THE NORMATIVE SIDE OF TECHNOLOGY: PHILOSOPHY AND THE PUBLIC INTEREST

Edmund Byrne, INDIANA UNIVERSITY–INDIANAPOLIS

It is little more than a truism that technology, in all its forms and functions, has become the predominant characteristic of human culture, at least on the developed part of our planet. It is perhaps most readily associated with the multitudinous machines upon which we have become so dependent. But these can hardly be understood in isolation from the inventive processes from which they derive or from the innumerable cultural transformations that their utilization eventually effects in society. Viewed thus largely and contextually, the concept of technology is almost as inclusive as that of culture. A concept so broad, being intellectually sterile even if defensible, "technology" tends in the literature to be limited to the processes and/or products of human inventiveness. But even when thus narrowed, this concept embraces a set of phenomena so complex as to defy comprehension.

Research in Philosophy & Technology—Volume 2, 1979, pages 91-109.

ISBN: 0-89232-101-6

Such, at least, would be the case if it were up to any one discipline to accomplish such a task. As it happens, however, various components of the task are being dealt with under the aegis of a variety of different disciplines, among which must be included history, the various social or behavioral sciences, law, religious studies, and philosophy. These various approaches to the study of technology have in common at least the general object of investigation; and this commonality is sufficient to justify speaking of them collectively as Technology Studies, and to anticipate ever more abundant cross-fertilization, leading eventually perhaps to the kind of inter-disciplinary attack on a problematic that has been in evidence in medical research.[1]

It being assumed, then, that only a research consortium could ever do justice to the complex object of Technology Studies; I propose in what follows to submit a kind of progress report on how far philosophy has come towards providing a component of such studies under the title of philosophy of technology. Secondly, I want to evaluate the appropriateness of this development in light of my own preconceptions as to the function which philosophers might most effectively perform in such a research consortium. My basic finding is that the philosophy component is, for the most part, being built upon the model of epistemology and philosophy of science. My chief bias is that other areas of philosophical expertise are also needed for Technology Studies; e.g., ethics, political and social philosophy, philosophy of law, and systems philosophy.

In the absence of any facts on the matter, one might have imagined that the complex phenomena that constitute technology are just the sort of thing that would challenge a discipline like philosophy, its past practitioners having on occasion been characterized by an occupational *hubris* that thrived on reducing to a system what to others surpassed all understanding. This *hubris,* however, has been markedly subdued in recent years, its inheritors being largely occupied with tidying up what others, especially those in prestigious disciplines, have dared to say about things. Philosophers have adopted this watchdog role not (wags to the contrary) to forestall unemployment, but in an effort to carry on in a new and different context the age-old quest for truth. Their major misconceptions have consisted in supposing that the attainment of truth requires something like absolute objectivity, and that truth thus sought is the only object worthy of the professional philosopher's consideration (goodness and justice being, by comparison, less amenable to objectivity).

Given this orientation on the part of mainsteam academic philosophy, a direct and vital interest in technology on the part of a philosopher would have to be considered somewhat eccentric. Yet, as is well known to readers of this volume, sufficient interest has been shown by philosophers in recent years to merit identifying philosophy of technology as an emerging special-

ization.[2] The range of topics dealt with under this specialization extends from ontology (What is technology?) to public policy (What is the proper role of technology in society?); but the center of attention to date has been on the outskirts, so to speak, of philosophy of science (How does technology differ, if at all, from science?). In any event, one result of these considerations is a gradual breakdown of an isolationist, or at best highly theoretical, philosophy of science; and this breakdown is opening the way to the world beyond theories of knowledge, where science interacts with technology and both impinge upon society—a world in which values, goals and priorities tend to be more important than categories and definitions.

This world is perhaps most readily identified as the world of science policy; and, taken strictly, science policy may be developed, at least in the abstract, without reference to technology. But the more that science is viewed concretely, as it is being pursued in fact, the more it is seen to be very closely tied to technology, not only for purposes of instrumentation but for research and development as well. This being the case, it is subject to all the political, economic, and legal constraints that are so inescapably associated with technology and, in particular, technology assessment. It is by no means assured that philosophy will contribute anything worthwile to the complex considerations which are in this way being approached. Indeed, as will be seen hereinafter, mainstream philosophy has been dedicated to the proposition that it has no business even trying. But even its attempts to analyze science have now brought it to a point where further progress seems possible only by subsuming philosophy of science under an over-arching philosophy of technology. This latter, in turn, will be of real value only to the extent that it includes in its purview the kinds of normative and prescriptive considerations that constitute public policy.[3]

The transformation of philosophy of science here proposed would be possible if philosophers were to reorder their hierarchy of values in only one major respect. What is required is that they cease to think of science as the pinnacle of human endeavor to which all others are to be compared unfavorably. This evaluative shift would, in turn, require additional secondary changes of emphasis; but these need not detain us here. All that matters for present purposes is that the recommended revaluation would undo almost a century of dedicated obedience to the tacit decree that philosophy of science shall be indifferent to science policy.[4]

Such concern for the purity of science has, to be sure, certain religious overtones; but these are more suited to the Age of Faith than to the Age of Science. During the Middle Ages all disciplines were unified at least inasmuch as they were all directed by theologians towards the goal of supporting the presumably sacred interests of the Church. And like theology in that pre-Galilean era, science in its turn came to be looked upon as a unified and unifying intellectual enterprise which was itself without need of

justification and as such could serve to justify others that were content to serve its presumed interests. This it did primarily by functioning as analogate and model for every sort of systematic attack on the problems of society. In the Newtonian Age, in particular, as described by John Herman Randall, Jr., "men set to work to become the Newtons in every field, especially in the various branches of the science of man and of society—in business life, in politics, in religion, art and morality."[5] To quote a writer of the times, Baron d'Holbach:

> It is to physics and to experience that man must have recourse in all his investigations; he must consult them in matters of religion, ethics, legislation, political government, the sciences and the arts, even in his pleasures and sufferings.[6]

The Enlightenment's rather childlike confidence in the ability of one scientific method, adequately perfected, to solve all human problems has over time been greatly shaken by the seeming intractability of historical events. And this has led to a somewhat ambivalent attitude towards public policy on the part of the mainstream practitioners of philosophy of science, the empiricists. In their desire to "rationalize" socio-political practice, they have certainly not always endeared themselves to authoritarian governments. But on the other hand, they have insisted that only through strict isolation can science be shielded from political infections.[7] No doubt anxious to move beyond a world in which power often causes "is" to be derived from "ought," spokesmen for the philosophy of science have tended to give almost canonical status to the Humean claim that "ought" cannot be derived from "is." Thus Henri Poincaré in a 1913 essay on "Morality and Science:"

> If the premises of a syllogism are both in the indicative, the conclusion will equally be in the indicative. In order for the conclusion to be put in the imperative, it would be necessary for at least one of the premises to be in the imperative. Now, the principles of science, the postulates of geometry, are and can only be in the indicative; experimental truths are also in this same mode, and at the foundations of science there is not, cannot be anything else. Moreover the most subtle dialectician can juggle with these principles as he wishes, combine them, pile them up one on the other; all that he can derive from them will be in the indicative. He will never obtain a proposition which says: do this, or do not do that; that is to say a proposition which confirms or contradicts ethics.[8]

Consistent with this tradition and with the view of most of its orthodox practitioners is Ernest Nagel's assertion that the scope of the philosophy of science "is controlled by the objective of analyzing the logic of scientific inquiry and the logical structure of its intellectual products."[9] Similarly, in a book which meticulously distinguishes science as a formal system from both its "metaphysical" interpretations and its "pragmatic" applications, Philipp Frank does little more than note in concluding that for "a real

understanding of his science" a scientist might begin to think about "science as a part of human behavior in general."[10]

However well-intentioned this limited-purpose approach to the study of science may have been, the traumatic history of the twentieth century has rendered it comparatively irrelevant to the needs of an ever-growing number of scientists and others who are, and have every reason to be, concerned about the impact of science on society.[11] What these needs are is well summarized by Jerome R. Ravetz in his extremely important and almost revolutionary book, *Scientific Knowledge and Its Social Problems*. Under the heading, "Problems of Morale, and of Morals," Ravetz observes:

> For many generations, up to but not including the present, the study of nature has been among the most serene of occupations. To be sure, the work is arduous and even hazardous; but many an eminent scientist turned with relief from the turbulence and faction of politics, commerce, and even institutional religion, to the innocent contemplation of the unchanging and impersonal laws of nature. In less than a generation's time, that haven has been lost. Science is in flux. Many who entered it as a refuge from the intellectual and moral squalor of ordinary society find, in their advancing years, that they are involved in administering just another bureaucratic establishment. They are enmeshed in the demands of society and the State; they must accomplish the administrative and social tasks of getting high-quality craftsmen's work out of a set of manpower-unit employees; and in participating in the leadership of their field, they must cope with the insoluble practical and moral problems which emerge when corruption sets in.[12]

This growing concern over the social responsibility of the scientist has, in turn, been complemented by an increasing interest in the history, politics, economics, sociology, and now even psychology of science.[13] These and other related studies have contributed greatly to a multifaceted and, as it were, three-dimensional view of science. But they have tended for the most part to leave beyond serious inquiry the basic goals, norms, and values of the scientific enterprise as traditionally understood by philosophers of science. And as a result, the latter have not, until very recently, been seriously challenged to concern themselves with the problem of personal (individual or corporate) responsibility for the consequences of science; that is, for the impact of science on society. Nor would they be very likely to take up such a problem of their own accord; for, as is well known, they have tended to think of their role with respect to science as being comparable to that of loyal courtiers in the court of a usually wise and beneficent king.[14] Assuming, of course, that, whatever the question, science has found or can find the answer, such dedicated partiality may be interpreted as more altruistic than self-serving. But such a subservient role-definition readily lends itself to all the methodological weaknesses of what Peter Winch has called "the underlabourer conception of philosophy."[15] This indeed is especially the case so long as the philosopher of science refuses even to

entertain the idea that the moral questions being asked by scientists with regard to the social impact of science are legitimately science-related questions. That in general they do not is due in large measure to the aforementioned model of science whereby science is purportedly protected from sociopolitical contamination by simply decreeing that it is isolated from the sociopolitical arena. Where this model fails, according to Gerard Radnitzky, is in the fact that it tends to foster what its proponents claim thereby to be avoiding. "The quarantine model of science," says Radnitzky,

> helps to create the vacuum which is a growing ground for totalitarian thinking. Its elective affinity with "decisionism" (voluntarism, etc.), which is particularly conspicuous in the meta-ethics and ethics inspired by LE (logical empiricism) such as the emotive theory of ethics, jibes with authoritarian thought. Value-neutrality and decisionism complement each other: a complete technocracy simply is impossible because the sum-total of all expert knowledge is chaos and hence the intervention of the "strong man," the politician, indispensable.[16]

It probably must be conceded to Radnitzky that the logical positivists, who have been the chief proponents of philosophy of science, have in fact fostered the myth that science is apolitical. And, what is more, they have probably believed this to be the case, taking "belief" in a sense that they, like no others, could well appreciate. But they have hardly been alone in their belief, especially among philosophers. For philosophers of whatever persuasion would be hard pressed to say how, if at all, science, as they understand "science," could possibly be not only *of* but somehow even *in* the world. The dichotomy here suggested owes much to Descartes, as Gilbert Ryle has so thoroughly instructed us.[17] But what it all comes down to is that philosophers have tended to think of science much more as a highly refined exercise in reasoning than as a complex process of specialized problem-solving behavior—as an act of mind rather than of will, to say nothing of body. This particular bias, in turn, is due in no small degree to the philosopher's well-known preference for questions of perennial, if not eternal, significance rather than those whose significance appears to be time-bound and possibly even ephemeral.[18] It is this preference, similarly, that has led philosophers to concentrate their attention on science, which they take to be of unfailing import, rather than on technology, which by contrast they have for the most part written off as *mere* applied science, an ephemeral enterprise offering little of professional interest to the philosopher of science.[19] It has been left to others, especially historians of science, to learn the lesson of Marx and others that scientists, like engineers, are themselves quite effectively enmeshed in the socioeconomic complexities now referred to simply as Big Science.[20] Put differently, science is a function of technology, and technology is inextricably a function of the socioeconomic processes that we call history. This point Ortega y Gasset makes with a number of examples, including the fact that "the young Galileo worked not

at a university, but in the arsenals of Venice among cranes and levers."[21] It is precisely for the reasons here only suggested that the emergence of philosophy of technology is of such singular importance. As the philosophy of technology becomes more and more concerned with broad-based questions of public policy, it may in the process begin to function as an over-arching discipline which can help to relate philosophy of science to public affairs.

It should, of course, be apparent from what has already been said that the philosophy of technology could hardly function as the over-arching discipline here suggested if it had at its disposal only those limited-purpose models of the scientific enterprise that have dominated almost all work in the philosophy of science to date. But, as a matter of fact, the emerging philosophy of technology can almost be characterized just in terms of its deviation from those models and towards contextual models more appropriate to the study of technology.[22] An important step has been taken in this direction by writers who regard models developed to study the natural sciences as inappropriate for the human sciences.[23] But it is not enough just to say, in effect, that the human sciences have content and/or methodology that cannot be reduced to those of the natural sciences. What is basically at issue here is not whether human sciences differ significantly from natural sciences, but whether any sciences, be they thought of as natural or human or whatever, ought to be pursued, formulated and reported without acknowledgment of their origins and their targets in the multipurpose world of human beings. And from this point of view, the reductionist unification of the sciences aimed at by the logical positivists was more appropriately holistic and universalist, at least in intent. Unfortunately, the reductionism by which they hoped to achieve their goal was not adequate to the task. However elegant logically, a unification in the formal mode would not guarantee any corresponding unification in the material mode. And, as it happens, the uniformities which are being found on different levels are structural rather than mechanical. In the words of Ludwig von Bertalanffy, "Unity of Science is granted, not by a utopian reduction of all sciences to physics and chemistry, but by the structural uniformities of the different levels of reality."[24] What this means, among other things, is that differences discovered at different levels are better accounted for than explained away, even if one's goal is a unification of the sciences. Moreover, such unification cannot be simply imposed but must somehow be developed out of an ever more complete understanding of differences. Among the differences that are particularly characteristic of human beings is their singular compulsion to *think* about what they are doing. To relegate all that this implies to the chaos of "emotive meaning" is a corollary not of any scientific law but rather of a purist refusal to accept straightforwardly the insurmountably exploratory character of all human deeds and deliberations.

More generally speaking, the chief problematic of philosophy of science in this century has in effect been just a special case of the predominant problematic of all twentieth century philosophy, namely to salvage some sort of stable essences from the wreckage of Newtonian absolutism.[25] Pragmatism and existentialism are exceptions to this rule only superficially, inasmuch as each of these philosophies simply shifted the essence from a present given to a future goal, from an object of intellect to a project of will. By so doing, these and other philosophies of our century have helped to break down the traditional barriers against interfacing philosophy of science with public affairs. Like Marx a century before, these project-oriented philosophies are better able to see that any human endeavor, science included, takes place not in a world of pure ideas but in an historical context; and this context is a factor in, and may be determinative of, whatever scientific research is done at any given time. Which philosophy best succeeds at historicizing intellectual processes is, of course, a much debated question. But what stands out in and through that debate is the commonly shared desire not to cut ideas off from their historical context.

This being said, it is no easy matter to give an account of just how ideas, especially scientific ideas, move through history. If one sees the historicity of scientific ideas as being at best circumstantial, as the logical positivists were wont to do, one might in effect maintain that scientific research is perhaps *in* the world, but its product, science, is at best only *of* the world.[26] If, on the other hand, one is prepared to admit that science itself is, in and of itself, an historical process as subject to pitfalls and pratfalls as any other historical process, then it becomes problematic how anything like scientific progress is even possible for fallible human beings. Karl Popper's suggestion that scientists back into the future on the strength of the *modus tollens,* that is, by refutations of conjectures, was in this regard not very reassuring.[27] Still less reassuring was Thomas S. Kuhn's contention of the scientific community, so called, which is committed to the "dogma" of "normal science."[28] Then, what Kuhn thought of as detrimental to the physical sciences, Abraham Maslow came to think of as practically destructive of the social sciences:

> The term "scientific objectivity" has, in effect, been preempted by the physics-centered theorists of science and bent to the use of their mechanomorphic *Weltanschauung*. It was certainly necessary for astronomers and physicists to assert their freedom to see what was before their eyes rather than having truth determined *a priori* by the church or the state. This is the kernel of sense in the concept of "value-free science." But it is this generalization, uncritically accepted today by many, that has crippled so many human and social scientists.[29]

These and other related contributions to a more expansive and more realistic model of the scientific enterprise have not entirely overthrown the "objectivist" model of science. But it may have encouraged orthodox

philosophers of science like Mario Bunge and Israel Scheffler to at least acknowledge that this objectivist model cannot survive undefended. Scheffler, for example, noting that "received opinions as to the source of objectivity in science are increasingly under attack," interprets that attack on received opinions as being nothing less than an attack on "the very conception of scientific thought as a responsible enterprise of reasonable men."[30] As such language suggests, Scheffler sees these attacks as being not only epistemologically but even morally dangerous; in his words, "the moral import of science" is "its dynamic articulation of the impulse to responsible belief, and its suggestion of the hope of an increased rationality and responsibility in all realms of conduct and thought."[31] Yet for all his obvious commitment to the cause of logical empiricism, Scheffler can conclude with nothing stronger than what amounts to a belief in scientific progress: "Science," he says, "generally, prospers not through seeking impossible guarantees, but through striving to systematize a continuously expanding experience."[32]

Where such crypto-religious concern for the purity of science falls short is precisely in its meticulous refusal to see any significant connection between science and society. But this particular form of monasticism—perhaps like all others—is becoming theoretically as well as practically untenable. Consider, for example, Leszek Kolakowski's insightful critique of rigorous positivism:

> The radical version [of positivism]. . . is an attempt to consolidate science as a self-sufficient activity, which exhausts all the possible ways of appropriating the world intellectually. In this radical positivist view, the realities of the world—which can, of course, be interpreted by natural science, but which are in addition an object of man's "existential curiosity," a source of fear or disquiet, an occasion for commitment or rejection—if they are to be encompassed by reflection and expressed in words, can be reduced to their empirical properties. Suffering, death, ideological conflict, social clashes, antithetical values of any kind—all are declared out of bounds, matters we can only be silent about, in obedience to the principle of verifiability. Positivism so understood is an act of escape from commitments, an escape masked as a definition of knowledge, invalidating all such matters as mere figments of the imagination stemming from intellectual laziness. Positivism in this sense is the escapist's design for living, a life voluntarily cut off from participation in anything that cannot be correctly formulated. The language it imposes exempts us from the duty of speaking up in life's most important conflicts, encases us in a kind of armor of indifference to the *ineffabilia mundi*, the indescribable qualitative data of experience.[33]

In the wake of such firm reminders of reality, it becomes easier to think of discovery, or innovation, not so much as a logical nuance but rather as a complex process that is at the center of the intense intercorporate and international competition. The older theoretician's view of technology as applied science is giving way to the problem-solver's view of science itself as

the research component in the process of product development that includes technology as its very heart and soul. In the words of Jerome R. Ravetz:

> Even if the scientist is personally interested only in [the] significance (of a research project) for advancng the field, he can well imagine a possible relevance of the result to some sophisticated and unsolved technical problem. An emphasis on this relevance will help the project to be considered as "mission-oriented research," which is naturally better endowed with funds than the useless sort. Now, it is possible for the scientist or the investing agency to keep the different aspects of a project, and the different values they represent, in separate compartments, considering it accidental and unsought good luck that interest in the problem should be so diversified as to bring it financial support. But such a state of affairs cannot persist indefinitely for a whole group of scientists. The natural tendency, to ensure good relations and continued support, is to give serious attention to those whose interest is essential and for the research to shift in their direction.[34]

Having thus located "systematic scientific inquiry" in the real world, where great sums of money are available for the solution of industrial problems, Ravetz concludes what the political scientist probably takes for granted:

> Hence the individual scientist, and even more those leaders of the scientific community who plead for public funds for particular projects as well as for general purposes, must be able to talk the language of economic (or military) benefit at least as well as that of the search for knowledge.[35]

This mercantile view of science is, in turn, complemented by a sociology of science, the main concern of which has been to help find the people who can best do the research jobs that the goals of business and industry require. Similarly, a politics and an economics of science take us even farther towards a transformation of our understanding of science from an ahistorical and impersonal body of eternal ideas into a complex series of behaviors and rules of behavior the societal functions of which are ever more totally subjected to institutional control.[36]

It is against this background, I would suggest, that one should read Mario Bunge's attempt to inaugurate the philosophy of technology as a study of rules. Noting that "while law statements can be more or less true, rules can only be more or less effective," Bunge proposes that under the aegis of the philosophy of technology, we (1) "try to ground our rules," and (2) "transform some law formulas into effective technological rules"[37] And towards these ends, he attempts to work out some of the logical interrelationships between what he calls nomological and nomo-pragmatic statements respectively. Passing then from strictly logical considerations to the real-world topic of technological forecast, Bunge notes that this latter involves, in addition to a "conceptual" and a "psychological" level, what he calls "the social level: the actions actually performed on the basis of the knowledge of p (the prediction) and in the service of extra-scientific goals."[38]

It is in this context that Bunge manages to approach the more straightforward realism of Ravetz by means of an empirically unfounded and fundamentally amoral distinction between the role of the scientist and the role of the technologist. The latter, according to Bunge, involves a "means-end relationship," and "such means are implemented by a specified set of actions, among them the technologist's own actions." Thus, "whereas the scientist's success depends on his . . . capacity of detachment, . . . the technologist's ability consists in placing himself within the system concerned—at the head of it. . . . This," Bunge insists, "does not involve *subjectivity*, since after all, the technologist draws on the objective knowledge provided by science." But insofar as technologists work towards ends determined by others, "they are decision makers, not policy makers."[39]

The startling naiveté of the role definitions that Bunge here proposes to preserve the "scientists" from reality and to preserve even the "technologist" from responsibility should not distract us from the importance of his acknowledgment that, after all, science touches reality via technology and that philosophy needs to respond accordingly.

In view of the foregoing, there is some reason for saying that philosophy of technology is simply an idea whose time has come. For, on the one hand, it has at its disposal a burgeoning literature on just about every aspect of what A. Cornelius Benjamin calls "the cultural fringe of science."[40] And, on the other hand, it arrives at a time when both scientists and public officials are seeking some viable answers to great normative questions about the impact of science on society. What they face, as do we all in different ways, are all kinds of policy problems that arise out of the concrete circumstances of scientific research and discovery and, on yet another level, out of the scientific enterprise itself as a set of societal roles and expectations.

Many scientists, of course, still remain indifferent to these problems; at least in their professional role as scientists. In view of the narrowness of their technical training there is some basis for the argument that such indifference is socially advantageous.[41] But there are also some indications that scientists can and will address policy questions quite effectively in and through their professional capacity as scientists. The Pugwash movement, the Federation of American Scientists, the Society for Social Responsibility in Science, and the Potere Operaio (in Italy) are examples. Especially important from the viewpoint of philosophy is the emergence of research programs devoted to "critical science."[42] In such programs, among which must be included that of Barry Commoner and his colleagues at Washington University, "collaborative research of the highest quality is done, as part of practical projects involving the discovery, analysis, and criticism of the different sorts of damage inflicted on man and nature by runaway technology, followed by their public exposure and campaigns for their abolition."[43]

This activist approach to professional responsibility on the part of some scientists, though steadily gaining respectability, is nonetheless hardly the mainstream. Many scientists, probably even a majority of them, still cling to pre-World War II dogma that science is value-neutral and that questions of good and evil arise only in connection with the utilization of science—a normative stance that in effect allows the working scientist to transfer all responsibility for the effects of science to government and industry. But the effects of science, planned and unplanned alike, have become far too complex and far-reaching to allow such an escapist self-serving, wait-and-see attitude towards science policy and technology assessment to go unchallenged and unchecked. In an age in which corporate planning tends to proceed in accordance with technocratic presuppositions, people who simply wait to see what science will come up with next may well have already waited too long. Accordingly, it cannot be left up to the working scientist, and still less to the business executive, the government official or the military strategist, but must become also the responsibility of the public at large to guide science towards humanly acceptable results.[44]

That the public at large should be involved in the process of setting science policy has been the theme of a loosely organized antagonist to the American Association for the Advancement of Science known as Science for the People. What this latter organization seems to envision as a distant goal by no means easily reach, I.C. Jarvie has presented, rather sanguinely, as an operative procedure. In his words,

> Technological knowledge is knowledge within the boundary of the circle . . . which coincides with the laws of science. What technology handles within the boundary are the practical problems set it by the society. . . . Society sets the limits on the kinds of solutions that can be seriously entertained, and closely scrutinizes those that are tried.[45]

Science policy and technology assessment, in other words, are not just matters of internal corporate costs but of social and environmental costs as well. Whether and to what extent these latter costs should be incurred, and how and by whom they should be paid, are complex problems that must be dealt with on many levels, from many different points of view; and each point of view is best represented by the skill or competency of the discipline which has most thoroughly and efficaciously exploited it.[46] But no amount of data will in and of itself determine what priorities should be favored, what policies should be adopted, what courses of action should be pursued, in either the short run or the long. These are all questions of policy; and policy is based, explicitly or (as is more likely) implicitly, on a society's basic values and preferences.

What our values and preferences are and what they should be is, obviously, not easy to determine.[47] But it is becoming almost axiomatic within the ecological movement that human beings have rights to social and

environmental amenities which take precedence over the demand for purely economic growth. And some now claim to be able to show that such growth is limited by the finitude of available resources. But even if the prognostications of the Club of Rome are essentially both correct and surprise-free, the information thus made available does not in and of itself tell us whether (not to mention how) to respond by limiting population or by limiting economic growth or what.[48] More generally, futurist studies, as usually carried out, tend not only to leave unanswered, but as often as not even to exacerbate, the crucial value questions on the answers to which the future of our race may well depend. Why, in a word, should it really matter to any living human being whether people in the next country or in the next century will be able to breathe, drink water, procreate normal offspring—in short, survive?

Questions of this kind have not, as a rule, greatly interested the philosophical profession.[49] And, as one notable consequence of this failure on the part of philosophy, when people attempt to support their claims to social and environmental amenities, be it in friendly discussion or in a court of law, they find themselves with little guidance from philosophy with regard to the fundamental values which are at issue. Yet it has been noted that in the field of environmental law, "Many courts have now reached the stage of development at which they may permit litigation of the question of what does truly aid 'the elevation of mankind.' "[50]

What, then, might philosophers contribute to the clarification of these most critical and ultimate issues? At the very least, it seems to me, they can help analyze, articulate and argue the ground rules, axioms, and priorities that are implied by the environmental concerns of our times. In other words, they can help bring into being an articulate, rational underpinning for environmental concern that would establish the latter as a new organizing principle around which public priorities might be determined. Or is it too much to suppose that just as the problems of earlier times brought forth arguments for property rights and civil rights and human rights, so too might the environmental crisis of our times challenge us to develop arguments in support of rights to such amenities as breathable air, potable water, habitable housing and, in short, a livable life?[51]

It only remains to ask in the present context how philosophers might start bringing this rational underpinning into being. Suffice it to say that to do this they will need to rethink past approaches to philosophy of science in light of the needs of critical science. And towards this end, they will have to move away from the reductionist mechanism of the past towards a holistic systems approach.

The first point is well made by Ravetz, who goes so far as to say that "if the style of critical science, imposed by the very nature of its problems, becomes incorporated into a coherent philosophy of science, it will provide

the basis for a transformation of scientific inquiry as deep as that which occurred in early modern Europe."[52] What Ravetz here overlooks, however, is the institutionalization of the Cartesian dichotomy into what C.P. Snow felt justified in calling "two cultures."[53] For, as the natural philosophy of old gave way to mechanistically oriented studies on the one hand and humanistically oriented studies on the other, the only way in which a peer-approved philosopher could concern himself with the impact of science on society was by means of some form of professional schizophrenia. To the extent, however, that this breach is closed on the basis of holistic and ecological considerations, philosophers will join with others in the urgent task of learning how to think about and deal with our world "as a complex and subtle system in its own right, and as a heritage of which we are temporary stewards for future generations."[54]

It is here implied that the philosophy of science might better turn less to physics and more to biology as the coordinating framework for its reflections. One interested in such a reorientation could perhaps derive some clues from the holistic evolutionism of a Teilhard de Chardin as to how biology might serve the function of organizing science. Other clues might be gained from Lewis Mumford, especially in *The Pentagon of Power*, where he caps his study of Darwin and the organic world picture with the following:

> Not by accident the isolationism and reductionism of orthodox science, following too studiously the conditions laid down by the power system for accelerating all forms of power, is under indictment, because of the catastrophic results of applying such anti-organic concepts to exploiting and controlling living species. All thinking worthy of the name now must be ecological, in the sense of appreciating and utilizing organic complexity, and in adapting every kind of change to the requirements not of man alone, or of any single generation but of all his organic partners and every part of his habitat.[55]

What Mumford here reports as a cultural historian is given considerable support in such works as those of René Dubos, a biologist, and Herbert Marcuse, a philosopher who as such has been almost unique in his critical analysis of the impact of technology on society.[56] Lacking in all of these and other related works, however, are methods and models really adequate to encompass the kind of data that their conclusions require if they are to be taken seriously.

Such methods and models, quite obviously, cannot be ordered on command and distributed to all interested parties, especially inasmuch as the latter should include all the different disciplines involved in Technology Studies. It is, however, precisely for this reason that articulation of the many facets of technology as a total system is practically a *sine qua non* if these different disciplines are to communicate and cooperate meaningfully, and avoid unnecessary duplication of effort, with regard to the object of their common concern. And such coordination of effort is all the more necessary

if one avers, as I do, that one of the principal justifications of Technology Studies is the need for multifaceted and multilateral input into the ongoing process of science policy and technology assessment.

In short, Technology Studies should be aimed at helping society to decide well the difficult problems it faces with regard to science and technology; and philosophy of technology should contribute to Technology Studies' carefully articulated statements of value considerations involved in any given program proposal. A thorough defense of this pragmatic role definition is beyond the scope of the present paper.[57] But the two points at issue may be illustrated by way of two anecdotes.

First anecdote. It is fairly widely known that one of the untoward consequences of building a series of dams on the Nile, especially High Aswan, has been a significant increase in the incidence of schistosomiasis among people who live along that river. What is less widely known is that this result was fully expected by parasitologists before the dam was ever built.[58] *Moral:* There is a need to develop effective mechanisms whereby the relevant knowledge of any given discipline will be appropriately weighted and considered in the political process of technology assessment.

Second anecdote. Arguments for and against the MIT-Club of Rome thesis that the world cannot sustain its present rate of economic growth have focused for the most part on whether or not their computer program and the data fed into it are sufficiently sophisticated to support the conclusions drawn. In only one instance (to my knowledge) has criticism focused on the intrinsic inability of any one discipline or method, however powerful in its domain of origin, to render superfluous the extensive efforts of other disciplines to deal with related problems by other methods which are subject to the quality control of each discipline in question. This latter criticism will be found in a collection of articles in which a number of scholars analyze Jay Forester's "world system" under the aegis of systems philosophy.[59] *Moral:* A sophisticated sensitivity to the strengths and limitations of the various specialized methodologies, long the forte of philosophy of science, is a valuable asset where the task at hand is to develop a multidisciplinary approach to the problems of science policy and technology assessment.

What these anecdotes are intended to suggest is that (1) systems methods will be of great help in the development of a normative, or critical, philosophy of technology, but (2) not just any systems method will do. Systems analysis and its various close relatives, for all their success in solving problems readily amenable to quantification, are of only limited help when it comes to dealing with questions of value, especially where the most constant factor in a decision-making process is the discretion of the decision maker. Thus, it is especially important to recognize that events on different levels of organization are as important for their differences from, as for their similarities to, events on other levels. Such recognition may be

said to be the distinguishing characteristic of the movement known as General Systems Theory.

As was intimated above, General Systems Theory was developed originally by biologists, especially Ludwig von Bertalanffy, as a method that would safeguard the irreducible content of that discipline from an inappropriately mechanistic reductionism. But the approach has subsequently been applied in just about all of the social and behavioral sciences. Similarly, some biologically and ecologically favorable judicial decisions have been won through litigation conducted on the basis of a systems approach developed by Orie L. Loucks and his colleagues in Wisconsin.[60] Whether this latter is desirable or even possible is, though worthy of discussion, not directly at issue here. What is at issue is whether the longstanding divisiveness of the disciplines can be sufficiently dissipated in our time to make possible a program like Technology Studies, and whether philosophy of technology can contribute to such a program. An answer in the affirmative, it would seem, necessitates a conscious effort to view methodological considerations holistically; that is to say, as pregnant with implications as widely diverse as the incidence of schistosomiasis and the end result of economic growth. Ancient and inherited *hubris* notwithstanding, the discipline of philosophy is quite incapable by itself of setting policy with regard to any of these matters. Such limitations may not apply to a cooperative, coordinated Technology Studies, but there arises excellent opportunity for philosophy of technology to give new purpose and direction to the traditional study of meaning and method so assiduously fostered by philosophy of science. Stated somewhat simplistically, all that is required, at least at the outset, is a willingness to change one's role definition to include concern not only for the purity of science but also for the priorities of technology, not only for the rigor of the professional but also for the rights of the citizen.

FOOTNOTES

1. This multidisciplinary trend is implicit in such works as the following: Maxwell H. Goldberg, gen. ed., *Needles, Burrs and Bibliographies*, Pennsylvania State University, Center for Continuing Liberal Education, 1969; Lynton K. Caldwell and Toufiq A. Siddiqi, *Science, Technology and Public Policy: A Guide to Advanced Study*, Bloomington, Ind.: Indiana University, School of Public and Environmental Affairs, 1972. It is explicit in such programs as that of the four-year NEH-funded National Humanities Institute at the University of Chicago, which is to focus on "Technology and the Humanities."

2. A variety of articles by various philosophers over the years culminated in 1973 with Carl Mitcham and Robert Mackey, eds., "Bibliography of the Philosophy of Technology," *Technology and Culture*, vol. 14, no. 2, part II, April 1973 (205 pp.). See also their anthology, *Philosophy and Technology: Readings in the Philosophical Problems of Technology*, New York: Free Press, 1972. More recently, in July 1975, a conference organized by Paul Durbin was held

at the University of Delaware to let "Philosophers Look At Technology;" the proceedings are printed as part of *Research in Philosophy & Technology*, vol. 1, ed. Durbin, official publication of the Society for Philosophy & Technology.

3. Useful guidance in this regard will be found in Albert R. Jonsen and Lewis H. Butler, "Public Ethics and Policy Making," *The Hastings Center Report* 5 (August 1975) 19–31. The Institute of Society, Ethics and the Life Sciences, which publishes this report, is an obvious example of the kind of involvement here being recommended. Another example is that of a $149,000 NSF grant to a group of philosophers and scientists at Notre Dame University to develop techniques whereby power company executives can build social and environmental considerations into their decision-making procedures: "Project at N.D. to Probe Effects of Technology," *The Indianapolis Star*, October 21, 1973. See also Henryk Skolimowski, "The Structure of Thinking in Technology," in Mitcham/Mackey, *Philosophy and Technology*, p. 42; Emmanuel Mesthene, "Technology and Wisdom," *ibid.*, p. 115.

4. See Gerard Radnitzky, *Contemporary Schools of Metascience*, 2nd rev. ed., 2 vols. in one, New York: Humanities Press, 1970, II, pp. 119–20, 128.

5. John Herman Randall, Jr., *The Career of Philosophy from the Middle Ages to the Enlightenment*, New York and London: Columbia University Press, 1962, p. 567. See also Allen Wheelis, *The End of the Modern Age*, New York, *et al.*: Harper Torchbooks, 1973, pp. 42–3; Edmund F. Byrne, *Probability and Opinion*, The Hague: Martinus Nijhoff, 1968, pp. 278–305; Edward A. Burtt, *The Metaphysical Foundations of Modern Physical Science*, rev. ed., Garden City, N.Y.: Doubleday Anchor, 1954; Karl Popper, *Conjectures and Refutations*, London: Routledge and Kegan Paul, 1963, pp. 97–119.

6. Quoted in Henry Guerlac, "Three Eighteenth-Century Social Philosophers: Scientific Influences on Their Thought," in *Science As Metaphor*, ed. Richard Olson, Belmont, Cal.: Wadsworth, 1971, p. 96.

7. Radnitzky, *op. cit.*, p. xxx.

8. Quoted in C.C. Gillispie, *The Edge of Objectivity*, Princeton, N.J.: Princeton University Press, 1960, pp. 154–5.

9. Ernest Nagel, *The Structure of Science*, New York: Harcourt, Brace and World, 1961, p. viii.

10. *Philosophy of Science*, Englewood Cliffs, N.J.: Prentice-Hall, 1957, p. 359.

11. See J.D. Bernal, "After Twenty-Five Years," in *Society and Science*, ed. Maurice Goldsmith and Alan Mackay, New York: Simon and Schuster, 1964, pp. 209–28.

12. Jerome R. Ravetz, *Scientific Knowledge and Its Social Problems*, Oxford: Clarendon Press, 1971, p. 66.

13. See AAAS Commission on Science Education, *Science for Society: A Bibliography*, 3rd ed., Washington: American Association for the Advancement of Science, 1972.

14. Radnitzky, *op. cit.*, pp. xii, II, pp. 132, 139.

15. Peter Winch, "Philosophical Bearing," in *Philosophy of the Social Sciences: A Reader*, ed. Maurice Natanson, New York: Random House, 1963, pp. 103–5.

16. Radnitzky, *op. cit.*, p. xxx.

17. Ryle's now classic critique of what he called "Descartes' Myth," often reprinted, occurred originally in *The Concept of Mind* (London: Hutchinson and New York: Barnes & Noble, 1949), a work whose reunifying intent and whose emphasis on learning behavior are functionally if not methodologically in accord with the position here being defended.

18. Mitcham/Mackey, *Philosophy and Technology*, p. 3. See also Ryle, *op. cit.*, pp. 25–61.

19. I.C. Jarvie, "The Social Character of Technological Problems: Comments on Skolimowski's Paper," in Mitcham/Mackey, *ibid.*, p. 50.

20. Emmanuel Mesthene, "How Technology Will Shape the Future," in Mitcham/Mackey, *ibid.*, pp. 122, 127.

21. Ortega y Gasset, "Thoughts on Technology," in Mitcham/Mackey, *ibid.*, pp. 312–13.

22. I.C. Jarvie, "Technology and the Structure of Knowledge," in Mitcham/Mackey, *ibid.*,

p. 59; Mario Bunge, "Toward a Philosophy of Technology," in Mitcham/Mackey, *ibid.*, p. 62 ff.

23. See, for example, Floyd W. Matson, *The Broken Image*, New York: Braziller, 1964; Ernest Becker, *The Structure of Evil*, New York: Braziller, 1968; Stephen Strasser, *Phenomenology and the Human Sciences*, Louvain: Nauwelaerts and Pittsburgh: Duquesne University Press, 1963; Lewis Yablonsky, *Robopaths*, Indianapolis and New York: Bobbs-Merrill, 1972; Charles Hampden-Turner, *Radical Man*, New York: Schenkman, 1970; Anchor, 1971.

24. *General System Theory*, New York: Braziller, 1968, p. 87. See also Yves R. Simon, "Pursuit of Happiness and Lust for Power," in Mitcham/Mackey, *Philosophy and Technology*, pp. 184–6.

25. Milic Capek, *The Philosophical Impact of Contemporary Physics*, New York, *et al.*: Van Nostrand, 1961; Gunter W. Remmling, *Road to Suspicion*, New York: Appleton-Century-Crofts, 1967.

26. Compare Claude Levi-Strauss's distinction between (abstract) science and "concrete science" in *The Savage Mind*, Chicago: University of Chicago Press, 1966.

27. See above, n. 5.

28. Thomas S. Kuhn, *The Structure of Scientific Revolutions*, Chicago: University of Chicago Press, 1962; "The Function of Dogma in Scientific Research," in *Scientific Change*, ed. A.C. Crombie, London: Heinemann, 1963, pp. 347–69; Stephen David Ross, *The Scientific Process*, The Hague: Martinus Nijhoff, 1971, pp. 132–33.

29. *The Psychology of Science: A Reconnaissance*, New York: Harper and Row, 1966; Chicago: Regnery, 1969, p. 114. See also Victor Frankl, *The Doctor and the Soul*, 2nd ed., New York: Bantam Matrix, 1969, pp. 154–60; Gunnar Myrdal, *Objectivity in Social Research*, New York: Random House Pantheon, 1969; Edmund F. Byrne, "The Drama of Realtime Complementarity," *Philosophy Forum*, II (March 1972), 167–206.

30. Israel Scheffler, *Science and Subjectivity*, Indianapolis, *et al.*: Bobbs-Merrill, 1967, pp. v–vi.

31. *Ibid.*, p. 4.

32. *Ibid.*, p. 124. For Bunge, see below.

33. Kolakowski, *The Alienation of Reason*, Garden City, N.Y.: Doubleday Anchor, 1969, pp. 203–4.

34. Ravetz, *op. cit.*, p. 52.

35. *Ibid.*, pp. 52–3.

36. See, for example, Norman W. Storer, *The Social System of Science*, New York, *et al.*: Holt, Rinehart and Winston, 1966; Paul Dickson, *Think Tanks*, New York: Atheneum, 1971; Edwin Mansfield, *The Economics of Technological Change*, New York: Norton, 1968. 36.

37. Mario Bunge, "Toward a Philosophy of Technology," in Mitcham/Mackey, *op. cit.*, pp. 68–9.

38. *Ibid.*, pp. 69–71, 73.

39. *Ibid.*, p. 72. See also Bunge, *Intuition and Science*, Englewood Cliffs, N.J.: Prentice-Hall, 1962.

40. A. Cornelius Benjamin, *Science, Technology, and Human Values*, Columbia Mo.: University of Missouri Press, 1965, pp. 226–37. Benjamin's approach might be characterized as a serious attempt to enlarge everyone's "humanistic" understanding of science without in any way calling into question C.P. Snow's dogma of the two cultures and almost everybody's dogma of the purity of pure science and the professional irresponsibility of appied science. See below, n. 53.

41. See in this regard Spencer Klaw, *The New Brahmins: Scientific Life in America*, New York: Morrow, 1968.

42. See Max Nicholson, *The Environmental Revolution*, London: Hodder & Stoughton, 1970.

43. Ravetz, *op. cit.*, p. 424. A good sense of the range of problems being taken up by critical

science may be gained from Martin Brown, ed., *The Social Responsibility of the Scientist*, New York: Free Press, 1971. For the history of one of the best known confrontations, see Frank Graham, Jr., *Since Silent Spring*, Greenwich, Conn.: Fawcett Crest, 1970. For an almost paradigmatic example of an interdisciplinary approach to a complex problem, see *Oil on Puget Sound: An Interdisciplinary Study in Systems Engineering*, Seattle and London: University of Washington Press, 1972.

44. See Lewis Mumford, *The Myth of the Machine: The Pentagon of Power*, New York: Harcourt Brace Jovanovich, 1970; Eugene S. Schwartz, *Overskill: The Decline of Technology in Modern Civilization*, Chicago: Quadrangle, 1971; Erich Fromm, *The Revolution of Hope*, New York: Harper & Row and Bantam, 1968.

45. "Technology and the Structure of Knowledge," *op. cit.*, pp. 59–60.

46. See Lynton K. Caldwell, "Toward a National Policy for the Environment," in *The Dying Generations*, ed. Thomas R. Harney and Robert Disch, New York: Dell Laurel, 1971, pp. 300–13.

47. See Nicholas Rescher, *Introduction to Value Theory*, Englewood Cliffs, N.J.: Prentice-Hall, 1969; Rollo Handy, *The Measurement of Values*, St. Louis: Warren H. Green, Inc., 1970.

48. See Jay Forrester, *World Dynamics*, Cambridge: Wright-Allen, 1971; Dennis Meadows, *et al., The Limits to Growth*, Cambridge: M.I.T. Press, 1972; New York: NAL Signet and Potomac Associates, 1972. Rejecting the developed nations' biases that they claim are built into these studies, a group in Buenos Aires under Amilcar O. Herrera is working on a different world model with different premises and assumptions. See *World* 7/31/73, vol. 2, no. 16, p. 27.

49. An early and extraordinary exception is Edwin A. Burtt, notably in his article, "The Value Presuppositions of Science," in *The New Scientist*, ed. Paul C. Obler and Herman A. Estrin, Garden City, N.Y.: Doubleday Anchor, 1962, pp. 258–79.

50. The quotation is from Norman J. Landau and Paul D. Rheingold, *The Environmental Law Handbook*, New York: Friends of the Earth/Ballantine, 1971, p. 436. The inner quotes refer to a passage from *Walden*: "Most of the luxuries, and many of the so-called comforts of life, are . . . positive hindrances to the elevation of mankind."

51. Useful towards this end would be, for example, E.J. Mishan, *Technology and Growth: The Price We Pay*, New York: Praeger, 1969; Howard T. Odum, *Environment, Power and Society*, New York, *et al.*: Wiley-Interscience, 1971; Eli Goldston, *The Quantification of Concern*, Pittsburgh: Carnegie-Mellon University, 1971.

52. Ravetz, *op. cit.*, p. 429.

53. For a broader consideration of the "two cultures," see Goldberg, *op cit.*, pp. 113–7.

54. Ravetz, *op. cit.*, p. 430.

55. Mumford, *op. cit.*, p. 393.

56. See René Dubos, *So Human an Animal*, New York: Braziller, 1968, Herbert Marcuse, *One-Dimensional Man*, Boston: Beacon Press, 1964. See also William Kuhns, *The Post-Industrial Prophets*, New York: Weybright and Talley, 1971.

57. See in this regard, however, my paper entitled "Humanization of Technology: Slogan or Ethical Imperative?" in *Research in Philosophy & Technology*, vol. 1, ed. P. Durbin (Greenwich, Conn.: JAI Press, 1978).

58. Thomas C. Cheng, *Symbiosis*, New York: Pegasus, 1970, pp. 100–1.

59. Ervin Laszlo, ed., *The World System*, New York: Braziller, 1973.

60. For Bertalanffy, see above, n. 24. See also Van Rensselaer Potter, *Bioethics: Bridge to the Future*, Englewood Cliffs, N.J.: Prentice-Hall, 1971. For Loucks, see his "Systems Methods in Environmental Court Actions," in *Systems Analysis and Simulation in Ecology*, ed. Bernard C. Patten, New York: Academic Press, 1972, vol. 2, pp. 419–73. See also Norman J. Landau and Paul D. Rheingold, *op. cit.*, pp. 413–76; Malcolm F. Baldwin and James K. Page, Jr., eds., *Law and the Environment*, New York: Walker, 1970.

61. Alistair M. Taylor, "For Philosophers and Scientists: A General Systems Paradigm," *International Philosophical Quarterly* 13 (March 1973) 111–29.