The Technological World Picture and an Ethics of Responsibility

THE TECHNOLOGICAL WORLD PICTURE AND AN ETHICS OF RESPONSIBILITY

Struggles in the Ethics of Technology

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Foreword

Since my first appointment, more than thirty-five years ago, as special professor of reformational philosophy[*] at eventually three technical universities in the Netherlands, the ethics of technology has proven to be an obvious focus for my teaching and writing. From the start, I felt called to address culture-related topics, especially issues related to the development of modern technology. The big questions concerning modern technology deserve a critical review from the standpoint of the Christian faith. Over the years, I have championed the need to evaluate the development of technological practice, especially its underlying motives, given its far-reaching influence.

In this little book, I want to consider the fluctuating state of ethical reflection on technological practice.[†] I have wrestled with this topic for decades, and it is a complicated subject. In this context, I will try to limit myself to the main lines of argument, I hope without doing injustice to the complexity of the matter.

Many, including those in academe, have raised and are raising ethical questions regarding technology. In the Netherlands, for example, the Minister of Education (Ritzen) in 1986 urged that Dutch technical universities give more attention to the ethics of technology. In 1994, the Technical University of Delft pub-

[*] In the Dutch educational context, organizations outside any university may request and fund a "special chair" [*bijzondere leerstoel*] devoted to a framework or ideology or focusing on a topic that is not represented or highlighted within a particular institution of higher learning.

[†] In Dutch, there are two words relating to technology: *technologie,* meaning the technical science, and *techniek,* referring to the result of that science, which has been developed so impressively in modern society. Both of these words are commonly translated as "technology" in English, although "technique" can also be used. In this translation, where clarity demands it, I will make the distinction by referring to "the science of technology" or just "technology" for the first and "the practice of technology" or "technique" for the latter.

lished reports on the topic, and the Dutch Royal Academy of Sciences reaffirmed its role in the discussion of the ethical aspects of scientific research. In 1999, the University of Eindhoven, likewise, took a stand regarding issues related to teaching engineering and ethics. One result has been that for a number of years, ethics has been a compulsory course for all students in Delft. Eindhoven is also testing this approach with some of its students. Moreover, these universities have set up "Platforms for Ethics and Technology" to systematically address the ethical questions engineers have to deal with when doing their work. These initiatives are all very understandable, because engineers, not only as researchers, designers, and developers, but also as managers of technical systems, increasingly have to wrestle with ethical problems.

I approach the ethics of technology in the perspective of reformational philosophy—a normative ethics rooted in a Christian-philosophical standpoint. This perspective differs from other current approaches. Most of the time, people are content to analyze and evaluate case studies and practical examples. Within those parameters, a world-and-life view is touched on at most in a descriptive manner. By contrast, I have a broad, normative ethics in view that contains directives grounded in the convictions of a Reformed Christian world-and-life view. In assuming this stance, my intention is to contribute to the cause of critical discernment—something urgently needed when it comes to the phenomenon of modern technology.

Lest some be put off: Although there are clearly different approaches—different responses—to these questions, the pervasive problems related to technology do provide a common ground. Moreover, there is a general awareness that technology is a shared experience that we may appreciate. Most agree as well that we should strive to do good things with technology (see §13).

§ 1 Introduction

Technology to date has fulfilled many promises. And it offers many more for the future. Unfortunately, people, often mesmerized by technology's phenomenal growth, fail to foresee potentially disastrous consequences. How is this possible? I suspect that our culture is predisposed to see only the positive side of technology. Filled with the spirit of modernity—and postmodernity—most see little need for a critical look at technology.

Is a quiet admiration of technology possibly the very heart of modernity? Technology is often fascinating and exciting. And yet, there is a downside. Many grant that technology contributes in important ways to the quality of life, but few suggest that the opposite could also be true. My sense is that it will become increasingly clear that the key issue in our culture is our attitude toward and our vision of technical development. Unfortunately, few people in our culture recognize this to be a problem because we allow ourselves to be guided by a technical view of reality. Everything—all of reality—is seen and evaluated in light of comprehensive technological control.

Technology helps us to become ever more familiar with the world. At the same time, however, we are increasingly alienated from it because the technical models that guide us when interpreting reality and when changing how things are also flatten and reduce—and sometimes even destroy—that reality. Repercussions of modern technology are manifest in nature and the environment but also in the coldly pragmatic and objective nature of a technological society with all of its inherent tensions.

Even though many reactionary movements have responded to these degradations, an uncritical embrace of the practice of technology persists, creating a great need for ethical reflection. Many advocate an "environmental ethics," an "ethics of development," or "business ethics," but few see the need for an ethics of technology—which to my mind is foundational to all of these issues.

Someone in the reformational-philosophical tradition may not sidestep an ethics of technology. Modern science and technology are part of the Judeo-Christian legacy. Does this tradition not have anything to say about a responsible ethics of technology? This question is all the more urgent because many view that same tradition as at least one of the historic roots of the dire consequences of technology.

In the following chapters, I wish to discuss briefly the need for an ethics of technology (§2), the question of what ethics is (§3), and the spiritual-historical background of modern technology (§4). The spirit of the Enlightenment has produced a scientific-technological picture of the world (§5) with an ethical recipe of intentions, values, and norms that is still current (§6). But there are, it seems, alternative approaches (§7). After drawing attention to the cosmological and the ethical deficiencies in contemporary ethics (§8), I make a case for a different approach that starts with the "enlightenment of the Enlightenment" (§9), that addresses both the cosmological and the ethical deficiencies (§10), and that implies a cultural paradigm different from the current one (§11). I pay a great deal of attention to ethics as an ethics of responsibility and the motives, values, and norms that such an ethic implies (§12). I will also highlight concrete possibilities inherent to this approach that could reorient our technological culture (§13) and that would lead to political changes as well (§14). This new perspective will undoubtedly involve struggle, but it will also afford hope (§15).

§ 2 The Call for an Ethics of Technology

The New Situation: "Technological Culture"

The need for an ethics of technology is not evident to all. But things are changing.

Traditional technologies of the guild and, later, artisans were characterized by an interpersonal dimension. A sense of the whole was apparent. The effects of their technologies were short-term and their negative impact minute and predictable. Furthermore, these technologies did not put their stamp on culture but were a part of it. Handicraft technologies were embedded, as it were, in the natural order. In this rather static situation, there was no demand for an ethics of technology. It was something self-evident and not at all problematic.

Compared to even a century ago, however, we find ourselves in a completely new situation. Modern technology is dynamic and has expanded tremendously. It has left its mark on culture and has become a world-encompassing system. In modern technology, everything is connected to everything else. The result is a technological environment. Take away this technology, and our culture collapses. It has become an essential precondition for our whole life. In particular, the connections between technology, business, and industry have changed the lay of the land. Clearly, modern technology and the economy are tightly interwoven. One cannot do without the other.

Therefore, although I attend to the ethics of technology, an ethics of the economy cannot be separated from it. As we will see, they are connected by an extremely technical mindset, a

technological spirit or frame of reference that necessarily generates problems for the ethics of both.

A good degree of uncertainty exists concerning the fast pace of changes in technology and the economy—of which we are a part, but with which we have little experience. To date, we have been able to draw few lessons from the past. Given the problems that we face, however, such lessons would be extremely valuable. Our lack of experience combined with our apparent inability or ignorance about ways to solve new problems makes an ethics of technology challenging. Some people do not sense this challenge because they see no reason to question the inevitability of these developments. But technology surely is not an autonomous process. Technology is a human endeavor for which we are personally and communally responsible—even though the increase in responsibility that technology brings may be difficult to realize and to bear.

Specialization in general, technology's complexity in particular, and the connections of both to still other developments add to the urgency of the situation. Technology has penetrated our individual lives to such an extent that we can scarcely create the distance we need to assess and evaluate it, let alone possibly change its direction. So let us first try to get a sense of the balance between the advantages and disadvantages of technology.

Advantages

Comparing our age with that of a few centuries back, one notices the great advantages of modern technology. The average life span has increased. Sanitary methods and water purification have led to a healthier environment. Mechanization, automation, and robots have relieved people of much hard manual and routine labor. Because of the connection with the economy, material wealth is greater than ever. We gratefully make use of

medical techniques, many of which can help heal diseases. Simultaneously, the hunger of many has been abated. Modern means of communication supply us with unprecedented information. In short, the possibilities for shaping reality according to our wishes have increased enormously.

It is no wonder that technology's potential has received laud and honor for some time now. "The Wonders of Technology," "The Age of Technology," and "The Triumph of Technology" are titles of books or slogans from some thirty years ago that point to the abundant blessings of technology. Imagined worlds and the picture of reality many people held to was defined by the possibilities of technology. In other words, technological products increasingly directed the development of new technological projects. Possibility became the grounds for applied implementation.

The Downside: Problems and Threats

In today's culture, however, the darker side of changes in science and technology is evident as well. Influenced by the human desire to master everything, we can and do arrange things as we would have them. Modern technology is beginning to penetrate and direct all of culture. The eventual result will be a "technological culture" in which technology puts a stamp on most everything and most everything becomes dependent on technology. When this dependence is connected with the economy, culture tends to become one-dimensional. Environmental problems arise, and the degradation of nature ensues. Likewise, human development becomes one-sided, and society begins to fall apart.

People discuss the threat of nuclear weapons or radioactive waste from nuclear power plants, the depletion of raw materials, the extinction of many plant and animal species, deforestation, the loss of useable land to salinization and desertification,

the depletion of the ozone layer and the increase of exhaust fumes with their far-reaching consequences for life and climate, and the scale of urban sprawl and reduction of arable land. Then there is the growing threat of overestimating genetic modification techniques and underestimating the repercussions of cloning and human gene therapy. Finally, the latest information and communication technologies promise ample information and communication—enough to drown in. Nevertheless, there is actually less face-to-face contact between people than ever before, leading to mutual alienation, loneliness, and social disintegration.

People are hoping to safeguard their culture through a development of technology that knows no bounds; all the while, what grounds their humanity seems threatened with destruction. The brutalities of current technological developments jeopardize the sustainability of the natural environment and of the biosphere. The values that hold here are being ignored. If—as seems to be the case—the disadvantages are going to exceed the advantages, we are going to be stuck with a major ethical problem.

Vulnerable Technology

There is something else. Technological development also faces threats from within. Large-scale technical developments regularly prove to be vulnerable and risky. Due to human error or poorly functioning technology, we are sometimes confronted with far-reaching, unexpected consequences. Think of Chernobyl, the chemical disaster in Bhopal, the "I love you" virus, or the Code Rep-worm. In a similar way, recent terrorist attacks have underscored how vulnerable modern culture can be because of its dependence on technology.

Power over Technical Power

Our conclusion can be that whereas people used to be mainly threatened by the forces of nature, they now also face the threat of a technological attempt to control everything. The pressing question today is whether we can contain and control technology itself.

Given the potential for negative consequences to the risks taken, human responsibility for these moves is becoming unbearable. Have we appropriated more technical power than we can manage? Can we prevent what Albert Einstein referred to as "the degradation of the scientific-technological culture"? These are ethical questions *par excellence.*

§ 3 What Is Ethics?

Now we come to the question of what we mean by *ethics*. The term knows many definitions. Fortunately, most overlap, at least in part, resulting in a large measure of agreement despite the differences. Most will agree that ethics is a theoretical discipline that reflects on the good or responsible actions of human beings. Ethics is not so much a specialized science as a multidisciplinary or interdisciplinary endeavor. Ethics has to do with human compliance to all normative aspects of reality.

An ethics of technology must therefore concern itself with people's good or responsible conduct in and with technology as well as with complying with the legitimate motives, sound values, and norms that hold for technology and its use.

Basic questions and answers regarding such issues do differ. What does it mean to be a human being? What are the criteria for good and responsible human actions? Where does technology fit in when it comes to nature and culture? Which norms and whose values hold here? Responses to these kinds of questions ground one's ethics. Differences in this regard make the task of ethics all the more arduous because there is no longer a unity of vision about humanity, history, the meaning of technology, culture, and the future. Differences in these matters have to do with one's philosophical orientation and the different convictions about life and the world in which these are rooted.

Consensus on values and norms may be what is called for, but a diverging pluralism seems to be the reality that confronts us. My position, however, is that in spite of this diversity, a

dominant theme is evident in the spiritual background of technological development.

§ 4 Spiritual-Historical Background

When discussing the problems and threats of the Technological Age, people often do not get beyond addressing the symptoms. This discussion needs to be more thorough and to include the deep-seated causes that developed a long time ago.

I would like to call the dominant way of thinking about things in Western culture "technical thinking." The legacy of this approach is made plain when one attends to the spiritual-historical background of the West. As things have changed, faith in the creation—and with it, belief in the Creator—has steadily disappeared. Technical thinking as a means of domination is rooted in the autonomy or acclaimed self-sufficiency of the thinker. It does not recognize the limits and limitations of human thinking.

Descartes is the father of modern thought. Descartes dealt with technical rationality in such a way that especially the natural sciences—and, in line with this tradition, later the technological sciences—were used as instruments with the pretense of putting everything under the control of human beings to solve human and cultural problems, both old and new. Descartes says that the laws of mechanics are the same as the laws that hold for nature. He sees nature as a set of automatons. In other words, nature is made up of material mechanisms. The mechanization of the world picture, to use a phrase of Dijksterhuis, is the result. "Nature is a machine, as easy to understand as clocks and automatons, as long as they are investigated precisely enough," says Descartes. Supposedly, once people know the power connections in nature, nature can be deciphered and directed. Because,

for Descartes, humankind is "*maître et possesseur de la nature*"—the master and owner of nature—humans can rule over nature and control it.

Descartes no longer acknowledges the integrity and intrinsic worth of plants and animals but sees them simply as manipulable things. He is sure that manipulation will put us in a position in one way or another to make advantageous use of these "things." Reality in its manipulability is viewed exclusively in terms of its use to us. The fullness of reality is reduced to the technical use that people make of it. This Cartesian mindset is evident today in bioindustries and genetic manipulation. Technical thinking seems insatiable and increasingly totalitarian and imperialistic.

We encounter this spirit already in a somewhat older contemporary of Descartes, Francis Bacon (1561–1626). Bacon is sometimes called "the herald of the new age." With his slogans "Knowledge is power" and "To conquer nature we must obey her," he anticipated everything that was going to be possible in a technical sense. Nature must be forced to serve humanity and, in that way, be made into a slave. Bacon says that nature must "be penetrated to her most intimate core." Instead of seeing through the nature-nihilism of this position, he pleads for man as absolute ruler over nature.

Although Reijer Hooykaas designates this development as "Christian-religious," it cannot be denied that Bacon was driven by godless pride. In his utopia *New Atlantis,* Bacon describes an ideal society in which all power is in the hands of natural scientists and engineers who will make sure that "Progress" happens. He contends that the development of science and technology should be applauded as imitating the divine works of creation. So, too, biblical-eschatological perspectives are reinterpreted into the prospect of progress. Bacon was even of the opinion

that science and technology could help humankind rise above the results of the fall into sin. He regarded his plans for the progress of science and technology as a restoration of the power that human beings possessed before the fall. His concern was not to ameliorate or prevent suffering with the help of technology—no, science and technology would be able to repair what the fall into sin had damaged. Themes of creation and redemption become tightly bound into one, something the twentieth-century philosopher Oswald Spengler captures in his pithy description: "Technology is eternal like God the Father, it redeems life like the Son, and sanctifies life like the Spirit."

Technical thinking, once dominant, is unstoppable—it refuses to acknowledge the impenetrable mysteries that most deeply characterize reality as creation. Once in gear, the tireless process of constructing and reconstructing all of reality ensues. What is there that cannot be measured, weighed, counted, and thus controlled? Reality is just one big machine or, to use more modern terminology, just one huge information-processing system.

The notion of technological control arose from the pretended autonomy of humankind, from the claim to absolute freedom—and the assumption that scientific-technical control will enhance this freedom. More and more, problems are presumed to be opportunities for scientific-technical resolution. In a certain sense, only those problems that are recognized can be solved through science and technology. Positivism later declared all questions relating to spiritual reflection and religious problems as nonsensical; they are, therefore, denied. It is not surprising that the technological culture that took shape is accompanied by secularization and a spiritual void on a scale previously unheard of. We could say that hidden behind the facade of modern technology and the mask of autonomous individual freedom is a spiri-

tual vacuum. That people are not inclined to deny this makes the situation even worse. The result is that a technical way of thinking, a technological mindset, pervades the entire culture. Its influence is evident in many sectors of society. In turn, the interrelationships of science, technology, and the economy are likewise influenced by an overextended technical spirit.

The spirit of the Enlightenment, in particular, promoted the influence of the technical control mentality. This movement, which started in the eighteenth century, linked the spirit of the Renaissance—an unlimited confidence in humankind's ability to renew life—with the development of the natural sciences. The pretense of human autonomy, humanity as Prometheus, attached itself to a scientific engagement that knew no bounds. Inspired by the successful development of the natural sciences, heroic Enlightenment figures believed that they would be able to overcome all problems and to renew themselves and society by means of the natural sciences. Because no other norm except the standards of instrumentalistic science itself was recognized, the way lay open for the limitless scientific-technical manipulation of all of reality. This dominating role of scientific thinking meant that every nonscientific authority was dismissed. With that, the definitive breach from God as the Origin of all things was accomplished.

In the course of time, the power of science soon knew no peers. As Christian convictions were secularized and Enlightenment trends were uncritically adopted, the Christian faith was secularized and resistance to the absolutization of science gradually diminished, a thoroughly secular vision for the future gained sway. Given that spiritual climate, positivism and pragmatism easily undid any resistance to the unhindered scientific-technological control of reality. The greater the influence of secularized science and technology have become, the more all of

reality is seen as matter-of-factly material and hence as controllable in a completely technical and rational manner.

In a certain way, this course of affairs confirms what Habermas called "the ideology of technology"—an ideology inspired by the Enlightenment, which, as do most, restricts or obstructs one's purview and rules. In this case, fundamental questions about what is behind the development of technology, its origin and meaning, and the values and norms that hold for technology are simply not asked. Modernity and expecting too much from modern technology go hand in hand. We will soon see that many people remain committed to unarticulated, deeply materialistic priorities, values, and norms.

This situation gives rise to problems. Allow me to give a current example. Some think that the greatest danger of the Internet is the polluting of "information" it makes available and that cleaning up the Internet will solve the ethical problems. Yet here, too, technical thinking promotes a certain pattern of behavior that ends up reducing the fullness of life. The patterns of thought built into the computer influence the uncritical user, who will increasingly follow that same pattern. When one's head and hands are busy day in and day out with technology, one's heart will soon be filled with the same as well.

Preoccupation with one thing inevitably decreases one's sensitivity to others. As data and information multiply, their cumulative meaning usually decreases. Contacts increase, but their significance is blurred. Information abounds while wisdom wanes and understanding hardly scratches the surface. Internet use may be on the rise, but spirituality is on the decline. Overestimating technology's hardware ossifies humans' spiritual software. That is why secularization grows as the technological mindset gains precedence.

David Noble's recent book, *The Religion of Technology,* incorporates probing examples of the expectation of technological salvation. He shows that since the Renaissance, many have claimed that technological practice puts us in a position to behave like gods. Technology is linked here, for the first time, with the idea of cocreation and coredemption. Notwithstanding the continued effect of evil, people in philosophical and scientific circles thought they could restore the original paradise with the help of technology. Technical Man is the new Adam. With this as its starting point, the religion of technology focuses on the earth's future. Technological paradise comes to replace the Kingdom of God and the Christian's hope for the future.

According to Noble, the expectation of salvation through technology lives in all new areas of technological development. This is not Noble's conjecture. With the help of quotations from space scientists, representatives of Artificial Intelligence, developers of cyberspace and virtual reality, and representatives of genetic manipulation, he documents their religious adoration of technology. Limits of space and time are transcended by technology; people strive to achieve machinelike immortality and long to perfect a digital presence of mind that will be omnipresent in the cyberage. Genetic manipulation likewise assures them of a re-created, new humanity.

§ 5 The Technological World Picture

Whatever does not fit into the technological model is usually disregarded or forgotten. As the purview of technical thought expands, the extent of reality shrinks. What remains is taken to be a conglomerate whole that is open for technological improvement. This overextended, technical way of looking at things translates into a technological world picture to which our culture has become enslaved.

This world picture, like the technological developments that it produced, is not static. In fact, the discoveries and innovations, and the technological advancements to which they give rise, render this world picture more dynamic and more easily adaptable. The technological world picture is therefore continually revised by new technological developments. It is, however, a human construct that functions as a cultural paradigm—a type of ethical framework within which people think and act. It sets the norm; priorities, values, and standards of excellence are derived from it.

Whatever science can analyze and explain, whatever it can manipulate, fits into this picture of the world— what science cannot analyze or manipulate does not fit. This picture of the world has with time come to define the development of Western culture, and it continues to characterize the current globalization. There should be no misunderstanding, however: technology and the technological world picture are not the same. The problems do not lie with technology as such, but with the technological world picture.

This picture of the world, derived from technical developments, has a far-reaching influence throughout and beyond the scope and realm of technology. Not only has it put a stamp on the relationship to nature and the environment, the relationship to human society is colored by it as well. By using technology, it strives to dominate or control both nature and society. Technological-economic powers, in particular, are the driving forces behind this picture of the world, and yet we all breathe its air. We all compromise ourselves with the desire for power and control by being touched as we are by the greed of consumerism.

This picture of the world is actually a scientifically technical take on the world. The picture it presents reflects the image of abstract science, emphasizing functionality, rationality, and universality. As such, it tends to reduce and level out reality. Sometimes its destructive influence even affects nature, from ecosystems to the biosphere, as well as society and the social environment. The ecological crisis has been in the limelight of late, which cannot be said about parallel problems in society.

§ 6 The Current Ethical Orientation: Its Priorities, Values, and Standards

The technological world picture generates a breadth of problems. That is not all. It is also usually decisive in defining desirable ethical solutions. Because of the technical way of thinking, there is a good deal of coherence in the most current approaches to these matters. In other words, the technological picture of the world defines contemporary ethics as well.

It is difficult to keep oneself from conforming to a technical systems approach to ethical questions. Current discussions in the ethics of technology are, generally speaking, limited to calculating precautions for behavior with an eye to reducing risk. I have sometimes called this "technical ethics." Ethics becomes a technique because people want to streamline and guide the technical development. In the ethics of technology, the "control-technical perspective" is then dominant. People restrict their attention to the adverse symptoms of an otherwise limitlessly developing scientific-technical control. In doing so, this ethics does bring relief to some of the problems technical developments create.

Changes in existing developments, the search for alternatives, and proposals to reject earlier decisions seldom occur. People have become rather entangled in technology. Many may wrestle with that fact but do not really know which way to turn. Information and communication technologies do not help matters. It is increasingly difficult to adopt another starting point, a different picture of reality with different priorities, values, and standards. In short, industrial and postindustrial societies are

permeated by strong technical values, attitudes, and ways of thinking—few of which are being questioned critically.

Attaining power over reality is the implicit priority of this ethical stance. It follows closely on the heels of technological innovation. Values behind this project include economic self-interest (greed) and an across-the-board increase in consumption. The presumed outcome will find humankind front and center, in control, as lord and master of technical progress. What this will do to us as individuals or as a society, let alone how this will affect the environment, are questions few take time even to ask.

The norms that follow from the values of the technological world picture are effectiveness, standardization, efficiency, success, safety, reliability, and maximum profit, with little or no attention given to the cost to humanity, society, the environment, and nature. In summary, the first and great commandment of "technological culture" is, "Be as effective as is technically possible," and the second like unto it is, "Be as efficient as is economically possible." The breadth and depth of a technological-materialistic culture hang on these two commandments.

Material values and standards clearly have the upper hand in the technological world picture. Given recent degradations of nature and related environmental problems, however, some are convinced that these values and standards, which continue to control culture under the banner of "progress," need to be transformed with an eye to "survival." That said, adjustments to date have come after the fact and are seldom more than politically correct.

We continue to encounter more problems in which the technological world picture and the ethics that accompany it fail us. This is especially clear from problems related to preserving biodiversity and sustainability. Recent decreases in biodiversity are shocking. Within the time span of a single generation, the num-

ber of species has been halved. This must surely be the result of looking at living reality from a predominantly technical perspective.

Sustainability ought to satisfy the requirements of the present generation without jeopardizing the ability of future generations to provide for their needs. Why is sustainability under pressure?

The prevailing technological world picture and its model of control dominate today's economy as well. Lopsided growth is engrained in the process from the start. As a result, sustainable development is by definition out of the question. Environmental technology may make some steps in the right direction, but these are often subsequently undone or negated by the technical economy, which provides the infrastructure for these environmentally friendly technical innovations. The technological world picture also stands in the way of resolving growing concerns about climate change. Our way of dealing with creation prevents us from gaining a new perspective within which to revise the problematics of this impasse.

The current cultural picture continues to be fed by a technological expectation of salvation. Spiritually, the focus is on technology. Discussion of basic assumptions and questions about meaning are usually excluded, and reality is reduced to a reality that has to be controlled. The guiding principle is the picture of a technical construction that continually increases in strength. Reality has no essential value. The focus is always on its instrumental value. Plants and animals are prized primarily for their material use to us in science and technology. Even human beings are increasingly considered remake-able.

Werner Heisenberg has drawn an impressive picture of this situation: "In what appears to be its unlimited development of material powers, humanity finds itself in the position of a captain whose ship has been built so strongly of steel and iron that the magnetic needle of its compass no longer responds to any-

thing but the iron structures of the ship; it no longer points north. The ship can no longer be steered to reach any goal, but will go round in circles, a victim of wind and currents."[‡] We have abandoned our culture to just such a lack of orientation. Technical power has undoubtedly increased, but the threat of devastation has also increased. Technological advancement as such is turning against man and his environment. These threats are frequently veiled by the vaunted superiority of technological effectiveness and economic efficiency. The ethical reduction these involve is scarcely discerned.

[‡] Werner Heisenberg, *The Physicist's Conception of Nature,* trans. Arnold J. Pomerans (New York: Harcourt Brace, 1958), 30.

§ 7 The "Empirical Turn" and Postmodernism: An Intermezzo

The recent, so-called "empirical turn" in the philosophy of technology[§] quite rightly challenges philosophers like Martin Heidegger and Jacques Ellul, who are of the opinion that the development of technology is an autonomous process; in this sense, people contribute to technological development, to be sure, but have, in fact, very little say over it. In underscoring this point, Heidegger and Ellul frame these developments as our inevitable fate. Thinkers of the empirical turn are correct in resisting this kind of fatalism. They concentrate their ethical reflections on specific problems, "case studies" in the practice of technology, which they abstract from the length and breadth of the history of technology. They pay very little attention to the structural development of technology or to a situating of technology within the whole of reality. That neglect is regrettable, because there is coherence both in the development of technology and in ethical problems, although this coherence takes on a special coloring in particular cases.

Attending to differences within technology is their strong suite. Not all ethical problems are equally urgent. In the reformational-philosophical conception of structures, due consideration is always given to that diversity. The idea of the autonomy of technology as a massive and impenetrable phenomenon, in

[§] See Peter Kroes and Anthonie Meyers, eds., *The Empirical Turn in the Philosophy of Technology* (Amsterdam: Jai, 2001).

which there is no place for responsibility, is also discounted. Reformational-philosophical teaching emphasizes, moreover, that technology takes place in a historical, cultural, social, and political context and that various groups within these contexts actively pursue various interests and goals. Each context or group influences the development of technology, but they cannot cut themselves off from the continuity of this development. We should consider whether the same spiritual-historical background that is an important cause of ethical problems conditions them all. Philosophers with an empirical bent too easily dismiss this issue. The current formula for dealing with ethical problems is to investigate cases in order to derive a rule of thumb for the future. People seldom go back to the roots of a problem or to the connection between problems. By combating symptoms, people merely displace problems and ignore their common roots. From an ethical point of view, they remain stuck in the "labyrinth of the technology."[**]

Only when we see technological development as a whole do the separate practical examples receive their specific place. In my opinion, it is important that we do justice to both the general basic structure of technology as well as the individuality of the separate technical phenomena. Concentrating on just one of the poles does an injustice to the other. By attending only to the individual problems (the trees), one loses sight of tendencies in technological development as a whole (the forest). Analysis that is restricted just to the players who have some influence on the technological development ignores common motives that are operative at a deeper level. Superficiality and a lack of coherence are the result.

It is possible to attain a deeper understanding of particular cases by seeing them in total and by not just connecting them

[**] See Willem H. Vandenburg, *The Labyrinth of Technology* (Toronto: University of Toronto Press, 2000).

with a description of what people have actually done. In a philosophical-ethical reflection, we are concerned in the first place not with the ethics of particular technical phenomena but with an all-encompassing ethical approach via cultural pictures, ethos, motives, values, and norms on the basis of which certain techniques can be evaluated later. We prefer to grasp at empirical examples so as not to have to pay attention to structural roots and backgrounds. The specialization prevalent in our time promotes this approach because it means that we know more and more about less and less. That is why we have become vulnerable in our appreciation of the whole situation. In other words, attention to individual technical phenomena can distract us from the main concern, meaning, the ethical quest for a reorientation such that technology will have a place and value in culture different than is currently the case. We can contribute to this reorientation on a small scale only if we know the priorities, aims, values, and standards that hold at the macrolevel. Or, to say it as a variation on a well-known slogan: "Think universally (globally), but act individually (locally)." It is not possible to evaluate the place of particular technical phenomena without a thorough understanding of technology as a universal phenomenon. One without the other leads to misguided appraisals. In other words, particular technical phenomena must be appraised in the light of the general phenomenon of technology, and vice versa.

There seems to be some connection between the so-called empirical turn and postmodernism. Postmodernism arose as a protest against the metanarratives of the Enlightenment and in reaction to the problems of modern technology. That is why it is sometimes said that postmodernism is technologically pessimistic. At the same time, it still draws from the roots of the Enlightenment and, in that regard, may be characterized as hypermodern. Postmodernism puts more emphasis on one pole

of the dialectic of the Enlightenment. It chooses freedom over control, and individuality beats out universality. As a result, postmodernism shows more fragmentation and discontinuity than coherence and continuity. Both postmodernism and the philosophy of the empirical turn lack a coherent view of reality and promote an ethical relativism. The attention shifts, as the postmodernist Jean-Francois Lyotard has taught us, from the ends told of in grand narratives to means for action.

Remarkably enough, recent developments, like information technology and nanotechnology, encourage postmodernism because they provide more, very concrete ways in which to individualize the technology. Assuming that this happens in a sound ethical context, doing so is an improvement on how things used to be.

By attending to specific technological phenomena, the empirical turn in philosophy as well as postmodernism have made important contributions, but by failing to deal with modern technology as a whole they have left the dominant ethics of technology that I have been sketching pretty much as it was. There are many examples of this, but I will limit myself to one.

Recent environmental technology has helped to make hothouse horticultural production cleaner than before. At the local level or microlevel, compared to the past, that is an improvement. To realize this improvement, however, requires so much additional investment up front that it simultaneously leads to an expansion in production—such that ultimately the energy taken from the source and the concomitant pollution increases correspondingly. At the macrolevel, when one factors in all of the links in the energy chain, the situation could turn out to be worse than before. Being blind to that fact is the result of reducing the ethics of technology to an ethics of particular technological phenomena.

§ 8 Cosmological and Ethical Deficiencies

I now return to the main line of my argument. Life as many understand it today was shaped and nourished by the spirit of the Enlightenment. Much good can be attributed to that spirit, but also much that is evil. In my estimation, current views about technology, generally speaking, suffer from a cosmological deficiency and from an ethical deficiency. Conceptions about the cosmos are often very limited because justice is not being done to the multifaceted depth and breadth of reality. Reality is often reduced to the world that science and technology aim to control—to a positivistic cosmology, a view of the cosmos to which technology is the key. This lopsided take on the world does not do justice to the many-sided dimensions and coherence of reality in its fullness and pays no attention to its dependence on and orientation with respect to its divine Origin, no heed to the transcendental direction of everything.

In addition to a cosmological shortfall, there is also an ethical deficit. The world around us is taken to consist of things to be manipulated. Scientific-technological thinking reduces everything to the status of useful object. The unique value and meaning of things is dissolved into the use or benefit that that reality has for humankind. This ethical deficiency can best be characterized as the lack of love, because justice is not done to the peculiar nature, individuality, or uniqueness of things. That is evident today in how the technological model dictates how we deal with animals. We see animals more and more as production units that supply the technologically defined functions we say we need. The

ideas behind the therapeutic and reproductive cloning of humans also fit in with this technological world picture.

The German philosopher Peter Sloterdijk provides a second illustration. He maintains that the influence of the Enlightenment in shaping humankind has not gone far enough and actually cannot do so. Human formation needs to be augmented with technological innovation. Developments in the area of genetic manipulation make that possible, and Sloterdijk is convinced that we should move in that direction.

These things being the case, what constitutes a critical approach to the technological world picture?

§ 9 Enlightening the Enlightenment

In general, because of their high expectations, people are oblivious to the deepest background of today's "technological culture" and the prevalent ethics of technology. The spirit of modernity seems to coincide with unrestrained technological development. Yet, as a result of the tangible problems and threats tied to that development, we are confronted in the meantime with all kinds of protest movements. Even so, the majority of people still support the Enlightenment project.

A thoroughgoing evaluation of "technological culture" cannot avoid dealing with the Enlightenment. To suggest that we are dealing with nature and society in too scientific and technological a fashion is actually to take issue with the Enlightenment's abstract postulate of autonomy. The crisis is imminent: It is increasingly clear that our culture cannot handle both absolute freedom and absolute controlling power.

The great philosopher Immanuel Kant answered the question as to what the Enlightenment is. People of the Enlightenment have come of age and do not accept any guidance from above: "Have the courage to avail yourself of your own intellect." Kant is concerned not only with the growth of knowledge or a spontaneous act of the will to liberate oneself but especially with the courageous decision to control praxis by means of scientific knowledge. Human reason is accepted as the controlling instrument: People set out to re-create the world as they wish it to be by means of science and technology. The spirit of the Enlightenment connects itself via technology and the economy

with happiness and freedom, with optimism, progress, and utility (but closes its eyes to the possible ill effects of its striving).

Many current cultural-philosophical critiques highlight the shortcomings of the Enlightenment. People are increasingly convinced that its instrumental rationality has and will continue to have devastating results. Technology is no longer the liberator, but itself stands in the service of power over humans and nature and, as such, binds humanity, destroys nature, and threatens culture. It is no wonder that philosophers of culture continue to discuss the meaning of the Enlightenment, but few are ready to let go of its point of departure. To ward off criticism of the practice and science of technology, people try to tweak what the Enlightenment is. Some, like Theodor Adorno and Max Horkheimer, want to unpack and deepen the Enlightenment. Others, like Heiner Hastedt, champion a broad outworking of the Enlightenment project, one that will include, for example, a new ecological ethics and an ethics for the management of systems technology. Yet none of these adjustments involve abandoning the autonomy of the scientific-technological person. It is almost impossible for these thinkers to relinquish autonomy. Instead, they seek to expand the *ratio* to a fuller or broader, multisided rationality that covers more areas. The technological world picture is constantly being adapted. Even when people plead for a second Enlightenment in which attention is given to metaphysical or spiritual questions that have been neglected in the course of time, they remain loyal to the Enlightenment's point of departure.

Reformational philosophy stands in a tradition that grew out of a fundamental critique of the world-and-life view of the Enlightenment, particularly, of the pretense of human autonomy and the intellectual hubris and will to power that are connected with it. Although we cannot turn the clock back on the Enlightenment, we must acknowledge its devastating conse-

quences and find a revised ethical framework for its positive results. Addressing the cosmological and ethical deficiencies will also require a different perspective. With Günter Rohrmoser, I advocate the "enlightenment of the Enlightenment"; to put it in terms similar to Psalm 36:9, "In God's light we see light." The divine light of Revelation must enlighten the "Enlightenment" itself. In the light of God's Word, a path can be found between technological paradise and technological apocalypse or, better said, a way that rises above that dilemma. To refer again to Heisenberg's metaphor of the ship: If the captain wants to set his ship on the right course, he will once again have to orient himself with respect to the starry heavens. So, too, a technological culture needs to be evaluated with reference to viewpoints outside technology.

The central point of the enlightenment of the Enlightenment is that we acknowledge that we live in a created reality, in the context of which a breach occurred between God and humankind; we acknowledge as well, in the perspective of the Kingdom of love and peace, that restoration has been made possible in Christ. His is a Kingdom in which nature and culture will be filled with the glory of God. This religious recognition cannot but throw new light on the ethics of technology.

§ 10 Covering the Deficit

When we acknowledge that reality is a created reality, we know that the cosmological and the ethical deficit resulting from a reductionistic-scientific approach to reality cannot be solved by more science or more technology. For example, however much systems analysis is presented as a holistic approach—and its merits should be appreciated—it remains an abstract scientific approach rooted in an anthropocentric outlook. Human beings are no longer seen as "lord and master," but when push comes to shove, it is still they who make the final decisions.

What we need is a vista and a vehicle that embraces more dimensions, something that provides a more comprehensive, holistic approach. People need to acknowledge that the breadth of reality is a given, bestowed—including for scientific analysis—long before science ever was, and that this reality does not depend on itself, but is in all respects dependent on and involved with God as its Origin. A cosmology grounded in such a vista clearly will lack the deficiencies referred to earlier.

The most intimate involvement of God with created reality is characterized by his love. Accepting this unity in love covers the ethical deficit of love. With good reason, the command to love God and one's neighbor is at the core of all of the directives, commandments, values, and norms in the Christian religion. All of the law and the prophets hinge on this love. This twofold love must be the starting point for an ethics of technology. This means that everything must be evaluated from the get-go according to its individual nature, including that which is weak and vulnerable. With love as our starting point, we must acknowledge that every created thing is characterized by earthly and—by even

more than earthly—divine secrets. This affirmation means that besides attending to technology's values and norms, we will pay attention to ecological and social—contextual—values as well.

Our task must be to trace what the covering of the cosmological and ethical deficit means for a responsible development of technology.

§ 11 A Renewed Cultural Picture

Is there a picture of reality more basic than science and technology (or the economy) provide that can help us understand how to reorient ourselves with respect to technological development? The cultural philosopher Hans Jonas can be helpful here. Imagine, he says, that we found ourselves on the Moon. We would be impressed by the vastness of the cosmos and, even more so, by how unique the Earth is compared to everything else there is to see. It is the only green planet in our solar system, filled to overflowing with a rich diversity of life. If we Moon travelers are to survive, we will have to return to Earth. But to our horror, says Jonas, we find that planet Earth is in danger, with so many of its life forms threatened by current technological-economic practices. Something is going to have to give. Technology and the economy may not threaten life. They must be used to serve life.

Responsible cultural development evokes an image reminiscent of the earth as a garden, tended by humans with the goal of creating a "communal home" within which nature, technology, and culture are in harmony and there is a meaningful place for everyone living and everything that lives. Foremost in that picture is an integral coherence in which every thing participates, all the while retaining its own individual value or nature. Before getting involved in scientific-technological activities, one needs to respect this intrinsic value of things. Every human activity should begin with caring contact and respectful treatment. Creation and its creatures have to be dealt with according to their nature; otherwise, life will disappear. This is no idolization of

nature; on the contrary, it is acknowledging the care of the Creator, a care we are to imitate. Technology and the economy ought to be directed to inhabiting the garden and to maintaining and strengthening every living thing.

The metaphor of a garden developing in the direction of a communal home also expresses the human connection with and dependence on the whole of the creation. Reality is given to us. We are not its lord or master, but creation's guardians and caregivers. We are allowed to unpack and unfold creation. Just as we carefully unwrap a precious gift, we should treat the gift of God's earth with a sense of awe and gratitude. A change in attitude and behavior is called for.

This image of the garden is also clearly linked to the original meaning of *oikonomos* (*oikos* house + *nemein* to manage). Caring, keeping, cherishing, and protecting go hand in hand with cultivating, harvesting, and producing. In the cultural paradigm of the managed garden, accelerated increases in scope and scale will be transposed to levels that will benefit the coexistence of human beings and the creation. The carrying capacity of nature will be respected and the goal of long-term occupancy set the direction for sustainable cultural development. Sustainability is possible within the metaphor of the garden. Technology, along with the economy, need not travel the road of manipulation, extortion, and pollution. As World Bank economist Herman Daly puts it, they should maintain the fruit-bearing capacity of the earth and, where possible, increase it. What we take from the earth should be offered to all human beings but limited to what we can use and enjoy, now and in the future. Responsible cultural development means living off the interest on the capital given to us, but it does not allow us to touch or deplete the capital sum itself. This notion of living off the interest fits well with human beings as stewards. (And even though some refuse to

use the term, what it entails is nevertheless often very attractive to their enlightened self-interest.)

The cultural picture sketched here differs from the current one and calls for a fundamental reorientation of the technological-economic order. It allows room for growth, but growth that is more proportional and selective. Besides the technology and economy involved in building and producing, more attention needs to be given to maintaining, protecting, conserving, guarding, and caring for—in a word, preserving—the diversity of life forms in the plant and animal kingdoms. Ecology, technology, and the economy will be in equilibrium as long as the natural cycles are not broken and the natural resources do not dry up. The whole earth will come to be seen as one big garden city.

While we must hang on to the original image of the garden that is unfolding in the direction of a communal home, it is also true that the conditions under which human beings are allowed to work in the garden were severely altered by the fall into sin. Since the breach between God and those who were to image him, thorns, thistles, and death abound, and their effects are evident in technology, too. Through God's love in Christ, there is a new perspective for the sin-marred creation. The meaning of it all beckons: the Kingdom of God. Acknowledging this implies struggle. This struggle is inherent to the human position. To orientate oneself to that Kingdom differs enormously from the materialistic and hedonistic attitude of our age: "What good will it be for a man if he gains the whole world, yet forfeits his soul? Or what can a man give in exchange for his soul?" (Matthew 16:26).

§ 12 An Ethics of Responsibility

Which ethical approach is best suited to cover the described ethical deficit of love in the current ethics of technology?

Deontological and teleological approaches to ethics are centuries old, but they no longer fit the dynamic and complex phenomenon of modern technology. Technology is no longer only characterized by the relationship between people and their tools. Due to the influence of science on technology, it has become a dynamic system with global ramifications. Modern technology is likewise intertwined with big business. This complex of scientific, technological, and corporate powers has become a dynamic force with so many members in the cast that an alternative to the older ethical approaches is called for.

Furthermore, deontology, which is an ethics of moral obligation, eventually has resulted in a more pragmatic or even pragmatistic ethics that has relativized what were formerly self-evident norms. Likewise, given technology's many unintended and deferred adverse results, the teleological approach, which evaluates actions according to their consequences, is also not up to the task: Not only must one attend to ascertaining the appropriate goals, but the many possible means to those ends need testing as well. As a result, some have turned to a "game theory" of ethics that allows even basic rules of the game to change and differs little from the ethics of pragmatism. In a certain sense, both approaches eventually culminate in what I have termed technological ethics (see §6).

An ethics of responsibility is, in my opinion, the most suitable approach for an ethics of technology, because it integrates ethos, intention, values, and norms in a coherent way.

Many assume that the ethics of responsibility has philosophical roots, but the theologians H. Richard Niebuhr and Karl Barth were writing about an ethics of responsibility long before Hans Jonas. Already in 1948, when the World Council of Churches was established, an ethics of responsibility formed the guiding principle in discussions about matters relevant to society.

The word *responsibility*—in the sense of accountable *for* and accountable *to*—is very apt because it also indicates that everyone involved in scientific-technological development must act as proxy or steward with reference to one another. In other words, every stakeholder must indicate the priorities, values, principles, and norms—the cultural picture—that constitute the ethos and grounds for one's actions and define one's contribution to the scientific-technological event. As a result, the ethics of responsibility nurtures a positive sense of vocation or calling. In current discussions about problematic developments, ethics is usually associated with "what ought not be allowed," whereas in an ethics of responsibility, one has to begin with an emphasis on the positive. For example, given new technological means to alleviate human needs and suffering, the ethical sense of possibly helping has become one of ethical obligation. In general, a good starting point for an ethics of responsibility seems to be that the participants are aware of the positive tenor of their actions in or with technology and give account of the same to the public.[††] In the image of the garden that is being developed into a communal home, the first concerns are to make and keep it habitable, to provide the basic necessities of life, and to alleviate the needs and suffering of all people.

[††] This is not to say that "responsibility" has the same content or profile for everyone. There are different kinds of responsibility: substantial, functional, individual, and professional responsibility. See also J. O. Kroesen, *Ethics and Technology* (Delft: TUD, 2001), 12–22.

I would now like to turn briefly to the implications of an ethics of responsibility for priorities, values, and norms.

Renewal of Priorities

We have seen from its historical-spiritual roots that the ethos pervading technology today takes power and control as absolutes. The same is true in those sectors, like agriculture, politics, and the economy, where technology holds sway. In science, this ethos is unpacked in terms of "knowledge is power." In technology, this becomes technology for the sake of technology, or technological perfection—what can be made must be made.

In industrialized agriculture, harvesting with unbridled scientific-technological power eventually leads to exploitation and land degradation. Materialistic politics and economics, in which people are only concerned with the power of money and material gain, weave cultural powers into a mutually dependent conglomerate. This convergence of powers proves to have a disruptive effect on both nature and culture. To think that these powers could serve other values than increased power, expansion, and intensity is a delusion.

When it comes to cultural activities undertaken within the perspective of developing the garden into a communal home, one should turn away from oneself out of love for God and one's neighbor. A healthy ethos like this affords a broad field of cultural activities a different sense of priority and even of content than is currently possible. Instead of encircling the ethos of power in self-interest around oneself, the ethos of love has a referential focus that draws one beyond oneself and into a variety of different cultural activities. In science, growth in wisdom becomes the objective; in technology, building and preservation; in agriculture, conservation and care as well as harvesting; in the economy, stewardship; and in politics, service and the promotion of law and public justice. This kind of differentiation helps

culture flourish meaningfully and protects the variously qualified responsibilities in these diverse cultural activities.

I now turn to what these authentic priorities mean for science and technology.

Science: Growth in Wisdom

The desire for technological control conditions modern science. The results of its applications do not make science technological; science is technological because it sees reality only to the extent that it is quantifiable and predictable. It is only interested in organizing and controlling reality. Even though curiosity and awe drive the aspirations of many scientists to know reality better, my thesis still stands: Modern science became technological in core and character because of prevailing cultural powers and priorities.

For one's scientific endeavors to stand in right relation to the fullness of reality we experience daily, one must first acknowledge the Origin and meaning of reality and reject an instrumentalist view of science. Science needs to be integrated into that full experience of reality, thereby deepening experiential knowledge. When that happens, science will serve the cause of growing in wisdom.

When approached in this way, science promotes increasingly comprehensive insight. Reality will no longer be reduced to logically independent, causally related factors or subjected to a human definition of the meaning of reality, for example, the benefit that functional reality affords a materialistically oriented humanity. In brief, science will then contribute to a comprehensively wise insight and enhance human responsibility with a view to directing everything that is going on in the world into a garden that is developing in the direction of a communal home. Seen in this light, an interdisciplinary approach is also highly desirable! Too few recognize that technology needs a more com-

prehensive scientific basis. A broader basis will facilitate a growth in wisdom, lead to more creative and circumspect actions, and help modern technology better serve life. If a more interdisciplinary approach to technology were in place, biology and ecology would have been accepted as foundational sciences long ago.

Technology in the Service of Life: Technology as Prosthesis

What I have said of science in general also applies to technological science, to technology: It should not be allowed to serve as an instrument of scientific-technological control. When it does, technology is robbed of its distinct character or meaning. The practice of technology should not be (as oft is said) the result of an instrumental use or application of science. That route will more readily blind and derail than provide room for the responsible development of technology.

At the same time, instrumental views also diminish the place of invention in technological development. Invention is in many ways the heart of technology. Science ought not to put a limit on human creativity, but old and new scientific knowledge can nourish and even foster human creativity. When training engineers, more attention should be given to responsible creativity through invention and innovation. Doing so will render technology more serviceable to life.

Technology's number one priority should be serving life and society. Technology must function, so to speak, as prosthesis,[#] both individually and collectively. Then people will (continue to) have a say in the matter. Nor is small-scale technology the only option. For example, when it comes to transporting goods, building underground is the way to go wherever possible, especially if

[#] "Prosthesis" narrowly defined means an artificial device to replace a missing part of the body. A pair of eyeglasses is one example.

doing so will preserve the environment and cause less disruption to society. Just one example of thinking outside the box and doing the right thing with respect to safety, the environment, and nature, would be the causeway built across the East Scheldt (an estuary in the Dutch province of Zeeland). This half-open, always closable dam is designed to protect the coastline during storms, but in the meantime, it allows tidal sea life to flourish.

Yet what about the costs? I can hear people protest. They will indeed be higher. In general, we have been getting modern technology too cheaply. We are good at figuring out the economic—or rather, the production—costs, but we usually fail to calculate in the damage to nature and the environment. Alternatively, to keep costs down, we take risks, for example, with respect to safety, that are greater than they ought to be. These are some of the consequences of accepting the technological world picture as a guide.

Modern technology too often neglects the criterion of service. What it delivers does dazzle, but as the complexity of it all increases, overconfidence does as well. We need to be more wary when turning to technology and to work harder at resisting its temptations. Instead of haughty, we need to become more humble. Timid awe befits us better as we involve ourselves with God's creation. Technological formation should help us cherish life.

Other Values: Ecological, Technological, and Social

Besides having the right posture (ethos) and sense of priorities, the preeminent ethical challenge for a responsible, well-directed technology is defining the values one embraces with respect to nature and the environment as well as to technology, the economy, and society.

Principal ecological values must certainly include preserving biodiversity and clean water and air, keeping and making the soil

fertile, and improving the living environment. The biosphere must remain unharmed; therefore, a war must be waged against dangerous emissions. Technology must adapt to natural life environs, not crushing the diversity found there but maintaining it.

Technical (and economic) values include being fit for habitation; being safe and reliable; providing basic necessities for life, such as food and health; battling sickness and suffering; countering threats from nature; fostering healing and sustainability; lessening the physical burdens of work; and so on. Beyond our physical wants, real fulfillment is found in spiritual growth, personal relations, and communal life—where technical values also touch social values.

The social values are those of community spirit, sobriety, justice, civility, mutual care and respect—of improving information, communication, and therefore social welfare in general. Is it too daring to suggest that "rest," "having time," and "spiritual flourishing" should be mentioned here as the forgotten social values of technology?

An Integral Framework of Norms: Simultaneous and Multifaceted Application

In my discussion of technological development, I have been focusing on the cultural picture—the ethos, priorities, and values that have to be considered: Technology must be serviceable to a great diversity of life forms and befit a responsible garden development, always with an eye on the current situation.

In addition to connecting with nature and culture and being defined by the right ethos and appropriate priorities, one needs to work at keeping to the normative course. A good number of normative principles and related norms are necessary to test the correct direction. These normative principles concern not only technology, but also the multifaceted relationship that technology has with people, nature, and society.

The integral framework of normative principles derived from the philosophical cosmology (or theory of structures) articulated by reformational philosophy constitutes a guide for responsible technological development. These norms include: cultural-historical norms; the norm of effectiveness; the norm of harmony between continuity and discontinuity, large-scale and small-scale projects, integration and differentiation, and universality and individuality; and the norms of clear information and open communication (among all participants); of harmony between people, technology, nature and society; of stewardship and efficiency; of always doing the right thing for all concerned, including nature and culture; of care and respect for everything and everyone involved in technological development; of service, trust, and faith. Within that framework, we distance ourselves from the suggestion that because "safety does not sell," irresponsible risks are an option.

Honoring such a normative framework[§§] ensures that a one-sided technological development makes room for a responsible, richly varied disclosure of nature and society. The practice of technology may not oppress but must serve nature and society. Not a one-sided or one-dimensional technological culture but a rich flowering of culture should be our aim.

Following this extensive ethical approach implies a broad point of view and, at the same time, a steady course.

[§§] For more on this integral framework of norms, see my *Faith and Hope in Technology* (Toronto: Clements Publishing, 2003).

§ 13 Consequences of a Cultural Reorientation

I now turn to some of the implications of this new approach to culture. To this point, I have set two different perspectives as ideal types over against each other. In reality, however, the differences are less stark. For example, when acknowledging that reality is a created reality, there is a clear relationship. The technological world picture is a parasite when it comes to created reality. It causes disturbances, but it can never distance itself from that reality. That is one reason why there is a good deal of versatility within the technological world picture, but it also explains why this take on the world often does not satisfy. Fortunately, there is an abundance of instructive inconsistencies. Conversely, those who acknowledge the world as created are often bound—in many ways and much more than one ought to be—to the technological world picture.

In this context, it is interesting to verify whether the cultural mandate of Genesis 1:28 ("fill the earth and subdue it") plays a role in discussions about the cause of the degradation of the earth. How one answers the question depends on the cultural picture one embraces. Appealing to that mandate from within the technological world picture leads to big problems; problems people are then party to, especially given that so little attention is given to protecting, preserving, and caring for creation. In my opinion, an appeal to the Genesis 1:28 mandate when seeing the garden as communal home leads to a much more harmonious development of technology. That is why it is better to speak of a *creation* mandate.

In any case, it must be clear that choosing the right direction remains an ongoing task, one that implies struggle and excludes laziness.

So, what are the practical consequences of the ethical-philosophical views I am advocating, and how do they differ from what is currently the case? We need to attend here to the meaning of this ethical perspective for technology today but also to indicate that precisely because of the creative responsibility of the technician when it comes to inventions and innovations, new technologies do provide opportunities for a change of direction. We need to stay away from the one-sided development of science, technology, and economy as a model for the whole culture. Such a one-sided "ladder-model" is very common, for example, in assessing so-called "developing countries."

If we want to express the development of culture in a model, it would be better to think of a folding wooden fan, just one segment of which would represent the development of science and technology in connection with the economy. This one segment would not characterize the whole culture, as is the case with the lowest rungs in the model of the "ladder."

Allow me to review a number of the implications of what I am suggesting.

An Ethical Assessment Framework as "Guide for the Perplexed"

I have endeavored to approach the phenomenon of technology from a different perspective than is currently in practice. What does this perspective mean for specific, individual technical phenomena, for what many refer to as "cases studies"? I said earlier that when these cases are considered individually, at the microlevel, some ethical improvements are almost always possible. However, in relation to the phenomenon of technology at

the macrolevel, ethical tweaking usually amounts to little more than temporary solutions.

The perspective I that have outlined, which highlights the importance of cultural projects, ethos, priorities, values, and norms, will have to be transcribed into a coherent ethical assessment framework. Such a framework could be used as a checklist for the analysis and evaluation of practical, individual technical matters. Responsible cases would then be evaluated relative to a responsible development of technology in general. In other words, those who are perplexed by the technological maze would be able to use this framework as a reliable guide and assessment tool. That does not always mean doing different things, but doing things differently. Nevertheless, choosing another direction can also mean choosing different technologies or doing different things.

First Things First

It is commonplace in science and technology to strive for fireworks, for the spectacular. When that happens, social justice is sometimes violated as less attention is paid to technologies that could help many people in their struggles against hunger and disease. It is painful to realize that attempts to address social injustice receives less funding and attention than, for example, prestigious, costly endeavors in space. I am referring not to communication satellites but to interplanetary space travel. This is an interesting project, but would it not be better to comply with our ethical obligations by setting different priorities? To mention another example of injustice, should we not say of the raw materials given to us that they require a just distribution so that the poor and needy who inhabit our communal home can also share in them?

By carefully setting priorities, we can ensure that there is enough for everyone; hunger results from a one-sided techno-

logical development: "There is enough for every need, but not for every greed."

Precaution with respect to future technical-economical development is crucial and needs to be emphasized in politics. Politics is the place to attend to the correct priorities beforehand, instead of what usually happens: reflection after the event.

Ecologically, Culturally, or Socially Applied Technology

We have to devote more attention, with the aforementioned principles in mind, to making modern technology a better fit for the unique situation of today, with regard to people, culture, nature, the environment, and even the landscape. Modern technology ought to be more ecologically and culturally responsible and accommodating. Where disruption has already occurred, restoration where possible should set the agenda.

The damage that has and continues to be done to nature and the landscape can be repaired or prevented by showing greater care. Care may cost more, but the price is worth it! This does not mean that I am advocating a return to the technology of the guild. Applied appropriately, technology needs to gain a breadth that it usually lacks today. Such a differentiation in technological development will obviously also need to have a cultural dimension.

Technological developments should not be at odds with the state of cultural development and the rich variety within it but should seek to fit in with the same. A technology that adapts to its culture will simultaneously enrich it. Unfortunately, we often see the opposite phenomenon in developing nations. In those countries, modern technology, rather than accommodating to the existing cultural diversity, often means a break with the existing culture. Atrocious cities filled with both myriads of poor people and, strangely enough, often venerable industries are the

flip side of an exodus from the country, which also results in the destruction of cultures that are centuries old.

Industrial countries, however, also have to deal with serious problems, for example, between technology and nature. These are often due to overdevelopment. Sometimes industrial waste is very damaging to people and nature. Engineers and those in engineering technology need to realize that dangerous byproducts have no place in a responsible technology. It is the duty of engineers to find solutions for processing such waste products. Allowing economic profit to define the bottom line will result in poorly developed technology.

It is a pity that the work of E. F. Schumacher, with his call for the wider application of intermediary or small technologies, no longer receives much attention. His was an influential voice during the energy crisis in the 1970s. When the crisis subsided, people made a caricature of him. Schumacher did not advocate a return to primitive and prescientific technology but to a technology that is in accord with nature and culture and thus a technology that fits the human scale. Such a technology should be adapted to external boundaries and human limitations.

We have mighty powers and forces at our disposal, but we remain dependent on fragile ecosystems. This is frequently not taken into consideration by the existing technological-economical powers, with well-known, serious consequences. Therefore, with a view to a healthy future, we must insist that what is needed is a creative technology, one with room for invention and innovation, a technology that is economically productive, accommodating to ecology and culture, socially just, and personally and communally fulfilling. Such technology could even be integrated with computers or the Internet because it would allow for a good degree of decentralization rather than the concentration of power. It is precisely when our tech-

nology provides us with more power that we must strengthen our commitment to use this technology with wisdom.

Culturally and Bioecologically Appropriate Agriculture

The power of technology is especially evident when it comes to industrialized agriculture. The problems here are huge. That some are switching to bioecologically and culturally adapted agriculture shows that the picture I have sketched may soon become reality. Unless agriculture wrongheadedly commits itself to an almost divine worship of nature, this alternative approach will increasingly find support as the problems of industrial agriculture increase.

What happens when we technologize agriculture? Modern technology usually does lead to larger yields and lower production costs; however, these increases parallel increased harm to farmers, animals, nature, and the environment. Overproduction precipitates uncertainties in agriculture and concerns about future possibilities: the loss of animal welfare, ground water pollution, land degradation, various new diseases of the soil, disturbance of the landscape, global toxification, loss of biodiversity, and impaired prospects for rural areas. Agriculture involves cooperating with a living reality, but we have been treating the land as though it were inorganic. When we subject agriculture to the grip of the ideal of scientific-technological control, we divorce it from its ecological, biotic, and cultural context.

Ecologically sensitive agriculture works to restore healthy biological relationships. Quality yields and environmental benefit are not mutually exclusive. It is not a matter of reverting to an earlier age, but qualitatively insightful biology, ecology, and soil science will help people handle soils, plants, and animals more wisely and ultimately preserve the fertility of the land.

Genetic Manipulation

The absence of a normative framework for new technologies is especially evident in the research and development of genetically manipulated organisms. In general, biotechnology usually treats life incorrectly from the start. The technical or machine model of organisms misjudges life. That happens, for example, when, in a popular way, one compares the genetic structure of all that lives to something made of interchangeable Lego blocks. Because of this reduction or even denial of life, it is no wonder that biotechnology (genetic manipulation) has to deal with so many hidden problems.

Genetic manipulation requires a more thorough critique and must be restricted ethically and legally. Current developments are unpredictable, risky, and possibly irreversible in their negative consequences. We need a model that is different from the technological one when approaching living organisms. Such a model should represent the organism as a living whole. Then life will be protected and not misunderstood, as happens in the technological model.

In general, regarding the possibilities of the genetic manipulation of plants, animals, and humans, I want to honor the ethical "No, unless . . ." principle that many other people have already accepted. That "No" must keep us from causing maladies, natural disturbances, or a loss of biodiversity with genetically manipulated plants. Should the introduction of genetic manipulation be contemplated anyway, then people must make a reasoned appeal regarding the "unless." Likewise, the entrepreneurs who are going to make use of this technology should probably also be made responsible from the start for the risks involved. Even then, the government should be obliged to establish a framework to assess the outcomes.

When people consider the genetic manipulation of human beings, the "unless" will obviously only apply to the level of or-

gans. Genetic manipulation via stem cells, which involve the whole human being, must remain prohibited. Fortunately, few people choose to pursue the therapeutic and reproductive cloning of humans, even though doing so could be taken as a logical consequence of the technological world picture. Where animals are involved, such as genetic manipulation for the purpose of producing medicines, the "unless" can have a more open interpretation.

Alternative and Sustainable Energy

In general, given looming problems, we cannot pay too much attention to alternatives. When we acknowledge the relative nature of science and technology and recognize the threats that do exist, we have every reason to become more creative in developing alternatives. Researching renewable energy sources is an attractive option. By extracting clean energy from garbage treatment plants, for example, process technology is making an important contribution. Process technology is also making use of new carriers of energy, such as hydrogen, photocells, biomass, wind, tidal currents, and the natural heat, hot water, and steam within the Earth. The switch to sustainable raw materials from the agricultural world, particularly from industrialized agriculture, becomes feasible by applying much more efficient biochemical processes. Separation technology, based on a much-improved fundamental process-science, plays a key role in these developments. The use of less or fewer materials ("dematerialization") is also an attractive alternative: solar energy, for example, can be directly converted to electricity or hydrogen. So as not to waste any materials, we need to promote recycling as much as possible. The life cycle of products should be controlled in such a way that almost 100 percent of the raw materials can be recycled.

Dilemmas

Even when technology is reoriented, acute dilemmas will remain. In other words, more needs to be done. Research must continue to seek ways to render harmless the radioactive waste from nuclear power generators. The aim should be a more responsible use of these facilities, which of late we are learning to better control. Only then may this source of energy be considered a resource more sustainable than the fossil fuels currently used. Nevertheless, until technology can render radioactive waste harmless, nuclear energy remains very risky.

§ 14 Political Consequences

Before concluding, I want to highlight the milieu in which the development of technological science and modern technology takes place. The framework I have sketched needs to be followed in a "free-market economy"—assuming that "free" is understood as "freedom in the context of responsibility." Reality teaches us, however, that economic powers usually intensify technicism and technologizing tendencies. To ward that off, many have turned to the government. However, the materialistic politics that usually prevails tends itself to bend with the economy and encourage the process. That notwithstanding, because the arrangement of society does concern everyone and because limitations can be put on economic enterprises, the political realm is the place to bring missteps to light and to counter wrongheaded developments. The political discussion, of course, will need to be attuned to the normative framework outlined earlier and, in keeping with the nature of the political realm, focus on law and public justice.

In light of the present state of disruption, pre-caution demands that we check the drive to trust in technology. We can use the political process to help weigh our choices: concerning a different direction for technology; regarding a broadly normative and differently constituted technology; focusing on technological investments that are friendlier toward the environment, nature, animals, and culture. Then ethically correct actions will be legally mandated. Such a national agenda, of course, can only be politically effective if it is based on law and a sense of public justice, and—given our globalized world—is backed in the international political arena. The prophetic message of Amos is of

current global interest: "But let justice roll on like a river, righteousness like a never-failing stream!" (Amos 5:24).

There are examples that indicate that politics can correct malformed developments. Over the course of time, legislation has been able to address all kinds of important issues: child labor, workers' safety, social security, guidelines for business and industry, wage and pricing policies, endangered species and environmental protection, quality control, and product safety, to name just a few. In doing so, the government has created a framework to protect responsible businesses and to encourage responsible technology. Technology's role as service provider needs to remain a priority.

Obliged Accountability

When new developments arise, people rightly appeal to "the precautionary principle." Rather than having the government act after the fact to correct matters, the intent is to prevent new processes or products that will not be safe for humans, society, nature, or the environment. An important question here is: Can the government foresee all possible implications and consequences of new technological-economical developments? I do not think so. The government is not sufficiently equipped for such a task, and making these calls is not its responsibility in the first place. And yet, the government must do something, because it can be assumed from the start that egoistic motives will have detrimental public consequences.

It would therefore be interesting to see if we can gain consensus about the possibility of general obligations articulated by the government for innovative companies such that, should they not follow through on these, they could still be called upon after the fact to take responsibility for these obligations to society. To date, the cost of dealing with the effects of this kind of corporate irresponsibility has usually been carried by the state

and therefore by the taxpayer. This burden should be shifted. Moreover, the societal responsibility of all who are involved with technological-economic development would become more explicit. The rights of corporations to pursue research and development carry with them societal duties and responsibilities. It would be wonderful if this sense of societal responsibility could be worked out in the normative direction I have attempted to indicate!

§ 15 Struggle and Hope

I do not mean to suggest that we are in a position to realize fully the perspective outlined here. But it will provide an enlightening framework in the middle of cultural problems and threats. Thorns and thistles will continue to accompany our work until, through God's intervention, the developed earth, now characterized by distortion, will be transformed into a godly, radiant garden-city (Revelation 21:9–22:5), where people will be revealed as liberated children of God, "brought into the glorious freedom of the children of God" (Romans 8:21). Then the work of science and technology will be seen in surprising ways, and in spite of people themselves, be involved in the new creation. That perspective gives hope and creates obligations. These, in turn, should inspire us to embrace an ethics in which people are expected to invest in their responsibility to seek the meaning of technology—not in isolation, but as woven into the full meaning of reality: the Kingdom of God. This is an ethical perspective that will continue to inspire us and that needs to be proclaimed and heard in our technological world.

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Appendix II

About the Author

Egbert Schuurman (born 1937) studied civil engineering at the Technical University of Delft and philosophy at the Free University in Amsterdam. He obtained his doctorate in 1972 with a dissertation that was translated into English in 1980 under the title *Technology and the Future: A Philosophical Challenge* (Wedge Publishing Foundation, Toronto, Ontario). In 1972, he was appointed professor in Reformational Philosophy at the Technical University of Eindhoven. Since 1974 and 1984, respectively, he also fulfills that role at the Technical University of Delft and at the University of Agriculture at Wageningen. From 1981 to 1983, he was a member of the so-called Broad DNA Committee, which, under government auspices, studied the societal and ethical aspects of activities involving genetic materials. From 1983 to 1984, he was in the United States as part of an international research team on *Responsible Technology* (the title of the resulting study, which was edited by Stephen V. Monsma).

Since 1983, Dr. Schuurman has been a member of the Upper Chamber of the States General for the Christian Union. From 1987 to 1997, he was president of the Prof. Dr. G. A. Lindeboom Institute for Medical Ethics. Since 1995, he has been president of the Institute for Cultural Ethics.

In 1994, the University of Potchefstroom in South Africa awarded him an honorary doctorate. In 1995, in Berkeley, California, he was granted a Templeton Award for his work as an educator in religion, science, and technology.

Dr. Schuurman is the author of several books, including *Perspectives on Technology and Culture, Technology in Christian-Philosophical Perspective, Reflections on the Technological Society,* and *Faith and Hope in Technology*. Several of his books have been translated into Chinese, English, Korean, and Japanese.

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