Chapter 11

DIFFICULT AND IMPORTANT QUESTIONS:

SCIENCE, VALUES, AND ETHICS

Our zealous endeavor to create a “value-free” science—which seems so essential a requirement of objective scientific method—has meant simply that the values dominating our thinking have retired to the arena of our underlying presuppositions, where they can maintain themselves against critical appraisal by being so completely taken for granted that no one’s questioning attention is focused upon them.

(E. A. Burtt)

We [scientists] produce the tools. We stop there. It is for you, the rest of the world, the politicians, to say how the tools are used. The tools may be used for purposes which most of us would regard as bad. If so, we are sorry. But as scientists, that is no concern of ours. This is the doctrine of the ethical neutrality of science. I can’t accept it for an instant.

(C. P. Snow)

QUESTIONS concerning the relationship of values and ethics to science are extremely important because science affects humans so powerfully. Science affects people in several ways, both directly and indirectly. Some examples of the influence of science are these: the profound changes in worldview that have accompanied major scientific revolutions; the effect of movements like behaviorism and sociobiology on humanity’s self-image; and the indirect effects of science resulting from the technologies enabled by scientific discoveries. Both the direct effects of science and its indirect effects have implications in the realm of values and ethics. The relationship between science and values is not simple, despite the many simple statements that are made. One such statement (often heard) is that science and values are unrelated because science is objective and value-free. In contrast, we sometimes hear that the study of science is evil because science is soulless and mechanistic (and/or it produces destructive and powerful technologies). At the opposite pole, other writers maintain that the study of science is an unmitigated good because science leads to the truth and produces material prosperity. We’ll subject all of these simple claims to critical scrutiny in this chapter.
§1. The Inherent Values of Science

The community of scientists shares, as a group, certain values. I am not talking about subtle unexamined biases here, just simple virtues like honesty and curiosity. Now honesty is usually considered a virtue by almost everyone, not just in the sciences. Curiosity, however, is not necessarily considered a virtue by all groups in our culture. Both of these values (as well as the others we'll discuss) are particularly highly regarded in the sciences. Let's consider some of these scientific values and their implications in more detail.

Free Flow of Information

The scientific community is in general opposed to secrecy and isolation. Scientific progress depends on the free and unimpeded flow of information from one scientist to another. If a scientist doesn't publish her results, that is, share these results with the wider community, then the results cannot contribute to a progressively more refined understanding of nature. A commitment to open communication of results is one of the bedrock values of science. Yet, scientists working in the military and in industry often need to keep scientific information secret. Their values as scientists are in conflict with their values as members of another societal institution. Each individual scientist must come to terms with this conflict, and the larger community must resolve issues as they arise. A famous example of this conflict occurred during the Manhattan Project (the effort to develop an atomic bomb), when General Groves (the military project director) tried to compartmentalize the knowledge of different groups of scientists. The scientists themselves were determined to share their knowledge with each other. Strife over this issue also flared up in the early 1980s, when the executive branch of the government tried (unsuccessfully) to widen the scope of scientific work which should be classified secret and remain unpublished.

Honesty

Obviously, truthfulness is held to be a virtue quite generally, not just in the sciences. But honesty does have a special place as a core value in the sciences, which is not always typical of other human affairs. We are not always shocked when politicians, lawyers, and businesspeople tell lies. Dishonesty in science, however, is still greeted by some outrage, and rightly so. The reason is not that scientists are considered more virtuous than other professionals, but because honesty as a virtue is more im-
important in doing science. You can engage in a real estate transaction or make a political deal without assuming that the other party is telling the truth; you can’t do science, however, without assuming that the other people engaged in the same work are giving you honest information. There is certainly some fraud occurring in science, as evidenced by a number of well-publicized cases. There is also a disturbing trend for some scientists in a few disciplines to be considered “experts” and thereby qualify for large payments in legal proceedings (which can be a corrupting influence). Fortunately, these things are still a very small part of the entire scientific enterprise. Even so, they are a matter of grave concern in the scientific community. Why? Precisely because honesty is considered such an important scientific value.

Curiosity

Curiosity, in this context, is the desire to know more and to better understand nature. In other words, scientists always consider learning more about nature to be a positive good. Such curiosity is not only a part of the personality structure of most scientists, but it’s also taken to be one of the values of the scientific community as a whole. Unlike honesty, curiosity is not always considered a virtue by all members of our society. Novel ways of thinking sometimes contradict traditional understandings. Certain religious groups find curiosity a threat to their dogmatic beliefs. One of the staples of science fiction is the scientist who seeks knowledge that humans aren’t meant to know. And, of course, there is the adage, curiosity killed the cat. Although curiosity is one of the core values of science, individual scientists might have a conflict between this value and the other values they hold. As a clear and simple example, consider the conflict between my curiosity about how much pain a human can withstand and my ethical revulsion over an experiment to find out. A more subtle and difficult example is the following: Suppose a line of investigation driven by curiosity (and therefore good to perform) gives us knowledge that leads to a new technology we know is very dangerous and/or harmful. Should we undertake this investigation?

Open-mindedness

A scientific result or idea must ultimately be based on evidence, that is, observation and experiment. If accumulating evidence contradicts one of our beliefs, no matter how strongly held, then we must give up the belief. This willingness to change your mind based on evidence is also one of the basic values of science. Of course, there are stubborn scientists who are hard to convince; scientists are humans. It’s fair to say, however, that
anyone who doesn’t share this value of open-minded willingness to alter a belief in response to evidence is not a scientist. Once again, not everyone in our culture shares this value. Generally speaking, the people who don’t like curiosity are also not thrilled by open-mindedness. Also, politicians who change their positions based on evidence are sometimes accused of being weak and vacillating (waffling).

Values Employed in Theory Choice

In determining whether one theory is better than another, scientists employ criteria that, from a philosophical point of view, can be considered as values. For example, we generally prefer theories that have greater accuracy, better consistency with other theories, a broader scope of application, a higher degree of simplicity, and are more likely to lead to progress. While these things are values (strictly speaking), they are not really in the same category as the rest of the subject matter in this chapter. Criteria for theory selection are discussed more extensively in chapter 14.

Value-free Science?

You often hear or read the statement that science is objective and/or value-free, but the meaning of this statement isn’t always clear. If the statement refers to the actual content of science (e.g., experimental and theoretical results), then the statement is problematic. Arguments over this issue are sophisticated and difficult; fortunately, we don’t need to deal with these arguments here because they are unrelated to the present issues of interest (see chapter 15). If the statement “science is value-free” refers to the overall context within which science is done, however, then this statement is utter nonsense. To the extent that science is the activity engaged in by scientists, then clearly science is tied to a set of values, namely, the shared values of the scientific community (which have been the main subject matter of this section).

§2. The Impact of Science on Values

We have focused our attention so far on the shared values of scientists, but this is only a small part of the story. Scientific results often lead to new technologies, profoundly affecting human society in ways that can be either useful or destructive. In this way, science becomes entangled in questions of values and ethics that lie far outside the original scope of scientific values.
For example, questions about the behavior of atomic nuclei, which were posed and answered by physicists many years ago, simply involved curiosity about the workings of nature. An unexpected result of the knowledge gained about nuclei was the development of the atomic bomb, a weapon of mass destruction. Similarly, studies of how organisms transmit inherited characteristics, motivated by scientific curiosity, have resulted in the technology of genetic engineering with its accompanying ethical dilemmas. These examples clearly illustrate how seemingly value-free scientific issues quickly become value-laden when the science bears technological fruit. Even in the absence of new technologies, new science can sometimes have unforeseen effects on cultural issues well beyond the scope of the science itself. Increasing knowledge alone can affect the way we think about our values. Let’s explore some of these issues (concerning both technology and science) in more depth.

New Technologies

Many of the important issues can be illustrated by looking at a specific case: molecular biology and genetics. Rather than looking at future scenarios of human clones, let’s consider the implications of some procedures that are present-day realities. A number of diseases are inheritable, such as Huntington’s disease, phenylketonuria, and sickle cell anemia. People with family histories of such genetic diseases are obviously at higher risk for having them. Until recently, however, there was no way to know whether an at-risk individual actually had the condition until the onset of symptoms (which may occur late in life, as in Huntington’s disease for example). Scientific advances in our knowledge of genetics now allow us to identify particular genes (or groups of genes) as being responsible for some of these diseases, so we now have the technological ability to tell someone whether or not a condition exists long before any symptoms become evident. Is this a good thing? The ability to determine whether an individual has a genetic disease opens up a range of ethical dilemmas. Unless we have a treatment for the condition, the person might well prefer not knowing. If a doctor knows, is it ethical to withhold the information from the person (or, for that matter, to not withhold it)? If an insurance company finds out, it might refuse to issue health or life insurance; how should society handle that problem? If the person is a minor, who should determine whether a test is performed, the person or the parents? If the test can be performed prenatally (which is often the case), the issues become even more complex due to the possibility of abortion if the genetic condition is detected. Many examples of this sort can be found in the biomedical field. New techniques, for example, now allow us to prolong life far longer than ever before. Few people would argue that this is not
good, but even this generally positive outcome of scientific progress opens up some difficult questions. At what point is it proper to allow a suffering and terminally ill person to die? How much of society’s scarce resources should be used for the expensive process of keeping very old and very ill people alive, as opposed to improving health care for babies and young children? The issues involved in such questions go far beyond the science and technology that provide the new techniques.

Biomedical applications are not the only technologies that raise issues of values and ethics. In chemistry, for example, the technological goal is often to produce some useful new substance. These substances can be powerful agents to benefit society, but they can also do unintended harm. Chemists have created new pesticides and fertilizers, allowing highly improved agricultural yields. Feeding more people is certainly good. The gains have been accompanied by serious side effects, however, such as environmental pollution and toxic effects on humans and wildlife. Weighing the positive and negative effects on humanity in a case like this depends at least in part on our values as well as our scientific knowledge.

The application of science to military technology is also an area rife with ethical questions. Although there are many examples of military applications, perhaps the most famous is the development of the atomic bomb (largely by physicists). The invention of nuclear weapons, with their unprecedented destructive capability, led many scientists in the postwar era to consider the ethical dimensions of scientific work more seriously than previous generations had done. The fundamental scientific work done earlier in the century to understand the nature of radioactivity and nuclear forces gave no hint of these devastating technological applications; many scientists completely dismissed the possibility of using the nucleus as a source of great energy. By the time they realized that such applications were practical, many scientists in the Allied countries perceived themselves to be in a deadly race with Nazi Germany to produce a bomb. On that basis, they believed their actions to be quite justified ethically. Subsequent events, including the use of atomic bombs on civilian targets and the arms race with the Soviet Union, caused some scientists to regret the decision to build the bomb (some withdrew from military work). Others considered their actions well justified by the Communist threat, and they continued to devise ever-more-destructive weapons.

As a final example, let’s take a look at computer science and cybernetics. We again have a case of powerful technologies that can greatly influence people’s lives. Realization came early that automated control systems could displace human workers for many tasks, and this trend has continued. Many commentators have noted the massive restructuring of our economy brought on by the information age, and with it the potential
for social dislocations and further marginalization of some segments of society. In addition, important issues of individual privacy, censorship, and intellectual property rights have been created by the advance of computer technology and networking (for example, private information about yourself, which you give voluntarily to one organization, will almost surely end up in many other databases without your knowledge or consent). Once again, we are forced to confront new challenges to our old values by the advance of technology. My main point here is that all of the issues we’ve been discussing exist because new scientific understanding gave us new abilities. I am certainly not arguing that scientific advances are bad because they may create new ethical issues. The gist of all these examples can be summarized by a statement that has been said so many times as to become trite: Science and technology give us power but not wisdom. Any tool can be used for good or for ill, and only we (as individuals and as a society) can choose.

New Science

Science and technology are very different. The previous examples have all involved technology, and concerned science only indirectly insofar as the technological advances were enabled by scientific understanding (see chapter 10). Does science per se have any direct impact on our values? Historically, the answer is certainly yes, as the following examples will illustrate. Whether science must necessarily affect our values is a philosophical question that is difficult to answer (and not really our main concern here).

An early example of the effects of science on values is the impact stemming from the rise of the heliocentric theory. Looked at from a purely practical point of view, it really doesn’t make much difference whether we believe the earth or the sun is at the center of the universe. But in the cultural milieu of late medieval Europe, the central location of the earth in astronomy was inextricably associated with the central importance of humankind itself in the grand scheme of things. The central position of the earth could not be dislodged without having people’s understanding of their own nature severely shocked. A people’s self-image is surely intimately connected with their values. As the debate over heliocentrism unfolded, academic questions of astronomy became increasingly bound up with the more general struggle between the forces of progress and reaction in Europe.

A similar process occurred with even greater intensity in the debate over Darwin’s ideas on evolution by natural selection. In this case, the stakes were even higher for the human self-image because humans them-
selves are part of the subject matter of the theory. Evolution by natural selection effectively removes a barrier between humans and the rest of the animal kingdom; the potential impact of evolutionary thought on values was profound. In the hands of careless thinkers, evolutionary theory led to the perfidious doctrine of social Darwinism (this was an attempt to use scientific advances improperly to justify existing social class inequities). The same strain of thought also contributed to the infamous eugenics movements of the early twentieth century (eugenics is the attempt to “breed” better humans by not allowing the “unfit” to reproduce). These unfortunate consequences were in no way implied by Darwinian thought, but they do illustrate how much potential impact science can have on values, and for that reason how careful we must be when making such interpretations.

Physics has also had an effect on humanity’s view of itself and thereby on our values. The equations of Newton’s classical mechanics are deterministic. In other words, if we know all the forces on a particle, and if we know its present motion, then we can exactly predict all of its subsequent motions. Actually, such a program was never really possible in practice (see chapter 17), but this practical difficulty didn’t affect the conclusions drawn by various eminent thinkers. The idea of a clockwork universe, in which the future is predetermined and free will doesn’t exist, became deeply embedded in our culture. The revolutionary new theories of twentieth-century physics (relativity and quantum mechanics) introduced a variety of radical ideas. One of these new ideas was an element of nondeterminism in microscopic events. In other words, we cannot always predict exactly what will happen to a particle even if we know everything that we can know about that particle. Once again, a number of eminent thinkers seized upon this result of physical theory to claim a place for free will in the world, and this idea has also passed into our popular culture.

Our final example deals with issues in which the impact of science on values can be extreme: the study of human beings by modern biology and psychology. A generation ago, the reigning paradigm in psychology was behaviorism and operant conditioning. Some extreme behaviorists claimed that all human behaviors were predictable based on past and present sensory stimuli; they furthermore claimed that mental processing, not expressed in behaviors, was an epiphenomenon of no importance. These ideas imply that free will and reflective self-consciousness are merely illusions, a claim that very strongly influences our values. The behaviorist fad has now passed, only to be replaced by its polar opposite: the claim that who we are as humans is primarily the result of evolution and genetic predisposition. The extreme viewpoint here is that only the genes are of any importance, and that we humans are merely convenient methods for the genes to propagate themselves (another claim that obvi-
viously influences our values profoundly). Remarkably, all of these claims have been passed off as purely scientific statements without any value-laden components, a point that we will reconsider near the end of the next section.

§3. The Impact of Values on Science

Do the values held by a culture or an individual affect the way science is done, or even the results of science? Whether the actual results (theories and facts) of science are much affected by the values (and other presuppositions) of a culture or individual is hotly debated in academia. We’ll examine this issue only briefly here (a more detailed treatment is found in chapter 15). But the more limited question of whether our values affect science in any way at all seems to me to have a clear answer: yes. For example, our cultural values regarding material prosperity influence the amount of effort we spend studying scientific questions that we think will contribute to our prosperity. The values of an individual concerning patriotism and/or pacifism might influence that person’s decision whether to work on a scientific project with clear military implications.

The Limits of Scientific Inquiry

Let’s look at another example in somewhat more detail: the issue of whether there should be any limits to our choices of which scientific questions to study (and if so, what those limits are). One dimension of this question concerns ethical issues surrounding the implementation of a research study, rather than the scientific knowledge resulting from the research. In this case, the ethical issues may extend far outside the boundaries of science, and there are clear limits to the extent of the inquiry allowed. An infamous example is the Tuskegee study of the long-term effects of syphilis in a group of black men from 1932 to 1972 (the men were purposely not treated, in order to observe the effects of the disease); a stark reminder that freedom of scientific inquiry has sharp limits when overriding ethical principles are involved. Other examples in this category (but where the issues are more complex, controversial, and difficult to resolve) include the use of animal subjects in research and the use of fetal tissue in research.

A much different category involves the question of whether there should be limits on scientific research if that research will lead (or might lead) to dangerous technologies. Restricting the early nuclear physics research that eventually enabled nuclear weaponry might be an example, or the molecular biology research that enabled genetic engineering. We
can make philosophical arguments both against and in favor of such limitations, but I think it’s a waste of effort to weigh such arguments because in practice the issue is moot; we can’t possibly predict all the technological consequences at the time the research is being done. The real issues concern how to control the technologies after they become apparent. These issues are important, but they are not issues about the limits of scientific inquiry. An interesting exception to this point might be research that is undertaken primarily in the hope and expectation that it will lead to a certain technology (for example, plasma physics/fusion power or geriatrics/increased longevity); in those cases, the desirability of the research might well be debated in terms of the desirability of the anticipated technological outcome.

Finally, we can ask the question of whether there should be limits to scientific inquiry because the knowledge produced is something we don’t want to know (or shouldn’t know). The knowledge might be antithetical to some cherished traditional belief, for example, or might exacerbate tensions between ethnic groups in society. We see here a clash between the inherent values of science (curiosity, open-mindedness) and other values esteemed by our society (or at least by some members of it). A discussion of such deep and complicated issues is beyond our ambitions here, but I will offer an opinion and a comment. My opinion is that freedom of inquiry is not something to be given up lightly, but rather should be considered one of the core values of our culture in general, not just in science. Ignorance is far more likely to harm us than to help us. My comment is that good, solid scientific knowledge rarely causes any problems. The problems usually arise when highly value-laden implications are drawn from scientific results, a procedure that we should always scrutinize as critically as possible.

**Risk Assessment**

Values also have an impact on science in the assessment of potential risks to society from toxic pollutants, disasters, and so on. The degree to which value-neutral science can be done in this field is controversial, and the question is obviously a significant one. Let’s look at the issues more closely. We’ll first dismiss from further consideration the extreme cases of ideological zealotry and commercial greed. People who will say virtually anything with no regard for evidence (tobacco industry employees claiming that heavy smoking does no harm, for example) may sometimes be labeled as scientists, but using the word doesn’t make it so. These extreme cases have little to do with real science and are not of interest here.

The interesting question is whether legitimate scientific risk assessments can be kept free of presuppositions based on values. A number of people,
including many scientists and engineers, believe that this is possible. “Facts are facts, and the results of properly made measurements don’t depend on our values.” According to this view, we employ our values when we make policy decisions based on the risk assessments; objective science tells us what the risks are, and our values tell us whether these risks are worth taking for the benefits involved. This point of view certainly has some merit, but it has been criticized as an overly idealized picture of the way the process actually works. The flaw in that picture, according to its critics, is that we rarely have a complete and definitive set of data. In fact, the typical situation is just the opposite: only a small amount of very sketchy information is available. Moreover, the information that does exist is often not directly applicable. For example, toxicity studies involving animals and high doses must be interpreted for the case of humans and low doses. No one knows how the dose extrapolations should be done, or what the differences are between the toxic substance’s effects on humans and on animals. In trying to formulate a risk assessment based on such inadequate information and high degrees of uncertainty, we are forced to make scientific judgments of various sorts.

Our scientific judgments, say the critics, can easily be influenced by our value judgments in general, especially given the fact that our assessments have importance for real people’s lives. For example, a person who generally thinks that industry is overly regulated might well emphasize the following point: large uncertainties allow the possibility that a substance is not very dangerous. A person who generally thinks that exposure to environmental toxins is a major public health problem, on the other hand, might instead emphasize the opposite point: these large uncertainties allow the possibility that the toxic substance is far more dangerous than we can presently document. Neither of these examples is bad science. In both cases, the people did as well as they could with the information at hand; the point is that the large uncertainties in the information allowed their values to influence their interpretation. This influence may or may not be inevitable. But to the extent that it happens, we’ll improve the quality and worth of our risk assessments by critically scrutinizing the risk assessment process in terms of both science and values.

**Studying Humans, Revisited**

We’ve already looked briefly at the impact of science on values in the scientific study of human beings. But perhaps that influence goes both ways; presupposed values might also affect the science being done in this case. In hindsight, for example, it’s quite obvious that much of the work on human heredity (closely related to the eugenics movement) in the early 1900s was tainted by class and ethnic prejudice. There have been at least
three major attempts to draw conclusions about humans based on studies of animals: behaviorism, ethology, and sociobiology. In each of these three cases, the claims concerning human nature have gone well beyond the legitimate scientific knowledge. If such claims about human nature are not justified by the purely scientific information available, they must surely contain significant value-laden elements. (I will admit that my judgment here might be controversial, though I don’t see how to avoid it.) Moreover, the very claim that such animal studies even *can* tell us something of importance about human nature is a presupposition (which is not to say that it’s wrong) rather than an empirical fact. I don’t think it’s stretching too far to say that this presupposition stems from the values of these investigators.

So far, we’ve only been talking about the influence of values on the overblown claims made in the name of science in these three cases. We still haven’t addressed the question of whether values influenced the scientific methodologies themselves, or the response of the scientific community to these studies. This question is more difficult, and I don’t think any definitive answers are possible. It does seem interesting that behaviorism became popular in the United States during the middle of the twentieth century, a time when the general thinking in the culture was receptive to the idea that people are primarily molded by their social conditions. In contrast, ethology grew out of a central European intellectual tradition that existed in cultural and political conditions of instability and authoritarianism; these conditions may have been more hospitable to an emphasis on inborn traits and instincts. Reading too much into such observations is dangerous, however, and any thoughts about the influence of cultural values on these sciences must remain speculative in the absence of a detailed scholarly discussion.

§4. Where Science and Values Meet

What is the proper relationship between science and values? As we’ve seen, one possible answer is this: “There is no relationship, because science tells us what is, and values tell us what ought to be.” But the many examples we’ve discussed make it clear that this answer doesn’t hold up very well under close scrutiny. The sentiment expressed is not completely wrong, just inadequate to cover all of the many situations possible. At the opposite extreme, we see claims that science and values are not only related but that the relationship is hierarchical (i.e., one thing totally controls the other). “Values are created by the brain, which can be studied scientifically; values are just a branch of biology.” So say the extreme reductionists. Of course, the extreme postmodernists say something dif-
ferent: “Sciences are always based on unstated presuppositions, which are really value preferences; scientific results are merely expressions of our social values.” Such extreme views surely don’t do justice to the subtle complexities involved in these questions.

So values and science are related to each other, but the relationship is not hierarchical. Each has an important role to play in examining issues, and these roles are complementary. Science can provide empirical information and a depth of understanding to inform our debates over values and our ethical decisions. But the resolution of these debates and decisions must ultimately depend on a sagacity that comes from outside the realm of science. Because science (through its associated technologies) also provides us with a great deal of power, the issues require careful thought. Both scientists as individuals and also society in general have responsibilities in the consideration of these issues. Some responsibilities of scientists are to exhibit extreme honesty concerning the uncertainties in our knowledge and to carefully scrutinize the broader ramifications of their work. Society as a whole must be involved in making decisions about those issues that cut across the boundaries of science, values, and ethics; the obligation of the scientist (as someone with special expertise) is to join the debate as an informed citizen.

For Further Reading
