RESEARCH AND DEVELOPMENT IN THE NAVY

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CONTENTS

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25 NOVEMBER 1947

GENERAL McKINLEY: Gentlemen: In this current course on technological progress, you have heard from General Aurand on the Army side and General Craigie on the Air Force side; this morning we are very happy to have with us Rear Admiral Paul F. Lee, who will speak to us on "Research and Development in the Navy."

Admiral Lee graduated from the Naval Academy in 1918 and has served in various assignments aboard ships and in Navy yards. Just prior to World War II he was Assistant Naval Attache in London. He is now Chief of Naval Research and has had that position for the last year.

I take great pleasure, indeed, in presenting Admiral Lee.

ADMIRAL LEE: Before discussing the Navy's research and development policies and programs, I believe it best that we first review briefly the composition of the Navy and its growth over the past century and a half.

The United States Navy is the largest technical organization in the world. It is the greatest user of power, operates the largest number of ships, and employs the largest number of technical personnel. During the late war the Navy operated ships of which the total horsepower exceeded that of all the public utilities of the United States. Two-thirds of all naval personnel in that war were technicians. The Navy operates in the air, on the surface of the sea, under the surface. It must design aircraft, surface ships of many types, and submarines, together with all of the thousands of devices for submarines, together with all of the thousands of devices necessary for the operation of such craft. Its weapons cover the entire field from small arms to guided missiles and atomic bombs. It must adapt all of these to the rigorous conditions imposed by the sea. It must train personnel in every phase of engineering and technology.

The history of United States naval power has followed closely the history of science and technology. The early nineteenth century saw the revolutionary development of Robert Fulton's steamboat. It also witnessed the conversion of the Navy from sail to steam. The Atlantic Ocean was first crossed under steam in 1837. After 1842, no United States naval ship was built exclusively for sail.

This same era produced the first submarine. This invention and the development of partially successful models by Bushnell, Fulton,

Holland, and others were followed by the Navy acquiring its first professionally built submarine, the PLUNGER, in 1893, and thereby becoming two-dimensional in the scope of its operations. It remained for the twentieth century to witness the invention of the airplane and its development and adaptation to naval uses.

The nineteenth century also marked the establishment of the first naval activities devoted to research and development. In 1866, there was established in the Navy Yard, New York, a small laboratory for the testing of lubricating oil. This event stands out as the forerunner of industry's later employment of chemists and engineers to pass upon the suitability of materials of all kinds.

In 1870, the Naval Torpedo Station was established at Newport, Rhode Island, and charged with the development of torpedoes, torpedo equipment, and explosives. In 1872, the first naval proving ground was opened near Annapolis, Maryland. As the range of guns increased, this activity was moved to Indian Head, Maryland. Here gun and armor research has led to many significant advancements in ordnance.

In 1881, the Naval Observatory was established in Washington.

Another early naval laboratory that will always rank high among the forerunners in organized research is the Experimental Model Basin. Authorized by Congress in 1896, it was opened in 1898 in the Navy Yard, Washington. Now located at Carderock, Maryland, it is the finest plant of its kind in the world. Established primarily to determine the best forms for ships' hulls, it has been expanded to conduct research in hydrodynamics, aerodynamics, mechanics, ship construction, and ship propulsion.

Shortly after the turn of the century there were established the Engineering Experiment Station at Annapolis, Maryland, and the Fuel Oil Burning Test Laboratory at the Navy Yard, Philadelphia. The scope of the latter has been broadened to include the testing of ships' boilers and main propulsion machinery. Both establishments are unique in this country—if not in the world.

The period of World War I was marked by a rapid expansion of existing naval laboratories and the establishment of new ones. Among those established were the Naval Mine Laboratory--now renamed the Naval Ordnance Laboratory--located at White Oak, Maryland; the Underwater Sound Laboratory at New London, Connecticut; the Naval Aircraft Factory in Philadelphia; and the Naval Research Laboratory at Anacostia. All of these establishments have made, and are continuing to make, important contributions in many scientific fields.

This same period witnessed a growing recognition on the part of the Military Services of the importance of scientists. As a result of this interest, there was authorized in 1915, the organization of the National Advisory Committee for Aeronautics, which was charged by Congress to "supervise and direct the scientific study of the problems of flight with a view to their practical solution," and to "direct and conduct research and experiments in Aeronautics." The National Research Council was established in 1916, under the auspices of the National Academy of Science. This Council undertook to mobilize scientists to work on problems submitted to it by the Army and the Navy. The third scientific organization created during this period was the Naval Consulting Board. Its primary function was to find worth-while inventions for war use. It was composed of outstanding individuals from the various technical groups and institutions of the country under the chairmanship of Thomas A. Edison.

This brief historical account makes it quite apparent that the Navy has long recognized the importance of research and development to our national security. It remained, however, for World War II to demonstrate beyond a question of doubt that the national security of this country is as dependent on our country's scientific strength as it is on our industrial strength. The recent war was indeed a race for scientific supremacy, for upon that supremacy depended the outcome of the war itself. We won that scientific race but we won it by the narrowest of margins. Indeed we won it more by the blunders of the Germans than by our own achievements--great as they were.

Our development of the proximity fuse, radar in all its forms, and the atomic bomb have perhaps made us belittle the scientific achievements of the Germans in World War II. Perhaps we fail to give them the credit which they are due for their development of the snorkel submarine; of the hydrogen peroxide type submarine which was the first true submersible; of the V-1 and V-2 missiles; and jet propelled aircraft.

It is true that these developments came too late to have a decisive influence on the outcome of the war. This was due, however, to the failure of the German High Command to recognize fully the importance of such scientific developments. There is strong evidence that all of these developments could have been put into operational use at least one year sooner than they were had the High Command not ordained what amounted to a year's holiday in the development of new weapons. The easy victories over Poland and France apparently convinced the Germans that they could win the war with the weapons they then possessed. As a result, they placed full emphasis on a production program of existing weapons at the expense of their development program. It was not until after their defeat at Stalingrad that they realized they could not win without new weapons. The year's holiday proved to be their downfall.

It is not pleasant to consider what would have been the effect of these new German developments had they become operational prior to our invasion of Normandy. The snorkel and hydrogen peroxide type submarines present a problem which we have not yet solved, even after two years of effort. The V-2 missiles are still without a counter. We are just now producing jet planes in any quantity--three years after the Germans first used them in combat.

The war demonstrated most forcefully that the national security of the United States is dependent, to a very large degree, upon our scientific strength. It demonstrated that from purely fundamental research studies comes knowledge which can have a profound effect upon the outcome of war. It demonstrated that the civilian scientists and the man in uniform must work together as a team if we are to take real advantage of our scientific strength and apply this knowledge to our national security.

In considering what the Navy should do in the research and development field, it is necessary that we consider all the factors involved, both national and international.

The United States is preeminent in the fields of applied research, engineering development, and production. This has been demonstrated very forcefully by our tremendous industrial development over the past 50 years. During the recent war, we out-produced the rest of the world combined. That war emphasized our national characteristic of being able to quickly apply fundamental scientific research to practical developments such as radar, the proximity fuse, penicillin, the atomic bomb, and a host of others.

Because we are so preeminent in the fields of applied research, development, and production, we should not be blind to the fact that in so far as basic or fundamental research is concerned we are not preeminent. It is a fact that in this field we have always occupied a secondary position. In prewar years we depended to a very considerable degree on the basic research which was conducted in Europe. It is imperative that we recognize this fact, for if we fail to take action to correct this situation we may well find ourselves hopelessly outclassed in the years which lie ahead.

Prior to World War II the great bulk of basic research was conducted in European laboratories. Many of the greatest discoveries made in the physical sciences in the past one hundred years were the result of this European effort. These results were available to us and used by us. From them stem many of our greatest industries and sure of the most important military developments of the war.

We now find a large percentage of the European research facilities nonproductive. Many of the great laboratories of Germany have been largely destroyed and their scientists and technicians scattered. Thousands of them are now in Russian hands. It is doubtful if we will see even a partial restoration of German and Austrian research within a generation. As a result, we have lost a great source of basic scientific knowledge upon which we depended heavily in prewar years. Due to the mass deportation of German scientists by the Russians we face an even graver situation. It is bad enough to have lost this source of knowledge. We not only have lost it, but we find a considerable part of it in the hands of a country whose ideologies are directly opposed to those of our own.

In addition to the deportation of thousands of German scientific workers, we find the Soviets embarked on a most extensive scientific effort. In their 1947 budget appeared an item of 6.5 billion rubles, or 1.2 billion dollars for scientific research. This was in addition to the research and development funds which are no doubt hidden in their military budgets. In addition, they have announced a Five-Year Plan for the training and education of scientists and technicians. The announced objective is to train and educate in the five-year period 1,280,000 technicians and 700,000 laboratory specialists with scholastic degrees. Whether or not the Soviets are successful in this phase of their program, it is a clear indication of the effort which they are exerting.

In addition to this Soviet scientific effort, we now find a strong trend towards scientific isolation on their part. In a speech by S.V. Kaftanov, Soviet Minister of Education, we find the following statements: "It is the sacred duty of our scientists to guard the secrets of their scientific work. It is absolutely inadmissible for them not to concern themselves about preserving their discoveries for their own country but immediately to publish abroad. Foreign scientists keep all of their discoveries secret. The desire of Soviet scholars to inform the West of their discoveries is incompatible with Soviet ideology. Unfortunately, our chemists have too widely published the results of their research; the same can be said of radio chemistry; there have been grave errors in the field of medicine. Important scientific discoveries got across the frontier."

This scientific isolation is a far cry from the freedom enjoyed by our own scientists, as well as scientists in countries other than those dominated by the Soviets. In the field of basic research, we permit our scientists to publish their findings, and, in fact, encourage them to do so. It is only when military implications or applications are involved in our basic research that we classify the project.

As a result, basic research being conducted in the United States, as well as in England and the free countries of Europe is available to the Soviets while theirs is not available to us. There is no doubt but what this Soviet policy will in the long haul reduce the productivity of their own scientists, but over a shorter period of time there is the possibility that it may work to their advantage.

Some time ago Secretary Forrestal, while still Secretary of the Navy, made the following statement: "Wars are fought primarily with weapons which are developed before the fighting begins. Experience demonstrates that a nation at war usually does not have time to push through a new line of fundamental research and then apply that research before the outcome of the war is decided. Research requires time. Application of its results requires additional time. Wars, long as they are, move much more swiftly than the research processes. During a war a nation usually has time only to improve and adapt weapons, the fundamentals of which were evolved during years of peace. It follows, therefore, that if a nation is to be scientifically prepared, its preparedness must be worked out in peacetime."

These observations of Secretary Forrestal will be even more valid in the years which lie ahead. It is probable that wars of the future will be considerably shorter than those we have heretofore experienced. Weapons of mass destruction--such as atomic bombs--will no doubt be used and by their use the industrial and economic strength of even a great nation can be quickly reduced.

During the recent war we had numerous examples of development work being carried to an advanced stage--even into production--before sufficient research had been conducted. Take the case of micro-wave radar. The Radiation Laboratory developed a certain type of radar equipment based on the use of a wave length of 1.25 cm. This development was carried through the breadboard stage and production contracts totaling more than 40 million dollars were made. It was then discovered that the particular wave length chosen had a high adsorption rate under conditions of high humidity. In rain, snow, or fog this radar set was practically blind.

In the field of supersonic flight we face today a similar situation. Were it possible that a plane capable of supersonic flight could be built today, we probably could not fly it because of the present human limitations. A great deal of basic research on man himself is required before we can safely fly piloted supersonic aircraft.

Another factor which has been considered in planning our research is the great importance of keeping those of us in uniform in close

touch with our civilian scientists during times of peace. In the past there was a tendency on the part of the Military Services to separate themselves from the civilian life of the United States—particularly from our university life. This was not entirely of our own choosing. Military personnel were not particularly welcome around such institutions during the late twenties. The belief was prevalent—particularly in our universities—that never again would this country become engaged in war. As a result, military personnel were considered to be a parasitic group. I had some very embarrassing experiences in this regard at my own university. It is probable that many of you had similar ones. It is very necessary that we do all in our power to prevent this gulf from developing once more. One of the best ways I know of doing this is for the Military Services to encourage and sponsor the conduct of research in universities. By so doing we will help to maintain the close ties between scientists and uniformed personnel which existed during the past war.

Military personnel can benefit greatly from close association with scientists. Such close association will tend to broaden the officer concerned and teach him to approach the problems he must solve with a keener appreciation of all the factors involved. During the past year, I have had an opportunity to observe the results of such association between scientists and naval officers. I can assure you that it has been a most gratifying experience. As time goes by, and more and more officers have the opportunity to become exposed to this scientific influence, I am certain that great good will result.

In considering the many problems associated with naval policy, one of the most difficult to solve is that of the emphasis which would be placed on the development of new weapons as compared to the maintenance of a fleet-in-being. This problem could be easily solved were we able to judge accurately when, if ever, we would again be involved in war. This we are unable to do. Should war come again it will come at the moment our enemies are prepared to make war. This places a nonaggressor nation such as our own at a distinct disadvantage. Should war come in the near future, it would be fought primarily with the weapons we used at the close of World War II. Should it be delayed for a period of say 25 years it might well be fought with the so-called "push button" weapons. Of course, if unlimited funds were available, we would not have to choose between two extremes. We could maintain our military strength at a high level and at the same time carry out a vigorous research and development program. But the economy of this country cannot support such expenditures. As a result high-level policy decisions must be made and a system of priorities established so that the funds made available to the Navy can be wisely allocated between the support of a fleet-in-being and the conduct of research and development. In arriving at

these policy decisions, due consideration has been given to the various factors which I have outlined earlier.

In order to conduct a coordinated research and development program, an organizational structure must exist within the Navy Department. The slide now before you is a simplified chart of this organization.

Actually the organization of the Navy Department is quite similar to that found in some of our large industrial establishments. In industry we frequently find the organization made up of a number of manufacturing divisions and a central research laboratory. It is the responsibility of these manufacturing divisions, under the general guidance of top company officials, to not only produce standard items but to conduct applied research and development leading to the improvement of these standard items.

It is the responsibility of the central research laboratory to conduct a broad program of research, partly in support of the manufacturing divisions and partly aimed at the acquisition of new knowledge which may lead to entirely new developments. The flow of information between the central research laboratory and the manufacturing divisions is continuous and in both directions.

In the Navy Department we could liken the Secretary of the Navy and the Office of the Chief of Naval Operations to the top officials in industry. The various material bureaus have their industrial counterpart in the manufacturing divisions. The Office of Naval Research is the headquarters organization corresponding to the central research group in industry.

It is the responsibility of the various material bureaus, under the coordination of the Chief of Naval Operations, to develop and have produced the ships, planes, and equipment of all kinds required by the operating forces. To do this they must, of course, engage in applied research and development and have under their administrative control the facilities required for such an effort. It is the responsibility of the Office of Naval Research to coordinate the research activities of all the bureaus and to conduct research, partly in support of the bureaus development programs, and partly of a very basic nature.

The slide now before you shows the various stages through which a new piece of naval equipment goes; who is responsible for each stage; and where the work is actually done.

To carry out the Navy Department's responsibilities in all technical fields, including research and development, a large group of

technically trained civilian personnel is required. The slide now before you indicates the number of these personnel and their distribution. This group contains scientists trained in practically every field of the physical sciences and in medicine, as well as a large group of engineers of many types.

DEPARTMENT OF THE NAVY TECHNICAL CIVILIAN PERSONNEL

Activity	Department	Field	Total
ONR	86	1626	1712
Bureaus	2972	--	2972
Labs. and Test Stations	--	9610	9610
All Others	____	1130	1130
TOTALS	3058	12366	15424

To provide the bureaus and offices with a guide to be followed by them in planning of their individual research and development programs the Chief of Naval Operations has promulgated the so-called A to M list. This slide shows these major categories:

(List Deleted)

As you see on the slide this list covers the major categories of naval warfare and operations. It is the responsibility of the bureaus and offices to so plan their own programs that they support these broad major categories. Each activity is required to classify each research or development project under one of the A to M headings. At periodic intervals representatives of the Chief of Naval Operations review with bureau personnel each of these projects and assign a priority thereto. These CNO representatives act as the user, and by their assignment of priorities under each major category exercise control over the total program.

The next slide shows the approximate number of research and development projects now active in the Navy Department, the bureau or office responsible for the project, and the funds appropriated in 1948 for the support of this program. You will note that the major support of research comes from the budget of the Office of Naval Research while the development program is largely financed by the bureaus.

DEPARTMENT OF THE NAVY

RESEARCH AND DEVELOPMENT PROJECTS AND FUNDS

Bureau or Office	Approximate Number of Projects	1948 Appropriations Research	Development
Medical	300	2,519,742	322,602
Ships	2000	3,420,000	41,580,000
Aeronautics	1700	5,850,000	69,150,000
Ordnance	800	2,000,000	48,000,000
ONR	1500	28,970,800	3,122,100
All Others	310	150,000	2,650,000
Totals	6610	42,910,542	164,824,702
Grand Total		207,735,244	

A very large proportion of the research supported by the Office of Naval Research is basic research as distinguished from applied research.

This slide indicates the distribution of the funds appropriated for research and development.

DEPARTMENT OF THE NAVY

RESEARCH AND DEVELOPMENT DISTRIBUTION OF 1948 FUNDS

Activity	Research	Development
Naval	19,797,842	49,173,550
Industry	9,044,000	100,193,000
Universities	12,226,400	12,352,000
Other Government	1,842,300	3,106,152
Total	42,910,542	164,824,702
Grand Total	207,735,244	

It must be recognized that these financial figures are approximations. It is extremely difficult to draw sharp lines of demarcation between basic research, applied research, or development. All of these merge into each other. However, these figures you have seen are representative of the effort being expended.

The Office of Naval Research had its genesis in the spring of 1945 when Secretary Forrestal established within the Navy Department the Office of Research and Inventions, charged it with the coordination of naval research and placed under its administrative control the Naval Research Laboratory, the Special Devices Center, and all patent activities of the Navy. In 1946, the Congress, by Public Law 588, gave this office statutory authority and renamed it the Office of Naval Research.

Under the law the Office of Naval Research is responsible, among other things, for:

1. The encouragement, promotion, planning, initiation, and coordination of naval research.

2. The conduct of research in augmentation of and in conjunction with the research and development conducted by the various bureaus.

3. The design, development, modification, improvement, and maintenance of synthetic training devices.

These responsibilities are carried out by three principal groups under the administration of the Office of Naval Research, namely:

1. The Research Divisions that are responsible for the planning and administration of the research programs.

2. The Naval Research Laboratory.

3. The Special Devices Center.

As I stated earlier a very large percentage of the research supported by the Office of Naval Research is basic or fundamental research as distinguished from applied research. This basic research program is, for the main, conducted in our educational institutions, over 150 of which now hold Navy contracts. The program covers every phase of the physical sciences as well as extensive work in medicine. Its breadth is indicated by the names of the subdivisions in the research group. These are: Physics, Nuclear Physics, Mechanics and Materials, Mathematics, Chemistry, Fluid Mechanics, Electronics, Geophysics, Physiology, Biochemistry, Bacteriology, Psychology, Biology and Biophysics.

It is the responsibility of the Research Divisions of ONR to plan and administer these programs and to make the results obtained from this research available to all interested bureaus in the Navy Department. These Research Divisions are staffed with a combination of civilian scientists--headed by Dr. Alan Waterman who has already addressed you--and naval officers. To assist this group in the administration of this network of contracts we have established five branch offices located in Boston, New York, Chicago, San Francisco, and Los Angeles. These offices are staffed with scientists, business administrators, and naval officers. They are in almost daily contact with the universities which are conducting the research work. In addition to the branch offices located in the United States we have established, under the Naval Attache, a London office which is in contact with those conducting research in England and those other European countries which are open to us.

One serious problem we face in the Office of Naval Research is the question of our civilian scientists. To plan and administer a program of the magnitude we now support requires that we have scientists of the very highest type. In addition it is essential that these scientists not remain too long in these administrative billets lest they become stale, nonproductive and bureaucratic. I am happy to state that the present scientific staff is one of the very highest type. They are men who have the respect and support of the scientific fraternity. To insure that we keep such men in the future we are now engaged in working out a program whereby universities will permit members of their scientific staff to come to Washington for limited periods of time--say for 18 months to 2 years--and join the scientific staff of ONR, thereby making it possible for our present scientists to return to universities or laboratories. It is my hope that this program will gradually build up a tradition among the scientists of this country whereby it will be considered one of their responsibilities to dedicate a portion of their careers to government service.

The two activities under the administrative control of ONR which actually conduct research are the Naval Research Laboratory located at Anacostia, and the Special Devices Center located at Sands Point, Long Island.

No doubt all of you are familiar to some extent with the Naval Research Laboratory. It was here that the phenomena of radar was first observed in the mid-twenties and its early development conducted. In the twenty-five years of its existence it has made many other significant scientific discoveries and developments, including pioneer work in the separation of uranium isotopes. Today the laboratory employs about 3,000 people, of whom about 1,000 are professional. Its annual budget is approximately 18 million dollars. It is engaged in basic

research, applied research, and development, and in test and evaluation of new devices and equipment. Its basic research forms part of the basic research program of ONR. Its applied research and development is in the support of the programs of the various bureaus.

The Naval Research Laboratory is for all practical purposes a civilian institution. The naval staff consists of only 30 officers--none of whom, with the exception of the Director, is involved in the actual conduct of the research activities. The ten civilian division superintendents, together with the Director, plan the programs of basic research, and working with the various technical bureaus plan the applied research and development programs. This is as it should be.

Since it is impossible to really describe the work being done at the Naval Research Laboratory, and since this activity is so close to the Industrial College, might I suggest, General McKinley, that a visit to the Laboratory be made a part of the curriculum of the College. I am sure that all of you would greatly benefit from such a visit.

The other field activity of the Office of Naval Research is the Special Devices Center. This Center is charged with both research and development in the field of synthetic training equipment of all kinds. Established during the war as a part of the Bureau of Aeronautics, it was originally concerned primarily with problems of training of aviation personnel. It made many very important contributions in this field. It is now much broader in its scope of activities. It is operating in the important field of the relationships between man and machines--human engineering--and is concerned not only with the problems of training personnel but also with the effects on equipment design of the limited capabilities of human beings. I know of no activity which has more potential importance. It is absolutely unique in the Navy, and, I am afraid, all too little known by the Navy. While it is not so conveniently located to this College as is the Naval Research Laboratory, I nevertheless suggest that a visit there be made a part of your curriculum. I can assure you it will be most worth while.

In conclusion I would like to sound a note of warning. In prewar years neither the Navy, the Army nor the Air Corps was fully alive to the implications of scientific research on the conduct of war. None of us utilized to any real degree the ability of our scientists. We depended to a large extent on industry converting newly discovered scientific knowledge into developments which we could use in our profession. As a result the time lag between the acquisition of new knowledge and its application to problems of national security was frequently very great. Radar is an eloquent example. This phenomena was first observed

in the mid-twenties. As early as 1930, its possible application to the detection of ships and planes was reported upon by scientists engaged in its study at NRL. As late as 7 December 1941, none of us had developed radar to anything like the degree which was possible with the scientific knowledge existing at that time.

Today, with the lessons of the war still fresh in our minds, we are more alive than ever before to the importance of research and development to our national security. It is essential that as the years go by we keep this lesson ever fresh in our minds. By so doing we can insure our national security. Failure to do so will certainly insure our defeat.

QUESTION: Admiral Lee, on one of your slides you showed a quantity of 6,910 people had been assigned to the test stations and laboratories. Does that figure include the operational development force?

ADMIRAL LEE: It does not. These are only civilian personnel.

QUESTION: How does that quantity compare with the personnel employed by (1) the Army and (2) the Air Force on like missions?

ADMIRAL LEE: I have not actually seen the total numbers for either the Air Force or the Army. I would expect, from what I know of their laboratories and test facilities, that the Navy's total is probably about the same as the total of the Army and Air Force combined.

QUESTION: Admiral, I noticed in your slide that the amount of money that you transferred to other governmental agencies is quite small. What is the plan of coordination between the Navy and other nonmilitary governmental agencies with regard to your research and development and with regard to possibly enlarging upon it in the future?

ADMIRAL LEE: In so far as coordination of the total work is concerned, should the coordination not be effective in the Navy, it would be caught by the Research and Development Board (RDB). However, I would expect the coordination to be done inside the Navy before it ever gets to the RDB.

I think the amount of money which will go into other governmental activities probably will increase.

GENERAL McKINLEY: Admiral, did I understand you to say that the activity at Sands Point is unique in that no other armed service has undertaken an activity such as that?

ADMIRAL LEE: No. It is unique to the Navy. The Air Force has been working in the same field for some time, and its work at Wright Field is very closely tied in to the work at Sands Point.

GENERAL McKINLEY: And which material bureau has cognizance of that work?

ADMIRAL LEE: No material bureau. It is under ONR.

GENERAL McKINLEY: One of your slides indicated that in some cases you were with a material bureau. I wondered whether the Bureau of Personnel might be in there.

ADMIRAL LEE: The Bureau of Personnel is tied in to it, and the CNO is tied in very closely to it.

GENERAL McKINLEY: That is a very important field.

ADMIRAL LEE: I think it is one of the most important fields we have, and, as I say, unfortunately it is one of the least known and the least appreciated.

GENERAL McKINLEY: We are reaching man's limitations; you are recognizing that fact.

QUESTION: Admiral Lee, I am particularly interested in coordination of information, and I would like to ask about a bill which the last session of Congress considered, the Technical Information and Services Act, which set up in the Department of Commerce a central information agency. What is the Navy's consideration of that, particularly if it could handle, under proper security, classified information?

ADMIRAL LEE: We supported that legislation in the last Congress. However, I do not think it is the answer, for one reason, because of the security involved.

There is being worked out in the Navy now and in the RDB a system of cataloguing and eventually getting on to IBM cards all the research and development projects of all three departments. By the use of IBM equipment, it will be possible to pull together quickly those projects which might bear on one specific field and to have abstracts of the research reports coming in made available.

It is a big problem, one we have faced all this last year and one which is not entirely solved. I anticipate that a great deal

more effort will have to be put into it. It is one of the most important ones we face.

QUESTION: Would that be decentralized to the three departments?

ADMIRAL LEE: I don't know what its eventual development will be. It might be that it would be a function of the RDB in the final analysis. We are trying to work it out in the Navy ourselves to get our own house in order. It might very well go to the RDB.

CAPTAIN ROWLEY: Along that line, sir, would you care to comment on the project you have with the Library of Congress?

ADMIRAL LEE: The project with the Library of Congress is a contract whereby we are taking advantage of the skills available in the Library of Congress to make very short abstracts of technical reports coming in, those abstracts to be made available to a very wide distributional list. It does not cover any classified work.

The question of classification, as you all know, is a ticklish one; when we start circulating classified information widely, we frequently find we have gotten our fingers burned.

GENERAL McKINLEY: It is a big problem with us, as you can imagine.

QUESTION: Admiral, you mentioned that for the 1948 fiscal year the amount of your appropriation is not in line with your request to Congress. Do you consider the present procedures and arrangements satisfactory for the reviewing of your program? You must do that when you receive notification of the appropriations that will be given to you. That is, I understand that you have priorities that are established in advance, and there must be priorities within priorities.

ADMIRAL LEE: That is actually what is done.

QUESTION: Within some of the current reports and statements we have been getting, there is an indication that there is a need for high-level policy review and determination in regard to programs. At the same time, there is a sort of brushing aside of budgetary factors, with the thought, "We don't intend that there shall be any budgetary procedures and methods that will be complicating to this procedure." It is a puzzle to me how a program can be reviewed without taking into consideration budgetary factors.

ADMIRAL LEE: In the review of the research and development program (particularly the development program, because that is where

the largest percentage of the money is), the budget certainly is taken into account. And as the Chief of Naval Operations representatives review the various projects and assign priorities under these A to M headings, by the priority they assign they recognize a budgetary limitation. Being the user, they try to determine what is the most important thing to the Navy from the user's point of view.

It is a difficult problem. I don't want you to infer that it is a bed of roses. It is far from it. It is going to be still more difficult when it gets to the RDB, where budgetary considerations will probably be taken up. With all the problems we have in the Navy, when you put the Army and the Air Force in too, it is not just three times as difficult, but is probably on the order of the cube. (Laughter)

QUESTION: With respect to the tradition you are building up among the scientists, Admiral, is there any coordinating agency to prevent a competitive scramble or dog fight developing among the three services to secure all the scientists or at least the better part of them?

ADMIRAL LEE: I don't anticipate anything like that ever developing. It certainly has not been evident up to now. When I spoke of scientists dedicating part of their careers to the Government, I was not referring to just the Navy. The same problem we face is faced by the other two departments and by the Government as a whole.

If the Steelman report is acted on and the Government supports research in universities at a level of 250 million dollars a year, a considerable staff in Washington will be required to do it; and what would work for us I think would very well work for any organization which handled this very large sum of money.

There must be some tradition built up in this country whereby the scientist does participate in government. I think it is a very healthy thing for the Government to have it happen.

COMMENT FROM FLOOR (By last questioner): At present there is no machinery set up whereby the Army, Navy, or Air Force can go out and, with a sales talk or other means of persuasion, garner in all the top research people for their own particular service.

ADMIRAL LEE: No; there is no definite setup to handle that problem.

GENERAL McKINLEY: Admiral, I am just romancing for a moment, but wouldn't the activities of the scientists while working for the universities indicate which of the services they would tend to gravitate to, because of their familiarity with the projects?

ADMIRAL LEE: Yes. And the very close association which exists among the scientists themselves is the best insurance against the occurrence of any such competition as was mentioned. They won't let it occur.

COLONEL McCULLOCH: Dr. Bush, in a talk a couple of days ago, pointed out that money for basic research was being appropriated to each of the various services. He stated that, in his opinion, money might be more effectively expended if it were controlled, at least on basic research, by an over-all agency. Do you have any views on that?

ADMIRAL LEE: Did he mean an over-all agency within the Military Establishment, or on the outside?

COLONEL McCULLOCH: Outside the Military Establishment, I should presume.

ADMIRAL LEE: I would be very strongly opposed to the military departments being deprived of their present authority to conduct basic research. I don't think there is any group that can ever be organized in the Government that is wise enough to do it for the entire Government.

GENERAL McKINLEY: I won't deny the correctness of Colonel McCulloch's statement, but Dr. Bush made a statement to me that he thought the entire research and development program should be presented for all the services in its entirety and defended as an entity, without depriving the people of the appropriations. It was merely, as I understood it, a grouping of the program in one place for coordination purposes. He may have said the other, too.

COLONEL McCULLOCH: You are entirely correct on that, sir, but he did also single out basic research for special treatment.

GENERAL McKINLEY: I didn't recall that.

COMMENT: I think the Colonel has in mind the National Science Foundation.

ADMIRAL LEE: Dr. Bush and I have discussed the impact of the National Science Foundation on the conduct of basic research by the Navy particularly. It was not my understanding that he felt that the National Science Foundation should take over all basic research. I certainly would oppose it if it were proposed in that way.

I think all three services should engage in basic research. I strongly believe that.

QUESTION: Admiral, how do you account, then, for the fact that in the Army there is one, and only one, basic research problem, whether it is out to a university or otherwise; that there is one, and only one, basic research problem in the Air Force; and that there are some twenty-six or twenty-seven from the Navy?

If all services are supposed to come in on a share-and-share-alike basis, is the idea that the Navy was there first and that what will be discovered from the Navy view can be allocated to either the Air Force or the Army?

And I would like to go a little further on that and mention the tendency of the various services to go out and get these civilian scientists, technicians, etc., and sign them up on a research basis or some other basis. The Signal Corps is doing it, the Signal Association, and others. They are sponsoring individuals, not necessarily with commissions, but they are sponsoring them so that if something happens, they say, "Bingo! You're mine." The Navy did it at the Radiation Laboratory, etc. (Laughter) Would you care to comment on that, sir?

ADMIRAL LEE: You are getting on to a rather touchy field. However, it has been my understanding that neither the Army nor the Air Force was as much interested in basic research as was the Navy; and, so far as I know, the amount of money which they have made available for truly basic research is quite small as compared to the amount the Navy has made available.

That does not change my views on the thing. All three departments should engage in basic research. However, there is a question whether all three of us should set up an organization such as the scientific staff we have in the Office of Naval Research to administer it.

I think a proper solution would be to have one organization in the Military Establishment charged with the basic research program. That organization could be staffed with uniformed people from all three departments both in Washington and in the field. That will have the advantage of all three groups keeping very closely in touch with scientists.

I don't think we should look on this as competition for scientists. I don't think scientists will let themselves be competed for. You cannot

go out from the Signal Corps or the Air Force or the Navy and tag one of these scientists. He may take a research project and accept government support for it, but it will be only in a field in which he himself wants to work. I am not alarmed about the competitive side.

The degree to which all three departments engage in basic research is, I think, a decision each of them will have to make.

I would like to point out that inside the Navy there are large numbers of laboratories that are under the administrative control of the bureaus. We not only encourage the bureaus to do basic research in these laboratories, but in some cases we are also financing the work to a substantial extent. We think it is the only way the laboratory can keep the interest of its scientific staff and maintain the whole scientific tone of the laboratory. I would be happy, if we had the money, to see us put basic research work in both the Army and Air Force facilities.

QUESTION: Relative to your scientific manpower problem again, has the Navy any particular plans for the mobilization of scientists through contracts with the universities and in the service laboratories in time of another national emergency?

ADMIRAL LEE: We are working now on a war plan, in so far as the Navy is concerned. It is a fact, however, that the network of contracts placed in universities by the Air Force, the Army, and the Navy, in effect, created a national scientific reserve to a much greater degree than we have ever had before in our military history. Those people working for all three departments would really form the framework of a new OSRD should war come again. I think we are far ahead of where we were this time after the previous war; not so far ahead as we should be, however.

GENERAL McKINLEY: Admiral, this has been a very interesting and stimulating morning. Thank you very much, indeed.

(26 November 1947--450)S/lg