-alike.
Painting by Ahmed S. Khan.



OBJECTIVES

Part I will help you to

- Understand consequentialist, utilitarianism and deontological ethical theories.
- Become aware of science- or technology-based ethical issues and conflicts.
- Understand science- or technology-based rights.
- Evaluate the challenge of contemporary science and technology to traditional ethical theories
- Appreciate the relationship between ethics and technology
- Develop a precise definition of technology
- To evaluate the way in which technology is created and functions in a culture
- To understand Kohlberg's Model of Cognitive Moral Development

INTRODUCTION

Every technology is both a burden and a blessing; not either-or, but this-and-that.
NEIL POSTMAN, AUTHOR, *Technopoly: The Surrender of Culture to Society*

As technologies are embraced as "blessings," this part resonates concerns that techno-users need to partake with immense responsibility so that newly developed technologies will not mature into societal burdens. Technology is more than a mechanism or tool; it is also a catalyst for societal changes. Once technology is introduced, life, thinking, behavior, and social norms change. When cars, microwaves, computers, birth-control pills, penicillin, and other technologies were invented, life as we knew it drastically changed. Our point of reference changed, and our behaviors were altered. With the advent of technology, we arrive places faster, communicate globally, cook quickly, and even look to medical technologies to get us to sleep swiftly. Technologies have been invented, for the most part, to make life "better," but do they also carry a societal or psychological cost?

For hundreds of years, the Kaiapo Indians of the lower Amazon basin were considered to be "skilled farmers and hunters and the fiercest warriors of central Brazil" (Henslin; Simons, 1995, p. 463). They eventually sold gold and mahogany and became a wealthy village. With the newfound wealth, Chief Kanhonk bought a small satellite, which the Indians called the "big ghost," so that they could watch television. Prior to the satellite purchase, the Kaiapos would meet at night to tell stories and share ancestral customs. After the purchase of the satellite, however, children were found straying from their ancestral storytelling traditions to watch Western cartoons instead (Henslin 1995, 464). When studying various cultures, we often find that each has its own story to tell about the impact of technology on the lives, culture, and values of its people.

As technology permeates through all cultures and timespans, sociological and behavioral adaptations develop. For example, in the 1930s, many American children surrounded the radio in their living room to let their imaginations go while listening to Orphan Annie, Terry and the Pirates, or Jack Armstrong and the All American Boy. The words emitted from the radio allowed children to create the characters and backgrounds within the world of their imaginations. No visual cues limited what their minds created. This all changed for their children when television dominated the living rooms of the 1950s. Children no longer relied on their imaginations, as the television presented every visual and auditory detail. Additionally, parents worried that their kids would end up with damaged eyes or receive large amounts of radiation from sitting too close to the television.

This part of the book, ethics and technology, discusses the link between technology and its implications for society. Many of the issues presented are more serious than those faced by the Kaiapos or American children in the 1930s and 1950s. But the issues remain the same: With each technology introduced at any time in any culture, adaptations seem to follow. Many of the cases presented in this part encourage users of technology to evaluate the technologies with respect and with their own analyses of personal and social responsibility.

Most technologies work to provide progress to those who use them. However, there are times when technologies are misused and harm or death befalls their users. Therefore, it is befitting to start this part of the book with ethics and its place in the development of technology.

As we bridge our way into a new century and prepare to hand our world over to a younger generation, it will be important to consistently evaluate the technologies that we use and their impact on society and the world in which we live. This part of the book supports that endeavor.

REFERENCES

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Ethics

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1

INTRODUCTION

For at least the last two decades, many of the most divisive ethical issues debated in Western societies have been precipitated by developments in science and technology, including advances in reproductive, genetic, weapons, and life-prolonging technologies. The adoption and alteration of public policy for regulating science- or technology-intensive practices, such as the provision of access to exotic medical treatment, the disposal of toxic waste, and the invasion of individual privacy, have also raised perplexing ethical issues. This chapter is devoted to the analysis of such conflicts.

There is no universally shared criterion for deciding when a conflict of values falls within the province of ethics rather than, say, law. However, the issues and conflicts discussed in this chapter involve values widely regarded as integral to the enterprise of ethics in contemporary Western societies; such values include freedom, justice, and human rights such as privacy. Disputes over whether an agent's freedom should be limited prospectively or its prior exercise punished, whether justice has been denied or done to some party, or whether someone's human rights have been protected or violated, are widely regarded in Western societies as specifically *ethical* disagreements, thus marking them as human value issues or conflicts of special importance in these societies.

As a prelude to analysis of science- or technology-based ethical issues, we will describe a quartet of basic considerations centrally involved in judgments about and the playing out of such conflicts. We will then characterize and analyze a number of important *kinds* of ethical issues and conflicts associated with contemporary science and technology. Where appropriate, we will indicate noteworthy sociocultural factors that, in concert with the technical developments in question, help generate the issue or conflict. All this will pave the way for a key conclusion reached in this chapter: that developments in contemporary science and technology are calling into question the adequacy of traditional ethical thinking. A more comprehensive and sensitive kind of ethical analysis is now required, one more adequate to the complexity and consequences of contemporary scientific and technological processes and products.

CLARIFICATION OF ETHICAL ISSUES AND CONFLICTS

Ethical issues and conflicts, whether or not they are associated with developments in science and technology, can often be usefully clarified if four kinds of considerations pertinent to ethical decision- and judgment-making about controversial actions, practices, and policies are kept in mind.[1]

The Facts of the Matter

One consideration is that of determining, as scrupulously as possible, the facts of the situation underlying or surrounding the conflict in question. Doing so may require ferreting out and scrutinizing purportedly factual assumptions and allegedly empirical claims made by disputants about the conflict situation in question. It may also require ascertaining whether any persuasive accounts of the facts of the matter have been developed by neutral parties. In such efforts, important concerns include unmasking pseudo-facts and factoids posing as bona fide facts, ensuring that the credibility attributed to an account of the facts reflects the reputation and interests of its source, and setting the strength of the evidence required to warrant acceptance of an account of the facts at a level proportional to the gravity of the issue or conflict in question.

Affected Patients and Their Interests

A second kind of clarificatory consideration in thinking about an ethical issue or conflict is that of identifying all pertinent "patients"—that is, all affected parties with a legitimate stake in the outcome of the dispute. Further, all protectable interests of each stakeholder should be delineated and their relative weights carefully and impartially assigned.

Key Concepts, Criteria, and Principles

A third kind of consideration is that of identifying the key concepts, criteria, and principles in terms of which the ethical issue or conflict in question is formulated or debated. For example, the abortion issue hinges critically on the protagonists' respective concepts of what it is to be a "human being" and a "person" as well as what is meant by a "viable" fetus. The ethical (and legal) debate over the withdrawal of technological life-support systems turns sharply on what is meant by "killing" someone as well as on which criteria implicitly or explicitly govern protagonists' use of the key terms "voluntary consent" (to withdrawal or withholding of treatment) and "death."

Ethical Theories and Arguments

A fourth kind of basic consideration to be kept clearly in mind is that ethical disputes often involve two quite distinct kinds of decision-making theories and arguments. *Consequentialist* ethical theories and arguments make determination of the rightness or wrongness of actions and policies hinge exclusively on their estimated *consequences.* The most familiar consequentialist ethical theory is utilitarianism—the view that an action or policy is right if and only if it is likely to produce at least as great a surplus of good over bad, or evil, consequences as any available alternative. There are different versions of utilitarianism, depending on, among other things, what a given thinker understands by "good" and "bad," or "evil," consequences. For example, so-called hedonic utilitarians, of whom nineteenth century British reformer Jeremy Bentham is perhaps the best known, took pleasure to be the only good, and pain the only bad, or evil. "Ideal utilitarians," such as the early twentieth century British philosopher G. E. Moore, construed "good" and "bad" quite differently, including things like friendship and beauty among goods and their absence or opposites, such as alienation and ugliness, among bads, or evils.[2]

The second kind of ethical theory and argument that often enters into ethical disputes is called deontological. *Deontological* ethical theories and judgments hold that certain actions or practices are inherently or intrinsically right or wrong—that is, right or wrong in themselves, independent of any consideration of their consequences. Different deontological theorists and thinkers point to different things about actions and policies, in light of which they are judged to be right or wrong. Some point to supposedly intrinsic moral properties of actions and policies falling into one or another category. For example, actions such as telling a lie or breaking a promise may be regarded as intrinsically wrong. Others emphasize that a certain course of action is obligatory or impermissible because it is approved or disapproved, or unconditionally mandated or prohibited by some authority, perhaps a deity. As we will see in this chapter, several of the most important kinds of ethical issues and conflicts engendered by developments in science and technology arise from or are exacerbated by the fact that partisans of one position on an issue are consequentialists while their opponents are deontological thinkers (for convenience, deontologists).*

KINDS OF SCIENCE- OR TECHNOLOGY-BASED ETHICAL ISSUES AND CONFLICTS

We now turn to examination of science- and technology-based ethical issues and conflicts. Given the purpose of this book, our objective here will not be to provide detailed discussions of—much less solutions to—even a select number of the long list of such problems. Rather, we will

*In reality, the ethical thinking of denizens of contemporary industrial societies is rarely so black and white. It often incorporates consequentialist, deontological, and perhaps other considerations in uneasy or unstable combinations.

identify and critically analyze the limited number of qualitatively distinct kinds of such disputes. (Eight are considered here.) The aforementioned quartet of basic concerns—facts; patients and interests; concepts, criteria, principles; and ethical theories and arguments—will be used to shed light on the sociotechnical roots and intractability of many of these problems.

Violations of Established World Orders

Some ethical conflicts arise from the fact that scientific or technological breakthroughs make possible actions or practices that, in spite of what some see as their benefits, others believe violate some established order of things whose preservation matters greatly to them. The order of things in question may be regarded as "natural" or as "sacred."

For example, much opposition to recent achievements in biomedicine and genetic engineering flows from beliefs that employing such techniques is *unnatural*. Thus some oppose the technique of *in vitro* fertilization as involving the unnatural separation of human reproduction from sexual intercourse. In a similar vein, the production of farm animals with genes from at least two different animal species ("transgenic animals") is viewed by some critics as a transgression of natural animal-species boundaries, while the use of genetically mass-produced bovine growth hormones to substantially increase the volume of milk produced by cows is opposed by some as "chang[ing] the natural behavior of animals" or as "interrupt[ing] the naturalness of [farmers'] environment."[3]

Opposition to technological violations of natural orders is, however, sometimes based on concern about the long-term consequences of intervention for human or other animal well-being or for ecosystem integrity. For example, some oppose the production of transgenic animals because they believe that the resultant animals will suffer physically as a result of being maladapted. Similarly, some critics of the use of bovine growth hormone to raise milk production levels are primarily concerned with the safety of such milk for young children. The plausibility of such consequentialist ethical thinking hinges on the details of the particular case under consideration, including the estimated magnitudes, likelihoods, and reversibility of the projected consequences of intervention.

Deontological ethical arguments against such intervention as intrinsically wrong take two forms. First, the intervention-free order of nature is regarded as natural and intrinsically "good," while technology is not viewed as part of the natural order but rather as artificial. Therefore, it is concluded, attempts to use technology to intervene in the natural order are improper. A second argument notes that something has existed or has been done in the so-called natural way from time immemorial and concludes that therefore it should be done or continue to be done in that same way—without technological intervention. Is either the "unnaturalness" or the "longevity" argument persuasive?

It is unclear why the development and transformative use of technology on nature should be seen as "unnatural." The claim that because God created the natural order it should not be "tampered with" by humans is suspect for two reasons. Those holding this idea presumably also believe that the human being was created by the deity, in which case the human is no less "natural" a creation than the "natural order" and indeed is properly regarded as part of that order. Moreover, they also presumably believe that God endowed humans with creative powers, including the ability to devise technics, thereby enabling them to intervene in the natural order. If so, why is it unnatural for natural creatures to use their God-given powers to intervene in the natural order? It seems implausible that the deity would endow its natural creatures with an unnatural power or with a power whose use was unnatural. If it is not the very use of technology to transform nature that is unnatural but only certain uses of it, then these opponents of technological violations of natural orders must clarify what it is that makes some technological interventions "violations" of those orders and others simply harmonious interventions in them.

As for the argument that the existing way of doing something is the proper way because of its longevity, it too fails to convince. That a practice is long-standing may make it familiar or seem natural. But long-standingness cannot by itself justify the view that the practice is proper. That would be drawing an *evaluative* conclusion from a purely *factual* premise. Conversely, a particular technological intervention in a long-established natural order might initially be resisted because it is unfamiliar or deemed unnatural. However, the fact that something runs counter to a long-standing practice does not suffice to show that it is improper. If that were so, then the abolition of slavery would have been improper. In fact, opposition to a practice initially regarded as unnatural because of its novelty or strangeness often diminishes over time as the new way becomes increasingly familiar. Some innovative technical practices eventually come to seem natural and quite proper, as has been the case with the use of antibiotics.

Is there, then, nothing to the concerns about technological violations of established orders as unnatural? Even if the deontological arguments examined here fail to hold water, the concerns they express still warrant serious consideration, for deontological thinking and argument are sometimes disguised or compressed versions of what are at bottom consequentialist thinking and argument. Reference to an innovative practice as unnatural and therefore as intrinsically wrong may be a powerful if deeply misleading way of expressing concern over its possible elusive long-term consequences.

Other scientific and technological developments have made possible practices that are seen by some groups as violations of world orders viewed not so much as natural but as *sacred*. Thus, in the Hasidic community centered in Brooklyn, New York, birth control is forbidden, supposedly on the basis of the Torah.[4] For the Wahabi, a fundamentalist Arabian Muslim sect, television, with its image-reproducing capacity, violates the sacred order related in the Koran. Opposition to certain technologies or technological ways of doing things as violations of sacred orders is less likely to ebb in the minds of such opponents, for the sacred way is apt to be regarded as God's way and, as such, as immutable and thus as something that ought not adapt itself to human technological change.

Violations of Supposedly Exceptionless Moral Principles

Other ethical issues arise from the fact that the use, failure to use, or withdrawal of particular scientific procedures or items of technology is seen by some as violating one or another important moral principle that its adherents believe to be exceptionless. For example, some people are categorically opposed to nuclear weapons on the grounds that their use will inevitably violate the supposedly exceptionless principle that any course of action sure to result in the destruction of innocent civilian lives in time of war is ethically impermissible.

Similarly, the supposedly exceptionless principle that "life must never, under any circumstances, be taken"—put differently, that "life must always be preserved"—is clearly an important ground of the categorical judgment that withdrawal of life-sustaining technologies, whether mechanical respirators or feeding and hydration tubes, is ethically wrong. A third example is the opposition by some to the "harvesting" of fetal tissue for use in treating Parkinson's or Alzheimer's disease, even in a relative. This opposition is often rooted in the supposedly exceptionless principle that "a human being must never be treated merely as a means to some other end, however worthwhile in itself."

Sociologically, opposition to certain scientific and technological developments on the grounds that they involve or may involve violations of some special order of things or some supposedly exceptionless moral principle, reflects a fundamental fact about modern Western industrial societies. While much has been written about their secularization, there remain in such societies significant numbers of people whose ethical thinking is deontological in character, whether or not religiously grounded.

The world views of such individuals contain categories of actions that are strictly forbidden or commanded. For them, the last word on a particular science- or technology-based ethical issue or conflict sometimes hinges solely on whether the action or practice in question falls into one or another prescribed or proscribed category. While deontological thinkers may resort strategically to consequentialist arguments in attempting to change the views of consequentialist opponents, the latter's arguments against their adversaries' deontologically grounded positions usually fall on deaf ears, however well documented the empirical claims brought forward as evidence. Deontological fundamentalists and consequentialist seculars are, in their ethical judgment and decision making, mutual cultural strangers.

An interesting consequence of deontological appeals to supposedly exceptionless moral principles in the context of potent contemporary technologies is the appearance of moral paradoxes. For example, Gregory Kavka has shown that the situation of nuclear deterrence undermines the venerable, supposedly exceptionless "wrongful intention principle"—namely, the principle that "to form the intention to do what one knows to be wrong is itself wrong."[5] Launching a nuclear strike might well be ethically wrong (because of the foreseeable loss of innocent civilian lives). But what about forming the intention to do so if attacked? According to the wrongful intention principle, forming the intention to carry out that wrong action would itself be *wrong*. However, since forming that intention might well be necessary to deter an attack and thus to avoid launching an impermissible retaliatory strike, it might well be ethically *right*. One and the same action—that of forming the intention to retaliate—is therefore both right and wrong, a moral paradox. Thus can technological developments compel reassessment of supposedly exceptionless ethical principles.

Distributions of Science- or Technology-Related Benefits

Some contemporary ethical issues and conflicts arise from the fact that the benefits of developments in science and technology are allocated in ways that do not seem equitable to one or another social group. This is particularly so with respect to medical benefits, whether they be diagnostic tests, surgical procedures, or therapeutic drugs, devices, or services.

Concerns over whether an allocation of such benefits is "distributively just" often emerge when demand for the benefit exceeds its supply and decisions must be made about who will receive the benefit and who will not—sometimes tantamount to deciding "who shall live and who shall die." For example, in the early 1960s, the supply of dialysis units available to the Artificial Kidney Center in Seattle, Washington, was insufficient to meet the needs of those with failed kidneys.[6] Criteria were selected to use in deciding who would be granted access to this beneficial scarce technical resource. Today, the demand for various kinds of human organs often exceeds available supplies. The criterion of "need" is thus by itself insufficient to make allocation decisions. Criteria such as "likelihood of realizing a physiologically successful outcome" seem promising, but are quite problematic, for, as Ronald Munson has argued,

> [T]he characteristics required to make someone a "successful" dialysis patient are to some extent "middle-class virtues." A patient must not only be motivated to save his life, but he must also understand the need for the dialysis, be capable of adhering to a strict diet, show up for scheduled dialysis sessions, and so on. As a consequence, where decisions about whether to admit a patient to dialysis are based on the estimates of the likelihood of a patient's doing what is required, members of the white middle class have a definite edge over others. Selection criteria that are apparently objective may actually involve hidden class or racial bias.[7]

Other criteria, such as "probable post-treatment quality of life" and "past or likely future contribution of the treatment candidate to the community" are no less problematic. Hence, some believe that for such allocations to be distributively just, once need and physiological compatability have been established, a lottery should determine access to the scarce benefit.

On other occasions, it is not the shortage but the high cost of a medical treatment and the inability of all needy patients who want the treatment to afford it that engenders ethical conflict. Science and technology are often central factors in these high costs, for such costs may reflect the high purchase price of a machine or drug paid by a care unit, something which may in turn reflect the device's or substance's high research and development costs. Such situations help pose the contentious ethical issue of whether access to some needed expensive drug or procedure should be permitted to hinge on whether a prospective patient can afford to pay the going market price.

Deontological ethical thinkers who have come to think of medical care as a basic human right may find it morally unthinkable that a person be denied access to such treatment simply because of not being able to afford it (or because, for example, of being "too old"). In contrast, consequentialists, some of whom find the concept of an "absolute right" potentially dangerous, may believe that a particular technically exotic treatment is so expensive that granting everyone in life-or-death need unlimited access to it will effectively preclude many more individuals from getting less expensive, more beneficial, non-life-or-death treatments. Diverging accounts of "the facts of the matter" and different criteria for what makes a treatment "exotic" often bulk large in such judgments.

Consequentialists are apt to believe that individuals do *not* have a moral right to draw without limit on public or insurance-company funds to have their or their family members' lives extended regardless of the quality of the sustained life and the prognosis for its improvement. They may even hold that the financial and social consequences of doing so create a moral obligation to *terminate* such treatment, or at least to cease drawing on public funds to pay for continued treatment. In such ways have advances in science and technology as well as people's varying concepts (e.g., of a life worth living) and divergent ethical theories become intertwined in complex ethical disputes over distributive justice, rights, and obligations.

Infliction of Harm or Exposure to Significant Risk of Harm Without Prior Consent

A fourth category of ethical issues and conflicts engendered by developments in science and technology arises from activities that, while undertaken to benefit one group, inflict harm or impose significant risk of harm on another without the latter's prior consent. Examples of this sort of phenomenon abound and include some research on animals; production of cross-border and multi-generational pollution; the maintenance of carcinogen-containing workplaces; and the operation of "hair-trigger" military defense systems. As with earlier categories, the ethical issues and conflicts here have both technical and social roots.

Most parties to such disputes would agree that, other things being equal, it is always unethical to subject a morally pertinent party to undeserved harm or serious risk of same without the party's freely given prior consent. Let us examine how the consent issue plays out in the four above-mentioned kinds of cases.

In laboratory experimentation on sentient animals, the issue of consent bulks large in the persistent ethical conflict. Consequentialist proponents hold, on cost-benefit grounds, that activities that promise future benefits (including avoidance of suffering) for humans but that (supposedly unavoidably) inflict suffering on existing animals are ethically permissible, perhaps even obligatory. Those carrying out such activities may proceed because since animals cannot consent to anything, they are different in a morally relevant respect from human beings.[8] Hence the consent condition, precluding similar treatment of humans, is, in the case of animals, legitimately waived. Some opponents of such research, often deontologists, also subscribe to the prior-consent principle, but they see animals such as rabbits and monkeys as no less morally relevant patients than are humans. They draw a diametrically different conclusion: Since the consent of laboratory animals cannot be obtained, research activity that produces suffering for animals is ethically wrong or impermissible, even if the suffering is "unavoidable"—computer models that make animal tests unnecessary may not be available—and the benefits of the research could plausibly be shown to exceed its costs. It is not difficult to see why resolution of this disagreement is unlikely to be forthcoming.

Explanation of the rise of ethical conflict over cases of cross-border and multigenerational pollution (e.g., acid rain, dumping toxic chemical or metal waste into multinational bodies of water, and the possibly insecure disposal of nuclear waste), must heed technical factors as well as the problematic issue of consent. But for the capacity of contemporary scientific and technological activities to produce potent geographically and temporally remote effects, these ethical disagreements would simply not arise. Moreover, this "action-at-a-distance" capacity contributes to the tendency either to neglect or to assign modest weights to the legitimate interests of affected patients at considerable geographical or temporal remove. This in turn facilitates proceeding with the activities in the absence of consent of such endangered parties, or, in the case of not-yet-born members of future generations, impartial reflection on whether they would consent if they were informed and in a position to give or withhold it. The facts that the human capacity for empathy tends to diminish rapidly the more remote the injured or endangered party and that the world is organized into a weak international system of sovereign states both contribute to the genesis of such ethical conflicts.

In ethical disputes over workplaces made dangerous because of scientific or technological activities or products, the issue of consent rears its head in a different form. Historically, employers or their representatives argued that maintenance of a dangerous workplace was not unethical because a worker who accepted a job in one thereby voluntarily consented to exposure to all its attendant risks. To the extent that workplace hazards in the early industrial era were primarily threats to worker safety and that a worker had other less dangerous employment alternatives, such a viewpoint might seem at least minimally plausible. However, as twentieth century industrial workplaces became pervaded with thousands of industrial chemicals of uncertain bearing on worker health, the notion that workers could meaningfully consent to the imposition of any and all risks that their workplaces posed to their health began to ring hollow. Workers had to make decisions to take or keep jobs in ignorance of what, if any, risks they would be or were being exposed to. Put differently, management could proceed with its risk-imposing activities without their workers' informed consent.

This situation came to be viewed by some as a violation of the prior-consent principle, and hence as unethical. Others saw it as ethically permissible because the benefits (to both company and workers) of proceeding in this way supposedly outweighed the (typically undervalued) costs of doing so. The main attempt to mitigate this situation has taken the form of right-to-know legislation: Workers have a right to a safe workplace but not to a risk-free (in particular, carcinogen-free) one. They are, however, entitled to that which is deemed necessary for their giving informed consent to imposition of workplace risks; specifically, they are entitled to "be informed about" all carcinogenic and other toxic substances used in their workplaces. Whether the extensive technical information provided and the way in which it is communicated to workers suffice to ensure their "informed consent" remains an open factual and criteriological question at the core of a persistent ethical issue.

Ethical conflict over the operation of "hair-trigger" military defense systems is also driven by both technical and social factors. Such systems are called "hair-trigger" because they can be set to "fire" on being subjected to slight pressures. Their risk arises from the enormity of destruction that can be unleashed by slight pressure on the sensitive firing mechanism; such pressure can be brought by mistaken "sightings" or misinterpretations of data. The 1988 downing of an Iranian commercial aircraft by the high-tech-equipped U.S.S. *Vincennes* because of misinterpretation of radar and electronic data is a tragic case in point, albeit on a relatively small scale. There have been numerous occasions on which American retaliatory nuclear forces have been activated and on the verge of being unleashed because of what turned out to be mistaken technological indications that a Soviet attack had been launched.

While technological "progress" is partly behind such ethical conflicts, consent is also a factor. In the case of hair-trigger military defense systems (e.g., ones operating on a "launch-on-warning" basis), the public has not been afforded an opportunity to explicitly give or withhold its consent, informed or otherwise, to the imposition of such grave risks. For opponents of such systems, this alone makes them ethically objectionable. For proponents, the astonishing speed of current or emerging offensive military technologies makes the risk of *not* employing hair-trigger defense systems exceed the risk of relying upon them. Moreover, such systems are morally justified, proponents argue, since the people have indirectly consented to such risks by voting democratically for the government that imposes them. The fact that civilian aircraft are permitted to fly over populous areas without their residents having first voted on whether to accept the associated risks does not suffice to show that the people do not consent to the risks imposed on them by this practice. Hence, it would be argued, the consent condition has not been violated and ethical impropriety has not been demonstrated. The same would be true in the case of hair-trigger defense systems. However, the greater the magnitude of the danger involved—enormous in the case of the nuclear war—the lower the risk of its accidental occurrence must be if the explicit securing of consent is to be reasonably set aside as having been implicitly given. The upshot is that the lack of shared criteria for deciding whether citizen consent has been effectively obtained in such cases is central to this acute ethical dispute.

Two morals of this kind of ethical conflict deserve attention. First, the problematics of consent are, to a significant degree, science- and technology-driven. Second, the potency of much contemporary scientific and technological activity is pressuring sensitive ethical analysts to enlarge the domain of morally pertinent patients whose interests are to be taken into account in assessing the ethical propriety of current or proposed actions or policies. This situation is reflected in ongoing struggles over whether to include various kinds of previously excluded stakeholders, such as those far afield who are nevertheless deleteriously affected by potent "spill-over" effects and future citizens whose legitimate interests may be jeopardized by activities designed first and foremost to benefit the presently living. Here, too, the contours of the evaluative enterprise of ethics are being subjected to severe stress by developments in contemporary science and technology.

Science- or Technology-Precipitated Value Conflicts

A fifth kind of science- or technology-based issue or conflict arises when a scientific or technological advance allows something new to be done that precipitates a value conflict, not necessarily between the values of opposed parties, but *between two or more cherished values of one and the same party.* For example, life-extending technologies have engendered situations in which family members are compelled to choose between two values; to both of which they owe allegiance: human life preservation and death with dignity. The crucial point about this increasingly frequent kind of value conflict is that the parties plagued by such conflicts would not be so but for scientific or technological advances.

Most recently, genetic tests allowing those with access to their results to know something of a sensitive nature about the health-related state or genetic predispositions of the person tested have proliferated. This has given rise to value conflicts between testers' or policymakers' concern for the protection of human *privacy* regarding disclosure of test results and their concern for *fairness* to one or another interested party other than the testee.

For example, in 1986 an adoption agency was trying to place a 2-month-old girl whose mother had Huntington's disease, a progressive, irreversible neurological disorder. The prospective adoptive parents indicated that they did not want the girl if she was going to develop the disease. The agency asked a geneticist to determine whether the child had the gene that would sooner or later manifest itself in the disease. The geneticist, while presumably sympathetic to the would-be adoptive parents' seemingly reasonable request, declined to do the testing. He reasoned that since many victims of the disease have claimed that they would have preferred to have lived their lives without knowing they had the "time-bomb" gene for the disease, it would be unethical to test someone so young, that is, at a point before she could decide whether to exercise her right to privacy in the form of *entitlement not to know* that she had the fatal gene.[9]

Tests for various genetic disorders, such as Down's syndrome, sickle cell anemia, and Tay Sachs disease, have been available for some time. In the foreseeable future, however, it is expected that tests will become available for identifying genetic traits that predispose people to more common health problems, such as diabetes, heart disease, and major forms of mental illness: Thus, according to Dr. Kenneth Paigen, "We are going to be able to say that somebody has a much greater or much less than average chance of having a heart attack before age 50 or after age 50."[10]

The potential implications of such advances for matters such as employment eligibility, life insurance qualification, and mate selection are formidable. Will employers with openings for positions with public safety responsibilities (e.g., commercial airline pilots) be permitted to require that applicants take genetic tests that will disclose whether they are predisposed to heart disease or to a genetically based mental disorder such as manic depression? Will insurance companies be permitted to require applicants for life or health insurance to take genetic tests predictive of life expectancy or diabetes? Will prospective spouses come to expect each other to be tested to determine their respective genetic predispositions and whether they are carriers of certain traits of genetic diseases and to disclose the test results?

In the case of companies recruiting for jobs with public safety responsibilities, prohibition of such tests to protect applicant privacy could impose significant safety costs on society. In the insurance case, preventing mandatory disclosure of test results in the name of individual privacy would spread the cost of defending this cherished value over society at large in the form of increased insurance premiums for those *without* life- or health-threatening genetic traits or predispositions. In the case of mate selection, declining to pursue and disclose the results of reliable genetic tests could set up partners for severe strains on their relationship should presently identifiable genetic disorders manifest themselves in the partners or their offspring at a later date.

It remains to be seen how society will resolve the public policy questions raised in such cases by the ethical value conflict between privacy and fairness. However, it is already clear that advances in genetic science are going to pose powerful challenges to society's commitment to the right of individual privacy. The knowledge about the individual afforded by such tests is likely to be of such pertinence to legitimate interests of other parties that the protection afforded individual privacy may be weakened out of concern for fairness to those parties, perhaps to the point of recognizing that under certain conditions they have a right to that knowledge. Put differently, technology is here bringing micro, or personal, justice and macro, or societal, justice into conflict.

Science- or Technology-Engendered "Positive" Rights

Besides conflicts over the values of freedom and justice, issues of "rights," especially "human rights," bulk large in contemporary Western ethics. In recent decades, advances in science and technology have engendered a new ethical issue: that of how best to respond to newly recognized so-called *positive rights.*

In the modern era, some claims have come to be widely recognized as "human rights"—that is, as irrevocable entitlements that people supposedly have simply because they are human beings. Human rights are thus contrasted with civil or institutional rights—rights that people have because they are delineated in specific revocable legal or institutional documents. Among the most widely recognized human rights are "life" and "liberty."

These rights, and some derived from them—privacy, for example, is widely thought to be a kind of special case of liberty—have traditionally been viewed as what philosophers call "negative" or "noninterference" rights—that is, as entitlements *not to be done to* in certain ways. Thus, the right to life is construed as entitlement not to be deprived of one's life or physical integrity. The right to liberty is construed as entitlement not to have one's freedom of action physically constrained or interfered with, unless its exercise has unjustifiably harmed another's protectable interests (e.g., those in life, limb, property, reputation) or poses an unreasonable risk of doing so.

As scientific and technological progress has gathered momentum in recent decades, several rights traditionally viewed as negative have given birth to a number of correlative "positive" rights—in other words, entitlements *to be done to* in certain ways. Consider three examples. Many believe that the right to life, traditionally construed as a negative human right, must, *in the context of new life-*

preserving scientific and technological resources, be regarded as having taken on a positive component: entitlement to be provided with whatever medical treatment may be necessary to sustain one's life (independently of ability to pay for it). According to this way of thinking, affirmation of the right to life in the contemporary scientific and technological era requires affirmation of a positive right of access to whatever means are necessary to sustain life. Thus, for example, denial of costly life-sustaining drugs to a patient in need of them on any grounds save scarcity, including concern over the aggregate high cost to society of providing them, is seen by many as a violation of the patient's right to life. Hence, depending on whether the ethical analyst is a deontological or consequentialist thinker, failure to provide these drugs would be deemed categorically or prima facie ethically impermissible.

The right to privacy has traditionally been viewed as a noninterference right, entailing, among other things, entitlement not to have one's home broken into by government authorities without a search warrant issuable by a court only upon proof of "probable cause." However, the computer revolution has put individual privacy interests at risk. To compensate for this, legislation in the United States and other countries entitles citizens to be provided with certain categories of information being kept on them in computerized files. For example, the U.S. Fair Credit Reporting Act of 1970 entitles each citizen to review and correct credit reports that have been done on them and to be notified of credit investigations undertaken for purposes of insurance, mortgage loans, and employment. Given the exceptional mobility of this information and the potential for severely damaging individual privacy that this creates, protection of the right of individual privacy in the computer era is held to require acknowledgement of countervailing positive rights: entitlement to know what exactly about oneself is contained in computerized government files and to have one's record rectified if it is shown to be erroneous.

A third, somewhat more speculative example involves a special case of the general right to liberty—namely, the traditional negative right of reproductive freedom: entitlement not to be interfered with in one's procreative undertakings, be they attempts to have or to avoid having offspring, including via "artificial" contraceptive means. It remains to be seen whether, in the context of the recent and continuing revolution in reproductive science and technology, the negative right of individual reproductive freedom will engender a positive counterpart: entitlement of those with infertility problems to be provided with (at least some) technical reproductive services enabling them to attempt to have offspring, where access does not hinge on a client's ability to pay or even perhaps on marital status.

As such scientifically and technologically generated positive rights expand, ethical tension will mount. Some deontologists, believing that human rights are "absolute," may conclude that their corresponding positive rights are likewise, hence inviolable. Others, including most consequentialists, while treating rights as claims that always deserve society's sympathetic consideration, may conclude that they cannot always be honored without regard to the social consequences of doing so. The most important consequence of this ethical tension may be that the day is drawing closer when society will have to come decisively to grips with the consequences of philosophical commitment to a concept of rights as "absolute" and "immutable."

Public Harms of Aggregation

Suppose that each of a large number of people carry out essentially the same action. Suppose further that, considered individually, each of these actions has at worst a negligible negative effect on a social or natural environment. Finally, suppose that the aggregated effect of the large number of people doing the same thing is that substantial harm is done to the environment in question. Let us call such outcomes *public harms of aggregation.* Many, if not most, such harms are possible only because, to an unprecedented degree, modern production, communication, and transportation methods have made many scientific and technological processes and products available on a mass basis. A curious moral aspect of such situations is that as the individual acts were assumed to be of negligible negative impact, they are typically regarded as being ethically unobjectionable. Hence, the aggregate effect of a mass of ethically permissible actions may nevertheless turn out to be quite ethically problematic. In ethics, sometimes numbers *do* count.[11]

Consider, for example, the pollutants emitted by each of the approximately 400 million automobiles in the world. The aggregate negative environmental effect of individually innocuous, hence seemingly ethically unproblematic, effects is known by now to be substantial. To the extent that this aggregate effect can be shown to harm people's health, particularly groups at special risk of being affected (e.g., the elderly, young children, and those with respiratory problems), the aggregate effect would begin to be judged as ethically unacceptable and unjust, and the individual pollution-emitting activities might begin to appear as something other than ethically neutral.

An analogy may help clarify this novel ethical situation. Suppose that a populous nation experiences a devastating depression in which many of its people suffer. Suppose that after the fact it is plausibly shown that an important contributing cause of the depression's occurrence was the fact that each family in the country had accumulated a substantial but individually manageable level of consumer debt. If the country was fortunate enough to recover its economic health, would not the new accumulation of a substantial but still manageable amount of consumer debt by an individual family be likely to be regarded as an ethically irresponsible thing to do? If so, the same could be said of an individual car owner's emission of pollution or an individual consumer's failure to recycle.

A somewhat futuristic example of the same pattern from the biomedical realm is that of predetermination of the sex of one's offspring. Given the fact that reproductive freedom is widely viewed as a human right, it is safe to assume that attempts of individual couples—at least married ones—to avail themselves of the latest scientific or technological means to determine the sex of their offspring will be regarded as ethically permissible. However, suppose that in a populous society with a culture biased in favor of male offspring a significant number of couples opt for predetermination and that a significant sexual imbalance of male over female offspring results. Suppose further that at least some of the ethically problematic consequences envisioned as resulting from this state of affairs come to pass (e.g., increased crime committed by men or heightened male aggressiveness in competition for scarcer female mates).

The upshot of this situation is that twentieth century science and technology may be pushing society toward reevaluation of "permissive" ethical judgments traditionally made about individual actions that are at worst "negligibly harmful." Consequentially speaking, the threshold of harm necessary to activate negative ethical judgments may be in the process of being reduced by the aggregative potential of modern science and technology in populous societies.

Practitioner Problems

The kinds of science- and technology-based ethical problems considered thus far have something in common: While spawned by developments within the spheres of science and technology, the resultant issues and conflicts unfold, not primarily within those spheres, but in society at large. In contrast, problems in the final category considered here, while related to concerns of society at large, arise primarily *inside* the communities of practitioners of science and technology. They are ethical problems associated with the concrete processes and practices of scientific and technological activity, both those in which these activities unfold and those in which their results are communicated. Such problems are sometimes viewed as falling within the province of "professional ethics," meaning that they are ethical problems that arise in the course of professional practice.

Problems of Execution Edward Wenk has identified three kinds of ethical issues faced by practicing engineers in their work.[12]

(1) *Distributive Justice.* The first is essentially an issue of distributive justice, involving as it does an allocation of costs, benefits, and risks. This kind of problem arises when an engineer must decide whether to embark upon or proceed with a feasible project that he or she recognizes is likely to expose people to a non-trivial degree of risk to their safety, health, or property without their consent. Beyond answering the question "Can it be done?" about the contemplated project, the would-be ethical engineer must confront the quite different question "Ought it be done?" For example, from an ethical point of view, should an engineering company accept a lucrative contract to erect a potentially hazardous structure, such as a hydroelectric dam, in a geologically unstable area near a rural village in the absence of the informed consent of its inhabitants?

Other things being equal, if the degree of risk—understood as a function of the estimated magnitude of the harm that could occur and the estimated likelihood of its occurrence—is substantial, then it would be ethically wrong to proceed. If it is negligible, then it would be ethically permissible, perhaps even obligatory, to do so. One problem with this kind of situation is that determination of what constitutes an "acceptable risk" is not a strictly technical question but a social and psychological one. Among other things, the answer to it depends on *what* members of the population at risk believe to be at stake, on *how highly* they value it at the time in question, and on *how seriously* they would regard its loss.

Meridith Thring has extended this analysis in the case of engineers who are independent operatives doing work in research and development. For years, Thring, a university professor of mechanical engineering, had been doing research on industrial robots. However, he eventually came to believe that "the primary aim [of such work] is to displace human labour." For this reason he abandoned work on industrial robots and decided to work only on

> applications where the aim is to help someone to do the job he does now without actually exposing his body to danger or discomfort; or where we need to amplify or diminish his skill and strength. A good example is "telechirics," . . . artifacts that allow people to work artificial hands and arms and operate machines in hazardous or unpleasant environments as if they were there, while they are in fact in comfortable and safe conditions.[13]

Thring implies that it is also ethically incumbent on engineers to consider whether the work they contemplate—here, a research and development project—poses an unacceptable risk to any important nonsafety interest of patients likely to be affected by it—for example, that of not being rendered redundant. At bottom, this too is an issue in distributive justice. For Thring, the ethical engineer must first carefully estimate the costs, benefits, and risks likely to be associated with a possible technological endeavor and then ask "Are those benefits, costs, and risks likely to be allocated to the affected parties in a way that is distributively just?" The engineer may then proceed with the work only if he or she can answer that question in the affirmative.

Similar ethical constraints apply to the initiation or continuance of scientific experiments that pose significant undisclosed risks to the safety, health, or property interests of people participating in or likely to be affected by them. Three of the most ethically repugnant scientific experiments carried out in or on behalf of the United States during this century are of this character and warrant brief description.

Beginning in 1932, U.S. Public Health Service researchers administered placebos to 431 black men in Tuskegee, Alabama. Each experimental subject, induced to come in for blood tests supposedly as part of an area-wide campaign to fight syphilis, was tested for and found to have syphilis. However, *the subjects were neither told that they had the disease nor treated for it.* The purpose of the experiment was to obtain scientific knowledge about the long-term effects of syphilis on mental and physical health. Nontreatment continued for 40 years, long after it became known that penicillin was a cure for syphilis and was widely available. Following press exposure in 1972, the experiment was terminated.[14] A Public Health Service investigation disclosed that of 92 syphilitic patients examined at autopsy, 28 men (30.4 percent) died from untreated syphilis—specifically, from syphilitic damage to the cardiovascular or central nervous systems. Hence, the total number of men who died as a result of nontreatment may have exceeded 100.[15]

In the 1950s, the U.S. Central Intelligence Agency solicited and funded a series of "mind-control experiments." Among the techniques used on experimental subjects were sensory deprivation, electroshock treatment, prolonged "psychological driving," and the administering of LSD and other potent drugs. By one estimate, at least 100 patients went through one series of brain-washing procedures.[16] Many participants in the experiments suffered long-term physical and mental health problems. In 1953, one subject was given a glass of liquor laced with LSD. He developed a psychotic reaction and committed suicide a week later.[17]

As part of its Biological Warfare program, the U.S. Army secretly sprayed bacteria and chemicals over populated areas of the United States (and Panama) during a 20-year period beginning in 1949. At least 239 such tests were carried out. The objective was to determine the country's vulnerability to germ warfare by simulating what would happen if an adversary dropped certain toxic substances on the United States. One frequently used microorganism was *Serratia marcescens.* Its safety was questioned prior to 1950, and strong evidence that it could cause infection or death existed in the late 1950s. Nevertheless, it continued to be used in tests over populous areas for the next decade. Four days after a 1950 spraying over the San Francisco Bay Area, a patient was treated at the Stanford University Medical Center for infection caused by *Serratia,* the first case ever recorded at the hospital. Within the next five months, ten more patients were treated at Stanford for the same infection. One of them died.[18]

Their ethically reprehensible character aside, such cases serve the useful purpose of showing that "freedom of scientific inquiry" is not an absolute, unconditional, or inviolable right. While clearly an important human value, "freedom of scientific inquiry" may, under certain conditions, have to take a backseat to other important values, such as protection of the dignity and welfare of each and every individual human being.

(2) *Whistle Blowing.* Wenk's second kind of ethical issue in engineering is that of "whistle blowing." Engineers—or scientists—may become aware of deliberate actions or negligence on the part of their colleagues or employers that seem to them to pose a threat to some component of the public interest (e.g., public safety, the effective expenditure of public monies, and so on). If the worried practitioner's "in-house" attempts to have such concerns addressed are rebuffed, then he or she must decide whether to "go public" ("blow the whistle") and disclose the facts underlying the concerns.

Problematic phenomena of the sort that impel some practitioners to consider such a course of action are often driven by the huge profits and professional reputations at stake in modern research and development activity. These phenomena can be associated with any of a number of phases of engineering or science projects. Consider, for example, misleading promotional efforts to secure public funding; cheap, unreliable designs; testing shortcuts; misrepresented results of tests or experiments; shoddy manufacturing procedures; intermittently defective products; botched installation; careless or inadequate operational procedures; or negligent waste disposal. A significant number of such cases have come to light in recent years, of which three follow.

At Morton Thiokol, Inc. (MTI), several engineers working on the *Challenger* space shuttle booster project tried to convince management that the fateful January 1986 launch should not be authorized since the already suspect O-ring seal on the booster rocket had not been tested at the unusually cold temperatures prevailing on the day of the tragedy. MTI senior engineer Roger Boisjoly testified before the presidential committee investigating the disaster about what led up to the decision by the company and the National Aeronautics and Space Administration (NASA) to authorize the launch, a process at whose turning point MTI's general manager told his vice president of engineering to "take off his engineering hat and put on his management hat."[19] For his candid testimony, Boisjoly was allegedly subjected to various forms of mistreatment within the company and was placed on extended sick leave.[20]

In 1972, three engineers employed by the San Francisco Bay Area Rapid Transit (BART) system, after receiving no response to their in-house memos of concern, went public about subsequently confirmed safety-related deficiencies that they had detected in the design of BART's Automated Train Control System. They were summarily dismissed for their trouble.[21]

A senior engineer at the Bechtel Corporation, part of a task force assigned to plan the removal of the head of the failed nuclear reactor vessel at Three Mile Island after the famous 1979 accident, became concerned about short-cuts allegedly being taken by his company in testing the reliability of the crane to be used to remove the vessel's 170-ton lid. When he protested the alleged shortcuts, he was relieved of many of his responsibilities. He then went public, was suspended, and later fired.[22]

Sociologically speaking, several things are noteworthy about such cases. Technical employees who find themselves in situations in which they are asked or required to do things that violate their sense of right and wrong are not an endangered species. Results of a survey of 800 randomly selected members of the National Society of Professional Engineers published in 1972 disclosed that over 10 percent felt so constrained. A "large fraction" were sufficiently fearful of employer retaliation that they acknowledged they would rather "swallow the whistle" than become whistle blowers.[23] A major 1983 study of technical employees found that 12 percent of respondents "reported that, in the past two years, they have been in situations in which they voiced objection to, or refused to participate in, some work or practice because it went against their legal/ethical obligations as engineers or their personal senses of right and wrong."[24]

For a number of reasons, engineers have traditionally been loath to criticize their employers publicly. Most obviously, those who feel compelled to "go public" enjoy precious little legal or professional-association protection against employer retaliation, often in the form of firing. However, as Wenk argues, some reasons that discourage whistle blowing are sociocultural in nature:

> For engineers, a problem arises because most work in large organizations and many find excitement of participation in mammoth undertakings. They learn to value formal social structures, an attitude akin to "law and order." They adopt the internal culture and values of their employer and are likely to be allied with and adopt the perspectives of the people who wield power rather than with the general population over whom power is held. As a consequence, there is less tradition and inclination to challenge authority even when it is known to be wrong in its decisions which imperil the public.[25]

Not without reason, engineers—and, increasingly, scientists in large industrial organizations—tend to see themselves as employees with primary obligations to their employers, not the public. Moreover, the notion that employees retain certain citizen rights—for example, freedom of expression—when they enter the workplace is a relatively new notion in American industrial history. In a classic 1892 opinion, Oliver Wendell Holmes, then Massachusetts Supreme Court justice, wrote:

> There are few employments for hire in which the servant does not agree to suspend his constitutional rights of free speech as well as idleness by the implied terms of the contract. The servant cannot complain, as he takes the employment on the terms which are offered him.[26]

Only in the late twentieth century has this traditional attitude begun to be reversed, partly because the costs of such enforced silence are now viewed as unacceptable to society.

Ethically speaking, the obligation of technical professionals to blow the whistle when it is appropriate to do so arises from several factors. First, much contemporary research and development is supported by public money, as is the graduate education of many scientists and engineers (through government fellowships and loans). Second, the scale of the possible harm to the public interest at stake in many contemporary technical activities is large. The third factor is the following ethical principle of harm prevention: "[W]hen one is in a position to contribute to preventing unwarranted harm to others, then, other things being equal, one is morally obliged to attempt to do so."[27] An engineer or scientist sometimes possesses personal, specialized, "insider" knowledge about a troubling facet of a technical activity or project. Coupled with the credibility attached to testimony provided by authoritative technical professionals (as opposed to claims made by nonspecialist activists), that knowledge puts the scientist or engineer in a special position to make a possibly decisive contribution to preventing unwarranted harm to others or at least to preventing its repetition. This gives rise to a moral obligation to blow the whistle—once all other reasonable steps to rectify the situation "in house" have been taken and failed.

Some have urged that the obligation to responsibly blow the whistle be emphasized during the formal education of scientists and engineers—by the use of actual case studies, for example.[28] Others have stressed the importance of effecting structural and policy changes in the organizations in which technical professionals work and in their professional associations so that whistle blowers are not required to choose between remaining silent and becoming self-sacrificing "moral heroes."[29] A third approach is that of legislation. A measure of protection for whistle-blowers has been built into some federal environmental and nuclear laws, and roughly half the states prohibit the firing of employees who have blown the whistle on their employers for practices violating existing public policies. However, some advocates for whistle-blowers see the need for comprehensive federal legislation allowing whistle-blowers who suffer reprisals to initiate legal action against their employers up to two years after such occurrences.[30]

(3) *Consideration of Long-Term Effects.* Wenk's third and final category of ethical issues confronting engineers in daily practice involves "managing the future." He argues that engineers have a tendency to focus on designing, producing, or installing "hardware" without adequately "anticipat[ing] . . . longer term effects." This is an abdication of the engineer's "professional responsibility." In terms of the "quartet of basic concerns" that we have utilized in this chapter, given the scale and scope of the effects of many contemporary engineering products and projects, engineers who fail to scrutinize their projects with comprehensive critical vision, both with respect to its likely consequences (including possible longer-term ones) and its likely patients or "stakeholders" (including, where appropriate, members of future generations) are guilty of unprofessional and ethically irresponsible conduct. Uncritical allegiance to the deontological dictum "if it can be done, it should be done" no longer confers immunity from charges of ethical impropriety on technical practitioners.

Problems of Communication Other ethical issues faced by technical practitioners have to do not with possible effects of scientific and technological projects on the safety, health, or property of those who may be affected by them, but with problematic aspects of *practitioners' communication* of and about their work.[31] Issues in this category, most notably ones involving *fraud* and *misrepresentation*, pertain to publication or presentation of claimed findings and to work-related interactions with nontechnical funding or policy-making officials. Cases of fraud have come to light in recent years in which experiments reported on in published papers were in fact never carried out, crucial data were fabricated, and conclusions were drawn from data allegedly known not to support them.[32]

(1) *Fraud.* Falsification of scientific data may not be as infrequent as normally supposed. June Price Tangney surveyed researchers in the physical, biological, behavioral, and social sciences at a large American university. Of 1,100 questionaires distributed, 245 were completed and returned. Half of the respondents were senior researchers with the rank of full professor. Not surprisingly, the survey revealed that 88 percent of the respondents believe that scientific fraud is uncommon. However, 32 percent reported that they had a colleague in their field whom they had at some time suspected of falsifying data.[33] This figure, while suggestive, must be interpreted cautiously. It is not proof that one third of all scientists engage in such misconduct, for not only may suspicions be mistaken, but multiple respondents could have had the same individual in mind.

Whatever the extent of fraud in science, scientists see a number of factors contributing to the phenomenon. Tangney's respondents identified the following as major motivations for fraud: desire for fame and recognition (56 percent), job security and promotion (31 percent), firm belief in or wish to promote a theory (31 percent), and "laziness" (15 percent).[34] Underlying many such factors, she contends, is *the highly competitive nature of contemporary science:* the pressure to publish, the shortage of desirable jobs, and the fierce competition for funds. Beyond contributing to fraud, Tangney argues that such pressures can negate "what might otherwise be a fairly adequate self-policing mechanism in the scientific community." Indeed, the results of her survey call into question the common wisdom about the self-correcting nature of science, via processes like refereeing and publication, for of the aforementioned 32 percent who had suspected a colleague of falsifying data, over half (54 percent) reported that they had taken no action to confirm or disconfirm their suspicions.[35] The competitive nature of contemporary science may have biased the reward system in the profession *against* undertakings aimed at uncovering fraud.

In a highly competitive academic environment, many researchers may feel that, if they raise questions about serious misconduct, their own reputations will be tarnished and their own chances for resources and advancement will be diminished. A scientist may be rewarded for uncovering "legitimate" flaws or shortcomings in a rival's work. However, there generally is little to be gained and much to be lost by attempting to expose a fraud.[36]

(2) *Misrepresentation.* Misrepresentation takes a number of forms in the communication of research findings, including both failure to credit or fully credit deserving contributors and crediting or overcrediting undeserving contributors. It might seem that such acknowledged species of misconduct, however regrettable, do not deserve to be called unethical, except perhaps by deontologists, for whom they fall into forbidden categories of actions regardless of the gravity of their consequences for science or society. However, consequentialists may also selectively regard such practices as unethical, since they can in fact result in serious public harm. In May 1987, a scientist was accused by an investigative panel of scientists appointed by the National Institutes of Health of "knowingly, willfully, and repeatedly engag[ing] in misleading and deceptive practices in reporting results of research."[37] The pertinence of these practices to consequentialist ethical judgment making becomes clear from the panel's finding that the scientist's publications had influenced drug treatment practices for severely retarded patients in facilities around the United States.

Presentations of research findings to groups of peers also offer opportunities for ethically problematic behavior. Such presentations are sometimes used to establish claims of priority in the conduct of certain kinds of research. However, given the intensely competitive nature of the contemporary scientific research enterprise, if the research work is still in progress, it is understandable that scientists may opt to disclose just enough of their findings to serve their priority interests but not enough to reveal their overall strategies or the next steps in their "battle plans." However, quests for priority and resultant recognition may go beyond being unprofessional and become unethical if deliberately misleading or outright false information is disseminated in hopes of sending rivals "off on wild goose chases," diverting them from paths believed potentially fruitful. While making such an ethical judgment may appear open only to a deontological thinker, doing so can also be defended on consequentialist grounds, by, for example, appealing to the harm that such deception can inflict on knowledge-sharing institutions like the peer seminar which have usefully served scientific progress and thus, indirectly, human welfare.

The interaction of scientists and engineers with public funding agencies or policy-making officials can also be ethically problematic. Institutional or organizational pressures to obtain funding for research and development ventures or units with significant prestige or employment stakes can induce applicants to resort to various forms of misconduct in hopes of increasing the chances of favorable action by a funding agency. Among these are use of false data, misrepresentation of what has been accomplished to date on a project in progress, and gross exaggeration of what can be expected in the grant period or of the scientific or social significance of the proposed work.

Dealings with makers of public policy often lend themselves to such hyperbole, for policymakers are typically individuals with nontechnical backgrounds who are unable to assess critically the plausibility of the claims made about current or proposed research or development projects. If a prestigious researcher deliberately misrepresents the potential or state of development of a pet project to an influential policymaker in order to enhance the project's funding prospects, then insofar as approval is secured through this deception and at the cost of funding for other worthwhile projects, consequentialist thinkers may join deontologists in judging the practitioner guilty of unethical conduct. This they may do not least on grounds of the long-term consequences for the welfare of society of undermining the integrity of the research funding process.

THE CHALLENGE OF CONTEMPORARY SCIENCE AND TECHNOLOGY TO TRADITIONAL ETHICAL THEORIES

The foregoing discussion of categories of ethical issues and conflicts engendered by developments in science and technology strongly suggests that these forces are putting growing pressure on traditional absolutistic ethical thinking. There are several reasons that the validity and utility of such thinking are being called into question in an era of rapid scientific and technological development.

As we saw, many such theories condemn or praise particular kinds of actions if they but fall into one or another category of supposedly intrinsically good or bad deeds. However, as noted, an action or practice condemned as "unnatural" can come to seem less so over time, especially if the original ethical judgment was predicated on the act's or practice's being unusual or unfamiliar when it first came to attention. Similarly, traditional absolutistic ethical outlooks are sometimes based on static world views born of their subscribers' limited experience. As a culture or subculture dominated by such a world view overcomes its geographical or intellectual isolation and interacts more with the rest of the world, supposedly immutable categories or rules pertaining to "sacred" things or ways tend to loosen up. Adherents of such world views may come to recognize that respectable members of different cultures or subcultures think and act differently than they do about the same matters. Further, new products, processes, and practices can, as noted, have long-term hidden effects. Their eventual eruption and empirical confirmation sometimes call for revision of ethical judgments made before recognition that such subterranean effects were at work. However, such reevaluation is not congenial to absolutistic thinking, which purports to base its unwavering ethical judgments and decisions on something other than consequences. Considerations such as these make it increasingly difficult to sustain absolutistic ethical theories and outlooks in contemporary scientific and technological society.

Besides challenges to its intellectual tenability, contemporary science and technology are calling into question the utility of traditional absolutistic ethical theories—that is, their ability to serve as intelligent guides to action in a world of rapid and profound technical and social change. Such categorical theories and outlooks are helpless when confronted with ethical issues and conflicts of the sorts discussed in the third section of this chapter. For example, such theories shed no light on cases involving the distribution of benefits, costs, and risks associated with scientific and technological developments; intrapersonal conflicts between two venerable ethical values; public harms of aggregation; or the situations of technical professionals torn between loyalty to employers, concern for their families' well-being, and devotion to promoting the public interest. Finally, traditional deontological approaches to ethical thinking offer no incentives to agents to consider whether, in the face of possible unforeseen effects of a technical innovation, expansion of the domain of pertinent patients or the list of their protectable interests might be in order.

This is not to imply that consequentialist theories and thinking are immune from difficulties when confronted by contemporary scientific and technological developments. For example, uncertainty about possible elusive or projected long-term consequences of scientific and technological innovations and developments makes ethical judgments based on such assessments provisional and open to doubt. However, that is a price that must be paid if ethical judgments and decisions are to be made on an empirical rather than an a priori basis and are to be focused on the bearing of scientific and technological developments on human harm and well-being.

One conclusion of this chapter, then, is that developments in contemporary science and technology call for revisions in traditional ethical thinking and decision-making. One kind of ethical theory deserving serious consideration we will call *qualified neo-consequentialism*. Under this theory, ethical judgments about actions, practices, and policies hinge first and foremost on assessments of their likely consequences. In particular, these assessments must have the following *neo-consequentialist* qualities. They should be

1. *Focused on harm and well-being*—directed to identifying and weighing the importance of consequences

likely to influence the harm or well-being of affected patients;*

2. *Refined*—designed to detect or at least be on the lookout for subtle effects that, although perhaps hidden or manifested only indirectly, may nonetheless significantly influence stakeholder harm or well-being;
3. *Comprehensive*—designed to attend to *all* harm- and well-being-related effects—social and cultural as well as economic and physical in nature—of the candidate action, policy, or practice on *all* pertinent patients, remote as well as present, "invisible" as well as influential;
4. *Discriminating*—designed to enable scientific and technological options to be examined critically on a case-by-case basis, in a manner neither facilely optimistic nor resolutely pessimistic, and such that any single proposal can emerge as consequentially praiseworthy and be adopted or as consequentially ill-advised and be rejected in its present form if not outright; and
5. *Prudent*—embodying an attitude toward safety that, as long as a credible jury is still out or if it has returned hopelessly deadlocked, is as conservative as the magnitude of the possible disaster is large.

Further, the assessments sanctioned by our proposed ethical theory must also meet certain conditions. If an action, policy, or practice is to earn our theory's seal of approval, its projected outcome must not only be likely to yield at least as large a surplus of beneficial over harmful consequences as that of any available alternative, but it must also meet certain additional *qualifications,* two of which will now be briefly discussed.

It is scarcely news that contemporary scientific and technological activities unfold in societies in which those who stand to benefit greatly from their fruits are rarely the same as those likely to bear their often weighty costs and risks. We therefore stipulate that to be ethically permissible or obligatory, the allocation of the scrupulously projected benefits, costs, and risks of a technical undertaking among the various affected stakeholders must also be *distributively just.*

Various criteria have been put forth for evaluating the justice of such distributions.[38] One that deserves serious consideration is John Rawls's famous "difference principle."[39] Imagine, says Rawls, a group of people in "the original position"—that is, convened to formulate from scratch the rules that will govern the first human society, one shortly to come into being. Suppose that these deliberations take place behind "a veil of ignorance"—that individual group members have no knowledge whatsoever of whom or what they will turn out to be (e.g., male or female, black or white, Asian or North American, physically handicapped or not) or of their eventual economic well-being or social status. Then, Rawls contends, the group would eventually reach agreement that it was in each member's best interest that the following rule of justice be adopted: an unequal distribution of any social or economic "good" will be permitted in the society-to-be only if there is good reason to believe that it will *make everyone, including the less fortunate, better off.* Indeed, Rawls eventually offered a stronger version of his principle according to which an unequal distribution of such a good is just only if there is good reason to believe that it will make everyone better off *and* that it will *yield the greatest benefit to those currently worst off.*[40] If either version of this rule is found compelling, it would have to be applied to each predominantly beneficial but unequal distribution of projected science- or technology-based benefits, costs, and risks before the conclusion could be reached that it was ethically permissible or obligatory to proceed with the action, project, or practice in question.

Our neo-consequentialist ethical theory has a second qualification. A science- or technology-related course of action may sometimes be denied ethical approval even if all of the foregoing conditions are met. Even then, it may be proper to withhold ethical approval if the projected harmful consequences (1) *exceed some substantial quantitative threshold*—either in a single case or when aggregated over multiple cases of a similar sort—and (2) are not *greatly* outweighed by their positive counterparts. In such situations, the decision-making party may decide that it would be prudent to decline the admittedly greater projected benefits offered by the option under consideration.

Ethical decision making that takes no account of the absolute magnitude of an option's projected negative consequences even if they are outweighed by their positive counterparts, or of how the outweighed negative consequences of an individual course of action may aggregate over multiple instances, is deeply flawed. Indeed, allowing

*The reader will note that no account has been presented here of exactly what is meant by human "harm" and "well-being." That substantial task must be left for another occasion. Suffice it to say here that for this writer, "harm" is not reducible to considerations of physiological deprivation, physical injury, and property damage or loss; nor is "well-being" reducible to considerations of material abundance, financial success, and high social status.

"yielding a positive balance of benefit over harm" by itself to compel ethical approval of individual courses of action may even be unjustified on consequentialist grounds, for following that criterion consistently in multiple instances may over time lead to unacceptable public harms of aggregation. For example, assessing the impact on traffic of individual proposed downtown high-rise office buildings solely in terms of the modest number of additional cars each structure may attract into the city may allow the aggregate effect on traffic of approval of a large number of such projects to go unreflected in individual decision-making processes.

CONCLUSION

Hopefully, the reader will find the qualified neo-consequentialist approach to thinking about ethical issues and conflicts just sketched more adequate to the realities of contemporary scientific and technological practice. In any event, in this chapter we have characterized a number of different kinds of science- and technology-based ethical issues and conflicts, indicated some noteworthy technical and social roots of such problems, and argued that important traditional ethical concepts and modes of thinking are being subjected to increasing pressure by scientific and technological changes in contemporary society. While this stress is being strenuously resisted in some quarters, it is likely in the longer run to lead to major transformations of ethical ideas and thinking.

ENDNOTES

1. I owe my initial awareness of this framework to a 1972 lecture at Stanford University by ethicist Dr. Karen Lebacqz.
2. See, e.g., William Frankena, *Ethics*, Foundations of Philosophy series, 2nd ed. (Englewood Cliffs, N.J.: Prentice-Hall, 1973), chaps. 2 and 3. See also Mary Warnock, *Ethics Since 1900* (London: Oxford University Press, 1960), chap. 2, pp. 48–52.
3. *Wall Street Journal*, May 4, 1989, p. B4.
4. Stephen Isaacs, "Hasidim of Brooklyn: Fundamentalist Jews Amid a Slumscape," *Washington Post*, "Outlook" section, February 17, 1974, Section B, p. 1.
5. Gregory Kavka, *Moral Paradoxes of Nuclear Deterrence* (Cambridge: Cambridge University Press, 1987), pp. 19–21.
6. Ronald Munson, *Intervention and Reflection* (Belmont, Calif.: Wadsworth, 1979), p. 398.
7. *Ibid.*, pp. 399–400.
8. For example, Carl Cohen argues that animals are not members of any "community of moral agents." Incapable of, among other things, giving or withholding consent, animals, unlike humans cannot have rights thereby precluding involuntary experimentation on them. See Cohen's "The Case for the Use of Animals in Biomedical Research," *New England Journal of Medicine*, 315, no. 14, 1986, 867.
9. Gina Kolata, "Genetic Screening Raises Questions for Employers and Insurers," *Science*, 232, no. 4748, April 18, 1986, 317.
10. *New York Times*, August 19, 1986, p. 21.
11. John M. Taurek, "Should the Numbers Count?" *Philosophy and Public Affairs*, 6, 1977, 293–316.
12. Edward Wenk, Jr., "Roots of Ethics: New Principles for Engineering Practice," American Society of Mechanical Engineers Winter Annual Meeting, Boston, Massachusetts, December 1987, 87-WA/TS-1, pp. 1–7.
13. Meredith Thring, "The Engineer's Dilemma," *The New Scientist*, 92 no. 1280, November 19, 1981, 501.
14. *New York Times*, July 26, 1972, p. 1.
15. *New York Times*, September 12, 1972, p. 23. For a detailed account of this episode, see James H. Jones, *Bad Blood: The Tuskegee Syphilis Experiment* (New York: Free Press, 1981).
16. Harvey Weinstein, *A Father, a Son, and the CIA* (Toronto: James Lorimer and Co. Ltd., 1988).
17. Leonard A. Cole, *Politics and the Restraint of Science* (Totowa, N.J.: Rowman and Allanheld, 1983), p. 111.
18. *Ibid.*, pp. 112–114.
19. Roger Boisjoly, "Ethical Decisions: Morton Thiokol and the Space Shuttle *Challenger* Disaster," American Society of Mechanical Engineers Winter Annual Meeting, Boston, Massachusetts, December 1987, 87-WA/TS-4, p. 7.
20. *Ibid.*, p. 11.
21. Stephen H. Ungar, *Controlling Technology: Ethics and the Responsible Engineer* (New York: Holt, Rinehart and Winston, 1982), pp. 12–17.
22. Rosemary Chalk, "Making the World Safe for Whistle-Blowers," *Technology Review*, January 1988, p. 52.
23. Rosemary Chalk and Frank von Hippel, "Due Process for Dissenting 'Whistle-Blowers.'" *Technology Review*, June/July 1979, p. 53.
24. Chalk, "Making the World Safe," pp. 56–57.
25. Wenk, "Roots of Ethics," p. 3.
26. Chalk and von Hippel, "Due Process," p. 53.
27. Compare this principle with Kenneth Alpern's "principle of due care" and "corollary of proportionate care" in his "Moral Responsibility For Engineers," *Business and Professional Ethics Journal*, 2, Winter 1983, 40–41.
28. Boisjoly, "Ethical Decisions," p. 12.
29. Richard DeGeorge, "Ethical Responsibilities of Engineers in Large Organizations: The Pinto Case," *Business and Professional Ethics Journal*, 1, no. 1, 1981, 12.
30. Chalk, "Making the World Safe," pp. 55–56.
31. For a useful bibliography on this aspect of the problem, see Marcel Chotkowski LaFollette, "Ethical Misconduct in

Research Communication: An Annotated Bibliography," published under NSF Grant No. RII-8409904 ("The Ethical Problems Raised by Fraud in Science and Engineering Publishing"), August 1988.

32. See, e.g., William Broad and Nicholas Wade, *Betrayers of the Truth* (New York: Simon & Schuster, 1982), pp. 13–15; and Nicholas Wade, "The Unhealthy Infallibility of Science," *New York Times*, June 13, 1988, p. A18.
33. June Price Tangney, "Fraud Will Out—Or Will It?" *New Scientist*, 115, no. 1572, August 6, 1987, 62.
34. *Ibid.*
35. *Ibid.*
36. *Ibid.*, p. 63.
37. *New York Times*, April 16, 1988, p. 6.
38. For cogent discussion of various criteria of distributive justice, see Joel Feinberg, *Social Philosophy*, Foundations of Philosophy Series (Englewood Cliffs, N.J.: Prentice Hall, 1973), chap. 7.
39. John Rawls, *A Theory of Justice* (Cambridge, Mass.: Harvard University Press, 1971), chaps. 1–3, especially pp. 75–78.
40. For discussion of alternate versions of Rawls's difference principle, see Robert Paul Wolff, *Understanding Rawls* (Princeton, N.J.: Princeton University Press, 1977), pp. 40–41.

QUESTIONS

1. How would you define ethics?
2. List three ways that ethics correlates to social responsibility.
3. There are four kinds of considerations that are pertinent to ethical decisions and judgment making. List and describe them.
4. What does the phrase "violations of supposedly exceptionless moral principles" mean?
5. Name a new technology and then provide an example of value-based conflicts that it has created.