CYBORG: MYTH OR REALITY?

by Henk G. Geertsema

Abstract. The idea of cyborg often is taken as a token for the distinction between human and machine having become irrelevant. In this essay I argue against that view. I critically analyze empirical arguments, theoretical reflections, and ultimate convictions that are supposed to support the idea. I show that empirical arguments at this time rather point in a different direction and that theoretical views behind it are at least questionable. I also show that the ultimate convictions presupposed deny basic tenets of traditional Christianity, while their claim to be based on science confuses scientific results with their interpretation on the basis of a naturalistic worldview.

Keywords: consciousness; cyborg; Donna Haraway; human-machine; influence of ultimate beliefs; information; methodological naturalism; ontology; origin; philosophy of mind; physicalism; technology.

In 1960 Manfred Clynes and Nathan Kline published the paper "Cyborgs and Space" ([1960] 1995) in which they described an experiment with a laboratory rat. They had implanted a tiny osmotic pump in the rat that could inject precisely controlled doses of chemicals as needed by the animal in different conditions. The idea was to invent an artificial system that could adapt a living being to conditions in space instead of adapting those conditions to Earthlike environments. A technological device was connected with a biological system in such a way that a new layer of homeostasis was created. In this way it should become possible to provide astronauts with technological systems connected to their bodies to make

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space travel easier. The natural conditions of the relationship between human physiological processes and the environment should be replaced by a controlled interaction between bodily systems and mechanical devices that would take care of necessary fuel for the body. The term *cyborg* was introduced as shorthand for this kind of cybernetic, or cybernetically controlled, organism.

Later it was pointed out that humans have existed for some time as cyborgs: technology has become an integral part of human functioning. This can be illustrated by cases in which people are able to function normally only because of artificial joints, pacemakers, cochlear implants, or heart-lung machines that temporarily take over bodily functions—all illustrations of cybernetic systems in which human organisms and machine-like artifacts are merged. We also can point to telecommunication systems, personal computers, even typewriters. Technology in one way or another has become an integral part of our lives. Andy Clark (2003) contends that humans always have existed that way, at least since the time they used pen and pencil.

A new element was introduced by Donna Haraway in 1985 with the publication of "Manifesto for Cyborgs: Science, Technology, and Socialist Feminism in the 1980s" (Haraway [1985] 1991), a rather complex essay with a strong political intent. Of central importance is the idea that all kinds of traditional oppositions have become irrelevant. This applies to such grand sociopolitical oppositions as white and black, male and female, as if individuals could easily be characterized as to their actual social position by being related to one of these groups. It applies also to ontological divisions between human and animal, organism and machine, and physical and nonphysical. In this context Haraway coined the term *cyborg* as an icon for the irrelevance of the distinction between the human/animal organism and the machine. We are all cyborgs; we are a hybrid of machine and organism. In our age every form of life is so controlled by technology that it does not make sense to distinguish sharply between organism and machine. Our food is grown with chemicals. Our health is supervised by technical means. All kinds of artifacts are implemented in our bodies to restore original functions or even improve on them.

In this essay I critically examine some of the arguments in favor of the idea that the distinction between human and machine has become irrelevant. As such the idea of the human as a machine is not new. René Descartes divided reality into matter and mind. All existence apart from the mind could be understood as a mechanism. Julian Offray de la Mettrie rejected the dualism and wrote *L' homme machine* already in 1748. Materialism has a long tradition. More recently, a lot of work in the field of artificial intelligence (AI) and, later, in artificial life was based on similar assumptions. The movement of transhumanism (Moravec 1988; Paul and Cox 1996; Kurzweil 1999), which projects a new phase in evolutionary

history on the basis of the use of technology, is another part of this tradition. In this later development the idea of information has become crucial. For this reason it may seem that the physical gets traits of the nonphysical as much as the other way around.

I use as my starting point the paper by Haraway because of its seminal function. But I consider a wider range of arguments. I distinguish between empirical and theoretical arguments. Although they cannot be completely separated, they should be treated independently as much as possible in order to understand to what extent strong expectations for the future have an empirical basis or whether it is mainly theoretical interpretations of reality that motivate them. Finally, I ask to what extent basic convictions are behind the idea that there are no sharp boundaries between human and machine. What kind of understanding of human personhood and the world is implied, and can this be consistent with a Christian view that is based on the biblical tradition?

Empirical Observations

In this section I discuss empirical arguments for the idea that the distinction between human and machine has become obsolete. I distinguish three kinds of arguments: implantation of technical devices within the human body, the idea of the autonomous machine, and the technical nature of the human world. Although I confine myself as much as I can to the empirical side of these phenomena, a critical analysis of them cannot refrain completely from theoretical considerations, discussed in the next section.

Implantation of Technical Devices within the Human Body. As already mentioned, the term *cyborg* was invented to describe the integration of a technical device within an organism, human or animal, such that one cybernetic system is the result. Many examples can be given of this integration. Much research is being done, and all kinds of new inventions can be expected. It is an important and in many ways promising development as far as cure or even enhancement of human functioning is concerned. Are these examples and expected future developments indeed arguments for the contention that the boundary between the human being and the machine is disappearing? The question can be asked in two ways. Is the human person becoming more or less like a machine? Is the machine becoming more or less like a human? The second question I discuss in relation to the second kind of argument: the idea of the autonomous machine. Here the first question is at stake. To answer it we have to look at the human being as such. How do these technical devices affect the functioning of the human person as a whole?

We can look at the human being from different angles. We can study the human body in terms of its physical particles and processes. Biophysics is a field of study that relates also to the human being: we can study the

human body as a living organism. But there are many other aspects to the human person. The field of human psychology is related to neurophysiology and pharmacology, but they do not exhaust it. Study of emotional life cannot be reduced to theories of physics, chemistry, and biology. The same applies to the meaning of language and the normative dimension of human behavior as discussed in the fields of law and ethics. It is only from the viewpoint of physics (or systems theory as far as it makes abstraction from the specific nature of different systems; cf. Strijbos 2003) that we might tend to ignore the difference between human and machine. In all other respects we have the natural inclination to look at human beings as different from machines.

Is this natural inclination changed by the implementation of technical devices within the human body? I think that the opposite is the case. When technical devices are implanted in the human body to repair or improve some of its functions, all of the aspects that make the human person different from a machine are (or should be) taken into account. On the level of the organism it takes intricate study and subtle technology to connect physically based artificial systems to organic ones, because already on the physical level organic systems are different. And when these difficulties are solved, before the technology is applied the question is (or should be) raised not only of how the body as an organism will react — Will it accept or reject the artificial devices?—but also of how the human person will be able to integrate this technical artifact into her functioning in an emotional sense. Ultimately the question should be asked whether the implantation of the technical artifact within the human body enhances the human functioning of the person as a whole. Which view of human personhood guides us when we answer the question of whether we will develop and make use of what is technically possible? I address this issue toward the end of this essay.

My conclusion so far is that the development and use of technical devices to heal or improve certain functions of the human body does not invalidate the difference between human beings and machines. The specific nature of the human body and the unique nature of the human person remain presupposed. To ignore them would make the application of the technology dangerous if not impossible for the integral functioning of the human being. The boundary between the specific nature of machine and human can be ignored only if abstraction is made from what characterizes the human person as such in distinction from the machine.

The Idea of an Autonomous Machine. Haraway writes: "Late twentieth-century machines have made thoroughly ambiguous the difference between natural and artificial, mind and body, self-developing and externally designed, and many other distinctions that used to apply to organisms and machines." In the past "machines were not self-moving, self-designing,

autonomous. . . . Our machines are disturbingly lively, and we ourselves frighteningly inert" (Haraway [1985] 1991, 152; cf. 153).

Undeniably there has been immense development when we look at the machines of today compared with those of a century ago. Two aspects of this development are (1) the size of the machine, its structure, and its parts and (2) the use of software programs. As to the first, in the past the machine was constructed basically on a scale that was determined by what the natural eye could see. Although for a long time already intermediums were used to support eye vision, contemporary technology has made possible working on a miniature scale that formerly was inconceivable. Nanotechnology appears to be the latest development in this respect. The second point concerns the multifunctionality of contemporary machines. The traditional machine was the realization of one specific design. It had to perform one or more well-defined functions and was devised according to a definite plan. Contemporary machines, such as robots, can be designed to perform different functions depending on the software programs that are put into action. Each of the programs a robot can execute is comparable to one traditional machine (cf. Coolen 1992). The writing of the program has become more important than the material construction of the machine. Consequently, machines can perform many more functions than in the past and also can learn themselves. Not all of the operations they are supposed to perform need to be programmed in a definite way beforehand. A machine could be called self-designing in the sense that it adapts its program to the conditions under which it has to work.

Now we should ask whether this empirically observable development is sufficient for the assertion that the machine is becoming more humanlike. Is the boundary between humans and machines disappearing? The answer depends on the theoretical framework used to interpret both the human person and the machine. I return to this in the next section. Here I confine myself to some observations and try not to anticipate any theoretical reflections. In what sense is there an empirical base for speaking of an autonomous machine? What do we mean by *autonomous* in relation to a machine?[1] Is the autonomy of a machine similar to autonomy as related to a human being?

As far as the machine as a material construct is concerned, technically it is still not possible to make a robot that can perform all the bodily movements that a human being can. The way that robots relate to their physical environment in terms of observing, moving around, and actively changing it is still very different from what humans do. In this respect there seems to be no empirical basis yet to deny the difference between humans and machines. Flexibility as we experience it in the behavior of humans we do not find in the same way in machines. Yet, this could change.

There is a more basic question. Human autonomy is related to conscious awareness, emotional experience, responsibility, and accountability

in relation to legal and ethical criteria. Is there any empirical basis yet to assume that machines can have these properties, too?

It is important to consider what the nature of a software program is. It appears to be possible to analyze all kinds of human functions and represent their structural nature in the logical-mathematical symbols of a computer language. These software programs can be objectified on a physical level in the electronic circuits of a computer. In this way we can have a machine performing many kinds of human functions—not only physical ones through a robot and its arms but also mental ones, like thinking, that become visible by way of the computer screen.

But does a computer think or speak in the way humans think and speak? At this time there is no empirical evidence that any conscious awareness exists in a computer or its program. Computer programs have real meaning only within a human context. The computer does not ascribe meaning to the symbols it is using. It is the human person who understands language and thought; the machine is just a physical device designed by human beings to perform certain functions. This does not change when computers perform learning processes. The computer as we have it today in itself functions only on the physical level. This level it shares to some extent with human beings. "To some extent," because the physical level of machines is still very different from the physical nature of the human organism. The computer as such does not function in terms of conscious awareness. It has no emotional experience and no sense of responsibility and accountability. It becomes related to emotions, responsibility, and accountability only in relation to humans.

Computer programs can be compared to sounds and their relationships within a language. It is not the sounds themselves that speak or experience meaning. Sentences in a certain language have meaning only in relation to the people who speak the language. A machine that produces these sentences according to the rules of the language they belong to does not understand this meaning, either. It still is only within the context of human beings that sentences have meaning and are understood. Syntactical rules of a language can be objectified within a computer program but not the semantic meaning, which is realized only in relation to human beings.

One can speak of autonomy in relation to machines in the same way as one can speak of autonomous physical and physiological processes within the human body—processes that are not dependent on conscious decisions. To say that therefore the boundary between humans and machines is invalidated is as unwarranted as to say that there is no basic distinction between the autonomy of the human nervous system and the autonomy of the human person in relation to his or her decisions and responsibility.

The Technical Nature of the Human World. I have discussed the question of whether the boundary between human and machine is invalidated because of developments concerning the implantation of technical arti-

facts within the human body and concerning the way machines are constructed. In both cases my conclusion was that there is no empirical reason to give a positive answer to the question. Technological developments in relation to human and machine do not warrant the use of cyborg as a symbol for a boundary evasion between them.

What should we say about developments in society as a whole? In an interview with Hari Kunzru (1997) Haraway points to several examples of networks that are part human, part machine: "an automated production line in a factory, an office computer network, a club's dancers, light, and sound systems—are all cyborg." She also mentions the way athletes are being prepared to achieve optimal performances in sport competition. "Winning the Olympics in the cyborg era isn't just about running fast. It's about 'the interaction of medicine, diet, training practices, clothing and equipment manufacture, visualization and timekeeping.'" Human performances in fields as different as economics, sports, entertainment, and the military are being controlled in a technical way, not much different from the output of a machine. Both are analyzed in terms of input and output, procedures to be followed, and technical control. And they are interconnected in this way. Haraway speaks of C3I—command-control-communication-intelligence—in this context ([1985] 1991, 150). Technology characterizes contemporary society as such. Does this not illustrate that the boundary between human and machine is evaporating fast?

Undeniably, networks exist in which people and machines are interconnected, and there is no doubt that these networks often are the result of a technological analysis applied to the functions of both the machine and of the human person. Is this state of affairs an argument for the cyborg as the symbol Haraway takes it to be?

As such, the cooperation between a human being and a machine is not an argument against the fundamental difference between them, even when the cooperation is the result of a functional analysis of both of them. The machine may be devised in such a way that it is completely determined by this cooperation, the network it is part of. It can be understood as nothing more than a functional part of a system. Humans usually are part of several networks, such as a family, a factory, an office, a political community, and a sports club. They function within them and are dependent upon them. These networks never are just means toward ends that are set by the person herself. A person is never autonomous in the sense of absolute freedom as to decisions and activities. We are part of several larger wholes in which we function in connection with other parts. These larger wholes sometimes consist of groups of people but may also include plants, animals, and machines. This applies to us in our physical, biological functioning and also in our economical and political functioning. These several different functions can be studied as such and influenced on the basis of the knowledge acquired. The important point is that we never become just a part of

such a functional system. We are always more than that. Not only are we part of very different larger wholes; in our unique individuality we are more than just parts of different wholes. We function also in relationships that are not part of structural units, such as an accidental encounter. We make choices for ourselves that go beyond our functioning in networks.

In this way we remain very different from machines. There is a problem here, however. Does the use of technology to shape present-day society and human activities sufficiently take into account the unique nature of the human person? Are human responsibility and freedom acknowledged in the way people are put to work, or are they actually taken as a functional unit in the same way as a machine? Here we touch on what is discussed in the next section. At this point it is important to note the tendency of modern society not to recognize humans as humans but to treat them as if they were complex machines. Indeed, we might become too much functioning parts of society understood as a technological system, because the way society is organized does not leave sufficient room for freedom and responsibility. At the same time, the fact that we are worried about this points to the distinction that we still make between humans and machines. Haraway's Cyborg Manifesto witnesses to that at several places when she pleads for freedom over against domination ([1985] 1991, passim) and inclusiveness over against exclusion (p. 155). Even Haraway does not show the same concern in relation to machines.

Theoretical Reflections

I have discussed whether there are any empirical arguments for the idea that the distinction between human and machine is dissolving and have tried to show that there is no reason in human practice to think so. The opposite is true: even the implementation of technical artifacts in the human body appears to be an illustration of the fact that the difference is taken into account. What, then, are the reasons for the idea of cyborg as the token that the distinction between human and machine is no longer of any importance? In this section I consider theoretical arguments that seem to support this idea of cyborg. I discuss the tendency toward physicalism in science, the idea of information as basic for understanding all of reality, and the prospects for artificial intelligence and life as, for example, proposed by the transhumanist movement. I do not discuss these fields in any depth but limit myself to general characterizations and some critical comments.

Physicalism and Its Problems. In her Cyborg Manifesto Haraway does not spend much time on the physical/nonphysical distinction. She claims that it "is very imprecise for us" and then refers to the miniaturization that has taken place in relation to modern machines as microelectronic devices: "they are everywhere and they are invisible" ([1985] 1991, 153).

Actually, an extensive discussion is going on about the question of whether the nonphysical can be reduced to the physical. Nonreductive physicalism at this time is still the popular view. This position could be described as the combination of ontological reductionism with epistemological nonreductionism. Ontological reductionism holds that all that exists is ultimately physical. There is nothing within the universe that does not consist of physical particles and has not emerged from a physical basis. Therefore this position is still a form of physicalism. Epistemological reductionism would argue that we could explain all nonphysical concepts and laws in terms of physical ones. This appears not to be possible. Even within physics, not all laws of a higher level can be reduced to laws of a more fundamental level, and it seems unlikely that this could be done for biological or mental phenomena. Mental concepts tend to lose their meaning when they are translated into physical ones. For example, the concept of pain implies the subjective experience of it. Neurophysiological concepts—how important the study of pain on the neurophysiological level is for the treatment of it—do not as such express this subjective element, and they cannot. To understand pain they are therefore not sufficient. The opposite is true: neurophysiological study of pain postulates this subjective element as the presupposition of its meaning.

The reason why this position is developed especially within the philosophy of mind is clearly that philosophers want to maintain the distinctive qualities of the human person. Basic intuitions like those of freedom, human agency, and subjective experience are taken as a starting point that must be accounted for in theoretical reflections (Heil and Mele 1993; Kim 2000; Nagel 1986; Brown, Murphy, and Maloney 1998). Haraway might claim that the distinction between the physical and the nonphysical has become has become irrelevant; the actual discussion within contemporary philosophy of mind makes clear that it is very much alive.

Although the general tendency within contemporary philosophy of mind is against strict reductionism, the position of nonreductive physicalism has its own problems. I mention two of them here and suggest elements for an alternative approach.

An important issue for nonreductive physicalism is the problem of mental causation. If the common-sense intuition of human agency and freedom will have meaning, freedom of choice and starting a chain of action must be accounted for in the understanding of human behavior. Explanation of human activities of whatever kind cannot be given exclusively on the level of neurophysiological events, although they undoubtedly are of basic importance. The question is how mental causation can be combined with a physical explanation if physical causes are part of a closed physical system. Physicalism implies that causes on the physical level are complete and not dependent on causes of a nonphysical nature and that the mental events are causally dependent upon the physical events. Is there any room left for

mental causes if physical causes determine mental events anyhow? How can mental causation—the acceptance of which is a reason for the position of nonreductive physicalism—be combined with physicalism as such?[2] Is the position of nonreductive physicalism not inconsistent by itself so that we are left with either physicalism with reduction or one or another form of dualism?[3]

Related to the problem of mental causation is the idea of supervenience of mental upon physical properties. In short, supervenience implies two things: (1) mental properties emerge on the basis of physical properties but cannot be explained in terms of those physical properties, and (2) the properties on the higher level cannot change without a change on the subvenient physical level.[4] The ideas both of emergence and of supervenience suggest an explanation of the relationship between the physical and the mental, but instead of explaining anything they just express the nonreductive physicalist view. In fact, as Jaegwon Kim (2000) has tried to show, the idea of supervenience may have been proposed to solve the problem of mental causation (see Murphy 1998), but it is not able to do so as long as physicalism is maintained as its basic assumption.

There is another, even more basic, problem for the position of nonreductive physicalism. To explain I return to the distinction between ontological and epistemological reductionism. If epistemological reductionism is rejected because concepts and laws of nonphysical fields cannot be reduced to physical ones, what kind of scientific argument is left for ontological reductionism, i.e., that all of reality is ultimately of a physical nature? There may still be some discussion of whether this nonreducibility is a matter of principle or just a practical matter because of our human limitations. As long as in actual science some kind of reduction has not been accomplished or proven to be possible, there is no scientific argument left for ontological reductionism or physicalism. Of course, reduction takes place in scientific research. Pain is studied on the level of neurophysiology, and important results are achieved. But this is methodological reduction, which abstracts from specific aspects of the studied phenomenon and as such has proven to be very successful. Methodological reduction by itself implies neither epistemological nor ontological reduction.

It seems that we are left with the alternative possibility of some kind of dualism. But this would lead only to other problems. Both common sense and scientific research seem to point to intrinsic relations between the mental and the physical, so how could they exist as essentially separate? On the other hand, why should this intrinsic relation lead to the conclusion that mental phenomena could (and should) be explained from their material basis, as many scientists seem to assume?

Several people have pointed out that behind the dilemma of physicalism or dualism is still Descartes' basic distinction between a material and a mental substance (Searle 1994; Midgley 2000; Geertsema 2000). If a du-

alism of independent substances or even properties cannot do justice to the intricate relationships between the mental and the physical, it seems that only a physicalist monism remains as an acceptable option. Or, if physicalism cannot be maintained, we have to choose for a kind of dualism. The idea of nonreductive physicalism is indeed very much dependent on the physicalism-dualism alternative. But how valid is Descartes' basic distinction if related to the complex diversity within reality that we daily experience and that comes to expression in a multitude of sciences? As attractive as the distinction between mental and physical may seem intuitively, it is not sufficient to do justice to the diversity of concepts and methods in the different sciences let alone to the complexity and variety of our phenomenal world. There are many sciences other than just physics and psychology. Concepts and methods of biology cannot be reduced to those of physics. On the other side, language, economics, legal phenomena, art works, moral relationships, and religious ideas all presuppose mental life; but as to their typical nature, not much is said if they are characterized as mental phenomena. They all require a science of their own with characteristic concepts and methods. Reality is more diverse than is expressed by the mental-physical distinction. To put it another way, there are more levels to be distinguished within reality than the physical and the mental.

Another point needs to be made. It seems to me that there has been some tension in modern science from its very beginning in the sixteenth and seventeenth centuries. A characteristic feature of science as it developed from the late Middle Ages and especially from the sixteenth century onward is that it no longer explained natural phenomena on the basis of essential properties. Following Aristotle, this had been common practice throughout the Middle Ages. The beginnings of modern science meant a basic revolution in this respect. Scientists instead looked for regularities in behavior that could be formulated in mathematical laws. In this way the same law could apply to very different phenomena. The tides, the falling of an apple, and the movements of the moon are all explained by the laws of gravity. Lawfulness of functional relationships rather than essential properties and different kinds of causes (material, formal, effective, and teleological) became the basis for explanation.

At the same time elements of the Greek philosophical tradition were continued in, for example, the corpuscular theory of matter. The question of the basic constituents of the universe was pursued first in chemistry and later in nuclear physics. This too was a break with the Aristotelian tradition. For the physical world in a strict sense, that is, the world of inanimate things, the corpuscular theory need not be incompatible with Aristotle's view. In connection with the realms of plants, animals, and humans, however, the understanding of the material component was essentially different. For Aristotle and his medieval followers in these areas the substantial forms determined the nature of the material component.

The life of plants, animals, and humans could not be understood by the physical elements, because to grasp the unity of these entities a specific principle was needed. Substantial forms were essentially different for different kinds of things.[5]

As such the simultaneous development of these two elements in modern science should not be problematic. The first approach suggests an explanation of reality in terms of actual phenomena and natural laws that account for the nature of these phenomena. The second approach pursues explanation in terms of entities and their properties. In the first approach laws are used to explain phenomena, but there is no problem if this happens on different levels of reality. Each realm may require its own laws. If laws of a higher level are not reducible to laws of a lower level, as is usually the case, this need not cause a problem. This is how reality happens to give itself. Explanation relates to the appropriate level of analysis (cf. Midgley 2000, 35–39). The second approach looks at the nature of physical phenomena and its ultimate constituents. As long as this view is limited to physical nature in a strict sense the discussion can be limited to physics, as the discussion later concerning the wave and particle theories of light illustrates. A problem arises, though, when these constituents of physical reality are understood as the ultimate constituents of reality. And this is what has happened—first in a dualist sense and later as a monistic physicalism. Physical properties then are seen as the basic or essential properties of all of reality. In this way an Aristotelian metaphysical element has returned in the interpretation of science, because physics is understood as dealing with the essential nature of reality. At the same time, the interpretation of physical matter as basic to all kinds of entities meant a radical break with the more nuanced view of Aristotle that attempts to account for the fact that different forms of living nature cannot be understood only in terms of physical matter.

In many ways this development has become characteristic of both philosophy and the dominant interpretation of natural science. The laws of physics are supposed to ultimately explain all kinds of phenomena, at least all those that have a material aspect. A clear illustration of this is Descartes with his idea of two substances, each with one essential property. The material substance with its essential property of extension is connected with the corpuscular theory of matter. This theory is supposed to be able to account for all phenomena except the mental. No special approach is seen as necessary in relation to plant and animal life. The discussion about reductionism and physicalism within contemporary philosophy of mind also seems to be defined by an approach in terms of entities and their properties in such a way that the ultimate constituents are of a physical nature and completely determined by physical laws. Because according to physicalism ultimate constituents and their properties are supposed to de-

termine all other properties, nonreductive physicalism is a difficult position to account for in a consistent way (see Davidson 1980; Kim 2000).

I suggest a different philosophical paradigm in which two kinds of lawfulness are acknowledged. The first kind relates to functional coherence on different levels of reality, not only on the physical and biological (genetics) but also on the psychological, social, lingual, and economic levels. The second kind concerns the specific nature of kinds of things, the unified structures they exhibit that make them into what they essentially are. The different levels of lawfulness cannot be reduced to one another. Neither can the structural lawfulness of kinds of things be understood just in terms of functional coherence. This approach would do justice to the explanatory success of all kinds of sciences. At the same time it can account for the discovery of several kinds of structural patterns. These structural patterns find their characteristic expression on different levels of reality, physical/chemical (atoms, molecules) and biological (cells, multicellular organisms) but also social (organizations) and linguistic (languages, texts). They integrate the functioning of these kinds of things on the other levels of reality as well. Cells have a physical aspect, as do organized communities. Basic to this approach is the idea of lawfulness with the implication of the distinction between the phenomena that appear to be lawful without being absorbed in their lawfulness and the laws that hold for these phenomena.[6]

In this way more justice is done philosophically to the importance of the change in approach in modern science. Lawful explanation instead of essential determination is taken as the starting point for a philosophical ontology. Because different scientific explanations in relation to different levels of the same phenomena can be distinguished, the dilemma of dualism or physicalism in whatever form disappears. These different explanations can exist side by side. They look at the same phenomena from different angles, and there is no need to attempt to reduce one theoretical explanation to another. The nonreducibility of these theoretical explanations actually may show an important characteristic of reality itself, which should be accounted for in philosophical ontology. Kinds of properties can be related to different levels and be analyzed in terms of laws and concepts that are appropriate for those levels. Causal explanation relates to those different levels without claiming to be complete beyond its own specific level of explanation (Midgley 2000; Geertsema 2002).

The Aristotelian intuition of the importance of different kinds of things as understood in our common-sense experience can be accounted for as well. Different theories relate to different levels of analysis as in nonreductive physicalism. But these different levels are not understood in terms of parts and wholes, the wholes leading to new properties that cannot be understood in terms of the parts. Wholes need to be analyzed in terms of

a structural unity in which different kinds of properties with their appropriate level of analysis are unified in a special way as in Aristotelian substantial forms. To understand this unification usually one level or aspect of reality will be of special importance, like the biotic for living cells and the psychic for mental life.

If different kinds of properties with their peculiar levels of analysis are understood in terms of nonreducible laws and concepts, the ideas of supervenience and emergence can be retained. Supervenience refers to a relationship between, for example, the physical as subvenient and the mental as supervenient as different levels of the same thing, not as the same level in different, physical and mental, terms. (See for the latter interpretation Kim 2000, 86f.) These levels, then, are integrated within the structural unity of the individual whole in such a way that one aspect does not change without some change in the other. The idea of emergence might be used to describe concrete phenomena as they develop during the process of evolution. It should not be applied to the laws that explain their nature, however. In fact, one could take the laws as a condition for the lawfulness of these phenomena and therefore as the very condition for the possibility of their coming into being, as the rules of chess make the game of chess possible. Emergence of new properties on a different level is dependent upon the laws pertaining to that level. Therefore it can only describe what happens, not explain it.[7]

It should be clear by now that physicalism cannot serve as a solid basis for the dissolution of the distinction between human and machine. It is loaded with all kinds of problems, because it starts with ignoring the diversity and complexity of the world as given in our human experience. There seem to be other and better ways to account for the lawfulness of reality and the special place of the physical therein. Instead of an argument, physicalism, widely accepted as it might be, is a doubtful and unwarranted assumption behind the cyborg icon.

The Idea of Information. For both Haraway's idea of cyborg and her understanding of contemporary society the idea of information has a crucial place. Contemporary society is characterized as C3I (command, control, communication, and information). Communication and information technology are the instruments that control present-day society. Those in power control society through directing the use of these instruments by their commands as military commanders control their subordinates. Communication and information technology look at reality as a conglomerate of information-processing devices. This is what society itself is supposed to be. The cyborg is an illustration of the same approach: both machine and organism are understood as information-processing devices. Therefore they can be united in the cyborg as an "information machine" (Kunzru 1997, 6).

Taken in this way, the idea of information undermines the clear boundary between human and machine. This goes back at least to Norbert Wiener who emphasized the importance of information next to matter and energy as a basic concept of physical reality and who relativized the distinction between human and machine on the basis of this concept. Pioneers of artificial intelligence such as Allen Newell, Herbert Simon, and Marvin Minsky, who started working in the direction of developing a machine that could not only equal but even surpass humans in their capabilities, took this up (Noble 1999, 153 ff.). The idea still influences much thinking behind information and communication technology. In this section, therefore, I begin to answer the question of whether it is justified to view the importance of information technology and its use in many areas as an argument to criticize the basic distinction between human and machine.

First, what is information? I do not try to give a definition here. Important is that information in a very general and abstract sense can be taken as functioning between a system of some kind and its environment. Information concerns input within the system, which leads to a specific output. Information always implies that the input makes a difference for the system into which it is imported. Three aspects can be distinguished: the amount and structure, the meaning, and the effect of the information. This relates to the three parts of semiotics: syntax, semantics, and pragmatics. Syntax, or grammar, studies a system of signs or a language apart from its relationship to the actual world. It includes the rules of grammar and the vocabulary of signs but not how words and sentences relate to the world or how they affect the world. Information technology, following the foundational work of Claude Shannon, is primarily concerned with the structure and amount of information. Most of the time abstraction is made from meaning and effect. This implies that abstraction is made from the nature of the system and the environment. Information in this sense applies as much to the function of DNA within an organism as to the warning sound made by an animal in case of danger, a traffic light that tells us to stop or drive on, and the input in a machine or a computer program. If the actual systems and their environment are taken into account, information appears to be a rather complex phenomenon that functions in various ways.[8]

This diversity comes into sight when we look at the vehicles or carriers of information and the specific context in which they function. Distinction can be made between *signals*, which are of a physical-chemical nature, *signs*, which depend on the presence of senses and a central nervous system in the higher animals, and *symbols*, which are typically human and the meanings of which are conventional and maybe different for different groups of people (Nauta 1972).

DNA molecules are an illustration of a signal. They function as vehicles of information within an organism in relation to living cells and their

environment. Signals work in a direct way. They do not refer to something outside of themselves, but they do have a semantic and pragmatic meaning. They code specific messages with a specific effect. An example of a sign is the warning sound an animal makes in the case of danger. A sign refers to something outside of itself (the specific sound in relation to danger). Signs depend on the senses and need to be interpreted in a sense different from the meaning of DNA. They usually involve a process of learning. Symbols include traffic lights but also words of human language. They have a conventional nature and can have different meanings for different groups. Their meaning also depends very much on the context within which they appear. Symbols function within human culture. They can carry normative meaning. With symbols it is possible to reflect on the information process itself. They, therefore, can have a metanature.

Each higher level of vehicles of information presupposes the lower: signs presuppose signals, and symbols presuppose both signals and signs. Verbal communication on the level of symbols (words) presupposes as a substrate level the senses and their relationship to the central nervous system, and this level depends on physical-chemical processes both within the organism and between the organism and its environment. At the same time, the different levels need to be distinguished to understand what is going on in verbal communication. Clearly, the different kinds of vehicles of information correlate to different kinds of systems and their environments, different kinds of messages, and different kinds of effects.

Distinctions need to be made also in relation to the technology that is related to information and communication. This becomes clear when the nature of an artificial-information system such as a computer is considered. A basic distinction here is that between hardware and software. Hardware is the machine that is devised to run a program; software is the program itself. Hardware is developed on the basis of technology of matter and technology of energy—the first related to the shaping of physical matter according to laws of physics into devices that suit explicitly stated human purposes and the second concerning the transformation of energy. Machine technology like a windmill or a steam engine includes only these two forms of technology. Software is developed on the basis of information technology. It is the latest development in technology and concerns the processing of information. In its actual application it always presupposes the other two. Information needs a vehicle in order to be processed; software for its functioning always depends on the proper hardware.

Obviously, there needs to be a relationship between the hardware and the software. The information processing of the software needs to be objectified on the physical level of the machine. A physical device represents the information processing. The machine needs to support this process. This requires that the information be coded in such a way that the code and its processing can be run on the physical machine. That is, the code or

language on the information level (the program) needs to correspond to a "language" on the machine level. To make this possible the original information needs to be translated into the code that is needed for the correspondence between the machine and the information level—that is, into computer language. This requires a specific kind of analysis of the original information.

Recall my earlier distinction between syntax, semantics, and pragmatics. Information and communication technology seem to be concerned primarily with the encoding of the original information such that it relates to the machine language. The emphasis is on the information processing. This relates to the syntactical side of information and abstracts from the semantic and pragmatic aspects. The same machine language and the same information code are used for information of all kinds. Information technology seems to make distinctions irrelevant. Everything can be reduced to information that can be processed in similar ways in relation to both hardware and software. These information processes have meaning, however, only when they are placed back in relation to the world. To achieve this, the semantic and pragmatic aspects need to be considered. Actually these aspects have never disappeared in the case of concrete information processes. In the processing of information the encoding of the original information, with its specific meaning and function, is there all along. Otherwise its use in the actual world would not be possible. On the syntactical level the specific nature of the field of information may even have some consequences.

My conclusion after this short exposition is that, contrary to appearances, the diversity of reality cannot be reduced to a single kind of information on the basis of information technology. Behind the formalization that is taking place the diversity of reality is maintained. Sender, content, and receiver of information can be of very different natures. If information is taken in the general and abstract sense, as I assumed in the beginning, in order to understand its function it is still of basic importance to take this diversity into account. Are sender and receiver physical systems, living organisms, animals, or people? What is the nature of the encoded content of the message? This diversity is presupposed when information is encoded and information technology is applied in all kinds of situations.[9]

How does this apply to the relationship between human and machine? It seems to me that it is characteristic of the machine that the vehicle of information is of the nature of a signal. In this respect the machine is like a living organism. The relationship between the signal and its information content on one hand and the effect on the other hand is of a direct nature. The signal works automatically even if this depends on reaching a certain critical value. For the organism this is the result of its inner structure or design. For the machine it is the result of the artificial design of the machine as a human artifact.

Of course, the information processed within a machine such as a computer can be of all kinds. It is not limited to the kind of information that is characteristic for the function of organisms. The program of a computer can process information that is typically human. The question is whether the semantic and pragmatic aspects of this information can be actualized apart from the functioning of the program in relation to humans. The text on a computer screen has no meaning for the machine itself, no matter what form of processing the machine may have accomplished. A program may simulate an emotional reaction to a dangerous situation, but the machine itself has no emotion. We can use a machine with its programs or information processing to deepen our knowledge about any kind of information processing on the sign and symbol level, in relation to animals and human culture. But this does not mean that the machine itself functions on those levels apart from its relationship to human use. By itself it functions only on the level of signals. At present there is no reason to assume that machines have mental representations, let alone emotional and moral evaluations. If they have a function within an emotional or moral context it is dependent on human use. If a machine is functioning as an autonomous device like a thermostat it functions as such only on a physical level, although even then its character is determined as a human artifact.[10]

Of course, many expect that this will change in the future. That is the subject of the next section. At this point I conclude that the idea of information as it is used today within information technology as such is no argument against the basic distinction between human and machine. If it is taken that way, it is the result of a reduced understanding of information in which all emphasis is put on the syntactic aspect with the semantic and pragmatic aspects left out of consideration. For the latter it is necessary to take into account the specific nature of the information system and its environment. These include, besides the vehicle and code (encoding and decoding) of the information, the sender, the receiver, the content, and the effect of the message, all of which can have very different natures. For the application of information technology this diversity has to be considered.[11]

Within a cultural context, a metalevel appears in which decisions are made about the use of the information processing itself, as is clear from Haraway's formula, C3I. In the hands of people, information processes can be used for understanding and control. In fact, this metalevel is the very supposition of information technology.

Science Fiction and Simulation. Can machines have a conscious life? It often is assumed in research concerning artificial intelligence and artificial life that they can. The theme is well explored in science fiction. Actually, much research related to artificial intelligence, artificial life, and—recently—artificial intellect[12] is motivated by the idea that in this way the limitations of human functioning, which are the result of its being bound

to a body of flesh and bones, can be overcome (Noble 1999, 159ff.). Once the software and hardware of computers are sufficiently sophisticated, not only will there be in these machines mental life and self-awareness comparable to the human sense of personal identity, but their mental capacities will far exceed the possibilities to which we are presently confined. The neural network of the human brain is related to its biological substrate. This not only implies mortality, because the human body decays after some time, but the speed of its internal reactions is limited also. Wiener already played with the idea that the content of the human brain could be coded as information and sent to other places just like a telephone message. Since then the idea of downloading the human person from the brain into an artificial hardware setting has become popular (Kurzweil 1999). This would not only overcome the limitations of a mortal body of flesh and blood but also would make it possible to speed up the functions of the human brain.

There are two scenarios for future development. In both a new phase in the progressive evolution of the universe is expected. In the more optimistic one (at least from the viewpoint of humankind), humans will be able to take part in the life of their own creations. Through a process of scanning brain content and downloading it on an artificial substrate we will be able to enhance our possibilities beyond imagination. Based on information processing we would be able to include in the brain all kinds of knowledge and abilities. Because we are not confined to a specific body anymore, immortality will practically be within reach (Moravec 1988; Paul and Cox 1996; Kurzweil 1999). However, a more pessimistic scenario seems to have the upper hand right now: that humans will lose their position at the top of the evolutionary pyramid and be replaced by their own creatures (de Garis 2001; Vinge 1993). Humans will become superfluous. It will not be an attractive position to be in, being considered by other creatures, made after our own image, as of much less intelligence. The reason why this scenario appears to prevail may be that, if the speed of human brain functioning were magnified in the order of thousands or even millions, this would far exceed the capacities to digest information and relate it to our overall functioning that characterize us as humans. If we can learn in five seconds what takes us several years now, it would completely change our sense of time and far exceed our behavioral abilities.

I do not discuss here the technical aspects of these scenarios for the future. Much is expected from nanotechnology. My questioning concerns the assumptions that are made. These are of a philosophical rather than a technical nature. First I look at the assumption that machines will develop conscious life. Then I discuss the idea of personal identity, including a sense of normativity and responsibility.

What do I mean by conscious life? I mean the experience of pain and pleasure, and intentionality as goal-directedness of behavior—inner experience in general. The basic assumption behind the idea of a machine

developing consciousness is twofold: first, that conscious life emerges naturally at a higher level of organization—the mental supervenes on the physical; second, that this development is independent of the material substrate—it is irrelevant whether this substrate is organic or inorganic.

It is the second part that raises more questions. What is the basis for the assumption that the development of conscious life is not related to a specific physical substrate? This seems to be the idea of information as determinative for all kinds of being. Software can function on different kinds of hardware, so the mind could function on different kinds of physical substrate. It depends on the program and the design of the hardware, not on its matter. But why should this apply to consciousness? Is consciousness just information in a syntactical sense? Remarkably, this view seems to introduce a new form of dualism in which in a basic sense mind is supposed to be independent of matter. Is this related to the attempt to overcome the limitations of the human body (Noble 1999, 159ff.)? As far as I know, there is as yet no empirical evidence for this assumption. The actual development of conscious life, both ontogenetically and phylogenetically, points in another direction.[13]

The first part of the assumption raises questions as well. Emergence in the sense of supervenience is the statement of a problem rather than an explanation. We study the way mental processes function on the level of brain processes and discover many fascinating facts about the functioning of the brain and the relationship of mental to neurophysiological processes, but this does not tell us in what ways consciousness or mental life come about let alone explain to us what they mean. The latter we know from our own experience, and this depends upon a cultural context. Apart from that we would have no idea what conscious life would be or mean.

Not only mental life is taken as captured in information processes; personal identity also is understood that way. Supposedly personal identity has developed within a machine that may present itself in the future with statements such as "I am bored" or "I think, therefore I am" (Kurzweil 1999, chap. 3). Personal identity of humans, too, is understood as information fixed within the brain that in the future could be scanned and downloaded. Again, the physical substrate is seen as unimportant. Who we are is identified as information stored within our brains (Paul and Cox 1996, 430). In this view abstraction is made not only from the body as an integral part of our identity but also from the historical dimension. Personal identity is seen as a result. If history has any importance, it is not the actual history of personal experience but history as recorded within the brain. Knowledge has become nothing but information input. It is not related anymore to learning and its different ways. The assumption is even made that the ability of a pianist or a soccer player could be scanned from one mind and downloaded into another. This seems to be far from actual human experience in which both bodily and historical dimensions are of

major importance for our sense of personal identity. They cannot be reduced to stored information. The experiences and efforts as actually made seem to be crucial.

The neglect of the body and of personal history points to another difference between machine and (human) organism that is ignored. Each human being (except identical twins) is unique already on the basis of genetics. Human tissue tends to reject tissues of another individual unless digested as food. Machine production makes use of semi-manufactures that are designed to be universally applicable. Therefore, broken parts of machines can be replaced by similar parts without any problem. Uniqueness in relation to humans is not only a moral characteristic in the sense that a human person should never be seen just as a means to an end but needs to be respected always as an end in itself (Kant [1798] 1970, 547, 551). This uniqueness is expressed already on the biological level in genetic descent.

In fact, the assumption of this approach is that the mystery of what we are as human beings, including our sense of self, our responsibility and longing, success and failure, happiness and guilt all can be reduced to information processes. First, what makes us human is placed within the mind. Next, the mind is understood as information processing. The latter is an assumption not based on empirical evidence. The first is the result of another unwarranted jump. In ordinary life I do not relate to other minds: I relate to people. Neither do I understand myself as just a mind. Mental life may be essential to full human existence. To be a human being who requires proper respect is not the same as being a mind.

This leads me to a final remark about artificial intelligence. Originally computer programs were designed to simulate all kinds of processes. The purpose might have been to improve our knowledge about these processes or to train for specific abilities. For this reason the flight simulator was developed to train pilots. But soon the distinction between real and simulation was denied its basic importance. The Turing test assumes that once an average person cannot distinguish simulation from real intelligence, the distinction loses its importance. To me it seems that the distinction remains crucial (cf. Searle 1981; Clark 2003, 184ff.). The distinction between the simulation of mental or life processes and the real ones is as real as the distinction between hurricanes within a flight simulator and real ones.

I do not believe in the possibility of robots with mental lives and personal identities. If robots were to be constructed that simulated human behavior to an extent that they could not be distinguished from human beings, this would horrify me. I would have a strong sense of alienation, as I do when I cannot distinguish between a dream and real life.

Ultimate Convictions

Up to now I have been considering empirical arguments and theoretical reflections. There seem to be no valid empirical arguments yet for the

contention that the distinction between human personhood and machine-like existence has lost its validity. Theoretical reflections that are behind this view also are far from convincing. Why, then, does the cyborg story sound so persuasive to many, both scientists and others?

In this section I consider some ultimate convictions that may help explain why the cyborg icon has become so popular. I first discuss stories of origin, or the ultimate horizon from which people look for orientation in the world. Next I argue that the ideas concerning the possibility of overcoming human limitations are comparable to religious expectations. In these discussions the function awarded to science in relation to ultimate beliefs plays a critical role. I end, therefore, with some comments on science in relation to ultimate belief. In all three sections I confront the views discussed with some basic biblical notions. Again I consider some ideas of Haraway, but the scope of my discussion is wider; therefore, as before, the treatment necessarily will be in quite general terms, with little attention given to detailed argument.

Origin Stories. It may seem strange to connect Haraway with stories of origin, especially in relation to the idea of cyborg. Indeed, cyborg stands over against definite origins. That is what Haraway likes about it. She writes, "the cyborg has no origin story in the Western sense" ([1985] 1991, 150). By its very nature the cyborg defies stories that claim an original unity that through some kind of fall has been broken apart and must be restored. Stories of this kind tend to fixate certain oppositions and use violence to restore original unity and wholeness. Belief in God as the creator is related to a patriarchal system that curtails women's rights (p. 193). Marxist stories label people according to definite categories and therefore cannot lead to freedom for all (p. 158). Just because of its ambivalence—having neither a completely organic nor a completely technical origin—the cyborg both as fact and fiction serves as a symbol against the idea of a definite origin (p. 151).

This does not mean that Haraway does not have some story of origin herself. At the beginning of her *Cyborg Manifesto* she writes: "The cyborg is our ontology; it gives us our politics. The cyborg is a condensed image of both imagination and material reality, the two joined centres structuring any possibility of historical transformation" (p. 150). Material reality and imagination form the ultimate horizon from which Haraway attempts to understand the human world. Both are characterized by contingency. We live in a world without absolutes. Knowledge is situated throughout. This applies to science as much as to ethics and politics. There are no essences given that we can refer to for an anchor point. There is no fixed human nature, neither male nor female. There is just material reality and our human imagination. Science cannot claim universal validity. Social reality is a human construction. Radical contingency is the ultimate hori-

zon. There is no original nature that we could seek to regain. Nature and culture are inextricably interconnected. There is no transcendence, no Platonic world of ideas, no Creator God. This is the world we live in, and we have to make the best of it.

Haraway is aware of the fact that holding this view creates some problems. In relation to scientific knowledge she describes the problem as "how to have *simultaneously* an account of radical historical contingency for all knowledge claims and knowing subjects, a critical practice for recognizing our own 'semiotic technologies' for making meanings, *and* a no-nonsense commitment to faithful accounts of a 'real' world" (Haraway 1991, 187). The same problem arises, and even more urgently, in relation to ethics and politics. Criteria are applied in assessing social and political systems in terms of oppression and freedom. And these criteria should be taken at the same time as just historically contingent and as having a claim to validity that seems to imply some kind of universality. Haraway wants to combine radical contingency with responsible commitment and acknowledges that this "combination is both contradictory and necessary" (p. 187).

Another problem surfaces when we compare her Cyborg Manifesto with her later *Companion Species Manifesto* (2003). In the first she writes, "By the late twentieth century in United States scientific culture the boundary between human and animal is thoroughly breached" ([1985] 1991, 150). This sociological observation serves as a starting point for the introduction of the idea of cyborg as the token for the disappearance of the main traditional ontological dividing lines between human and animal, organism and machine, and physical and nonphysical. To make her point she refers to developments in biology and evolutionary theory. One can think of empirical studies that have argued against all kinds of theories that try to define scientifically the difference between humans and animals. It is argued that with animals we cannot find traces of language or that no animal can learn language with elements that are supposed to be typically human. It also is argued that animal life shows no social structure or political fights and strategies or that there is no truly altruistic behavior among animals. Studies of apes seem to have falsified all of these definitions of humankind that attempt to separate human from animal.[14] Evolutionary theory also has given strong support to the idea that the difference between human and animal is only relative.

It is clear that at this point Haraway is taking a scientific perspective to understand the relationship between humans and animals. In the other manifesto her approach is quite different. Here the emphasis is that dogs should not be treated as humans but should be treated in their own right (2003, 38f., 43f., 48f.). Alertness to otherness is the key. That applies to each dog as being different from others, but it certainly also applies to dogs as being different from humans. Interestingly, Haraway does not argue here on the basis of scientific theories but refers to the practice of dog

training, including her own experience, and the views different trainers have about dogs in relation to humans. Human practice and intuition lead to a different conclusion than abstract theoretical analysis does. It may be possible to speak of animal rights, but this does not relativize the distinction between humans and animals;[15] it just means that animals should be taken for what they are and treated with respect, not as commodities.

In the *Cyborg Manifesto* we find traces of modernity in a postmodern disguise. On one hand there is science understood as the ultimate way to knowledge of reality. This is manifest in the theoretical arguments used to support the idea of cyborg, in which the boundaries between human and animal, organism and machine, physical and mental are taken to be only social constructs that have lost their validity on the basis of scientific arguments. This relates to the material component in Haraway's story of origin. Matter is "essentially" the same in all we know. On the other hand there is the ideal of the free autonomous individual taken in its socialist form: freedom over against oppression, inclusivity over against exclusion. Cyborg becomes the icon of protest against fixed oppositions. At the same time the ideals of modernity are understood as themselves intrinsically dangerous. Science in its connection with technology has become a threat to individual freedom. Political strategies for freedom have turned out to be oppressive themselves. Yet, there is another element—human intuition and sense of responsibility. This speaks not only against the original ideals of modernity, both its idea of science as determinative for all knowledge and its idea of human autonomy as being absolute, but also against the inherent consequences of their postmodern transformation.

So Haraway's story of origin as expressed in the cyborg idea is not necessarily convincing. Actually, Haraway is aware of the fact that it is not a neutral scientific idea but rather "an ironic political myth faithful to feminism, socialism, and materialism" ([1985] 1991, 149). In her own words, the cyborg idea could not be anything other than her own construct to promote feminism, socialism, and materialism. It expresses a deep conviction that shares with modernity its rejection of any transcendent reality. At the same time, Haraway still needs some kind of givenness that relativizes her idea of cyborg both for science—the material world including its being structured in a specific way—and for ethics and politics. Scientific knowledge needs in some sense the givenness of the real world. Responsibility requires some normativity that it can respond to, even where this normativity is dependent on the historical form it has received. It is hard to understand true normativity without any universal element that as such is given (Taylor 1989). Haraway's story of origin is, therefore, incomplete.

I conclude this section with some remarks about the biblical story of origin. To me it seems evident that the biblical story of creation in whatever way it is understood is incompatible with Haraway's starting point in the material world in combination with human imagination. Genesis

teaches that we humans should understand ourselves as being called into existence by God, made in God's image. Our knowledge might always be situated (Haraway 1991, chap. 9), but understanding this call is meant to be universal (Anderson 1982; McFadyen 1990). Accepting it need not be a denial of the results of science (Brown, Murphy, and Malony 1998; Gregersen, Drees, and Görman 2000), yet it implies that there is something more to human life than material reality and imagination. Contingency is not ultimate. We are called to respond to God, who created us, and to live according to the intentions given with creation.

Is this view necessarily oppressive, as Haraway seems to suggest? Indeed, Christian tradition and church history show many examples of Christian beliefs having led to oppression. There also are examples of the opposite. It is true that the story of creation limits human autonomy. We are responsible before God. But does this decrease the meaning of being human? Actually I do not know a way that leads to a deeper understanding of what human personhood means.

Inevitably there is some relationship between the way we understand ourselves and the way we understand the ultimate origin of our world. This applies to biblical belief as much as to other views. If the ultimate origin of the world is supposed to be impersonal, this in one way or another will influence our understanding of ourselves. Richard Rorty and Daniel Dennett are clear illustrations. Contingency in the sense of time and chance seems to define their ultimate horizon. This comes close to Haraway's idea of material reality and imagination. Against that background it should not come as a surprise that they deny the existence of a central self. Rorty speaks of a network of beliefs and desires (1989, chap. 2). For Dennett the self is no more than a web of discourses, narratives woven together (1991, chap. 13). This view fits well with the idea of cyborg and its denial of the distinctive natures of human and machine (Clark 2003, 138ff.).

This theoretical approach may clash with concrete human intuition, which, I assume, is present even in Rorty and Dennett when they write their books, send them to the publisher, and wait for public reactions. Yet these theories do affect our actual understanding of our self. In the long run they may even undermine our concrete sense of self and our understanding of responsibility. As such they leave less room for the idea of human autonomy than the biblical story of creation. They easily lead to an understanding in which human behavior is ultimately a matter of cause and effect, which excludes the possibility of genuine responsibility and authentic freedom.

The biblical story of creation emphasizes selfhood and responsibility (Heschel 1966). It does not unravel the mystery of being human, but it does open it up. Because the human person is called to be by the One who is deeply personal himself, beyond all understanding, there is a depth to

being human that can be experienced only in relationships from person to person. Being created in the image of God implies, as Genesis 1 teaches, having a unique position of responsibility in the midst of earthly creation. All of God's creatures should be treated with openness and respect. In this respect Haraway is certainly right. Normativity is given with creation. This implies that we respond with openness and respect, with love, to all creatures but in a unique way to those by whom we are addressed on the level of personal relationships.

The modern and postmodern approach of the human self often is characterized by an objective scientific method, which does not leave room for responsibility and freedom, or by a subjective projection of an inner self, which puts all emphasis on autonomy. It wavers between a third-person and a first-person approach. Often the two approaches go together in a combination full of tension (see Dooyeweerd [1953–1958] 1997, vol. 1). The biblical story of creation is able to overcome this dilemma. It suggests a second-person approach in which we first are addressed and then respond. Our sense of personal identity does not start to develop out of an inner subjectivity, even less out of scientific knowledge; it begins as a response to somebody who relates to me as a person. This is true for our sense of self in human relationships. It is true in a deeper sense in relation to our being human as such. According to the biblical story our true sense of self grows once we respond to being addressed, to the call and promise of God as revealed in Jesus Christ. The structures of our being human as studied by science and the freedom and creativity we experience as characteristic of our humanness find their proper place in this being responsive. The structures open up opportunities with their limitations as rules in a chess game. Freedom and creativity give room for real response (Geertsema 2000). To me it seems evident that this understanding of human personhood cannot be applied to machines.

Religious Expectations. David F. Noble (1999) argues that the development of technology in the Western world is deeply rooted in religious expectations. I mention some points of his argument here and add a few comments of my own before coming back to Haraway's position.

Noble starts his historical survey in the beginning of the Middle Ages. Over against the early Christian view, which separates the spiritual from the natural, around the eighth century technology was related to the original destination of humankind and connected with spiritual life. Different crafts were defined as mechanical arts and understood as being part of humankind's being created in the image of God. The development of these arts, then, was seen as a restoration of an original ability (Noble 1999, 12ff.). In the twelfth century something new is added. Joachim de Fiore clearly articulates a view in which the idea of progress becomes crucial for the understanding of history. He distinguishes three successive stages, characterized respectively by God the Father, related to the family and the mar-

ried state; God the Son, connected with the church and the priesthood; and God the Spirit, embodied in the monks.[16] Joachim believed that he lived in the time of transition to this last period, which would be characterized by a new freedom manifest in a general spiritual illumination and in redemption from misery (1999, 24ff.). Later on, technology itself is related to the expectation of this new phase of history. Roger Bacon (thirteenth century) saw the advance of the mechanical arts "as a means of restoring humanity's lost divinity." He saw it at the same time "as a means of anticipating and preparing for the kingdom to come, and as a sure sign in and of itself that that kingdom was at hand" (p. 26).

The main point of Noble's book is that technology in its modern development is still motivated by the same religious expectations. Thus he traces a line from Descartes in the seventeenth century via George Boole in the nineteenth to the development of artificial intelligence in the twentieth. Descartes looked at the body as inferior to the mind. The mind is defined by characteristics we humans share with God; the body reflects human fallenness rather than its divinity and stands opposed to reason, so the body is something to overcome. Pure thought is what characterizes human beings as human. And geometry and arithmetic are models of such pure thought (p. 144f.).

Boole goes a step beyond Descartes. For him mathematics changed from "just a model for pure thinking" to "the means of describing the process of thought itself. . . . Like Descartes, Boole believed that human thought was mankind's link with the divine and that a mathematical description of human mental processes was therefore at the same time a revelation of the mind of God" (p. 146).

The project of Boole was continued by Gottlob Frege, Bertrand Russell, and Alfred North Whitehead and ultimately led to the construction of the thinking machine in the twentieth century by Shannon, Alan Turing, Minsky, Simon and Newell, and others. Noble characterizes this development in strong religious terminology:

> A thinking machine that replicated the defining characteristics of the human species, *Homo sapiens*, would not . . . represent an irreverent depreciation of humanity in favor of mechanism. . . . Rather, it reflected a new form of divine worship. An exaltation of the essential endowment of mankind, that unique faculty which man shared with God. . . . The thinking machine was . . . an embodiment . . . of what was specifically divine about humans—the immortal mind. In Cartesian terms, the development of the thinking machine was aimed at rescuing the immortal mind from its mortal prison. It entailed the deliberate delineation and distillation of the processes of human thought for transfer to a more secure mechanical medium—a machine that would provide a more appropriately immortal mooring for the immortal mind. (1999, 148; cf. 152, 159ff., 168ff.)

One might object that Noble is selective concerning the sources he draws upon. Yet, the picture he sketches of Western technological development makes it perfectly clear that the cyborg as the human-machine hybrid is

not just a practical device constructed for pragmatic purposes but is connected with deep human longings and expectations. Noble emphasizes the understanding of the human mind as divine and aiming at immortality. The other element he mentions, the idea of progress through technology, may be even stronger. Especially the possibilities of AI are dependent on the conviction of an overall progress achieved by technology. The movement of transhumanism often speaks of a new phase in the process of evolution. Noble writes of the "religion of technology" and gives much evidence to support his thesis. Yet his view needs some qualification.

First, his sketch of early Christian thought needs modification. From the very beginning a positive appreciation of technical arts and crafts existed next to the more negative attitude. Christopher Kaiser has pointed out that already within early Christianity a balanced view was developed in relation to engineering techniques and medical art as found in the surrounding world. Because the world is God's creation, based on God's will and not on eternal ideas, it is open to change. Technology, therefore, can be used freely to restore what is broken in reality and redeem human abilities that are lost. Yet it should be used for human benefit with the purpose of serving the needy, not for the increase of power of a small elite (Kaiser 1991, 34–44). The tradition of the Benedictine monks with their positive attitude toward natural things to which Noble refers goes back at least as far as Basil of Caesarea in the fourth century.

More important is the ambiguity in Noble's use of the term *religion*. Noble does not distinguish between the explicitly Christian context and motivation of technology as the mechanical arts especially in the Middle Ages and the secular motivation in religious terms behind, for example, the development of AI. For him this distinction mainly serves as a criterion to divide his book in two parts: "Technologies and Transcendence" and "Technologies of Transcendence." However, it is one thing to understand the development of technology within a religious context, even if technology is connected with restoration and redemption, and quite another when technology itself is understood as the exclusive way to redemption and salvation, even if the two views are historically connected in the sense that the second presupposes the first. The turn of the one into the other is of a radical nature. It means the secularization of religion itself.[17]

It may be that within Christianity, when technology is seen as a means for restoring what is broken or for a recovery of what is lost, the nature of evil in the biblical sense of sin and rebellion against God is not properly understood. As a result the view of technology may be too optimistic, as if evil and sin could not become manifest within technology itself. On the other hand, already in early Christianity there was awareness that technology should not be separated from the virtues of the Christian life (Kaiser 1991, 38). In any case, within Christianity redemption and salvation will always be more than just overcoming the consequences of sin by means of

human technology. Redemption implies also and more basically a reconciliation with God and fellow humans for both this life and the next. The secular context in which the technology of AI is developed is completely different. Here technology itself is the ultimate tool for overcoming human misery—misery understood not primarily in moral or religious terms but as conditioned by both physical and mental limitations. Human limitations are supposed to be overcome by means of technology, even in such a way that humans get traits of the divine. To achieve this, however, the assumption needs to be made that both humankind and the world should be understood primarily from a technological perspective. So one could say that technology itself has become religion as an ultimate conviction concerning the nature and destination of humankind and the world.[18]

Some observations that Noble makes in relation to the worldview of persons pursuing the ultimate goals of AI over against those involved with the Human Genome Project may be of interest. Concerning those whose work has been crucial to the development of AI and its expectations he admits that "most of them were professed agnostics or atheists" (Noble 1999, 170). In relation to the other project, several professing Christians are mentioned as having an important place in its pursuit (1999, chap. 11). For Noble this difference does not appear to be important. Still, one may ask whether the aims of the first project do not reach much farther than those of the second. Cyberspace is associated with omniscience, omnipresence, and omnipotence—in traditional theology properties that are exclusively attributed to God. In relation to the possibilities of genetic engineering the typical ideas Noble mentions are stewardship and co-creation (pp. 158, 193). Even if *co-creation* is a strong term (for me the term *stewardship* seems to be more appropriate), it still implies the distinction between creature and Creator. Only in a secondary sense are humans involved in making things. Certainly, the Human Genome Project also runs the risk of assuming a technological perspective on humankind and the world. Yet it does make a difference whether technology as a secular religion determines the ultimate outlook on reality or technology is integrated within a religious perspective that provides a normative framework for assessing the aims and tools of modern technology.

It is evident that Haraway's idea of cyborg does not fit into the picture that Noble sketches of the technological dream. As we have seen, she rejects origin stories that start with an original unity or integrity, assume a fall or disruption, and aim at a restoration of what was given originally. But she does not identify either with dreams of total technological control or prospects of immortal life. Her emphasis on embodied and situated knowledge points in a different direction. Actually the idea of cyborg is introduced to undermine these technological dreams. The cyborg may have its origin partially in "militarism and patriarchal capitalism" in its conjunction with "C3I, command, control, communication, intelligence,"

but actually it is an "illegitimate offspring" and as such exceedingly unfaithful to its origins. As a mixture of nature and culture, of organism and machine, "cyborgs are . . . wary of holism, but needy for connection" (Haraway 1991, 150–51). Cyborgs relate to earthly survival (p. 150), not to dreams of omnipotence, although Haraway does not reject modern technology and "its imposition of a grid of control on the planet" (p. 154; cf. 163).

In some sense Haraway may be more open to the achievements of technology than Noble is. But they share the conviction that technology should be separated from religious expectations and limited to down-to-earth pragmatic ends. They also share the belief that there is no ground for religious expectations as such (Noble 1999, 208). Life on Earth is all that we have. There seems to be no place for transcendence in a philosophical, let alone religious, sense. The difference from the traditional Christian perspective is clear. The resurrection of the dead and the expectation of a new creation are central themes in the New Testament.

There is another difference. Haraway connects evil especially with social and political conditions and strategies, but she certainly is not blind to all kinds of physical and mental deficiencies that could be alleviated by means of science and technology. Like Noble she wants to remain down to earth. Embodied and situated knowledge does not allow for dreams of immortality, omnipresence, and omniscience. Christians would agree that our creational constraints should not be seen as limitations to overcome. Being created in the image of God does not necessarily mean taking on God's divine nature. She should also sympathize with limited expectations in relation to technology. She certainly would not concur with a view in which technology itself becomes a religious perspective. Yet, if humankind is created in the image of God, there is more to evil than its physical, mental, social, political, and ethical dimensions. Evil has to do with missing our destination in the relationship with God as expressed by the great commandment of love (Matthew 22:37–39). Because our destination is, according to Jesus, in our relationship with God, it reaches beyond death. God is a God of the living, not of the dead (Matthew 22:31–33).

Faith and Science. In what precedes I have referred to elements of traditional Christian teaching such as creation, evil as sin and rebellion against God, resurrection, and a new creation. The question could be raised whether this is not naive. The contemporary scientific worldview seems to leave no room for such beliefs. John Searle writes: "Our problem is not that somehow we have failed to come up with a convincing proof of the existence of God or that the hypothesis of an afterlife remains in serious doubt, it is rather that in our deepest reflections we cannot take such opinions seriously" (1994, 90). Is there not deep opposition between traditional Christian doctrine and the results of modern science? In this sec-

tion I argue that the opposition is not between Christian faith and modern science but between two worldviews that both have the nature of ultimate convictions and neither of which can claim to be based on scientific argument alone. The modern scientific worldview as far as it claims an overall explanation of reality is guilty of a transgression of the intrinsic limits of science. Scientific theory as such cannot be directed to the whole of reality in an all-encompassing sense, because it needs to work on the basis of methodical procedures and well-defined concepts.

The first point I want to mention is the fact of the diversity of sciences and the impossibility of reducing them all to just one. Physicists look for a theory that can unite the basic physical forces of electromagnetism, gravity, and the strong and weak nuclear force. They aim at the unification of relativity theory and quantum mechanics. The suggestion is sometimes made that once this Grand Unified Theory has been accomplished it will in principle be an explanation of everything: all entities, events, and processes in the universe. Therefore it also is called a Theory of Everything.

I do not know whether the basic theories of physics will ever be unified into one embracing theory. It seems unwarranted to me, though, to assume that such a theory will by itself also give an explanation of the nature and origin of life in our universe, let alone of the nature and origin of consciousness or morality. This assumption is based on the idea that the physical is all there is and that therefore physical theory is the basis of all explanation. This is philosophy or worldview, not science.[19] The questions of the origin of life and of the emergence of consciousness are not covered by the theories of physics, which are part of the attempt of unification. So, even if this unified theory were found, it would not help solve these other problems. The Grand Unified Theory should be seen as just a theory of physics. It does not embrace everything. However grand it might be, it is still a limited theory, related to a specific realm of reality, not to the world in its totality.

Something similar should be said in relation to evolutionary theory, although the situation here is more complex. In its popular form evolutionary theory does not restrict itself to developments within a particular kingdom such as plants, animals, or human life and culture. It claims to encompass them all, notwithstanding the important differences between them. This popular understanding ignores the differences between evolution as studied by geology, biology, and the cultural sciences. The mechanism of chance mutation and natural selection, as far as it goes in biology, is not suited for explanations in geology. Neither can it be applied in the strictly biological sense in those fields of human behavior where normativity is involved. How could the moral urge of a human obligation be understood if based on the principle of the survival of the fittest through natural selection? If evolutionary theory is taken as a theory that encompasses all

evolution—of the physical, the organic, and the human world—it has become a worldview rather than a scientific theory. It springs from naturalism rather than from science. If one theory claims to explain at the same time developments within a particular realm, as defined by particular concepts, developments within another realm, which needs concepts of a quite different nature, and developments between these realms, the theory is making unwarranted jumps. The concepts used become necessarily fuzzy. Scientific theory claims to explain too much if it attempts to cover the world in its totality. The basic diversity of reality is put aside, and the intrinsic limitations of science are ignored.

There is another sense in which scientific theories are limited by their very nature. Science does not tell us about the meaning of things. It does not explain the experience of beauty and ugliness, of pain, suffering, and joy, of guilt and forgiveness, of justice and injustice, of boredom and enthusiasm. It may explain some of the underlying mechanisms, but it does not tell us what they mean. Even in relation to nature, scientific explanation is limited to how it works; it does not tell us what it is. Biology can help us understand some of the functions of mental and moral life, but their specific nature cannot be explained that way. Even if evolutionary theory could explain how specific functions have arisen, it never could explain them completely. Evolutionary theory makes use of all kinds of theories that imply lawful structures that are not explained by the evolutionary account but are presupposed by them, such as genetics in the modern evolutionary synthesis. More important, evolutionary theory does not explain what things are. This is understood, if understood at all, from other sources. So, like the physical theory of everything, evolutionary theory, even in principle, cannot give a complete explanation of life phenomena.

The problem can be illustrated by the tendency to reduce phenomena of one kind to another. A clear example is the explanation of our sense of morality. Evolutionary explanation has a hard time doing justice to the intuitive understanding of a moral obligation as something that comes to us as an appeal from outside. It seems counterintuitive to understand it just in terms of utility for adaptation. But the same applies to the emergence of consciousness. The nature of conscious life is easily reduced to the mechanisms of its physical or organic functions, but this does not explain the nature of consciousness as such. The specific character of consciousness needs to be presupposed in order to make it possible to apply the physical or biological theory to it. Otherwise the theory does not even touch upon the nature of consciousness; it only relates to its physical or organic substrate without connecting with consciousness itself. An example of such confusion is the reduction of knowing to cognitive processes that can be accomplished by computer programs, completely ignoring the intuitive difference between a machine and a human being.

Of course, some may claim that all of this originates in a natural process, just the result of time and chance. But that is no longer a scientific statement. It has the nature of a philosophical theory or a worldview. Scientific theory, of course, can ask the question of origin. Evolutionary theory is a typical example. As a scientific theory, however, it can never be a total explanation. It always presupposes a body of knowledge, especially of laws or lawful structures. These concern the nature of the field for which the question is asked. The concepts used need to be well defined and appropriate for the specific object of research. The laws and concepts assumed also concern the nature of scientific analysis and argument itself. The logical rules that define the scientific method are the very supposition of scientific explanation. Evolutionary biology does not explain these laws and concepts; they are presupposed in the very possibility of evolutionary biology's making any truth claim. Only philosophy can ask in a proper way the question of origin in a more encompassing sense. This question would include the origin of the laws themselves. It also would not be confined to the presuppositions of just one science but would apply to them all.

At least three views are possible regarding the nature of laws as assumed in science.[20] They can be seen as originating in the process in which the phenomena they apply to come into being themselves. This seems to be implied in most versions of naturalism. But because the phenomena themselves are not possible without at least some basic laws (otherwise they could not be used to explain them), this view is not self-evident. Another possibility is to take laws as having a kind of independent existence—they just are there. This is close to the Platonic and Aristotelian idea of forms and essences. One might wonder how far this view is consistent with naturalism, because in this view laws have some kind of transcendental or even transcendent being. A third possibility is to understand the laws that are discovered to be part of the world as creation, as being given by God the Creator. This view also has a long tradition in the Western world (Kaiser 1991, 5ff.). One's choice of views, of course, can be argued for, but this discussion is not of the nature of science in the proper sense; it belongs to philosophy and ultimately to worldview or religion.

I argue for a distinction between the question of origin in the special sciences and the question of origin in philosophy and religion or worldview. Only the latter is all-encompassing. It implies the origin of the laws themselves and of the nature of things, their meaning and being. A scientific explanation that claims to give a total explanation ignores the limitations that are set for it by its very nature. It ignores the limitations of the specific concepts and methods used. It ignores that different sciences often are needed to explain different aspects of the same phenomena and that these different explanations presuppose some idea about how one explanation relates to another. This relationship is not the subject of the

scientific theory but is of a philosophical nature. It ignores also that the way we experience reality in its rich diversity is beyond scientific explanation. Science explains in many ways how things work, but it cannot explain what they are and mean. Philosophy is concerned with reality as a whole, not the special sciences. Naturalism, or physicalism, therefore, is not a scientific theory but a philosophical one and ultimately a worldview. As such it goes far beyond the results of scientific research.

Methodological Naturalism. I conclude this section with a discussion of the idea of methodological naturalism to illustrate the importance of the distinctions I propose. I start with a description of methodological naturalism as given by Michael Ruse in a discussion with Alvin Plantinga.

> The methodological naturalist is the person who assumes that the world runs according to unbroken law, that humans can understand the world in terms of this law, and that science involves just such understanding without any reference to extra or supernatural forces such as God. Whether there are such forces or beings is another matter entirely and simply not addressed by methodological naturalism. Hence, in no sense is the methodological naturalist thereby committed to the denial of God's existence. It is just that the methodological naturalist insists that, inasmuch as one is doing science, one avoid all theological or other religious references. In particular, one denies God a role in creation. This is not to say that God did not have a role in the creation but simply that, qua science—that is, qua an enterprise formed through the practice of methodological naturalism—science has no place for talk of God. (Ruse 2001, 365)

Some, including Plantinga ([1996] 2002), reject methodological naturalism because they believe it is not compatible with Christian theism. Others, also Christians, defend it because they think the nature of scientific theory implies that God should not be included as a factor in a theoretical explanation (McMullin 2002). Part of the discussion is caused, I think, by the ambiguity of what is meant by scientific explanation. If scientific theory claims to give total explanations, a view of scientific theory that excludes in principle any reference to God is in conflict with Christian theism, which confesses that God is actively involved in the world. If, on the other hand, science claims not total explanations but only explanations from a specific viewpoint as defined by its specific concepts and methods, it seems to me that a reference to God as an explanatory element within a scientific theory is indeed in conflict with the nature of science. The idea of methodological naturalism is ambiguous in this respect, however.

Part of Ruse's description is that a methodological naturalist denies God a role in creation. How should this be understood? Does science as such deny that God has a role in creation? If science claims a complete explanation and accepts methodological naturalism, this is indeed a necessary implication. In that case atheism is assumed as a methodological starting point. But as such it implies metaphysical naturalism, because as science it

claims that God has no role in the creation. This is not far from the scientific worldview of Searle. Plantinga, as a Christian, is correct in his opposition to methodological naturalism because it is in conflict with Christian theism, which claims not only that God is the Creator at the beginning but that God is actively involved with the creation at all times. Ruse's statement that the methodological naturalist denies God a role in creation suggests such an interpretation.

If, however, methodological naturalism assumes that science can give only limited explanations and for that reason does not refer to God's involvement in the world, there is no conflict with Christian theism. But then it does not make sense to contend that a methodological naturalist denies God a role in creation. The scientific explanation is not denying anything outside of its limited theoretical context that is defined by specific questions and concepts both in distinction from other sciences and from philosophy and worldview or religion. It does not claim a total explanation and leaves room for other explanations by these other sciences and for explanations of a different kind in terms of philosophy and worldview. So it leaves room also for God's having a role in creation. In this case, though, one might wonder what the reason is for speaking of methodological naturalism because of the connotations of the term. No naturalism is involved, only an acknowledgment of the specific nature of science and its limitations.

The issue becomes complicated because Plantinga, too, seems to adhere to a view of science that implies the pursuit of complete explanations. Otherwise his argument that all the knowledge we have should be used in developing scientific theories is hard to understand (Plantinga 2002). Over against this view the appeal to the practice of science is justified. Yet, the confusion between a reductionist worldview, which is often (if not necessarily) implied in the idea of science giving a complete explanation, and the proper method of science because of its method and concepts gives Plantinga reason to oppose methodological naturalism. Regarding methodological naturalism as defined by Ruse and Plantinga, I advise a careful distinction of different levels of understanding and argument: the level of the special sciences, the level of philosophy that still has a theoretical nature, and the level of worldview, or religious faith. The latter can be argued for also, at least to some extent, yet at the end it implies an ultimate commitment. Searle's scientific worldview is such an ultimate commitment. It does not come out of scientific studies. It is the worldview commitment that colors the interpretation of scientific results. In this way scientific explanations of origin are interpreted as referring to *origin* in a philosophical and religious sense, thereby transgressing the proper limits of science.

I am not claiming that science should be separated from worldview and religion. The opposite is true. Philosophy and worldview will necessarily

have some impact on the wider interpretation of scientific results (Clouser [1991] 2005; Geertsema 1996). But they should be distinguished. It seems crucial to me that science is understood in its limitations. If not, it will take on the nature of a worldview or religion, because it claims to give ultimate explanations. In this respect there is no difference with Christian faith. Both Christianity and naturalism transcend science and should be open to account for the results of science. As traditional Christianity is facing here some problems, so is naturalism (cf. Armstrong 1995).

It is naturalism as a worldview that promotes the cyborg idea as suggested by Haraway, because it looks at the natural sciences for an overall understanding of reality. Then, indeed, the difference between human and machine is easily lost sight of in spite of the intuitions connected with our daily practices. On the other hand, because the contemporary scientific worldview is indeed a worldview with a commitment to naturalism, it can be opposed by a Christian commitment based on biblical teaching without denying the results of scientific research.

Conclusion

The question I have examined in these pages is whether recent developments in science and technology have made the distinction between human and machine obsolete. I observed that the influence of technology on human existence in many ways has indeed increased tremendously, but this does not mean that the distinction between human and machine has become irrelevant. The opposite is true. For a responsible implementation of all kinds of technology it is of crucial importance that the distinct nature of human personhood be taken into account. It appears that views of a distinct theoretical nature promote the idea of the human-machine hybrid. Yet these views themselves raise basic questions and cannot, therefore, be considered as a convincing argument.

It is clear that ultimate convictions of the nature of worldview decide about the interpretation of science and technology that inspires the cyborg idea as Haraway suggested. As far as cyborg stands for the implementation of technology in the human body and the increasing dependence of human life on technological means it is certainly a reality. Taken as an icon for the irrelevance of the distinction between human and machine, however, it is a myth based on questionable theoretical conceptions that ultimately are inspired by a commitment to the worldview of naturalism. As such it is incompatible with basic notions of Christianity.

In a way this conclusion may not be much of a surprise. In her Cyborg Manifesto Haraway herself introduces the cyborg idea as an "ironic political myth" ([1985] 1991, 149). It is directed against fixated political oppositions and meant to undermine technology's total grasp on human existence as far as its development is conditioned by militarism and capitalism in their conjunction with C3I (p. 151).

One may wonder whether I have not confused in my critical analysis the irrelevance of boundaries with that of distinctions. Does Haraway not rather speak of boundaries having become obsolete than of distinctions (pp. 149, 150, 151)? Is the focus of her argument not that nature and culture cannot be taken as separate parts of reality? How could this seriously be denied?

In the first place, I would agree with Haraway if her argument were directed only against the view that opposes technology by trying to restore an original nature. Culture and nature are indeed integrated in many ways. Technology is not evil because it disrupts a supposedly natural integrity. It is not just boundaries that separate which are at stake, however. Haraway does speak of distinctions that have become "leaky," like that of animal-human organism and machine (p. 152). Also, the arguments just examined show that much more is at stake than simply the separation of nature and culture. The cyborg myth questions the uniqueness of human personhood in a deep sense. It suggests that human life in the end is not different from machines. It implies a technological perspective on humankind.

Second, it may be that Haraway meant to undermine the total claims of modern technology as conditioned by militarism and capitalism by promoting the cyborg as their illegitimate offspring that does not have reverence for its parent (p. 151). Yet, the actual result of the cyborg promotion campaign rather has been an increase of the total expectations in relation to technology (Gray 1995; Clark 2003). If distinctions are erased on the basis of a technological perspective both on humankind and the world, no boundaries for technology's "grid of control on the planet" (Haraway 1991, 154) are left, and the other side of cyborg as a "myth for resistance and recoupling" (p. 154) loses its potency.

NOTES

1. I largely refrain here from discussing the idea of autonomy itself. Clearly, the idea of the autonomous human subject raises its own questions. Therefore I limit myself to some elements of human autonomy that are implied in daily human behavior both personally and socially.
2. This problem is the main theme of Kim 2000.
3. Dualism would imply that mental causes are functioning independent of physical causes. But this seems to go against the causal effect of physical on mental events, which appears to be widely supported by empirical research as well as by common sense.
4. Supervenience is defined in different ways. See Murphy 1998, 132ff. I have chosen the one that is most modest in its claims.
5. The insufficiency of physical elements and the laws that pertain to them as an explanation of the patterns of organic life is also at stake in the contemporary discussion concerning intelligent design. See, for example, Behe 1996; Dembski 2002; Pennock 2002.
6. This would be a realist view of laws. Our knowledge and formulation of these laws need to be distinguished from the laws as they actually hold for nature.
7. These few suggestions are based on the philosophical approach of Herman Dooyeweerd (see Dooyeweerd [1953–1958] 1997; Hart 1984; Clouser [1991] 2005). In these works not only the distinctions between different levels of analysis and between different kinds of things are elaborated but also the interconnection between these levels and between the lawful structures.

8. In Howell and Bradley 2001 the concept of information is connected with the idea of intelligent design. See pp. 306ff. where intelligent design could be compared with the Aristotelian substantial form.
9. This raises the question whether the coding of the original information into a computer language can take place without a loss of information. In the main text I ignore this question. Yet it is an important issue. Too easily it often is assumed that concrete reality can be grasped fully by abstract analysis and formal procedures.
10. This parallel is reflected in the double origin of cybernetics: Ludwig von Berthalanffy developed it in relation to biology and Wiener in relation to technology.
11 . Interestingly, in the field of knowledge engineering the need for a well-developed ontology with the distinction of several ontic levels has arisen (see Poli 2001).
12. "Artilect" for Hugo de Garis (2001) is shorthand for artificial brains that according to him will be developed in the coming decades and will far exceed the capacities of the human brain.
13. See Searle 1981, 371–72. As far as I can see, Douglas R. Hofstadter in his response (1981, 373–82) does not address this point.
14. But see biologist Francisco J. Ayala (1998), who stresses that also from a biological viewpoint humans are unique compared with other animals. Interestingly, for Andy Clark (2003, 6) humans are distinct from all other animals just because they are natural-born cyborgs.
15. Compare *The Companion Species Manifesto* (Haraway 2003), 53, with the Cyborg Manifesto (Haraway [1985] 1991), 152. Both manifestos plead for connection over against the separation of nature and culture, but it seems that the former emphasizes specificity of humans and animals whereas the latter suggests the disappearance of uniqueness in relation to humans.
16. Actually Joachim added a fourth stage: eschatological glory, in which the other three find their consummation (see Moltmann 1980, 224).
17. For a similar development in relation to the view of history see Löwith 1953.
18. Compare the critical assessment of modern technology given in Schuurman 2003.
19. See the earlier discussion about physicalism and its problems.
20. In my argument I assume that science in principle is concerned with theories about laws that are real. It tries to discover and formulate what is given. If this critical realist view of science is replaced by an instrumental or constructivist view, there is no longer an issue between truth claims of religious faith and scientific theories. In that case the latter do not claim any truth in a realist sense that could be opposed to religious truth.

REFERENCES

Anderson, Ray S. 1982. *On Being Human: Essays in Theological Anthropology.* Grand Rapids, Mich.: Eerdmans.

Armstrong, D. M. 1995. "Postscript: 'Naturalism, Materialism, and First Philosophy' Reconsidered." In *Contemporary Materialism. A Reader*, ed. Paul Moser and J. D. Tout, 47–50. London: Routledge.

Ayala, Francisco J. 1998. "Human Nature: One Evolutionist's View." In *Whatever Happened to the Soul*? *Scientific and Theological Portraits of Human Nature*, ed. Warren S. Brown, Nancy Murphy, and H. Newton Malony, 31–48. Minneapolis: Fortress.

Behe, Michael. 1996. *Darwin's Black Box*: *The Biochemical Challenge to Evolution*. New York: Free Press.

Brown, Warren S., Nancey Murphy, and H. Newton Maloney, eds. 1998. *Whatever Happened to the Soul? Scientific and Theological Portraits of Human Nature*. Minneapolis: Fortress.

Clark, Andy. 2003. *Natural-born Cyborgs: Minds, Technologies, and the Future of Human Intelligence*. New York: Oxford Univ. Press.

Clouser, Roy A. [1991] 2005. *The Myth of Religious Neutrality of Science: An Essay on the Hidden Role of Religious Belief in Theories*. 2d rev. ed. Notre Dame, Ind.: Univ. of Notre Dame Press.

Clynes, M., and N. Kline. [1960] 1995. "Cyborgs and Space." In *The Cyborg Handbook*, ed. C. Gray, 29–34. London: Routledge,

Coolen, M. 1992. *De machine voorbij* (Beyond the Machine). Amsterdam: Boom.

Davidson, Donald. 1980. *Essays on Action and Events*. New York: Oxford Univ. Press.

de Garis, Hugo. 2001. "Artificial Brains and Species Dominance." Lecture at Robo Sapiens, USKCI Incognito Symposium on Embodied Intelligence, Utrecht, April 4.

Dembski, William. 2002. *No Free Lunch: Why Specified Complexity Cannot Be Purchased without Intelligence*. Lanham, Md.: Rowman and Littlefield.

Dennett, Daniel C. 1991. *Consciousness Explained*. Boston: Little.

Dooyeweerd, Herman. [1953–1958] 1997. *A New Critique of Theoretical Thought*. Vol. 1: The necessary presuppositions of philosophy. Vol. 2: The general theory of the modal spheres. Vol. 3: The structures of individuality of temporal reality. Lewiston, N.Y.: Edwin Mellen.

Geertsema, Henk G. 1996. "Faith and Science in Biblical Perspective: Human Responsibility before God." In *Facets of Faith & Science. Volume 4: Interpreting God's Action in the World*, ed. Jitse M. van der Meer, 285–312. Lanham, Md.: University Press of America.

———. 2000. "Science and Person: Beyond the Cartesian Paradigm." In *Studies in Science and Theology. Yearbook of the European Society for the Study of Science and Theology* 1999–2000, ed. Niels Henrik Gregersen, Ulf Görman, and Willem B. Drees, 47–64. Aarhus, Denmark: Univ. of Aarhus Press.

———. 2002. "Which Causality? Whose Explanation?" *Philosophia Reformata* 67:173–85.

Gray, C., ed. 1995. *The Cyborg Handbook*. London: Routledge.

Gregersen, Niels Henrik, Willem B. Drees, and Ulf Görman, eds. 2000. *The Human Person in Science and Theology*. Edinburgh: T&T Clark.

Haraway, Donna J. [1985] 1991. "Manifesto for Cyborgs: Science, Technology, and Socialist Feminism in the 1980s." *Socialist Review* 80 (1985), 65–108. Reprinted as "A Cyborg Manifesto: Science, Technology, and Socialist Feminism in the Late Twentieth Century," in Donna J. Haraway, *Simians, Cyborgs, and Women: The Reinvention of Nature*, 149–81. London: Free Associations Books.

———. 1991. *Simians, Cyborgs, and Women: The Reinvention of Nature*. London: Free Associations Books.

———. 2003. *The Companion Species Manifesto: Dogs, People, and Significant Otherness*. Chicago: Prickly Paradigm Press.

Hart, Hendrik. 1984. *Understanding Our World: An Integral Ontology*. Lanham, Md.: University Press of America.

Heil, J., and A. Mele, eds. 1993. *Mental Causation*. Oxford: Oxford Univ. Press.

Heschel, Abraham J. 1966. *Who is Man?* Stanford, Calif.: Stanford Univ. Press.

Hofstadter, Douglas R. 1981. "Reflections." In *The Mind's I: Fantasies and Reflections on Self and Soul*, composed and arranged by D. R. Hofstadter and D. C. Dennett, 373–82. London: Penguin.

Howell, Russell W., and W. James Bradley, eds. 2001. *Mathematics in a Postmodern Age*. Grand Rapids, Mich.: Eerdmans.

Kaiser, Christopher. 1991. *Creation and the History of Science*. London: Marshall Pickering, and Grand Rapids, Mich.: Eerdmans.

Kant, Immanuel. [1798] 1970. *Kritik der Urteilskraft*. Immanuel Kant Werke in sechs Bänden. Band V. Darmstadt: Wissenschaftliche Buchgesellschaft.

Kim, Jaegwon. 2000. *Mind in a Physical World: An Essay on the Mind-Body Problem and Mental Causation*. Cambridge: MIT Press.

Kunzru, Hari. 1997. "You Are Cyborg." Interview with Donna Haraway. *Wired*. *http://www.wired.com/wired/archive/5.02/ffharaway.*

Kurzweil, Ray. 1999. *The Age of Spiritual Machines*. New York: Viking Penguin.

Löwith, Karl. 1953. *Weltgeschichte und Heilsgeschehen*. Stuttgart: Kohlhammer.

McFadyen, Alistair I. 1990. *The Call to Personhood: A Christian Theory of the Individual in Social Relationships*. Cambridge: Cambridge Univ. Press.

McMullin, Ernan. 2002. "Plantinga's Defense of Special Creation." In *Intelligent Design Creationism and Its Critics: Philosophical, Theological and Scientific Perspectives*, ed. Robert T. Pennock, 165–96. Cambridge: MIT Press.

Midgley, Mary. 2000. "Consciousness, Fatalism, and Science." In *The Human Person in Science and Theology*, ed. Niels Henrik Gregersen, Willem B. Drees, and Ulf Görman, 21–40. Edinburgh: T&T Clark.

Moltmann, J. 1980. *Trinität und Reich Gottes*. München: Kaiser Verlag.

Moravec, Hans. 1988. *Mind Children: The Future of Robot and Human Intelligence*. Cambridge: Harvard Univ. Press.

Murphy, Nancey. 1998. "Nonreductive Physicalism: Philosophical Issues." In *Whatever Happened to the Soul? Scientific and Theological Portraits of Human Nature*, ed. Warren S. Brown, Nancey Murphy, and H. Newton Maloney, 127–48. Minneapolis: Fortress.

Nagel, Thomas. 1986. *The View from Nowhere*. Oxford: Oxford Univ. Press.

Nauta, D. 1972. *The Meaning of Information*. Den Haag: Mouton.

Noble, David F. 1999. *The Religion of Technology: The Divinity of Man and the Spirit of Invention*. New York: Penguin.

Paul, Gregory S., and Earl Cox. 1996. *Beyond Humanity: CyberEvolution and Future Minds*. Rockland, Mass.: Charles River Media.

Pennock, Robert T., ed. 2002. *Intelligent Design Creationism and Its Critics: Philosophical, Theological and Scientific Perspectives.* Cambridge: MIT Press.

Plantinga, Alvin. [1996] 2002. "Methodological Naturalism." In *Intelligent Design Creationism and Its Critics: Philosophical, Theological and Scientific Perspectives*, ed. Robert T. Pennock, 338–61. Cambridge: MIT Press.

———. 2002. "When Faith and Reason Clash." In *Intelligent Design Creationism and Its Critics: Philosophical, Theological and Scientific Perspectives*, ed. Robert T. Pennock, 113–46. Cambridge: MIT Press.

Poli, R. 2001. ALWIS: Ontology for Knowledge Engineers. Ph.D. diss., Utrecht University.

Rorty, Richard. 1989. *Contingency, Irony, and Solidarity.* Cambridge: Cambridge Univ. Press.

Ruse, Michael. 2001. "Methodological Naturalism under Attack." In *Intelligent Design Creationism and Its Critics: Philosophical, Theological and Scientific Perspectives*, ed. Robert T. Pennock, 363–86. Cambridge: MIT Press.

Schuurman, E. 2003. *Faith and Hope in Technology*. Toronto, Canada: Clements.

Searle, John R. 1981. "Minds, Brains, and Programs." In *The Mind's I: Fantasies and Reflections on Self and Soul*, composed and arranged by D. R. Hofstadter and D. C. Dennett, 353–73. London: Penguin.

———. 1994. *The Rediscovery of the Mind*. Cambridge: MIT Press.

Strijbos, Sytse. 2003. "Systems Thinking and the Disclosure of a Technological Society: Some Philosophical Reflections." *Systems Research* 20:119–31.

Taylor, Charles. 1989. *Sources of the Self: The Making of the Modern Identity*. Cambridge: Cambridge Univ. Press.

Vinge, Vernor. 1993. "The Singularity." Paper presented at the VISION-21 Symposium, sponsored by the NASA Lewis Research Center and the Ohio Aerospace Institute, 30–31 March. *http://kuoi.asui.uidaho.edu/~kamikaze.doc.vinge.html.*