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ABSTRACT

The problems and prospects of using science and technology to help solve world problems are briefly reviewed in this paper. Public attitudes toward these two areas have currently been changing due to recent scientific and technological developments that have been threatening or have had obvious deleterious consequences. Despite these criticisms, the need for innovative contributions from the basic and applied sciences and the physical and social technologies has never been greater. Institutional difficulties which inhibit these contributions are enormous but need to be overcome if science and technology are to make more important contributions to the solution of world problems and to improvements in the state of man. Possible institutional arrangements include the development of global models to which analysts in countries throughout the world contribute, a new United Nations organization which would conduct system studies and publish lists of urgently needed science and technology, the establishment of internationally linked science policies, a supranational team of experts, and an international monitoring system to forecast impending world crises. (Author/DE)

CAN SCIENCE AND TECHNOLOGY HELP SOLVE WORLD PROBLEMS?*

T. J. Gordon

Scholars looking back at our time a hundred years or a thousand years from now may well name it the age of the transistor, or the computer era, or the century of synthetics. They are likely to describe our late twentieth century as a complex civilization functioning through the grace of a well-oiled technology. It may seem to them a society which, in advanced countries at least, ate what the machine manufactured and wore what it wove, traveled where its steel treads went, under water, under earth, or into space--and lived in a synthetic, controlled environment, carefully chosen to stimulate our senses and promote our well-being. Despite certain embarrassing pockets of poverty, they will find that we had greater health and more luxury and oppulence than any society before us.

But they will have missed the point. Not only have we created this glittering era, we have, at this particular point in time, come to question our motives for doing so and for continuing to do so, and <u>that</u> is the essence of our time. Those future scholars, granted sufficient insight about these self-doubts, might call our time either the Age of Conscience or the Age of Cowardice; only from the perspective of history will we be able to tell which name fits us best.

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In short, what is unique about our time is that we have become concerned about the future which we are creating. We now know technology has its costs. We now know that there are risks to progress. And we now question where change is taking us, and properly so. Yet, if the answer leads to stopping technology and distorting science, we will have missed the chance, perhaps the only chance, to mitigate the coming world crises. The issue I wish to address is how to direct science and technology to better serve the interests of humanity.

As you know, and as you will hear again and again throughout this Conference, the world, in the next three decades, is facing problems of unprecedented complexity and importance. Indeed, all of these issues face us now and promise to intensify in the next immediate instant of time. They elude solution for many reasons: they are systemic--acting on one may intensify another; they require global perspective--attempts to correct the issues may require unprecedented international cooperation; they are oriented to the long term--that is, they require giving priority to long-term considertations over short-run payoff.

There is at least one more important characteristic of these problems: they all interact strongly with science and technology. Future scientific and technological developments could help solve or intensify most of these issues. The nature of this interaction is the focus of this paper; the discussion is presented in the following 7 steps:

1. Recognizing that advancing science and technology has sometimes had significant costs in terms of social and human impacts, intellectual criticism of both science and technology has been mounting. The view that technology can continue to solve problems is challenged; critics believe that further technological development may bring a net social loss.

2. Whether in response to or leading this criticism, public attitudes toward science and technology have been changing as well.

3. It is, in fact, true that some scientific and technological developments of the recent past have been threatening, and have had obvious deleterious consequences. There are prospects for more such inventions in the years immediately ahead.

4. Science occasionally produces intrinsically threatening developments because its structure is asocial--that is, social need is not a major determinant of the direction of research.

5. Technology, on the other hand, is directed by sources of funding. Funding is largely controlled by mission-orientation of government agencies and industrial interests.

6. Despite the rise of an intellectual anti-technology movement, and a similar popular sentiment, and despite the odious technologies of the past, the need for innovative contributions from the basic and applied sciences and from the physical and social technologies has never been greater.

7. Yet the institutional difficulties which inhibit these contributions are enormous. If they could be overcome to some extent, science and technology could make more important contributions to the solution of world problems and to improvements in the state of man. We must work to that end.

On the first point--the criticism by intellectuals of science and technology--here are some of the points of articulate critics.

- Science and technology may, through inordinate growth, become increasingly irrelevant to any human interest except that of the technologist or corporate enterprise.

- Scientific projects, as practiced today, require that the human being stand apart from nature as an isolated spectator or pit man against nature.

- And when scientists argue that it is their task merely to understand nature, not to determine how knowledge of nature will be used, critics answer: Why has science systematically taught our society to regard knowledge as a thing apart from wisdom?

- Science is being used to create new technologies which have nothing to do with human need--only to create new human wants.

- Scientific and technological knowledge can be equated with power; but, as knowledge and specialization grow, power based on knowledge becomes increasingly centralized.

- Scientific and technological achievements which seem to have beneficial primary consequences often have pernicious side effects.

- And, the most obvious point of all, technology can be put to bad as well as good use--but as we develop more powerful technologies, the deleterious applications can become much more pronounced and more often outweigh the benefits.

The image that emerges from these criticisms is one of science serving technology, and technology serving unreasoning economic drive--acquisitive, depleting, polluting--moving in directions which cause dehumanization, desensitization, and unexpected side effects which are most often deleterious.

These attitudes are coming to be reflected in public opinion as well. A recent study indicates, for example, that the public can make discriminations between science and technology, and that it is considerably happier about science than they are about technology. This study found:

- The public's reaction to the impact of technology upon society is one of wariness and some scepticism.

- The public applies a rather wide range of sometimes contradictory values to its evaluation of technology.

- The public has a distrust of the institutions associated with decisionmaking in the technical policy areas.

- A clear element of political ideology is present in the evaluations of technology made by an important segment of the public.

If these findings are representative, they indicate that in 1974 at least, almost 80 percent of the people no longer believed that technology would come along to solve our problems.

Simultaneously with the change in attitudes, we increasingly find it possible to identify examples of potentially dangerous future inventions. No doubt the method of conducting science and developing technology has been immensely successful. Certainly science and technology have made it possible for men to live with higher material standards than ever before. But there is nothing in the way basic science is accomplished, in the way applied science is funded, or in the mechanism for creating technology which suggests that capabilities which are merely new will be what society needs to avoid the major problems which are likely to develop in the next few decades. Indeed, in the search for such new capabilities, we may be on the verge of achieving some very threatening technologies. Some of these--if they are actually realized--will be institution-rocking achievements, and, for the most part, their needs are in current research.

Now, science is not unconstrained. It moves in directions which are largely determined by the scientific reward system and the scientific method itself. As critics have agreed, these guiding factors are not in fact related in any reliable way to social need; on the contrary, they may produce results which are socially catastrophic.

Why do researchers rush into newly opened problem areas? Because the reward system which society and science itself has devised for scientists involves reputation; reputation requires discovery and publication; discovery and publication require the performance of spectacular and original work; and, clearly, most opportunity for spectacular and original work exists at the new frontiers of knowledge. The problem is that the new frontiers too frequently do not coincide with the needs of society.

What reputations are to the directions of basic science, funding is to the directions of technology. When President Eisenhower departed from office, he made a well remembered speech about the dangers of the military-industrial complex. In the same address, he said, "the prospect of domination of the Nation's scholars by Federal Government, project allocation, and the power of money, is ever present, and is gravely to be regarded." He who pays the piper still calls the tune.

In short, while it can be argued that basic research produces inventions that are asocial because of the methods of science, R&D as a whole has links to social need only insofar as the missions of the agencies which fund it are in the social interest.

The United States currently devotes about 2.5 percent of its GNP to the performance of research and development. In view of the problems which face use, should a nation such as ours be content to spend only 2.5 percent of its GNP on R&D? Whatever the level of expenditures, are we spending the money in the places where it will do the most good?

Take an inventory of world crises and ask whether science and technology could help avoid these issues or at least diminish their intensity. The answer is most probably.

Indeed, the opportunities for contribution abound. The problem with forming lists of opportunities is that they are "shotguns" and give no information about priority or desirable resource allocation. But there are some approaches to research planning which do provide at least crude insight into issues of priority. The catch is that they involve more formal planning than we've known in the past. And, the problem with implementing this kind of

structured planning leading to more relevant and helpful science and technology is, of course, primarily institutional. Here are some of the more important institutional considerations:

- The predelicition of many scientists is to resist structured planning.
- Within the U.S. and most countries, funding agencies respond to problems which are popular, national in scope, and already in existence; unpopular, global, and forecasted problems receive little attention.
- Within the United States, science policy is essentially non-existent.
- There are few organizations with global perspective which have any prospect of making large-scale contribution to the solution of world issues through science and technology.

As pointed out earlier, all of these institutional problems exist in a social context in which the adverse consequences of prior and forecasted scientific and technological developments are real and in which, as a result, anti-technology sentiments are apparent. And an integral part of this social context is that there are two contrasting views on the organization of scientific research: one holds that a goal structure is becoming more necessary in our modern society; the other, that a visible goal structure is inimical to scientific progress. It is apparent that many scientists responsibly recognize this dilemma.

In the United States, as I have suggested, we are very distant from any sort of science and technology planning. But, if there were to be a cohesive science policy, where would it originate? From the White House? From the National Science Foundation? From the National Academy of Sciences? In the Congress? In OTA? Within the scientific community itself? Would these in-

stitutional arrangements be able to do the kind of planning that is necessary to deal with the challenges and opportunities presented by science and technology?

There are other possibilities. I urge you to consider them. Imagine the development of global models to which analysts in countries throughout the world contribute. Each model runs in real time and is interactive, so that decisionmakers in the various countries can test proposed actions using the model and, within its domain, identify the flow of consequences from their actions.

Imagine a new U.N. organization which would conduct system studies of the sort described here and publish lists of urgently needed science and technology, the successful accomplishment of which would be viewed as a contribution in kind from the orginating nation and thus reduce its fiscal obligations. This would hopefully inject new reward mechanism into the mechanics of science and technology.

Imagine the establishment of internationally linked science policies.

Imagine an operational foresight function within the legislatures of various nations which bring incipient problems to the attention of law makers.

Imagine supra national teams of experts--technicians, scientists, policy analysists, administrators--available to tackle issues which relate to their expertise anywhere in the world.

Imagine an international monitoring function--the input to a world crisis information system which would track and forecast the rise and fall of measures related to the probability, intensity, and geography of crises.

Such steps will not come easily, but, in my opinion, they surely will come. For it is through the creation of such new institutions and capabilities that science and technology can be better mobilized in the interest of global society. Without planning, all we can say is that new science and technology may help or they may intensify world problems--or they may do both. We can do better than that.