

Artificial Intelligence and Spiritual Life¹

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Angels, whether one believes in them or not, are defined as rational beings without bodies. By contrast, we humans are known to be rational beings *with* bodies. In a standard Judeo-Christian framework, humans are not only rational beings that happen to have bodies, they are embodied rational beings. That is, human mental life and human bodily life are theologically conceptualized as inextricably interwoven. The Greeks and their modern idealistic heirs, on the other hand, see the human mind as only accidentally connected to the body. For those taking this approach, we humans are rational beings who just happen to have bodies--but our bodies are only a necessary accident of having a physical existence and are not intrinsic to who and what we are. For these theorists, there is no necessary link between the nature of our body and the nature of our mind.

I still remember, about 1960, as a graduate student in psychology, when I was first introduced to the concept of a computer program. My professors emphasized that the beauty and power of a program lay in its independence of the particular physical material in which it might exist. A program, like a statement in formal logic, could be written in chalk on a blackboard, it could exist as a sequence of ones and zeros as written in machine language, it could be punched as holes in a deck of IBM cards, it could be a magnetic pattern on tape, or it could be a sequence of electronic states in the computer itself where the program could be stored and then retrieved and run. These examples should make it clear that a computer program, in its very nature, is remarkably free from any particular physical stuff. A program can be embodied in almost any material so long as the material in question allows one to fix the symbols expressing the program. And a program can be run in a computer that uses widely different basic electronic elements. The elements must allow for a rapid and reliable binary representation--e.g., on or off. However, vacuum tubes or silicon chips or who knows what in the future can serve this function. In short, the program with its structure exists independent of any particular physical medium. Strange as it may sound, a computer program is

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somewhat closer to an angel, that is to a rational intelligence without a body, than it is to the mind of a human being--at least that is the claim being made here.

In fact, this fundamental difference between a computer program and the human mind has long been established empirically in the biological sciences. And in the past few decades research in neurophysiology has very thoroughly elaborated and deepened the evidence that the human mind is dependent on the different particular materials of the brain. The research is well known, though apparently the implication--that computer programs are quite different from the human mind--is not commonly appreciated. Over 150 years ago, the great German physiologist Johannes Müller first clearly articulated what is known as the "law of specific nerve energies." Put simply, what this means is that a given nerve gives rise to a sense quality that depends on the specific character of the nerve. Stimulation of a visual nerve gives rise to visual experience; stimulation of an auditory nerve gives rise to the experience of sound, and so on. For example, in hearing there are specific nerve fibers in the cochlea for almost every specific sound frequency. Thus, the hair cells on the organ of Corti at the bottom of the cochlea respond to high frequencies, while those at the top respond to low frequency sound. Now this principle is far more general than the qualitative experience of the five senses for it characterizes the central nervous system--e.g., the cortex--as well as the peripheral senses. For example, recent research shows that this kind of qualitative specificity is present in the auditory cortex where it is known as a tonotopic map.² That is, the frequencies to which the hair cells in the cochlea are sensitive are mapped into columns of cortical cells--with each column of cells responding only to a particular and very narrow band of tone frequencies. The columns of cells are laid out in a spatial pattern that reproduces the spatial structure in the cochlea. In short, the particular neurons in the auditory cortex are not interchangeable, general-purpose neurons like silicon chips; rather they are highly specific and qualitatively different.

This same principle characterizes the visual system--indeed here the degree of specificity is, if anything, even greater than in the case of audition.³ In the retina it has long been known that there are three different kinds of color-sensitive receptors (cones) plus light-sensitive receptors (rods). However, research starting three decades ago has demonstrated that retinal ganglion cells are also specialized for certain elementary kinds of light stimulation as well as for retinal location--the best identified types of ganglion cells are known as X,Y and W cells; in the lateral geniculate nucleus (part of the brain) visual neurons are specialized for one of four colors, for location on the retina, and so on. In the visual cortex the specialized complexity expands even further. Here we find groups of visual neurons specialized for straight lines of different orientations ranging from vertical to horizontal (or spatial frequency analyzers); cortical visual neurons appear to exist that respond only to binocular disparity, while other groups of cortical neurons deal only with color processing, still separate systems appear to specialize in form and movement

perception. In short, throughout the structure of visual cortex there are qualitatively distinct channels analyzing or responding to elementary visual properties. Typically these channels process the various qualitatively different kinds of visual information in parallel, that is, at the same time.

Since the mid-nineteenth century it has been known that elsewhere in the cortex there are special systems both for understanding speech (Wernicke's area) and for producing speech (Broca's area). The motor cortex is another major area of specialized neurons. Indeed the cortex is now known to consist of a very large number of interconnected sub-systems of neurons, each with specialized qualitatively different sensitivities. One major consequence of this now-established understanding of the cortex is that to simulate the human mind it will be necessary to simulate the human body.

This extension of the law of specific nerve energies from the peripheral sensory system to the cortex clearly shows that the human brain operates on a principle that is the opposite of a digital computer. That is, digital computers are made of identical and interchangeable electronic elements. The possibility that certain chips, for example, could only process one kind of information (e.g., a payroll but not a mathematical equation or a business letter), would destroy the utility, the very *raison d'être* of the modern digital computer.

This is not to imply that all cortical neurons are qualitatively different from each other. Certainly within a cortical neural system there is some redundancy. Thus, a whole column of cells in the visual cortex may be sensitive to the same line orientation (or spatial frequency orientation); but this local redundancy should not be allowed to keep us from understanding that many different cortical areas are involved in qualitatively different kinds of processing and experience.

In other words, the understanding of the cortex today is that it consists of a complex, interconnected group of sub-systems. Each of the many sub-systems represents a specialized and qualitatively different kind of processing; often these sub-systems are also associated with qualitatively different *conscious* experience. All this means that the basic neural elements--or the "chips"--in each sub-system would have to be highly specific and different from those in each other sub-system; the same is also probably true for the large number of interconnecting neural structures.

A different but closely related fundamental biological fact is that the nervous system and the human body are intimately linked with properties of the external physical world. As just one example, consider the range of light waves that the human eye is sensitive to. This range, known as the visible spectrum, is from about 380 nm (violet) to 760 nm (red). Now the potential spectrum of light (electro-magnetic energy) is enormously greater and ranges from extremely short waves (gamma rays) to very long radio waves and AC circuits. The visible spectrum is thus a very small slice of this potential spectrum. However, it is reasonable to assume that the human eye is only concerned with the light available on the surface of the earth. To be able to see waves that only exist elsewhere in the cosmos would be a waste of

biological energy and tissue. The human eye is, however, responsive to almost all of the spectrum that actually reaches the surface of the earth with any significant amount of energy. Only the relatively small ultra-violet and infrared parts of the spectrum are not part of our sensitivity. That is, the human visible spectrum is close to the available spectrum on the surface of the earth. Over and over again scientists find evidence of this type showing how the body is adapted--even fine-tuned--to its environment.

There are two well-known major theoretical understandings of the complex and intimate connection between the human body and the external physical world.⁴ Among scientists today the most common is the atheistic or agnostic theory of evolution. This familiar intellectual framework assumes that life originated by chance and then evolved or developed over many millions of years. For those who hold this view, life forms are understood to be a marvelously complex, long-term, natural response or adaptation to the surrounding physical and biological reality.

My own view--which can be called theistic evolution--accepts much of the previous position; but, like many others, I assume that the physical and biological world was created by God. In this framework the origin and evolution of life over time is a God-governed phenomenon. However, the nature of *how* the changes took place is a scientific question that can be investigated without reference to the Divinity. In spite of theoretical conflict about origins, both the atheistic and theistic versions of evolution accept almost all of the same scientific findings. That is, they both assume that life in all its forms is closely connected to the outside environment in which life has developed and to which it is adapted. Thus, both kinds of scientists assume an animal's nervous system can't be understood when separated from its body and neither the nervous system nor the body can be understood when separated from the animal's environment, since the three constitute a mutually interacting system.

The major point that mind is embodied is, of course, not a new one. For example, recently it has been emphasized in the writings of the information theorist Donald MacKay⁵ and in the discussions of Artificial Intelligence (AI) by the philosopher Dreyfus, who sums his position by a quote from the poet Yeats: "Man can embody the truth, but he cannot know it."⁶

I am aware that some of the difficulties that arise from ignoring the body are beginning to receive serious attention in AI and related areas. Neural nets, now fairly common, are a small step toward a more neurological or "body-like" model of the mind. Nevertheless, very serious difficulties remain before even a modest simulation of the biological basis of mind appears possible. One expression of the difficulties involved in the simulation of the human brain is represented by the terms "hardware" and "software." Hardware refers to the fixed physical and electronic components in a computer or robot. However, there is no real hardware analogy to the human body where even muscle and bone tissue are, at best, a kind of "software." A computer program is called software, but there is no evidence that the

program level actually exists for humans. The body exists and conscious experience exists, but there is no evidence that a level analogous to a computer program exists as a functioning part of the brain/mind. The difficulties involved derive from the fact that computers and robots are based on silicon while animal life is primarily carbon based. Computers are not, in principle, restricted to silicon systems, but they are all based on silicon (including neural nets) for what appear to be practical reasons--namely silicon is cheap and allows very reliable binary representation. As such, silicon systems are devoted to dryness, so to speak, while carbon systems are devoted to wetness. Water quickly destroys or "kills" a computer, while too much dryness quickly kills humans and other animals. The brain is very much a wet system and simulating it will have to involve simulating this very fundamental property which is so different from computers. In brief, the human brain consists of different kinds of what might be called "wetware" and hardware and software are irrelevant or misleading terms. In any case my fundamental point here is that a true simulation of the human mind would require a simulation of the human brain and body. Whether this is possible remains to be seen.

In fact the intellectual world of the digital computer and of research on AI is often far removed from the body and the world within which the body lives. As previously noted, the advocates of digital computer programs as models of mind reject, or at least commonly ignore, the connections between the mind and body. They tend to present a very abstracted or idealized view of reason and of mental activity in general. With this as background and context, it is now time to focus on our central topic--namely, artificial intelligence and the spiritual life.

First, I wish to emphasize that the prior point on the interrelationship of the mind and body is proposed as an analogy to a similar interrelationship between mind and spirit. Just as our mind is inextricably bound up with the body and physical reality, so it is likewise bound up with God and spiritual reality. Thus, I start with the assumption that there *is* a transcendent spiritual realm, and that the human mind is constantly interacting with this realm. Now, I am fully aware of the fact that it is precisely this assumption that is rejected by many scientists, especially those in the world of artificial intelligence. I will examine the basis of this rejection and present a case for the existence of spiritual reality. Obviously, this realm must first be accepted as existing before one can accept its relevance for an understanding of mind. Therefore, the subsequent remarks are primarily addressed to the skeptical or atheistic scientist.

Throughout human history and its varied cultures, three great external realms of reality commonly have been assumed to exist. These are the external physical world, the world of other minds and the transcendent spiritual world (for example, of God or the gods). An interesting feature that these three presumed realities share is that we cannot prove the existence of *any* of them. Indeed, some years ago the prominent philosopher Alvin

Plantinga published a very important proof on the subject.⁷ Briefly, what Plantinga was able to prove was that the degree of rational and empirical uncertainty about the existence of other minds and about the existence of God is exactly the same. That is, the rational grounds for accepting the existence of both of these realms has the same structure, and involves the same assumptions--assumptions Plantinga shows are often question-begging in both cases. For example, we never directly experience other minds and our assumption that they exist is based on an analogy with our own mental life. Plantinga's proof itself is sophisticated and cannot be summarized easily, but its general structure is not hard to outline. Plantinga first systematically shows that neither natural theology nor natural "atheology" offers a satisfying solution to the problem of a rational justification of belief in God's existence or of God's non-existence. He then tries another approach to the justification of belief in God by exploring its analogies and connections with a similar question--the "problem of other minds"; that is, how do you justify the existence of other people's minds. Plantinga goes on to "defend the analogical argument for other minds against current criticism and argue that it is as good an answer as we have to the question of other minds. But it turns out that the analogical argument finally succumbs to a malady exactly resembling the one afflicting the teleological argument [for God's existence]." He concludes that "belief in other minds and belief in God are in the same epistemological boat; hence if either is rational, so is the other. But obviously the former is rational; so, therefore, is the latter."⁸ His formal proof for this conclusion has stood without a successful challenge for over 20 years.

Elsewhere Plantinga shows that just as we can't prove the existence of other minds, it is also impossible to prove the existence of external physical reality, or even to prove the existence of the past.⁹ Again, he shows that the failure in each proof is identical to the failure in the teleological argument for God's existence. One obvious implication of Plantinga's work is that if scientists, for example, tend to assume the existence of physical reality and of other minds but to reject that of God, then this is done on non-rational grounds. Before turning to some of the non-rational reasons behind the rejection of the spiritual realm, it will be useful to discuss how it is that the existence of the external world is commonly accepted. First, the problem of proving the existence of external reality arises once one accepts the fact that our knowledge of external reality is always mediated by the nervous system. All we are directly aware of is our own states of mind. We must--we can only--infer an external reality existing behind and acting as a cause of our sensations and perception. The *validity* of this inference is what cannot be proved. We may accept Plantinga's reasoning in this matter or we may be convinced on other grounds that proving the existence of the physical world is not possible. There is, of course, a long line of skeptics on this issue in Western philosophy (including David Hume, Bishop Berkely and Thomas Reid), whose writings certainly support Plantinga's conclusion.

Nevertheless, almost no one has ever doubted physical reality to the point

of trying seriously to live by such a position. If a person lived on the basis of such doubt it is not clear why one would eat food, avoid walking into walls, or even bother to get dressed. A few idealist philosophers in the last two hundred years or so seem to be the intellectual representatives of a position that denies or comes close to denying the physical world.

The overwhelming majority of scientists, and of average citizens of the world, have always accepted the existence of an external physical reality. Scientific theories are, after all, about something outside of us. The ground for this acceptance seems to be that we are so made that sensory and perceptual experience carries with it the overwhelmingly convincing notion that it is external reality that is experienced. Put somewhat differently, our normal interaction with what appears to be physical reality naturally creates a firm conviction of its existence.

Of course, in some rare instance one's perception of external reality may be faulty. There are such things as illusions and hallucinations. But to believe that the whole realm of physical reality doesn't exist, or that most, or even much, of our perceptual experience is without an external source, would be considered--would *be*--bizarre indeed. Except for certain kinds of philosophers, such as the just-mentioned idealists (who are given a kind of philosophers' license to suspend common sense), anyone who failed to believe in the external world would be judged as suffering from a mental pathology.

Likewise, our belief in the existence of other minds comes from interaction with other people. Sensory contact with a person plus interaction involving language and symbols appears adequate for us to reliably assume the existence of other minds. The tendency to interpret other minds as existing is so strong that often it reaches the point of projecting mind onto something which is not mind at all. Children project human minds onto many animals; even trees or inanimate objects, especially at night, are often understood by children as having minds. Anthropologists commonly note that in so-called primitive cultures certain special objects, such as a mask or talisman, sometimes are superstitiously understood as possessing mind and spirit. This anthropomorphism is one tendency scientists have traditionally guarded against. However, some of those in AI seem especially susceptible to this error of projecting mind onto objects. For example, one prominent AI scientist attributes beliefs to thermostats.¹⁰ Apparently thermostats have three beliefs: it is too hot, it is too cold, it is just right. That a thermostat has beliefs seems to me to be a rather crude, if updated, example of anthropomorphic thinking.

Although even AI scientists may sometimes see in, or project mind onto things or places where it doesn't exist, few seriously propose that other minds don't exist. Even if mind is assumed to be an expression of matter, few doubt that other people's integrated consciousness--that is, thoughts, feelings and purposes--actually exists. For all practical purposes everyone *assumes* both the existence of other minds and also of physical reality.

It is important to note that a crucial issue with respect to initiating and

maintaining contact with external physical or mental reality is whether the person has the will or desire to initiate the interaction with the presumed reality. For example, suppose you find a man who is on an artificial respirator in a darkened room and who claims there is no external reality. After some investigation you discover that he has not walked, or used his eyes or ears for some time. His last tape-recorded utterance is a comment to the effect that there is no external physical world. You desire to cure him of this intellectual ailment--one obviously supported by his markedly reduced physical and perceptual activity. A reasonable strategy would be to strengthen his muscles, get him to open his eyes, unstop his ears and to talk with him often. In time, you, his guide, would ask him to walk and later to come out of his room and, enter the outside world. Therapy for his pathological intellectual position is thus to immerse him in the direct interactional experience of the reality that he denies. In this case there is every reason to believe that such a program would convince him of the realist position. But such a procedure depends upon his willingness to cooperate with you and, as for proof, that would remain, as always, impossible.

Suppose you find someone who not only denies that other minds exist--but lives as though other minds don't exist. (Such a position, of course, seems to be quite rare.) Let us also suppose, as would be likely, that our subject's condition is strongly supported by his social isolation. He lives alone and has for years. He never speaks to anyone. As a result, his lack of belief in other minds is hardly surprising. He remembers interacting with people when he was young, but these experiences he attributes to a childish and immature understanding of things at the time. Again, this man's condition is fundamentally a mental pathology and correction would involve the slow introduction of interpersonal communication into his life. In time he would discover friends, and enemies; perhaps even love. Years later, if he were to be reminded by an old friend of his former belief that other minds didn't exist, the only answer, and a likely one, would be to look at his friend and laugh. In short, interaction with other minds is necessary in order to accept their existence, indeed in most cases it is sufficient.

Let me suggest that the situation with respect to belief in the transcendent spiritual realm is similar. First note that most of the people who deny not only the existence of God but also the entire spiritual realm constitute a relatively small group that seems to have come into existence in Western Europe about 250 years ago. They live in rather peculiar environments, and most of them have been trained in science or other rationalistic and intellectual disciplines. They tend to work in laboratories and universities which are highly specialized and peculiar places. They tend to socialize mostly with those having similar skeptical outlooks. What they mean by "real thinking" is the mental manipulation of abstract written symbols, often numbers, or other very digital elements. To such people a proper belief system or world view is something constructed by correct sequencing of these symbols with occasional checks on whether some kind of observation backs it up. That is, their world view is

something that exists in a digital code and they seem to assume that digital codes are adequate for representing any kind of question, problem or knowledge. The very notion of a belief system based on an oral tradition of knowledge, or on analog information coded in the body and often unavailable to conscious verbal expression, or on a world view based primarily on direct personal experience, doesn't occur to them.

Also "strange" is the fact that these people never, or almost never, go to church or to a synagogue or read religious writings. But, most peculiar of all is that they appear never to pray, to meditate or to engage in other spiritual exercises. That is, they rarely, if ever, use the well-known procedures for getting and staying in contact with the spiritual realm.

Again, the answer to this pathology is not some vain attempt to prove the existence of God or of spiritual reality. As in the other cases this is impossible anyway. The answer is to try to convince such a person to pray, that is to talk with God, or listen for God's voice, or to engage in other spiritual activities. If such a person refuses to interact with the transcendent and is determined to remain in his spiritual isolation, there is little else one can do.

This requirement that one engage in prayer and meditation is a serious one. For example, if someone doubted some astronomical claim (such as the existence of moons around Jupiter) or the reality of a whole level of physical existence (such as sub-atomic particles), an honest search for an answer would require a number of things. First, the person, if ignorant of astronomy or physics, would need a guide--a trained scientist--and would have to become at least something of an amateur scientist. It would take considerable time and commitment from the seeker. After all, observations are often ambiguous; and, in any case, observations don't reliably interpret themselves.

In almost all religious and spiritual traditions, a knowledgeable person--a guide, if you will--is needed. And, prayer and meditation are the primary instruments, the "telescopes," for contacting or interacting with spiritual reality. No scientist who refuses to seek religious experience has the intellectual right to say that spiritual reality doesn't exist or that the mind cannot be affected by that reality. A person who has had no religious experience is simply unqualified to comment on the existence, much less the nature, of most spiritual phenomena. Please note, I am not saying that the person must have a particular interpretation or understanding of his religious or spiritual experience--only that he must have had a reasonable amount of such experience. Perhaps, after various religious experiences the person will conclude it was all an illusion or something other than what it first appeared to be. Fine. Scientific observations, too, can be mistaken; they can be artifacts, and so can particular spiritual experiences. Or perhaps even all such experience is illusory. However, a scientist without systematic empirical understanding of a phenomenon is not in a position to give informed criticism. And a scientist who was ignorant of and refused to get involved with the experimental methodology used to demonstrate that a major phenomenon existed would be considered irrelevant to evaluating the claim. If he actively

persisted in rejecting the phenomenon on a priori grounds, his colleagues would rightfully dismiss his claims as unqualified--even should subsequent research prove his position to be right.

I trust the argument is clear. Religion for most people is supported by religious or spiritual experience in which people claim a relationship or interaction with a spiritual realm. This may mean interaction with God, or Jesus, or with a dead person, or even with evil spirits. To evaluate the validity of these extremely important claims requires that an investigator seek contact with spiritual reality. There are various ways people do this--but first they must have the will to actively seek. The desire to seek, of course, is something rooted in psychological factors and has relatively little to do with what is usually called by such terms as "reason" or "evidence." Given the will to seek, then the most common instruments or techniques for contact with spiritual reality are prayer and meditation; they are, the telescopes of the religious person. No true scientist should be afraid to seek new knowledge or be afraid to look through any kind of telescope.

The primary reason for presenting the preceding case for belief in the transcendent realm is because of its bearing on the intellectual problem of artificial intelligence. AI is involved in simulation of intelligence--often this means simulating the human mind. The possible existence of mental interaction with spiritual reality, in particular with God, relates to this task. For example, if God exists and if some people, some of the time, are doing God's will and not their own will--then the problem of simulating human mental life takes on serious difficulties, to put it mildly. On the other hand, if God and other spiritual "persons" or forces are purely psychological phenomena, projected into "heaven" so to speak, then such concepts may add complexity to simulating the mind, but no dramatic new or impossible challenge is involved.

A secondary reason, however, for introducing the topic of spiritual reality is to provide a framework for comment on the moral implications of statements and attitudes sometimes found in the world of AI. In my own contact with scientists in AI, cognitive psychology and neuropsychology, sometimes I have encountered an attitude toward humans that I find extremely disturbing. A small but significant number of these scientists have a hard, hostile attitude toward any appreciation of humanity that implies human specialness. Apparently, the very notion of special human characteristics such as our free will or having a transcendent spiritual meaning is viewed as a threat to an intellectual desire to demonstrate we humans are nothing but matter, or nothing but a complex computer. Let me quote from one prominent AI professor. He said that the next generation of computers will be so intelligent that we will "be lucky if they are willing to keep us around as household pets."¹¹ The attitude of hostility and even contempt expressed toward humans in such a statement is obvious. That humans will soon be the slaves to a master race of machines is, however, fundamentally a totalitarian goal. Why should anyone support such a purpose? If the proposed outcome is possible, then it is certainly morally rational for people to refuse to fund such scientists

and their research. If the goal is not possible, then the attitude expressed by such remarks does much to harm the good name of science. Scientists today are rightfully worried about the growth of an anti-scientific mentality in the non-scientific community. This growth is quite real, both on the political right and especially on the political left. However, subtle or gleeful comments about humans having no free will and soon being replaced by powerful, complex computers or bio-computer systems does little to endear science or scientists to the non-scientific world. Instead such fundamentally non-scientific and often irrational statements by scientists create a morally justified fear of science on the part of those outside the scientific community.

The very power, size and complexity of contemporary science suggests that it should be especially interested in avoiding the dangerous attitudes that power, size and complexity so often create. The contemporary scientific environment is very different from that of even 50 years ago. Today in science the effects of personal ambition, ideology, unscrupulous empire building, obvious financial rewards and power are especially noticeable. Interest group pressures, moral anarchy and lack of mutual cooperation also are not uncommon in the contemporary scientific community. Unless scientists work conscientiously to counter anti-scientific attitudes within AI, as elsewhere, there is real danger that growing external criticism of science will cause the scientific baby to be thrown out with its dirty bath water. In fighting such external criticism, science, which is (or should be) a bulwark of sanity should not allow itself to be poisoned from within by the anti-human and other biased attitudes of a small group of its present practitioners.

Now, I am convinced that AI, cognitive psychology and neuropsychology all have major positive contributions to make to the human condition. I am equally convinced that this field needs to recover more of an attitude of humility as it studies the mind. Let me suggest that if scientists recover an awareness of God and of our spiritual destiny it may be a great facilitator of such an attitudinal change. An attitude of humility and wonder before the natural world has been an essential quality of the great scientists from Copernicus, Galileo and Newton to Einstein. Historically this attitude has been rooted in the belief in God.¹²

In any case, although there is much to learn about both artificial and natural mind, to reject in advance a spiritual perspective on human mind because it implies limits to scientific understanding is an irrational bias. Science has learned to live with uncertainty principles, Gödel's proof and similar knowledge about intellectual limits. Science has also learned to live with the mind/body problem. It can also learn to live with (and even to benefit from) a mind/spirit problem.

Notes

1. A later and somewhat extended discussion of the ideas presented here can be found in "God, The Body and The Good Life," published in *This World.*, 25 (Spring

1989): 91-103.

2. G. L. Romani, S. A. Williamson and L. Kaufman, "Tonotopic organization of the human auditory cortex," *Science*, 216:1339-1340.

3. This information can be found in most good recent treatments of the nervous system. See, for example, E. R. Kandel and J. H. Schwartz's *Principles of Neural Science*, 2d ed., (New York: Elsevier, 1985).

4. A third theoretical framework for understanding life is known as creationism. This viewpoint, besides assuming God is the origin of life, also assumes that present life forms are the result of a drastically shorter period of time than is assumed by the theistic and atheistic evolutionary viewpoints. For present purposes this difference is not relevant. Creationists accept the marvelously complex interrelationship of the body and the outside environment. Indeed, years before evolutionary theory was proposed by Darwin, this general understanding was expressed in the natural theology of William Paley and in the Bridgewater treatises. In short, from each of these three perspectives, it makes no sense whatever to attempt to construct a model of the mind that is not closely connected with the properties of the physical reality to which the body responds and within which the mind exists.

5. See MacKay's "Machines, Brains, and Persons," *Zygon* 20:401-412, and "Mind Talk and Brain Talk," in *Handbook of Cognitive Neuroscience*, edited by M. Gazzaniga (New York: Plenum, 1984), p. 293-317.

6. H. L. Dreyfus, "From Micro-worlds to knowledge representation: AI at an Impulse" in *Mind Designs*, edited by J. Haugeland (Cambridge, MA: MIT Press, 1981), p. 204.

7. A. Plantinga, *God and Other Minds* (Ithaca, NY: Cornell University, 1967).

8. *Ibid.*, p. vii-viii.

9. A. Plantinga, "Reason and Belief" in *Faith and Rationality*, edited by A. Plantinga and N. Wolterstorff (Notre Dame, IN: Notre Dame University, 1985).

10. John McCarthy is thus quoted in J. Searle's *Minds, Brains and Science* (Cambridge, MA: Harvard University, 1984), p. 30.

11. *Ibid.*, p. 30. A quote by Marvin Minsky.

12. There are, of course, a great many scientists who have believed in God; examples just from the nineteenth century include such giants as Humphrey Davy, Count von Rumford, Julius R. Mayer, Prescott Joule, G. A. Hirn, Lord Kelvin, Alessandro Volta, Andre Ampere, Michael Faraday, L. Galvani, James Clark Maxwell, Augustin Fresnel, Joseph Fraunhofer, Armand Fizeau, A. L. Lavoisier, J. von Liebig, M. E. Chevreul, J. Berzelius, J. Dalton, David Brewster, Claude Bernard, G. J. Romanes, Theodore Schwann, Johannes Müller, Louis Pasteur, and many others. See K. A. Kneller, *Christianity and the Leaders of Modern Science* (London: B. Herder, 1911).