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## AGAINST THE IMPERIALISM OF INSTRUMENTAL REASON

That man has aggregated to himself enormous power by means of his science and technology is so grossly banal a platitude that, paradoxically, although it is as widely believed as ever, it is less and less often repeated in serious conversation. The paradox arises because a platitude that ceases to be commonplace ceases to be perceived as a platitude. Some circles may even, after it has not been heard for a while, perceive it as its very opposite, that is, as a deep truth. There is a parable in that, too: the power man has acquired through his science and technology has itself been converted into impotence.

The common people surely feel this. Studs Terkel, in a monumental study of daily work in America, writes;

“For the many there is hardly concealed discontent. . . . ‘I’m a machine,’ says the spot welder. ‘I’m caged,’ says the bank teller,

and echoes the hotel clerk. 'I'm a mule,' says the steel worker. 'A monkey can do what I do,' says the receptionist. 'I'm less than a farm implement,' says the migrant worker. 'I'm an object,' says the high fashion model. Blue collar and white call upon the identical phrase: 'I'm a robot.'"<sup>1</sup>

Perhaps the common people believe that, although they are powerless, there is power, namely, that exercised by their leaders. But we have seen that the American Secretary of State believes that events simply "befall" us, and that the American Chief of the Joint Chiefs of Staff confesses to having become a slave of computers. Our leaders cannot find the power either.

Even physicians, formerly a culture's very symbol of power, are powerless as they increasingly become mere conduits between their patients and the major drug manufacturers. Patients, in turn, are more and more merely passive objects on whom cures are wrought and to whom things are done. Their own inner healing resources, their capacities for self-reintegration, whether psychic or physical, are more and more regarded as irrelevant in a medicine that can hardly distinguish a human patient from a manufactured object. The now ascendant biofeedback movement may be the penultimate act in the drama separating man from nature; man no longer even senses himself, his body, directly, but only through pointer readings, flashing lights, and buzzing sounds produced by instruments attached to him as speedometers are attached to automobiles. The ultimate act of the drama is, of course, the final holocaust that wipes life out altogether.

Technological inevitability can thus be seen to be a mere element of a much larger syndrome. Science promised man power. But, as so often happens when people are seduced by promises of power, the price exacted in advance and all along the path, and the price actually paid, is servitude and impotence. Power is nothing if it is not the power to choose. Instrumental reason can make decisions, but there is all the difference between deciding and choosing.

The people Studs Terkel is talking about make decisions all day long, every day. But they appear not to make choices. They are, as they themselves testify, like Winograd's robot. One asks it "Why did you do that?" and it answers "Because this or that decision

branch in my program happened to come out that way." And one asks "Why did you get to that branch?" and it again answers in the same way. But its final answer is "Because you told me to." Perhaps every human act involves a chain of calculations at what a systems engineer would call decision nodes. But the difference between a mechanical act and an authentically human one is that the latter terminates at a node whose decisive parameter is not "Because you told me to," but "Because I chose to." At that point calculations and explanations are displaced by truth. Here, too, is revealed the poverty of Simon's hypothesis that

"The whole man, like the ant, viewed as a behaving system, is quite simple. The apparent complexity of his behavior over time is largely a reflection of the complexity of the environment in which he finds himself."

For that hypothesis to be true, it would also have to be true that man's capacity for choosing is as limited as is the ant's, that man has no more will or purpose, and, perhaps most importantly, no more a self-transcendent sense of obligation to himself as part of the continuum of nature, than does the ant. Again, it is a mystery why anyone would want to believe this to be the true condition of man.

But now and then a small light appears to penetrate the murky fog that obscures man's authentic capacities. Recently, for example, a group of eminent biologists urged their colleagues to discontinue certain experiments in which new types of biologically functional bacterial plasmids are created.<sup>2</sup> They express "serious concern that some of these artificial recombinant DNA molecules could prove biologically hazardous." Their concern is, so they write, "for the possible unfortunate consequences of the indiscriminate application of these techniques." Theirs is certainly a step in the right direction, and their initiative is to be applauded. Still, one may ask, why do they feel they have to give a reason for what they recommend at all? Is not the overriding obligation on men, including men of science, to exempt life itself from the madness of treating everything as an object, a sufficient reason, and one that does not even have to be spoken? Why does it have to be explained? It would

appear that even the noblest acts of the most well-meaning people are poisoned by the corrosive climate of values of our time.

An easy explanation of this, and perhaps it contains truth, is that well-meaningness has supplanted nobility altogether. But there is a more subtle one. Our time prides itself on having finally achieved the freedom from censorship for which libertarians in all ages have struggled. Sexual matters can now be discussed more freely than ever before, women are beginning to find their rightful place in society, and, in general, ideas that could be only whispered until a decade or so ago may now circulate without restriction. The credit for these great achievements is claimed by the new spirit of rationalism, a rationalism that, it is argued, has finally been able to tear from man's eyes the shrouds imposed by mystical thought, religion, and such powerful illusions as freedom and dignity. Science has given to us this great victory over ignorance. But, on closer examination, this victory too can be seen as an Orwellian triumph of an even higher ignorance: what we have gained is a new conformism, which permits us to say anything that can be said in the functional languages of instrumental reason, but forbids us to allude to what Ionesco called the living truth. Just as our television screens may show us unbridled violence in "living color" but not scenes of authentic intimate love—the former by an itself-obscene reversal of values is said to be "real," whereas the latter is called obscene—so we may discuss the very manufacture of life and its "objective" manipulation, but we may not mention God, grace, or morality. Perhaps the biologists who urge their colleagues to do the right thing, but for the wrong reasons, are in fact motivated by their own deep reverence for life and by their own authentic humanity, only they dare not say so. In any case, such arguments would not be "effective," that is to say, instrumental.

If that is so, then those who censor their own speech do so, to use an outmoded expression, at the peril of their souls.

There is still another way to justify a scientist's renunciation of a particular line of research—and it is one from which all of us may derive lessons pertinent to our own lives. It begins from the principle that the range of one's responsibilities must be commensurate with the range of the effects of one's actions. In earlier times this

principle led to a system of ethics that concerned itself chiefly with how persons conducted themselves toward one another. The biblical commandments, for example, speak mainly of what an individual's duties are toward his family and his neighbors. In biblical times few people could do anything that was likely to affect others beyond the boundaries of their own living spaces. Man's science and technology have altered this circumstance drastically. Not only can modern man's actions affect the whole planet that is his habitat, but they can determine the future of the entire human species. It follows therefore that man, particularly man the scientist and engineer, has responsibilities that transcend his immediate situation, that in fact extend directly to future generations. These responsibilities are especially grave since future generations cannot advocate their own cause now. We are all their trustees.<sup>3</sup>

The biologists' overt renunciation, however they themselves justify it, is an example which it behooves all scientists to emulate. Is this to suggest that scientists should close their minds to certain kinds of "immoral" hypotheses? Not at all. A scientific hypothesis is, at least from a scientific point of view, either true or false. This applies, for example, to Simon's hypotheses that man is "quite simple" and that he can be entirely simulated by a machine, as well as to McCarthy's hypothesis that there exists a logical calculus in terms of which all of reality can be formalized. It would be a silly error of logic to label such (or any other) hypotheses either moral or immoral or, for that matter, responsible or irresponsible.

But, although a scientific hypothesis can itself have no moral or ethical dimensions, an individual's decision to adopt it even tentatively, let alone to announce his faith in it to the general public, most certainly involves value judgments and does therefore have such dimensions. As the Harvard economist Marc J. Roberts recently wrote,

"Suppose we must choose between two hypotheses. No matter which we select, there is always the possibility that the other is correct. Obviously the relative likelihood of making a mistake when we select one or the other matters—but so too do the costs of alternative mistakes, the costs of assuming *A* is true when in fact *B*

is true or vice versa. We might well choose to risk a more likely small cost than a less likely large one. Yet the magnitude of the cost of being wrong in each case cannot be determined except on the basis of our values.

"Consider an extreme example: the view that there are genetic differences in the mental functioning of different races. Suppose society were to accept this view, and it proved false. I believe that very great evil would have been done. On the other hand, suppose society adopted the view that there are no differences, and that turned out to be incorrect. I would expect much less harm to result. Given these costs, I would want evidence which made the hypothesis of interracial similarity very unlikely indeed before I would reject it. My scientific choice depends on my values, not because I am uncritical or would like to believe that there are no such differences, but because consistent choices under uncertainty can only be made by looking at the cost of making alternative kinds of errors. In contrast, a would-be 'value-neutral scientist' would presumably be willing to operate on the assumption that such differences exist as soon as evidence made it even slightly more likely than the reverse assumption.

"These questions do not arise routinely in scientific work because traditional statistical methods typically subsume them under the choice of test criteria or of the particular technique to be used in estimating some magnitude. That choice is then made on conventional or traditional grounds, usually without discussion, justification, or even acknowledgement that value choices have been made."<sup>4</sup>

Roberts chose to illustrate that scientific hypotheses are not "value free" by citing the values enter into the scientist's choice to tolerate or not to tolerate the potential cost of being wrong. Values, as I will try to show, enter into choices made by scientists in other (and I believe even more important) ways as well. For the moment, however, I mean only to assert that it is entirely proper to say "bravo" to the biologists whose example we have cited, and to say "shame" to the scientists who recently wrote that "a machine-animal symbiont with an animal visual system and brain to augment mechanical functions" will be technically "feasible" within the next fifteen years.<sup>5</sup>

The introduction of words like “ethics” and “ought” into conversations about science seems almost always to engender a tension not unlike, I would say, the strain one can sense rising whenever, in conversation with elderly German university professors, one happens to allude to the career of one of their colleagues who prospered during the Hitler years. In the latter situation, the lowering of the social temperature betrays the fear that something “unfortunate” might be said, especially that the colleague’s past inability to renounce his personal ambitions for the sake of morality might be mentioned. There is a recognition, then, of course, that the conduct not only of the colleague, but of all German academicians of the time, is in question. In the former situation, the tension betrays a similar concern, for ethics, at bottom, deals with nothing so much as renunciation. The tension betrays the fear that something will be said about what science, that is, scientists, ought and ought not to do. And there is a recognition that what might be talked about doesn’t apply merely to science generally or to some abstract population known as scientists, but to the very people present.

Some scientists, though by no means all, maintain that the domain of science is universal, that there can be nothing which, as a consequence of some “higher” principle, ought not to be studied. And from this premise the conclusion is usually drawn that any talk of ethical “oughts” which apply to science is inherently subversive and anti-scientific, even anti-intellectual.

Whatever the merits of this argument as abstract logic may be, it is muddleheaded when applied to concrete situations, for there are infinitely many questions open to scientific investigation, but only finite resources at the command of science. Man must therefore choose which questions to attack and which to leave aside. We don’t know, for example, whether the number of pores on an individual’s skin is in any way correlated with the number of neurons in his brain. There is no interest in that question, and therefore no controversy about whether or not science ought to study it. The Chinese have practiced acupuncture for many centuries without arousing the interest of Western science. Now, suddenly, Western scientists have become interested. These examples illustrate that scientific “prog-

ress" does not move along some path determined by nature itself, but that it mirrors human interests and concerns.

Surely finely honed human intelligence is among the scarcest of resources available to modern society. And clearly some problems amenable to scientific investigation are more important than others. Human society is therefore inevitably faced with the task of wisely distributing the scarce resource that is its scientific talent. There simply is a responsibility—it cannot be wished away—to decide which problems are more important or interesting or whatever than others. Every specific society must constantly find ways to meet that responsibility. The question here is *how*, in an open society, these ways are to be found; are they to be dictated by, say, the military establishment, or are they to be open to debate among citizens and scientists? If they are to be debated, then why are ethics to be excluded from the discussion? And, finally, how can anything sensible emerge unless all first agree that, contrary to what John von Neuman asserted, technological possibilities are not irresistible to man? "Can" does not imply "ought."

Unfortunately, the new conformism that permits us to speak of everything except the few simple truths that are written in our hearts and in the holy books of each of man's many religions renders all arguments based on these truths—no matter how well thought out or eloquently constructed—laughable in the eyes of the scientists and technicians to whom they may be addressed. This in itself is probably the most tragic example of how an idea, badly used, turns into its own opposite. Scientists who continue to prattle on about "knowledge for its own sake" in order to exploit that slogan for their self-serving ends have detached science and knowledge from any contact with the real world. A central question of knowledge, once won, is its validation; but what we now see in almost all fields, especially in the branches of computer science we have been discussing, is that the validation of scientific knowledge has been reduced to the display of technological wonders. This can be interpreted in one of only two ways: either the nature to which science is attached consists entirely of raw material to be molded and manipulated as an object; or the knowledge that science has purchased for



man is entirely irrelevant to man himself. Science cannot agree that the latter is true, for if it were, science would lose its license to practice. That loss would, of course, entail practical consequence (involving money and all that) which scientists would resist with all their might. If the former is true, then man himself has become an object. There is abundant evidence that this is, in fact, what has happened. But then knowledge too has lost the purity of which scientists boast so much; it has then become an enterprise no more or less important and no more inherently significant than, say, the knowledge of how to lay out an automobile assembly line. Who would want to know that "for its own sake"?

This development is tragic, in that it robs science of even the possibility of being guided by any authentically human standards, while it in no way restricts science's potential to deliver ever-increasing power to men. And here too we find the root of the much-talked-about dehumanization of man. An individual is dehumanized whenever he is treated as less than a whole person. The various forms of human and social engineering we have discussed here do just that, in that they circumvent all human contexts, especially those that give real meaning to human language.

The fact that arguments which appeal to higher principles—say, to an individual's obligations to his children, or to nature itself—are not acknowledged as legitimate poses a serious dilemma for anyone who wishes to persuade his colleagues to cooperate in imposing some limits on their research. If he makes such arguments anyway, perhaps hoping to induce a kind of conversion experience in his colleagues, then he risks being totally ineffective and even being excommunicated as a sort of comic fool. If he argues for restraint on the grounds that irreversible consequences may follow unrestrained research, then he participates in and helps to legitimate the abuse of instrumental reason (say, in the guise of cost-benefit analyses) against which he intends to struggle.

As is true of so many other dilemmas, the solution to this one lies in rejecting the rules of the game that give rise to it. For the present dilemma, the operative rule is that the salvation of the world—and that *is* what I am talking about—depends on converting

others to sound ideas. That rule is false. The salvation of the world depends only on the individual whose world it is. At least, every individual must act as if the whole future of the world, of humanity itself, depends on him. Anything less is a shirking of responsibility and is itself a dehumanizing force, for anything less encourages the individual to look upon himself as a mere actor in a drama written by anonymous agents, as less than a whole person, and that is the beginning of passivity and aimlessness.

This is not an argument for solipsism, nor is it a counsel for every man to live only for himself. But it does argue that every man must live for himself first. For only by experiencing his own intrinsic worth, a worth utterly independent of his "use" as an instrument, can he come to know those self-transcendent ends that ultimately confer on him his identity and that are the only ultimate validators of human knowledge.

But the fact that each individual is responsible for the whole world, and that the discharge of that responsibility involves first of all each individual's responsibility to himself, does not deny that all of us have duties to one another. Chief among these is that we instruct one another as best we can. And the principal and most effective form of instruction we can practice is the example our own conduct provides to those who are touched by it. Teachers and writers have an especially heavy responsibility, precisely because they have taken positions from which their example reaches more than the few people in their immediate circle.

This spirit dictates that I must exhibit some of my own decisions about what I may and may not do in computer science. I do so with some misgivings, for I have learned that people are constantly asking one another what they must do, whereas the only really important question is what they must be. The physicist Steven Weinberg, in commenting on recent criticisms of science, writes, for example,

"I have tried to understand these critics by looking through some of their writings, and have found a good deal that is perti-

nent, and even moving. I especially share their distrust of those, from David Ricardo to the Club of Rome, who too confidently apply the methods of the natural sciences to human affairs. But in the end I am puzzled. What is it they want *me* to do?"<sup>6</sup>

My fear is that I will be understood to be answering a question of the kind Weinberg asks. That is not my intention. But the risk that I will be misunderstood cannot excuse me from my duty.

There is, in my view, no project in computer science as such that is morally repugnant and that I would advise students or colleagues to avoid. The projects I have been discussing, and others I will mention, are not properly part of computer science. Computers are not central to the work of Forrester and Skinner. The others are not computer science, because they are for the most part not science at all. They are, as I have already suggested, clever aggregations of techniques aimed at getting something done. Perhaps because of the accidents of history that caused academic departments whose concerns are with computers to be called "computer science" departments, all work done in such departments is indiscriminately called "science," even if only part of it deserves that honorable appellation. Tinkerers with techniques (gadget worshippers, Norbert Wiener called them) sometimes find it hard to resist the temptation to associate themselves with science and to siphon legitimacy from the reservoir it has accumulated. But not everyone who calls himself a singer has a voice.

Not all projects, by very far, that are frankly performance-oriented are dangerous or morally repugnant. Many really do help man to carry on his daily work more safely and more effectively. Computer-controlled navigation and collision-avoidance devices, for example, enable ships and planes to function under hitherto disabling conditions. The list of ways in which the computer has proved helpful is undoubtedly long. There are, however, two kinds of computer applications that either ought not be undertaken at all, or, if they are contemplated, should be approached with utmost caution.

The first kind I would call simply obscene. These are ones whose very contemplation ought to give rise to feelings of disgust in

every civilized person. The proposal I have mentioned, that an animal's visual system and brain be coupled to computers, is an example. It represents an attack on life itself. One must wonder what must have happened to the proposers' perception of life, hence to their perceptions of themselves as part of the continuum of life, that they can even think of such a thing, let alone advocate it. On a much lesser level, one must wonder what conceivable need of man could be fulfilled by such a "device" at all, let alone by only such a device.

I would put all projects that propose to substitute a computer system for a human function that involves interpersonal respect, understanding, and love in the same category. I therefore reject Colby's proposal that computers be installed as psychotherapists, not on the grounds that such a project might be technically infeasible, but on the grounds that it is immoral. I have heard the defense that a person may get some psychological help from conversing with a computer even if the computer admittedly does not "understand" the person. One example given me was of a computer system designed to accept natural-language text via its typewriter console, and to respond to it with a randomized series of "yes" and "no." A troubled patient "conversed" with this system, and was allegedly led by it to think more deeply about his problems and to arrive at certain allegedly helpful conclusions. Until then he had just drifted in aimless worry. In principle, a set of Chinese fortune cookies or a deck of cards could have done the same job. The computer, however, contributed a certain aura—derived, of course, from science—that permitted the "patient" to believe in it where he might have dismissed fortune cookies and playing cards as instruments of superstition. The question then arises, and it answers itself, do we wish to encourage people to lead their lives on the basis of patent fraud, charlatanism, and unreality? And, more importantly, do we really believe that it helps people living in our already overly machine-like world to prefer the therapy administered by machines to that given by other people? I have heard this latter question answered with the assertion that my position is nothing more than "let them eat cake." It is said to ignore the shortage of good human psychotherapists, and to deny to troubled people what little help computers can now give them merely because presently available computers don't "yet"

measure up to, say, the best psychoanalysis. But that objection misses the point entirely. The point is (Simon and Colby to the contrary notwithstanding) that there are some human functions for which computers *ought* not to be substituted. It has nothing to do with what computers can or cannot be made to do. Respect, understanding, and love are not technical problems.

The second kind of computer application that ought to be avoided, or at least not undertaken without very careful forethought, is that which can easily be seen to have irreversible and not entirely foreseeable side effects. If, in addition, such an application cannot be shown to meet a pressing human need that cannot readily be met in any other way, then it ought not to be pursued. The latter stricture follows directly from the argument I have already presented about the scarcity of human intelligence.

The example I wish to cite here is that of the automatic recognition of human speech. There are now three or four major projects in the United States devoted to enabling computers to understand human speech, that is, to programming them in such a way that verbal speech directed at them can be converted into the same internal representations that would result if what had been said to them had been typed into their consoles.

The problem, as can readily be seen, is very much more complicated than that of natural-language understanding as such, for in order to understand a stream of coherent speech, the language in which that speech is rendered must be understood in the first place. The solution of the "speech-understanding problem" therefore presupposes the solution of the "natural-language-understanding problem." And we have seen that, for the latter, we have only "the tiniest bit of relevant knowledge." But I am not here concerned with the technical feasibility of the task, nor with any estimate of just how little or greatly optimistic we might be about its completion.

Why should we want to undertake this task at all? I have asked this question of many enthusiasts for the project. The most cheerful answer I have been able to get is that it will help physicians record their medical notes and then translate these notes into action more efficiently. Of course, anything that has any ostensible connec-

tion to medicine is automatically considered good. But here we have to remember that the problem is so enormous that only the largest possible computers will ever be able to manage it. In other words, even if the desired system were successfully designed, it would probably require a computer so large and therefore so expensive that only the largest and best-endowed hospitals could possibly afford it—but in fact the whole system might be so prohibitively expensive that even they could not afford it. The question then becomes, is this really what medicine needs most at this time? Would not the talent, not to mention the money and the resources it represents, be better spent on projects that attack more urgent and more fundamental problems of health care?

But then, this alleged justification of speech-recognition “research” is merely a rationalization anyway. (I put the word “research” in quotation marks because the work I am here discussing is mere tinkering. I have no objection to serious scientists studying the psycho-physiology of human speech recognition.) If one asks such questions of the principal sponsor of this work, the Advanced Research Projects Agency (ARPA) of the United States Department of Defense, as was recently done at an open meeting, the answer given is that the Navy hopes to control its ships, and the other services their weapons, by voice commands. This project then represents, in the eyes of its chief sponsor, a long step toward a fully automated battlefield. I see no reason to advise my students to lend their talents to that aim.

I have urged my students and colleagues to ask still another question about this project: Granted that a speech-recognition machine is bound to be enormously expensive, and that only governments and possibly a very few very large corporations will therefore be able to afford it, what will they use it for? What can it possibly be used for? There is no question in my mind that there is no pressing human problem that will more easily be solved because such machines exist. But such listening machines, could they be made, will make monitoring of voice communication very much easier than it now is. Perhaps the only reason that there is very little government surveillance of telephone conversations in many countries of the world is that such surveillance takes so much manpower. Each con-

versation on a tapped phone must eventually be listened to by a human agent. But speech-recognizing machines could delete all "uninteresting" conversations and present transcripts of only the remaining ones to their masters. I do not for a moment believe that we will achieve this capability within the future so clearly visible to Newell and Simon. But I do ask, why should a talented computer technologist lend his support to such a project? As a citizen I ask, why should my government spend approximately 2.5 million dollars a year (as it now does) on this project?

Surely such questions presented themselves to thoughtful people in earlier stages of science and technology. But until recently society could always meet the unwanted and dangerous effects of its new inventions by, in a sense, reorganizing itself to undo or to minimize these effects. The density of cities could be reduced by geographically expanding the city. An individual could avoid the terrible effects of the industrial revolution in England by moving to America. And America could escape many of the consequences of the increasing power of military weapons by retreating behind its two oceanic moats. But those days are gone. The scientist and the technologist can no longer avoid the responsibility for what he does by appealing to the infinite powers of society to transform itself in response to new realities and to heal the wounds he inflicts on it. Certain limits have been reached. The transformations the new technologies may call for may be impossible to achieve, and the failure to achieve them may mean the annihilation of all life. No one has the right to impose such a choice on mankind.

I have spoken here of what ought and ought not to be done, of what is morally repugnant, and of what is dangerous. I am, of course, aware of the fact that these judgments of mine have themselves no moral force except on myself. Nor, as I have already said, do I have any intention of telling other people what tasks they should and should not undertake. I urge them only to consider the consequences of what they do do. And here I mean not only, not even primarily, the direct consequences of their actions on the world about them. I mean rather the consequences on themselves, as they construct their rationalizations, as they repress the truths that urge them to different courses, and as they chip away at their own auton-

omy. That so many people so often ask what they must do is a sign that the order of being and doing has become inverted. Those who know who and what they are do not need to ask what they should do. And those who must ask will not be able to stop asking until they begin to look inside themselves. But it is everyone's task to show by example what questions one can ask of oneself, and to show that one can live with what few answers there are.

But just as I have no license to dictate the actions of others, neither do the constructors of the world in which I must live have a right to unconditionally impose their visions on me. Scientists and technologists have, because of their power, an especially heavy responsibility, one that is not to be sloughed off behind a facade of slogans such as that of technological inevitability. In a world in which man increasingly meets only himself, and then only in the form of the products he has made, the makers and designers of these products—the buildings, airplanes, foodstuffs, bombs, and so on—need to have the most profound awareness that their products are, after all, the results of human choices. Men could instead choose to have truly safe automobiles, decent television, decent housing for everyone, or comfortable, safe, and widely distributed mass transportation. The fact that these things do not exist, in a country that has the resources to produce them, is a consequence, not of technological inevitability, not of the fact that there is no longer anyone who makes choices, but of the fact that people have chosen to make and to have just exactly the things we have made and do have.

It is hard, when one sees a particularly offensive television commercial, to imagine that adult human beings sometime and somewhere sat around a table and decided to construct exactly that commercial and to have it broadcast hundreds of times. But that is what happens. These things are not products of anonymous forces. They are the products of groups of men who have agreed among themselves that this pollution of the consciousness of the people serves their purposes.

But, as has been true since the beginning of recorded history, decisions having the most evil consequences are often made in the service of some overriding good. For example, in the summer of 1966 there was considerable agitation in the United States over America's



intensive bombing of North Viet Nam. (The destruction rained on South Viet Nam by American bombers was less of an issue in the public debate, because the public was still persuaded that America was "helping" that unfortunate land.) Approximately forty American scientists who were high in the scientific estate decided to help stop the bombing by convening a summer study group under the auspices of the Institute of Defense Analyses, a prestigious consulting firm for the Department of Defense. They intended to demonstrate that the bombing was in fact ineffective.<sup>7</sup>

They made their demonstration using the best scientific tools, operations research and systems analysis and all that. But they felt they would not be heard by the Secretary of Defense unless they suggested an alternative to the bombing. They proposed that an "electronic fence" be placed in the so-called demilitarized zone separating South from North Viet Nam. This barrier was supposed to stop infiltrators from the North. It was to consist of, among other devices, small mines seeded into the earth, and specifically designed to blow off porters' feet but to be insensitive to truck passing over them. Other devices were to interdict truck traffic. The various electronic sensors, their monitors, and so on, eventually became part of the so-called McNamara line. This was the beginning of what has since developed into the concept of the electronic battlefield.

The intention of most of these men was not to invent or recommend a new technology that would make warfare more terrible and, by the way, less costly to highly industrialized nations at the expense of "underdeveloped" ones. Their intention was to stop the bombing. In this they were wholly on the side of the peace groups and of well-meaning citizens generally. And they actually accomplished their objective; the bombing of North Viet Nam was stopped for a time and the McNamara fence was installed. However, these enormously visible and influential people could have instead simply announced that they believed the bombing, indeed the whole American Viet Nam adventure, to be wrong, and that they would no longer "help." I know that at least some of the participants believed that the war was wrong; perhaps all of them did. But, as some of them explained to me later, they felt that if they made such an announcement, they would not be listened to, then or ever again.

Yet, who can tell what effect it would have had if forty of America's leading scientists had, in the summer of 1966, joined the peace groups in coming out flatly against the war on moral grounds? Apart from the positive effect such a move might have had on world events, what negative effect did their compromise have on themselves and on their colleagues and students for whom they served as examples?

There are several lessons to be learned from this episode. The first is that it was not technological inevitability that invented the electronic battlefield, nor was it a set of anonymous forces. Men just like the ones who design television commercials sat around a table and chose. Yet the outcome of the debates of the 1966 Summer Study were in a sense foreordained. The range of answers one gets is determined by the domain of questions one asks. As soon as it was settled that the Summer Study was to concern itself with only technical questions, the solution to the problem of stopping the bombing of the North became essentially a matter of calculation. When the side condition was added that the group must at all costs maintain its credibility with its sponsors, that it must not imperil the participants' "insider" status, then all degrees of freedom that its members might have had initially were effectively lost. Many of the participants have, I know, defended academic freedom, their own as well as that of colleagues whose careers were in jeopardy for political reasons. These men did not perceive themselves to be risking their scholarly or academic freedoms when they engaged in the kind of consulting characterized by the Summer Study. But the sacrifice of the degrees of freedom they might have had if they had not so thoroughly abandoned themselves to their sponsors, whether they made that sacrifice unwittingly or not, was a more potent form of censorship than any that could possibly have been imposed by officials of the state. This kind of intellectual self-mutilation, precisely because it is largely unconscious, is a principal source of the feeling of powerlessness experienced by so many people who appear, superficially at least, to occupy seats of power.

A second lesson is this. These men were able to give the counsel they gave because they were operating at an enormous psychological distance from the people who would be maimed and

killed by the weapons systems that would result from the ideas they communicated to their sponsors. The lesson, therefore, is that the scientist and technologist must, by acts of will and of the imagination, actively strive to reduce such psychological distances, to counter the forces that tend to remove him from the consequences of his actions. He must—it is as simple as this—think of what he is actually doing. He must learn to listen to his own inner voice. He must learn to say “No!”

Finally, it is the act itself that matters. When instrumental reason is the sole guide to action, the acts it justifies are robbed of their inherent meanings and thus exist in an ethical vacuum. I recently heard an officer of a great university publicly defend an important policy decision he had made, one that many of the university’s students and faculty opposed on moral grounds, with the words: “We could have taken a moral stand, but what good would that have done?” But the good of a moral act inheres in the act itself. That is why an act can itself ennoble or corrupt the person who performs it. The victory of instrumental reason in our time has brought about the virtual disappearance of this insight and thus perforce the delegitimation of the very idea of nobility.

I am aware, of course, that hardly anyone who reads these lines will feel himself addressed by them—so deep has the conviction that we are all governed by anonymous forces beyond our control penetrated into the shared consciousness of our time. And accompanying this conviction is a debasement of the idea of civil courage.

It is a widely held but a grievously mistaken belief that civil courage finds exercise only in the context of world-shaking events. To the contrary, its most arduous exercise is often in those small contexts in which the challenge is to overcome the fears induced by petty concerns over career, over our relationships to those who appear to have power over us, over whatever may disturb the tranquility of our mundane existence.

If this book is to be seen as advocating anything, then let it be a call to this simple kind of courage. And, because this book is, after all, about computers, let that call be heard mainly by teachers of computer science.

I want them to have heard me affirm that the computer is a powerful new metaphor for helping us to understand many aspects of the world, but that it enslaves the mind that has no other metaphors and few other resources to call on. The world is many things, and no single framework is large enough to contain them all, neither that of man's science nor that of his poetry, neither that of calculating reason nor that of pure intuition. And just as a love of music does not suffice to enable one to play the violin—one must also master the craft of the instrument and of music itself—so is it not enough to love humanity in order to help it survive. The teacher's calling to teach his craft is therefore an honorable one. But he must do more than that: he must teach more than one metaphor, and he must teach more by the example of his conduct than by what he writes on the blackboard. He must teach the limitations of his tools as well as their power.

It happens that programming is a relatively easy craft to learn. Almost anyone with a reasonably orderly mind can become a fairly good programmer with just a little instruction and practice. And because programming is almost immediately rewarding, that is, because a computer very quickly begins to behave somewhat in the way the programmer intends it to, programming is very seductive, especially for beginners. Moreover, it appeals most to precisely those who do not yet have sufficient maturity to tolerate long delays between an effort to achieve something and the appearance of concrete evidence of success. Immature students are therefore easily misled into believing that they have truly mastered a craft of immense power and of great importance when, in fact, they have learned only its rudiments and nothing substantive at all. A student's quick climb from a state of complete ignorance about computers to what appears to be a mastery of programming, but is in reality only a very minor plateau, may leave him with a euphoric sense of achievement and a conviction that he has discovered his true calling. The teacher, of course, also tends to feel rewarded by such students' obvious enthusiasm, and therefore to encourage it, perhaps unconsciously and against his better judgment. But for the student this may well be a trap. He may so thoroughly commit himself to what he naively perceives to be computer science, that is, to the mere polishing of his

programming skills, that he may effectively preclude studying anything substantive.

Unfortunately, many universities have "computer science" programs at the undergraduate level that permit and even encourage students to take this course. When such students have completed their studies, they are rather like people who have somehow become eloquent in some foreign language, but who, when they attempt to write something in that language, find they have literally nothing of their own to say.

The lesson in this is that, although the learning of a craft is important, it cannot be everything.

The function of a university cannot be to simply offer prospective students a catalogue of "skills" from which to choose. For, were that its function, then the university would have to assume that the students who come to it have already become whatever it is they are to become. The university would then be quite correct in seeing the student as a sort of market basket, to be filled with goods from among the university's intellectual inventory. It would be correct, in other words, in seeing the student as an object very much like a computer whose storage banks are forever hungry for more "data." But surely that cannot be a proper characterization of what a university is or ought to be all about. Surely the university should look upon each of its citizens, students and faculty alike, first of all as human beings in search of—what else to call it?—truth, and hence in search of themselves. Something should constantly be happening to every citizen of the university; each should leave its halls having become someone other than he who entered in the morning. The mere teaching of craft cannot fulfill this high function of the university.

Just because so much of a computer-science curriculum is concerned with the craft of computation, it is perhaps easy for the teacher of computer science to fall into the habit of merely training. But, were he to do that, he would surely diminish himself and his profession. He would also detach himself from the rest of the intellectual and moral life of the university. The university should hold, before each of its citizens, and before the world at large as well, a vision of what it is possible for a man or a woman to become. It does

this by giving ever-fresh life to the ideas of men and women who, by virtue of their own achievements, have contributed to the house we live in. And it does this, for better or for worse, by means of the example each of the university's citizens is for every other. The teacher of computer science, no more nor less than any other faculty member, is in effect constantly inviting his students to become what he himself is. If he views himself as a mere trainer, as a mere applier of "methods" for achieving ends determined by others, then he does his students two disservices. First, he invites them to become less than fully autonomous persons. He invites them to become mere followers of other people's orders, and finally no better than the machines that might someday replace them in that function. Second, he robs them of the glimpse of the ideas that alone purchase for computer science a place in the university's curriculum at all. And in doing that, he blinds them to the examples that computer scientists as creative human beings might have provided for them, hence of their very best chance to become truly good computer scientists themselves.<sup>8</sup>

Finally, the teacher of computer science is himself subject to the enormous temptation to be arrogant because his knowledge is somehow "harder" than that of his humanist colleagues. But the hardness of the knowledge available to him is of no advantage at all. His knowledge is merely less ambiguous and therefore, like his computer languages, less expressive of reality. The humanities particularly

"have a greater familiarity with an ambiguous, intractable, sometimes unreachable [moral] world that won't reduce itself to any correspondence with the symbols by means of which one might try to measure it. There is a world that stands apart from all efforts of historians to reduce [it] to the laws of history, a world which defies all efforts of artists to understand its basic laws of beauty. [Man's] practice should involve itself with softer than scientific knowledge. . . . that is not a retreat but an advance."<sup>9</sup>

The teacher of computer science must have the courage to resist the temptation to arrogance and to teach, again mainly by his own example, the validity and the legitimacy of softer knowledge. Why

courage in this connection? For two reasons. The first and least important is that the more he succeeds in so teaching, the more he risks the censure of colleagues who, with less courage than his own, have succumbed to the simplistic worldviews inherent in granting imperial rights to science. The second is that, if he is to teach these things by his own example, he must have the courage to acknowledge, in Jerome Bruner's words, the products of his subjectivity.

Earlier I likened the unconscious to a turbulent sea, and the border dividing the conscious, logical mind from the unconscious to a stormy coastline. That analogy is useful here too. For the courage required to explore a dangerous coast is like the courage one must muster in order to probe one's unconscious, to take into one's heart and mind what it washes up on the shore of consciousness, and to examine it in spite of one's fears. For the unconscious washes up not only the material of creativity, not only pearls that need only be polished before being strung into structures of which one may then proudly speak, but also the darkest truths about one's self. These too must be examined, understood, and somehow incorporated into one's life.

If the teacher, if anyone, is to be an example of a whole person to others, he must first strive to be a whole person. Without the courage to confront one's inner as well as one's outer worlds, such wholeness is impossible to achieve. Instrumental reason alone cannot lead to it. And there precisely is a crucial difference between man and machine: Man, in order to become whole, must be forever an explorer of both his inner and his outer realities. His life is full of risks, but risks he has the courage to accept, because, like the explorer, he learns to trust his own capacities to endure, to overcome. What could it mean to speak of risk, courage, trust, endurance, and overcoming when one speaks of machines?