

RESEARCH AND DEVELOPMENT WITHIN THE DEPARTMENT OF DEFENSE

21 October 1953

779

CONTENTS

	<u>Page</u>
INTRODUCTION--Brigadier General L. J. Greeley, USA, Deputy Commandant, Industrial College of the Armed Forces.....	1
SPEAKER--Honorable Donald A. Quarles, Assistant Secretary of Defense (Research and Development).....	1
GENERAL DISCUSSION.....	19

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INDUSTRIAL COLLEGE OF THE ARMED FORCES

Washington, D. C.

Honorable Donald A. Quarles, Assistant Secretary of Defense (Research and Development), was born in Van Buren, Arkansas, 30 July 1894. He attended high school there and enrolled in the University of Missouri Summer School at Columbia in 1910, 1911, and 1912, teaching mathematics in the Van Buren High School in the intervening seasons. In 1912 he entered Yale University and received a B.A. degree in 1916. In May 1917 he enlisted in the Army and, after two years in France and Germany, was discharged with the rank of captain in field artillery. Returning to civilian life in 1919, Mr. Quarles was employed by the Western Electric Company in New York City in the Engineering Department, which became Bell Telephone Laboratories in 1925. As a part-time student at Columbia University in 1920 and 1921, he studied theoretical physics. Mr. Quarles was associated with the Western Electric Company and the Bell Telephone Laboratories in New York City in various capacities from 1919, and became vice president of Western Electric and president of Sandia Corporation, a Western Electric subsidiary which operates the Sandia Laboratory in Albuquerque, New Mexico, for the Atomic Energy Commission, 1 March 1952, and served in that capacity until he was sworn in as Assistant Secretary of Defense (Research and Development) on 1 September 1953. He is a member of Phi Beta Kappa, Sigma Xi, the American Physical Society, the Institute of Radio Engineers, the American Association for the Advancement of Science, the Yale Engineering Association, the Telephone Pioneers of America, and a fellow and member of the Board of Directors of the American Institute of Electrical Engineers.

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781

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GENERAL GREELEY: Our subject today is "Research and Development Within the Department of Defense." Our speaker is the Honorable Donald A. Quarles, Assistant Secretary of Defense (Research and Development).

Mr. Quarles is particularly well-qualified for that highly important and brand new job of his. He has been actively engaged in industrial research and engineering for more than 30 years and head of that extremely important activity, the Sandia Corporation, since March 1952. His appointment as Assistant Secretary dates from July 1953.

And so, Mr. Quarles, it is indeed an honor, a privilege, and a pleasure to present you to this audience.

MR. QUARLES: General Greeley and gentlemen: I see there are some visitors here. I suspect there are some people here who know already a lot of the things that I am going to talk to you about.

I want to tell you first that it is a very great pleasure to me to come back here. I believe it was four years ago that I stood on this platform and addressed the class that was here at that time. A lot has happened to me since then, and I am sure that a lot has happened here. I know that this organization has done a tremendous service to the military establishment throughout the years, and in particular in the years since 1949; and it is a very great pleasure to me to come here again, as it was at that time.

I have a little apology to make to you. I have a feeling that the talk I am going to give you will be a little heavy this morning. I am not going to pick out the exciting new developments that one could talk to you about. That always gives people a good time. That always makes a good show. I know Dr. Buckley, who used to be very active in giving speeches, always got up on the platform with his pockets full of gadgets; and as his talk went on, he reached in one pocket and pulled out a gadget, and reached in another pocket and pulled out another gadget. He always used to say to me: "Give them a speech of that kind. That is easy. All you need to do is have some interesting gadgets in your pocket, and at the right time just pull them out; and the thing sort of carries itself along."

Well, unfortunately, I felt that I ought to deal with a few of our operations in the Defense Department that don't get done with

gadgets. So I must warn you in advance that you are in for a heavy talk, without any gadgets in my pocket. So my apologies to you. But, nevertheless, I feel that this is a topic you would want to hear about; and in that sense I make no apologies.

Now, as you all know, effective as of the end of June, the Department of Defense was reorganized. Among other agencies, the Research and Development Board (RDB) was abolished; but most of its functions were continued in the Office of the Assistant Secretary of Defense (Research and Development).

There were many other agencies abolished; and we are, I must tell you frankly, still in the process of working out a scheme of things, a system of operation, under this new organization. It seems apparent to all of us that there were some strong points in the re-organization, and that some of these things will be very valuable when they are worked out. But as of this very moment I would have some difficulty in proving to you that we are better off than we were before in our current operations.

The importance of research and development in the national defense cannot be overemphasized. I don't need to tell you that. It is fundamental to achieving and maintaining the defense posture of this Nation. It provides us with superior weapons, with a knowledge of how to use them; and thereby tends to offset the probably very great numerical superiority of a potential enemy.

Our overall objective is to keep our weapon systems ahead of those of all potential enemies, with the hope that through being prepared we shall prevent war. In this atomic age the interval between the onset of aggression and widespread destruction is so short that we cannot delay development of new weapons until the enemy strikes. The weapons required to wage war cannot be conceived and developed overnight. The Department of Defense has, and must continue to have, an effective research and development program.

Recognizing the importance of research and development to our national defense, let us consider some of the fundamental factors involved in its top-level management from the Department of Defense standpoint.

First, we want to be certain that our research and development program has the broadest possible technological base that the country can produce. Of course we accomplish this primarily by our contracts with industrial laboratories, with universities, and with other non-profit institutions. In the last fiscal year about 70 percent of the research and development funds were contracted outside the Department, 30 percent being applied to in-shop operations of one kind or

another. Of that 70 percent, about 60 percent was contracted to the industrial and the profit-type organizations; and 10 percent was contracted to universities and nonprofit organizations. Actually a greater portion of research and development work is done outside the Government than might be indicated by these percentages, because a sizable amount of that spent within the Government is in connection with the administration, supervision, or liaison with the outside groups performing this contractual research and development work.

A portion of the outside contract work is, as you know, applied development, to meet military needs and deficiencies as determined by the services. By means of the outside contracting, the latest techniques developed by civilian industry are applied to current military projects.

In addition there are many contracts which attempt to utilize the independent creative thinking of civilian scientists in exploratory studies and in work based on such studies. The remarkable advances in the fields of guided missiles, transonic aircraft, and work on distant early warning lines for air defense are a few examples of areas in which the original conceptual thinking has come primarily from civilian scientists and engineers. In order to use the Nation's scientific resources to the fullest possible extent, it is necessary that we foster and encourage the use of civilian scientific experts in the planning and review of our research and development programs as well as in the execution phases. In this manner we will encourage our scientists to think sympathetically about our basic defense needs, and, as time passes, to evolve unconventional and radically new weapons systems. We must make certain that we disprove, by our actions, the charge that military men are reactionary and suppress new ideas for weapons systems or allow them to go unrecognized without honest attempt to ascertain their merit.

I might say, parenthetically, that I have had very intimate contact with the military in the field of research for the last 10 or 15 years; and I personally completely reject the thesis that there is this kind of reactionary attitude on the part of the military. Nevertheless, one must recognize that the military is charged with just such an attitude; and for that reason I think we must be doubly careful to disprove the charge, and at all times be seeking a means of establishing our openmindedness and imaginativeness in developing new means of warfare.

While we wish to utilize civilian science and technology to the maximum possible extent, we cannot, of course, use all civilian scientists and engineers. To attempt to do so would be incompatible with the fulfillment of other national needs in addition to those of

defense. It has been estimated that about half of the country's current technical potential is being applied to military purposes, including related atomic energy programs. Under such conditions it is, of course, impossible to double the effort; we are already using such a substantial fraction of it.

In addition to the inherent limitations of available scientific manpower and facilities, we have budgetary restraints. The funds to support Department of Defense research and development are included in the various appropriations for the departments and in some cases for the subdivisions of the departments. There is no single, overall research and development appropriation. One example of budgetary restraints is indicated by the fact that the funds for the Office of Naval Research in the current fiscal year were cut about 10 million dollars from the level recommended by the President. Therefore it would be contrary to the wishes of Congress to divert funds into this activity from other appropriations, even if we felt that it was desirable to do so.

In addition to such specific appropriation limitations, there are less tangible limitations inferred from the questioning and comments during budgetary hearings. For example, in recent years there has been considerable difficulty in the defense before congressional committees of budgetary items for the support of work in some of the fields of social science, such as psychology and sociology. Thus, within the research and development area we have limited freedom in shifting funds from one field to another.

The services' fighting missions determine the scope and character of the research and development work in the Department of Defense. These missions are so broad that many scientific and technical fields are applicable to the problems of all three services. No restraints by scientific or technical fields have been imposed; so that each service can utilize whatever techniques it considers necessary for its operations. Each department has a vertical organization responsible for all operations pertaining to its materiel. It has the responsibility for research, development, procurement, and the worldwide distribution and maintenance of its equipment. Research and development in this sense is but the first phase in the equipping of that department's forces with weapons.

A comparison of today's weapons systems with those in use at the end of the war indicates the effectiveness of their research and development activity. We must preserve the momentum which has been acquired; otherwise our potentialities could be seriously reduced in this critical period. Therefore unification and coordination on the Department of Defense level must be kept in proper balance with departmental control of their weaponry.

Based on the service missions, operational requirements are written and development tasks initiated by the departments. The requirements sometimes result in similar technical programs and similar systems. Under the existing military threat there has been too little disposition on the part of the departments to coordinate and compromise operational requirements before development commences, so as to reduce the similarity or the duplication of technical activity; or, in some cases, even to provide for the desired compatibility or interoperation of end equipments.

The departments have not, in general, evolved satisfactory joint procedures wherein the operational requirements of one may be given due consideration in the developments of another. In this respect also the Research and Development Board's allocation of responsibility was not effective in achieving the gains believed possible by the advocates of unification.

With this review of the fundamental factors of the situation, the basic top-level management problem begins to become apparent. It is a problem of organization and operation in such a manner that we achieve and maintain a military technological superiority with due regard to the circumscribing restraints and limiting factors.

We are already using about half the country's technical manpower, and we are face to face with a limitation of available scientific manpower. There will continue to be budgetary restraints. There are three services operating on a force mission basis, with effective large-scale research and development programs. If we are to achieve our national objectives, we must, therefore, attempt to utilize the country's scientific potential more effectively.

Now, as to possible solutions: In England, as you probably know, military research and development, as well as procurement, are handled largely by a Ministry of Supply, separate from the services. The system as established and operating in England appears to meet its needs. In this country, however, the background conditions are much different. Congress has considered our defense organization on several occasions in recent years and has reaffirmed our separate military department concept.

After the war, when the Department of Defense was created, various plans were considered; and the National Security Act of 1947 provided for the three military departments, each as integral operating units. The Secretary of Defense and the statutory Munitions and Research and Development Boards were generally conceived as coordinative bodies.

While the RDB accomplished many useful things, it failed to achieve many of the important results which had been predicted by the

more enthusiastic advocates of unification. I do not intend here today either to criticize or eulogize the RDB. It did represent a definite step in the evolution of the management of the Department of Defense research and development program, but I feel that its proper evaluation will evolve only after we gain some additional perspective with the passage of time.

The Rockefeller Committee Report of early 1953 is not very specific in its remarks pertaining to the management of research and development. In recommending the dissolution of the RDB, it does advise the Secretary of Defense "not to sacrifice such parts of the present functions of the Research and Development Board as are now operating satisfactorily." A somewhat noncommittal recommendation, I may say.

The report does, however, set forth a philosophy for the operation of the Secretary of Defense and his office. It is, therefore, usable as broad guidance for the Assistant Secretary for Research and Development. Incidentally, I think all of you who have not read the Rockefeller Report would be interested in doing so.

Reorganization Plan No. 6, which the President filed with Congress toward the end of April, and which became law at the end of June with congressional consent, abolished the RDB by vesting its statutory functions in the Secretary of Defense. It also clarified the responsibility of the Secretary of Defense with respect to the management of the military departments. The plan provided authority for the appointment of six additional Assistant Secretaries of the Defense without specifying their precise duties, vesting in the Secretary of Defense the authority for so doing. The Assistant Secretaries have been appointed, in accordance with the recommendations contained in the Rockefeller Report; and I am honored to be the Assistant Secretary for Research and Development.

After a careful review of the problem and its related factors, we are now at the point of issuing a detailed statement of functions for the Assistant Secretary of Defense (Research and Development). Since the formal directives and organization charts are not available at this time, I think, instead, I will have to limit myself to giving you informally my own views on the matter.

As to concepts I may say this: In setting up a method of operation, the existing momentum of the three services in research and development must be maintained. Rather than wholesale reorganization from the laboratory level upward, we must provide assistance and guidance to the three departments in their research and development operations. Without in any way denying the ultimate responsibility and authority of the Secretary of Defense, there must be a large degree of decentralization.

The responsibility of the services for research and development operations is recognized. It is a fundamental and inseparable phase of their overall responsibility to provide themselves with proper weapons. The three military departments are considered to be individually responsible for planning and executing sound departmental research and development programs. The departments are responsible not only for determining that their programs are realistic in relation to the state of the art and to their own departmental needs, but also for insuring that their programs are sound in relation to the programs of the other military departments. That, I might say, gentlemen, is a new concept, and one that I regard as quite a fundamental concept to our new setup.

Among those things considered to be primarily service responsibilities are interservice action to provide for meaningful preproject coordination; to effect the easy transfer of technical information among service laboratories and their contractors; and to enter into joint research and development operations to reduce duplication, to promote efficiency, and to achieve economy.

The Assistant Secretary of Defense (Research and Development) will review the departmental programs to see that they are well-coordinated, and that collectively they constitute a sound and integrated overall Department of Defense program. He has the responsibility for developing policies and establishing procedures to insure the effective conduct of research and development operations by the departments. The policies must provide for sound research and development objectives; for plans based on these objectives; and for budgets, facilities, and organizations to implement the plans. The Assistant Secretary (R&D) must see that all these things come to pass, not only by his own actions in policy preparation, but also by review of the service operations, and by providing the leadership and guidance for those operations.

In order to facilitate meeting the service responsibilities for coordination and to assist in monitoring and review of the research and development operations for the Secretary of Defense, it is proposed to establish in-service coordinating committees for the dozen or so major research and development technical areas. These groups will consist of the principal departmental officials in the particular fields, as well as a senior member of my staff. That is to say, there will be a senior representative of the Army, the Navy, and the Air Force and a senior representative of my staff on each one of these coordinating committees; and to such committee will be assigned an appropriate field of research and development. I won't attempt to name these fields. I think you will understand their general character when I tell you that the whole area is divided into roughly a little more than a dozen such fields.

These in-service coordinating committees will provide for the coordination so necessary for the effective and economical performance of our research and development. My own staff will participate in the groups and will provide an informal communications link with the top echelon of the Department of Defense, so that difficulties and trouble spots may be brought into focus for action at the proper level with the least delay.

To say that in plain English, it means that, if the departments at this coordinating committee level can't get together and agree on a sound program, then it becomes a matter for refereeing in the Office of the Secretary of Defense. That sounds a little bit like a threat, but I don't mean it that way. The departments feel, and I feel, that, given the opportunity to do so, they can in very large measure get together and work out among themselves a program that is overall sound.

But we can't escape two facts here. One is that the departments are fired by a certain amount of zeal for their own missions, which is very laudable and sound, and are irked by interference with considerations outside their own departments. The second is the fact that we are all human beings, and we have certain competitive instincts. We still have this human instinct of one department having in the back of its mind how much fun it will be to get ahead of the other departments. So we have to recognize these things. We would not be realistic if we didn't have an organization that recognized that some amount of this is going to happen and that it requires refereeing in the Office of the Secretary of Defense to straighten it out when it does happen.

Another element of this new setup is a Research and Development Policy Council, which will be set up as advisers to me. It will consist of the top people, both on the Secretary's side and the military side, of each of the departments charged with the research and development programs of those departments.

Generally speaking, there is not an Assistant Secretary in each department specifically charged with the research and development responsibility alone. The nearest approximation to that will be a representative of that department on the civilian side; and the senior military officer will be the representative on the military side. That Policy Council is being set up with the concept that not only will it be advisory to me, but the Secretary of Defense will understand that important matters of research and development are being coordinated in that council before they are presented to him.

Now, in order to benefit from the services of experienced civilian scientists in the planning and review of our research and

development programs, it is proposed to establish technical advisory panels in various scientific and technical fields. These panels will consist entirely of persons selected for special competence in their fields, that is, outside consultants. The advisory panels would not necessarily cover the identical areas as the in-service coordinating committees. However, as a whole they would cover most of the technical areas represented in the defense research and development programs.

The civilian advisory panels will review the military research and development programs assigned to them. They will advise the cognizant in-service coordinating committees with respect to the military programs; and they will report their conclusions and recommendations to the Assistant Secretary (R&D) noting particularly their endorsement of or disagreement with the technical programs of the departments. In this manner they will assist the Assistant Secretary (R&D) by providing the independent audit of programs and of the effectiveness of performance which was visualized by the Rockefeller Committee. In addition the civilian group would provide for the application of independent, creative thinking to the broad technological aspects of the defense effort. An unobstructed, unfiltered communications channel would thus be provided for the flow of new ideas and unconventional weaponry proposals to the top echelons of the Department of Defense.

I would like now to say a word about the relations of research and development to applications engineering. Incidentally, I see that the Assistant Secretary of Defense (Applications Engineering) Frank Newberry is here this morning. I am delighted that he could take the time to be here; I suggest that if you have any questions later about this particular topic, he might be willing to join with me in the discussion of it.

In accordance with the recommendations of the Rockefeller Committee, an Assistant Secretary of Defense (Applications Engineering) has been appointed to cover, in the words of the report, "the broad field which lies between research and development, on the one hand, and the quantity production of weapons, on the other." That is another quote and another illustration of the delightful way in which these committees' reports can use nice words and not help you very much.

It is further defined as covering such matters as the suitability of new developments for their intended purposes; their reliability, simplicity, and economy of production; engineering policy; and standardization problems. The delineation of applications engineering as a separate field is a new concept in the Department of Defense, which we believe can be very fruitful in improving effectiveness.

Due to its newness and its functions, there arises the question of the definition of its boundary with that of research and development. For the time being we are using a rule that has been developed in consultation with Mr. Newberry, which provides that in those cases in which the art is well-established, or parallels closely civil design, research and development work will be limited to the exploratory phases, through the research or breadboard model stages; and that cognizance will pass to applications engineering at the stage where final design work can be undertaken. On the other hand in areas in which advanced technology or new art is involved, the field of research and development is considered to include those activities usually termed basic and exploratory research, applied and supporting research, laboratory and engineering field tests of prototypes, as well as systems analysis and evaluation incidental to such development.

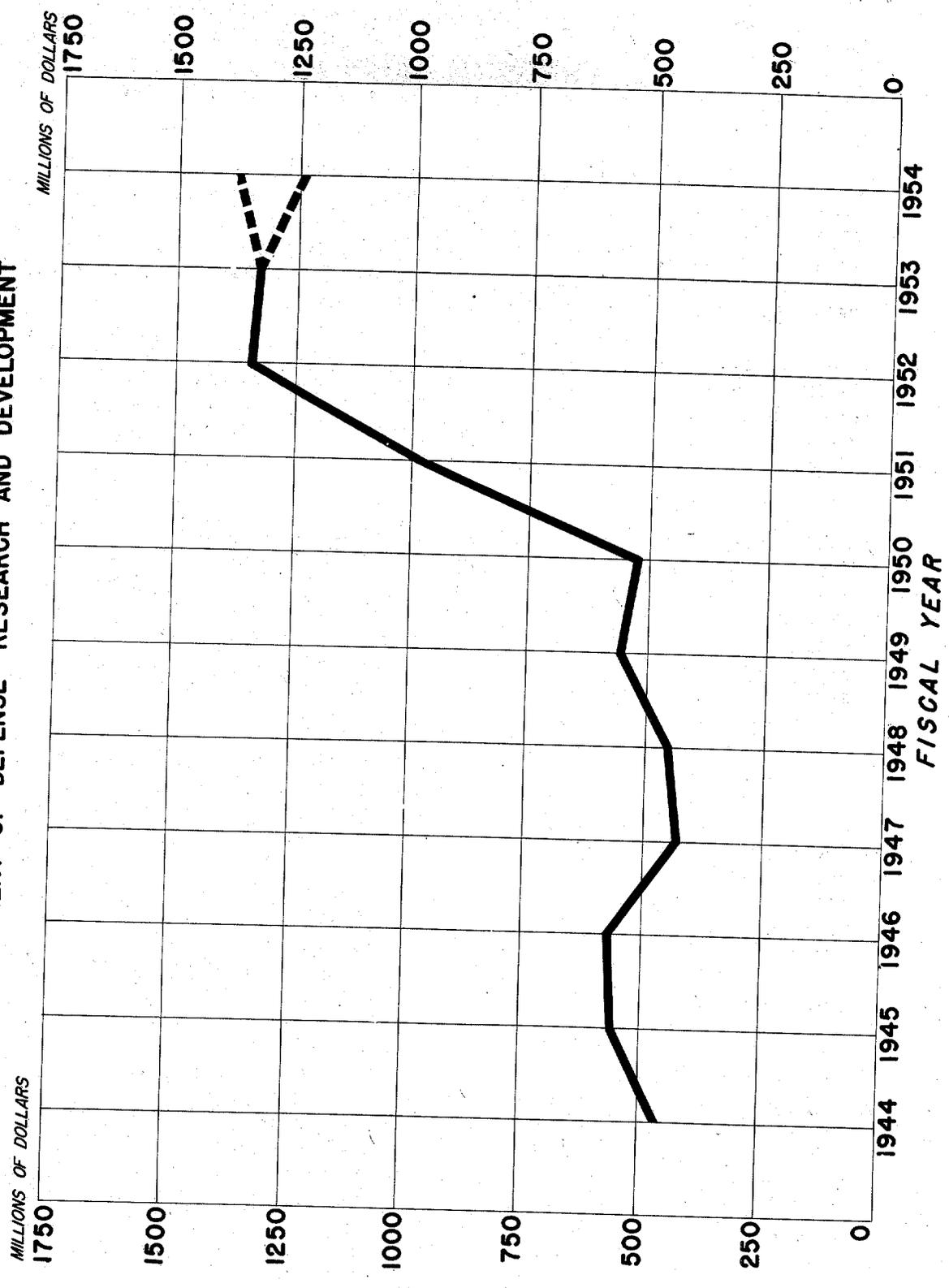
I might illustrate by saying that we would regard, for example, much of the heavy mechanical development work in connection with military motor vehicles of the conventional type as being in the area of well-established art, paralleling closely the civil counterpart. In that area research and development would be limited to the early exploratory phases, leaving it to applications engineering to follow up on specific design work. On the other hand on an electronic fire-control system, to take that as an example of the area of forward art, the research and development functions would carry through the whole development phase, as I think most of us understand it, including engineering evaluation of prototypes, and the demonstration by engineering field tests that the new development does in fact meet the stated military characteristics for the development. It still leaves to applications engineering the consideration of standardization and the engineering aspects of the decision to produce it, such matters as evaluation by the using arm and the results of each evaluation. Those areas, even in the forward art, would be phases of applications engineering.

As you can all see, this is a somewhat tenuous boundary between these two operations. It is recognized to be the case, and simply leaves it to the two assistant secretaries to work it out in good faith, perhaps initially somewhat on a case-by-case basis.

Now I would like to turn to a little different topic and talk about the budgetary levels of research and development.

Chart 1, page 11.--I think you would be interested in seeing the very broad trends of the research and development budgetary levels in the Department of Defense. I hope all of you can see the numbers. If you can't, the abscissa of the chart is in years. They extend back around 1944 and up through 1954. These ordinates are dollars, this line being a billion dollars.

CHART 1  
**OBLIGATION TRENDS (DIRECT COST ONLY)**  
DEPARTMENT OF DEFENSE - RESEARCH AND DEVELOPMENT



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As you see, during the pre-Korea years, following World War II, we were operating at a level of approximately a half billion dollars a year. With Korea this was stepped up violently; and since that time we have been operating at about two and a half times the pre-Korea level.

This deals with actual obligations of funds. At this time, in fiscal year 1954, there is an uncertainty illustrated by the wide-open mouth of this snake. It implies that we might go to the upper band if we obligated all the funds available to us; or, if we carry over into next year funds equivalent to those carried over into this year, we might obligate only the lower amount.

In any case, we are currently actually spending on Department of Defense research and development at the highest level in our history. Our expenditures last year were about on the 1.3 billion level; and this was roughly about the level of the congressional appropriations this year.

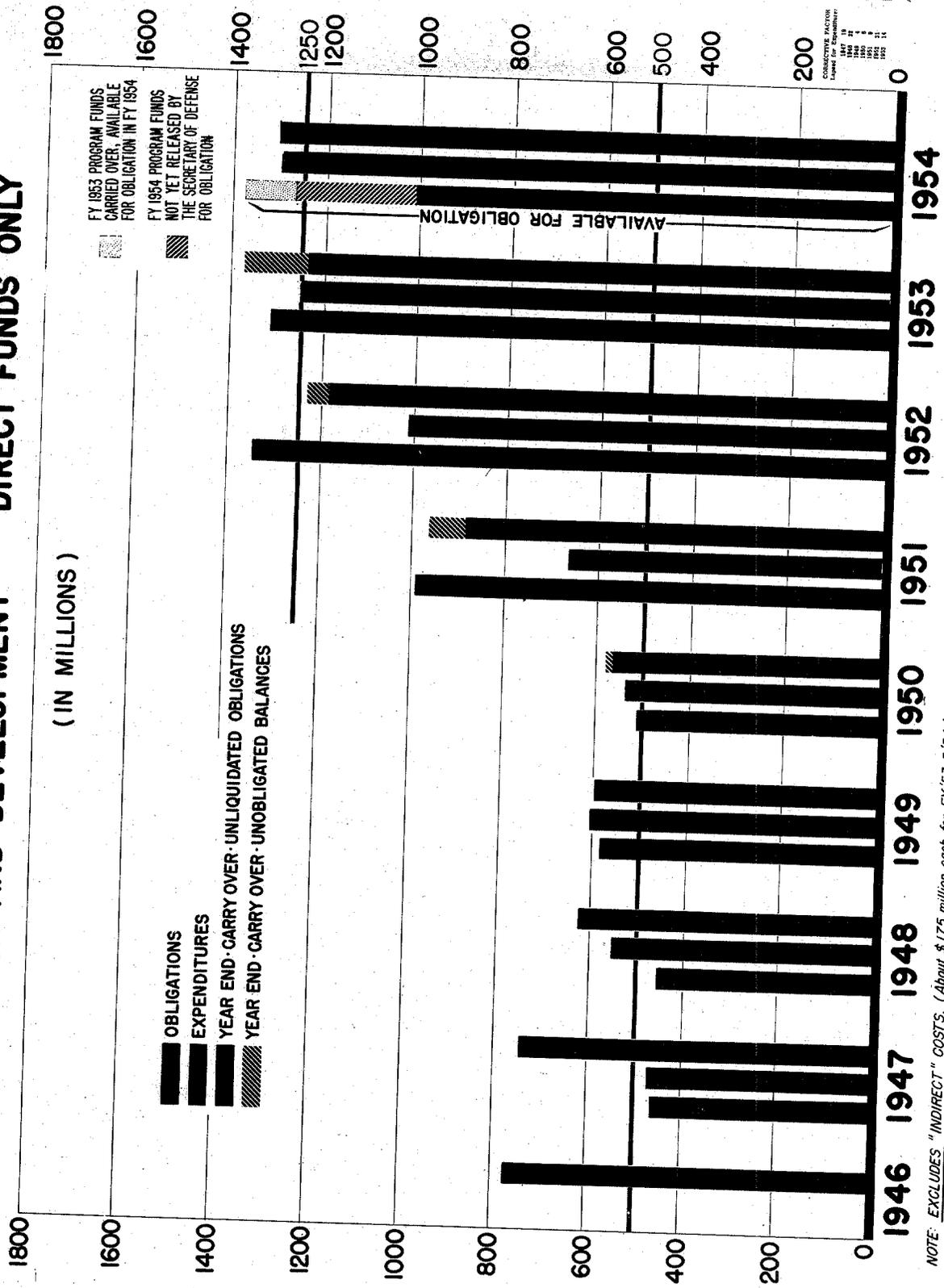
Chart 2, page 13.--This chart presents the same picture in a little more elaborate form. I wanted to subject you to this chart for this reason: There is so much loose talk about the terms "appropriations," "obligations," "expenditures," and "unexpended balances" and so many erroneous conclusions have been drawn from this loose talk, that I hoped that at least we in this highly select circle could keep these things straight and not fall into any of the errors that, for example, we sometimes encounter in dealing with the congressional committees.

What I would like you to note here is this: that, taking this area, the period before Korea, the first line, represents the annual obligations, the obligations actually placed during that fiscal year. The second line represents the actual expenditures from the Treasury during that year. The third line represents the carryover of unliquidated obligations. That simply means that there were contracts placed, and the funds were obligated toward contractors in that amount; but the contractor had not performed his obligation and had not billed the Government. So that at the end of each year, as you see, there was something fairly close to one year's level of operations in unliquidated obligations.

One of the interesting things is that we always have people saying: "Well, if you've got a whole billion dollars of unliquidated obligations, why don't we just leave you alone for a year?" The obvious answer is that this procedure only works in a continuous process--or let us say, it can only work well in a process--in which you take on new authorizations and place new obligations; and at the end of each year you continue to have an unliquidated balance. That simply represents an orderly planning of the operation.

# RESEARCH AND DEVELOPMENT - DIRECT FUNDS ONLY

CHART 2



Now, in the transition from this level to this level you throw the system out of kilter, as you would expect to do. The new obligations, as you see, during 1950-51 went up much further than the actual expenditures for those years could go up. But even then it was still true that the unliquidated obligations at the end of the year fairly well met each year one year's actual new obligations.

I would just like to say a thing about 1954. Here we used shaded rather than black, because there is not as of this date a history as to just what will be obligated in this year. But there was appropriated by Congress in this year the amount of approximately 1.27 billion dollars, which brings it to the top of this shaded column, plus the crosshatched part. There were carried over valid, unobligated funds from the previous year in an amount to bring you up to about 1.38 billion dollars. I don't remember that figure exactly. At any rate, the total sums available for obligation in this fiscal year are at the top of this column and correspond to the upper jaw of the snake, so to speak. If the departments carry over into next year as much as they carried over this year, this amount of obligated funds would be the lower jaw of the snake. That is simply history that has not been written yet.

This year the Office of the Secretary expects to expend from the Treasury this amount; and we expect to carry over unliquidated obligations of the third column, which again is quite closely one year's operations.

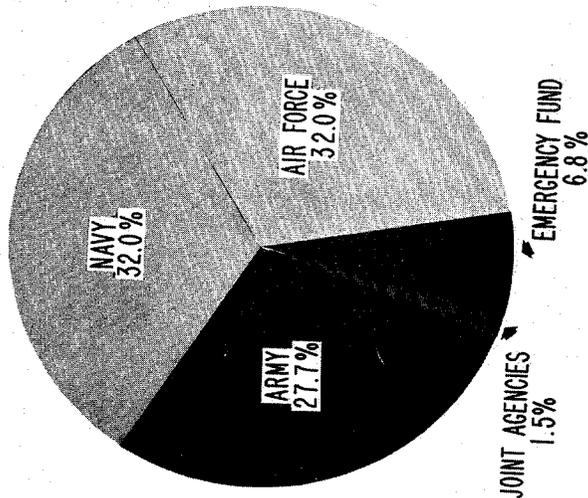
Probably you would like to have me tell you where this chart is headed. Now that we have some kind of a cessation of the Korean hostilities, there are so many conflicting trends there that I think it would be very hazardous to suggest an answer. But I will say this: I believe we have tried a too rapid buildup in the 1951-52 period, too rapid for real economy and success in the program. I believe that some part of this two and a half factor was an over-compensation for somewhat less than should have been done during the pre-Korea years. And I believe that by an orderly process we will work downward somewhat from this billion three level. But I don't suggest at all that we will work down to the half billion level of the pre-Korea time. I think, in fact, it would be disastrous to do so in the face of the problems, such as air defense and atomic warfare, and all the other things that are involved.

Chart 3, page 15.--This chart shows the approximate percentage distribution of the obligations among the three departments for the three recent years. At first glance I think you will be struck by the constancy of that distributions between the three departments. Not only do the service areas look to be about constant, but they look to be roughly equal. Actually they are not. The Air Force has

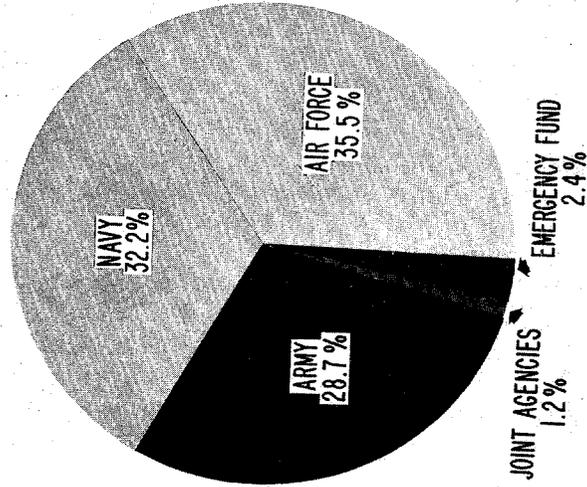
CHART 3

DEPARTMENT OF DEFENSE  
RESEARCH AND DEVELOPMENT

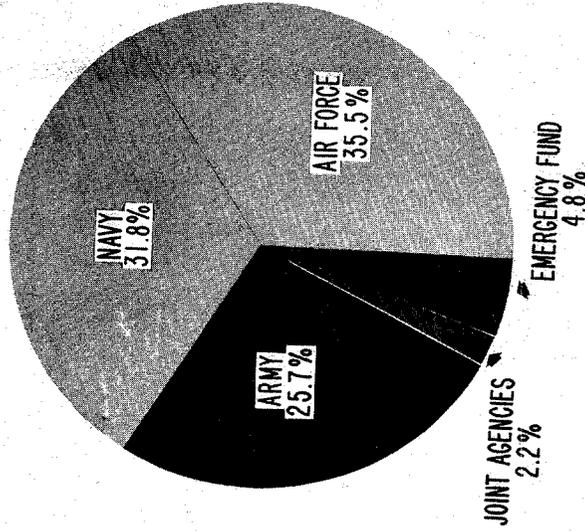
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a bit more than the Navy, and the Navy a bit more than the Army; and the Air Force proportion of it has shown a moderate increase, but not a large one.

In addition to the three major departments, we have two other little slices of the pie there. Of those two the larger one, I believe, is the reserves that have been held back in the department at the end of each year for emergency uses. In previous years that has been largely applied to such things as special atomic weapon tests, or new and very urgent projects that came up after the original planning in the department. Those funds have been roughly equally distributed between the three departments.

The smaller slice is small and represents the portion of this total Department of Defense R&D budget allocated to certain special agencies, joint agencies, such as the Armed Forces Special Weapons Project in the atomic area and the National Security Agency in the security field.

Now, in addition to the costs of research and development that you see shown on this chart--and I have said that these are just the direct costs, budgeted as such--you have certain indirect costs, that are also budgeted as such, that I believe run about 10 or 15 percent of these costs. That has to do with supporting personnel of various kinds and supporting facilities.

Over and above that, we have costs that are not budgeted as research and development at all, which really could be classified as research and development costs--for example, the payroll of the military personnel who are working in the research and development field. If you added all of those costs together, you would accumulate a total that is almost equal to the direct costs.

So that if anybody wishes to go into a philosophical debate with himself about whether this is a proper level of research and development for the country to sustain in its defense, he should be conscious of the fact that there are things other than the direct items shown here entering into that equation.

There are just one or two other matters that I want to touch on briefly. I realize I am doing too much talking here. I would like to leave some time for discussion.

One thing I would like to mention is the National Bureau of Standards, and the things that have happened in recent months in relation to it.

Here I will preface it by saying that about 3 percent of the research and development budget of the Department of Defense over

these recent five years has been allocated to other executive departments for execution by them of Department of Defense programs. A substantial fraction of that has been allocated to Commerce for the Bureau of Standards program.

With the kind of new broom psychology which a new administration always has, and I think should have, these areas were looked at quite critically; and it was concluded that there should be a reform here; that the Department of Defense should either assume direct responsibility for these other operations where they are purely defense operations, or should make certain very strict criteria if it does transfer funds to any of the other departments.

In line with that, the proximity fuze program of the Bureau of Standards was transferred to the Army Ordnance Department; and its missiles activity out on the west coast was transferred to Naval Ordnance, thus cutting out a very substantial fraction of the Bureau's budgetary area. These two defense operations accounted for 75 or 80 percent of the Bureau's activities.

Some of you probably read the recent Kelly Report, which recommended that the proper functions left in the Bureau be substantially strengthened. So this action was not meant in any sense to be a curtailing of the Bureau. This merely seems to be a proper realignment of the functions as between executive departments.

Another matter that has had a lot of publicity--and some, I may say, rather bad effects so far as the new Administration is concerned--is the area of basic research. I just want to say a word about it.

First I had better define it. People have very different concepts when you talk about basic research. The thing I am talking about represents just a very small fraction of the total research and development money that you saw pictured there. It is of the order of, depending on how you define it, anywhere from 25 or 30 million to 75 or 80 million dollars.

A considerable part of this is research projects placed by the Office of Naval Research in a major degree, and in a lesser degree by the corresponding organizations of the Air Force and the Army, with universities. Those of you who have been following the congressional hearings on appropriation matters last spring will remember that both on the part of Congress and on the part of some of our officials defending our budgets before Congress, there was a tendency in the basic research area, to say: "Well, it's a lovely thing, but it probably isn't defense. So why should we fight for it on the defense side with Congress?" There is some inclination to say: "Why should we bother about the appropriations on our side?" Then they pick up some

examples and start talking about them. And, unfortunately, there were some examples that had labels on them that were very badly conceived, at least as sales labels to Congress. So the whole thing got a rather black eye. There was a lot of correspondence with irate college presidents and others expressing regret that the new Administration should revert so to the Dark Ages.

Actually, while there was that kind of talk, there never was that intent. Unfortunately, there has been that effect. Congress, through a misunderstanding of what was available from prior years for the future year's contracts, did strip off 10 million dollars from the appropriation of the Office of Naval Research. That did directly hit the ability of ONR to support research in the universities.

It has been possible to repair that in some degree. But it is true that as a result of that the Defense Department's support of basic research will be somewhat lower this year than in previous years. In part this is due to Defense backing out of some of the more fundamental areas, leaving the new National Science Foundation or the Atomic Energy Commission to support those areas rather than Defense. But I want to assure you that it is no part of the policy of the new Administration to belittle or downgrade basic research as a fundamental element of its whole research and development plan.

Now, just in case there are some skeptics among you who think that perhaps it should be downgraded, that we should get out of basic research and stick to the game of producing new weapons, I should just like to read to you the concept of the Department of Defense, in this matter. The Department of Defense needs basic research:

First, to provide a flow of fundamental knowledge of the sort that the military establishment needs, now or in the future, in connection with the practical problems of weapons systems development.

Second, to maintain contact with the scientists of the country, so that the scientists are encouraged to be interested in fields of potential importance to defense. This contact serves to make the services aware of new scientific findings; to provide a base for prompt mobilization of scientific effort in case of great emergency; and it has a special effect on the planning of the research and development programs of the three services, because it keeps giving them the vista ahead all the time.

We do not, however, feel that the Department of Defense should support basic research just on the thesis that basic research is good for the country. If there is any obligation of that kind on the part

793

of the Federal Government, it is the obligation of the National Science Foundation and not of the Department of Defense. But even recognizing all that, it is still the obligation of the Department of Defense to support such basic research as specifically underlies and is useful to the programs of the departments. I am happy to say that all my contacts with other policymaking organizations in the Government give me confidence that this kind of attitude toward our research program will be preserved.

Now, gentlemen, I have talked longer than I had meant to. I hope, however, that I have covered some areas that you will find of interest. If time permits, I will be very happy, General Greeley, to answer any questions or enter into any discussion that you might like to have. I hope that this area of research and development in the Department of Defense and how we are thinking about carrying on in that field has been a subject that you wanted to hear about. Thank you.

COLONEL DIEHL: Gentlemen, before we proceed with our question period, I would like to introduce to you the Assistant Secretary of Defense for Applications Engineering, Mr. Newberry. His presence here is an unexpected honor that we had not anticipated.

Gentlemen, Mr. Quarles is ready for questions.

QUESTION: Mr. Secretary, you have explained the instrument for coordination among the three military departments. Is there any mechanism set up which provides or insures coordination between Defense and other departments of the Government, such as Commerce or Agriculture, in some areas that might be of interest and value to Defense?

MR. QUARLES: Coordination in these other areas is very largely ad hoc. For example, in the matter of air navigation systems we have an arrangement between Commerce and Defense in the form of an Air Navigation Development Board, on which we are jointly represented. There are other joint areas with Commerce of that kind. In Agriculture we have some common areas. There has been Agriculture participation on a kind of advisory and consultant basis in some of our areas of biological warfare, for example. I don't know of many contacts of that kind with Agriculture. So I think the best general answer to your question is that we try to single out these particular areas of joint interest and set up coordinating instruments of one kind or another, depending on the circumstances.

The development area of the Department of Defense is in very large measure self-contained. I have mentioned the Atomic Energy Commission. I would really regard its military programs as being

integrated into the Department of Defense programs. Their collaboration area is very close. I am sure you appreciate that.

QUESTION: Mr. Secretary, could you give us a rough approximation of the percentage of the R&D budget that goes into what is ordinarily called hardware, as opposed to the amount that goes into, say, man-hours of scientific talent and laboratory work?

MR. QUARLES: That is one of the hardest lines to draw, because it depends so greatly on your definition of it. You see, a person so minded might say that none of it is hardware. It is all working in ideas and developing processes and making things on paper, and none of it is hardware. On the other hand one might allege that it is all hardware, because through research and development we get hardware; all research phases of the thing are pointed toward hardware.

One index that might be helpful here is that the development that is specifically directed toward meeting military requirements for new elements of military materiel constitutes something around 75 or 80 percent of the total budget.

The other 25 percent includes such things as basic research that I referred to earlier; and basic research is, let us say, very roughly 5 percent--maybe even less. Then it includes various systems studies and operations analysis and things of that kind, that have to do with standardization functions but not directly with hardware.

QUESTION: Most of our 1953-54 funds for R&D have an 18-month tag on them. They have to be spent within 18 months. I would like to ask two questions about that. The first is this: What is the feasibility of giving more of the R&D funds on a no-year basis? The second question is: Do you favor such a principle if it is feasible?

MR. QUARLES: Let me say first that your statement about the year-and-a-half funds is rather special to the Air Force. The corresponding statement would be different for the other two departments, particularly the Navy. It is more limited in the availability of its funds as to time.

Now, the answer to at least one of your questions is that I would strongly favor the appropriation of more funds on a no-year basis, or a greater part than we have at present. But here we encounter a perhaps quite natural congressional distaste for appropriating funds and leaving so many years for the application of them, for the obligation of them. They have a feeling, which I don't share, I believe, that this works against close congressional knowledge of what is going on and control of it.

I think you could show, if you would be objective about it, that you gain much more by the ability to use funds wisely and soundly by the no-year attack than you do when controlled by being limited to one year or eighteen months.

QUESTION: Mr. Secretary, under the new reorganization what do you anticipate will be the relationship of the Weapons Systems Evaluation Group to the in-service committees and the Policy Council on the technical side?

MR. QUARLES: That is a good question that I might well have covered earlier. It happens to be a question that has already been tackled and resolved; so that we are on a new course.

The Weapons Systems Evaluation Group (WSEG) will continue as an agency of the Department of Defense, with its primary mission that of operational analysis for the Joint Chiefs of Staff. It will be their operations analysis organization.

It is assigned to my office administratively, on the theory that there is a close tie between R&D and their operations; and on the theory that the people whom we have to bring in are people that in general our R&D people are more apt to know and can interest.

I would just like to add that it is the view of all that the WSEG operation should be strengthened in its function of servicing the Joint Chiefs of Staff with operations analysis. It is proposed to do that by giving them a closer tie to the operations analysis work in the three military departments, and also by giving them through contracts the support that agencies that might correspond roughly to what we have in RAND and other military department agencies are getting in this field.

QUESTION: Mr. Secretary, what special emphasis will your department place on the producibility aspect of an experimental item, so that when it is turned over to production, it will not have to be redesigned?

MR. QUARLES: That also is a good question, one in which both Mr. Newberry and I would be interested. Obviously, a good development job has not been done unless producibility has been considered in the process.

Now, in the area of what we call well-established art, applications engineering picks up at the contractual stage and has the responsibility for the specific design. In the specific design phase, producibility is an important consideration.

In the newer art, such as electronic systems, generally speaking we will seek to contract those to people who have experience not only in designing for the forward art, but experience in producing for the forward art. So that we hope that producibility would be a prominent consideration, and expected to be, throughout the later developmental phases. But the specific function of production engineering, that is, taking a design and engineering it for production, comes in the broad field of applications engineering.

QUESTION: Mr. Secretary, on the matter of maintaining liaison with certain foreign governments on research and development, is that coordinated through your office or is that still handled through the respective services?

MR. QUARLES: It is, of course, handled through channels of the kind you refer to. Ordinarily my office would be responsible for cultivating it and for carrying on a certain limited amount of it with the necessary top people whom we talk to on a policy basis and on a specific year basis.

Specifically, the general concept here is that the passing of intelligence to foreign countries on specific military developments is a function of the individual departments rather than a function of the Department of Defense. So I, for example, in dealing with these people, would want to keep the discussion on a policy and general, broad planning level, and refer them to the appropriate department if they wanted to get down into the technical details.

QUESTION: You referred to the fact that Congress does not think much of sociological and psychological research. Would you care to comment upon what your views are on that kind of program, and what we might expect in the next several years?

MR. QUARLES: I am an electronics man by profession, I suppose I should say. I don't have much feeling for psychological warfare. Certainly I don't understand just how it is that these Communists can do some of the things they do with influencing people's minds. I have a feeling that we aren't as smart there as we ought to be. So I have been rather in favor of putting some blue chips on some horses that are used to running in that field, to see if we couldn't get smarter. So, without having a very good feel for its professionally, I have favored research and development fields of the type you refer to. Still I have a good deal of sympathy for the Congressmen who make the statement that it is d--- nonsense.

Our answer is that we are going to concoct a program that seems wise to us. We are going to defend it before Congress. I can't go beyond that and predict in the future.

COLONEL DIEHL: Mr. Secretary, the clock has caught up with us. On behalf of the Industrial College, I thank you for an informative lecture and discussion period.

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804

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