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The Scientist and National Policy

Nothing about his experience and training cut him off from *any* responsible activity in government.

McGeorge Bundy

The problem of talking to an audience of this kind is severe for a man with my absence of background in the sciences. One cannot talk about science as such, so one must talk about science and something else. I toyed with the idea of talking about science and the academic administrator, but the less I tell you about the trade secrets of academic administrators the more grateful my former colleagues will be. I played with the notion of discussing science and other cultures, a question sometimes framed as "science or culture," and sometimes as "science is culture." This is a topic everyone else has been discussing in the last few years, but I steered away from it, partly because it's too big and partly because I don't myself believe much in these distinctions between scientists and other parts of culture or society or politics; I think most of them are doubtful and misleading.

I thought also of talking about science and government, and especially about the interesting art of getting money out of government for science, but there is no point in my doing that in the presence of the great painless extractor, Alan T. Waterman, the most notable dentist of the progress of science that the government has ever been exposed to. Waterman's particular success is that he has taught the government to enjoy this process and even to claim the credit for it. In an article not long ago Robert Oppenheimer reported a calculation that if the *Physical Review* continued to grow at the rate of speed developed between 1945 and 1960, it would be as big as the earth in another 100 years. In the same way, money for science will soon consume the whole federal budget unless we can get Alan Waterman to retire.

After discarding these larger themes, either because they are non-themes or because there are people present who are better able to deal with them than I am, I concluded that it would be well for me to try to talk to a much narrower topic, the topic of the role of the scientist in the processes of judgment and action that go beyond science itself and affect other parts of public policy.

I do not think this is necessarily the largest role for a scientist in government. It can well be argued, and I think there is a good deal of force in the argument, that the largest single problem of scientists in their relation to the political process is to insure that science itself is understood, supported, and advanced. On this view, from the point of view of society itself, the progress of science is as large an issue as any that the scientist can concern himself with.

But I want to talk about a quite different topic, the problem of the relation between science and political judgment, when what is at issue is not the advancement of science but the protection of some other interest of the political power concerned. I suppose that one excuse for my trying to do this is that this is the kind of scientific participation in government with which I currently find myself associated. Most of what I have to say will find its most useful illustrations in the field of nuclear problems—nuclear testing, the search for a nuclear test ban, and the handling of nuclear weapons systems. And I know very well that much of what I say will be familiar to you, because nearly everything that can be said on this topic has been said.

About the only thing any one critic can do is to try to distinguish what he thinks are the helpful from the unhelpful commonplace propositions.

The Right Man in the Right Place

My own first proposition about the role of the scientist in these kinds of questions is that it is essential that he should be *there*. That really is a fairly simple proposition. But it carries somewhat more weight than that plain statement of it might suggest, because to be *there* in the process of government means more than one place, more than one role, and more than one moment in time. What I really mean to suggest by this first broad assertion is that all the kinds of there-ness which are relevant to the process of government should include the there-ness of the scientist whenever any component of the problem is essentially scientific in character.

I say that there is more than one place to be *there*. Government is an enormous layer cake with the sugar left out. It has all sorts of flavors and

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colors and mixtures in it, and it has been put together by a nongeometrical cook. There are therefore as many ways and as many places to be present in government as there are little balls in those models of large molecules which are so popular in your demonstrations to beginning students nowadays. And it is just as hard, unless you know the rules, to know just what you are doing in the molecule. Science has to be present not simply at the moment of crucial decision one minute before zero-hour. Science has to be present in the process of consideration which usually begins a very long way from the point or time of decision. And that is true not only in the obvious case of scientific research which may lead to development of a new weapon; it is true also if one is engaged in the problem of trying to design a section of a draft treaty which might eventually lead to the control of the weapon; and it is equally true, between these extremes of weapon design and disarmament, if one is concerned with the problem of the relation between one friendly government and another in their efforts to cooperate in the use of some such weapons system. Whether one is talking about initial research in a scientific laboratory on the West Coast, or about the preliminary staff studies, in the disarmament agency, of a new proposal for arms control, or about the framework of the relationships which connect us with the United Kingdom, there is no way of making progress effectively if there is not an intimate connection with the kind of knowledge, the kind of perception, the kind of awareness of possibility and impossibility which we associate with the scientist. So there are many places for the scientist to be *there*.

I also say that there are many roles. This is a point which is often ignored in the sterile debate as to whether scientists and other experts should be on tap or on top. It all depends. There are many situations in the management of government affairs in which it is best that the officer in charge should have a full technical background. I would myself hold that there is a very strong case for this kind of representation not only in the obviously technical jobs but in others. I think it has been a great reinforcement to the Atomic Energy Commission that in the last 2 years two of the commissioners have been scientists. While both of the new commissioners who are lawyers are friends of mine, I do not think that we should miss them as much as we should miss their two scientific colleagues, not because of any difference in natural ability or concern with the topic, but because in the framework of that particular assignment there is a special importance in the presence of men who understand the scientific basis from which this whole vast enterprise has developed.

On the other hand, when one gets to the negotiations in Geneva, or when one gets to the level of presidential decision it is, I think, self-evident that no one giving advice—whether he be a scientist or nonscientist—can expect or should desire to take to himself that final responsibility which we call political, though it is true that any given political judgment may have a heavy component—perhaps a governing component—of science, or of law, or of economics, or of some other special kind of knowledge.

So that there is more than one way to be a scientist in this process, and it is very dangerous to try to think of it in linear terms: that there is this particular job which this kind of man does, and there is only this one job. There are many jobs; they take many shapes. They can be managing, they can be advisory, they can be conciliar, they can be part time and full time. They can be professional in the sense that the man must be an experienced long-term officer of government, and they can be nonprofessional in the sense that he comes in for a while and goes out. To make a theory of any one of these multiple roles is, I think, to miss the complexity, the color, and the wide range of meaning which this association should have and is, I think, coming to have.

The one generalization I would offer is that it is of great importance that the scientist should be *there* through time, one way or another. I do not mean in saying this to be critical of part-time advisory committees or panels, which have often been of great value, especially indeed in this very field of nuclear tests and nuclear test bans (*1*). But I do mean to say that government, like all other human activities, is a process, and it is a process made up of a very large number of steps. You cannot come in and out of government, on a week-end, I'll-write-you-a-letter basis, and expect your opinions to have the kind of impact which in your sense of virtue and of rightness you think they deserve to have upon the process of government. This is not a rule which is peculiar to the scientist; it is equally true of the political scientist (a very advanced form of nonscientist); it is true of newspaper editors; and it is true of politicians—in fact, it is perhaps preeminently true of politicians. Nobody ever persuaded anybody of anything with one editorial. Nobody ever made a lasting contribution to government by one visit to Washington. We should not allow dramatic episodes—letters from Einstein to FDR—to mislead us on this point. What really bends the processes of government is continuous, sustained, and intensive effort, generally uncertain at the beginning of what its exact final outcome will be, always responsive to the situation as it is, and continuously aware of the need to be on top of *that* situation, and not of some abstract plan of what it ought to be, or was when one once knew it, or would be if only the people in Washington had more sense.

So much for my first general proposition. If I may take a moment to give a judgment, let me say that we are making progress in the government in developing the necessary there-ness of science, and that you and your colleagues in your profession throughout the country have made very great progress over the last 20 years in developing ways and means of responding, as a profession (or really as a set of professions), to this requirement. It's not an easy thing to do.

There is a special problem for the scientist in giving his time to other things than his science, even when what he is asked to do is impossible to conceive of except as an outgrowth of his learning. I myself have listened to the wailing and weeping of many very able wailers and weepers, telling me how a distinguished scientist's career is ruined if he is put on even the smallest interdepartmental committee, in a university in which everyone knows that the administration is dictatorial to begin with. This terror that you all have, of the destructive intrusion of the world upon your laboratories, is of course a proper terror, based on ample evidence from horrible case histories. That American science as a trade has been ready, even eager to find ways of filling the many different kinds of roles which I have just been sketching is a tribute to the sense of responsibility of scientists as scientists and of scientists as citizens.

Shared Responsibility in Speaking for Science

My second general proposition is that it is very important that at the crucial points of counsel, judgment, decision, and action there be more than one scientist involved. This is true, I think, for a number of reasons. One of them is that government itself is not a monolith—it is the product of many different forces, as I have been suggesting, and each of these forces has a right to its own sense of what the scientific meaning of the problem is. As the problem comes to judgment, therefore, there is a reason for having more than one scientist in the discussion.

But there is another and somewhat deeper reason for this second rule. The task of the scientist advising on matters affecting the national security is in very considerable measure a task of translation, a task of communicating to a man who does not himself grasp and understand the real meaning of a subject, what its implications are and what its possibilities are. How big a bomb can you make? How long a time will it take? And what will its characteristics be? These problems, which became enormous for government in the early 1940's and which are with us still, cannot be decided out of his own internal knowledge by a political figure. It is very important for him not to be dependent upon a single channel of information even if on a surface impression it is only information that is at stake.

This is a form of translation, and all translation is an art. Translation from one language to another—for example, from English to French or French to German—has all of the splendid complexities and ambiguities which beguile the philologists. And in the same way it is no small task to present scientific propositions or scientific probabilities to laymen in language that does not mislead them. Especially in new fields, where there is both uncertainty and great room for misunderstanding, the task of the expositor is a most demanding one. If there is only one man engaged in this process, a very dangerous burden falls upon both parties, both the expositor and his interlocutor. It is very difficult for either of them to have full confidence in his lonely process of communication, and when there is such full confidence it tends to be misplaced. We all know of exceptions. We know of men of such serenity of spirit, such clarity of mind, and such sympathy of audience that they are able to deal easily with this kind of problem of communication, but they are exceptions indeed. It is really quite simple and cheap (with all due respect for the value of your time) to enlarge the numbers of scientists engaged in exposition, and it helps the man who is reinforced.

I had this point brought home to me the other day in talking with Chairman Seaborg about some of his problems at the Atomic Energy Commission. He was saying that for his work as a scientist on the commission, leaving aside for the moment his special responsibilities as chairman, it was a great help that he had Commissioner Haworth with him. It's not that they have sharply different approaches to the topic (though that can also be important, as I shall be saying in a minute); it is rather that neither of them alone need feel the burden of assessing and translating technological meaning to laymen. They are able to check their judgments with each other, and to provide to others what we may call a binocular view of the situation. So without approving of all his illustrations I would not disapprove of the conclusion which Sir Charles Snow reached in his Godkin lectures two years ago: that an arrangement which places the whole of the apparatus of science as a community at the disposal of a single adviser is unsound.

There is, I think, a deeper and more intrinsic reason for opposing the notion of a single adviser. It is really against nature, in the sense that no one man *can* have a monopoly on relevant scientific information. If in fact it is scientific information, then unless it has just that moment been straightened out in some one man's workroom, more than one man understands it; more than one can have a crack at stating it, and there is no one expert. There are fields in which experts are fewer than they should be, and there are issues upon which one man for a while may be lonely and right, but broadly speaking it is not in the nature of science that it should have to come through only one man. In other fields sometimes there really is only one expert. There are ambassadors who really do have a unique perception of the behavior of the chiefs of government to whom they are accredited, and there are members of the executive branch and members of Congress who have a unique perception of the special political complexities to which they have given large sectors of their lives. But broadly speaking I think you would agree that it is in the nature of science that it has to be something which can be perceived and understood by more than one mind—if not, then it does not become a part of the corpus of science.

Hazards of Overstatement

Third, and again this is very obvious but very easy to forget, it is of the highest importance that a scientist acting as a scientist in the processes of governmental decision should respect his calling. He should carefully limit the occasions upon which he speaks *ex cathedra*, in order not to lose his reputation for infallibility. This is obvious and has been said by many people; one of the most eloquent statements, by Van Bush, was printed in the journal of your society not very long ago (*2*). But I think it's worth spelling out.

As a listener to science, let me say that there are many things that are important for the layman to understand which he does not automatically understand in his own ignorance. One of them is how much is *not* known, even to scientists. There is a tremendous pressure upon the political figure or the bureaucrat to press a scientific adviser for an answer. How many unappetizing electrons will a proposed high-altitude test spread around in distant sectors of the earth's environment? How many British astronomers will be angry? One could answer the second question, but not the first.

You all know, I suppose, the classic comment that Alfred North Whitehead made after a remarkable lecture on the cosmos by Bertrand Russell. It was a wonderful lecture and it left the audience in a state of total confusion, and Mr. Whitehead remarked in closing the proceedings, "We must be grateful to Lord Russell for the unequaled skill with which he has left the vast darkness of the subject unobscured." That is one of the necessary functions of the scientist in government. It goes without saying that it should be a deliberate and not an inadvertent success. What one means by probable accuracy, how normal it is to be off by an order of magnitude, how uncertain, at the edges, quantities are—these are things which nonscientists do not immediately

appreciate and to which their attention must be directed.

The best expositors of science problems in the process of government are the men who are most modest, and I may illustrate the hazards by taking an example from a man whose comments and insights in this topic I, at least, find continuously challenging though not invariably persuasive. Let me read to you a little of what was said to you from this platform two years ago by Charles Snow. He was talking about what scientists know (*3*):

> Scientists *know* certain things in a fashion more immediate and more certain than those who don't comprehend what science is. . . .
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> I had better take the most obvious example. All physical scientists *know* that it is relatively easy to make plutonium. We know this, not as a journalistic fact at second hand, but as a fact in our own experience. We can work out the number of scientific and engineering personnel needed for a nation-state to equip itself with fission and fusion bombs. We *know* that, for a dozen or more states, it will only take perhaps six years, perhaps less. Even the best informed of us always exaggerate these periods. . . .
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> We are faced with an either-or, and we haven't much time. The *either* is acceptance of a restriction of nuclear armaments. This is going to begin, just as a token, with an agreement on the stopping of nuclear tests. The United States is not going to get the 99.9-percent "security" that it has been asking for. This is unobtainable, though there are other bargains that the United States could probably secure. I am not going to conceal from you that this course involves certain risks. They are quite obvious, and no honest man is going to blink them. That is the *either*. The *or* is not a risk but a certainty. It is this. There is no agreement on tests. The nuclear arms race between the United States and the U.S.S.R. not only continues but accelerates. Other countries join in. Within, at the most, six years, China and several other states have a stock of nuclear bombs. Within, at the most, ten years, some of those bombs are going off. I am saying this as responsibly as I can. *That* is the certainty.

Now before I make a few critical comments, let me say that I think there is great reality in the danger of diffusion of nuclear weapons and the hazard that some of them might go off accidentally, or in a crisis that was relatively trivial. These are indeed very grave dangers; they demand, and I think in our government they have, the prayerful attention of political leaders and the constant effort of officers of the executive branch.

But it's not as simple as Snow made it. Moreover, he made it simple with the authority of a scientist, and in that, I suggest, there is great danger. What he did was to talk what *can* happen, meaning what is physically possible, and it is true that several states can do these things, though it is probably not true that there are as many such states as he said, and probably not true that the time limit he set is long enough. But what is much more serious is that Sir Charles has omitted altogether the question whether those states *will* do what they *can* do. No government, to our imperfect knowledge, has moved newly into this process of the development of nuclear weapons in the 2 years since Sir Charles spoke. I doubt if Sir Charles himself would now predict that a dozen countries by '66 will have these weapons, or even that "China and several other states" will by then "have a stock of nuclear bombs." The prediction, which he made as a scientist, dealt with political as well as with scientific phenomena; it dealt with very complex questions of choice and allocation of resources as well as with what was conceivably possible, and it assumed certainties from possibilities. This I suggest to you is a dangerous kind of thing to do.

The second error exemplified here is that of taking a problem which has many gradations in shape and meaning and making it an "either/or." Either we ban the bomb, preferably tomorrow, or the world blows up, probably the day after tomorrow. Now again, with no attempt to conceal or limit the unexampled hazards of the time in which we live, or the degree to which they are increased by continuing development and deployment of these kinds of instruments, nonetheless it is not that kind of a problem. It has not been that kind of a problem over a 17-year period. People do make more or less dangerous decisions about the kinds of weapons they will have, and about whether they will have such weapons at all. The phenomena of command and control, of discipline, of diplomatic tension and restraint, operate in less black-and-white terms. Technology itself can work on both sides of the equation, and one of the great issues for scientists in this field is that they should assert and exert the influence of scientific method upon the control as well as upon the explosion. These things, in other words, are not quite that clear; one should not make them wrongly clear while wearing the cloak of the profession.

Common Fallacies

So those are my three simple points. If there are enough scientists and they are on the scene in the right places, if they are not given the overstrain of sole personal responsibility for interpreting the meaning of science at a point of decisive significance, and if they are careful not to overstate what is still the very large range of their competence and their skill, they cannot but serve effectively and with enormous influence in the process of government. But let me, as a kind of coda, give you some general propositions that are *not* true, some common fallacies that one runs into day in and day out. One of them is that scientists should give advice on scientific subjects and keep away from military, political, social, and economic topics. This happens to be nonsense. You can't stay away from military topics when the question with which you are concerned is the design of a weapon. You cannot design a sensible weapon, a practicable one, one which is useful to the people for whom and with whom you are cooperating, if you do not know what it is they are trying to do. One of the first things that was learned—one of the great lessons, I think—in the flowering of scientific cooperation with government during the second world war was that there has to be an interpenetration of understanding such that a man can know what the other man's problem is. It is madness to assume, as very many people habitually do, that there is somehow an act of trespass if the scientist shows himself alert to a problem which stretches beyond the purely technical problem. There is every reason for avoiding these narrow divisions.

This applies with equal clarity when you go the other way, incidentally (and this is not a point which scientists always so readily accept); the nonscientific partner has a right and an obligation to try to have some critical view of what the technological contribution can be. And in the same way it is nonsense to say that military men should stick to military matters. We get to wearing special hats in government; we get typed as character players; we are condemned by imagery and by expectation to as monotonous a life as the late Lionel Barrymore. Everybody knew good old Lionel. You know: here comes the scientist; he's going to give you scientific advice;

he will probably forget his spectacles; he doesn't really understand ordinary things; he's a crusty old curmudgeon; but oh boy, he's great on diagnosis, and basically lovable too.

Well, the real world is not like that, and the moment people begin to construe it that way, they go wrong.

What is going on here is a process of communication among human beings. The problems do not divide apart that way. You don't solve the problem of nuclear weapons and their relation to the world by saying, "Here is a nuclear core—that's scientific; here is a nuclear weapon—that's military; here is a treaty—that's political." These things all have to live with each other. There are elements that are indeed military, or technological, or diplomatic, but the process of effective judgment and action comes at a point where you cannot separate them out.

It follows, I think, that it is also nonsense to talk about the political neutrality of scientists. Scientists are people, a fact which is frequently forgotten, but verifiable experimentally; they are bound to have feelings which for want of a better word we will call human. If they become deeply concerned with the development of a laboratory, or with the elaboration of an international proposal, or with an assessment of the real value of continued nuclear testing in this or that environment, it is inconceivable that they should be so inhuman as to have no personal judgment about the problem as a whole. It is important, obviously, that scientists and others should recognize that they do have personal judgments. But one should not suppose that this is in any way wrong, or even necessarily dangerous.

It is a simple but important fact of American life that in this whole great field of the exploitation of nuclear energy for military purposes there are schools of thought, among scientists as among others, which are essentially political. To pretend that they do not exist is to misunderstand much of the internal history of the government over the last 15 years, to misunderstand why great injustices have been done to some notable individuals, and to fail to appreciate that there is great feeling, of a simple, human, wicked sort, in these issues. The way to deal with this fact is to accept it, not to be startled by it; to live with it and to insure that there is a wide spectrum of feeling, attitude, and point of view, among scientists who are asked for their honest advice—a spectrum wide enough so that the final judgment of political authorities is not cramped by any arbitrary or accidental narrowness in technical counsel. Indeed, I would say that one element in the necessary thereness of the scientist is that there should be enough scientists, having enough ideas and enough ways of attacking problems, and enough notions of what it is that it is important to attack, so that a wide range of choice is always open to the political leaders. If the range of scientific counsel is limited, then the choices available to the politician may be fewer than he might wish, and the path of political action may be narrowed.

In this particular field of testing and test bans, incidentally, it has been the practice of this administration to seek a very wide range of advice. I think it's fair to say that there is no leading member of any of the great schools of thought whose views have not been heard with interest and respect. Strong differences of opinion do not mean that one man is wrong and sinful and the other man is right and virtuous; they only mean that these are the kinds of questions upon which human beings are bound to have sharp feelings and divisions. We must live with those things; we must accept them. The processes of government should allow for them, and scientists should not be cut off from these quite human activities either by their own image of themselves or by other people's picture of them.

And that, I think, is the wider point that I would make at the end. There is nothing in the experience, the training, and the discipline of the scientist that should cut him off from *any* responsible activity in the government—nothing but the fact that scientists are so busy, so eager to be back in the laboratory, and so few in number compared to the number of jobs that there are. I think that it would be worth your while to consider whether, as a profession, you should not enlarge still further your contribution to the processes of government. It may be important over the next 10 or 15 years that there should be more scientists who are ex-scientists, doing wholly unscientific things, acting as cabinet and subcabinet officers *without* a specific responsibility for research, serving on commissions that are *not* necessarily the Atomic Energy Commission, directing agencies that may *not* be just the National Science Foundation. For the interpenetrations of science and government, science and public policy, science and politics, are bound to increase, and the processes of communication from man to man, thick as they are and thickening steadily, are not yet as deep, as thick, as varied—are not, above all, as much taken for granted—as they need to be.

Our Science and Our Society

There is a still larger reason for being in favor of science and of scientists in this context—and this thought I will put as an affirmation, not as anything I know how to prove. I suggest that there is a wide, deep, and important coincidence between the temper and purpose of American national policy and the temper and purpose of American science. Our science and our society are deeply alike in their pragmatic, optimistic, energetic, and essentially cooperative view of the way in which useful things get done. They are alike, too, in having been exposed to great sophistication and great proliferation of responsibility, over a relatively short period of time. They are alike in having surprised the world by the measure of their success in responding to this new exposure, and there is good reason to suppose that in coming constantly closer together they will reinforce each other's high purposes. I think, in short, that there is no fundamental conflict between your existence as scientists and your existence as Americans.

Reference and Note

1. Many of the members of these advisory panels are men whose long experience and continuing close involvement put them quite out of range of the present comment.
2. V. Bush, *Science* **134**, 1163 (1961).
3. C. P. Snow, *ibid.* **133**, 255 (1961).