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PROBLEMS IN RESEARCH AND DEVELOPMENT

21 October 1955

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Dr. Milton Stanley Livingston, Professor of Physics at the Massachusetts Institute of Technology, was born at Broadhead, Wisconsin in 1905. He received the following college degrees: A. B., Pomona College, 1926; A. M., Dartmouth College, 1928; and Ph. D., University of California, 1931. Previous to teaching at MIT he was Instructor in Physics at Dartmouth College and the University of California and Assistant Professor of Physics at Cornell University. His chief accomplishments have been in the field of nuclear physics. He was associated with Professor Ernest O. Lawrence at the University of California in the development of the original cyclotron and in 1947-1948 was chairman of the accelerator project at the Brookhaven National Laboratory, responsible for the design of the three-billion-volt cosmotron. He has been Chairman of the Federation of American Scientists. This is his first lecture at the Industrial College.

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DR. WILLIAMS: A few years ago in one of the larger universities a controversy occurred regarding the tenure and freedom of speech of the faculty. It created much interest throughout the academic world. About that time I was attending a meeting of social scientists in a mid-Western city. They had a breakfast session addressed by a speaker. I wouldn't want this to leak out, but sometimes when we social scientists get together, on rare occasions we may have some pretty dull programs. This was one of them. The speaker was droning on and on and the attention of the audience was lagging, until all of a sudden he made mention of a professor who had been fired. Everybody sat up. They wanted to hear about this unfortunate man who had been disconnected from his position. But it wasn't that at all. He had been fired with enthusiasm for scholarship.

Today the Armed Forces are responsible for almost half of the research and development in the United States. The members of this class, when they go out from these walls, when they are sitting in the seats of the mighty and their handsome photographs are looking down from the glittering walls of the new building, will have influence in the field of military policy-making and administration, and many will deal with research and development.

One of the functions of the Armed Forces arising from their responsibility for research and development is to maintain enthusiasm for scholarship and build up conditions favorable to creative science. The environment of the scientist is exceedingly important; and its effect upon scientific progress could easily be proved, if we had time, by citing illustrations from the history of science. I do not have time for this, but today we have with us a speaker who is well qualified to talk along these lines. He not only has had notable achievements of his own in the field of nuclear physics, but has also been president of the Federation of American Scientists. In other words, he is a scientist's scientist. He is going to talk to us this morning on problems in research and development from the scientist's point of view. It is with very great pleasure that I present to you Dr. Livingston, of the Massachusetts Institute of Technology.

DR. LIVINGSTON: Dr. Williams, officers of the college, and gentlemen: It is a pleasure to be here. I am pleased to have an opportunity to discuss some of my views in regard to the field of research--I am not competent to speak authoritatively in the field of development--and to show you some of the things that scientists think are important in making progress, not just in science, but towards the long-range security and strength of the country. I want to say in passing that scientists are loyal people. They want to do their best, but they need certain conditions in order to do their best. This is what I would like to speak of today.

First I would like to expand a bit, if I may, on my qualifications, because I don't think that you should accept my advice without knowing my qualifications. You really have to judge for yourselves. I have, as Dr. Williams said, been a research scientist. That in itself is no qualification whatsoever for this talk. It simply means that I have been one of that group of scientists who have engaged in fundamental research in the field of nuclear physics.

But I have had some other experience which I think has given me broader views. I have been a designer of accelerators. My doctor's thesis at the University of California under Professor Lawrence was on the first cyclotron. I was in charge of the development of the cosmotron at the Brookhaven National Laboratory. At the present time I am engaged in organizing a project for a six-billion-volt accelerator for Harvard and MIT. In this field I have found it necessary to study the problems of administration, how you get scientists to work, and how you provide the kind of conditions in which they can have new ideas and can really be progressive; also how you can make them happy, satisfy their gripes and solve other problems that occur, so as to get the most out of them.

Furthermore, during the war I had the opportunity of being with the Navy Department as a civilian scientist in the Operations Research Group. I saw some of the applications of operations analysis to the methods and tactics of antisubmarine warfare and the use of weapons. So I feel that that helps me to understand how military weapons development comes into the picture.

I was chairman of the Federation of American Scientists last year. Perhaps that is one of the reasons why I have become so outspoken in this field. Some of the things I will say today are the direct result of that experience in working with other scientists in our attempts to

assist and guide the thinking in the Government regarding the use of science for the country's benefit.

This much may be enough to persuade you that what I have to say may be worth listening to.

I would like to start, however, by invading your own field, the military field, and speaking of the changes in military needs as I have observed them in the last ten years and particularly during the past war.

We now have a very complex and technical military problem, in which weapons are more important because of their newness and uniqueness and the special things they can do, than because of their quantity. This is an unusual situation for the military. Quality counts now more than ever before in terms of potency.

The area of responsibility of those of you in the military who have the job of stimulating development has enlarged tremendously. It has enlarged to such an extent that you have to consider things that never before were necessary. You have to be responsible to some extent for the private lives of citizens in this country. Just as an example, part of your planning certainly must include an understanding of the meaning of civil defense in the atomic age and how the private lives of citizens are going to be affected by the weapons and the tactics that are devised.

Also you are going to enter, and already have entered, the field of international politics. The weapons tests in the Pacific by the Atomic Energy Commission probably have had as large an effect on international relations as the activities of the State Department, during the past few years. This is what I mean when I say that the area of responsibility of the military has increased. I think those of you in the services must accept this responsibility soberly, and know what power you have to affect the course of human events through the use you make of this power.

Under these special conditions it is necessary to study the problem of security. What do we mean by security? Is secrecy enough? Is it good? Is it bad? I will challenge you today to prove that secrecy is either good or bad. The problem is still wide open. We have to start with an understanding of a much broader meaning of security.

Just one example to make this point before I go on. Suppose that we had not had such strict secrecy regarding the radar detection equipment that was available in the Hawaiian Islands at the time of Pearl Harbor. Suppose we had had more general understanding among our own officers and the services, and that it had not been so highly classified that the officers and the men were unable to understand and appreciate its value. In that event it seems to me the warning that came from our radar might very well have been in time to have served a major purpose in reducing the casualties at Pearl Harbor. That is one example where internal secrecy within the military services can definitely be questioned.

To extend the example: Suppose we had not held radar secret at all, and the Japanese had known about the radar installations. Suppose they had known that our services out there were prepared to rely on our radar. There is a certain possibility that they would not have mounted an attack on Pearl Harbor as they did.

This is what I mean when I say that the area of responsibility of the military is much broader now than ever before. It is not at all obvious that retaining the old-fashioned type of secrecy is proper or necessary. Superiority is important and we must have it. But how do you obtain superiority? This is the question.

New ideas, I believe, are more important than new weapons, certainly more important than just more of the present kind. I think that brains have top priority in coming years in keeping our superiority in the weapons development field, in this country.

We have become aware of a considerable change in weapons development during this past war. We have seen new weapons and new gadgets come into the weapons field that didn't exist before the war. You are well aware of some of them. Let me spell out a bit what I have observed and my analysis of the reasons for this change.

At the start of the past war the Office of Scientific Research and Development was established within the Government for the purpose of stimulating scientific and technical studies as applied to weapons development. That office was planned, directed, and managed by scientists or by administrators who had a scientific background. We cannot thank those people too much--people like Dr. Conant, Dr. Compton, and Dr. Bush--who did so much to establish this program of scientific research. They knew the needs and they knew the possibilities. They

attracted research scientists directly out of universities and got them into laboratories where they could apply their knowledge to the needs of the hour.

Out of that came a marked change in military laboratory practice. Scientists were not pressed heavily by bureaucratic procedures, but were pretty much given their heads. They operated similarly to the way in which they had operated in their universities. There were in this group people with all types of ability. They could talk freely within the group, could travel to other laboratories and exchange ideas. Out of this came a situation in which the scientists were reasonably content. They felt that they were respected and were being given responsibility; and things happened.

As you must know, this scientific effort resulted in the development of a large number of new weapons. The start on several major weapons was made in the OSRD--in radar, the proximity fuze, and the atomic bomb--just to mention the big three. They were started within OSRD, although they were soon transferred to other services as the need for practical application developed. There are few who would disagree that these three weapons were instrumental in winning the war, and each got its start in an OSRD laboratory. The reason was that there was a wealth of scientific knowledge available to these scientists, which they picked out of their own experience and applied to the problems of the time.

The methods used in this laboratory could well be studied as prototypes for present laboratories and procedures. The willingness to substitute speed in achievement for thoroughness in bureaucratic procedure is a very important part. The willingness to listen to new ideas is another. The number of times when new ideas were developed and then translated rapidly into trial tests in the laboratory, and from there on into the field, were innumerable. This brought about one of the most significant and rapid developments of the technological side of warfare that has been seen in the history of the world, and it came because the conditions were proper.

I might point out that we stripped the field of its backlog of ideas. We took everything that was available, including some ideas that had hardly ripened; but they were used. We do not have an equivalent backlog of new material ready and waiting for us today. We have to search deeper and work harder to build up a new backlog of ideas. But these new ideas are coming. New possibilities are here.

We were discussing, as we walked in this morning, the announcement from the University of California of the discovery of negative protons with their big accelerator. This is a breakthrough in the field of scientific knowledge of nuclear physics. We have as yet no idea of its application, but it is one of those basic ideas from which new developments may come.

Research science is the beginning of all new developments. But all research cannot be guaranteed to lead to practical results. If the research man is competent, there is about one chance in five or ten that a new idea may prove to be practical and useful. But it is a statistical result. You cannot pick out any one idea and say: "This is the one we must push. This is the only important thing." If you do, you will find that you stultify the freedom of thinking which leads to variety in new ideas, which is what I am speaking for. Variety and freedom, a wide range of speculation--these are the things that lead to a sufficient number of new ideas to yield the fraction of important practical results that the country needs.

I would like to entitle my next topic, "Requirements for Scientific Superiority." We must first recognize the importance of scientific superiority in the modern military program. Only through scientific superiority will we be able to acquire the ideas which bring effective developments ahead of a potential enemy. This is not a plea for any special privileges for scientists. They will take their lumps with the rest of the people in this country. They did, during the war, as you probably know. But I am recommending those conditions which lead to maximum productivity of scientists.

The purpose of a research and development policy should be to stimulate scientific progress. You cannot impose obsolete traditional ideas on this field without getting into trouble. Bureaucracy is a nuisance in any field. But in the field of research it is catastrophic. It kills everything you are trying to support. Research laboratories must be free from bureaucracy.

This takes a lot of doing. It means that somebody at a pretty high level has to stick his neck out and accept the responsibility for the use of what may seem to be loose or lax procedures within the research and development laboratory. This puts the responsibility directly on the top officers, the policy officers, to see that there is sufficient flexibility so bureaucratic procedures do not overwhelm the people in the laboratories. They should be allowed to speculate freely and to travel freely, to talk with each other and to cross boundaries between divisions.

The problem of compartmentalization has been one of the most serious handicaps of our laboratories and our services. It has definitely caused harm. No one knows how much farther ahead we might be at the present time if we had been able to avoid compartmentalization and secrecy barriers between the various divisions of the individual services. A person who is cleared for one thing is not allowed to hear about another topic at the same classification level unless he can show a need. Now, ideas don't come from showing need in advance. They come from accidental things, from stimulation by discussing new problems with someone else. They come by arranging for a person who is an expert in one field to enter into another field. For example, put a mathematician in contact with one of the tactical weapon jobs. He might have a useful idea. Who knows?

The important thing is to see to it that ideas can cross service and department boundaries with ease. Remember, ideas can't always be written down on paper in an adequately intelligent and useful way. They very often lose that little flare of real value when they are written. We also need to increase the exchange of research information between scientists in Government laboratories and those outside the Government.

What have we to lose? Security officers might not agree, perhaps. I am speaking, however, of a broader type of security which goes beyond the concept of secrecy. We have to decide whether or not it is necessary to keep secrets of certain kinds within closed security barriers. Wouldn't it be wiser if the scientists in Government laboratories, for example, were allowed to travel around and talk over some of their problems with university colleagues that they know and respect, and come back with a new idea or two? Isn't that worth the risk?

Those colleagues at colleges and universities are not potential traitors. They are all sincere and loyal citizens. It is interesting to note in passing that there has not been one single American scientist indicted or convicted of subversion or espionage. This is a wonderful record. I am proud of it. The newspapers have given us the opposite impression. They are just wrong; that's all.

So my suggestion is that effectiveness in research requires fertility of new ideas, and not only in the weapons field. An idea for a bigger hydrogen bomb at the present time might be completely unnecessary. But an idea, for example, in the international field--a useful

idea to reduce the probability of war--now, there is an idea worth having. That sort of idea comes best when people are allowed to discuss freely the significance of what they are doing with those of other disciplines outside their own field. It does not come if you keep them locked up inside a secrecy barrier.

We should increase the emphasis on the peacetime uses of atomic energy. The nonmilitary uses are tremendously important to the military services. It is in the development of a broad range of industrial applications of atomic energy that we are going to train large numbers of new minds to think in this field. Out of such training will come our basic strength, the strength of trained minds.

Let me define this concept of security as the largest number of trained minds. It is more important than any number of secrets in the vaults, or any number of existing weapons. Perhaps it is even more important than the ideas under development at the moment. In this way I conceive that we can really strengthen our security.

You are only a few of those who face these problems. The country as a whole has the same problem. Willingness to recognize and to train ability in younger people is of vital importance to the future strength of this country.

I would like to say a few words more, about the security system, to illustrate my rather dramatic statements and justify my recommendations.

Let us consider the requirements of military security in the days when there were individual weapons which could be described by a blueprint or a plan on one sheet of paper, and which could be put in a vault. That time is past. A military weapon is no longer a single secret that can be written down and filed away. It is a complex of ideas, taken from all fields of science and engineering, including electronic controls, computing machines, new mechanical devices, new sources of energy, all put in practical packages. Such weapons are no longer secret in their entirety, as they have been in the past. Only certain phases require secrecy. There are certain parts or aspects of military weapons which are obviously in the province of the military services. The services are required to maintain their necessary trade secrets and keep them from a potential enemy. Most of us could easily recognize such specifically military information.

There is another large category of information that doesn't deserve to be classified or to be treated as secret. This is information

on ideas and on development in the general industrial effort. In this wide-ranging category most of the information goes beyond specific military needs. Up to the present time much of this has been highly classified. Such classification has reduced our speed and efficiency in development unnecessarily and dangerously. I don't think we can afford that sort of thing. We have to learn what are the few things we need to keep secret, and then put really high fences around those and open up the rest.

Secrecy-at-any-cost may prove too costly. I mentioned the Pearl Harbor incident. There are others. I ran into some of them in my own two years with the Navy Department during the war, in which I saw, for example, an antisubmarine weapon that was highly thought of, made completely useless because it was classified too highly. There were not enough people out in the field who knew about it or how to use it. The reason that it never made a kill was that it was too highly classified. This has happened in the military more times than you think. It has occurred most frequently in the top secret category, when information was handled separately and compartmentalized even within the base itself. So even inside the military services compartmentalization leads to trouble.

In many unclassified fields we find similar problems. Government agencies have been having a rough time in the last five or six years. They have had to accept a lot of undesirable practices, such as the application of personnel security and clearance hearings when no secret information was involved. They have had to spend an enormous amount of time and effort to no useful purpose. It has caused antagonism and has alienated people who are good friends and whose help we need. For example, a renewal contract was denied by the Public Health Service to a professor at "Cal Tech," a Nobel prize winner--this was before he won the Nobel prize--on a project in biochemistry that was completely unclassified, because he was not considered clearable for classified work. But when some of his colleagues resubmitted the application under their own names--of much lesser repute--it went through. It is disturbing to see security abused in this way. It has led to a large number of difficulties and has upset lots of people, not only in this country but abroad. This sort of thing disturbs our international scientific relations.

Medical information has been badly mishandled. To this present day the Atomic Energy Commission has not released adequate information on the magnitude of radiation intensities from fallout from the

hydrogen weapon in sufficient detail to be made useful to the doctors and the citizens and the civil defense groups in this country. This can't by any conception be called a military secret, since the Russians know about it from their own tests. It is slowness. The civil defense people are trying hard to get adequate information, but they haven't been able to, because of the bureaucratic procedure.

We must think of this from a broader view of overall, maximum security. We have to find ways of getting around the limiting details of the security regulations; we must find intelligent ways to interpret the regulations, rather than bereaucratic ways.

As you might gather, some scientists have been pretty badly disturbed by what has been reported in the papers concerning the personnel security hearings which have swept through the country during the last few years. At Fort Monmouth the investigation was inspired by political reasons. Demagogues wanted power and wanted influence. The distorted evidence which was spread in the newspapers by spokesmen for these demogogues gave the impression to the public that there was a serious problem of disloyalty. The facts are completely different. The evidence that has been published to date shows no sign of disloyalty or espionage. A large percentage of those men who were questioned have been reinstated and cleared. Of the few that were not, there has not been a single indictment for subversive activities or disloyalty. There was nothing but the rather commonly used charge of "suspicious association." American scientists have not been disloyal. However, a few have been damn fools, like other people.

The hearing by the Atomic Energy Commission on Dr. J. Robert Oppenheimer and the denial of his clearance have also been a cause of considerable disturbance and discussion among scientists. After reading carefully all the testimony, I can only conclude that the people who made the decision came to a wrong decision. Some of the most competent legal experts of the country have said that the causes for this decision were due to other pressures, pressures that were outside the legitimate field of the hearings.

Now, these things caused trouble; the scientists of the country reacted violently and a large fraction were antagonistic. At least 90 percent of those who knew Oppenheimer think the Atomic Energy Commission was wrong. All the testimony was published so these people know everything that the hearing boards knew.

If this impression is correct, what does it mean? It means that something went wrong with the application of the security regulations. It was abuse, not use, of security. A significant fraction of the scientists of this country were made to fear Government employment, and to fear security investigations. In my capacity as placement officer for the graduate students in physics at MIT, a little more than a year ago I made a survey of the interests of these students in employment. One of the questions was whether they would accept a job which required security clearance. Almost 50 percent said they would prefer not to, and would accept a lower salary in order to avoid clearance requirements.

This is not trivial. There is no rebellion; most of the scientists are working and will continue to work. But they have become worried about what is going to happen in their own future professional life. Can they trust the administrators of this Government to treat them fairly? I have seen quite a few of my colleagues, who have for years been doing useful work as consultants in one way or another for Government agencies, reducing their efforts deliberately so they will not have to fill out another security form.

This is not good. It is due to overemphasis of the most extreme applications of rigid security regulations. We must have a more intelligent understanding of the meaning of security and how to apply it than we have at present. We need to study the political problems, the philosophical problems, the technical problems, associated with security--something that will give us a new philosophy about security. We must decide what true security is. One thing it is not; it is not secrecy. Achievement, brain power, potential ideas--these are the new priority items, as I see them.

We must find a way to provide safeguards for those few people who cannot be cleared for military research and see that they are not unnecessarily harmed by security procedures in the Government. We must see that they are accorded the traditional American rights. It is not because those few people are essential. It is because the rest of us, myself included, are disturbed when we see someone else being unfairly treated. I want to see all people in this country be accorded the rights that are guaranteed by our Constitution and by tradition.

Let me summarize a few recommendations: Keep aware of the new, the novel, the original ideas. Find out who are those people that scientists consider to be original thinkers, and give them complete

freedom to work on their own, to explore new ideas, to cross all boundaries between areas, so that they can pick up ideas and develop them from whatever part of the field of learning they find them. Listen to the new ideas. Don't jump too fast, but allow stimulating concepts to circulate. Don't order them to be put into an official report immediately and then classify the report; let them grow.

Utilize the advice of people outside of the military. There is a large amount of ability and intelligence in this country outside the Government agencies. Use that ability and intelligence. This means consulting freely with business leaders, with experts in all fields, with research scientists in laboratories, with engineers in other areas, and with people in many places in society.

You should stimulate the highest quality training for the maximum number of scientific and engineering personnel. It is necessary for our future security. In the process, you may have some influence in helping to change a long-standing public attitude of antagonism toward intellectuals in general. We can't change this overnight, but we can work on it. We have to improve the standing and the reputation of the teacher, of the scientist, of the intellectual in general, in this country. This means they must be supported by recognition and respect. That is the main point. Money and adequate salaries will come eventually. But recognition is the important thing.

Another point: Relax rigid security regulations wherever they are not essential. See if you can find an opportunity for penalizing a man who overclassifies something. That would be a major step forward.

Finally, our military strength depends on the strength of our economy. We are only as strong, in my opinion, as the supply of trained minds. What we must do here is plan for long-range strength, and search for those things which will increase our ability to act and act fast when the need arises. This long-range strength is associated directly with a vital civilian economy, and with the promotion of the maximum amount of specialized training for our young people.

I hope that these views will be of some interest to you.

DR. WILLIAMS: Who has the first question?

QUESTION: Sir, I think this splendid record of no indictments of which you spoke is a remarkable one, and I think you can be proud

of it. But isn't that perhaps in great measure the result of our system which you decry. Perhaps it can be compared with the British experience, where they have perhaps lost a great deal by not having some of the kind of security that apparently we do have?

DR. LIVINGSTON: I believe the reason for the excellent record in this country of a minimum of espionage, sabotage, and disloyalty by American citizens is fundamentally due to the fact that they live in America, and are Americans. They have observed what they have and they want it. I think we have a larger percentage of citizens who are truly loyal than in any country in the history of the world. I think it is due to our form of government. I think it is due to the fact that our people have consciously decided what they want. During this past war the amount of sabotage and attempts at subversion were almost negligible. It was much smaller than during World War I, when we were at war with Germany, and when we had a large, unassimilated German-heritage population.

Our principles of government, of society, are so appealing and so desirable that people just naturally want them; and for this reason there is a decreasing fraction who are subject to temptation, persuasion or bribery than in many other countries. I think our record of very few Americans who have been indicted for subversion or disloyalty as compared with the enormous number investigated, is proof of my point. The percentage is very much smaller than the percentage of idiots in the population.

QUESTION: In connection with your statement in regard to the loss of effectiveness of a scientist through the security program, especially the defense security program, I am thinking of a totalitarian country, where, of course, security is part of the way of life. We know that in Germany in the last war even under their system they were remarkably effective, and we are told that the Russians are catching up on us. How do you reconcile these two things?

DR. LIVINGSTON: That is a good question. I am not sure I can give you an answer that is completely satisfactory.

It is really a philosophical problem. The young scientists of Russia, to take an example, have been raised in a society where totalitarianism is accepted. They accept it because they know of no other system. When they enter their universities and become well trained, they have a high enthusiasm for their work.

Now, our society is based on different traditions, traditions of individual freedom. In our free society we observe the same amount of enthusiasm developing under normal conditions. I think the difference is that, if you tried to impose a totalitarian system on a society trained in democracy, you would get an antagonistic reaction and damage; while the maintenance of a totalitarian system in Russia would not cause similar antagonism or damage.

QUESTION: Are universities like MIT doing anything to encourage their graduates to enter government service?

DR. LIVINGSTON: We try to avoid influencing the students. We try to sense what they want to do and to help them individually. We do not specifically urge them towards government service, or towards industry, or towards teaching. There is relatively little attempt to influence them, but rather we try to provide them with information on all of the possible fields and let them make their choice.

QUESTION: Doctor, there was one word you used in speaking about our treatment of scientists in carrying out an operation. I believe it was "lax." I believe you said we should be more lax in our dealings with the scientific approach. Now, I have had the job of security officer; and I know that people, without meaning to be disloyal, with no question of loyalty involved, do things that violate security. It is just a question of getting them trained out of their habitual behavior and into certain procedures. Do you object to that type of procedure whereby the scientist would be required to observe certain rules in the interest of safety and security?

DR. LIVINGSTON: No. I don't object to following the regulations in the full spirit of what the best interpretation is of the needs. I do think, and I would like to urge, that the underlying policy on which those regulations are established be very much more carefully investigated. I think if that is done, there might be major changes in the type of regulations and the wording of the regulations.

The word "lax," as I used it, is applied in my thinking more to the question of bureaucratic procedures in an organization. I did not mean to be lax with regard to security procedures. I do not deprecate the necessity of rigid security and secrecy regulations, in those areas that are specifically of a secret type and have military necessity and on which we can get general agreement. I would even like to put higher fences around those than is at present possible.

I rather think that what we need to do is to investigate these areas more generally in terms of their overall significance, to see whether we can't completely wipe out secrecy requirements in a large number of areas where they are now imposed. If we looked at it very carefully, I think we would find that it would be to our general benefit, and would result in greater security in terms of progress and achievement.

QUESTION: I wonder if you would care to comment, sir, on why you think a wrong decision was made in the Oppenheimer case.

DR. LIVINGSTON: I would almost like to say, the record speaks for itself. I have read the testimony before the hearings of the Personnel Security Board with great care. I have read the testimony of the scientists and others who stood up for Oppenheimer, who believed in his loyalty and who accepted his interpretation of the events that were being questioned. About forty-five top-level scientists and high administrative people took that stand. I also read the testimony of those who felt that Oppenheimer was hiding facts, who tried to prove that other interpretations could be made, and who opposed his clearance. Those added up to about six in number.

I have read all the evidence. I knew about forty of these forty-five people, personally or professionally. I knew many of them personally well enough to respect their judgment. The net result of my study was a conclusion that the official decision was not in accord with the facts as presented in the hearings.

QUESTION: Doctor, you have given a rather grim picture of the status of the scientist today. I concur that he is not getting adequate recognition either in an economic or political way; that his status in the overall population is not as effective as it should be. But does that concept think a little bit of the status of our scientists in the country as a whole? It seems to me that, if you read about the way in which industry is doing today, hiring scientists and putting them on their boards of directors--you find industry setting up its own laboratories and not only dealing with development work, but dealing with fundamental work--it seems to me that today we have a greater recognition both on the economic side and the political side in this country of the preeminent position of the scientist. Would you care to comment on that?

DR. LIVINGSTON: I would agree with you, in general, that some progress has been made. I wish I had had time to expand a little during my talk.

There has been a major change in the attitude toward scientists, especially in the government agencies. New techniques and practices have been brought into the field. The use of scientific advisory boards is now common, and the use of experts in almost every one of the agencies. There is a growing amount of respect for and a growing use of scientists in all levels, including that of policy formation. I think this is valuable and helpful.

Perhaps it is difficult always to give a balanced picture. I am not generally pessimistic, but rather optimistic about the trends. I feel there has been a major improvement, and I think it is continuing. I may have overemphasized some of the ills of the past few years in order to point out things to avoid, and to make progress more rapid.

QUESTION: I have a little difficulty, I think, seeing how you would draw a distinction between two types, between the two categories--one, free thinking, as opposed to a weapons system where we should perhaps put a higher fence around it. Does this imply that we should have separate people as idea men from those who are doing development work?

DR. LIVINGSTON: Let me answer the last part of the question first, rather briefly. I don't think the separateness is significant. I think the important thing is consultation between people in different fields, so that men doing the development work would have access to other ideas where possible. I suggest the maximum use of consultants and of people in other development divisions.

Now, as to the more general part of your question: Yes; I think that we can set up division lines between secret and nonsecret work. I will stick to my own field, where I can use words more accurately.

Anything in the nature of a measurement of the constants of nature, or facts of nature, which other competent scientists anywhere can duplicate, is in my opinion a foolish thing to classify except for very grave emergency cases of immediate development. As an example, during the recent Atoms-for-Peace Conference at Geneva the Russian measurements of the neutron cross-sections of uranium and all the heavy elements, were compared with the American and the British measurements; and they were right on top of each other. All of them were alike, although they were measured separately in these countries. They had been classified by all these countries. Classification caused a blockade to the proper circulation of this information within our

country. The harm of overclassifying that kind of fundamental information is that the universities need this data to guide thinking in research and development. Meanwhile the Russians had full information. So it was foolish for us to keep that a secret, and reduced our own progress.

One other point: The Russians offered one curve of the cross section of a reaction on an element which was discovered in this country, called americium. The Americans had not gotten around to separating it in quantity and making this measurement. The Russians did it first and have now given us the cross section. The whole field of atomic power, the entire theory, is now wide open because of the Geneva Atoms-for-Peace Conference. I think it is good. I think it was past due. It should be followed-up by more international conferences and publication of all nonmilitary information.

There are other areas that have to do with the manufacture of weapons, and the specific properties and features of those weapons, which are not the scientist's business. They don't need this information and would like to see it kept classified.

In general I think this can be said: if you can reduce the total amount of information to be kept classified, you can increase the security of that which you do keep secret.

QUESTION: I believe it is true that in the past decade or so no one man has been responsible for a true scientific break-through. In other words, the developments that eventually became break-throughs were the product of pooled ideas. You brought that out in your remarks. Now, surely, compartmentalization, as you described it, that would defeat the exchange of ideas, is stupid. And probably compartmentalization, if it prevented an exchange of ideas between universities, would also be stupid. But I wonder if you would comment on how much we should exchange our basic research in science with the different countries, between the United States and our allies or the United States and some of the Russians. Would you care to comment on what we gain and what we stand to risk by that kind of cross-fertilization?

DR. LIVINGSTON: A variety of things could be said on this subject. First, the technical answer is, yes; we did learn something that we didn't know before from the Russians. It was not as large an amount as what the rest of the world learned from this country. I think the most significant thing that happened at the Atoms-for-Peace

Conference was the tremendous amount of information released by the U. S. Atomic Energy Commission; and I congratulate them heartily for it.

Now, what good did it do to release this information to other countries, since we released more than we got? Well, I consider that the years ahead are going to be years of severe competition. I hope this is not going to be military competition, that is, warfare. But I am sure it is going to be competition, and severe. We are not going to change the basic ideological differences that exist. So the competition will be to persuade people throughout the world that our system is better than the Soviet system.

To that end, the good will of other nations, our usefulness to other nations, our help to them, becomes of major political significance. I believe that in the long run the giving of information and technical assistance is going to be of much greater value to us than having more bombs, because it will make it possible for us to keep ahead in this competitive period, to keep ahead at all times, and to keep ahead not just on the technological level, but ahead in terms of our influence on other peoples in the world.

I have mentioned that the military problem has an international aspect. I would like to say a few more words. Our opportunity to help other neutral countries through the giving of information, useful technical information and scientific data, which are not available to others because they haven't had the experimental equipment set up to obtain such information, will, I am confident, help our overall international standing. And that is in my opinion of even more importance than the balance of technical strength. The real battle is for the minds of men.

QUESTION: I recently became interested in the national register of scientific personnel. I understand that there are about 135,000 or 200,000 people of all categories registered. In view of your remarks I wonder if you would care to comment on whether there is reluctance among the scientists who registered for this project because of fear of clearance or fear of getting involved in security matters.

DR. LIVINGSTON: I don't think I have observed any reluctance except the obvious reluctance to filling out forms. However, the large mass of young people who are active in research or on their studies,

do not have quite as much awareness of the needs of the government agencies for scientific service as you might think. Maybe they are not yet convinced of the importance of it.

I don't think there has been any reluctance to fill out the National Register forms from the point of view of security. However, there is a continuing pressure on scientists to fill out the same form time after time, every time they take a different job. This is a major handicap.

QUESTION: I would like to say I am with you a great deal in your plea for a better understanding. I think the services and the Government might do a great deal toward this thing. I would like also to look on the other side of the picture. When you have indiscretion, it seems that the scientists rise to protect the man, not necessarily because they agree with his indiscretion, but because they are protecting his right to do as he wishes and say what he pleases. Now, possibly the scientists could help a great deal by exerting some group pressure upon the new scientist who commits some indiscretion, to make him more discreet. Would you care to comment on that?

DR. LIVINGSTON: I think that none of us condone indiscretion. I don't know any scientist who does. We think a man ought to have his wrist slapped when he has been indiscreet or ignorant of the rules. But not by the mechanism of calling him disloyal and disclosing his name to the newspapers, which leads to persecution beyond reasonable bounds.

This is just a matter of balance in how you do it. Every administrator--and I have had to do this myself--has had to chastise individuals for getting out of line, for making mistakes. You do it privately, in your office. In nine out of ten cases at least it is successful. That man has learned his lesson and does not make the same mistake again. This is the normal procedure. Let's use the normal procedure. Let's not use the newspapers. That is really my point.

QUESTION: As a scientist do you consider that there is a shortage of scientists in this country? And, if so, is the situation critical?

DR. LIVINGSTON: There is a shortage of good scientists, yes. But that is true all over the world. One of the interesting things that was reported to me from Geneva was that in talking with their Russian friends--and they called themselves friends during that conference and acted in a friendly way--one of the Americans asked: "What is your big problem in your Russian laboratories?" The answer was: "The

problem of filling out forms--bureaucracy in government." And they also said they have another problem, of not enough good students in the universities.

In other words, good scientific ability is characteristic of nothing more than the average intellectual level and ability of the people as a whole. I think we are probably not getting as large a fraction of really top people into science at present as would be desirable from the point of view of our technological race. I think it would also be desirable to have more highly-trained people in all fields.

But I am not at all sure that number is the determining factor. I think it is the rate of progress. I think that improved conditions under which we can make progress will bring an adequate number. After all, our society is so arranged that we will always have, due to the pressure of supply and demand, the number that we need for the kinds of jobs that need doing. There is a lag now. But it will be made up as salaries rise and other conditions change. I don't think we have any serious lack. I think we are doing all right. I think we ought to recognize the shortage problem for what it is and search for the best students and provide opportunities for the best possible training for those who really want to go into science.

QUESTION: I can appreciate this barrier that classification builds up, so that you can't cross lines or get your scientist associated with other scientists who are of a parallel standing. I am just wondering whether our military research and development organization otherwise is an efficient organization, in your opinion.

DR. LIVINGSTON: Let us put it relative to what it was earlier, say, before the war. It is tremendously better. A lot has been learned. I think that the present military development groups are of the highest quality that they have ever been in the history of this country. There has been a great improvement. That, obviously, is not saying they are at the top. You can always improve. I hope that my remarks have helped to show how we might further that improvement. A great deal of improvement is possible even at the present time. I am myself a strong proponent of modifying conditions so that military laboratories can grow to be even stronger than they are.

DR. WILLIAMS: Doctor, it was very fine of you to come down here. On behalf of the Commandant and the student body and faculty, I want to thank you most warmly for doing it.

(8 Dec 1955--450)E/ibc