

Language, Logic, Logos

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PHILOSOPHY OF MACHINES AND MECHANISTIC PHILOSOPHY

The title of this essay* may seem to contradict the rule that logic should come first. The rule may be particularly appropriate in connection with artificial intelligence, a topic synonymous with computers, or logic machines as they are often called. Very recently, the Nobel-laureate biologist Gerald M. Edelman spoke of computers as logic machines in order to distinguish them from the human brain: "What a computer can do is an effective procedure. What you can describe beforehand in a meaningful way, it can deal with. A computer is a logic machine. The brain is more than a logic machine." Immediately following this came the phrase, "It [the brain] can deal with novelty," which, though the words of the reporter, obviously reflected the thinking of Edelman. Not content with emphasizing the difference between the brain and the computer, Edelman made a parting shot at reductionists: "I know that people have tried to reduce human beings to machines, but then they are not left with much that we consider truly human, are they?" In fact he went so far as to claim that "individuality is not an epiphenomenon; it's at the very center of our humanness."¹

In making these statements Edelman could hardly be unaware of those who nowadays see in human intelligence a subspecies of artificial intelligence, or AI for short, an intelligence already embodied in computers and with unlimited future potentialities. But he seemed to be unconcerned about the way he used the word "meaningful" and, more importantly, about the inconsistency of his own work: a simulation by computer programming, called Darwin III, of the working of nerve connections in the brain. Those

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connections, along which information passed between various parts of the brain, were too numerous in his view to be predetermined by the genetic code.

Edelman's failure to define the word "meaningful" in a context relating to computer programming will reveal its problematic and symptomatic character as the argument of this essay is developed. More obvious should seem the inconsistency in his method: If the brain processes in question are too numerous to be physically specified, then how could they be simulated by a computer program which contains a set of steps exceedingly limited by comparison? When inconsistency can work itself into the very start of the reasoning of a scientist who is most eager to avoid the pitfalls of equating the mind with a machine, it should not be surprising that inconsistencies run amok in the writings of those who glory in the "mind equals machine, machine equals mind" proposition, which is the very cornerstone of AI as a mental construct.

A careful look at whether one's first move is logical may not be really necessary if one dealt with mere machines. Machines, if properly constructed, require no more than plainly worded operating manuals that are useful in the measure in which their writers make no pretense to philosophical sophistication. Indeed very little can be written about the philosophy of machines, unless one is ready to take prolixity for substance. In the philosophy of machines the essential point can be made, *pace* Mumford, in a few lines. Chesterton's dictum, "There must in every machine be a part that moves and a part that stands still," is philosophy of its deepest kind, partly because it is followed by the unwavering generalization: "There must be in everything that changes a part that is unchangeable."²

The profundity of Chesterton's dictum becomes obvious as soon as one considers that in a world of change rational, that is, meaningful judgments must assume a connection between the starting and end points of any process. This, however, makes sense only if something remains identical while the process or change runs its course. The merit of this consideration is recommended not only by its balanced character, but also by the vertiginous stances to which any tinkering with that balance inevitably leads.

One such stance is occasionalism or the claim that all events, physical or mental, are strictly disconnected. Needless to say, occasionalism was not referred to when computers were given the first opportunity, in connection with machine translation, to prove that they embody some intelligence, even if purely "artificial." Advocates of AI, who hardly ever demonstrate a serious concern for basic philosophical problems, let alone their very long history,

would not, of course, be embarrassed on that score. They are determined to go about those problems *ambulando*, that is, in Diogenes' way of coping with one of Zeno's paradoxes or sophisms. Nevertheless, the philosophical presupposition that language is decomposable into strictly separate units has always been a cardinal tenet in the ideology underlying AI programs including machine translation. The ideology reveals its Ockhamist character by the very fact that those units, artificial to be sure, resist efforts aimed at grouping them into a coherent intelligible whole, such as any plain discourse.

Those disdainful of wider views would do well to recall four chief advocates of occasionalism, al-Ashari, Ockham, Malebranche and Sartre. Being so widely separated from one another in time and space (and culture), their identical options should seem to represent a pattern of the inner force of logic. That science and the making of machines are not germane to occasionalism is amply illustrated by the virulently antiscientific dicta of al-Ashari and Sartre. That Ockham and Malebranche were keen on science has not failed to give headaches to those students of theirs who easily overlook the ineradicable call of human nature for intellectual coherence.

The other departure from that balance advocated by Chesterton is the denial of real change standing for real differences. As will be seen, spokesmen of AI fall back time and time again on the claim that intelligent or ultraintelligent machines are possible because the various manifestations of "intellect"--from amoebas through rats and dolphins to men--represent no real differences. The idea that all events, ideas, things and perceptions lie along an unlimited continuum and smoothly fuse into one another, has also been an invariable feature of AI ideology, although it clearly contradicts the one outlined above. In the thoroughly materialistic views of AI advocates, novelties are merely the critical points where the gradual accumulation of quantities appears, however illogically, as a really new grade or quality. Marxists would nod in agreement. That machines are impossible to make in terms of the former, or occasionalist, stance, that allows no connectedness, should seem obvious. It is still to be widely realized that the making of machines (electronic or not), where parts must be different in spite of their connectedness, also becomes a logical contradiction within the continuum principle as embraced in the ideology of AI.

So much about the philosophy of machines which is very different from mechanistic philosophy and from the philosophical or ethical problems posed by the use of machines and of making more machines. Mechanistic philosophy came to the fore in the

second half of the eighteenth century in the writings of De la Mettrie, d'Holbach, Helvetius and other *philosophes*. In the world picture they offered man was a mere machine, which, if true, implied that machines could in principle turn into men, or at least into the kind of humans that have already been deprived of their humanness. The machines of the mid-eighteenth century, so many elaborations on medieval technological breakthroughs, were too crudely mechanical to appear human, however embryonically. Still too heavily mechanical were the steam engines, the mainstay of the Great Exhibition of 1851, to appear to be more than powerful tools of humans rather than their potential competitors. The coming of electric motors brought some relief from smoke and soot but no real departure from the markedly non-human unwieldiness of machines.

The disparity in size between man and machine has not changed with the transformation of purely mechanical computers, operating with gears and rods, into the first generation of modern computers that were huge sets of vacuum tubes. Even the so-called second-generation computers, introduced in the 1950s, following the invention of transistors, still occupied much of a large room that, in addition, had to be air-conditioned. Only when integrated circuits allowed the elimination of wires, did computers (their third generation) begin to shrink. They became similar in size to human brains only when the introduction of silicon chips gave rise to their fourth generation. No further major miniaturization seems to come with their much talked about fifth generation.³ Few users of typical desk computers, now almost a household commodity in the USA, have seen, of course, that small brain-size unit that gives them moments of exhilaration as well as occasional despair. At any rate, the typical work station can at least by its size give the impression of a possible symbiosis between an artful intellect and an "artificial" intelligence.

The wide availability, since the early 1970s, of desk computers parallels the flood of writings, most of them boldly assertive, on the advent of AI. A section on AI, a section distinct from computer manuals, is now a staple feature in major bookstores. So much about the inexorable logic whereby the celebration of *l'homme machine* by Julien Offroy De la Mettrie,⁴ leads, once opportunity arises, to widespread belief that some artifacts think as humans do. What is meant here by artificial intelligence is very different from mere computers and of software called "expert systems." Had the latter been called, say, complex data channels, a possible misunderstanding might have been nipped in the bud. Awareness about the danger posed for understanding by careless use of words may in itself commend the merits of starting with

language, instead of logic, and also may help keep in focus that those "expert systems" are no more expert in channelling data than are gutters and canals in hydrodynamics as they drain rain and marshes.

To forget this is to repeat the pattern whereby "natural selection" and similar expressions, suggestive of a personal "Nature" that "selects," have created endless equivocations about evolution. Metaphorical attributions of human capabilities to machines have been greatly responsible for creating the belief about the existence of electronic feedback mechanisms that are "experts" and about the reality of a new type of intelligence, although it is a mere artifact. Expertise, properly so-called, is synonymous with the ability to think and to plan. That ability is at the very core of the claim that there are now artifacts that have intelligence in a manner in which humans do and will soon outdo all humans in the art of understanding.

In promoting their mechanistic philosophies, the late eighteenth-century *philosophes* brazenly exploited the marvels of classical physics in plain disregard of the anti-mechanistic views of great eighteenth-century physicists and of Euler in particular. In the same way the extravagant claims about artificial intelligence became a vogue only after the creators of analog and digital computers had done their pioneering work. John von Neumann who--no less than H. H. Aiken and Vannevar Bush--had no use for "thinking" computers,⁵ had been dead for two years when, in 1958, A. Newell and H. Simon claimed that "there are now in the world machines that think, learn and create." Most readers of that phrase were far less startled by that stupendous claim than by its sequence, namely, that the ability of those machines "to do these things is going to increase rapidly until--in the visible future--the range of problems they can handle will be co-extensive with the range to which the human mind has been applied."⁶ An age like ours, which is defiantly contemptuous of basics, can hardly appreciate the insight demanded by the construction of the first wheel. Much less would it recognize the enormous superiority of that insight over the mere cleverness of making better wheels and many more of them. It is still to be widely perceived that understanding does not primarily consist in its vastness but in its very fact, small as its momentary range may be.

THE PHENOMENOLOGY OF ARTIFICIAL INTELLIGENCE

Failure to appreciate that difference has invited ever bolder appraisals of AI that now constitute its cultural "phenomenology." In the process popularizers were greatly encouraged by experts. In 1959, Simon predicted that within ten years "the digital computer

would be the world's chess champion, unless the rules bar it from competition." This contemptuous proviso, so expressive of confidence in the computer, could appear all the more justified when presented as a follow-up to a remark of Mikhail Botvinnik, world chess champion at that time. He not only held that "in the future the machine should surpass the grandmasters," but also that parallel to championships among them there would be also one among chess playing computers. Both Simon and Botvinnik were quoted in John Pfeiffer's *The Thinking Machine*,⁷ a book based on a one-hour program on CBS TV, hardly a stage for serious thinking. Pfeiffer glibly developed the inability of "experts" to determine the limits of the computers' "thinking ability" into the claim that the further "evolution of computers" will become a "significant part of human development."⁸ Reinforcement did not fail to come from the experts. Before too long, Newell and Simon spoke of the programmed computer and the human problem solver "as two species belonging to the genus 'Information Processing System'."⁹ On behalf of the correctness of that perspective they offered but the vague generality that both men and computers were "adaptive."

Once those who in the AI field were known above all for technical writings had struck a "philosophical" chord, colleagues of theirs with a visionary zest got emboldened. Caution was nowhere in sight as a wide sampling of that zest reached the public in late 1970 when *Life* magazine carried an article that, in view of the shakiness of its reasoning, was aptly titled "Meet Shaky, the First Electronic Person."¹⁰ There Marvin Minsky, a chief protagonist of AI at MIT, who subsequently turned to computer-generated music, was quoted as saying that "within three to eight years, we will have a machine with the general intelligence of an average human being." (Others who found Minsky's timetable too optimistic, were willing to bet on a mere fifteen years!) The really telling aspect in Minsky's prediction is not that it dismally failed to become true, but rather the force of logic it reveals. Once a basic though proper understanding is granted to a computer, no limit can be set to its self-education. Moreover, that self-education would come with an explosive speed. Once there is on hand, Minsky contended, a "machine that will be able to read Shakespeare, grease a car, play office politics, tell a joke, have a fight," it "will begin to educate itself with fantastic speed. In a few months, it will be at genius level, and a few months after that, its power will be incalculable."¹¹

The only logic in all this was the recognition that the "incalculable" may contain, like anything truly incalculable, a terrifying prospect. Once machines achieved, in Minsky's words,

“immense mentalities,” they could hardly be kept under control by human minds, puny in comparison. Actually, those machines would control us and, to continue with Minsky, “we would survive at their sufferance. If we’re lucky, they might decide to keep us as pets.” Logic was quickly honored in the breach when Minsky also voiced confidence that though “the machine dehumanized man, it could rehumanize him.” Those willing to live with reversals of logic would then indulge in a masochistic savoring of the destruction of human intelligence. R. Quillian, described in that *Life* report as a computer memory expert and a “nice warm guy with a house full of dogs and children” (in that hardly logical order), was in fact found to face up intrepidly to the chilling choice: “I hope that man and these ultimate machines will be able to collaborate without conflict. But if they can’t, we may be forced to choose sides. And if it comes to a choice, I know what mine will be. My loyalties go to intelligent life, no matter in what medium it may arise.”¹² Once more the medium turned out to be the message.

The inexorable force of logic was at work in the fact that the “intelligent life” in question did not fail to be described as universal intelligence, embodied, of course, in the medium of the Ultra Intelligent Machine, or UIM for short, a phrase coined in the early 1970s. One such machine, predicted to be ready by the 1990s, was quickly envisioned as the key to “all major political decisions, including matters of war and peace.”¹³ Whether the price of that achievement, “the piecemeal conversion of people into UIPs” (ultraintelligent people), to say nothing of the “conversion of the world’s population into a *single* UIP,”¹⁴ is worth being taken, is not the point at issue for the moment. Here the immediate task is to register a runaway logic: once a computer is granted to understand a single word, the world, or the very cosmos or universe, becomes the only limit to AI. If holders of distinguished chairs in AI departments could wax prophetic, their students could hardly be blamed for seeing visions. Speculation about AI work elsewhere in the galaxy prompted Hans Moravec, a graduate student at Stanford University’s AI laboratory, to predict that the Ultra Intelligent Machine would “convert the entire universe into an extended thinking entity.”¹⁵ Roger Schank, computer scientist at the University of California, was not so modest as to count on extraterrestrial cooperation: “I think there’ll be an all-knowing machine someday. That’s what *we’re* about” (*italics added*).¹⁶

The expression “all-knowing” attached to mere machines may in itself indicate those deepest roots in AI ideology that are distinctly theological though hardly in the sense Christians and believers in an infinitely perfect personal God would take that expression.

When materialism becomes mystical, the result is a replay of age-old pantheism. Some Greek sages of old, some Averroists (Muslim and Latin), then Bruno, Spinoza, and Jacobi, and finally Rudolf Steiner and Arthur Koestler are echoed when an AI devotee, in innocent ignorance of an age-old pattern, speaks of "the gradual erosion of individuality, and [the] formation of an incredibly potent community mind" all across the universe.¹⁷ Formerly, the process was predicated on the "unicity of intellect," or the cosmic mind-repository from which all individual minds emanate at birth and into which they return after death.

The "unicity of intellect" is a very refined notion in comparison with the easy metaphors grafted on computers as "all-knowing" machines and harbingers of "the elixir of life"¹⁸ or plain immortality. Such implicitly theological metaphors easily take on a sarcastic hue in the diction of AI protagonists. A case in point is A. Turing's reference to man's creating the ultra intelligent machine (UIM), a performance whereby humans act "as instruments of God's will providing mansions for the souls that He creates."¹⁹ Contempt for matters theological shows through E. Fredkin's puzzlement over God's failure to make artificial intelligence. The making of AI would have alone been worthy of that God whom Fredkin, tellingly, did not credit with two other events "of equal importance," or the creation of the universe ("a fairly important event" in his magnanimous concession) and "the appearance of life."²⁰

Yet even in this post-theological and post-Christian era, it is difficult to assume that the idea of a substitute "God" is not at least subconsciously on the mental horizon when one attributes a most specific kind of knowledge to "all-knowing" AI machines. It is not merely knowing *all* but also knowing *all* about oneself: "One artificially intelligent device can tell another not only everything it knows in the sense that a human teacher can tell a student some of what he knows, but it can tell another device everything about its own design, its make-up--its genetic characteristics, as it were--and about the characteristics of every other such creature that ever was."²¹ Here, too, logic is inexorably at work as misplaced presuppositions are allowed to have their full implications unfolded.

Again, if AI is taken for the latest and best example of the human being's effort to rise to a "metahuman" level,²² the soaring will have its own perils. One of them is the charge, often used against the "old" religion but now returning as a boomerang against the "new-fangled" one, that man is merely caught in futile self-projection. That ultimately all insights of man may be but thinking about models man makes of himself and of things and not

about himself and the things around him is the gist of Minsky's remark: "When intelligent machines are constructed, we should not be surprised to find them as confused and stubborn as men in their convictions about mind-matter, consciousness, free will and the like, for all such questions are pointed at explaining the complicated interactions between parts of the self-model. A man's or a machine's strength of conviction about such things tells us nothing about the man or about the machine except what it tells us about his model of himself."²³

In a less sophisticated way, the same futility is acknowledged when the reality of AI is predicated on its eventually becoming as bored with itself as humans become with themselves.²⁴ Finally, there is the fearful possibility, hardly exorcizable on the basis of AI ideology, that man, in inventing things, is but the dupe of a blind runaway process. The testimony of Turing should seem to be impeccable as the "Turing's test" still lingers on as the ultimate touchstone of truth for AI. As he discussed with his friend, the mathematician A. H. Newman, the construction of a large digital computer known as MADAM (the Manchester Automatic Digital Machine at Manchester University), also present was Mrs. Newman who, though much of the conversation was above her head, suddenly picked up a remark of Turing: "I suppose when it gets to that stage we shan't know how it does it." In reporting this to Turing's mother, Mrs. Newman added that the remark "sent a shiver down my back."²⁵ Nothing is so fearful as an all-knowing being that becomes a complete mystery.

The claims about AI reaching pseudo-theological heights have been recalled here at the outset as an illustration of the merciless manner whereby logic exacts its due. The claim that a machine, once sufficiently sophisticated, does think, has innumerable consequences. Since these include not only their philosophical, psychological, and sociological but also their theological varieties, a theological reflection, of a very different kind of course, on AI should seem entirely legitimate even on the basis of mere parity. But there is, as will be seen, a justification for that reflection far more serious than the one assured by the rules of civilized debating.

In the second half of the 1960s, when my *Brain, Mind and Computers* was researched and written, not much was yet visible of the rising tide of interest in AI and much less that it would turn into an infatuation that blocks sensitivity for plain logic. An illustration of this is Pamela McCorduck's admission that "if the effort to make artificial intelligence has taught us one thing, it is that natural intelligence is a formidable and woefully underutilized resource."²⁶ Had she utilized that resource more effectively, her

book may not have ended on a love affair with anti-intellectualism. For if her foregoing statement has any coherence, she cannot be consistent in stating that "the accomplishments [of AI research] have been significant and the promises are nearly beyond comprehension."²⁷

Contrary to McCorduck, inconclusive arguments and self-contradictory reasonings cannot be settled by references to the difference between Hellenic and Hebraic minds, the former not subject to brooding and the latter given to it. (It is indeed strange that so many Hebraic, though wholly secularized, minds in the AI establishment are most vociferous with their disclaimers of having second thoughts on the matter. Or do they protest too much?) Nor will those arguments and reasonings become non-existent by, to quote McCorduck, "claiming fortitude, exhibiting courage," and by "pausing to savor the thrill of sharing in something awesome."²⁸

Such declamations set the tone (distinctly unintellectual) of nine out of ten books on AI nowadays displayed in any large bookstore. The prospects they conjure up are awesome, not because of the chances, absolutely nil, of the coming of intelligent machines. (About that dream world in which those machines exist, one thing should, however, be noted. There they cannot help being locked in an "awesome," blind, life-to-death struggle with themselves and with us according to that Darwinist ideology which, because it rests on the continuity of all, heavily supports dreams about AI). The actual awesomeness of those prospects pertains to the intellectual and not to the biological level. Were the human body threatened by fantasies about AI, the Food and Drug Administration could easily move in, as it did recently on finding that leading producers of cosmetics have taken to marketing their magic facial creams and other "elixiric" ointments under scientific labels as if they were well-tested drugs. Such creams have for time immemorial been harmless though very costly make-beliefs about make-up. Those who can afford spending large sums on unguents that act as elixirs of legendary fountains of youth, are free to deceive themselves. Equally, the producers of those "miraculous" chemicals are free to be part of a lucrative game of mutual self-deception. But when scientific labels came to be used to abolish the difference between reality and fantasy, the F.D.A. decided that society deserved to be protected.²⁹

THE REALITY OF FIRST BASE

No such action is, of course, conceivable in matters purely intellectual. The harm to the intellect may be the greatest of all harms, but it is neither legal, nor culturally respectable, to call for censorship. The marketing of AI under scientific label will only

increase in decibels if this is possible at all. Momentary admissions about "chronicling the history [of AI] as one of the most wrong-headed human follies in existence"³⁰ are artful means of disarming the typical reader's suspicion that both sides of the coin have been equally presented. Little does that reader realize that as far as reasoning is concerned the cards have been heavily stacked against reason. Even less would that reader guess the farce which is latent in the game played with the mechanism that carries the ploy. The mechanism is language which, if carefully considered, may through its very terms, reveal the fallacy of a logic according to which some, let alone all, machines have intelligence.

That language is a subject that eludes a simplistic approach should have been amply clear to those who in the 1950s tried to make the breakthrough to AI along the lines of machine translation. The evidence, which only gained in strength since then, was plain about the chronic failure of linguists to find a primitive language. In fact, languages of all primitive peoples have been found to display syntaxes as complex as is the case with any modern language. For the most part rank amateurs alone keep constructing futile schemes in which basic words of all languages are made to appear as close parallels to sensory experiences stretching from hardness to softness, from suddenness to slowness and so forth.³¹ Only with a touch of amateurism can one disregard a by-now-old story which shows that the decomposition of languages into atomistic units is indeed a futile exercise.³² Only wishful thinking can make one overlook the fact that Darwinist evolutionary theory is caught in a *petitio principii* whenever it tries to cope with the problem of the origin of language.

The pattern made its first and dramatic appearance shortly before Darwin completed *The Descent of Man*. There he merely paraphrased the imperious *No!* (hardly a scientific argument) which he had penned on the margin of a paper that Wallace published shortly beforehand. Wallace correctly argued that if language had its origin in the need for survival, the larger brain that makes possible linguistic operations had to be available to pre-hominids before they sensed the need for language.³³ Nothing essentially new was added to this observation (a warning about the futility of trying to lift oneself by one's bootstraps) when N. Chomsky dressed it up with the claim that special neuronal networks have to be present in the brain before it can serve as a vehicle of that only form of language which operates with sentences.³⁴

All these considerations, so many exposures of the shortcomings of the scientific method, fail to touch on the true nature of language. Being a reality, steeped in the use of the intellect, language requires for its proper appraisal an epistemology if it is

really about *episteme* or understanding and not about mere formalisms of it. But even on a purely empirical ground, it should be clear that language is a communication of something understood to somebody capable of understanding. Although propagandists of AI have always been wary about confronting this elementary feature of language, they recognize it by their use of language as they talk in private or in public about their favorite subject. They may speak of language as if it were a mere skeleton, but in doing so they still "press the flesh," that is, they want to be understood by flesh-and-blood intelligent beings. In that fact of understanding, as verbally communicated, there is involved a procedure which goes far beyond mere formalization. The latter can become its own object and retain no meaningful tie with the object of which it was the formalization in the first place. Understanding always bears directly on its object, the very reason why any talk becomes a mere shooting of the breeze unless it is about something.

Verbalization is a connection between the subject who understands and the object which is understood. That connection between the object and the subject is a tie between two existents, with the tie being not only conceptual but also existential, though not in the sense given to that word by Sartre and his followers. They voiced contempt for arguments that implied validity beyond the moment, while they failed to notice that they meant their brand of existentialism to have a validity for each and every moment. More importantly, as they wanted to be understood through their discourses, they served evidence that language as an intellectual communication is a primary datum, not explainable in terms of something else, and certainly not in terms of a language which is not intellectual.

Language is not the only datum which is primary or primitive. Other such data or factors are no less important to list, especially in a debate with AI propagandists whose basic strategy is to set up a very special game aimed at skirting around the very first step. Thus, to use baseball as an analogy, they try to make it appear that starting from the second base is not a break of the rules. Implicit in that strategy is the assumption that any earlier step, such as facing the pitcher and producing a hit that allows the runner to reach first base, let alone second base, is not a matter of truly valid rules. Translated into epistemology, the analogy means that basic or primary questions need not be asked, and in particular the question of what it means to know anything before one can reflect about formalizable aspects of that knowledge. In trying to make their intellectual game appear creditable, the propagandists of AI act very much for a purpose, though in terms of their "rules of game" they are not entitled to do so. Such is a further serious

think in their armor to be discussed shortly.

Since few champions of AI have given evidence of familiarity with basic epistemological questions, it may not be useless to spell out the thrust of that game analogy. Since the advent of rationalism, Cartesian and Kantian, to say nothing of the skepticism and pragmatism it generated, it has become a sign of cultural sophistication that basic epistemological questions about understanding the real have no validity. The alleged reason for this is that to raise those questions is not a "scientific" procedure. Invariably overlooked in that reasoning is that science deals only with the forms of already existing things and much less does it provide those forms, let alone the things. So much about the genesis and merits of the claim that intellectual pursuit must start from second base where the formalizable or quantitative aspects, solely useful for scientific purposes, are already available.

That the real as the carrier of those aspects cannot be accounted for by the rules of that new-fangled epistemological baseball game has a telling impact on the thinking of those fond of its "rules." The impact is all too often observable in the writings of logical positivists, almost invariably the only kind of philosophers read by devotees of AI. Some logical positivists have indeed been logical to the point of realizing that their disdain of reality traps them in their own world-building, a sort of solipsism.³⁵ One "hacker" made the point bluntly: "You can create your own universe, and you can do whatever you want within that. You don't have to deal with people."³⁶ Except, of course, when the "hacker" wants to market his software about his private universe so that he may have access to the non-private mini-universe of a supermarket for the daily bread.

Mere logicism or solipsism cannot be refuted on its own grounds. The only effective argument against solipsists must rely on the reality of language as an intellectual tie with the real outside the subject. On that basis alone can one point out to the solipsist that he has no right to leave his own universe by talking to others about it. The only right solipsists (including their AI brand) have is to cherish their own dreams.³⁷

Only when that point is made clear can one call attention, without the danger of being trapped in mere voluntarism or subjectivism, to another primary factor, the sense of purpose. Acting for purpose is different from mere instinct evident, say, in the unreflective pulling back of one's hand after it has come into contact with a hot object. Unlike an instinctive act, an intellectually perceived action is to be acted on by a conscious will if the sense of purpose is to arise. This alone should make it clear why the argument that although AI may cope with knowledge it

cannot cope with purpose, is no real threat to speculations about it.³⁸ The argument cannot forestall the counterargument that if AI can imply an understanding of the real, then its understanding of the purposeful action may become tantamount to being possessed of real purpose as well. Similarly, machines cannot effectively be denied self-awareness, unless emphasis is laid on the fact that self-awareness is not a mere idea, but a real perception of the subject insofar as it is its own real object, and that this perception presupposes awareness of objects separate from the self.³⁹

Purposeful action involves not only an intellect whose nature is to know things, but also a will that is a mere instinct if it is not free. The freedom of the will, another primary datum that cannot be circumvented or leapfrogged, has always been a source of nightmares for those dreaming about a purely "scientific" or strictly deterministic state of affairs fully engulfing man. Those dreams, as long as they are mere games with the intellect, have always been less repulsive to common sense than plain denials of free will. This is why AI ideology contains more fantasies about the fusion of all intellects into one than about the sublimation of all free wills into one Will that no argument can make appear free,⁴⁰ so that the wills participating in It may have this share of freedom.

Undue preoccupation with scientific evidences had for some time been undermining sensitivity about much more immediate evidences before AI came to the scene. This is not to suggest that this process, mostly psychological, has resulted in lessening the weight of evidences much more immediately available than their scientific kind. One of them is one's immediate awareness about one's ability to move one's little finger at will. About the weight of this evidence no less a physicist than A. H. Compton noted that it intensely outweighs all evidences of Newtonian physics. In fact, he held the disparity so great that he preferred the abandonment of that physics, were it to contradict the foregoing evidence about free will.⁴¹

Newtonian physics, which is very different from mechanistic philosophy, or from materialist determinism, can be no more in opposition to the freedom of the will than quantum mechanics can be a support for it. In both cases the limitations of the scientific method foreclose that this or that law, formalism, or experimental result of physics should have legitimate bearing on the reality of free will. Tellingly, no physicist who subscribed to materialist determinism has ever claimed that his work in physics was not a free activity. There was at least one early interpreter of quantum mechanics, Eddington, who publicly recognized the nonsensical character of his claim that quantum mechanics made first possible a

rational belief in the freedom of the will.⁴² Unfortunately, countless is the number of physicists who, from Heisenberg on, declared the abolition of causality in the name of quantum mechanics. They all failed to perceive the fallacy in the inference that an interaction that cannot be measured exactly, cannot take place exactly. The inference is fallacious because "exactly" taken in an operational sense is very different from "exactly" taken in an ontological sense.⁴³

Possibly, the literature promoting AI is lacking in references to Heisenberg's uncertainty principle because of a lopsided preoccupation there with mere patterns in logic.⁴⁴ Unfortunately, one cannot assume that advocates of AI--so much the prisoners of various current intellectual fashions--would remain free of that pervasive fashion which confuses quantum mechanics, a marvelous physics, with its Copenhagen interpretation, a most fallacious philosophizing.⁴⁵ An interpretation, which is most germane to sheer phenomenology or to mere pragmatism, will not fail to appeal to protagonists of AI as in both only knowledge about aspects or forms of things is allowed but no knowledge about the very things existing. The better-known result of this is a decrease of confidence in the objectivity of knowledge, accompanied by the stultifying claim that the observers create reality. They certainly create--the multiworld theory of quantum mechanics is witness⁴⁶--their own subjective worlds or universes. The lesser-known but no less instructive result is the inevitable reification of mere aspects and relations as if they had an existence of their own. It is on that basis that, as so often happens in endorsements of AI, the sign is taken as equivalent to the thing signified.

That non-realist, non-objectivist philosophies are driven, as if by an inexorable logic, to reinstate, however illogically within their perspective, the objectivity of knowledge, is an illustration of the fact that picket lines, useful as they may be elsewhere, are powerless against the reemergence of age-old truths. Among these is the view of knowledge as a mental act to know things. Merely to know, without knowing something, is impossible. Moreover, that something has to be a real object before it can become a conceptual object in the act of knowing.

THE DYNAMISM OF KNOWLEDGE

Herein lies a crucially important aspect of knowledge with respect to AI. The act whereby one becomes a knower is the forging of a dynamic tie between the mind and an object. Such a tie is not a conceptual or static relation between the concept of the mind and the concept of something else. Were the latter the case, thinking would be resolvable into conceptual analysis. This is not

to suggest that thereby a royal road would be open to AI. As will be seen, most concepts have supple contours that cannot be accommodated within the cubbyholes of binary algebra or of any mathematics for that matter. Still, it cannot be emphasized enough that knowledge is above all an act that establishes a dynamic unity between the object and the intellect. The unity is not a reduction of the object to the subject, nor of the subject to the object. The former case should easily be recognizable as Kantianism, the latter as a variant of Platonism. Both, in their own ways, block access to external reality and by the same stroke spark doubts about the mind as it is being turned, against its nature, into a source of reality (in Plato) or of its structure (Kant).

Nothing may be more logical at this point than to recall Aristotle as the erstwhile protagonist of the epistemological stance which consists in the resolve to render both mind and matter their due. Such a recall is especially appropriate at a time when a return to Aristotle is advocated as a remedy to the "closing of the American mind."⁴⁷ Its author failed to list AI ideology among the sickly symptoms to be cured by an exposure to Aristotle. That the remedy will not be easily found may be gathered from the rank misconstruction of Aristotle's philosophy in the most widely read critique of AI ideology by one holding a Ph.D. in philosophy from a prestigious American university. More of this later.

Even more revealing than a recognition of that remedy was the cryptic admission that Aristotelianism, owing to its being taught in Catholic colleges, did not become entirely unknown in America. That in a book written by an academic mostly for fellow academics the survival of Aristotelianism was not specified any further has more to it than what meets the eye. In those Catholic colleges Aristotle was kept alive because of belief in Someone who made a far greater impact in history than did Aristotle. For reasons that should not be difficult to fathom, Christ is not to be acknowledged as a gigantic fact of history in a culture that boasts about its respect for facts alone. At any rate, the Aristotelianism taught in Catholic colleges, seminaries and universities is an Aristotelianism that was saved by faith in Christ from Aristotle himself.⁴⁸ How Aristotle's thinking can turn into a self-defeating straitjacket received ample illustration in Averroes and the Averroism he started. Averroes found nothing repulsive in Aristotle's lack of resolve to save the individual intellect from being submerged into one "cosmic" mind. Nor was Averroes agitated by Aristotle's hesitation to recognize the freedom of the will. If the reaction to Aristotle on the part of medievals, and especially of Thomas, was so different on those two points (and on some other crucial points as well),⁴⁹ it was due to their unswerving allegiance to the gigantic

fact of Christ, which reveals the true God in true man.

This is not the place to recount a story, vastly documented in researches on medieval philosophy during the last hundred years. The story tells about the immense debt which Christian philosophy, or moderate realism, owes to its allegiance to dogmatically defined tenets about Christ as a union of two natures (divine and human) in one divine person. Those tenets, which include the survival of Christ's true human soul (or mind) after his bodily death on the cross, were so many unfoldings of what is contained in the principal ecclesial dogma, issued at Nicea in A.D. 325, about Christ as the Incarnate Divine Word, or Logos, consubstantial with the Father.⁵⁰ Nothing would be more mistaken than to take for a purely philosophical proposition the unflinching resolve with which the dualist doctrine about man is maintained in genuine Christian ambience, and not also for a most considered reflection on the gigantic fact which is Christ.

Non-Christians (and even liberal, well-nigh secularized Christians) will hardly appreciate this Christological perspective of a doctrine about the nature of man. Excuse themselves as they may on "religious" grounds, they have no such liberty when it comes to that doctrine's epistemological fruitfulness. The latter extends even to taking a proper measure of the true merits of AI. The doctrine implies a dualism, though certainly not its Cartesian kind, where the soul or mind is never truly united with the body but merely attached to it. According to that dualism, the mind is not a ghost in a body-machine,⁵¹ elevated as the latter is to the status of a "computer that happens to be made out of meat," to recall a crude phrase of a champion of AI.⁵² The mind is rather in the most intimate symbiosis with the body and carries out its activity in the utmost dependence on the body.

This means, on the one hand, that the acts of knowledge are truly intellectual, that is, they transcend the limitations of material entities. This is why any knowledge of any material entity has a universal bearing, or in technical terms, the intellect perceives the universal in the particular and that this is its only way of knowing particular things. Herein lies the fundamental and only ground for denying the claim that machines, composed of truly singular items and singular in all their workings, can *know* as much as a single word or symbol. Herein lies also the justification of the view that unless such knowledge is denied to a computer, there is no way of denying to it the ability to know all words, symbols and their syntactical combinations. Failure to make recourse to this kind of knowledge leaves the critics of AI with lame alternatives. They will either limit AI to knowledge as distinct from purpose, will and emotions,⁵³ or they will say that there can be an AI about ordinary

knowledge but not about creative knowledge and wisdom.⁵⁴

The view of knowledge as the active recognition of the universal in the singular has its proof in each and every word--noun, verb, adjective. None of them can be restricted to a single thing, action or quality. All of them are universals that can be seen only by the mind's eye in any singular sensory perception. Any word is a magic tool whereby a concrete limited item appears in a limitless perspective. In that sense no book is so systematically packed with metaphysics as is any ordinary dictionary. There word after word bespeaks of that wondrous ability which is to generalize. To restrict any word to a singular empirical item can only be done with the help of two most generic words, *this* and *that*. Every use of them (on countless occasions in each and every day) witnesses the working of the mind's dynamism that alone, by its existential presence, can turn the singular item to useful account even from the strict pragmatist viewpoint. The mind's presence should seem even more in evidence when it effectively describes most particular situations and relations by a word *it*, possibly the most nondescript word of them all and yet a word which the mind can invest with overpowering weight.⁵⁵

A WORD ABOUT WORDS OR SYMBOLS

About that dynamic or existential manner which is present in the use of words as means of reaching the real world, two remarks are in order. One is that it reflects the same dynamic quality that has already been noted about the act of knowledge itself. Words are not the mechanical images of things physical, or of physical actions and qualities. Precisely because of this they can only serve as means of reaching the real insofar as it can be understood. Whatever else words are, they cease to be words unless they are in the active service of the intellect. In fact, all of them are the intellect's free creations as shown by the incredible variety of languages. (No less evident is this fact in a facet present in each and every language: one word--the example of the English "bit" will be discussed shortly--can denote a bewilderingly wide variety of objects and actions). This is why words exist only inasmuch as the intellect uses them as signs that mean something only because the intellect actually signals with them things, actions and qualities. Nothing is indeed more dangerously misleading than Popper's turning of the world of phonetic and written symbols (and all the cultural plethora resting on them) into a "third world"; that is, into a realm on equal footing with the mind and the purely physical realm. As will be seen shortly, it is precisely because of this that Popper's stance versus AI is a mere evasion.

Symbols or signs are, however, very tangible items. In an almost

literal sense they *embody* what is intelligible in the concrete particular. Therefore they take part in that fundamental characteristic of each concrete thing which is to have form. Herein lies the source of an unlimited opportunity for computers and also of their radical limitedness.

No limit seems to be set to the computer's receptivity in those areas where the formal aspect is almost identical with its content. Such areas are mathematics and geometry, with their manifold ramifications and vast range of applicability. Units, fractions, points, lines, angles, areas, volumes, coordinates, transforms, logarithms, functions and series have a meaning that is almost exhausted in their "forms." Hence the stunning measure to which computers can be programmed to correlate very complex set of numerical data, a measure which is made even more impressive by the speed with which the task is executed.

In any problem in which words relating to quantitative data dominate, as they do in many problems of business and engineering, the effectiveness of computers can indeed be made so great as to create the impression that they do an "expert" job. But in the measure in which one departs from the strictly quantitative or geometrical realm, words, always the carriers of meaning, offer fewer and fewer formal aspects of things and ideas they represent. This is already evident in words denoting plain physical entities, such as a stone or a stick. Even their weight, density and hardness are far more than so many numerical measures. This disparity between physical reality and its formalizable aspects becomes still more striking when complexity and vastness are part of that reality, let alone when it is the source of an aesthetic experience, as is the case, for instance, with a human figure or a sky bathed in the rays of the setting sun. An even more perplexing disparity between form and content is latent in negative terms, such as invisible or intangible. A debilitating problem for AI may be posed, for instance, by the term "atom," if it really stands for something that cannot be cut or divided. Any formal representation of an "atom" by an extended symbol or signal, which is always divisible, implies a contradiction with the idea to be represented. Similarly instructive is the impossibility of adequately formalizing the process involved in "going to the limit" in integral calculus. In that respect the square root of -1 should seem to take on an added measure of irrationality.⁵⁶

When one moves to the area of words dominating everyday discourse that are not primarily quantitative, the formalistic aspects no longer have the definite contours that most mathematical concepts have. While much of mathematics may be built up from the juxtaposition of units, and much of geometry from similar

operation with an extended point (leaving aside the problem of formalizing a non-extended point), other areas of discourse rely on words with no strict contours. This is why defining most words in any dictionary is always an unfinished job. Even in the case of objects with markedly geometrical forms, the "extent" of their meaning can indeed be rather indefinite.

Thus the word "bench" is defined in *The Random House Dictionary* as "a long seat for several persons." The definition does not give the exact measure where a seat becomes a bench. Nor does the definition specify the word "several." Whereas "two" can mean "several," a "love-seat" does not thereby become a bench. When a word, which is often the case, carries several metaphorically different meanings, their respective formalizations may have no similarities at all. Here it should be enough to think of the widely different formalizations called for when, say, "bench" stands for judicial authority, or for the judges themselves, or for substitute players, or for a good or bad team, or for a shelf-like area of rock with steep slopes above and below. Further differences in formalization will arise when "bench" is used as a verb.

Even more bewildering differences come into view when, as is the case with "bit," homonymous uses are possible. From the viewpoint of meaning there is absolutely nothing in common between the mouthpiece of a bridle, a small measure of time, twelve and a half cents, the cutting part of a hatchet, the end of a key that moves the bolt, a part in a play, units of information as defined in computer theory, and a B(achelor) of I(ndustrial) T(echnology).⁵⁷ The fact that this short paragraph contains at least one other word, "bolt," that also lends itself to homonymous use, may suggest the enormous number of such words that could be gathered from the same dictionary. Proportional to that number should be the "fun" such words present to ambitious programmers of conversations "understood" by computers.

That in all such cases the "exact" meaning, which is always far more than its formalization, can only be established from the context, should be obvious. Such a context is the definition of each and every word in any dictionary. Almost all of them are based on a recourse to synonyms, each with an "extent" of meaning that can be circumscribed only by dotted lines. Being used in a definition, these not strictly defined areas of meaning are made to partially overlap one another. The more "exact" is a definition of a word, the greater is its share in those not strictly circumscribable overlappings. The more of them there are on hand, the greater is the "formal" imprecision, both with respect to content and to total outline, that is, the "extent" of meaning. Such

is a graphic rendering of the reason that prompted Whitehead to speak of the "Fallacy of the Perfect Dictionary."⁵⁸

Why is it then that verbal definitions, or any discourse for that matter, are not a potential vicious circle? For such would be the case if knowledge were, as Hobbes claimed, a mere reckoning with words,⁵⁹ a perspective very much at the basis of the AI ideology. Then the explanation of a word, always imprecise in itself, in terms of other imprecise words, would become equivalent to the compounding of probabilities, or to the decrease of certainty or clarity. The reason why the best minds usually take the fewest words is not that they are in sympathy with the consequences of Hobbes' hopelessly flawed view. Rather, they cast a vote on behalf of the dynamism whereby language is an exercise of an intellect zeroing in on the intelligible object with unflinching immediacy.

THE UNWISDOM AND POVERTY OF REDUCTIONISM

The intelligible character of the spoken or written word that carries a meaning has an epistemological primacy even in that realm, mathematics and geometry, where the formalized aspect may seem self-explaining. Actually, it was in connection with the most formalized systematization of mathematics, the one worked out by David Hilbert, that his foremost disciple, Hermann Weyl, wisely stated that even there "one must understand directives given in words on how to handle the symbols and formulae."⁶⁰ That this is also true of the notations of symbolic logic should seem all the more logical, except perhaps to some infatuated with it. Those who are strangers to what Hilbert, Weyl and other leading mathematicians deal with still can grasp the priority of words over formulae and shapes by reflecting on the figure indicating the "quantity" called zero. Unless an intellect substantially superior over matter were at work in the pronunciation of the word "zero," the word itself would necessarily stand for "something," the very opposite of nothing. The formalization in the shape of a small oval circle of the concept of zero may indeed be the most explosive among all discoveries of the mind, "the coining of Nirvana into dynamos."⁶¹

At the other end of the quantitative spectrum is that infinite whose description as the realm where "zero is the magician king,"⁶² will appeal only to the wise. It should be enough to think of the resistance which some advocates of the "transfinite" infinite set up against the logical stringency of the inference whereby one concludes to the impossibility of an actually realized infinite quantity.⁶³ About the schizophrenic reasoning which supported for so long in scientific cosmology the presumed reality of an infinite universe,⁶⁴ a remark of Eddington may seem most appropriate:

“That queer quantity ‘infinity’ is the very mischief and no rational physicist should have anything to do with it.”⁶⁵ Wise programmers take note!

Just as in moving from basic words used in mathematics to words relating to everyday realities one encounters an increasing disparity between meaning and its formalization, a similar situation is on hand when one moves from mathematics to the empirical sciences. This fact received a poignant recognition in a remark of Professor George Wald, a Nobel laureate for his studies of the physiology of vision. Much as we know about the physics and chemistry of vision, he remarked, “we don’t know what it means to see.”⁶⁶ The source of epistemological defeatism (and touch of unwisdom) transpiring through his remark lies in the assumption that understanding consists in knowing all the quantitative, that is, easily formalizable, aspects of a process and that whenever we don’t have complete information about those aspects, we don’t understand.

A chief merit of Professor Wald’s remark is that its ill-concealed defeatism evokes the poverty of reductionism, a poverty brought about by sheer unwisdom. Reductionism is the very same philosophy that lies at the base of hopeful statements about AI. They all share in the facile oversight of two facts: One is that as close as form and meaning may be in basic mathematical notions, the form as such means nothing unless it is understood. The other is that understanding is a primary datum that cannot be reduced to something else so that it may be better understood or understood at all. Reductionism, which, once grafted on the interpretation of science, turns the latter into a cultural wasteland, is also the source of the pathetic predicament generated by belief in AI. There one can also see the hapless resistance of human sanity to becoming the victim of self-despoilment.

A telling illustration of this is Douglas R. Hofstadter’s *Godel, Escher, Bach*, a book offered by him as a perspective on the battle that still rages between the followers of De la Mettrie and their opponents. Hofstadter assigns ultimate victory, which he specifies as one of the major theses of his book, to De la Mettrie’s followers on the ground that the opposition between the two camps does not represent a “contradiction at all.” The ground is equivalent to stating that one’s opponents are actually non-existent, a way of resolving crucial differences worthy of that make-believe realm which is nowadays being crowned by copious assertions about the existence of AI. Yet the battle line separating those opponents remains as real as ever. A proof of this is Hofstadter’s oversight of the fact that from his point of view it is plainly contradictory to urge “each reader” to engage in a most non-mechanical activity,

namely, "to confront the apparent contradiction head-on, to savor it, to turn it over, to take it apart, to wallow in it, so that in the end the reader might emerge with new insights into the seemingly unbridgeable gulf between the formal and the informal, the animate and the inanimate, the flexible and the inflexible."⁶⁷

That Hofstadter, a physicist turned philosopher, failed to urge his readers to reflect on what it means to understand both that battle and the activity he recommended, should not seem surprising. The act of understanding that cannot be understood in terms of anything else is not part of the instruction offered in the philosophy departments of most American universities. There one is allowed to discuss intelligent behavior, which Hofstadter explicitly mentions in the context, but not what it means to be intelligent. There philosophy begins with Descartes (or with Ockham), grows into pragmatism, logical positivism, and linguistic analysis, and ends with the illusion that no respectable philosopher would ever consider but problems that are "analytical."

This illusion, particularly strong in British and American philosophical circles, received most recently a rebuff so sharp as to make front page news.⁶⁸ The American Philosophical Association, dictatorially ruled by the "analytical" establishment that has only its sceptical solvent for questions relating to ontology, is now challenged by a breakaway group, called the Society of Philosophers in America. Members of the latter are resolved to give proper attention to questions such as: What is being? Is there a purpose? Is there something beyond the physical? and the like. Their revolt is the bursting to the surface of long suppressed dissatisfaction with the "received view," a quintessence of which is Quine's answer to the most fundamental question, made famous by Hamlet: "To be is to be the value of a boundary variable." Clearly, such is not an answer that would have agitated a Hamlet or anyone not shielded from reality by the emoluments of opulently endowed chairs of philosophy. It is therefore supremely ironical that Quine could be referred to as the "titan of American philosophy," unless, of course, for the unintended reason that his definition of "to be," if taken logically, that is, with full consistency, is a foolproof directive to a titanic catastrophe of thought and life.

It would be an illusion to hope for a change of heart on the part of most "analysts" who, for ample reason, see no threat in that revolt to their domination of the academia. They will continue to dismiss their opponents' appeal to the long history of philosophy with the words of Ruth B. Marcus of Yale, words illustrative of the mere game with words into which the "analysts" can turn the interpretation of philosophy or of anything else: "It's not just fake

history, it isn't even history. The tradition up to Kant was analytical. It was one of addressing questions in a careful way and giving reasons for one's point of view." Clearly, the program of instruction in most departments of philosophy will continue in its "analytical" tracks. Neither the true Plato, let alone the true Aristotle in quest of making clear the understanding of the real, will be spoken of, nor those who saved Aristotle from himself, and much less those who presented that story to our times with extraordinary historical scholarship.⁶⁹

An aspect of the poverty of that instruction in philosophy is that it imparts no intellectual sensitivity for pondering the points which precisely those critics of AI brought up who steeped their criticism of it in the primacy of understanding. A case in point is Hofstadter's description of my *Brain, Mind and Computers* as a book "whose every page exudes contempt for the computational paradigm for understanding the mind." Yet, although he admits that the book brings up points "interesting to ponder," he considers none of them.⁷⁰ Nor does he mention even the four main points of my book, although, being the themes, prominently listed, of its four chapters,⁷¹ they are too obvious to be overlooked. None of those points can, of course, be eye-catching to any of those countless "modern" philosophers who try to begin understanding with the forms of understanding that constitute "intelligent behavior" and not with that understanding whose nature is to understand things before it can understand itself.

One aspect of those points made in my book relates to some patent, jewel-like evidences, the very source of philosophical riches, of what it is to understand. One's mental eyes are continually excited by those evidences, one of them the word *now* or rather the intelligible reality it evokes. The reality is indeed the immovable axis on which everything else revolves in intelligent life, including any discourse about behavior, intelligent or not. It has often been stated that animals experience neither the past nor the future. If this is so, it is only because they have no sense of the present. The *now* which does not exist for them, exists for humans and is the very factor that turns their particular mental possessions into that whole which is more than the sum of its parts. It is in terms of that whole that humans can conceive of the Perfect Being, God, in whom all is present all the time and this is why He is not touched by time, the great spoiling factor.

Compared with that eternal present, man's grasp of the *now* is incredibly imperfect though still so reliable as to constitute in his mental "machinery" (a place with incessant transformations) the pivotal factor that remains unchanged. This is why man's conscious identity, his chief and most precious possession, is

retained through incessant transformations, not only mental but also physical, including the entire replacement of all atoms in his body (and brain) in every seven years. Chesterton's definition of a machine reveals its philosophical depth precisely because it can illustrate even the "machinery" of the mind without turning it into a machine. In addition to depth he also showed courage when long before the appearance of computers he labeled the expression "thinking machine" as a "baseless phrase of modern fatalism and materialism." A machine, he added, "only is a machine because it cannot think."⁷² As to those who can take basic philosophical advice only when it is offered by a prominent physicist, they would do well to ponder Einstein's remark, targeted at no less a logical positivist than Carnap, that the *now* completely escapes the net of physics.⁷³

What, indeed, would be a formalization, even remotely convincing, of the *now*? For if an electrical impulse, or a given dot on the screen, is taken to represent the *now*, do not thereby all such impulses and dots become representative of the *now* and make meaningless its arbitrarily chosen "formalist" representation? Similar questions could be raised about such words as *nevertheless*, *if*, *but*, *however*, and, last but not least, about *as*, a tiny word that carries on its back an enormous variety of conceptual relations.

And what about signs of punctuation? They should seem so easy to formalize as they are but mere forms, yet the intangible nuances of meaning they are meant to convey are all too often hopelessly elusive to a formalist representation. An exclamation mark gives itself away and so does a quotation mark. Yet in both cases a sense of impotency should be felt if some proportion were to be found between the formalization and the shift in meaning those marks can bring about. Thus the distance should seem enormous between the unimportance suggested by a cursory "don't mention it" and the crucial importance of a "don't mention it!" The difference between God and "God" is abysmal and so is the one between God and god, whereas most computers operate on the basis that there is no difference between upper case and lower case. A mere comma can turn the confidence of "God save the Queen" into a cry of desperation: "God, save the Queen."⁷⁴ Efforts at formalization should seem doomed to failure if it is true, as H. W. Fowler, the arbiter of the King's English, stated that a comma "separates the inseparables."⁷⁵

Phrases of this kind, undoubtedly paradoxical, are instances of the mind's inventiveness that should seem magical, if not plainly absurd, from the reductionist viewpoint. Prospects for finding some formalization of that inventiveness are nowhere in sight. Furthermore, ever fresh evidences of the inexhaustible riches of

that inventiveness turn up continually. One of the pleasures of keeping up with the latest and best in novels and poetry is to come across ever new verbal virtuositities, whereby insights, situations, motives, fears and hopes come alive in a light never seen before. The average reader can savor at regular intervals either in *The New York Times Magazine*⁷⁶ or in the *Reader's Digest*⁷⁷ fresh offerings about the latest exploits in the use of language that should make computer programmers groan with despair. The delight or plight of teaching English has in part to do with being exposed to some hilarious misuse of words and errors in spelling that turn up in term papers. College-bound students can come up with the declaration that they want to be "bilingual in three or more languages" or with their desire to be "weight-listed," or with a gently needling "needles to say."⁷⁸

As to the last two cases a computer can easily be programmed to be led to the proper expression as the differences are but slight between the incorrect and correct forms. The day may not be far when computerized author listings will bring up the right author even if his or her name has been slightly misspelled. The problem represented by the improper use of *bilingual* is far more complex. To cope with it the programmer has to pay attention to the large variety in which *bilingual* can be connected with names of languages and various groups of them. Programming subtle paradoxical nuances may present so great a difficulty as to appear insurmountable.

TEN GUIDELINES ABOUT AI

In view of all this, nothing is more tempting than to oppose AI on the ground that practically impossible may seem the task of programming into computers the kind of information that goes considerably beyond the use of purely quantitative terms.⁷⁹ Such a temptation must be resisted for a reason far more serious than the prospect of making a wrong bet. In fact, if guidelines are to be set for dealing with the cultural malaise embodied in AI, the *first* should be the following: Don't insist unnecessarily on the enormous complexity of formalization connected with ordinary human discourse and reasoning.

Undoubtedly, insistence on that difficulty can effectively cut to size brash spokesmen of AI and deny them undeserved psychological advantage. But the same insistence may undermine the merits of a truly dualist view of man as outlined above. According to that view, all workings of the human mind, insofar as they are conveyed, that is, made known, have sensory aspects which lend themselves to various degrees of formalization. A complete listing, for the purposes of programming, of all those

aspects may forever lie beyond the combined practical capabilities of all human talents, but great advances along these lines have been made and even more of them will come, and at an accelerated rate.

A genuine dualist should never become a crypto-manichean suspicious of technology and even of that technology-on-paper, which is programming. Insistence on the failures of programming should never serve as the basis of defense of the existence of the human mind. Such a basis would prove as counterproductive as did those arguments in which shortcomings of physical science were taken for a justification to invoke God. Holes in scientific knowledge have an uncanny way of being filled up and leave shortsighted divines stranded. Formalization, too, will proceed by leaps and bounds.

The *second* guideline is that while with respect to formalization one should be most generously minded, one should not yield an inch, not even the fraction of an inch, on the essential issue of understanding. That issue is the priority of understanding over the formalization of what is understood. Those who oppose AI on any other ground inevitably give away the game. They do not fail to demonstrate the dire consequence of dangling one's hand through the bars of a lion's cage. Two cases have already been mentioned. One is the denying to computers wisdom and creativity while granting them ordinary understanding or intelligence. The other is to grant to computers the ability to know but not the ability to experience purpose. A third one is the granting to computers the ability to make some modest discoveries but not the ones that represent a real breakthrough.⁸⁰ The computer no more discovers anything than does a slide rule or an abacus.

The *third* guideline relates not to the difficulties of formalization but to the claims according to which AI has been achieved in whatever rudimentary form. While the countering of those claims is ultimately a philosophical task, psychologically a most effective use can be made of blunt appraisals of the state of art by some leaders in computer programming. One of those appraisals was heard in the full glare of publicity at the 1984 conference of the computer-science community in San Francisco. There Herbert Grosch, a member of the advisory board of the Association for Computer Management, minced no words: "The emperor, whether we call him fifth-generation project or artificial intelligence, is stark from the ankles up. Or to put it in the vernacular, most of what we're talking about is a bunch of crap. Now I said from the ankles up. From the ankles down the emperor is wearing a well-worn and sturdy pair of shoes...and we call them expert systems...they are good. We need lots and lots of expert systems. And we'll grind them out the way we've been grinding

them out for thirty years. We won't generate them with magic. We won't generate them with artificial intelligence."⁸¹ The effectiveness of recalling outspoken criticisms of AI that may appear too negative, can greatly be strengthened with references to some scathing words which basically sympathetic critics of AI offered about some programs embodying conversational understanding: "I have just said," M. Boden wrote, "that PARRY is a fraud. This is fair comment also on ELIZA, to whom human interlocutors typically attribute a good deal of common sense and reasoning ability."⁸²

The *fourth* guideline is about the paramount importance of seeing through the hollowness of the rhetoric of advocates of AI. Whenever they admit the substantial failure of this or that project, they credit the failure with great advances as well. A case in point is the statement Michael Brady of MIT made in 1985 about the status of robotics: "Robotics is the intelligent connection of perception to action....We've barely scratched the surface. It is going to be a long haul for hundreds of years to get to anything with the same kind of capabilities as man. On the other hand, there has been some damn spectacular work in the last five or ten years."⁸³ A curious scratching of the surface that, admittedly, was but barely touched. The interview, of which Brady's words formed a part, was presented under the title, "Today's robots have to be told." Obviously Brady could not convince the reporter that the wall separating non-intelligence from intelligence has been pierced by robotics, however slightly.

Especially much should be made, and this is the *fifth* guideline, of the occasional admission by AI advocates about a pressing need for clarifying basic philosophical questions. "We *do* have problems," stated Edward Feigenbaum, "and they could be illuminated by a first-class philosopher." Typically, Feigenbaum failed to spell out those problems as *he* saw them. He could think "of only one, perhaps two philosophers who have the grasp of what AI and computing are all about, and also know philosophy." They were of no use, according to him, because both were busy with their own problems and not with the basic philosophical problems posed by AI. Clearly, such was a transparently cheap way of coping with a situation, which, and here Feigenbaum was on target, could not be cleared up with Dreyfus's phenomenology, aptly described by Feigenbaum as "that ball of fluff! That cotton candy!"⁸⁴

The *sixth* guideline is that only by being steeped in moderate or methodical realism can one cope with false philosophical criticisms of claims about AI. The most talked about of those criticisms is the one offered by Dreyfus who falsifies Aristotle by turning him into a forerunner of Descartes!⁸⁵ By taking Aristotle for an

intuitionist, he ignores Aristotle the realist and the very reason for which Aristotle was a critic of Plato insofar as the latter was a rationalist. But if one can ignore that difference between Plato and Aristotle, the far greater difference between Aristotle and Descartes will appear non-existent. Furthermore, nothing will then transpire about the straight road that led from Descartes's rationalism (a subtle form of the priority of the formal and mathematical over the physical or ontologically real) to De la Mettrie's sheer materialism.⁸⁶ The farce is then crowned by Dreyfus's effort to overcome the dehumanizing materialist consequences of AI ideology by opting for a covert materialism.

To be sure, *human* thinking is a reality only because the mind operates in and through a body. Dreyfus rightly emphasizes the bodily parameters of the expression of any perception and judgment. They are indeed omnipresent, enormously large in number, and interconnected in staggeringly complex ways. But this does not turn the act of understanding into a mere bodily or physical process, however complex. Yet Dreyfus would be the last to take the mind for a reality essentially different from the body, however closely connected with it.⁸⁷ No wonder. Phenomenology, which he takes for a guide, has been notorious for blocking genuinely metaphysical perspectives and has served all too often as a specious excuse to disregard them.

The *seventh* guideline is methodical realism which is a dogged, systematic resolve to recall at every juncture the basics in epistemology. This procedure is the only safe guide when it comes to criticisms of AI that are dressed more in scientific than in philosophical terms. The chief among them is the one offered by Godel, author of the famous incompleteness theorems in mathematics that formed the center of many debates about AI. This is not the place to sum up, however briefly, those debates.⁸⁸ Let it merely be noted that, according to those theorems, no set of mathematical propositions can have its proof of consistency within itself. Herein lies a feature, which a machine obviously cannot embody, namely, to "go outside itself" for a proof of its consistency which it must have or else it would not work in a genuinely machine-like manner.

Only those overawed by mathematics or formalization see a crucial argument against AI in those theorems. They do so by taking them for a proof that there is at least one thing a man can do that a machine cannot. Severed from sound epistemology that argument does not amount to much. Godel, in fact, provided a telling illustration of this as he granted to computers the ability to know, though with the meager proviso that the ability in question will not include mathematical certainty.⁸⁹ Clearly, Godel

overlooked the elementary fact that it is the immediate certainty (never achieved with the aid of mathematics) of knowing ordinary external reality that alone assures the applicability of mathematics to physical reality, including the ability to talk about it to other real beings.

Certainty of knowledge severed from that reality will easily become a feature of the solipsist heaven. In fact, it is that solipsism which threatens to engulf Popper's scorn for computers as so many "glorified pencils"⁹⁰ and his criticism of them as thinking machines. The criticism is aimed at Turing's challenge or the claim that any specified, that is, formalized way of man's superiority over computers can be shown to be computerizable. Against that challenge Popper offered the distinction between specifiability or formalizability and subjective experience. This distinction, as it stands in Popper's phrasing, cannot cope with the fact that the subjective, as such, can never be communicated. For once it is communicated, it takes on tangible, that is, specifiable or formalizable aspects. Popper would not, however, admit, and for strictly antimetaphysical reasons, that the act of verbalizing an intellectual judgment represents a unity of mind and matter, of the unformalizable and of the formalizable. By taking refuge in the "subjective," which he does not identify with an objectively existing mind or soul, Popper can only warn that "Turing's challenge should not be taken up,"⁹¹ a warning that counsels resolve not to meet one's opponent head-on.

In debating with advocates of AI, and this is the *eighth* guideline, one should remain especially aware of the difference between proofs and convincing. Proofs, however sound in themselves, can be convincing, that is, effective with a real opponent only if reality as such is acknowledged as the ground of any proof. Anyone who is unwilling to admit the primacy of man's grasp of reality either when he thinks or when he acts for a purpose, makes himself immune to arguments about the inanity of AI. That by the same unwillingness one locks himself into solipsism has, of course, its own instructiveness, though only for the realist. The solipsist is a philosophical narcissist who, enamored of his own mental physiognomy, grows unappreciative of the real world around him. In view of what has been said about AI as an invitation to solipsism, advocates of AI fully deserve Chesterton's devastating "Cherish it!"--his reply to one who extolled solipsism as the best of all philosophies.⁹²

The *ninth* guideline calls for courage to call a spade a spade. The daring may seem outrageous, but hardly unnecessary in a society that merrily marches down the road to anarchy. The march is to the tune of brass bands composed of academics who have

been busy trumpeting that exclusive attention to quantitatively specifiable patterns is the only posture with intellectual respectability.⁹³ Such a pattern is on hand whenever a behavior, no matter how queer, is acted upon in a statistically significant number. From there it is but a short step to claims to legal recognition and protection, as on the basis of mere patterns, so many pure formalizations, everything becomes a mere machinery, with no allowance for distinctions between the morally good and the morally evil. Hence the steady erosion of sensitivity for hallowed principles, as if they were so many words, and the growing readiness to grant social respectability to any behavior, provided it establishes itself as a pattern.

The measure to which AI ideology is fueling that sinister decay of modern society should seem obvious. To oppose that subversive trend the least one should do is to imitate the courage of Winston Churchill, not a great philosopher by any standard but certainly alert to threats which so many of his contemporaries preferred to ignore. On being presented, in 1949, with an honorary degree at MIT, an early stronghold of AI research, Churchill had to listen to the oration of the dean of humanities who boldly predicted, with an eye on computers and biochemistry, the complete control of human mind and will within the foreseeable future. In accepting the honor conferred upon him, Churchill acidly remarked that he "would be content to be dead before that happens."⁹⁴

Courageous remarks are not, however, enough, which is the very point of the *tenth* and last guideline. One may wonder whether Churchill was sufficiently aware of the debt which his sense of human dignity owed to Christian cultural tradition. Yet, even more frequently than in Churchill's days is the brave claim made in purely secularist circles that the unconditional dignity of the individual can be secured on grounds that exclude religious perspectives. Historically, the matter should be clear. Sophocles could compose admirable choruses about the marvel which is man and especially about the marvel of human speech, but he remained perplexed in the face of Antigone's single-minded commitment to moral ideals. His perplexity was part of a surrender to a blind Fate engulfing all human beings and above all their dignity.⁹⁵

Escape from that dead end came only when the human word was found to be a worthy means for carrying mere man into God's innermost life. Belief in the Word (Logos), eternally uttered by the Father, has become the salvation of human words as well. Only in that perspective have those words remained immune to being degraded into mere tools of facile intellectual games, all aimed at undermining the intellect itself. Such games systematically cater to

infatuation with the moment, so different from the *now* transcending the succession of moments. Hence the irreconcilability of a view of the mind, trapped in those games, with the vision of Christ as one who is the same yesterday, today and forever (Heb 13:8). The eternal *now* which is Christ is the inspiration behind the motto, *stat crux dum volvitur orbis*, engraved on the obelisk at the center of St Peter's Square in Rome, a motto evocative of Chesterton's view of the machine, be that machine of cosmic dimensions.

Those unwilling to follow this theological train of thought may not be equally reluctant to take a closer than customary look at scientific history. Advocates of AI are wont to look at the alleged advent of AI as the culmination of man's scientific progress. They still have to face up to an apparently most untheological question about science: Why did science, the great pride and advantage of the Western world, not arise in any of the great ancient cultures? The question should seem all the more important as the rise of science in ancient China or India would have greatly changed the course of world history. Few things are indeed as instructive as the desperate efforts in the modern counterparts of those cultures to catch up with Western science and the various explanations given there for their backwardness.⁹⁶

Any serious probing into these topics brings up, however, questions about world views and with them theology, too. In all those cultures the world view was dominated by emanationism which invariably implies the growing absence of order and rationality as the chain of being extends farther and farther from the source of emanation, however divine. It was only with belief in that Word or Logos--as is clear from the writings of Athanasius who fully perceived in Arianism a potential backsliding into emanationism--that there came a categorical assertion about the full rationality of a world created by a fully divine Logos.⁹⁷ Was not that cosmic rationality--so alien to the Greeks of old who took the sublunary realm for the arena of partial disorder--the very precondition for seeing the fall of an apple and of the moon as expression of the same law? Was not empirical investigation sparked precisely because a given set of created physical laws could be seen as contingent, that is, only one among an infinitely large number of possible sets of laws, all available for the free choice of a truly transcendental, personal Creator? Was not belief in the createdness of man's mind to the image of such a Creator the source of confidence that man's words, the tangible signs of his intellect, can truly grasp the laws of a universe no less created than was man's mind?⁹⁸ And was not that createdness best safeguarded among all monotheistic religions in the one in which the work of

creation was assigned to the Word?⁹⁹

In *That Hideous Strength*, C. S. Lewis offers a remark couched in medieval garb about those who lose their hold on human words because of their growing insensitivity to God's word.¹⁰⁰ Modern secularized culture, which wallows in mental contortions (poignantly evoked by Escher's drawings¹⁰¹) to make the idea of AI respectable, certainly illustrates this point. But those ready to make that point and appreciative of not yet being engulfed in a global vortex of irrationality, must have an eye for the other side of the coin as well. (That a coin has two sides to it may seem obvious, but only the Word of God made an emphatic recall of that elementary truth, another memorable proof of His being a safeguard of rational balance). If indeed our cultural debt to that Word or Logos is immense, we must be logical to the point of realizing our intellectual duties as well.

Those duties are part of that Christian worship about which Paul enjoined that it should be a *logike latreia*, or a reasoned worship (Romans 12:1). While Paul did not recommend logic chopping, he certainly did not suggest a timid, let alone a suspicious recourse to reason.¹⁰² History is a witness that a steady hold on the Word of God always implied a firm resolve to vindicate the human word as a reliable tie with intelligible reality, physical and spiritual, human and divine. Such a view of reality is the basis of that salvation which safeguards man's ability to wonder in the broadest sense. Wonderment is not only the condition of that love of wisdom, to recall the very opening of Aristotle's *Metaphysics*, which is philosophy, but also the mental stance that alone can do justice to the wonder which is any machine, primitive or sophisticated.

It is that wonder which is turned into a pseudo-admiration within the ideology supportive of AI and therein lies its sin against humanity. For as Chesterton put it in his *Heretics*: "The wrong is not that engines are too much admired, but that they are not admired enough. The sin is not that engines are mechanical, but that men are mechanical."¹⁰³ Whereas machines cannot sin, a chief of man's sins has become his abuse of machines. Recent history is in fact a record of tragic abuses of artifacts that in themselves are but so many wonders of human inventiveness. In view of this disheartening past, contemplation of the future should be full of foreboding about possible abuses of that machine, which, though perhaps the most wondrous among all of man's machines, should be best called a mere logic machine.

NOTES

1. D. Hellerstein, "Plotting a Theory of the Brain," *The New York Times Magazine*, May 22, 1988, pp. 17-19, 27-28, 55, 61, 64. For quotations see pp. 61 and 64. If, however, individuality is more than an epiphenomenon, then the abolition of essences by Darwinism, conceded by Edelman (*ibid.*, p. 17) cannot also be true. The failure of Edelman (and of the reporter) to see this contradiction should make one doubtful about Edelman's "eloquent recounting" (in the words of the reporter) of "the mind-body problem from the time of Descartes to the present" (p. 61). Anyone who starts that recount with Descartes, as Edelman does, tries to initiate a march with the second or third step. Far more frequent is, of course, the characterization of the brain as a computer. The categorical claim that "the brain is nothing more than an immensely complicated computer" was made by the social anthropologist Sir Edmund Leach in a guest editorial (*Times*, Nov 16, 1968, p. 11) which appropriately had for its title: "When Scientists Play the Role of God."
2. G. K. Chesterton, *What's Wrong with the World* (London: Cassell, 1913), p. 129.
3. See E. A. Feigenbaum and P. McCorduck, *The Fifth Generation: Artificial Intelligence and Japan's Computer Challenge to the World* (Reading, MA: Addison-Wesley, 1983).
4. Available in English translation, *Man a Machine* (La Salle, IL: Open Court, 1961).
5. As documented in ch. 1. of my *Brain, Mind and Computers* (New York: Herder & Herder, 1969), reprinted with a new introduction (South Bend: Gateway Editions, 1978).
6. H. A. Simon and A. Newell, "Heuristic Problem Solving: The Next Advance," *Operations Research* 6 (Jan-Feb, 1958), p. 8.
7. J. Pfeiffer, *The Thinking Machine* (Philadelphia: J. B. Lippincott, 1962), pp. 173-174.
8. *Ibid.*, pp. 20-21.
9. A. Newell and H. A. Simon, *Human Problem Solving* (Englewood Cliffs, NJ: Prentice Hall, 1972), pp. 870-871.
10. See *Life*, Nov. 20, 1970, pp. 58B-68. Brad Darrach, author of the report, began his description of Shaky, a computer at Stanford Research Institute, with an appeal to fantasy: "It looked at first glance like a Good Humor wagon sadly in need of a spring paint job. But instead of a tiny little bell on top of its box-shaped body there was this big metallic whangdoodle that came rearing up, full of lenses and cables, like a junk sculpture gargyle" (p. 58C).
11. For Minsky's statement see *ibid.*, p. 58D. Another aspect of the illogicality transpired in the admission that human prodding was needed to turn those "immense mentalities" into reality. An illustration of this was the musing of Joshua Lederberg, a

Nobel-laureate biochemist, about the tediousness of programming the computer for each new problem: "Couldn't we save ourselves work by teaching the computer how we write those programs, and then let it program itself?" (ibid., p. 65). The same human superiority was in view when Minsky asserted, in another context, that computers could be programmed to have emotions once "we've decided which emotions we want in a machine." Quoted in P. Huyghe, "Of Two Minds," *Psychology Today*, Dec. 1983, p. 34. To compound illogicality, Minsky admitted that the programming of emotions into computers presupposed the programming of thoughts into them. The latter was not a reality long after the deadline set by Minsky's prediction quoted above. To complete the farce Huyghe's article was followed by an advertisement about a "thinking thermostat" to be had for a paltry \$79.00 plus \$3.95 for postage and handling.

12. *Life*, Nov 20, 1970, p. 67.

13. Quoted in C. Evans, *The Mighty Micro* (London: Gollancz, 1984).

14. I. G. Good, "Human and Machine Intelligence: Comparisons and Contrasts," *Impact of Science on Society*, 21 (1971), p. 321.

15. Quoted from Moravec's essay, unpublished for better or for worse, in P. McCorduck, *Machines Who Think: A Personal Inquiry into the History and Prospects of Artificial Intelligence* (San Francisco: W. H. Freeman, 1979), p. 335.

16. Quoted in F. Rose, *Into the Heart of the Mind: An American Quest for Artificial Intelligence* (New York: Harper & Row, 1984), p. 208.

17. A statement of Moravec, quoted in McCorduck, *Machines Who Think*, p. 354.

18. A statement of Good in his "Human and Machine Intelligence," p. 321.

19. A. Turing, *Computer Machinery and Intelligence*.

20. Quoted in McCorduck, *Machines Who Think*, pp. 352-353.

21. Ibid., p. 346.

22. A remark of McCorduck, ibid., p. 329.

23. Quoted ibid., p. 340.

24. A remark of Schank, in Feigenbaum and McCorduck, *The Fifth Generation*, p. 93.

25. Sara Turing, *Alan. M. Turing* (Cambridge: W. Heffer & Sons, 1959), pp. 97-98.

26. McCorduck, *Machines Who Think*, p. 328.

27. Ibid., p. 357.

28. *Ibid.*, p. 357.

29. See editorial, "A Tale of Magic Wrinkle Creams," in *The New York Times*, April 10, 1988, p. E30.

30. McCorduck, *Machines Who Think*, p. 355.

31. Not much more believable are those very professional linguists who confidently reconstruct a language (called Nostratic), spoken presumably about 15,000 years ago by the common ancestors of most Indo-European and Semitic people. In J. N. Wilford's report, "Linguists Dig Deeper into Origins of Language" (*New York Times*, Nov. 24, 1987, pp. C1 and C4) it is mentioned that a Soviet émigrée champion of Nostratic was cautioned at Yale against mentioning that "language" in class.

32. A thorough coverage and critical analysis of efforts, going back to Condillac, aimed at atomizing language is given in E. Gilson's *Linguistics and Philosophy: An Essay on the Philosophical Constants of Language* (Notre Dame, IN: University of Notre Dame Press, 1987).

33. L. Eiseley, *Darwin's Century* (Garden City, NY: Doubleday, 1962), pp. 311-313.

34. N. Chomsky, *Aspects of the Theory of Syntax* (Cambridge, MA: MIT Press, 1965), p. 58.

35. R. Carnap's *Der logische Aufbau der Welt* (Berlin: Schlachtensee Weltkreisverlag, 1932), is a classic in a world-construction (on the basis of pure logic) that totally fails about that real *Welt* which is the cosmos or universe.

36. Jay Sullivan, as quoted in S. Levy, *Hackers: Heroes of the Computer Revolution* (Garden City, NY: Doubleday, 1984), p. 290.

37. I am merely paraphrasing a statement of Chesterton, to be quoted later; see note 92.

38. Thus, for instance, M. A. Boden, *Artificial Intelligence and Natural Man* (New York: Basic Books, 1977), pp. 421-425. Boden, however, demolishes the threat which she seems to pose to AI by that distinction with her remark "categories of subjectivity, meaning, and purpose *as currently understood* can be attributed to artifacts only in a secondary sense" (italics added). Shortly afterwards she crowns that self-defeating proviso with the assertion that "there need be no danger to a humane image of mankind in allowing that machines are (or one day will be) intelligent in a *nonanalogous way*" (p. 425). Her assertion assumes that reasoning can be based on sheer equivocations, the only alternatives to analogous terms, unless, of course, one assumes the possibility of a univocal identity between artificial and human intelligence. Similarly defective are her assertions in her *Minds and Mechanisms: Philosophical Psychology and Computational Models* (Ithaca, NY: Cornell University Press, 1981), pp. 86-87.

39. A point amply brought out by the classic investigations of J. Piaget.

40. Here it should be enough to think of Poincaré's devastating remark: "C'est librement qu'on est déterministe."

41. See Compton's Terry Lectures at Yale, *The Freedom of Man* (New Haven: Yale University Press, 1935), p. 154.

42. Eddington did so in his *The Philosophy of Physical Science* (London: Macmillan, 1939), p. 182.

43. First pointed out in the pages of *Nature* in 1930. For details see the first essay in my *Chance or Reality and Other Essays* (Lanham, MD: University of America Press, 1986).

44. Hence the inordinate praises accorded to Boole, the founder of mathematical logic, in books favorable to AI, such as, for instance, G. Johnson, *Machinery of the Mind: Inside the New Science of Artificial Intelligence* (Redmond, WA: Tempus Book, 1986), pp. 38-39, and P. McCorduck, *Machines Who Think*, pp. 40-41.

45. For a discussion of the anti-objectivist and anti-realist biases of the Copenhagen school, see chap. 13, "The Horns of Complementarity," in my Gifford Lectures, *The Road of Science and the Ways to God* (Chicago: University of Chicago Press, 1978) or its paperback reprints.

46. For a short and non-technical discussion, see *ibid.*, p. 411.

47. My reference is, of course, to Allan D. Bloom's greatly overvalued book (New York: Simon and Schuster, 1987), see especially pp. 377-378.

48. Details of this are masterfully presented and documented in E. Gilson's *A History of Christian Philosophy in the Middle Ages*.

49. Such as creation out of nothing and in time, and the strictly personal characteristic of the Prime Mover.

50. In commending, not enthusiastically though, the word "consubstantial" in his *Institutes* (I. 13. 5), Calvin does not face up to the crucial question about the apparent ineffectiveness of the scriptural term "monogenes" in the Arian controversies.

51. A main target of A. Koestler's *The Ghost in the Machine* (New York: Macmillan, 1967).

52. Minsky's words, quoted by B. Darrach, see note 10 above, p. 68.

53. As done by Boden, see note 38 above.

54. Thus J. Weizenbaum in his *Computer Power and Human Reason: From Judgment to Calculation* (San Francisco: W. H. Freeman, 1976): "However much intelligence computers may attain now or in the future, theirs must always be an intelligence *alien* to genuine human problems and concerns" (p. 213).

55. As, for instance, in H. G. Wells's devastating criticism of Herbert Spencer's cosmogenesis: "He believed that individuality (heterogeneity) was and is an evolutionary product from an original homogeneity, begotten by folding and multiplying and dividing and twisting it, and still fundamentally it." *First and Last Things: A Confession of Faith and Rule of Life* (London: Watts and Co., 1929), p. 30.

56. The Pythagorean of old who first noted the irreducibility to an integer of the square root of the hypotenuse of a right-angled triangle with unit sides, committed suicide in despair. Since then all that has been learned about the limitations of quantitative method would allow for AI champions a less drastic escape from the clutches of an irrationality of their own making.

57. Similar reflections could be sparked by a brief look at the 35 meanings listed in the same dictionary in connection with the word "bite," which by its similarity in form (and strict identity as a simple past and past participle to "bit") could easily turn matters nightmarish for programmers.

58. N. A. Whitehead, *Modes of Thought* (1938; New York: G. P. Putnam, 1958), p. 235.

59. "Words are wise men's counters—they do but reckon by them; but they are the money of the fools" (Hobbes, *Leviathan*, Part I, chap. 4). A grim reckoner like Hobbes, could but make a mockery of wisdom. One wonders what interpretation Hobbes would have given to the reasoning of the three Wise Men of the Nativity story.

60. Quoted from Weyl's lecture, "Knowledge as Unity," from the text of lectures delivered at the Columbia University bicentenary celebration, October 1954, and published under the title, *The Unity of Knowledge*, ed. L. Leary (Garden City, NY: Doubleday, 1955), p. 22.

61. An expression of Halsted, quoted in B. L. Van der Waerden, *Science Awakening*, tr. A. Dresden (New York: John Wiley & Sons, 1963), p. 56.

62. P. Carus, "Logical and Mathematical Thought," *The Monist* 20 (1909-1910), p. 69.

63. In spite of the warning of Hilbert, a foremost admirer of Cantor's transfinite numbers, that "the infinite is nowhere to be found in reality. It neither exists in nature nor provides a legitimate basis for rational thought." D. Hilbert, "On the Infinite," in *Philosophy of Mathematics*, ed. P. Benacerraf and H. Putnam (Englewood Cliffs, NJ: Prentice Hall, 1964), p. 151.

64. Throughout much of the nineteenth century and during the first decades of the twentieth when the Milky Way was taken for the forever visible part of the infinite universe. For details, see chap. 10, "The Myth of One Island," in my *The Milky Way: An Elusive Road for Science* (New York: Science History Publications, 1976).

65. A. S. Eddington, *New Pathways in Science* (Cambridge: University Press, 1934), p. 217.

66. Quoted in P. J. Davies and R. Hersh, *Descartes' Dream: The World According to*

Mathematics (New York: Harcourt, Brace, Jovanovich, 1986), p. 245.

67. D. R. Hofstadter, *Gödel, Escher, Bach: an Eternal Golden Braid* (New York: Basic Books, 1979), p. 26. The subtitle, a vote on behalf of cosmic eternalism, was also expressive of its interminable convolutedness, a facet aptly rendered by Escher's drawings, but, contrary to Hofstadter, incompatible with the magnificent linear architectonic of Bach's compositions.

68. As reported by R. Bernstein, "Philosophical Rift: A Tale of Two Approaches," *The New York Times*, Dec. 29, 1987, pp. A1 and A4. Quotations in this and the next paragraph are taken from that report.

69. Such as E. Gilson, in particular.

70. Hofstadter, *Gödel, Escher, Bach*, p. 750.

71. This is all the more curious because he referred to the second edition of my book in which that listing is succinctly given in a new Preface.

72. G. K. Chesterton, *The Father Brown Stories* (London: Cassell, 1929), p. 11.

73. As reported by Carnap himself in his intellectual autobiography, *The Philosophy of Rudolf Carnap*, ed. by P. A. Schilpp (La Salle, IL: Open Court, 1963), pp. 37-38.

74. See Pico Iyer, "In Praise of the Humble Comma," *Time*, June 13, 1988, p. 80.

75. H. W. Fowler, *Modern English Usage* (1944; Oxford University Press, 1950), p. 567.

76. I mean, of course, William Safire's weekly column "On Language."

77. I mention the February 1987 issue which lay around in the room where I was collecting my thoughts in preparation of this lecture. On p. 111 it contains a half-page long section under the caption "One Good Thing..." illustrated with seven facetious remarks, one of them being "...about playing a piece of modern music is that, if you make a mistake, no one notices."

78. See the excerpt from a communication by Richard Lederer of St Paul's School to *National Review*, May 13, 1988, p. 16.

79. At present they cannot cope with the slightest misspelling, say, of an author's name, as countless users of computerized library catalogues have already found out.

80. Anyone who follows carefully the steps of programming in the system called BACON (developed by Gary Bradshaw, Pat Langley and Herbert Simon) can easily see that the "discovery" by that system of Ohm's law, of Snell's law of refraction, and of Kepler's third law of planetary motion was an inevitable consequence. Failure to note this is only one of the several serious misconceptions in the article, "Computers and the Nature of Man: A Historian's Perspective on Controversies about Artificial

Intelligence" (*Bulletin of the American Mathematical Society*, Oct. 15, 1986, pp. 113-126) by Judith V. Grabiner who systematically skirts basic questions of epistemology as if mere historical perspectives were a satisfactory substitute to them. Even the distinction between exaggerated and modest claims about AI (a distinction on which Grabiner ultimately falls back) cannot be made unless an epistemological judgment is made, however implicitly, about intelligence and understanding.

81. Quoted in G. Johnson, *The Machinery of the Mind*, p. 235. Grosch was applauded by not a few in a gathering which AI advocates hoped to use as an undisputed platform of publicity and propaganda. Sanity, it appears, has a greater presence in the computer field than suggested by that systematic and sensationalist cultivation of half-truths, equivocations and insinuations bordering on rank falsehood to which Pulitzer provided so much respectability.

82. Boden, *Artificial Intelligence and Natural Man*, p. 106.

83. Quoted in G. Johnson, *The Machinery of the Mind*, p. 150. Only contempt is deserved by T. Winograd's phrase, "computers can only touch the shadow of what we call emotion," quoted in *Newsweek's* cover story, "Machines That Think," June 30, 1980, p. 53, whereby he did not suggest that there is a shadow only if there is a thing, but that the shadow is a part, however minute, of the thing itself.

84. Quoted in McCorduck, *Machines Who Think*, p. 197.

85. He does so both in the revised edition of his *What Computers Can't Do: The Limits of Artificial Intelligence* (New York: Harper and Row, 1979) and in his *Mind over Machine: The Power of Human Intuition and Expertise in the Era of the Computers* (New York: Free Press, 1986), see especially pp. 202-203, which he wrote jointly with his brother, S. E. Dreyfus.

86. The development was carefully traced by Gilson in his *The Unity of Philosophical Experience* (New York: Charles Scribner's Sons, 1937), pp. 174-175.

87. According to Dreyfus, it is the body that organizes and unifies "our experience of objects." See *What Computers Can't Do*, p. 234. In sum, Dreyfus's ultimate argument against AI is that computers cannot grow into organisms comparable to human bodies.

88. For a summary, see my *Brain, Mind, and Computers*, pp. 214-216.

89. In fact, Godel granted the possibility that "there may exist (and even empirically discoverable) a theorem-proving machine which in fact is equivalent to mathematical intuition." The sole difference, according to Godel, between that machine and human intelligence is that the former could not prove its intuition. Godel spoke in this vein in his Josiah Willard Gibbs Lecture in Providence, Rhode Island, on December 26, 1951. The foregoing quotation is from a somewhat longer passage from the manuscript of Godel's lecture that first appeared in print in Hao Wang, *From Mathematics to Philosophy* (New York: Humanities Press, 1974), p. 324.

90. A phrase which Popper used as early as 1950 and which he emphatically repeated

in his *The Self and Its Brain*, written jointly with J. C. Eccles (New York: Springer International, 1977), p. 208.

91. *Ibid.*

92. Maisie Ward, *Return to Chesterton* (London: Sheed & Ward, 1952), p. 130.

93. The principal parts of that brass band are behaviorists, sociobiologists, logical positivists and linguistic philosophers.

94. Quoted in J. W. Kratch, *The Measure of Man: On Freedom, Human Values, Survival and the Modern Temper* (Indianapolis: Bobbs-Merrill, 1954), p. 45.

95. Sophocles' perplexity should seem particularly poignant when viewed against his summary of man's excellence: "O clear intelligence, force beyond all measure" (*Antigone*, Ode I, antistrophe 2).

96. A point discussed through chapters 1-6 and 9 of my *Science and Creation: From Eternal Cycles to an Oscillating Universe* (Edinburgh: Scottish Academic Press, 1974; 2d enlarged ed., 1986) and in chap. 1 of my *The Savior of Science* (Washington DC: Regnery-Gateway, 1988).

97. It was also on that ground that Athanasius opposed the idea of several universes (see his *Against the Heathen*, 39), an idea whose blatant illogicality is still to be perceived by many modern men of science.

98. Such is a consideration to which Galileo gave a pivotal role in his methodology of science as can be seen in the concluding pages of the First Day of his *Dialogue concerning the Two Chief World Systems*. Conversely, the absence of that consideration among Chinese of old was singled out by J. Needham as the cause of their failure to formulate science.

99. For a discussion of the dogma of Incarnation as a shield against pantheism within genuine Christian contexts, see chap. 2 of my *The Savior of Science*.

100. C. S. Lewis, *That Hideous Strength* (1946; New York: Collier Books, 1962), p. 351. "*Qui Verbum Dei contempserunt, eis auferetur etiam verbum hominis*" or "They that have despised the word of God, from them shall the word of man also be taken away."

101. That Escher's world is worlds removed from Bach's can easily be seen by anyone who tracks down in Hofstadter's rambling pages the mere one page he is able to offer on the "similarity" of the two. Typically, the "proof" is Bach's Crab Canon, a simple musical joke, and less than a mere drop in Bach's vast, and linearly lucid, creativity. Bach's name in the very title of Hofstadter's book is typical of the intellectual flippancy characteristic of AI advocates. That flippancy, which is refractory to any argument, however cogent, received its most revealing, as well as self-defeating, formulation in Good's idea that the gap between mind and computers will be closed "because we shall

gradually make human thinking less mysterious and machine operations more so." See his "Human and Machine Intelligence," p. 306.

102. Similar enjoining of the same rationality is 2 Corinthians 5:12, Colossians 4:6 and 1 Peter 3:15.

103. G. K. Chesterton, *Heretics* (London: John Lane, 1905), p. 140.