

RESEARCH AND DEVELOPMENT IN GOVERNMENT
AGENCIES (EXCLUSIVE OF DEPARTMENT OF DEFENSE)

27 September 1950

CONTENTS

	<u>Page</u>
INTRODUCTION--Brigadier General J. L. Holman, USA Deputy Commandant for Education, ICAF.....	1
SPEAKER--Dr. Wallace R. Brode, Associate Director of the National Bureau of Standards.....	1
GENERAL DISCUSSION.....	12

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GENERAL HOLMAN: Gentlemen, In order to give you leads for the discussion period I will read some notes from Dr. Brode's biography so that you will get to know him better:

"Dr. Brode has had extensive experience in research and development activities, having served for 20 years as Professor of Chemistry at the Ohio State University, and during the last war took an active part in the scientific defense activities. He was head of the Paris Office of the Office of Scientific Research and Development in 1944 and 1945 and, following the collapse of Germany, joined the Navy's civilian research work as head of the Science Department and Associate Director of the Navy's largest research laboratories at the U. S. Naval Ordnance Test Station at Inyokern, California. Dr. Brode spent two years in the organization and planning of this defense laboratory and is now a member of its Advisory Board."

He has had duty with the Central Intelligence Agency and since 1948 has been Associate Director of the National Bureau of Standards.

Dr. Brode, we certainly appreciate you coming here. You have been at the college before, and it is certainly a great pleasure to have you with us this morning.

DR. BRODE: General Vanaman, General Holman, gentlemen: It is a pleasure to be here this morning and to take part in the college activities. I often sat in the audience during the lectures and enjoyed them very much. I hope I can contribute as much as I have received from previous lectures here.

My understanding is that it has been decided to have two lectures on research and development in government, one of which will deal with agencies within the Department of Defense and one with agencies outside the Department of Defense; and that you will have a subsequent talk in this series from a representative of the Research and Development Board, covering the research and development within the defense agencies. I am going to confine my discussion almost entirely to the research and development program of the nondefense agencies.

RESTRICTED

What I think would be desirable for you people to know is: What are the plans and structures of the nondefense, or civil, research laboratories of the Federal Government?

The broad differentiations of defense and nondefense agencies, into which this sort of dual presentation I have described will be divided, are not easily effected. Much of the work done by defense agencies is of a broad, public welfare character, since there is medical research and the work of the Army Engineers in flood control; and many of the so-called nondefense agencies, such as the National Bureau of Standards, receive much of their financial support from defense agencies. In addition, certain agencies, such as the Civil Aeronautics Authority, the National Advisory Committee for Aeronautics, the National Bureau of Standards, and the Coast Guard, have what might be called a quasi-defense character, in that their character changes with the emergency or the times; they may become defense agencies or they may be civil, nondefense, agencies.

To make a drastic division, or partition, we will place the Army, Navy, and Air Force in one group as defense agencies and consider all other governmental agencies as nondefense agencies. In other words, we will say, for instance, that the National Advisory Committee for Aeronautics is a nondefense agency, from the point of view of this discussion of research programs and operations.

We are going to have to leave atomic energy entirely out of this discussion. We are not putting it in either defense or non-defense agencies, or even considering its research program, because it is somewhat outside this scope of activity. In addition, a great deal of the information concerning the amount of work, where it is done, and how it is done is really classified to a pretty high degree.

Such a division of our research and development operations in the Government--that is, placing Army, Navy, and Air on one side and all the rest on the other side--is not exactly a 50-50 division, at least from the standpoint of financial investment. It approximates, rather, about an 80-20 division. About 80 percent of our national funds devoted to research and development are spent upon defense activities, and about 20 percent of such funds are spent on nondefense activities. A rough estimate is that the sum of about 750 million dollars is appropriated for research and development within the Government, and the amount of approximately 150 million dollars or about 20 percent of the total, is devoted to the nondefense agencies.

RESTRICTED

The nondefense agencies are innumerable, we might say, but we can narrow them down to about 15 that might be considered the principal nondefense agencies, none of which receives more than 5 percent of the total amount that the Government spends on research and development. The top three Federal agencies, from the standpoint of the amount of money involved and the size of their research and development activities in the Government, are essentially the Department of Agriculture, Department of the Interior, and the National Advisory Committee for Aeronautics; each spends about 35 million dollars a year on research and development. These are closely followed by the Federal Security Agency, which spends nearly 15 million dollars, and by the Department of Commerce, which spends approximately 11 million dollars. Of the 11 million dollars spent by the Department of Commerce on research and development, the National Bureau of Standards receives 8 million dollars, which, in the over-all total, amounts to about one percent of the Nation's investment in research and development. Other agencies, such as the Tennessee Valley Authority, Reconstruction Finance Corporation, Veterans Administration, Federal Works Agency, Smithsonian Institution, and Treasury Department, receive, on the average, less than one-half of one percent of the Government's investment in research and development, and no other Federal agency receives much more than one-tenth of one percent of the Government's investment.

While the one percent of the Government's investment in research may seem small for the principal Federal agency for research in the physical sciences, which is the definition of the Bureau of Standards, this is not quite a true picture, in that the investment is actually about 5 percent of the nondefense budget. In addition, we receive transferred funds from many other agencies of the Government, so that actually over half our budget comes from that means of transfer. That steps us up to about 10 percent, and it becomes a more respectable portion of the Government's investment in nondefense research.

In this subdivision of governmental laboratories, we have listed, as I said, about 15 different agencies, of which the top three are the Department of Agriculture, the Department of the Interior, and the National Advisory Committee for Aeronautics. Each of these agencies is divided into multiple sections and subdivisions, so that the various laboratories often lose their identity with the department. We are not quite certain whether the Food and Drug Administration is in the Federal Security Agency or whether it is in the Department of Agriculture. We may not be quite sure whether the Bureau of Mines is in the Department of the Interior or in the Department of Commerce, because many of these laboratories--and the National Bureau of Standards is one of them--achieve national prominence and importance which almost overshadow, sometimes, the departmental agency for which they work. Take the National Institute of Health as an example; the Federal Security Agency is its custodian,

although most of us consider it to be almost an independent government agency. It does operate quite independently and has many directives and forms of its own, just as does the National Bureau of Standards

These principal nondefense agencies have many characteristics that are common and that serve to differentiate them from defense research agencies. These nondefense agencies generally spend their whole appropriation, and often more, within their own structure and seldom contract research performance to other agencies or laboratories. On the other hand, the defense agencies carry out the major portion of their research, two-thirds of it in fact, by contract to nongovernment laboratories--universities, industrial companies, and the like. So that there is a marked differentiation and distinction between the methods by which research is administered, directed, and organized in the defense and the nondefense agencies. I think that is a justification for separating these two talks, so as to consider the organizational structure of the civil research agencies of the Government, as distinguished from that of the defense agencies.

Many of the nondefense laboratories are recipients of contracted funds. In fact, the National Bureau of Standards, as I mentioned before, receives 8 million dollars, or about half of its total appropriations, by direct appropriation, and about 8 million dollars by contracted service funds from other government agencies. On the other hand, there are some agencies, such as the Office of Rubber Reserve and the Civil Aeronautics Authority, that have practically no laboratory facilities and contract nearly all their research work; yet almost all their contracted research work is with other Federal laboratories.

Behind this contracting and intragovernmental service is often legislation that directs this particular procedure. In other words, a great many of the bills in Congress will specify that full use shall be made of existing government facilities in the performance of this work. This procedure is justified; it avoids the construction of duplicate facilities and efficiently uses the facilities that the Government has, and that is part of the objective. One of the reasons why the Bureau of Standards has grown so large in recent years is that we have become, to many other government agencies, a sort of service laboratory where a specialized short-term research project can be contracted and performed.

Once in a while, especially in Congress, we run against some opposition to this transfer system. Some Members of Congress might have decided that a certain agency should be reduced in size and scope, and they cut down the appropriation accordingly. In the next year, when they come back to look over the operations of this agency, they find it is twice as big as it was the previous year, as a result of having received transferred funds from other agencies--funds that had been originally appropriated to those other agencies. It sort of gripes them at times.

Yet the Economy Act of 1932 specifically provided that just exactly that sort of thing should be done; that especially within research and development agencies of the Government, where the facilities are available in one agency, another agency can, by request and transfer in the standard form 1080, transfer funds to the former agency to do this work for it. This is preferable to the latter agency going out and establishing its own laboratory and hiring its own personnel to do a short-term or even a long-term research project. So that I think it is only a matter of explanation and acceptance on the part of those who feel a little antagonistic. We will fully justify this method of transfer of government funds within the Federal agencies.

Concerning what might be called the broad classifications of research and development, we might break this down into a series of subdivisions. In your subsequent discussion with the Research and Development Board speaker, the same subject and the same definitions will probably come up because we both have probably read the same original raw material. Research and development may be broken down into four major headings, as follows:

"Fundamental Research," which is a basic, theoretical analysis and exploration into the frontiers of science.

"Background Research," which is the preparation of the necessary over-all survey to determine the need of a fundamental research project.

"Applied Research," which is essentially the taking of basic data and putting it into application in the operation of research.

"Developmental Research," which is the adaptation of research findings to experimental and demonstration operations.

The vast majority of the government effort, especially in defense laboratories, is devoted to the category of developmental research. Even in the nondefense agencies not much more than 15 percent of our total effort is devoted to fundamental, or basic, research. The small effort in basic, or fundamental, research is a reflection of the pressure on government laboratories to provide a visible, tangible service in response to immediate customer demand.

About three years ago the Government Printing Office published a series of five small volumes generally entitled "Science and Public Policy," a report prepared by the President's Scientific Research Board, under the chairmanship of John R. Steelman. This survey, of which Volume II is entitled "The Federal Research Program" and touches on the basic subject of both this lecture and the subsequent one in the series, is a thorough

RESTRICTED

362

study made by competent experts in the various governmental research and development laboratories and contains a very large amount of basic information. I recommend it to you if you are interested in further reading in this field, that is, this general subject of the Federal research program. These volumes consider both the defense and the civil research programs.

While this series was prepared about three years ago, much of the material is equally pertinent at present because most of the nondefense agencies are long-time, well-established groups that do not oscillate very much in their entire program and emphasis in a matter of a few years. There are gradual changes, but the basic situation remains much the same.

I will try to stress this morning the changes that have taken place since this report came out, changes that might appreciably alter the apparent picture of the attitude within the Government toward basic development and fundamental research.

An examination of the Federal division of science among the various governmental departments at the time these reports were prepared will disclose a surprising separation and division. That is, the system by which the Federal Government has subdivided science within its various agencies is too difficult to comprehend. Why certain agencies would be in one department and others in another department was usually a matter of political influence at the time they were created, so that we do not have a really scientific assignment of agencies within the Government. We have health in one department of the Government, food in another, textiles in another, and fuels in another; and in each of these departments of the Government there are many other interests, so that quite often these particular interests are not the principal interests of the department. With no reflection on the Department of Commerce, it is obvious that the National Bureau of Standards is not the basic, fundamental interest of the Department of Commerce; the same might be said of many other departments. The Federal Security Agency has interests other than that of health. And so we go through our listing.

There has been, however, some movement within the last few years to correct some of this difficulty by improving the liaison between these various groups. In particular, the President has appointed the Interdepartmental Committee on Scientific Research and Development, which has proved very useful in improving the liaison between these various working laboratories. Uniform methods have been developed on handling patents of research workers, on the handling of guest workers and exchange of information, on the handling of security and clearance of people going from one laboratory to another, and on the handling of publication and training. In particular, this committee and the subcommittees of the group have been concerned with the recruitment of good scientific personnel, dealing not

RESTRICTED

with the problem in any one government research laboratory but with the general problem in all governmental research laboratories. I might add that this Interdepartmental Committee on science includes not only non-defense but defense laboratories, and the same problems occur in both categories with regard to the recruitment of good technical personnel.

Another development in the progress towards better coordination of activities has been that many of the larger departments in the government--such as Agriculture, Commerce, and Interior--within themselves, have created scientific committees so as to coordinate the various scientific and research interests within the respective departments; at times, they were far apart. That is, before that went into effect we had no really good liaison between the Bureau of Standards and the Weather Bureau; although they were both in the Department of Commerce, they might just as well have been in different departments. We were friendly but we had no getting together, with the idea of trying to join hands so as to better affect the viewpoint of the Department of Commerce with regard to some of this technical material.

Another important effect in recent years upon the scientific operations within the Government has been the Hoover Commission Report and the resultant directives that have been adopted. New directives or enabling acts have gone through, some of which, like the new National Bureau of Standards Act, have been under consideration for quite some time--even before the Hoover Commission Report was prepared; however, the added impetus that the Hoover Commission Report gave to a thorough reconsideration of the enabling acts has made it possible for us to obtain the passage of these new definitions of authority and area.

In many of these an attempt has been made to broaden discretionary powers on a departmental level. One of the recommendations in the Hoover report is that, rather than Congress specifying that a given laboratory shall do a given job, the authority shall be given to the departmental head, the Secretary of Commerce, for instance, to do a job, and that he may, within his discretion, assign it within various areas of the Department of Commerce. This increases flexibility and it has been adopted. In fact, the new enabling act, or authority, for the National Bureau of Standards does not mention the Bureau of Standards by name; it merely says, "The Secretary of Commerce shall do this...."

In the earlier report of the Steelman Board considerable time was spent in considering the statutory basis for Federal research programs and the limitations that were prescribed. There have been many cases of unfortunate limitations as to how far one could go in a given department or research laboratory, and as to whether one laboratory could deal with a given subject or whether it belonged in a certain area. We are not quite sure whether fuels belong in the Bureau of Mines or the

Bureau of Standards. We determine the knock rating on fuels, and the Bureau of Mines determines the BTU content. We are not quite sure whether mildew belongs in the Textile Division of the Bureau of Standards because it affects the strength of open fiber, or whether it belongs in the Department of Agriculture. We have these borderline cases. Most of them, usually on the lower level, are handled very amicably. For example on the question of X-ray dosage, the National Institute of Health prescribes the treatment of X-ray dosage, and we determine the strength, the intensity of X-ray, and the protective qualities of various materials against X-ray or radioactive effects.

Some of the legal limitations go back to statutes that were adopted as long ago as 1789, and many of these have obviously failed to keep up with the rapid advance of science. It is no wonder that the legislation adopted by Congress in 1901, some 50 years ago, in the establishment of the National Bureau of Standards, did not specifically authorize the type and character of work that we are now doing. I think an examination of the new legislation will give you a pretty good idea as to the change of trend in thinking with regard to the assignment of scopes and areas within the civil research laboratories.

The new law, Public Law 619, which was passed by the Eighty-first Congress a couple of months ago and signed by President Truman, has defined, in very broad and general terms, what the Secretary of Commerce should do with respect to the custody, maintenance, and development of technical standards; the determination of physical constants; the development of methods for testing; cooperation with other government agencies and private organizations; advisory services to government agencies; and how one should handle the invention and development resulting from the work of these various laboratories. Specifically, the law quotes the principal jobs we are now doing but leaves the way open to say that these are examples and similar other things may be done. So we have a very wide authority for operation of a national research laboratory.

The law closes with three rather important clauses. One of them is a perpetuation of the Economy Act, namely, authorization to receive money by transferred funds. Another clause authorizes the Secretary of Commerce to retain the equipment once he has obtained it, unless some other arrangement has been made, so that things purchased with transferred funds remain with the research laboratory to improve the laboratory. Lastly, a new clause, which we are very much pleased to have, authorizes the Secretary of Commerce to receive gifts and benefactions for the benefit of science and to operate under that procedure.

The latter clause is one that has not always been tacked on to government agency authorizations, and the lack of such authorization has caused a great deal of difficulty. We did not have such authorization before this law was passed. It is true that the National Institute of Health can receive and handle funds, such as the Cancer Fund, dispense the money, and carry out research under a particular fund, although it is not an appropriated fund of the Government. But we had been forced, more or less, as a blind and subterfuge, to go to the National Research Council, the American Society of Mechanical Engineers, or some such organization, and say, "Would you be the treasury of this particular fund of a group of research people who wish to establish something at the Bureau?" If we turn the money over to the Government, it goes into the Treasury. Then we have to go to Congress and get an appropriation for the same money to do the work, we may not get it, and the money will be lost. The procedure then was to establish research associate projects aid for by the American Petroleum Institute, the American Society for Testing Materials, and so on; or the National Research Council was the holder of these funds. It is now legal in the Department of Commerce to receive the money directly and dispense it in the operation of these research associate projects with industry and with national scientific and technical associations.

This broadening of the viewpoint toward scientific research has been further carried out in recent bills in Congress. For example, there was a recent enactment that authorized the Secretary of Commerce to receive and dispense technical information. The Bureau of Standards, the Office of Technical Services, the Weather Bureau, and other groups in the Department of Commerce, can all operate under this same law because it does not specify any one particular agency. Authority was also given for the existence of a sort of rotating fund so that we can print something and sell it; then use the money we sell it for to print more, rather than having to go back and get a continued appropriation for the maintenance of a given series of technical data. The X-ray crystal pattern cards are an example. We have been publishing them for quite some time at the Bureau of Standards, but we don't get credit for it. The American Society for Testing Materials actually gets the credit inasmuch as the cards are received and sold through that organization; otherwise, the financial arrangements through the Government Printing Office would just be too complicated to handle. This improves the facility with which we can prepare and publish research materials.

It might be in order at this point, in closing my talk, to discuss briefly the actual research and development program of the Bureau of Standards as an example of the research and development carried on in the Government. I think the general, broad viewpoint and scope are typical of any of the advanced research laboratories in the Government.

Research and development by the Bureau of Standards primarily falls into two categories. There are, first, investigations that result from the Bureau's responsibility for fundamental measurements in the physical sciences, the development and maintenance of primary standards in science and engineering, and the testing and calibration of standard measuring apparatus and reference standards. In these fields research and development is mainly directed toward greater precision in measurements concerned with the Nation's fundamental scientific standards, physical constants, and properties of substances and materials. I might add that one of the things Dr. Condon is most anxious to do is sort of push the decimal point one place further in all our physical constants, to improve the method of measuring time, length, mass, and electrical energy. All these things are being pushed with the idea of developing a more precise science. He believes that one of the principal functions of the Bureau of Standards should be the publication of the physical constant of nature. At the same time, however, new standards and measurements of this general type must be investigated and developed as science opens up such new fields as atomic and nuclear physics, higher frequency and radio propagation, and chemistry of high polymers. We have recently issued new standards for neutron intensity and radioactive intensity. People working in different laboratories in other parts of the country will be able to measure their radioactive materials and know that they are measuring the same quantity that some other laboratory is measuring.

A second phase of the research and development at the National Bureau of Standards consists of large-scale specific projects that are undertaken under congressional authority, such as our radio operations, or that come from other government agencies. Examples of these are the work in artificial radioactivity, building technology, high polymers, guided missiles, ordnance, electronics, jet fuels, electronic computing machines, and numerical analysis.

While it is true that most people think of the Bureau of Standards as the custodian of weights and measures, it is a reasonable portion of our load but not the major portion. I think our major portion of work goes into the testing of materials and the approval of their purchase; that is, conformity to specifications and the preparation of specifications for Federal purchase and supply. We also prepare codes of specifications for municipalities, cities, and other agencies.

We consider the over-all responsibilities toward the definition of physical constants. Somebody has to take that responsibility and authority. If you have followed Public Law 617, which was passed by the Eighty-first Congress a couple of months ago, you know it is an unusual law in that it is a definition of physical constants. It defines the ampere, the volt, the watt, the lumen. This is a law that was prepared by the Bureau of Standards, and strangely it went through Congress with

practically no opposition. You may wonder, "Why is it necessary to enact a law to define simple physical constants?" These are items that are bought and sold. Kilowatts of electric power are transported and exported from one country to another. We buy kilowatts, and we would like to know that what we are getting is a defined unit, the same as the gallon or the power unit in thermal units of fuel values. We would like to know, also, that the watt is a specific value of recognized legal amount. We also have defined in this same law certain light intensities, so that, when you buy a certain amount of illumination, you will get that particular number of lumens, or candle power, as defined by proper legal standards.

We have produced many of these standards, we define them, and we assist other nations in defining them. We have a large number of exchange arrangements with other countries in maintaining a common commercial standard of mass, time, and so on.

Time does not permit a discussion of the various separate types of research projects in which we are engaged. The director issues an annual report of the National Bureau of Standards that is incorporated in the Secretary of Commerce's annual report. I think it gives a very good picture of the over-all research of the National Bureau of Standards, which, I think, is typical of many of the Government's research laboratories.

As I have nearly used the time allotted, I will not try to discuss any of the specific research projects; however, I think you will find many of them of interest. We have developed new methods of insulation at high temperatures, new types of leather substitutes, and methods of extending the life of paper and paper materials through bonding procedures.

We have done quite a bit of work on the new metal, titanium, which undoubtedly will replace iron in many types of construction. Of our structural metals, titanium ranks about fourth in abundance, there being more titanium than copper, zinc, and other common elements. That is something which just has not been pushed and developed.

With the pressure for new materials, and substitutes for existing materials, the Bureau of Standards and other government laboratories are doing considerable work along this line. We are not alone in this. The Bureau of Mines is working extensively on new metals and new fuels. The Department of Agriculture is working on new foods and substitutes. We are all concerned with the general, over-all picture of the supply and demand within this country as to materials.

RESTRICTED

Sometimes these projects result in touchy political situations. We recently announced the production of synthetic mica at the Bureau of Standards. Synthetic mica does not mean a great deal to this country from the viewpoint of the total industrial operation, but it is a very important commodity for certain electrical operations. It is an essential strategic material. We import from India practically all the mica we use. This synthetic mica will provide a measure of safety to us. But it also means the destruction in some other country of an industry that is fairly large in that country although small to us.

We have done that before in science. We destroyed the Indian indigo industry by the production of synthetic dyes. We destroyed the Japanese silk industry by the production of rayon. We have gone through a cycle, and I think we can only say that we will always have people who are victims of progress. We must, in our planning, devise aids to these countries or groups to provide some other activity that will offset the progress which we have effected through our science and research.

Thank you.

QUESTION: Doctor, would you give us your opinion on the most advantageous division of funds between basic research, on the one hand, and applied research and development, on the other hand?

DR. BRODE: I think that would be predicated somewhat on the area involved. I think that within the defense agencies the funds are properly divided, with perhaps 80 or 90 percent devoted to developmental research.

The experience at the Naval Ordnance Test Station has been very satisfactory because there has been an earmark, or a tag, on 10 percent of all the funds that come in, to provide a working fund that may be drawn upon for basic, fundamental research, and the people have been allowed a certain amount of their time to do this. By doing that, we have attracted scientists there who have been able to do a certain amount of basic work and to publish it. Technical papers are now coming out from that laboratory.

The interesting thing is that the scientist has not gone wild in choosing some abstract subject that has no connection with the assigned work in his group. For his fundamental, basic research he has chosen subjects that have proved so interesting and useful to the Bureau of Ordnance, which sponsors this particular laboratory, that various research and development branches there have fought for permission to list them as one of their projects and pay for it. In other words, the thing has become of apparent usefulness.

RESTRICTED

A good, thinking scientist will not choose a subject that does not have something to do with the field he is concerned with and does not advance that particular subject. And with the choice he makes, the fundamental research becomes basic, the basic becomes applied, and the applied becomes developmental as we go through this particular progress.

I think that the real point is not that there must be a fixed and hard division, but there must be some basic research tied to the general program of developmental research. The amount is not so important as the concept. Generally, I would say, in the nondefense laboratories certainly not less than 15 percent should be basic, and probably 20 to 25 percent.

QUESTION: Doctor, you spoke of the development of new insulating materials and other advances that are useful in the civilian economy. I recall that a couple of years ago the NBS developed a magnetic clutch. I wonder if you would tell us something about the patent arrangements that arise out of the application by industry of NBS developments.

DR. BRODE: Until recently, the different government agencies had different rules on patents, but a presidential directive has cleared up this matter by making all patent regulations alike in the nondefense agencies. In the Bureau of Standards the individual who discovers or invents something has no patent rights to royalties, or otherwise, within the United States. The patent is given to the Government and may be used by any industry that wishes to develop this particular patent. It is dedicated to the public.

This does not essentially encourage patent activity, you might say, except that the Department of Commerce is concerned with it in that new inventions or discoveries that are patentable are patented. We have a patent officer at the NBS who spends his time looking over these reports and discoveries that are referred to him, because it is the desire of the Department of Commerce to insure the public's interest. If something is not patented by the Government, it might be patented commercially or privately by somebody outside the Government, and the Government loses the vested interest that it has in having paid, from government funds, for the development of a new process or idea that should be given to the people.

That does not always follow in the defense laboratories, I believe, in that in the defense laboratories there have been arrangements by which patents are dedicated to the Government so far as their use in defense is concerned; but, industrially, the individual may obtain royalties and rights upon the same. Again, that creates a sort of demarcation between defense and nondefense government activities.

RESTRICTED

370

In defense activity it is obvious that the work is for defense purposes, and whether it has commercial interests outside of those purposes is not generally taken into consideration. But in the nondefense activities, it is considered that the interests of the Government are the interests of the people in any application.

QUESTION: You mentioned the liaison and coordination within the Government in the nondefense research laboratories. I wonder if you would care to comment a little on what coordination and liaison the nondefense research and development agencies have with industry and the universities in order to get away from a lot of this overlap that we see.

DR. BRODE: I think that is coming. I have carefully ducked that subject. There is an organization with the initials "NSF," which sometimes means "Not sufficient funds"; otherwise it means the National Science Foundation. The two are synonymous at the present moment because the Government failed to appropriate funds for the National Science Foundation in sufficient quantity, at least, to make it operable. That agency is supposed to be the agency to do what you ask; namely, to provide the liaison between research and development in the government agencies and research and development programs in industry, universities, and research foundations. It just is not operating at the present time.

QUESTION: Dr. Brode, you mentioned that among some of the departments the several bureaus sometimes seem to be independent, that they have built up their own reputations. As a result, there is a great deal of overlap of activities and, in some cases, there is a great deal of confusion, to the detriment of the whole program. Would you care to discuss some of the factors that may help pull the bureaus together into an integrated program and some of the factors that will keep them apart? And, in your opinion, can they be pulled together?

DR. BRODE: That is a very difficult subject for me to discuss. I am one of the participants, you might say, involved in the effects of such a move. Perhaps it would be more logical for the National Science Foundation, or a group of disinterested bystanders, to consider to what degree we should coordinate the various bureaus of the Government, remove the present reputation of autonomous, independent operation, and make them all one unit; or whether it is better to let them remain as separate institutions of national reputation in a limited field of activity. I find it a little difficult to answer that. But I think the Hoover Commission proposals and the National Science Foundation together, if and when put into effect and adopted, will cover that point as well.

We are always undergoing a certain amount of change. For example, in the Bureau of Standards, just within the last few months, we divested ourselves of a section of the NBS and gave it back to the Department of

RESTRICTED

Commerce. On the other hand, we would like to take another piece out of the Department and put it into the NBS. Such things can be done. The part that we gave up was Commodity Standards and Specifications. This is now a part of Domestic Commerce, to which it, perhaps, a little more logically belongs. It is a bit difficult to draw these sharp lines of demarcation.

QUESTION: One of the arguments that has been advanced by the rubber industry against continued government ownership and operation of the synthetic rubber plants has been that government research and development is considerably inferior to commercial research and development in the synthetic rubber field. Are you in a position to comment on that, either directly or in general as to whether the profits spur in the commercial laboratory is of significant assistance in furthering research?

DR. BRODE: I am of the opinion that government research is good in those areas in which it has been properly supported, and it is a question, I think, of supplying the funds for such research activity. I think the cost of research in industry is at least as expensive as it is in government activities, if not more so, and I think the results obtained for the dollar spent in government research are better than those for the dollar spent in industry research.

QUESTION: The Research and Development Board reports have expressed concern over a shortage of scientific personnel. Are you experiencing any difficulty in obtaining sufficient scientific personnel to carry on your research?

DR. BRODE: The answer is, yes, we are. We have difficulty in obtaining scientific personnel--even mediocre personnel, to say nothing of top personnel--and we have difficulty in holding our top personnel. A part of the difficulty is due to the civil-service structure, which is, I hope, being continuously revised and favorably studied. Another part of this difficulty has been the shortage resulting from the increased demand for these people. We have quite a number of vacancies that we are unable to fill, and we do not have the authority to pay the high salaries that industry or now even universities are paying in many of the types of positions that we control. That is true, I think, throughout the Government.

I think there should be a release, we might say, of the ceiling that prohibits high salaries in certain areas, so that the Government could compete with industry in obtaining the top advisory and technical people. I realize that in the armed services and in other government laboratories there has been a great deal of difficulty in filling the positions because of inability to attract the people they really want.

RESTRICTED

372

QUESTION: Doctor, you brought out the answer to one question-- that the NSF is to coordinate government departments and universities. I did not quite understand, during your talk, whether the Interdepartmental Committee now insures complete exchange of information, both as to projects being worked on and as to the results of end products and by-products, among the various nondefense government agencies, and between the defense and nondefense government agencies.

DR. BRODE: No, it does not. The Interdepartmental Committee on Science has no authority similar to that of the Research and Development Board within the defense agencies, in that projects are not cleared and coordinated through the Interdepartmental Committee. Its activity is only as a result of the desires of the members who partake in it. The Interdepartmental Committee was appointed by the President and is now under the chairmanship of Dr. Hafstad; with an executive secretary, Dr. Scott, who was formerly with the Research and Development Board. I think that, under Dr. Hafstad, who is the Director of Reactor Development of the Atomic Energy Commission, and the present composition of the Interdepartmental Committee, we may look forward to some distinct activities.

This committee has appointed subpanels, one of which is on personnel, and is trying to solve the difficulties of all government agencies with regard to recruitment of personnel. Another one deals with security in the handling of foreign visitors, which is a problem faced by all government laboratories. The various subgroups within this committee are equivalent to the panels and subgroups within the Research and Development Board, as to phases and scope.

COLONEL CAVE: Dr. Brode, can you tell us a little more about the research associates program that you have?

DR. BRODE: We have authority to receive guest workers, and we have set up a procedure by which industrial groups--any individual, for that matter--can present themselves as research associates. If the work they wish to do is work the Bureau of Standards feels is within its cognizance, and would like to do if it had the money, it will accept a research associate arrangement, with the stipulation that the work must be under the direction of a Bureau of Standards employee; that is, the head of the department, division, or section, depending on the size and character of the work.

We recently have had a complete section devoted to the American Petroleum research associate arrangement; the American Petroleum people are paying 60 persons who are working on the critical constants of petroleum hydrocarbons, preparing standard samples of known hydrocarbons

RESTRICTED

known purity, and determining their physical properties. This project has been going on for about five or six years. We have projects from the Portland Cement Company and the Cast Iron Pipe Company. We have various textiles projects. The American Dental Association maintains a project in the expansion, contraction, and corrosion of filling materials for teeth. It has been a very successful program in improving the quality and character of these dental materials. The American Society for Testing Materials maintains two people there to work on the knock value of hydrocarbon fuels. We do the tests, but the standard of knock value is set out under the name of the American Society for Testing Materials and distributed as its knock standard.

So that I would say we maintain on the NBS campus continuously between 50 and 100 people who are research associates. They are paid by one of these industrial groups, or by a society or association. It has been a very useful means of doing things we wanted to do but just did not have the money with which to do. Quite often a particular project is something that may have been started by the NBS employee in charge of it, may be his pet hobby, and he may have sold it to the association to get it to continue to support it.

MR. BAUM: Dr. Brode, I see our time has run out. Speaking for the faculty and student body, I thank you very much, sir, for a most informative lecture and discussion period.

1 Oct 1950--650)S.

374