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The Social Function of the Scientist

A scientist already renowned for his experimental work, J. D. Bernal was a pioneer in the systematic examination of the reciprocal relationships of Science and Society. In this article, I will deal with a number of issues bearing on those themes. Despite my doctrinal differences with Bernal's Marxist perspective, and my stress on a U.S. experience versus his in Britain, I have found much that was inspiring and provocative in his writings, throughout most of the 50 years that have elapsed since his "Social Function of Science".

Had I shared his disillusionment about the automatic benefits to humanity from scientific discovery, I might have been deterred from my initial commitment to a scientific career - one that also goes back five decades. We recall that 1939 was the climactic beginning of World War II; it also occasioned the World's Fair in New York City, a celebration of the applied benefits of science, nowhere better epitomized than by the slogan of the DuPont Corporation: "Better Things for Better Living - Through Chemistry".

Six years before, Albert Einstein, already had to reverse his prior uncompromising pacificism, and urge the Western democracies to mobilize for the defeat of Hitler. In the U.S., the mobilization of science and the development of nuclear weapons followed from the same imperative of preempting Hitler. The consequent culmination of that scientific and technological effort in 1945, was the division of the world into sovereign, nuclear-armed superpowers. As Einstein tirelessly taught, this has undercut any simple ethical or political constructs of the humanitarian consequences of scientific advance. It has left all scientists deeply concerned about their obligations to society. For a generation, it has also necessitated that nuclear physics be consulted in the highest levels of discussion of national policies. This has been a precedent for a new relationship of all scientific expertise to government, to the enlightenment of the electorate, and to private conscience.

Bernal had commented that Descartes, faced with Bruno's immolation, established the ground rules of the relationship of science to the ecclesiastical establishment, that these should be mutually incommensurate and non-interfering spheres. That philosophy has endured up to the modern era in the relationship of science to statecraft as well. Since 1945, the relationship has been in unresolved crisis: on the one hand, the consequences of science to the social order are too important to be relegated to the sidelines. On the other, the political establishments

of all persuasions prefer to "Keep scientists on tap, not on top". In-sufferable as this doctrine is, scientists must take care to ask whether they can achieve a greater influence on policy without also invoking the converse, more explicit political control of the conduct of science.

My essay will pick up from Descartes' dilemma. After reviewing the diverse roles of scientists in contemporary society, I will return to some prescriptions about their overarching responsibilities, about the social function of the scientist. In my view, to tell the truth is the categorical imperative.

In contemporary society, the scientist is the one who discovers. We should complicate our definition of discovery, usually given as the uncovering of new knowledge; hidden here is the premise that all "old knowledge" is visible and understood. Furthermore, what is discovered must be important, it must meet some canon^{ical} criteria of significance: implicitly we look for an extension of understanding of the natural world. This embraces experimental facts, but, quite as importantly, theoretical insight and the recording, communication, persuasion and dialectic of those insights. All this implies a community of scientists. Without such engagement in that community, without a forum for insistence on and organized, skeptical criticism of claims of conceptual novelty, factual discovery would be useless for still further increments, would be totally sterile. Science is then inherently a social enterprise; an important social function of science is the design and management of its own organization so as to optimize the creative possibilities of its practitioners, and at the same time generate the fruits that justify the ever more costly social investments needed for science to continue. As Bernal repeatedly insisted, and to this day, most political establishments are relatively unsophisticated in their understanding of the essentiality, difficulties, and inevitable long time scales of basic scientific research. They tend to be captivated by nicely encapsulated albeit sometimes very costly projects whose goals appear to be well-defined at the expense of maintaining an alert community able to create and capitalize on the most important - which are always the unexpected - discoveries.

My first assertion is that the preeminent social responsibility of the scientist is the integrity of science itself: to engage in discovery to its furthest reaches as a personal goal, to be part of the community of discussion and criticism, to maintain the ethics of truth-telling, to use no other standards than those of scientific accomplishment in the selection and the operation of the managers and gatekeepers of science. To satisfy these responsibilities goes beyond being the most efficient technician in the elicitation of scientific fact, which is the orientation of today's highly specialized disciplinary training. It requires relentless criticism of others' ideas, and equity and compassion in dealing with their claims for personal standing. It may require a

broader study of reaches of science, so as to explore their interconnections, than is achievable in school; and likewise an attentiveness to history, to an understanding of what is known, that may be momentarily a distraction from today's new experiment.

This ideal is not always congruent with the interests of the organization, the corporation or the state. The truth is not always the superordinate goal of political affairs, self-deception being even more prevalent than malice. But if scientists ever compromise themselves on this principle, Nature will be no more forgiving than will be a society which has nowhere else to turn for objective analysis of technically convoluted affairs.

Descartes' compromise was negotiated under force majeure; it was motivated by saving for science its integrity within the sphere in which it could authentically operate. His patience paid off: all the theological fuss about heliocentrism and evolution has hardly impaired the claim of contemporary dogmas to spiritual authority. They have had to acknowledge that their primitive pioneers were over-zealous in looking to descriptions of the natural world as having any bearing on the eschatological province. Bruno and Vavilov were both victims of crude fundamentalisms that no one defends today.

In the present era, scientists are often called upon, and some volunteer as well, to give advice to society on a multitude of questions requiring scientific expertise. Many of these fall in the category of risk-cost-benefit analyses: the greatest frustration of the scientific expert is in dealing with expectations of perfect safety or zero pollution (in contradiction to an Avogadro's number, 6×10^{23} molecules per gram-mole that assures us that every breath we inhale contains at least one particle of Nefertiti's perfume). At the next step of that analysis, it may be equally frustrating to be driven to conclusions when the evidential basis remains tantalizingly fragile. However, the scientist has the ability and the responsibility to bring to the analysis the same attention to objective fact, and its delineation from value inclination, as inheres in an experiment: it is impossible to free oneself from bias, but the exercise of scientific judgment within the discipline of the peer group can go far to identify what are the value-oriented, what are the scientific underpinnings, of the tradeoff analysis.

A byproduct of playing a key role in major social decisions is the double-edged scalpel of political power. Many scientists may seek more influence in the political process, partly out of a conviction of what the scientific mind can bring to it, partly for the usual human motives of ambition and quest for power and prestige. I have no doubt that government could be vastly improved by changing the proportion of scientists to lawyers in its legislatures and at the top reaches of the executive. The danger is the inversion of the process: can scientists live at the court of the Prince, can they gain more political power and prestige

without the intrusion of political criteria for advancement within the scientific community? Can they achieve their fair share of affluence without being corrupted? Where else can society turn for untarnished advice on matters that may have immense political and economic consequences?

Finally there is the unbidden advice, the foresight about future extrapolations for which early warning may have inestimable social value. It is said that "prediction is difficult, especially about the future." However, scientists are better experienced than most prophets in articulating predictions as hypotheses; the ability to make confirmable predictions is the core of experimental science. That art, together with an understanding of technical complexities of matters pertaining to the environment, to human biology, to weapons effects, to technological capabilities of different groups or countries over time, is indispensable in helping a society foresee the long term consequences of its policies in all those spheres. Many scientific advances in this century - nuclear fission is the prototype - have elicited well-founded anxieties about the compatibility of quarreling national sovereignties with the survival of human culture. We are so far from a feasible world model of supranational control of such enormous powers of destruction that scientists today have a special responsibility to assist in the design of the interim arrangements of inter-national accommodation to domesticate such powers. I say scientists, for it is unlikely that other vocations have offered a comparable realism about the destructive power at stake or the possibilities of its containment.

Some say that scientists in a given country should simply refrain from conducting science that could have such fruits. How futile that is! On the one hand, who could have foreseen that studying atomic structure, teasing out the neutrons, could so quickly result in weapons; one would have to suspend all science for that assurance. On the other, that abjuration might offer some self-satisfaction to the individual scientist, but it can hardly alter natural fact. Instead, it merely assures that the technological breakthroughs will be the monopoly of the most unscrupulous. Even with their limited prophetic vision, nevertheless, scientists are uniquely situated to extrapolate the future possibilities of technological advance, to offer all possible early warning to what "society" must do to reap the most benefits, risk the least harm. Today's world, divided North/South as well as East/West, offers many impediments to constructive responses to global threats, be they from natural, social or technological sources. All the more reasons for the utmost clarity of foresight.

Those foresights, together with the inherent supra-national character of scientific advance, have made the scientific profession uniquely motivated and practised in sustained international concern and dialogue. This is already enough to alarm sovereign states, which

have sought to humiliate an Oppenheimer, to keep a Sakharov in internal exile. In the past a country that constrained scientific freedom could do great injury to its own development, as we know from the examples of Vavilov, and from the Jewish scientists exiled from Germany and Italy before World War 2. Today, there is an even broader stake. These lines are written during an exhilarating turnaround of East/West perspectives on nuclear arms control: for the first time in decades, we foresee the possibility of reversing the accumulation of the most destructive weapons. The broad range of political conflict aside, the fear generated by these weapons has achieved a life of its own in sustaining security anxieties. We see bold proposals, and new approaches to verification including on-site inspection, that were unimaginable a few years ago. In a short time, "Glasnost" promises to reopen an unprecedented scope of individual expression in the Soviet Union. We can therefore be newly optimistic, and should be correspondingly insistent, about the development of a framework of East-West confidence that can lead to still more comprehensive measures. Scientists could play a special role as monitors of sovereign compliance with international order. They have the skills, they have the motivation; it remains for them to receive and sustain the freedom.

In the long run, and when the gravest security interests are at stake - as applies with the most substantial reductions of arms - self-inspection and self-monitoring must be a centerpiece of verification and compliance. The investigative press, the Congress, and the concerned scientists play that role in the U.S. to a degree that only today's Glasnost would permit us to imagine in communist countries. In all countries, still more robust legal guarantees of freedom of access to information and of expression, of assembly and of movement are necessary. The traditions of truth, of international communication, of supranational concern, of personal courage have marked many notable scientists as trusted guardians of shared values. They are often nuisances to the established order, sometimes to the tranquility of their own fraternity. But they may be the keystone of the phasedown of arms and of international hostility which is the precondition of survival of any stable social order. That goal is shared by all governments. An indispensable means is the commitment of every government to assure the freedom of expression of its own scientists, to make them credible as tellers of the truth, and of scientists to make themselves worthy of that confidence.