On the Origins of Cognitive Science

THE MECHANIZATION OF THE MIND

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translated by M. B. DeBevoise

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Preface

TO THE MIT PRESS EDITION

I have set before you life and death,
blessing and curse; therefore choose life,
that you and your descendants may live.

—Deuteronomy 30:19

When this book first appeared in English in 2000, some reviewers considered its conclusions too pessimistic and its outlook too bleak. For I saw the history of cybernetics—the first great attempt to construct a physicalist science of the mind—as the story of a failure. And indeed cybernetics was soon forgotten, apparently consigned to a dark corner of modern intellectual history—only to reemerge several decades later. In the meantime it had undergone a metamorphosis and now bore the features of the various disciplines that make up what today is known as cognitive science, most of which pretend not to recognize their kinship with cybernetics. And yet it was cybernetics that gave birth to all of them.

The history of cybernetics is undeniably fascinating. Its ambition was unprecedented, the minds who animated it were among the most exceptional of their time, and its heritage was rich and varied. But cybernetics got certain things wrong. It was riddled with contradictions that it did not know how to resolve, if it recognized them at all. Overly confident of its powers, it held itself aloof from other disciplines of the mind that might have pointed it in more promising directions. Today, cognitive science is poised to repeat these errors, I believe, only in a far more dangerous way than before—as though it has learned nothing from the failures of cybernetics. But perhaps this should not come as a surprise, since it does not acknowledge cybernetics as its true source.

More than one reader has been surprised by the seemingly paradoxical character of this book. How, it is asked, can I take an interest in something that I judge to have been a failure? But why should it be any

different with an ecology of ideas than with our personal lives? Do we not learn chiefly from our own failures? I make no secret of my hostility, as a philosopher, toward the underlying assumptions of a physicalist science of the mind. But here again, why should it be any different with intellectual combat than with other sorts of combat? To create the strongest possible position for oneself, mustn't one know one's adversaries from the inside, and no less well than they know themselves? Nor do I hide my fascination with an intellectual movement whose aims I do not share. I am committed to arguing on behalf of a certain point of view, but my commitment has nothing to do with that of a scientist dedicated to advancing the cause of the discipline in which he or she has freely chosen to work. For I am making an argument *against.* This may be why my book has puzzled some readers.

It is therefore a book that seeks to disabuse readers of a number of ideas that I consider mistaken. Cybernetics calls to mind a series of familiar images that turn out on closer inspection to be highly doubtful. As the etymology of the word suggests, cybernetics is meant to signify control, mastery, governance—in short, the philosophical project associated with Descartes, who assigned mankind the mission of exercising dominion over the world, and over mankind itself. Within the cybernetics movement, this view was championed by Norbert Wiener—unsurprisingly, perhaps, since it was Wiener who gave it its name. But this gives only a very partial, if not superficial idea of what cybernetics was about, notwithstanding that even a philosopher of such penetrating insight as Heidegger was taken in by it.

In the pages that follow, I rely on Karl Popper's notion of a metaphysical research program, which is to say a set of presuppositions about the structure of the world that are neither testable nor empirically falsifiable, but without which no science would be possible. For there is no science that does not rest on a metaphysics, though typically it remains concealed. It is the responsibility of the philosopher to uncover this metaphysics, and then to subject it to criticism. What I have tried to show here is that cybernetics, far from being the apotheosis of Cartesian humanism, as Heidegger supposed, actually represented a crucial moment in its demystification, and indeed in its deconstruction. To borrow a term that has been applied to the structuralist movement in the human sciences, cybernetics constituted a decisive step in the rise of *antihumanism.* Consider, for example, the way in which cybernetics conceived the relationship between man and machine. The philosophers of consciousness were not alone in being caught up in the trap set by a question such as "Will it be possible one day to design a machine that thinks?" The cybernetician's answer, rather in the spirit of Molière, was: "Madame, you pride yourself so on thinking. And yet, you are only a machine!" The aim of cognitive

science always was—and still is today—the mechanization of the mind, not the humanization of the machine.

A great many things have happened in the eight years separating the second edition of this book from the first that, I fear, only confirm the pessimism of my conclusions and justify the gloominess of my outlook.

I have in mind not so much the intellectual evolution of cognitive science itself as its embodiment by new technologies, or, as one should rather say, its instantiation by ideas for new technologies. For the moment, at least, these technologies exist only as projects, indeed in some cases only as dreams. But no matter that many such dreams will acquire physical reality sooner or later, the simple fact that they already exist in people's minds affects how we see the world and how we see ourselves.

Since this book was first published, I have thought a great deal about the philosophical foundations of what is called NBIC convergence—the convergence of nanotechnology, biotechnology, information technology, and cognitive science—and about the ethical implications of this development. Here I have found many of the same tensions, contradictions, paradoxes, and confusions that I discerned first within cybernetics, and then within cognitive science.[1] But now the potential consequences are far more serious, because we are not dealing with a theoretical matter, a certain view of the world, but with an entire program for acting upon nature and humankind.

In searching for the underlying metaphysics of this program, I did not have far to look. One of the first reports of the National Science Foundation devoted to the subject, entitled "Converging Technologies for Improving Human Performance," summarizes the credo of the movement in a sort of haiku:

> If the Cognitive Scientists can think it,
> The Nano people can build it,
> The Bio people can implement it, and
> The IT people can monitor and control it.[2]

Note that cognitive science plays the leading role in this division of labor, that of thinker—not an insignificant detail, for it shows that the metaphysics of NBIC convergence is embedded in the work of cognitive scientists. It comes as no surprise, then, that the contradictions inherent in cognitive science should be found at the heart of the metaphysics itself.

One of the main themes of the present book is the confrontation between Norbert Wiener and John von Neumann, Wiener embodying the ideas of control, mastery, and design, von Neumann the ideas of complexity and self-organization. Cybernetics never succeeded in resolving the

tension, indeed the contradiction, between these two perspectives; more specifically, it never managed to give a satisfactory answer to the problems involved in realizing its ambition of *designing* an autonomous, self-organizing machine. Nanotechnology—whose wildest dream is to reconstruct the natural world that has been given to us, atom by atom—is caught up in the same contradiction.

The most obvious element of the nanotechnological dream is to substitute for what François Jacob called *bricolage*, or the tinkering of biological evolution, a paradigm of design. Damien Broderick, the Australian cultural theorist and popular science writer, barely manages to conceal his contempt for the world that human beings have inherited when he talks about the likelihood that "nanosystems, designed by human minds, will bypass all this Darwinian wandering, and leap straight to *design success.*"[3] One can hardly fail to note the irony that science, which in America has had to engage in an epic struggle to root out every trace of creationism (including its most recent avatar, "intelligent design") from public education, should now revert to a logic of design in the form of the nanotechnology program—the only difference being that now it is humankind that assumes the role of the demiurge.

Philosophers—faced with the ambition of emerging technologies to supersede nature and life as the engineers of evolution, the designers of biological and natural processes—may suppose that they are dealing with an old idea: Descartes' vision of science as the means by which man may become the master and possessor of nature. Again, however, this is only part of a larger and more complicated picture. As another influential visionary, the American applied physicist Kevin Kelly, revealingly remarked, "It took us a long time to realize that the power of a technology is proportional to its inherent out-of-controlness, its inherent ability to surprise and be generative. In fact, unless we can worry about a technology, it is not revolutionary enough."[4] With NanoBio convergence, a novel conception of engineering has indeed been introduced. The engineer, far from seeking mastery over nature, is now meant to feel that his enterprise will be crowned by success only to the extent that the system component he has created is capable of surprising him. For whoever wishes ultimately to create a self-organizing system—another word for life—is bound to attempt to reproduce its essential property; namely, the ability to make something that is radically new.

In her masterful study of the perils facing mankind, *The Human Condition* (1958), Hannah Arendt brought out the fundamental paradox of our age: whereas the power of mankind to alter its environment goes on increasing under the stimulus of technological progress, less and less do we find ourselves in a position to control the consequences of our actions. I take the liberty of giving a long quotation here whose pertinence to the

subject at hand cannot be exaggerated—keeping in mind, too, that these lines were written fifty years ago:

> To what extent we have begun to *act into nature*, in the literal sense of the word, is perhaps best illustrated by a recent casual remark of a scientist [Wernher von Braun, December 1957] who quite seriously suggested that "*basic research is when I am doing what I don't know what I am doing.*"
>
> This started harmlessly enough with the experiment in which men were no longer content to observe, to register, and contemplate whatever nature was willing to yield in her own appearance, but began to prescribe conditions and to provoke natural processes. What then developed into an ever-increasing skill in *unchaining elemental processes*, which, without the interference of men, would have lain dormant and perhaps never have come to pass, has finally ended in a veritable art of "*making*" *nature*, that is, of creating "natural" processes which without men would never exist and which earthly nature by herself seems incapable of accomplishing. . . .
>
> [N]atural sciences have become exclusively sciences of process and, in their last stage, *sciences of potentially irreversible, irremediable "processes of no return"*.[5]

The sorcerer's apprentice myth must therefore be updated: it is neither by error nor terror that mankind will be dispossessed of its own creations, but by *design*—which henceforth is understood to signify not mastery, but nonmastery and out-of-controlness.

Arendt began the same, decidedly prescient book with the following words:

> The human artifice of the world separates human existence from all mere animal environment, but life itself is outside this artificial world, and through life man remains related to all other living organisms. For some time now, a great many scientific endeavors have been directed toward making life also "artificial," toward cutting the last tie through which even man belongs among the children of nature. . . .
>
> This future man, whom the scientists tell us they will produce in no more than a hundred years, seems to be possessed by *a rebellion against human existence as it has been given*, a free gift from nowhere (secularly speaking), which he wishes to exchange, as it were, for something he has made himself.[6]

The nanotechnological dream that began to take shape only a few decades after the utterance of Arendt's prophesy amounts to exactly this revolt against the finiteness, the mortality of the human condition. Human life has an end, for it is promised to death. But not only do the champions of NBIC convergence oppose themselves to fate, by promising immortality; they quarrel with the very fact that we are born. Their revolt against

the given is therefore something subtler and less visible, something still more fundamental, than the revolt against human mortality, for it rejects the notion that we should be brought into the world for no reason.

"Human beings are ashamed to have been born instead of made." Thus the German philosopher Günther Anders (Arendt's first husband and himself a student of Heidegger) characterized the essence of the revolt against the given in his great book, first published in 1956, *Die Antiquiertheit des Menschen* (The Antiquatedness [or Obsolescence] of the Human Being).[7] One cannot help recalling here another philosophical emotion: the nausea described by Jean-Paul Sartre, that sense of forlornness that takes hold of human beings when they realize that they are not the foundation of their own being. The human condition is ultimately one of freedom; but freedom, being absolute, runs up against the obstacle of its own contingency, for we are free to choose anything except the condition of being *un*free. Discovering that we have been *thrown* into the world without any reason, we feel abandoned. Sartre acknowledged his debt to Günther Anders in expressing this idea by means of a phrase that was to become famous: man is "to freedom condemned."

Freedom, Sartre held, never ceases trying to "nihilate" that which resists it. Mankind will therefore do everything it can to become its own maker; to owe its freedom to no one but itself. But only things are what they are; only things coincide with themselves. Freedom, on the other hand, is a mode of being that never coincides with itself since it ceaselessly projects itself into the future, desiring to be what it is not. Self-coincidence is what freedom aspires to and cannot attain, just as a moth is irresistably attracted to the flame that will consume it. A *metaphysical self-made man*, were such a being possible, would paradoxically have lost his freedom, and indeed would no longer be a man at all, since freedom necessarily entails the impossibility of transforming itself into a thing. Thus Anders's notion of "Promethean shame" leads inexorably to the obsolescence of man.

Had they lived to see the dawn of the twenty-first century, Sartre and Anders would have found this argument resoundingly confirmed in the shape of NBIC convergence—a Promethean project if ever there was one. For the aim of this distinctively metaphysical program is to place humankind in the position of being the divine maker of the world, the demiurge, while at the same time condemning human beings to see themselves as out of date.

At the heart of the nanotechnological dream we therefore encounter a paradox that, as the present work shows, has been with us since the cybernetic chapter in the philosophical history of cognitive science—an extraordinary paradox arising from the convergence of opposites, whereby

the overweening ambition and pride of a certain scientific humanism leads directly to the obsolescence of humankind. It is in the light, or perhaps I should say the shadow, of this paradox that all "ethical" questions touching on the engineering of humankind by humankind must be considered.

In 1964, Norbert Wiener published an odd book with the curious title *God and Golem, Inc.: A Comment on Certain Points where Cybernetics Impinges on Religion.* In it one finds this:

> God is supposed to have made man in His own image, and the propagation of the race may also be interpreted as a function in which one living being makes another in its own image. In our desire to glorify God with respect to man and Man with respect to matter, it is thus natural to assume that machines cannot make other machines in their own image; that this is something associated with a sharp dichotomy of systems into living and non-living; and that it is moreover associated with the other dichotomy between creator and creature. Is this, however, so?[8]

The rest of the book is devoted to mobilizing the resources of cybernetics to show that these are false dichotomies and that, in truth, "machines are very well able to make other machines in their own image."[9]

In recent years, the enterprise of "making life from scratch" has been organized as a formal scientific discipline under the seemingly innocuous name of synthetic biology. In June 2007, the occasion of the first Kavli Futures Symposium at the University of Greenland in Ilulissat, leading researchers from around the world gathered to announce the convergence of work in synthetic biology and nanotechnology and to take stock of the most recent advances in the manufacture of artificial cells. Their call for a global effort to promote "the construction or redesign of biological systems components that do not naturally exist" evoked memories of the statement that was issued in Asilomar, California, more than thirty years earlier, in 1975, by the pioneers of biotechnology. Like their predecessors, the founders of synthetic biology insisted not only on the splendid things they were poised to achieve, but also on the dangers that might flow from them. Accordingly, they invited society to prepare itself for the consequences, while laying down rules of ethical conduct for themselves.[10] We know what became of the charter drawn up at Asilomar. A few years later, this attempt by scientists to regulate their own research lay shattered in pieces. The dynamics of technological advance and the greed of the marketplace refused to suffer any limitation.

Only a week before the symposium in Ilulissat, a spokesman for the Action Group on Erosion, Technology and Concentration (ETC), an environmental lobby based in Ottawa that has expanded its campaign

against genetically modified foods to include emerging nanotechnologies, greeted the announcement of a feat of genetic engineering by the J. Craig Venter Institute in Rockville, Maryland, with the memorable words, "For the first time, God has competition." In the event, ETC had misinterpreted the nature of the achievement.[11] But if the Ilulissat Statement is to be believed, the actual synthesis of an organism equipped with an artificial genome ("a free-living organism that can grow and replicate") will become a reality in the next few years. Whatever the actual timetable may turn out to be, the process of fabricating DNA is now better understood with every passing day, and the moment when it will be possible to create an artificial cell using artificial DNA is surely not far off.

The question arises, however, whether such an achievement will really amount to *creating life.* In order to assert this much, one must suppose that between life and nonlife there is an absolute distinction, a critical threshold, so that whoever crosses it will have shattered a taboo, like the prophet Jeremiah and like Rabbi Löw of Prague in the Jewish tradition, who dared to create an artificial man, a *golem.* In the view of its promoters and some of its admirers, notably the English physicist and science writer Philip Ball,[12] synthetic biology has succeeded in demonstrating that no threshold of this type exists: between the dust of the earth and the creature that God formed from it, there is no break in continuity that permits us to say (quoting *Genesis* 2:7) that He breathed into man's nostrils the breath of life. And even in the event that synthetic biology should turn out to be incapable of fabricating an artificial cell, these researchers contend, it would still have had the virtue of depriving the prescientific notion of life of all consistency.

It is here, in the very particular logic that is characteristic of dreams, that nanotechnology plays an important symbolic role. It is typically defined by the scale of the phenomena over which it promises to exert control—a scale that is described in very vague terms, since it extends from a tenth of a nanometer[13] to a tenth of a micron. Nevertheless, over this entire gamut, the essential distinction between life and nonlife loses all meaning. It is meaningless to say, for example, that a DNA molecule is a living thing. At the symbolic level, a lack of precision in defining nanotechnology does not matter; what matters is the deliberate and surreptitious attempt to blur a fundamental distinction that until now has enabled human beings to steer a course through the world that was given to them. In the darkness of dreams, there is no difference between a living cat and a dead cat.

Once again, we find that science oscillates between two opposed attitudes: on the one hand, vainglory, an excessive and often indecent pride; and on the other, when it becomes necessary to silence critics, a false humility that consists in denying that one has done anything out of the

ordinary, anything that departs from the usual business of normal science. As a philosopher, I am more troubled by the false humility, for in truth it is this, and not the vainglory, that constitutes the height of pride. I am less disturbed by a science that claims to be the equal of God than by a science that drains of all meaning one of the most essential distinctions known to humanity since the moment it first came into existence: the distinction between that which lives and that which does not; or, to speak more bluntly, between life and death.

Let me propose an analogy that is more profound, I believe, than one may at first be inclined to suspect. With the rise of terrorism in recent years, specifically in the form of suicide attacks, violence on a global scale has taken a radically new turn. The first edition of this book belongs to a bygone era, which ended on September 11, 2001. In that world, even the most brutal persecutor expressed his attachment to life, because he killed in order to affirm and assert the primacy of his own way of living. But when the persecutor assumes the role of victim, killing himself in order to maximize the number of people killed around him, all distinctions are blurred, all possibility of reasoned dissuasion is lost, all control of violence is doomed to impotence. If science is allowed, in its turn, to continue along this same path in denying the crucial difference that life introduces in the world, it will, I predict, prove itself to be capable of a violence that is no less horrifying.

Among the most extreme promises of nanotechnology, as we have seen, is immortality (or "indefinite life extension," as it is called). But if there is thought to be no essential difference between the living and the nonliving, then there is nothing at all extraordinary about this promise. Yet again, Hannah Arendt very profoundly intuited what such a pact with the devil would involve:

> The greatest and most appalling danger for human thought is that what we once believed could be wiped out by the discovery of some fact that had hitherto remained unknown; for example, it could be that one day we succeed in making men immortal, and everything we had ever thought concerning death and its profundity would then become simply laughable. Some may think that this is too high a price to pay for the suppression of death.[14]

The ETC Group's premonitory observation—"For the first time, God has competition"—can only strengthen the advocates of NBIC convergence in their belief that those who criticize them do so for religious reasons. The same phrases are always used to sum up what is imagined to be the heart of this objection: human beings do not have the right to usurp powers reserved to God alone; *playing God* is forbidden.[15] Often it is added that this taboo is specifically Judeo-Christian.

Let us put to one side the fact that this allegation wholly misconstrues the teaching of the Talmud as well as that of Christian theology. In conflating them with the ancient Greek conception of the sacred—the gods, jealous of men who have committed the sin of pride, *hubris*, send after them the goddess of vengeance, Nemesis—it forgets that the Bible depicts man as cocreator of the world with God. As the French biophysicist and Talmudic scholar Henri Atlan notes with regard to the literature about the golem:

> One does not find [in it], at least to begin with, the kind of negative judgment one finds in the Faust legend concerning the knowledge and creative activity of men "in God's image." Quite to the contrary, it is in creative activity that man attains his full humanity, in a perspective of *imitatio Dei* that allows him to be associated with God, in a process of ongoing and perfectible creation.[16]

Within the Christian tradition, authors such as G. K. Chesterton, René Girard, and Ivan Illich see Christianity as the womb of Western modernity, while arguing that modernity has betrayed and corrupted its message. This analysis links up with Max Weber's idea of the desacralization of the world—its famous "disenchantment"—in regarding Christianity, or at least what modernity made of it, as the main factor in the progressive elimination of all taboos, sacred prohibitions, and other forms of religious limitation.

It fell to science itself to extend and deepen this desacralization, inaugurated by the religions of the Bible, by stripping nature of any prescriptive or normative value. It is utterly futile, then, to accuse science of being at odds with the Judeo-Christian tradition on this point. Kantianism, for its part, conferred philosophical legitimacy on the devaluation of nature by regarding it as devoid of intentions and reasons, inhabited only by causes, and by severing the world of nature from the world of freedom, where the reasons for human action fall under the jurisdiction of moral law.

Where, then, is the ethical problem located, if in fact there is one here? It clearly does not lie in the transgression of this or that taboo sanctioned by nature or the sacred, since the joint evolution of religion and science has done away with any such foundation for the very concept of a moral limitation, and hence of a transgression. But that is precisely the problem. For there is no free and autonomous human society that does not rest on some principle of self-limitation. We will not find the limits we desperately need in the religions of the Book, as though such limits are imposed on us by some transcendental authority, for these religions do nothing more than confront us with our own freedom and responsibility.

The ethical problem weighs more heavily than any specific question dealing, for instance, with the enhancement of a particular cognitive ability by one or another novel technology. But what makes it all the more intractable is that, whereas our capacity to act into the world is increasing without limit, with the consequence that we now find ouselves faced with new and unprecedented responsibilities, the ethical resources at our disposal are diminishing at the same pace. Why should this be? Because the same technological ambition that gives humankind such power to act on the world also reduces humankind to the status of an object that can be fashioned and shaped at will; the conception of the mind as a machine—the very conception that allows us to imagine the possibility of (re)fabricating ourselves—prevents us from fulfilling these new responsibilities. Hence my profound pessimism.

Since this book first appeared, I have been saddened by the loss of three dear friends who figured in its conception and publication: the psychiatrist and communication theorist Paul Watzlawick, who was one of the chief disciples of Gregory Bateson; the Chilean neurophilosopher Francisco Varela, cofounder of the theory of autopoietic systems; and finally Heinz von Foerster, a Viennese Jewish immigrant to the United States who, after serving as secretary to the Macy Conferences, the cradle of cybernetics in its first phase, went on to found what was to be called second-order cybernetics. Francisco and Heinz play important roles in the story that I tell in this book. I miss them both terribly.

The first edition of this book was dedicated to my teacher Jean Ullmo, who had passed away long before, as well as to Heinz von Foerster, then still very much alive. I had the good fortune of being able to present Heinz with my book and to see his appreciative reaction to it. To pay him a final homage, I would like to conclude by recounting a very lovely and moving story he told me, one that has a direct bearing on the arguments developed here.

The story takes place in Vienna toward the end of 1945, and it concerns another Viennese Jew, the psychiatrist Viktor Frankl, whose celebrated book *Man's Search for Meaning* was to be published the following year. Frankl had just returned to Vienna, having miraculously survived the Auschwitz-Birkenau camp; in the meantime he had learned that his wife, his parents, his brother, and other members of his family had all been exterminated. He decided to resume his practice. Here, then, is the story as my friend Heinz told it:

> Concentration camps were the setting for many horrific stories. Imagine then the incredulous delight of a couple who returned to Vienna from two differ-

> ent camps to find each other alive. They were together for about six months, and then the wife died of an illness she had contracted in the camp. At this her husband lost heart completely, and fell into the deepest despair, from which none of his friends could rouse him, not even with the appeal "Imagine if she had died earlier and you had not been reunited!" Finally he was convinced to seek the help of Viktor Frankl, known for his ability to help the victims of the catastrophe.
>
> They met several times, conversed for many hours, and eventually one day Frankl said: "Let us assume God granted me the power to create a woman just like your wife: she would remember all your conversations, she would remember the jokes, she would remember every detail: you could not distinguish this woman from the wife you lost. Would you like me to do it?" The man kept silent for a while, then stood up and said, "No thank you, doctor!" They shook hands; the man left and started a new life.
>
> When I asked him about this astonishing and simple change, Frankl explained, "You see, Heinz, we see ourselves through the eyes of the other. When she died, he became blind. But when he *saw* that he was blind, he could see!"[17]

This, at least, is the lesson that von Foerster drew from this story—in typical cybernetic fashion. But I think that another lesson can be drawn from it, one that extends the first. What was it that this man suddenly saw, which he did not see before? The thought experiment that Frankl invited his patient to perform echoes one of the most famous Greek myths, that of Amphitryon. In order to seduce Amphitryon's wife, Alcmena, and to pass a night of love with her, Zeus assumes the form of Amphytryon.

> All through the night, Alcmena loves a man whose qualities are in every particular identical to those of her husband. The self-same description would apply equally to both. All the reasons that Alcmena has for loving Amphitryon are equally reasons for loving Zeus, who has the appearance of Amphitryon, for Zeus and Amphitryon can only be distinguished numerically: they are two rather than one. Yet it is Amphitryon whom Alcmena loves and not the god who has taken on his form. If one wishes to account for the emotion of love by appeal to arguments meant to justify it or to the qualities that lovers attribute to the objects of their love, what rational explanation can be given for that "something" which Amphitryon possesses, but that Zeus does not, and which explains why Alcmena loves only Amphitryon, and not Zeus?[18]

When we love somebody, we do not love a list of characteristics, even one that is sufficiently exhaustive to distinguish the person in question from anyone else. The most perfect simulation still fails to capture some-

thing, and it is this something that is the essence of love—this poor word that says everything and explains nothing. I very much fear that the spontaneous ontology of those who wish to set themselves up as the makers or re-creators of the world know nothing of the beings who inhabit it, only lists of characteristics. If the nanotechnological dream were ever to come true, what still today we call love would become incomprehensible.[19]

Jean-Pierre Dupuy
Paris, July 2008

NOTES

1. See Jean-Pierre Dupuy, "Some Pitfalls in the Philosophical Foundations of Nanoethics," *Journal of Medicine and Philosophy* 32, no. 3 (2007): 237–261; Jean-Pierre Dupuy, "Complexity and Uncertainty: A Prudential Approach to Nanotechnology," in *Nanoethics: Examining the Social Impact of Nanotechnology*, ed. John Weckert, et al., 119–131 (Hoboken, N.J.: John Wiley and Sons, 2007); Jean-Pierre Dupuy, "The double language of science, and why it is so difficult to have a proper public debate about the nanotechnology program," foreword to *Nanoethics: Emerging Debates*, eds. Fritz Allhoff and Patrick Lin (Dordrecht: Springer, 2008); and Jean-Pierre Dupuy and Alexei Grinbaum, "Living with Uncertainty: Toward a Normative Assessment of Nanotechnology," *Techné* (joint issue with *Hyle)* 8, no. 2 (2004): 4–25.

2. Mihail C. Roco and William Sims Bainbridge, *Converging Technologies for Improving Human Performance: Nanotechnology, Biotechnology, Information Technology, and Cognitive Science* (Washington, D.C.: National Science Foundation, 2002), 13.

3. Damien Broderick, *The Spike: How Our Lives Are Being Transformed by Rapidly Advancing Technologies* (New York: Forge, 2001), 118.

4. See Kevin Kelly, "Will Spiritual Robots Replace Humanity by 2100?" The Technium, http://www.kk.org/thetechnium/.

5. Hannah Arendt, *The Human Condition* (Chicago: University of Chicago Press, 1958), 231.

6. Ibid., 2–3.

7. See Günther Anders, *Die Antiquiertheit des Menschen*, 2 vols. (Munich: Beck, 1980), 1:21–97.

8. Norbert Wiener, *God and Golem, Inc.: A Comment on Certain Points where Cybernetics Impinges on Religion* (Cambridge, Mass.: MIT Press, 1964), 12.

9. Ibid., 13.

10. The Ilulissat Statement, Kavli Futures Symposium, "The Merging of Bio and Nano: Towards Cyborg Cells," June 11–15, 2007, Ilulissat, Greenland.

11. Carole Lartigue's JCVI team had succeeded in "simply" transferring the genome of one bacterium, *Mycoplasma mycoides*, to another, *Mycoplasma capricolum*, and showing that the cells of the recipient organism could function with the new genome. In effect, one species had been converted into another.

12. See Philip Ball, "Meanings of 'life': Synthetic biology provides a welcome antidote to chronic vitalism," *Nature* 447 (June 28, 2007): 1031–1032.

13. A nanometer is one-billionth of a meter.

14. Hannah Arendt, *Journal de pensée (1950–1973)*, 2 vols., trans. Sylvie Courtine-Denamy (Paris: Seuil, 2005), 2:786.

15. See the section "Concerns about 'Playing God'" in the November 1982 report of the U.S. President's Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research, "The Social and Ethical Issues of Genetic Engineering with Human Beings," 53–73.

16. Henri Atlan, *Les étincelles de hasard*, 2 vols. (Paris: Seuil, 1999–2003), 1:45.

17. Translated from the German ("Wir sehen uns mit den Augen des anderen. . . . Als er aber erkannte, daßer blind war, da konnte er sehen!"); see Heinz von Foerster, "Mit den Augen des anderen," in *Wissen und Gewissen: Versuch einer Brücke*, ed. Siegfried J. Schmidt, 350–363 (Frankfurt: Suhrkamp, 1993).

18. Monique Canto-Sperber, "Amour," in *Dictionnaire d'éthique et de philosophie morale*, 4th edition, ed. Monique Canto-Sperber, 41 (Paris: Presses Universitaires de France, 2004).

19. Some readers regretted that I did not develop a more provocative argument than the one I merely hinted at here, namely that a marriage of cognitive science and Husserlian phenomenology would have been much more fruitful than the one that was actually consummated between cognitive science and the analytic philosophy of mind and language. But it was not my intention to include my own work or that of my colleagues in the philosophical history that I recount in the pages that follow. The desired argument is laid out in extensive detail in Jean Petitot, Francisco Varela, Bernard Pachoud, and Jean-Michel Roy, eds., *Naturalizing Phenomenology: Issues in Contemporary Phenomenology and Cognitive Science* (Stanford: Stanford University Press, 2000).

Cognitive science studies the basic processes of cognition, often mirroring the simple informational environments for which our brain is adapted. Though our brain is adapted for simple environments, we live in an era in which we have access to more information and are surrounded by multiple distractions vying for our attention. This â€œattention economyâ€ has redefined critical questions in cognitive science.Â Within mathematics and science education, cognitive science research has focused on the study of the mental strategies that are done as an individual solves problems or develops understanding of phenomena. Most work has been done with students in a specifically defined domain such as addition/subtraction or physics. The conceptual history of cognitive science remains for the most part unwritten. In this groundbreaking book, Jean-Pierre Dupuy--one of the principal architects of cognitive science in France--provides an important chapter: the legacy of cybernetics.Â The importance of cybernetics to cognitive science, Dupuy argues, lies not in its daring conception of the human mind in terms of the functioning of a machine but in the way the strengths and weaknesses of the cybernetics approach can illuminate controversies that rage today--between cognitivists and connectionists, eliminative materialists and Wittgensteinians, functionalists and anti-reductionists. Dupuy brings to life the intellectual excitement that attended the birth of cognitive science sixty years ago. The conceptual history of cognitive science remains for the most part unwritten. In this groundbreaking book, Jean-Pierre Dupuyone of the principal architects of cognitive science in Franceprovides an important chapter: the legacy of cybernetics. Contrary to popular belief, Dupuy argues, cybernetics represented not the anthropomorphization of the machine but the mechanization of the human.Â @inproceedings{Dupuy2000OnTO, title={On the Origins of Cognitive Science: The Mechanization of the Mind}, author={Jean-Pierre Dupuy}, year={2000} }. Jean-Pierre Dupuy. Published 2000. Philosophy. The conceptual history of cognitive science remains for the most part unwritten. Morality and Cognitive Science. What do we know about how people make moral judgments? And what should moral philosophers do with this knowledge? This article addresses the cognitive science of moral judgment. It reviews important empirical findings and discusses how philosophers have reacted to them. Several trends have dominated the cognitive science of morality in the early 21st century.Â Some philosophers have argued that attempts to change moral beliefs on the basis of cognitive scientific findings are indeed confusions of this sort. a. Semantic Is/Ought. In the mid-twentieth century it was popular to understand the is/ought distinction as a point about moral semantics.