SCIENCE AND PUBLIC POLICY

25 October 1960

CONTENTS

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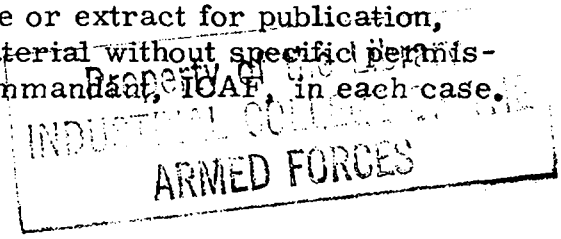

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INDUSTRIAL COLLEGE OF THE ARMED FORCES

Washington, D. C.

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COLONEL KNOX: General Mundy, Gentlemen: In addition to the regular units of the course here, the Industrial College schedules each year a series of lectures under the General Studies Program. These lectures deal with subjects that are not fully covered, or perhaps are only touched upon, during the regular course units. This morning's lecture is the first in a series under this program, dealing with the relationship of science and technology to our national security.

Our speaker today is a professor of government at Dartmouth College. As you noted from his biography, he has recently co-authored a book which is the most definitive study we have on the Reserve Officers Training Program, entitled "Education and Military Leadership."

He is a student of some of the more subtle and intricate aspects of government. Among other things, he has interested himself in the ways by which the Government is able to get productive work out of scientists, in spite of the fact that they are sometimes cantankerous and hard to work with; and also the ways by which the scientists are able to do productive work for the Government, in spite of the Government bureaucrats, who are also sometimes cantankerous and hard to work with.

It gives me great pleasure to introduce to you gentlemen for his first appearance at the Industrial College, Dr. Gene M. Lyons, who will speak on the subject "Science and Public Policy."

Dr. Lyons, it's a real pleasure to present you to the Industrial College.

DR. LYONS: Gentlemen: Some of you will remember the story of how, during the First World War, the eminent British scientist, Lord Rutherford, received an invitation to attend a committee meeting about a war-research problem. He replied that it was impossible for him to get away since he was busy with experiments in which he seemed to have split the atom. "If this is true," he is reported to have said, "it is far more important than your war."

I must confess that I am not sure that this incident actually occurred. But I am sure that it might very well have--not only because Lord Rutherford was presumably somewhat crusty, but also because I can

readily see how a first-rate scientist could be more interested in a scientific breakthrough that will make its political and social impact a generation or two hence, than in a war that is shaking our political and social foundations today. Most of us are concerned and involved in immediate problems--as are many scientists. But I hope that by this time, we have developed a more acute sensitivity to the requirements of basic scientific research than we have had in the past. One thing is certain. We have now made a place for science in the highest echelons of Government even though we have not really thought out what the role of the scientist should be in our political process.

We have come to be concerned with the full range of problems of science and public policy because of their immediate and dramatic manifestation in the area of national security. Advances in science and technology are among the major forces in shaping the dimensions of strategic doctrine. Once we have said this, we have, of course, not really said very much. While it is true that technology is a key in the formation of strategic plans, advances in technology do not lead to inevitable conclusions. They usually open up a spectrum of alternatives and greatly complicate the problem of choice. The role of the scientist in national security policy planning is therefore twofold--to be in a position where he can effectively communicate the implications of scientific and technological advances in terms of strategic objectives; and to insure that these factors are realistically integrated into the policy process.

In theory, policy is a balance of political, economic, military, and technological considerations--in practice, one set of considerations is quite likely to dominate because of conditions that, on the surface, seem to have no inner logic of their own--the ruling philosophy of the President, the relative power of the governmental and political forces involved in the policy process, the temper of the times, and the sense of what Congress and the public will support under existing conditions. The problem is moreover complicated by continual debate over our national interest and our national goals. There is thus no absolute measuring rod policy or the means we choose in order to meet our security requirements.

At other times in our recent history, we separated war and peace into separate compartments and, by formulating our objectives in absolute terms, we were able to resort to a system of priorities that enjoyed general consensus. In the atmosphere of uneasy peace and international tension that exists today, the situation is infinitely more complex. The strategic objectives that can gain a majority are necessarily ambiguous and offer no firm guidelines for setting up a list of priorities. We are

agreed on the objectives of a broad strategy of deterrence but this hardly closes the discussion. The choice between "massive retaliation" and "flexible response"--between "counterforce" and "infinite" strategies--between Bomarc and Nike--between a $40 and a $35 billion defense budget--still remains and, indeed, is the heart of the matter. The situation is further complicated when it becomes clear that our national security is not entirely a matter of military strength, but rests on other foundations as well--on the success of diplomatic and economic programs and on action, by allies or the United Nations, as well as by ourselves.

Within this environment of variables, risks, and uncertainties, the policy process operates within an open system of debate, publicity, and accountability. Opposing factions vie for power and for influence and seek to apply pressure by a skillful use of publicity techniques and by developing alliances within the executive or with outside groups in Congress, in industry, or among experts whose know-how has a meaning for the resolution of the problem at hand. The argument that has staying power in this kind of atmosphere is very often the one that can lay claim to the most authoritative kind of support. Certainly there is little that can be conceived to be more authoritative than scientific facts set down by eminent scientists whose motives cannot be viewed as anything but objective. Against an educated but nevertheless politically controversial estimate about the amount of defense the economy can afford and an assessment of the probability of limited war by Army leaders who have a stake in the development of conventional forces, a technical description of the capability of a new weapon system is likely to provide a safer political base from which to make an important policy decision.

What I am saying is that when it is possible to base a policy decision on scientific information, other factors that do not point in the same direction, are likely to be ineffective. It is possible to find a variety of expert opinions about the state of the economy, the psychology of Soviet leadership, the Sino-Soviet schism and the dependability of our NATO allies. It is, of course, also possible to find several opinions about the probability of detecting nuclear blasts or a scientific timetable for developing the anti-missile-missile. Nevertheless, of all the experts, the scientists are the experts par excellence because the facts they deal with must ultimately be consistent with nature. The real problem arises when political pressures force the scientist to testify to the validity of phenomena whose consistency with nature he has not been able to verify and about which he can only testify in terms of probability or to testify on an issue which does not really turn on the scientific or technological component. This, of course, is a dilemma for all experts in Government.

But it has special significance for the scientists whose work must be based on an exact and impartial analysis of the facts.

The important role that the scientist has come to play in national security policy planning has not come about because of any theoretical assessment of the impact of science on strategy. It is the result of the sense of vulnerability and urgency that swept the Nation when the Soviet sputnik was sent aloft in October 1957. Prior to then, scientists were certainly evident in Washington but not in the positions of influence to which the Russian satellite lifted them. Except for the special case of atomic energy, research and development had been largely left to the individual services with military leaders making whatever use of scientific advice they thought necessary. Science, like logistics, was largely treated as a service function, and the emphasis was on an early payoff. In some cases, highly imaginative and creative leadership brought science into the inner councils of planning. But for the most part, scientists found themselves buried deep in the bureaucracies. Indeed, the group that was elevated to the high place in the President's Scientific Advisory Committee had existed before within the Office of Defense Mobilization, but in frustrating inactivity. At the Defense level, scientists operated within the old Research and Development Board and, after 1953, within the Office of the Assistant Secretary of Defense for Research and Development. Until 1958, however, Defense agencies could not initiate scientific research nor exercise authority over the research programs of the services. Nor was there a role for scientists at the strategic planning level of the Joint Chiefs of Staff--even though the Rockefeller Committee report of 1953 had recommended that civilian scientists be brought into the Joint Strategic Survey Committee.

In his book, "Modern Arms and Free Men," published in 1949, Dr. Vannevar Bush pointed out that "We have arrived at the point where military planning of adequate comprehensiveness is beyond the capacity of military men alone." He was, of course, talking of the direct contribution of scientists to strategic planning--through the impact of technology and through the application of techniques of operations research. And he went on to warn that "Professional men in neighboring fields have no present intention of kow-towing to any military hierarchy, in a world where they know that other professional subjects are just as important in determining the course of future events in the nation's defense as are narrowly limited military considerations."

Dr. Bush was speaking not only of the postwar situation, but also from his own experience during World War II, when he had served as director of the Office of Scientific Research and Development (OSRD).

Indeed the present organization of science for national security bears a sharp resemblance to the wartime situation when Dr. Bush could move freely inside the White House, had funds with which to undertake basic research that had no immediate military use, and was in a position to mobilize the full resources of the scientific community. In his now famous report to the President in 1945--"Science, the Endless Frontier"--Dr. Bush in fact recommended that an OSRD-type of organization be established in peacetime, "having close liaison with the Army and Navy, but with funds directly from Congress and with the clear power to initiate military research which will supplement and strengthen that carried on directly under the control of the Army and Navy."

No such independent scientific agency was established and research and development was, for all practical purposes, placed under the control of the military departments. The defeat was not, however, the result of military opposition, but rather a consequence of the severe cut-back that all Government programs suffered at the end of the war and the failure to understand the role of basic research--a failure that we have been desperately seeking to overcome in the last three years. Indeed when the National Science Foundation was finally established in 1950 after five years of debate and procrastination, its funds for basic research were so severely reduced as to eliminate the Foundation's ability to perform the function that Dr. Bush had originally envisaged.

Very often the relationship between scientists and the military has been discussed in overly simple terms and turned into a kind of bitter rivalry with the scientists "the good guys" and the military "the bad guys." Like most oversimplifications, this one is as frequently false as it is true and certainly doesn't go very far in helping us understand the problem. For that matter, those who do think in these terms would have a hard time explaining the motivations that led to the establishment of the Office of Naval Research in 1946 to perform the function of basic research that, it was clear, was not being done elsewhere. Indeed a recent study of basic research in the Navy indicates that the Navy had a substantial lead over the rest of the Federal Government in the percentage of its budget that was devoted to research and development in the years 1946 to 1958.

At the same time, the Chief of Staff in 1946 called for the Army to support science and for a separation of research and development from the procurement operation. Unfortunately, in this case the intentions were far ahead of the action and an independent office for research and development was not established until 1952. In the Air Force, too, innovation was slower than in the Navy. Nevertheless, in 1949 the Air Force

set up a special committee under Dr. Louis Ridenour and, on its recommendation, established an Air Research and Development Command, quite separate from the supply function and on equal status with other major commands.

Despite these breakthroughs, there was still not the kind of "professional partnership" which had been established between scientists and soldiers, sailors, and airmen, during the war. For one thing the military could not command the funds that were required to make real advances in basic research. Their own budgets were continually tight and when a choice had to be made it is not surprising that, more often than not, it was the more immediately usable project, the applied research, that won out. There was, moreover, little possibility to combine resources through joint efforts because of the weak authority at the defense level and the fierce interservice rivalries that were so rooted in competitive technological systems. One of the ways the Research and Development Board sought to coordinate service programs was through a "master plan" for research and development. The "master plan," however, depended on the definition of rather clear-cut strategic objectives by the Joint Chiefs, on the basis of which a priority list might be established. It was thus frustrated by the inability of the Chiefs to come to agreement. Finally, the services could not attract top-ranking scientists into posts that were subordinate to military officers and could not offer them either the facilities or the freedom of operation that they would have wanted. The situation was, in addition, severely aggravated by the problem of secrecy, the inhibitions that heavy classification regulations put on scientific interchanges and the irresponsible attacks to which so many eminent members of the scientific community were subjected, especially after the Soviet nuclear explosion in 1949.

To a certain extent, the inability to attract first-rate scientists into the military departments was met by the development of the contracting technique. This procedure enabled the services to farm out scientific projects to industry, universities, or research institutes and thus utilize resources not otherwise available for direct Government work. It did not, however, meet the problem of insuring that strategic planning took scientific advances into account. The integration of project recommendations into planning and programs of the Defense Establishment continued to be a department-based military responsibility and this often proved to be a frustrating experience for the scientists. The continental air-defense study perhaps illustrates this problem most dramatically.

Some of you will undoubtedly remember the case. It involved three separate projects, between 1951 and 1953, Project East River, Project Lincoln, and the Lincoln Summer Study Group. Project East River was sponsored by the Federal Civil Defense Administration, the National Security Resources Board, and the Department of Defense and was undertaken by the Associated Universities which runs Brookhaven Laboratories. Its purpose was to study the nonmilitary factors involved in defense against an attack, including the effect on population and industry and the relocation of those essential activities without which the Nation would, in effect, no longer exist as a viable entity. The scientists who contributed to this project came to the conclusion that civil defense measures would be effective against atomic attack only if the damage was reduced to "manageable proportions." They thus pointed up the interrelationship of military and nonmilitary defense measures and the need to think of both as part of the same fundamental problem.

At the same time, military defense was, in fact, under study in the Lincoln Project at MIT. This project had come out of an earlier study at MIT, Project Charles, conducted under an Air Force contract to determine the feasibility of defense against weapons of mass destruction. On the basis of Project Charles, the Lincoln Laboratory was established in 1951 to carry out research and development on air defense on a continuing basis for all three services. Early in 1952, Dr. Lloyd Berkner, the president of Associated Universities and a key figure in Project East River, approached some of the scientists at Lincoln and, as a result of these talks, the conclusions of the East River group were merged with the work of Lincoln. The marriage actually took place during the summer months of 1952 and came to be known as the Lincoln Summer Study Group. In essence, the Study Group came up with strong recommendations for the development of an early warning system and concluded that such a system was not only technically feasible, but was a vital prerequisite for any program of civil defense.

The Study Group came under violent attack almost immediately. In one instance, its proposals were characterized as a "jet-propelled electronically /controlled/ Maginot Line." The scientists were accused of drawing up the air defense proposals as a substitute for the deterrent power of the Strategic Air Command and as a basis for bringing about a shift in our basic strategy, relying less on the deterrent power of our retaliatory force and more on an ability to survive atomic attack. But behind the controversy there was more. For one thing the controversy broke out not long after the great debate among scientists over the hydrogen bomb. Robert Oppenheimer, the most prominent scientist opposing our going ahead with the super-bomb, had participated in some

of the sessions of the Summer Study Group. This seemed to suggest to many SAC advocates that the Lincoln proposals, like Oppenheimer's earlier stand, were largely based on a defensive strategy and reflected the "guilt complex" of many scientists "for having developed the atomic bomb." But secondly, the SAC wing also genuinely feared that the expense of both an offensive and defensive capability would not be acceptable to the Administration and Congress and that the costs of developing an early warning system would almost automatically result in a sharp cut in the SAC budget. In truth, there was probably good justification for this position. As Bernard Brodie has pointed out, "strategy wears a dollar sign" and if previous experience was any guide, budgetary considerations could be dominant.

The most complete statement of the scientists' position was set down in an article published late in 1953 by James Killian, president of MIT, and A. G. Hill, professor of physics at MIT and the director of the Lincoln Laboratory. Its importance is more than historical, since it illustrates how scientists must deal with the nonscientific factors involved in a policy problem and also reflects the viewpoint of Killian who later became so instrumental in fashioning a role for science at the very highest levels of Government. Killian and Hill responded to the "guilt complex" attack by suggesting two sets of considerations that had led the scientists "to advocate a greater emphasis on air defense:" the first was "the knowledge that there were important technical developments which make an improved air defense more feasible"; and the second was "their understanding of the catastrophic implications of atomic bombs in the hands of a dictator." With regard to the problem of costs, they emphasized that their purpose was "only to point out the budgetary implications of current technical developments" and disavowed any ulterior motives regarding SAC. They went on to point out that "an adequate program for continental defense will be costly to the nation and will require sacrifices," but added their own conviction that "this cost may be small compared with the risks."

Here, it seems to me, is an excellent example of how policy is a mix of factors that lose more and more of the unique characteristics the closer we get to the point where a decision must be made. Consider that even though Killian and Hill started with the technical feasibility of new scientific methods of detection and interception, they dealt, in their analysis, both with an estimate of Soviet capabilities and intentions and with the politically torturous issue of allocation of national resources. But the question of how effective they would be in influencing the course of policy decisions was undoubtedly still troublesome.

It seems clear that Killian was convinced that the motivations, objectives and the importance of the work of the scientists in the East River and Lincoln Projects and in the Summer Study Group were being misinterpreted and that this situation would continue unless the scientist was able to play an effective role in the policy process himself. Indeed it was largely due to his own efforts that the continental defense problem was brought up to the level of the Secretary of Defense and finally the President. As a result, late in 1953 the work was begun that has since led to the DEW line, the BMEWS line, and, most recently, to the so-called "Winter Study Group" that earlier this year examined and made recommendations on the problems of command involved in the coordination of our present complex defense system.

Killian and most of the top-notch scientists in the country were given an opportunity to express their views on the role of science in strategic planning the next year when Congressman Riehlman (of New York) undertook an investigation of the "organization and administration of the Military Research and Development Programs" in mid-1954. Again the statements of Dr. Killian are not only pertinent but important--and I would underscore the sharp similarity tothe words of Vannevar Bush that I quoted earlier. Killian told the committee that "In the period of rapid technological change such as the one we are in, I do not see how the Chiefs of Staff or even the Joint Chiefs can effectively make policy decisions without a full understanding of the impact of new technology on tactics and strategy." He went on to explain his own view that "There has been occasional evidence that at times some of our top military leaders have been uninformed by their staffs about technological developments relevant to the decisions they are making." I am willing to hazard a guess that part of the "occasional evidence that Dr. Killian had in mind was his own experience with the continental air defense case.

Since October 1957 we have at least made a beginning in meeting the deficiencies pointed out by Dr. Killian. In the Defense Department, the Director of Research and Engineering has become third in command after the Secretary and his Deputy. But more important, he is the key official in carrying out the wide authority of the Secretary under the Reorganization Act of 1958 to transfer weapons systems from one service to another and to maintain centralized direction of all military research and development. At the White House level, the President's Special Assistant for Science and Technology, backed by the full force of the President's Scientific Advisory Committee, has become one of the most powerful men in Washington. He has constant access to the President, carries the mantle of leadership of the scientific community on which the Defense Establishment depends, and enjoys the high prestige that comes

both from his place in the executive hierarchy and from the standard of scientific impartiality he symbolizes. The post and duties of the Director of Defense Research and Engineering are supported by legislation, but the Special Assistant for Science and Technology is a Presidential appointment. It is nevertheless difficult to conceive that the next President, whoever he might be, will not want scientific advice available to him within his own immediate staff. But having come to this point, we still have to grapple with the problem I mentioned at the beginning of this talk--of thinking out what the role of the scientist should be in our political process. And in doing so, we have to bear in mind a more fundamental problem than the organizational one--the impact of the political process on the objectivity of the scientist and on the integrity of science itself.

In seeking to come to some reasonable conclusions about these issues, let me emphasize two points: first, the most important problems with which the scientist has to deal involve making judgments and choices about future and as yet inclusive scientific and technological advances; and second, even when basic decisions are made, there is still a long and troublesome path that needs to be followed to put them into effect. At the time of decision, the scientist, except on rare occasions, has more than one alternative open to him. He can make a choice and bear the blame if it turns out wrong. He can procrastinate and bear the blame for delaying action. He can equivocate and bear the blame of seeming to compromise. Whatever he does, he makes himself vulnerable to the slings and arrows of political responsibility for he cannot help but render his judgment with a total political context.

I think it important to emphasize that scientists make choices every day in their laboratories and that these choices are not always so precise and rational as we might suppose. The elements of chance, intuition, and accident have played an important part in the history of science. Some of you might recall the words of Albert Einstein that "there is no logical way to the discovery of . . . elemental laws. There is only the way of intuition, which is helped by a feeling for the order lying behind the appearance." This is not to say that scientists undertake investigations on a helter-skelter basis. Indeed, there is literature on scientific strategy and tactics that competes favorably with the literature on military strategy and tactics. Strategy in the laboratory is, however, quite different from strategy in the political arena. In the laboratory, there is only nature to contend with--there is no Congress, there is no public, there is no Bureau of the Budget. There are pressures under both conditions--but they are quite different in scope, in magnitude, and in intensity.

One of the most fateful decisions in which science has played a key part in our recent history involved the ICBM program. Let me recall the statement of Dr. Herbert York, the Defense Director of Research and Engineering, at the time his appointment was being confirmed. Dr. York was asked to help explain how the Russians had come to beat us in the ICBM race. He pointed out that the issue in "the late 1940's" had been to find the right mix between warhead weight and missile power and that many people had been discouraged about the possibility of success at an early stage. But he went on to say that "what was left out of the technical analysis made at that time was what you might call just a faith in progress, a faith that we would come to a warhead and a guidance system that was suitable, and that is in fact what happened." He went on to say ". . . what exactly was in the back of the Russian's minds, I do not quite know, but they went ahead. They didn't have a guidance system or a suitable weapon, either. I think that perhaps we outsmarted ourselves by being too strict about this analysis and not noting that in a field as new as nuclear weapons, there was bound to be radical improvement."

Scientists themselves have recognized the special problems that arise when they enter Government. They have expressed the fear that "the integrity of science is beginning to erode under the abrasive pressure of its close partnership with economic, social, and political "affairs." Some have refused to participate in Government projects. Others have sought to separate scientific from nonscientific considerations in the formation of policy and to restrict their participation to the scientific component. But I hope that I have said enough to demonstrate that the fragmentation of a policy problem into its separate parts becomes more and more unrealistic the closer we come to where a decision must be made. This, I might add, is as true for military leaders as it is for scientists. In effect, the integrity of science cannot be protected by insulating it from the pressures of political responsibility. The events of October 1957 demonstrated to the scientists as well as to others, that science has become an instrument of national policy no matter now transcendental are its precepts.

We thus return to the basic issue that I have stressed throughout this talk--the need to devise a role for scientists in national security policy planning that will preserve the integrity of science itself. In our organizational arrangements we have brought science into the White House and given it the political protection that can only come from the Presidency. This association now needs to be supported by legislation. There is considerable pressure for the establishment of a Department of Science and Technology both from scientists and from legislators, but I am not sure

that this would be a wise move. There would be a tendency for any such department, first, to seek jurisdiction over scientific activities in the operating departments and, second, to resist competition from scientific advisers the President might have on his personal staff. In either case much would be lost--the sense of direct purpose that comes from close association between science activity and program requirements and the sanctity of presidential privilege which, I repeat, is the best protection that the integrity of science can have in the political process.

We have also strengthened science in the Office of the Secretary of Defense. Advanced research cannot be divided into separate segments reflecting the particular interests of the services. Nor can service disagreements be reasonably and sensibly adjudicated without developing a technical capability for making decisions at the top level of the Department. But while science needs to be strengthened at the top level, it also needs to be strengthened at the departmental level. Here too, progress has been made and by now each department has raised research and development to a major command status and has a civilian scientist serving as an Assistant Secretary (or equivalent). We also need to expand and perfect contracting practices in order to mobilize the full strength of our scientific and technological resources.

Our progress in the area of Government organization is not enough, however. We still have a long way to go in creating the total political environment in which science can play the important role it must in the policy process without losing its essential strength. We need a deeper understanding among the nonscientists in Government, in the military and the foreign service particularly, and in Congress, as well, of the nature of science, of the methods of scientists, and of the sociology of science. The scientists themselves, and particularly those in Government, need to develop an acute awareness of the relations of science and public policy. Finally, we need a climate of public understanding that will accept with patience, with sensitivity, and with imagination, the struggles that are involved in developing science and relating it to public policy. In a democratic society, this is very often the most difficult and yet the most important task. I know of no easy way of achieving such understanding except through the example of political leadership and the process of education. I only fear that without this understanding any institutional superstructure that we construct, no matter how efficient, is liable to collapse.

COLONEL KNOX: Gentlemen, Dr. Lyons is ready for your questions.

QUESTION: This has been characterized many times as the age of science. We had this morning a speaker from one of our universities telling us about the role, or the necessity to create a role, for scientists. I believe he made several points as to the necessity of its being at the top of organizational policy-forming level and having a bigger role in other places such as marshaling public opinion to support the scientist himself or the expert puts himself up on a pedestal and says: "I'm not going to enter into the hurly burly. I know there are a lot of things besides science, but I'm not going to enter into the hurly burly of all the other facets of national life and so on." He wants to put himself on a pedestal, so to speak and has this special role created, but does not want to get into this policy formation. What is the responsibility of the scientist and those meeting with scientists to develop a different mentality and climate of opinion in the scientist himself? How do you convince him of it?

DR. LYONS: I think that their responsibility is great. And this is why I emphasized--but perhaps didn't emphasize enough--at the end that there also is a need to have the scientist understand the social, political, and military implications of science and technology.

I hope that it is clear from what I said that the scientist cannot avoid political responsibility. There is no way that the President's Special Assistant can avoid political responsibility. Maybe the President is going to take the brunt of the responsibility--that's all right, because the President gets elected and the Special Assistant does not get elected.

How will the scientist meet this responsibility? Well, I think many of them have. I think when you talk to people like Killian, A. G. Hill, and Lloyd Berkner, you find they have not avoided the hurly burly of politics. They have gotten very much involved. They have made themselves just as vulnerable as Congressmen do or as anyone else does, when he takes a position for which he must seek public support in one way or another.

I think it's true that many of them have refused to get involved and have set themselves apart. I did mention the fact that some scientists were terribly concerned that if they got too involved in the political process, science itself would lose its integrity. I was actually quoting from a statement by the American Association for the Advancement of Science (AAAS). This statement was made just last year, when, for the first time in its history, the AAAS took a positive position in terms of the relationship of science to public policy; and it has now taken a policy stand, if you will--that it will become involved in politics. Some of you

may be aware of this and may know more of the details than I do, but I understand that there is a series of meetings and dinners that have been set up by the AAAS to enable scientists to meet with Congressmen to exchange views and to make scientists available to Congressmen who may want information on one field or another because of particular legislation or appropriations which are coming up. The AAAS is now undertaking a full program in the field of science and public policy.

I think this is rather a remarkable departure from past history. You may recall that there was a smaller group of scientists, under the banner of the Federation of American Scientists, many of them men who worked on the atomic bomb during the war, who set themselves up in 1946 deliberately to seek to influence legislation. Their particular concern at that time was international control of atomic energy. But this was never too large a movement. There were some very influential scientists involved in it, but it was always small--a small activist group in the scientific community.

But the decision of the AAAS which is the grandfather of all scientific societies in the United States, to take an active role in politics and in the political process is of some consequence. It does indicate that the problem that you refer to, that is, the reluctance of scientists to get involved in the hurly burly of real life, is a thing of the past. There will certainly be some who will want to refuse to participate, just as there are individuals in other fields. There are other experts who still don't want to get involved in politics.

QUESTION: Doctor, you have mentioned several changes which have taken place since 1958. I wonder if you would address yourself to a comment on NASA and how it figures in on any security policy involvement and on the acceleration of scientific achievements.

DR. LYONS: I have just finished reading General Medaris' book. I assume that most of you know how he feels about NASA and the separation of the civilian and military aspects of space exploration--that in point of fact this is an unrealistic differentiation.

I myself do not feel that having a separate space agency, and having space work in the Defense Department, is necessarily dangerous. I don't think that it needs to split the scientific community and the application of our strength and resources to this essential problem. Nor need there be any harmful competition.

We have the example of the Atomic Energy Commission, which has a military application unit, and which very successfully is able to meet the needs of the military departments. In the case of space, I think we have had some abortive attempts to set up coordinating machinery, but it has been above the operating level.

In a recent study that A. B. Little did for the Navy--some of you may recall this--on basic research, I was very much taken with a chart in this study showing the important influence of Rabi on naval research. When a man who has worked so closely with the military departments and who has given so much of his time, does speak in a national publication on this problem, I think it's important for us to heed his words.

QUESTION: Doctor, you mentioned in the course of your presentation the role and the contribution which science and which operations research can make at the JCS and at other comparable or lower levels. Would you address yourself to the question of the contribution that the operations research method and its associated techniques might be able to make at the national security policy-making level, specifically with reference to the National Security Council and the Planning Board thereunder or to the permanent staff thereof?

DR. LYONS: The problem of the limits of techniques of operations research is a fascinating one. Certainly we can explore uses of operations research to a greater extent than we have. I do, however, feel that it has limitations.

The moment we have to make choices and the data with which we are dealing is nonquantitative, the moment we move into an area where we have to take into consideration value systems, then I think we have to assume that there are limitations to the use of operations research to this kind of problem. Operations research can be used, for example, for the problem of command and control within our air defense system. But it cannot be used to decide what our policy in NATO should be; whether we ought to have a NATO deterrent power or whether we ought to maintain a unilateral deterrent power. What is involved here are long-range objectives, relationship with allies--many factors that cannot be qialified.

When you have a value-free situation, then I think there is possibly no end to our use of operations research techniques. But the moment we insert the problem of values, of national objectives in terms of values, beyond that point we probably limit the use of operations research.

Along these lines some of you may have been reading some of Charles Hitch, of the Rand Corporation. Hitch and one of his colleagues have recently come up with an excellent volume on the economics of national defense. It is based on a good deal of work that has been done at the Rand Corporation. I was interested in finding that Hitch feels that there are limits to the use of operations research; that when we no longer have a value-free situation, we cannot use operations research.

QUESTION: You mentioned the case of the two levels--Presidential and Department of Defense; that at that level there should be some authority to direct research in furthering our objectives. Have you seen that they actually have it now, even though we have established these two positions and they are certainly powerful in the case of Dr. York and can do this; but can you point to some projects which they have initiated at that level directly? Or do they not have any?

DR. LYONS: I would almost say that you all would probably be better judges than I, especially those of you who are in R & D work in the departments.

Let me mention one or two instances that I know about; and my sources are only the public records and occasional conversations and interviews which I might have had.

I think of one instance, for example, in which a very high-ranking officer in R & D work was stymied because he couldn't get the funds that he wanted, even from the Defense Department; and so he resorted to contacting one of the members of the President's Scientific Advisory Committee. He knew this scientist was interested in this problem and knew something about it. The scientist, by intervening, through Mr. Killian's office presumably, was able to get the project into operation. My own information is that this is not an isolated case; that this is happening.

Indeed I suspect this is exactly one of the reasons why there are many legislators who would like to have a Department of Science and Technology--because a Department of Science and Technology would have to come up for yearly appropriations; and a Secretary of a Department of Science and Technology would have to respond to certain questions and inquiries made by Congress about incidents such as these. But a Special Assistant to the President does not necessarily have to. I know that there have been some Congressmen who have been a little uneasy about this kind of problem, which suggests, in itself, that there is a good deal of unusual power in these places.

STUDENT: What I had in mind there were projects of interest to all three services. I personally can't think of one project that they have initiated.

DR. LYONS: There is another kind of problem. When we seek to identify particular projects, it may be the wrong way to approach this problem, because we certainly need basic research that does not have immediate use; and this is something that the Departments cannot entirely do themselves. The Office of Naval Research has done a magnificent job, as have others. I pointed to the ONR because they were the first ones to do this.

But it's peanuts to what we should have had all this time, you see. What Dr. Killian's and Dr. York's offices can stimulate more is not individual projects, but just straight research, more than we had before, and to support more work on the outside.

There is also another need, and this is a need to develop a technical capability at the Defense level, so that there is a reasonable basis for judgment when two rival technological systems come up for evaluation.

WSEG, of course, has been available for evaluation on request, and the request usually had to come from the Joint Chiefs or from the individual services. But so long as there was no independent authority at the Defense level, it was rare when WSEG had a request and could actually move in decisively and make a positive contribution; although WSEG did on occasion make a positive contribution.

This is not a very satisfactory answer. But I think that some of you might have greater access to information on that than I have. One thing I would appreciate. If any of you know of anything that would put my observations in error, I would be pleased to know about it.

QUESTION: My question is sort of correlated with this other one, but we have been presented with statistics to the effect that the Russians have been making greater strides in the production of engineers and technical personnel than we are. Therefore we assume that we may have fallen behind on the production of experts. In addition to this, my observation in the Government service has sort of led me to believe that we many times take an engineer and saddle him with procurement management responsibility rather than letting him deal with scientific and engineering work. My question, then, along this line is, Can we get to the point of integrating this scientific individual so much into our social and political areas without jeopardizing his scientific effort?

DR. LYONS: Let me see if I get this right--that we actually use scientists and engineers for other things, so that they are not being employed as scientists and engineers and that this is poor utilization of manpower. Is that the point of your question?

STUDENT: I say, this is my observation. I was a research and development man for a short period of time, and I have observed actual scientists doing little more than administering a contract with somebody else outside.

DR. LYONS: I think that the management and utilization of our resources, which you, I am sure, have been getting into or will be getting into here at the College, is an essential part of our problem.

In the past we have given this very little attention. We have been concerned with the other economic factors, with the allocation of material resources, and we have neglected our manpower resources. There's no question about this. Let me refer to some of the studies, for example, that President Eisenhower, when he was president of Columbia, did generate through the National Manpower Commission, working under the direction of Dr. Eli Ginzberg.

We in the universities and colleges have a responsibility here in the production of more engineers and scientists. Private industry has a responsibility in the utilization of scientists and engineers. And certainly the Government has.

We must be careful of one thing, however--that simply because a man has a tag on him--"I am an engineer because I happen to have a degree in engineering" or "I am a scientist because I happen to have a degree in science" doesn't make him a good scientist or engineer. The personnel people have to make judgments about this. Very often a man who has been trained as an engineer makes a darned good administrator and he's not a very good engineer. But there is something about an engineering education which does teach him to grapple with a lot of problems, weave them together so that they can be focussed on a single objective.

Another aspect of this, as you well know, is that in actually administering a contract, an engineering contract, you do need some engineering and scientific advice. Either you have it yourself or you have to get it from somebody who has it. So that in many respects we can use engineers for this kind of job, though I would agree with you. I think we have to be very careful that we are using our manpower so that we can get the best out of people.

I'm afraid that some of our personnel practices haven't been terribly efficient in private industry and in the Government and in universities; so that we haven't raised people to the highest potential of which they are capable. There is certainly a good deal of work to be done there. And if there are any personnel people here, I'd be pleased to hear your point of view.

QUESTION: Doctor, from an organizational viewpoint solely, has not the President had for about the last 100 years an office of scientific advice, like the National Academy of Sciences or the National Research Council?

DR. LYONS: Yes. We've had an Academy of Sciences, but it performs a completely different function. There is no question but that the President could have made anybody a special assistant. He could have had a scientific special assistant in 1947 and asked him to go about doing certain work and used his Presidential power to actually create some of the things that were created after 1958. There's no question about that.

I think that very often a President will use the power that he feels the people will support, that he feels Congress will support. I cannot conceive, for example, in the late forties of the President using too much power in this particular area. I'm not sure he would have been supported by Congress. I'm not sure he would have been supported by the people. Unfortunately, we needed the kind of shock that we got in October, 1957. We don't like the idea that we needed it, and as we look back and think, Why did we need this kind of shock?

Now, in direct response to your question, the National Academy was set up for an entirely different purpose. In Don K. Price's book "Government and Science," he recounts the early history of the National Academy. It really was set up as an honorific academy, and was a vague attempt to seek to develop a clearinghouse for science and technology.

But it never could really take a very aggressive stand. And the reason was that this would have meant Government intervention, indirectly if not directly, into a very large and very private sector of our society and many sectors of our economy.

But if we are going to have a national policy on science and technology, and if, as I believe, science must become an instrument of national policy, then it does mean an aggressive and active program on behalf of the Government, not only in terms of Government science programs, per se, but also in terms of those scientific research and development

programs in industry and in universities. There's no getting away from it.

The National Academy performs a number of functions. They have annual meetings, scientists report there, and therefore scientists in universities and industry and scientists in Government know what is going on. But it's a more leisurely kind of organization than the one that we have begun to construct since October of 1957.

COLONEL KNOX: Dr. Lyons, we appreciate very much the stimulating presentation you have made and your fine response during the question period. On behalf of the whole College, I want to thank you very much.

(31 July 1961--5,400)B/ekh

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