

Purists and Politicians

Under fire from economic reaction and romantic rebellion, science must look to its political strategy.

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Sometimes the tone of a headline tells you more than the news. Last summer a *New York Times* headline read "Pure Physicists Stay That Way: Vote to Remain Out of Politics." The story was a straightforward account of the decision by the members of the American Physical Society that it would adopt no resolutions on political issues (1). The flavor of the headline suggested a great deal more: that the typical newspaper readers and perhaps even a good many scientists are still inclined to think that the moral obligation of a scientist is to remain aloof from policy issues and political controversy.

Since I applauded the tactical decision of the physicists but deplored the implications of the headline, it occurred to me that this apparent contradiction was worth some further thought. Perhaps it is the crux of the apparent dilemma which the entire scientific community shares with the physicists. The dilemma is ages old—the dilemma between truth and power, or, rather, between starving in the pursuit of truth and compromising truth to gain material support. But it takes its new form in the dilemma posed for the scientific community as it now comes under attack simultaneously from two sides—from a political reaction and from a new kind of rebellion.

This attack from the two extremes makes it hard for the scientific community to continue its traditional political strategy, especially since—as sometimes happens in politics—the two

extremes may in effect be allies, even though superficially in conflict.

The traditional political strategy of scientists has been to keep their sights set firmly on the advancement of basic knowledge in the conviction that their mode of thinking is in the vanguard of political and economic progress, and at the same time to persuade politicians and philanthropists to support science for its indirect payoffs in power and wealth.

This strategy was based on a belief in automatic progress that had its origins in the same way of thinking that produced economic laissez-faire. Scientific knowledge, like economic initiative, could be relied on to produce progress if government could be persuaded not to interfere, except with the necessary subsidies.

The Two-Front Attack

But now, under attack on two fronts, scientists find this strategy harder to sustain.

On one side, the attack comes from a political reaction, which has three main purposes. Politicians want to cut down on the appropriations for research, to have more of the money spent on practical technology and less on academic theory, and to break down the degree of autonomy which the leaders of the scientific community gained a generation ago in the procedures by which research grants are dis-

tributed. On each of these points the reaction conforms to the best American tradition of the political pork barrel.

On the other side, the rebellion is a cosmopolitan, almost worldwide, movement. One is tempted to identify it with its violent and fantastic and adolescent fringe—flower power and student insurrections. Obviously, the young are the ones who charge the cops in Chicago and barricade the buildings at Columbia or Berkeley. They have to be: my contemporaries no longer have the muscle and the wind for such exertions. Today's youth are indeed the student activists, just as today's youth are the infantry in Vietnam. But it would be as much a mistake to give the student leaders credit for the ideology of the rebellion as to give the G.I.'s credit for the war plans of the Joint Chiefs.

The ideology of the rebellion is confused; you can find in it little clarity or consistency of purpose. Its mood and temper reflect the ideas of many middle-aged intellectuals who are anything but violent revolutionaries. From the point of view of scientists, the most important theme in the rebellion is its hatred of what it sees as an impersonal technological society that dominates the individual and reduces his sense of freedom. In this complex system, science and technology, far from being considered beneficent instruments of progress, are identified as the intellectual processes that are at the roots of the blind forces of oppression.

For example, André Malraux, denying that the problem is one of conflict between the generations, says that "the most basic problem of our civilization" is that it is "a civilization of machines," and that "we, for the first time, have a knowledge of matter and a knowledge of the universe which . . . suppresses man" (2).

Jacques Ellul, one of the heroes of alienated young Europeans, presents a more systematic indictment of scientists

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as "sorcerers who are totally blind to the meaning of the human adventure," whose system of thought is bringing about "a dictatorship of test tubes rather than hobnailed boots" (3).

The theme was echoed by Erich Fromm in his support of Senator McCarthy's presidential candidacy, in a public protest against the type of society in which "technical progress becomes the source of all values" and we see as a consequence "the complete alienation and dehumanization of man" (4).

Herbert Marcuse, who is of course the favorite philosopher of the rebels, reduces the issue to its fundamental point (5): "the mathematical character of modern science determines the range and direction of its creativity, and leaves the nonquantifiable qualities of *humanitas* outside the domain of exact science . . . [which then] feels the need for redemption by coming to terms with the 'humanities.'"

In one sense, the challenge does indeed come from the humanities. The student rebels and their faculty sympathizers, at home and abroad, are found more conspicuously in the departments of humanities and in schools of theology than in the natural sciences or engineering (6). If the danger comes from the humanities, however, it comes not because they are politically powerful but, rather, because, as Mr. Marcuse suggests, they may have convinced scientists themselves that science is an inhumane discipline. The case for *laissez-faire* vanished when businessmen themselves became aware that unregulated initiative brought depressions and economic disaster. The potential effects of the power created by modern science and technology are so obviously dangerous to the modern world—whether in terms of the cataclysm of war or the slower but equally disastrous degradation of the environment—that it would not be surprising if even scientists should wonder whether we have been reduced to these dangers by the reductionism of their system of thought.

The Pressure from the Reaction

Most scientists try to avoid thinking about this basic problem very much because they are apt just now to worry more about the reaction than the rebellion. For the reaction touches sensitive budgetary nerves in anyone who is a laboratory director or a department

chairman or even an aspirant to a fellowship.

I think this choice is a mistake. The reaction is a tolerable discomfort, the rebellion a fundamental challenge—and a challenge that poses problems scientists should think about critically rather than dismiss with contempt.

It is easy and misleading to blame the reaction on the Vietnam war and therefore to sympathize with the anti-military sentiments of the rebellion. But this view overlooks the facts that two earlier wars produced more money and autonomy, not less, for science, and that the civilian agencies of government (including those with some of the most generous and humane purposes) have been more likely than the military to insist that research funds be spent on practical problems, and that they be distributed more evenly among universities and regions.

Indeed, it seems to me that the reaction mainly uses the war as an excuse, and it is hard to see how the reaction could have been so long delayed. In slowing down the rise in appropriations, congressmen were reacting naturally to the projection of curves on the budgetary graphs that lumped basic science together with engineering development. In emphasizing application, they responded to the salesmanship of scientists who told them in congressional hearings a great deal about how science would make us healthy and wealthy, and very little about how it would make us wise. And, in their avarice on behalf of their own districts and institutions, congressmen differed only in degree from scientists themselves. In these practical ways, the reaction is in the highest tradition of the English-speaking scientific world, which has always assumed that science was justified in large part by its contribution to material welfare—the tradition of Francis Bacon, who caught cold and died while trying to learn how to refrigerate poultry, and of the Royal Society, with its initial interest in "Manufactures, Mechanick practices, Engynes, and Inventions," and of Ben Franklin's American Philosophical Society, "held at Philadelphia for promoting useful knowledge."

The Novelty of the Rebellion

But the rebellion is a different matter. It is the first international radical political movement for two or three

centuries (I am tempted to say since Francis Bacon) that does not have material progress as its purpose. Far from proposing to use science and technology to improve the material welfare of the poor, it rejects technological progress as a political goal. Far from calling on government to distribute the fruits of technology more equitably, it denounces big organization in government and business indiscriminately. For three centuries science has worked on the comfortable assumption that it could pursue fundamental truth and at the same time contribute to human welfare and humane values. Since Bacon, revolutionary leaders have accepted this assumption and considered science to be in the vanguard of political progress. But now the rebels say that science, by its intrinsic nature, has reduced itself to an inhumane mode of thought, and our polity to an engine of oppression, and so they conclude that humane feelings demand the overthrow of the whole system, if necessary by an irrational rebellion.

Even though many of the young rebels call themselves Marxists, the guiding spirit of the rebellion is as much in conflict with Marxism-Leninism as with Western democracy—perhaps more so, because communism believes that science can provide the basis for political values, and the New Left considers the degree of scientific influence over our political system a disaster. Communism is a system of rigorous discipline and meticulous dogma; the New Left has neither. It is more like a religious heresy, renouncing a concern for power and wealth, than like a political movement, and even its emphasis on drugs and sex is reminiscent of the antinomian rebellions of the Middle Ages (7).

The rebels are right when they complain of the symptoms of sickness in modern society—symptoms that afflict the Communist as well as the capitalist world. We have not learned how to make our technological skills serve the purposes of humanity, or how to free men from servitude to the purposes of technological bureaucracies. But we would do well to think twice before agreeing that these symptoms are caused by reductionism in modern science, or that they would be cured by violence in the name of brotherhood or love.

As the first step toward a diagnosis of our problem, we must admit that, as scientists, we have not been very clear in the past as to the basic relation of

science to politics. When the rebels charge science with destroying freedom by subverting moral values or controlling policy decisions, we cannot dismiss the charge by repeating the old principle that political authorities determine policies on the basis of philosophical or moral values, and that scientific knowledge only tells us how best to carry out those policies—that is, tells us the best means to those ends. This reply will no longer do. In Marxist countries official dogma holds that science determines the basic values, and in America many scientists have been hypocritical on the issue; they use the old formula as a defense for public relations, even though they realize that science has, and must have, a profound influence on values, and are inclined to believe that science could provide the answers to policy questions if politicians were not so stupid.

It is high time that we become more critical—instead of hypocritical—in facing this fundamental issue. As we do so, we should remember that the relationship of science to politics has at least three aspects. They are knowledge, institutions, and policy.

Knowledge

Let us consider knowledge first. The way people think about politics is surely influenced by what they implicitly believe about what they know and how they know it—that is, about how they acquire knowledge, and why they believe it. In traditional political systems—a few still persist in the world—issues were decided on the basis of immemorial custom, religious tradition, or the divinely sanctioned will of a ruler. Before this could change to a system in which elected assemblies could consider facts—perhaps even on the basis of scientific evidence—and then deliberately enact policies, a revolution in the nature of knowledge had to take place. That long slow revolution went along with the progress of science, and the main line of progress has of course been that of *reduction*—the change from systems of thought that were concrete but complex and disorderly, and that often confused what *is* with what ought to be, to a system of more simple and general and provable concepts.

It is clear, as Mr. Marcuse points out, that this reduction of knowledge to its abstract and quantitative bases is a calculating approach to reality that

makes no allowance for humane sentiments or moral judgments. It is also clear that serious practical politicians who disapprove in theory of Mr. Marcuse may agree with him in practice, and may fear that reductionism will impair our political responsibility. For example, leading candidates for political office have charged that the Supreme Court's weakness for sociology and statistics is eroding the moral fiber of the nation, and congressmen in committee hearings have expressed concern that the new mathematical techniques of systems analysis may dominate our strategic decisions.

But it is not at all clear to me that reductionism is a threat to political freedom or responsibility. In their practical political behavior, scientists are not quite so consistent or doctrinaire. To say that science feels the need for redemption seems to me (if I may use a technical literary term in addressing a scientific audience) a pathetic fallacy. Science feels nothing. Scientists have feelings, and on political issues their feelings seem to me to be just as varied and moralistic as anyone else's.

On a more theoretical level, it seems to me that reductionism has not been pushing scientists generally toward a belief that science as such can solve the issues in which the average man is most interested, or can determine the nature of the political system. Although other branches of science admit their growing reliance on mathematics and physics, they seem no more likely than they were a century ago—perhaps less likely—to assume that they can solve all their problems by reducing their disciplines to atomic or subatomic bases.

The notion that scientific advance cuts down the freedom of the human spirit, and reduces the range of choice open to mankind, is an obsolete idea; on the contrary, every new grand simplification opens up a new range of complex questions for exploration. Man found it hard to change from the astronomical conception of a closed world to one of an infinite universe; the notion that scientific advance on reductionist principles will cut down our freedom, in either intellectual or political terms, seems to me the result of hanging onto an obsolete and narrowly mechanistic 19th-century conception of science.

Before we decide that the remedy for our present disorders is to put moral sentiments back into science, it

may help us to remember that science is not the only mode of thought which has gone through a reductionist trend and then found that the simpler abstract concepts provided less specific guides to action than one might hope. If reduction is the change from complex and disorderly ideas that confuse what *is* with what men would like, to more simple and general (if not always provable) beliefs, the change in theology from polytheism to monotheism was reductionist, and so was the change from the Ten Commandments and the intricacies of the Talmud to the simpler commandment to love God and your neighbor as yourself. And in theology, as in science, reductionism brought a shocking denial that natural laws were in harmony with human righteousness: "for He makes His sun rise on the evil and on the good, and sends rain on the just and on the unjust."

If science can learn any lesson from theology on this point, it is that reductionism does not cause the political problem, nor can it solve it. For the simple law of love was taken, over the centuries, as the antinomians' justification for the abandonment of all moral laws as well as for the rigorous moralism of Calvinist Geneva and the Spanish Inquisition, for the anarchy of the hermits and the Ranters as well as for the ruthless tyranny of the Byzantine emperors.

The trouble with reductionism, as far as politics is concerned, is not that it gives *all* the answers to the important issues but that it gives hardly any. I suspect that the current attacks on science come less from those who have always feared it than from those who were frustrated when they tried to put too much faith in it. To them, it was another god that failed. Science is quite impartial in debunking idols—its proudest claim is that it is always debunking itself.

Institutions

If we are concerned with political freedom we cannot concern ourselves only with the theory of knowledge. Reductionism in science is not the real problem. We do harm not by reducing science to its mathematical bases but only by reducing men to a concern for nothing but science. As we ponder the political status of science it may help us to recall that freedom of religion

resulted less directly from the reformation of theological thought than from the competition of dissenting churches and from changes in the political system itself. That brings us to the second aspect of the relation of science to politics—institutions. And so we must face the question whether a scientific and technological establishment, or the aggregate of scientific and technological institutions, is a threat to freedom, especially because of its intimate alliance with a bureaucracy managed on scientific principles.

At the same time that science has been reducing knowledge to fewer and simpler general concepts, society has been expanding the number and the variety of the institutions that develop and apply that knowledge. From the traditional community ruled by a priest-king, combining in one set of institutions political power and the preservation and transmission of traditional knowledge, has been evolved the complex structure of modern society. This process of *specialization* has separated from the center of political power various more or less autonomous institutions that are then permitted to operate according to their own functional requirements.

The fundamental basis for the freedom of specialized institutions is that the public recognizes that they can do their particular job better for society if they are not immediately controlled by those who hold ultimate political power. The business corporation can be more efficient, the scientific laboratory can be more innovative, if it is granted substantial autonomy. And the same principle works, within limits, within the formal structure of government itself; it is the justification not only for a nonpolitical judiciary but for a professional diplomatic or military service and for a civil service run on merit principles.

But the free institutions' role in serving society is not merely to be more efficient within their specific functions. It is also to serve as a source of independent criticism of those who hold power. It is, in short, to prevent centralization of authority. Scientific and technological competence is so necessary today for understanding the complex programs of government that scientists who are employed by institutions outside the immediate executive hierarchy have an important role to play in criticizing official policy and checking centralized power.

If they are to play that role, they must be close enough to the big issues to understand them, but they must have enough independence of action to speak without fear of damage to their status or careers. But how can they be closely enough involved without sacrificing their independence? Logically, the dilemma seems absolute. The judiciary cannot get into the fight over civil rights without being accused of usurping the power of the legislature. Churchmen cannot preach social justice without coming under political attack. And scientists cannot get involved as consultants to government, or universities accept contracts for applied research, without being accused of prostituting themselves to political power.

Obviously, an institution can be more surely free of political influence if it deals with pure science and shuns the competition for power. But absolute purity is a delusion. It is a delusion partly because every institution needs material support and cannot isolate itself from the society that supports it. Even more important, absolute purity is a delusion because it is a refusal to serve one of the essential purposes of an independent and nonpolitical institution, that of providing some independent standards of criticism of public policy.

You can resolve the dilemma in one of two ways. If your approach is doctrinaire, you can try to resolve it by forcing the competing elements together within a single institutional system. Politics and religion are obviously related, so church and state cannot be separated. Economic and political power are related, so the state must own the means of production. Political decisions must be made scientifically, so science must provide a theory of politics and a methodology for deciding public issues, and then must be controlled by the state. That way, of course, lies totalitarianism.

But if you are sensitive to the danger that any single doctrine or theory may be perverted in the interests of power, you will take a more pluralistic and more discriminating approach. You can distinguish between different types and degrees of political involvement on the part of nonpolitical institutions; even more important, you can distinguish between what it is prudent and effective for an institution to do and what that institution's members are free to do in their capacity as private citizens or as

participants in other institutions. (I hope it was this line of reasoning, more than any fundamental distaste for politics, that led the American Physical Society to abstain from political resolutions.) A member of a church may also be a member of a political party, and need not expect both institutions to play the same roles. A professor in the university may also be a consultant to a research corporation or a government agency and a member of a scientific society. His freedom to play different roles in these different institutions—and to defend the autonomy of each institution against the others—is one of the most important safeguards of freedom in modern society.

Independent institutions are not, of course, the fundamental basis of freedom. Their independence comes from their roots in the way people think and what people believe. You will not want to let a university or scientific society function free from governmental direction if you think its work will immediately determine the major political decisions of the day.

We believe in free academic and scientific institutions not because we consider them irrelevant to practical political concerns but because we tacitly understand that their type of knowledge does not directly and clearly provide the answer to any complex political issue. Does this contradict the power of the reductionist approach that has given science its great effectiveness in dealing with practical as well as theoretical problems? I think not. Reduction in knowledge and specialization in the definition of institutions and their roles go hand in hand. Just as the zoologist or botanist may admit the great contributions that biochemistry and biophysics have made to biology and still see that tremendous problems remain at the more complex levels of organization, to be dealt with by different modes of thought, so the politician (and his scientific adviser) may make full use of analytical science and yet be left with difficult problems of synthetic judgment in making his decision.

The type of thought that, in the style of the Marxist dialectic, rejects traditional dogma in favor of reductionist science, and then tries to make science the basis of a new dogma, is not reductionist, but only dogmatic. Reductionist knowledge provides no rationale, and no rationalization, for centralized authority. Like the specialized institutions in which it is developed, it tends

to be a check on general political power, an impediment to sovereignty rather than a tool of tyranny. Reductionism and specialization have indeed biased our political system toward some of the practical abuses of power that the rebels deplore, but they have done so not by creating a centralized system. On the contrary, they have so greatly strengthened the productivity and power of specialized concentrations of economic wealth and technological competence that our general constitutional system is incapable of controlling them.

Policy

This brings me to the third aspect of the relation of science to politics—policy, or the definition of public purpose by responsible authority.

As a complex civilization has developed its system of knowledge by *reduction*, and its institutions by *specialization*, its policy has moved over the centuries toward *generalization*. The purposes of politics have broadened from the tribe to the feudal community to the nation, and are beginning dimly to be perceived in terms of world interests; they have broken down the rigid lines of caste and class, and are beginning to transcend differences of race. With almost as much difficulty, the general purposes of responsible politics must now try to control the specialized functions and institutions of government in the general interest.

This movement toward political concern for all men, and toward the sharing of power with them, was perhaps made possible by the other two aspects of politics—the reduction of knowledge to a more effective scientific basis and the transfer of specialized social functions away from the general system of sovereignty to institutions less concerned with power and more with material welfare. Without new techniques of communication to let men share ideas from place to place, and new techniques of production to give them enough material goods to share, the broadening of political concern would have been impossible.

I am also inclined to believe that this broadening of public purpose was encouraged by that earlier form of reductionism, the theological reductionism that slowly and partially converted religion from a complex of local superstitions to a broader and simpler faith.

As far as the general evolution of public policy is concerned, the processes of reduction toward simpler and more fundamental ideas in science and in religion have had similar effects.

But I must qualify this assertion of faith with a cynical concession. Science has an intellectual advantage over religion: a reductionist science comes out with grand generalities in the form of mathematical equations that the layman reveres because he cannot understand them; a reductionist religion comes out with grand generalities in the form of platitudes that only embarrass the layman because he thinks he understands them all too well. For example, the tough-minded ghost writers for one of our leading politicians, I am told, were always annoyed at being required to put into each of his speeches a reference to what they called BOMFOG—their derisive acronym for the Brotherhood of Man and the Fatherhood of God.

As scientists we are apt to take pride in this distinction: even pious people, unless they are simpleminded, can laugh at BOMFOG, but nobody makes fun of $E = mc^2$. But such pride is ill-founded. If we ridicule BOMFOG, it is not because we do not believe in God or human brotherhood; indeed, the more we believe, the more we are likely to see that such belief does not solve practical political problems, and that a politician who appeals to such abstractions for self-serving purposes is absurd. It seems obvious to us that $E = mc^2$, while it may be the fundamental equation of atomic energy, does not tell us even how to make atomic bombs, much less how to get international agreement against their use; no politician would win votes by using a basic scientific formula as an incantation.

But this is a parochial idea. We may not make a political slogan out of a scientific concept, but others do. We find it hard to imagine the political quarrels that took place in Russia over the scientific philosophy of Mach or Einstein (8), or to understand how Soviet scientists give credit for their discoveries to Marxist-Leninist doctrine, and Chinese scientists give credit to the thoughts of Mao. But, at least in Russia, the more sophisticated scientists react to the scientific dialectic the way we react to BOMFOG—with an appropriate mixture of reverence and ridicule.

If, as Americans, we have escaped

the Communist habit of muddling scientific theory with political practice, we cannot claim too much credit. We had been inoculated, so to speak, by the English-speaking historical culture against the translation of the great simple truths into practical policy. We had tried that under Puritanism—under Oliver Cromwell and John Winthrop—and had had enough. So Jefferson, as clearly as Burke, was against the Worship of Reason in the French Revolution, and T. H. Huxley opposed Comte's conversion of science into a political dogma—the dogma (which Lenin later enforced) that diversity of opinion was no more to be tolerated in politics than in chemistry.

With respect to knowledge and institutions, politics becomes more civilized as it moves in the analytical direction—toward reduction and specialization. But policy is a synthetic process: generalization requires more than analytical skills. Indeed, it demands special care with respect to analysis and specialization, not to prevent but to control and use them, and not to be misled by thinking that any one type of basic knowledge or institutional skill will solve the problems of a complex political organization. Reduction is the prescription for basic knowledge, but reductionism—taken neat—can be poisonous for policy.

America is not entirely free of the idea that some scientific formula will guarantee our political salvation. The president of the AAAS gets frequent letters outlining such schemes. If I were not too honest to steal such secrets from their authors, I could tell you how to provide unlimited energy without cost, and thus eliminate poverty, and how to remove all feelings of hatred and aggression, and thus guarantee universal peace. But it is typical, I think, that most of those American scientists whom their colleagues consider crackpots are interested, not in basic theory or ideology, but in gadgetry—in finding gimmicks to cure the world's ills.

Pragmatic Reductionism

This taste for the so-called “practical,” of course, the crackpot shares with his fellow countrymen. In America, we are not dialectical materialists, only practical materialists. We do not convert our science into political faith—only our technology into business

profits. We do not make our political theory into a revolutionary crusade; we only assume that technical assistance and more calories will make peasants contented, and that B-52's are cost-effective in pacifying jungle villages, and that welfare payments will remove racial hate in our urban ghettos.

The philosophers who blame such blunders on scientific reductionism—who believe that the mathematical and fundamental approach to knowledge is the basic flaw in modern politics—are themselves reducing the problem to a more abstract level than is useful. We get into political difficulties less because our method of knowing is wrong than because we put too much confidence in specialized programs and institutions and show too little concern for the processes of government that relate those specialties to general policy. It is true, of course, that many political controversies are over meaningless issues or insoluble problems, and new “technological fixes” [as Alvin Weinberg calls them (9)] are often useful ways out. But this approach will work best if it is tried by some responsible authority who is thinking about the problem as a whole, as a part of the general political system; it can be disastrous if it is peddled to politicians by a special interest in the business or bureaucratic world that is concerned only with increasing its own profits or professional influence.

To deal with any public issue of any consequence, we need to bring science and politics together in all their aspects. We need more precise knowledge. We need more effective institutions. And we need both the will and the competence required for the synthesis of general policy. Of these three, the most difficult is the policy aspect, for generalization cannot be reduced to precise techniques, or delegated to a specialized profession or institution.

But synthesis and analysis are not incompatible processes of thought, any more than facts and values are totally separated from each other. The new techniques for the analysis of complex systems developed by mathematicians, physicists, economists, and other scientists have become the most powerful tools for the critical study of the components of policy, and hence for the development of general policies.

You cannot synthesize a sensible policy unless you have first analyzed the problem. Reductionism is not the enemy of humane political thought; it

is the first practical step toward it. To take both steps is hard work, and requires the scientist to share the complexities and uncertainties that harass the politician, and to join in compromises that offend the purist in either science or morals.

From these uncertainties, the human mind is tempted to seek refuge in phony reductionism—the new rebels reducing the complexities of politics to the simplicities of moral feeling, the scientists taking shelter in the purity of research. Both these paths to purity are like BOMFOG—you feel obliged to respect them, but the trouble comes in putting them into effect.

The Alliance of Opposites

What is wrong with the purists, on both the moral and scientific sides, is not that their objectives are evil but that they tackle the problem at the wrong level of abstraction. In the United States we are in no danger of using science to deny political freedom, or of rejecting BOMFOG in favor of a theology that would support a caste system. But there is a real danger, it seems to me, that the two types of purists—the scientist and the moralist—will withdraw from public affairs and leave responsible political authority without support against the powerful combination of technological skill and special industrial and bureaucratic interests.

For example, take the Institute for Defense Analyses. IDA is a prime target for the new rebels; to them it symbolizes the corruption of the purity of scholarly institutions by military power. IDA is also not very popular among theoretical scientists; it represents the kind of applied work with government support that does little for pure science. Yet IDA was not created in the interest of irresponsible military power. On the contrary, it was a part of the effort to give responsible civilian political authority the ability to control the competing special military interests. The constitutional authority had always been there, but without the special knowledge or the special institutional controls needed to make that power real, and hence to make possible the synthesis of the independent missions of our Army, Navy, and Air Force into a general policy.

Even before 1961, IDA was one of the tools the Secretary of Defense used

as an aid in the synthesis of general policy. There was no antithesis here, in either theory or practice, between, on the one hand, reductionist knowledge and specialized staff institutions and, on the other, an effort to make general policy supreme over special technological interests.

In opposition we saw officers from the most powerful and independent segment of American bureaucracy, the career military services, supported by industrial clients who disapproved on principle of any not-for-profit corporation, rise to denounce the whiz kids in the research corporations and the Office of the Secretary of Defense. The use of mathematical and scientific techniques to deal with military policies, such as strategic plans and weapons systems, was a cold and calculating and heartless approach, they said, to what ought to be an affair of the heart—a vocation to be followed on moral rather than quantitative principles. Or as Admiral Rickover put it (10), “The Greeks at Thermopylae and at Salamis would not have stood up to the Persians had they had cost effectiveness people to guide them.”

I find much of Admiral Rickover's critique of our overemphasis on technology and bureaucracy refreshing—especially coming from an Admiral. What other Admiral would ask (11), “Does man exist for the economy or does the economy exist for man?” and charge that the “larger bureaucratically administered organizations” in which most Americans now work, as a result of the Industrial and Scientific revolutions, “are in every respect the obverse of a free society”?

But I doubt that this rhetoric, which ought to endear the Admiral to the new rebels, really advances our understanding of the nature of freedom in modern society. Whenever a powerful special interest begins to appeal to basic moral or philosophical principles in an effort to escape subordination to general policy, we are entitled to be skeptical if not cynical. The new purists in morals and in science who join with rebellious segments of the Air Force and Navy in attacks on IDA and the Office of the Secretary of Defense are in much the same position as the contemporary religious fundamentalists who become allies of reactionary industrialists by seeing social security, the income tax, and the regulation of business as the work of Godless communism.

A New Strategy

In the current state of the world the question whether scientific societies should pass political resolutions is a trivial tactical issue; the community of science needs to look to its broader strategy.

In this strategy the idea of scientific purity—of avoiding involvement in political compromise—was once a useful notion. It helped to free science from the teleology of the earlier philosophers, and scientific institutions from the obligation to work on practical problems as practical men defined them.

This reductionist strategy, while protecting the freedom of scientific institutions, did not slow down the practical application of science in political systems that had shaken off feudal or bureaucratic constraints in an era of optimism about material progress.

But the new rebels are right in thinking that that era of optimism—that blind faith in automatic progress—has ended.

That optimism misled Western thought in two ways for a century or two after the Enlightenment.

After the French Revolution there spread eastward through Europe and Asia the optimistic notion, stemming from the Enlightenment, that science, by perfecting our philosophy and our values, will teach us how to revolutionize society and eliminate the corruptions of politics; in its Marxist form, that notion proposed to let the State itself wither away.

After the American Revolution, the pragmatic West came to a less doctrinaire but almost equally optimistic conclusion: that the advancement of science would lead to the progress of technology and industry and an increase in material prosperity, and to a withering away of governmental interference with private initiative.

The rebels are right in being pessimistic about such notions. I do not think they are even pessimistic enough. To me it seems possible that the new

amount of technological power let loose in an overcrowded world may overload any system we might devise for its control; the possibility of a complete and apocalyptic end of civilization cannot be dismissed as a morbid fantasy.

And the rebels are far too romantically optimistic in their remedy. Mere rebellion to destroy the existing order—mere purposeless violence to upset the establishment—assumes that those who gain power by violence will be nobler and more generous in purpose than those who now try to hold together the delicate web of civilized institutions.

If scientists wish to maintain the freedom of their science and, at the same time, play a rational and effective role in politics, they need to adopt a strategy that is more modest in its hopes for the perfectibility of mankind and more pessimistically alert to the dangers of power—not only power that is obviously political but the power that calls itself private as well. They should start by acknowledging in theory what in the United States we have always taken for granted as a practical matter: that reductionism in scientific knowledge, while it may provide the fundamental advances in scientific theory, does not alone provide the answers in the realm of policy, or the basis for a political ideology.

If this point is clear, no one will need to take seriously the charge that the scientific mode of thought is a fundamental threat to humane values. The threat comes not from the theoretical reductionism of science but from the very pragmatic reductionism which assumes that applications of advanced technology are automatically beneficial, or that we are always justified in granting special concentrations of technological and industrial power freedom from central political authority.

If everyone understands that science, as such, does not control policy decisions, scientists will then be free—and, in my view, will be morally obliged—to devote their synthetic as well as their analytic skills to the for-

mulation and criticism of policies by which the nation may control technology and apply science in the public interest.

In an era which is beginning to be alert to the threats posed by modern technology to the human environment, the role of science in politics is no longer merely to destroy the irrational and superstitious beliefs which were once the foundation of oppressive authority. It is, rather, to help clarify our public values, define our policy options, and assist responsible political leaders in the guidance and control of the powerful forces which have been let loose on this troubled planet.

References and Notes

1. *New York Times* (14 July 1968).
2. *Ibid.* (22 Oct. 1968), pp. 49 and 56.
3. J. Ellul, *The Technological Society* (Knopf, New York, 1964), pp. 434 and 435.
4. Statement in campaign advertisement, *New York Times* (22 May 1968).
5. H. Marcuse, "The individual in the Great Society," in *A Great Society?*, B. M. Gross, Ed. (Basic Books, New York, 1968), p. 74.
6. For a confirmation of this impression, see D. W. Brogan, "The student revolt," *Encounter*, July 1968, p. 23; and S. M. Lipset, "Students and politics in comparative perspective," in *Dædalus*, Winter 1968, p. 1. A similar observation regarding the lack of participation in Germany by young scientists, technologists, and medical students may be found in M. Beloff, "Letter from Germany," *Encounter*, July 1968, p. 29. It seems likely that the difference in this respect among the disciplines is less important than that between the academic disciplines and the various types of professional training.
7. On the distinction between the new rebels and Communists, see P. Goodman, "The black flag of anarchism," *New York Times Magazine*, 14 July 1968; on its antinomian overtones, see D. P. Moynihan, "Nirvana," *Amer. Scholar*, Autumn 1967. For a fuller account of the medieval rebellions, see N. Cohn, *The Pursuit of the Millennium* (Essential Books, New York, 1957).
8. D. Joravsky, *Soviet Marxism and Natural Science* (Columbia Univ. Press, New York, 1961).
9. A. M. Weinberg, "Social problems and national socio-technical institutes," in *Applied Science and Technological Progress* (National Academy of Sciences, Washington, D.C., 1967) (available from the Government Printing Office, Washington, D.C.).
10. Testimony, 11 May 1966, on Department of Defense appropriations for 1967, before the House Committee on Appropriations Subcommittee on the Department of Defense, 89th Congress, 2nd Session, part 6. I do not argue here that the systems analysts have been right, only that they have been attacked for the wrong reasons.
11. H. G. Rickover, "Technology and the citizen," address before the Publishers' Lunch Club, New York, 7 January 1965.