PSF

Safe: Vannevar Bush

PSF - Safe - Bush

THE WHITE HOUSE

WASHINGTON

January 13, 1942.

~~SECRET~~

MEMORANDUM FOR THE

DIRECTOR OF THE BUDGET

FOR RECOMMENDATION.

F.D.R.

Letter to the Pres. from Vannevar Bush, Director of Office of Scientific Research and Development 1/9/42 re Civilian Scientific Corps and the mobilization of same.

PSF - Sage

From the Office of

V. BUSH

March 16, 1942.

Mr. Rudloph Forster,
The White House,
Washington, D.C.

I hand you a report for the President. It contains secret and confidential material which should be securely guarded, for much is here summarized.

I have thus far transmitted no copies of this report, and I will appreciate it if you will advise me if the President indicates his wishes in this regard. He may wish to see me to have certain points expanded, and, if so, I am always at his call. This week I plan to be in New York on Wednesday and Thursday, but I can always cancel when needed.

V.B.

V. Bush.

PSF-Safe: Bush

THE WHITE HOUSE

WASHINGTON

March 20, 1942.

MEMORANDUM FOR

DR. VANNEVAR BUSH

I have read your extremely interesting report and I agree that the time has come for a review of the work of the Office on New Weapons. I think you had better go ahead and work this out with the Chief of Staff and Chief of Naval Operations -- confining the whole thing to a very small number of people.

I am returning the report for you to lock up, as I think it is probably better that I should not have it in my own files.

F. D. R.

PSF: Safe - Bush

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OFFICE FOR EMERGENCY MANAGEMENT
OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT
1530 P STREET NW.
WASHINGTON, D. C.

VANNEVAR BUSH
Director

March 16, 1942.

The President,
The White House,
Washington, D.C.

Dear Mr. President:

I transmit herewith a report on the operations of the Office of Scientific Research and Development.

This consists of a brief statement of the status of research on new weapons in various fields. The opinions expressed in regard to relative importance and promise are my own, not the results of study by a group. Medical research is summarized very briefly: the principal point here is that the work is proceeding entirely harmoniously. Appendices give the usual summaries of organization and operations.

Nearly all of the relations of my Office with the Armed Services are on the tactical level, and are cordial and effective on this basis. Much is being done. In my opinion, however, the time has come for a complete review of the work of this Office on new weapons, for the scientists of the country skilled in the necessary ways are limited in number. This review should be on the strategic level, to determine emphasis and be sure that striking opportunities are not being overlooked or inadequately pushed. If there are steps which you wish me to take in order to bring this about, or if you would care to have me express more completely my thoughts on the matter, I await your instructions.

Respectfully yours,

V. Bush,
Director.

REPORT

 of the ~~SECRET~~

NATIONAL DEFENSE RESEARCH COMMITTEE

for the
First Year of Operation

June 27, 1940 to June 28, 1941

PSF Safe - Bush

OFFICE FOR EMERGENCY MANAGEMENT

OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT

1530 P STREET NW.

WASHINGTON, D. C.

VANNEVAR BUSH
Director

July 16, 1941.

The President,
The White House,
Washington, D.C.

Dear Mr. President:

I have the honor to submit herewith a report of operations of the National Defense Research Committee for the first year of its existence during which I was Chairman of the Committee.

This I have purposely made brief. The detailed reports of results obtained from the Committee's activities are placed in the hands of the Army and Navy as rapidly as they are obtained, and the full detailed record is thus available. I have hence confined this summary report to the more important programs, and have treated these generally. I shall of course be glad to extend this report to any extent you may wish.

The scientists of the country realize keenly their responsibilities in the present emergency, where the adequacy of new and sometimes intricate techniques have already profoundly influenced the course of events. They continue to be anxious to put forth their best efforts under your leadership.

Respectfully,

Vannevar Bush

Vannevar Bush,
Director.

This page and pp 34, 35

~~SECRET~~

R E P O R T

of the

NATIONAL DEFENSE RESEARCH COMMITTEE

for the

First Year of Operation

June 27, 1940 to June 28, 1941

Contents

1. Scope of the Committee's Activities.

The Order of the Council of National Defense of June 27, 1940, charged the Committee with the duty of supplementing the activities of the Army and Navy in the development of instruments of war*.

In carrying out this duty the Committee has set up an organization, divided into Divisions and Sections in accordance with subject matter, in which are included a large proportion of the outstanding scientists of the country, especially in physics, chemistry, and allied sciences+. These scientists, like the members of the Committee, serve on a voluntary part-time basis without pay. They are aided by a small number of paid Technical Aides. They take the responsibility for formulating and guiding the programs, and for rendering the results available to the Army and Navy and to the British. They are in constant close touch with skilled officers of the armed services#.

The method of operation is by means of contracts with colleges, universities, scientific institutions, and industrial laboratories. These contracts are on

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* Complete text on p.61.
+ Lists on p.38.
# System of liaison on p.48.

a cost basis. It has been the aim to provide arrangements by which university and other laboratories may proceed energetically, without gaining or losing financially in the process. The laboratories are in general contributing the use of their facilities, and are often making other contributions, as by the services of senior scientific staff for consultation and advice. There about 200 contracts in effect* covering a large range of effort. In the interests of speed, and to gather scientific groups of diverse talents, it has been necessary in some cases to concentrate work in universities and institutions having large facilities, but the work is spread all over the country. The Committee also utilizes the services of government laboratories, notably the Bureau of Standards, and transfers funds to provide for such work.

Great care has been taken to ensure proper secrecy in regard to operations. Many of the matters with which the Committee deals are of such nature that information should be securely guarded. Scientists and

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* List on p.56.

others are carefully investigated before being taken into the organization. Highly secret matters are handled by carefully restricted special groups. There is a rule that no man in the organization learns of confidential matters except as is necessary to his proper functioning. Proper rules in regard to the handling of documents, etc., are enforced. There has been no evidence of any leak of important information through the Committee's operations.

In the Sections of the Committee there meet together scientists and engineers especially skilled in the subject matter with which the Section deals, together with officers of the Army and Navy having knowledge and responsibility in the field under study. This has resulted in desirable interchange between the two services in numerous instances. It also ensures that problems are approached with a due regard to the practical military needs. The Army and Navy have welcomed the organization of the Committee, and have cooperated wholeheartedly with it.

The Committee has close relations with the British Central Scientific Office. It also maintains a London office, and sends scientists there to interchange information with British scientists and to study problems under field conditions. This interchange has proved to be highly important.

While the Committee has carried on research on a wide variety of problems, it has kept keenly in mind the necessity for concentrating effort on those matters of great and pressing importance. On these it has strained every facility to obtain practically useful results in time. Research, by its very nature, takes time; and there are many steps from the conception of an idea to its practical utilization. The task of compressing into months a development which, in normal times, would take years is strenuous. Nevertheless, out of the work of the Committee, there are already coming some results which can now be applied in practice to great advantage. More are on the way, and the effect will become cumulative as the work of the Committee proceeds.

2. Summary of the More Important Programs of Research and Development and Progress thereon.

The subjects chosen for summary are the following:

Aircraft Detection and its Resulting Developments

When the war started both the Army and Navy had already developed radio devices for aircraft detection in their own laboratories, and so had the British. These were all very similar.

It is exceedingly fortunate that this was the case. When the air assault upon England occurred last summer and fall, as a prelude to invasion, it was repelled with heavy losses because of the effectiveness of air defense. No small part of this was due to the fact that the British were forewarned by their detectors of each assault, and could order their fighters into the most advantageous position to intercept it. This experience impressed all thinking men with the importance of radio devices of this general nature, and there has been rapid development since that time. It also convinced the Committee that it could contribute to defense in an almost immediate manner by concentrating on this problem. Hence this field has been the one in which the Committee's efforts have been greatest. The outstanding scientists of the country, of such background as to work effectively in this field, have been

gathered together, largely at the Massachusetts Institute of Technology since the best facilities for their work were already there, and supplied with organization, materials, and technical assistance. The great electrical research laboratories of industry have worked closely with this group. This has occurred, not in the usual manner where each commercial company pursues its independent development, but on a definite basis of pooled information, and a subdivision of development for its most advantageous distribution. Close liaison has also been maintained with Army and Navy, and with the continuing work of their laboratories.

In nine months a new art has been advanced to a degree which would ordinarily have taken years. The matter has now progressed to the point where both the Army and Navy are placing large production orders for equipment of this type, much of which is of a form which was unknown a year ago.

It is a remarkable thing that a radio pulse detector can work at all. A radio station, somewhat like a broadcasting station, sends out a pulse of radiation lasting for only about a millionth of a second.

A few millionths of a second later it "hears" an echo come back, reflected back to it from an airplane in the distance. That this can still be done, and the echo distinguished from all those coming from the immediate neighborhood, when there is to be detected a single small airplane 150 miles away, is uncanny. Yet physicists can compute and design such equipment, and be sure that it will work. The equipment can be sufficiently rugged and reliable to operate under practical conditions in the field. From the elapsed time before the echo returns, the distance of the plane can be precisely indicated, and its direction can be found from the direction from which the echo returns. It is even possible to obtain a measure of the altitude at which the plane is flying.

All this was accomplished before the Committee came into existence. There was, however, one great difficulty. The apparatus worked on relatively long wave lengths, and was hence cumbersome. There were many evident applications, if the equipment could be rendered compact and very precise, such as to use it for direct control of the firing of guns. There is a

general relation that, the shorter the wavelength, the smaller the corresponding equipment. Hence it was highly necessary that devices be developed which would enable the wavelength to be reduced to about a tenth of that then used. Herein resided a serious difficulty. Equipment for these ultra-short wavelengths was indeed known in a few laboratories and by a few men. But it was very feeble, and great power was necessary for success. Moreover the entire behavior of electric circuits at ultra-high frequencies was not understood, and the parts of it that were known were treated by only a few scientists whereas the combined work of many was necessary for success.

Fortunately the early interchange with British scientists gave the subject a great impetus. It appeared that the British had gone far on transmitting tubes, whereas the Americans had produced advanced receivers.

The rest of the story is one of hard scientific analysis, experiment, and test. Inventions have been made, numbers of them, and been freely made available

to all investigators. But this has been no sudden brilliant flash of an individual. It has been the result of teamwork of the highest order.

As soon as equipment can be made compact and rugged for field use, many applications appear.

One of these is the ground control indicator. A piece of this radio-reflection equipment constantly scans the entire sky about it. Wherever it detects a plane it automatically places a dot on a map to indicate its position. The map is the top of a cathode ray tube, and the dot is a small glow of light. Other equipment, used in conjunction, can reveal whether any particular dot indicates a friend or foe. A series of such stations, which have a lesser range than the simpler long-range detectors, can cover an entire area with their maps overlapping, with telephone communication so that knowledge is passed on from one to the next, and to a central control station. Auxilliary devices also provide for obtaining the altitude of any particular plane under observation. The device works just as well at night or through clouds, as in

full daylight. No plane can fly higher than it can reach. Such devices are now in use, mostly at high, but not ultra-high frequencies. The present effort is to render them more powerful, smaller, more precise, and this is best done by increased frequency. Their great use is of course to control the defense fighters so that they may intercept the enemy even at night. They can, by radio communication with fighters, bring them into the general neighborhood of the enemy under the most advantageous conditions for contact. Something more is needed at night for the final contact, and more on this appears below. Advanced equipment of this sort is ready for final engineering attention and production.

The same general sort of equipment is also of great value at sea. In fact it is rapidly revolutionizing the strategy and tactics of naval warfare. When a warship can know the precise location at all times of every ship out to the horizon, and apparently even somewhat beyond, in night or haze, with directions somewhat approximate, and range very precisely, there

are evidently new conditions and it is important to be in the forefront of advance. More on precise direction will be stated below. Again, the situation is one of development for compactness and power, for the Navy has long been working on this matter. A recent test on the Semmes, using ultra-short wavelength equipment which is readily installed at the top of the mast, and which scans and plots positions automatically, has given excellent results, and the improved equipment is moving into production.

Evidently, if a plane's position can be precisely determined from the ground, a navigating system is available, especially over water. The need here is for very long ranges, and so the device is modified somewhat from the usual echo scheme. This has not been as pressing a problem as some others; however equipment for this purpose will be tested this summer and promises well.

It has long been realized that it would be exceedingly valuable if devices of this sort could be built to be mounted directly on aircraft. This has in fact been done in England using high but not ultra-high frequences. With this equipment a pursuit plane, placed in the general neighborhood of a bomber by ground control,

can then "see" the enemy. The device has indeed already produced striking results. With the usual frequencies, however, there are strict limitations. In particular the field of view is restricted and the bomber can evade pursuit by maneuvering, if it realizes it is being followed. The need for more compact apparatus, of adequate range, automatic scanning, and large field of view is hence intense; and these results are best attained by going to ultra-short wavelengths. The Committee's work has concentrated on this problem more than on any other. Two leads are being followed, one at 10 cm. which produces equipment which will readily go in the nose of a two-engined fighter, and the much more difficult task at 3 cm. which holds promise of producing equipment which can even be placed in the wings of a single-engined fighter. The research and development work on the former is practically complete, and what remains is engineering refinement and production which can proceed simultaneously under orders being placed. Sets have been tested in this country and England. With one of these, when the pilot is put

within a few miles of his target by ground control, he sees a dot on a screen which tells him the target location in elevation and azimuth, and its distance away. He can "see" through a horizontal angle of 180° and a vertical angle of 60°, and can hence readily maneuver into position. When he gets close enough he can often actually make out the target against the sky and fire. Here there is a hitch. It would be preferable if he could, at the final instant, get the exact direction and range with sufficient promptness and convenience to be able to fire without taking his eyes off of his instruments. The laboratory is intensely engaged in an added auxilliary which promises to accomplish this very thing. Even without it, the the 10 cm. AI set, as it is called, is capable of rendering it exceedingly uncomfortable for night bombers. It is being pushed to the utmost.

An auxilliary device which promises well in this connection has very recently appeared from another section of the Committee's work. This is a night glass, which appears to be a radical advance over anything previously available. With it planes can be seen on

dark nights much further than before. It is the result of combined efforts of optical scientists and experimental psychologists. Right now it is undergoing its first tests. If completely successful it will supplement rather than supersede, radio devices.

The mounting of radio echo devices in aircraft is of as great importance to the Navy as to the Air Corps. In particular it is of great importance for combatting submarines. In fact, the location of submarines on the surface by patrolling aircraft is one of the most promising methods in sight for overcoming the submarine menace. The Navy has long been alive to this matter, and has developed energetically. The successful use of extremely short waves, in the Committee's laboratories, supplements this work well, for the equipment becomes more compact and versatile. Devices embodying the most recent scientific results are now moving into production for this purpose.

The devices described give the direction of a plane or ship only somewhat roughly. It is entirely possible to construct devices along these lines which give direction with considerable precision, in fact with sufficient precision to directly control gunfire. Such

devices have been built, and are in preliminary use. The same considerations as to compactness, ruggedness, and power apply. Recently there was constructed an ultra-high frequency device for this purpose which, when directed at a plane target, will automatically continue to point at that target with sufficient precision to control anti-aircraft fire. The plane cannot evade the beam, once it is directed on it, by the most violent maneuvering, and of course it would not ordinarily know it was being followed at all. Such devices, now approaching wide use, are capable of greatly improving the effectiveness of anti-aircraft fire. The ultra-short wavelength types are being energetically developed.

The use of such devices at sea is of evident importance, and is being similarly furthered.

It would evidently also be useful to mount this sort of equipment on planes, to aid in controlling their fire. One aspect of this has already been mentioned. Other aspects are still in embryo.

In spite of the fact that much has been accomplished in this field of radio pulse reflection, the whole science and its applications are in the early stages of a great development.

In particular, it must be remembered that counter measures are often possible. Thus, if a ship uses a radio range-finder, it is possible for the opposing ship to jam this and prevent it from being used. It is also possible to so design the range-finder that jamming is very difficult, and perhaps practically impossible. A target can hardly jam the equipment by which its direction is indicated without setting up a radio disturbance which itself renders location in direction relatively easy. Thus as the art advances, if adversaries are both scientifically and technically able, there will occur a race between techniques. It is important to be somewhat ahead. The Committee has recognized this aspect of matters. Early in its development of radiation devices it set up a separate group of scientists with instructions to develop equipment aimed at counteracting the efforts of the main group. Increasing attention to counter measures will become necessary as the work proceeds.

It is, however, entirely evident that there is no counter to radio devices as a whole. They will continue to increase in importance. They will probably constitute the outstanding new military device of the present war. They are already completely modifying methods of fighting.

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b. Gun Control.

Some of the modern radio aspects of gun control have already been mentioned. There is, however, an aspect beyond that of merely knowing the target's position at all times. This is the job of applying the corrections to the gun control so that the shell and the target will arrive at the same position at the same time.

This matter has a long history, and there are industrial laboratories which have been in close contact with Army and Navy along these lines. Hence the Committee's activities in supplementing have been to perform auxilliary tasks of analysis and scientific experimentation, rather than to launch new broad developments. Nevertheless, there is important work going on under Committee auspices.

The automatic predictor for long-range naval fire has been highly refined over many years. The advent of the airplane brought in a parallel development of predictors for fire against high-altitude aircraft. The use of the airplane at low altitudes, and for dive bombing, requires very rapid predictors and flexible gun controls. Fortunately the corrections do not need to be highly refined for this short-range work, and hence the devices may be relatively simple. They are, however, needed in great quantity, and they must be sufficiently fast and accurate for their intended purpose.

The field may be divided into three ranges. First there is the point-blank range, under which a simple sight, aided by tracer bullets, suffices. This has been the usual condition thus far in plane-to-plane fire. Second there is the intermediate range, up to two or three thousand yards, where rapid fire cannon are still effective, but where corrections are highly necessary. Third, there is long-range fire, with complete corrections, which is an advanced art. In the intermediate range there is now rapid development.

The simplest and most interesting development in this field is the device by which the line of sight is itself shifted, by means of a small gyroscope mounted directly on the sighting bar, in such manner as to give the approximately correct lead. There is an interesting British development along these lines, and several in this country. The precision is good enough for relatively close-in machine gun fire, or the control of aircraft turrets. Range can be inserted roughly, and, for aircraft work the correction for trail, or the effect of the plane's own speed through the air. These devices are ready for production, and will be useful. They are an improvement for use in the borderland of the point-blank field.

More complete correction is, however, necessary in intermediate ranges. For use on land, against low-flying aircraft, the British have an excellent device, containing a much simplified predictor. With a special use of tracers it is effective. Known as the Kerison director if provides a device for this purpose which can be produced readily in quantity.

When used on shipboard a more elaborate device is needed. Angular changes need to be referred to a gyroscope instead of to the ship, and the servo mechanisms which move the gun need to be rapid and precise enough to overcome the ship's roll. For intermediate ranges the device can be simpler than the elaborate mechanisms used against high-altitude targets. There are excellent developments of such devices, and what is needed is their production in quantity. They are highly necessary for ship protection against low-flying aircraft.

The placing of adequate controls of this sort on aircraft is of great importance. A plane which can fire accurately at 2000 yards may never be forced to conduct close-in firing. The problem is difficult but can be solved, and a complete solution might be highly significant in connection with control of the air. Both the Army and Navy are engaged in developments along these lines. There are involved gyroscopically stabilized sights, adequate but simple correction computers, and servo-controlled turrets. The Committee is aiding in this work by bringing scientific talent to bear on analysis of the problem and in other ways. This type of device is of such importance that it should be expedited in every way.

Ultimately it is to be expected that, in connection with all devices of this sort, visual sighting will be replaced to some extent by automatic radio sighting. There is close contact between the scientific groups working in the two fields.

Mechanical predictors, especially of the complex type needed for long-range work, are expensive and hard to produce in adequate quantity. The Committee has hence instituted a development of electrical predictors. It appears possible to secure adequate precision in this way, at decreased cost and decreased burden on manufacturing facilities. The development is in a relatively early stage.

Rocket fire against aircraft has been greatly developed in England. The Committee is cooperating with the Navy in rocket development for this purpose. The advantage is, of course, that a rocket device is much easier to build than a gun and its ammunition, for the same calibre. The disadvantage is lack of precision and range. This development will be again mentioned below.

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c. Proximity Fuses.

A proximity fuse is a device incorporated in a shell or the like which will detonate it when it is in the proximity of the target.

This would be a very significant device, if it could be successfully developed, to improve the effectiveness of anti-aircraft fire. A high explosive shell, in order to wreck an aircraft, must go off within a short distance of the plane. However, with ordinary fusing, the indeterminateness of the fuse is such that the explosion may occur anywhere along a thousand feet of the shell path, so that, even if all other factors are favorable, the chances of a hit are low. If it could be arranged so that the explosion would occur at just the right point, high-altitude anti-aircraft fire might be ten times as effective, perhaps more. Where, under the best conditions today, about 2500 shells are used per hit, this might be very much reduced, and anti-aircraft fire might furnish such protection that it would not pay to fly bombers over protected areas adequately protected by anti-aircraft batteries capable of effective fire to the maximum altitude at which planes fly.

With other improvements in anti-aircraft artillery and controls that are coming into use or in sight, this subject of proximity fuses takes on great importance. Hence, even although it appeared exceedingly difficult, if not impossible, to attain the desired result, the Committee early instituted a considerable program aimed at this objective. Success is now in sight.

The difficulty resides, of course, in constructing sensitive instruments which can stand the enormous stresses imposed by gunfire. When it is realized that a piece of equipment, weighing an ounce, will be subjected to a force of over 1000 pounds during the acceleration of the shell in the gun, the magnitude of the difficulty becomes apparent.

In spite of the difficulties in the way the program was launched with the thought that, even although success with shell was not attained, the devices might be used in bombs and rockets where conditions are less severe. In fact a device has been produced which operates successfully when tested in bombs, and it is being applied to rockets. The use of the bomb against formations of aircraft has diminished in importance as tactics have altered. The rocket still seems to have real importance.

There are several ways in which a device may be caused to become actuated when in proper proximity to a plane. Methods depending upon the noise of the plane, or its electrostatic charge, have been examined and abandoned. There remain the photoelectric and radio types, both of which have been very considerably developed.

The photoelectric type "watches" the sky, by means of a plastic lens and photocell, and gives its impulse when the plane cuts off part of the sky light. It is hence limited to daylight use, and only at proper angles to the sun. However it is relatively simple and has been developed first. It is this type which has been successful in bombs.

The radio type is of two sorts. In one the shell carries an actual radio transmitter, and the reactions of this when near a plane provide the impulse. In the other the shell carries a radio receiver, and it is set off at the correct instant by a radio pulse from the ground. Both types are of interest, and each has its own advantages, so they are being developed together.

The first task was to develop radio tubes and batteries which would stand the shock of shellfire. After much effort this has been successfully accomplished.

Next it was necessary to incorporate these into a rugged radio set small enough to go inside a shell. The present units are about half the volume of an ordinary 12 oz. bottle, containing tubes, batteries, and the rest of the equipment of a radio set.

To determine whether the unit was sufficiently rugged one of them, arranged as a transmitter, was fired in a 5 in. shell. During its flight the signals it sent out were successfully received on the ground.

This proved that the most difficult part of the problem had been solved. The arrangement of the equipment to detonate the shell at the right distance from the plane has also been tested under static conditions. Hence, while severe problems undoubtedly will still be encountered, a successful outcome is now probable. For this reason the work is being expedited by increasing the scientific group at work on it, and in other ways. It is hoped to have units for actual test in two months.

d. Anti-Submarine Devices.

One aspect of hunting submarines, by means of radio devices on ships or planes, to detect them when on the surface, has been mentioned above.

The principal method of detection has, however, been the use of supersonic echo devices. These were developed in the years before the war, both in this country and in England. When interchange occurred the two developments were found to be very close together. The supersonic device is excellent when it works. Unfortunately, under certain conditions of the water, it works with extreme difficulty or not at all. This occurs when the water is much disturbed by propellors, or especially by depth charges; but it also occurs when the temperature gradients in the water are severe.

The Committee early instituted oceanographic work on the subject of temperature gradients in this connection. It is desirable to know the conditions in various ocean regions at various times of the year, in order to be able to predict in advance the likelihood

of successful operation of supersonic devices in the region. An instrument has been developed which will take the necessary readings without stopping the ship, and these are being installed on many ships to collect the desired data in the course of their regular activities. This instrument will also enable the commander of a ship, equipped with a supersonic device, to determine whether the absence of a signal means that there is no submarine in the vicinity, or whether it may mean simply that conditions are unfavorable for detection.

About two months ago the Navy requested the Committee to greatly enlarge its anti-submarine investigations. Accordingly, scientific groups are starting work in connection with two new Navy stations for anti-submarine investigations, at New London and San Diego. It is of course too soon to expect results from this new effort, where many new lines of research are being started.

However one result has recently appeared from work started by the Committee at Woods Hole in connection with the oceanographic study. It has been found that, in deep water, it is sometimes possible to detect

the presence of a submarine by simply exploding a small charge under water and listening with a suitable microphone. There is much indication that this will work even when conditions are unfavorable for supersonic searching. The position of the submarine can be determined by using two charges. Tests so far has been made with the listening ship stationary, but this may not be necessary after further development. It is too soon to know whether this device is capable of filling in the blanks left by supersonic searching. If it will, it is of such nature that it could be built relatively rapidly. The study is being pursued vigorously.

The submarine depends entirely upon concealment under water. However, sound will penetrate water, and there are many kinds of sound and devices for dealing with them. There are also possible optical methods. Moreover, the submarine comes up to breathe, and it can then be detected on the surface by radio means which can sweep large areas in a night. When once found, if it can be followed with assurance, and its position

accurately determined, it is realtively easy to destroy. By a sufficient development of devices of various sorts the submarine can undoubtedly be overcome, provided there is sufficient time in which to develop and get into operation devices to supplement in one way and another the excellent devices already in use.

e. Explosives and Gases.

A valuable military explosive must meet many requirements. It must be capable of production in large quantity, it must be reasonably safe to handle, and it must not deteriorate too rapidly. There are explosives known which are more powerful than those in present extensive use, but they are deficient in other respects.

It is not possible in a brief non-technical summary, to treat adequately the research being carried on in this field. The Committee has many chemists at work on various phases. Apparently there were very few chemists indeed in this country having a knowledge of military explosives, which is quite a different subject

than commercial explosives. Hence it has been necessary for organic chemists to learn a somewhat new art. The work concerns the stabilization of materials otherwise apparently satisfactory, and the investigation of new methods for producing the materials out of which explosives are built.

There has been developed a theory of explosives which appears to offer a means for determining in advance the properties of suggested substances. Also there has been organized, in cooperation with the Bureau of Mines, a station where explosives can be adequately tested. The means of production of explosives of promise has been examined into.

Propellants have also been studied. This is of importance, for one reason, in connection with rockets. At present there is no good American source of some of the best propellants for this purpose, and these may be of value in connection with assisted take-off of aircraft, as well as for rockets used against low-flying aircraft.

Fortunately in this war, thus far, gases have not been used on a large scale. However it would be very unwise to assume that they will not be.

The work of the Committee along these lines is concerned with possible new gases, and new methods of using old gases, as well as with methods of protection. New absorbents, methods of rendering absorbents ineffective, and methods of preventing this from occurring are being intensively studied, in close collaboration with the Chemical Warfare Service. It would be a very serious matter if there were gas attack methods against which the gas masks in use would be ineffective. Much attention is being devoted to this angle of the subject.

The chemists associated with the Committee have carried on many researches outside of the fields of explosives and gases. One of these has to do with oxygen supply for aircraft personnel and submarine crews. In particular, in collaboration with medical men and physiologists, there has been developed an oxygen mask for use at high altitudes which appears to be a distinct advance over masks previously available. It is so arranged as to avoid difficulty from the freezing of exhaled moisture.

f. Uranium

Early in the war the question arose whether it might be possible to obtain large sources of power from atomic fission, or even to create an explosive of tremendous power in this manner. The subject is highly abstruse, but one thing is certain: if such an explosive were made it would be thousands of times more powerful than existing explosives, and its use might be determining.

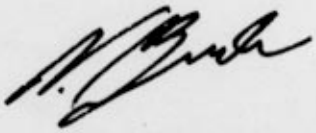
When the Committee was formed there was already in existence, in collaboration with the Navy Department, a special committee under the chairmanship of Dr. Briggs of the Bureau of Standards dealing with this subject. The Committee has continued this work under Dr. Briggs' direction.

For some time it appeared that the possibility of a successful outcome was very remote. The Committee was faced, on the one hand, with the responsibility of expending public money on what might eventually appear to have been a wild search. On the other hand, it was known that much work on this subject had been done on the continent of Europe, and it was felt to be highly

unsafe not to acquire knowledge concerning the underlying physics of the process. The Committee did not feel justified, in view of the apparently remote chance of success, in diverting to the work the efforts of scientists in considerable numbers, in view of the scarcity of highly qualified physicists for its other important work. It has therefore carried on a careful, but not an elaborate or expensive program.

The subject is too complex for brief summary. There has appeared recently, however, new knowledge which makes it probable that the production of a super-explosive may not be as remote a matter as previously appeared. A program to determine this adequately would be extensive, and expensive in the time of scientists and in direct costs. The subject is being intensively studied in England. The Committee is now making a reexamination of the matter. It is of sufficient importance so that the whole matter should be placed before the President, if this present study indicates any probability that super explosives are possible.

The list of contracts appended* shows a wide range of effort. Many more programs, while not as extensive as those treated above, might be similarly summarized. The full details are in the hands of the armed services. The Committee will be glad to report to the Commander-in-Chief upon any of these matters, and to the extent that further information is desired.



Vannevar Bush.

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* List of contracts, p.56.

FORM OF ORGANIZATION

Committee Members

Vannevar Bush, Chairman of the Committee, President of the Carnegie Institution of Washington.

Richard C. Tolman, Vice Chairman of the Committee and Chairman of Division A (armor and ordnance), Carnegie Institute of Technology

James B. Conant, Chairman of Division B (bombs, fuels and gases), President of Harvard University

Frank B. Jewett, Chairman of Division C (communication and transportation), President of National Academy of Sciences.

Karl T. Compton, Chairman of Division D (detection, controls and instruments), President of Massachusetts Institute of Technology

Conway P. Coe, Chairman of Division E (patents and inventions), Commissioner of Patents

Brigadier General Richard C. Moore, Deputy Chief of Staff

Rear Admiral Harold G. Bowen, Director of the Naval Research Laboratory

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Chairman of the Committee on Uranium (Lyman J. Briggs, Director of National Bureau of Standards)

Secretary of the Committee (Irvin Stewart, Director of Committee on Scientific Aids to Learning)

as of June 1, 1941

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James B. Conant
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as of June 1, 1941

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- L. A. Delsasso
- W. M. Fife
- E. N. Gelotte
- R. J. Hansen
- H. P. Robertson
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- E. Lakatos
- G. R. Stibitz

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H. D. Smyth, Chm.

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- W. Bleakney
- L. A. Delsasso
- H. P. Robertson

Section T
Investigations at DTM of C.I.W.

M. A. Tuve, Chm.

Consultants:
- H. D. Batchelor
- J. A. Bearden
- R. A. Becker
- L. V. Berkner
- R. B. Brode
- R. H. Crane
- J. A. Fleming
- W. A. Fowler
- G. K. Green
- L. R. Hafstad
- J. E. Henderson
- R. E. Holzer
- J. C. Hubbard
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- K. H. Kingdon
- E. J. Lawton
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- R. C. Meyer
- R. D. Mindlin
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- S. H. Neddermeyer
- L. A. Obert
- H. C. Pollock
- H. H. Porter
- R. B. Roberts
- W. V. B. Roberts
- V. L. Ronci
- W. J. Rooney
- C. H. Shaw
- P. L. Spencer
- J. F. Streib, Jr.

Section T
(continued)

Consultants: (cont.)
H. Tanis, Jr.
V. K. Ulrich
K. L. Warthman
P. T. Weeks
Ross Wood
E. J. Workman

Section E
Investigations at
Bureau of Standards

A. Ellett, Chm.
H. L. Dryden, Vice Chm.

Consultants:
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Wm. Fondiller
W. S. Hinman, Jr.
T. Lauritsen
F. L. Mohler
H. F. Olson
W. J. Shackelton
G. W. Stewart
L. S. Taylor
R. M. Zabel

Section X
Miscellaneous
Investigations

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J. W. Beams
R. D. Bennett
P. W. Bridgman
D. S. Clark
A. J. Dempster
R. E. Gibson
R. W. Goranson
W. P. Jesse
F. J. Malina
C. B. Millikan
J. W. Parsons
J. T. Tate
T. vonKarman
E. C. Watson
R. W. Wood

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Roger Adams, Vice Chairman
W. K. Lewis, Vice Chairman

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F. G. Keyes
G. N. Lewis

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W. R. Kirner, Tech. Aide
C. S. Marvel, Tech. Aide

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J. C. Holtz
Fred Olsen
W. H. Rodebush

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J. G. Kirkwood
D. P. MacDougall
J. K. Senior
J. vonNeumann
E. B. Wilson, Jr.

Bureau of Mines Com:

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L. P. Hammett, Vice Chm.

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R. C. Elderfield
W. H. Rodebush

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Member:
P. D. Bartlett

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W. G. Brown
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H. H. Willard
J. H. Yoe
D. M. Yost

Consultants:
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C. R. Hauser
A. R. Olpin
W. H. Taliaferro

Section A-4 Vesicant Action

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V. duVigneaud
E. M. K. Geiling
W. C. Johnson
E. K. Marshall, Jr.
A. R. Moritz
A. N. Richards
W. H. Taliaferro

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T. K. Sherwood, Cons. on Chem. Engin.

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V. LaMer
I. Langmuir
R. Stevenson

Consultant:
W. G. Brown

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L. Pauling
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G. P. Baxter

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Section L-5 Paint Removers

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Member:
E. S. Wallis

Section L-6 Higher Oxides

W. K. Lewis, Chm.

Section L-7 Oxygen Storage

Consultant:
C. R. Hoover

Section L-8 Gas Drying

O. A. Hougen, Chm.

Section L-9 Metallurgical Problems

A. E. White, Chm.

Members:
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R. F. Mehl
B. Stoughton
R. S. Williams

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Exhaust Disposal

W. H. McAdams, Chm.

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- J. C. Elgin
- H. F. Johnstone
- W. L. McCabe

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W. M. Latimer, Vice Chm.
W. L. McCabe, Vice Chm.
F. T. Gucker, Jr., Tech. Aide

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- A. B. Burg
- A. P. Colburn
- T. B. Drew
- P. H. Emmett
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- T. F. Young

Consultants:
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- S. Brunauer
- G. L. Clark
- R. G. Dickinson
- W. D. Harkins
- A. R. Olson
- T. D. Stewart
- W. P. Yant

Section L-12
Oxygen for Airplanes

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Consultant:
- T. M. Carpenter

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- D. B. Williams
- J. C. Zimmer

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- D. P. Morgan
- E. W. Reid
- E. R. Weidlein

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T. Midgley, Chairman
A. L. Henne, Vice Chm.

Section C-2
Pyrotechnics

G. B. Kistiakowsky, Vice Chm.

Section C-3
Special Problems

G. A. Richter, Chairman

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C. B. Jolliffe, Vice Chm.
Hartley Rowe, Vice Chm.
R. D. Booth, Vice Chm.
J. T. Tate, Vice Chm.

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A. F. Murray, Tech. Aide

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W. L. Everitt
J. A. Hutcheson
L. F. Jones
R. K. Potter
Haraden Pratt
C. A. Priest

Consultants:
L. V. Berkner
D. G. Little

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Transportation

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P. C. Putnam, Tech. Aide

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Redfield Proctor
E. J. Reardon

Consultant:
H. L. Smith

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P. C. Putnam, Tech. Aide

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P. J. Den Hartog
H. E. Edgerton

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(continued)

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W. M. Hall
J. M. Lessells
C. R. Soderberg

Consultants:
R. J. Evans
H. E. Ives
E. L. Rose

Section C-4
Submarine Studies

J. T. Tate, Div.Vice Chm.

Section C-4a
Oceanographic Studies

C. Iselin, Chairman

Section C-4b
Magnetic Studies

Section C-4c
Supersonic Studies

Section C-5
Sound Sources

Section C-5a
Sound Sources

Harvey Fletcher, Chm.

Members:
Harte Cooke
Hallowell Davis
V. O. Knudsen

Division C (continued)

as of June 1, 1941

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V. O. Knudsen
G. B. Pegram
L. B. Slichter

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DETECTION, CONTROLS, INSTRUMENTS

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J. C. Trump, Tech. Aide
A. L. Loomis, Vice Chairman

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Detection

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- R. Bown
- J. A. Hutcheson
- E. O. Lawrence
- G. Metcalf
- H. H. Willis

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- W. P. Allis
- W. A. Andrews
- L. W. Alvarez
- W. R. G. Baker
- W. L. Barrow
- Charles Butt
- H. H. Buttner
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- J. H. Cook
- L. A. DuBridge
- M. Eastham
- I. A. Getting
- A. M. Grass
- E. A. Guillemin
- W. M. Hall
- G. A. Hobart, III
- M. H. Kanner
- R. B. Lawrence
- J. L. Lawson
- C. V. Litton
- F. W. Loomis
- E. M. Lyman
- E. M. McMillan
- L. K. Marshall
- P. H. Miller
- H. V. Neher
- W. B. Nottingham
- A. P. G. Peterson
- I. I. Rabi
- N. F. Ramsey, Jr.
- Shepard Roberts
- S. J. Simmons

Section D-1
(continued)

Consultants: (cont.)

- J. C. Slater
- J. T. Soller
- J. A. Stratton
- J. C. Street
- A. E. Thiessen
- W. G. Tuller
- L. A. Turner
- J. H. Van Vleck
- S. N. Van Voorhis
- M. G. White
- L. F. Woodruff
- C. A. Woodward, Jr.

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Warren Weaver, Chm.
E. J. Poitras, Tech. Aide
T. C. Fry, Vice Chm.

Member:
- S. H. Caldwell

Consultant:
- Arthur Hardy

Section D-3
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J. S. Coleman, Tech. Aide
J. P. Molnar, Tech. Aide
Paul Klopsteg, Vice Chm.

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- E. A. Eckhardt
- L. O. Grondahl
- T. H. Johnson

Consultants:
- J. A. Becker
- Brian O'Brien

Section D-4
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W. H. Radford

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H. H. Beverage
E. U. Condon
Donald Cooksey
C. S. Draper
E. W. Engstrom
W. C. Evans
W. W. Hansen
Harold Hazen
M. J. Kelly
P. M. Morse
Norbert Wiener

DIVISION E
PATENTS AND INVENTIONS

C. P. Coe, Chairman

May 19, 1941

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Lt. Col. H. W. Dix

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NDRC Liaison

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Capt. W. G. Brown

Project Liaison

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Major G. W. Goddard
Major P. H. Kemmer
Capt. F. C. Wolfe
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NDRC Liaison

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Lt. B. R. Bierer

Project Liaison

Lt. Col. W. D. Fleming

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NDRC Liaison

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Major Cortlandt Van R. Schuyler

Project Liaison

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Capt. Arthur L. Fuller

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Major C. H. Chorpening
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Project Liaison

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Capt. Wm. Baker
Capt. J. L. Green
Lt. R. R. Arnold

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NDRC Liaison

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Lt. R. J. Powers

Project Liaison

Lt. Col. K. F. Adamson

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Lt. Col. E. W. Van Deusen

Project Liaison

Capt. Jean Engles
Lt. H. W. Holtzkemper

SIGNAL CORPS

NDRC Liaison

Lt. Col. Hugh Mitchell
Lt. Col. T. C. Rives
Major David E. Washburn

Project Liaison

Lt. Col. John H. Gardner
Lt. Col. R. B. Colton

as of May 1,1941

NAVY DEPARTMENT LIAISON OFFICERS

Navy Department Liaison Officer

Comm. R. P. Briscoe

Bureau of Ships	Name	Room	Ext.
Research and Development	Capt. Lybrand Smith	3350	772
Communications and Direction Finders-Radio Microwave	Lt. Comdr. L.B.Blaylock	4309	520
	(Lt.Comdr.S.M.Tucker	4314	2491
	(Lt. H. C. Owens	4307	244
	(Lt.Comdr.F.D.Kime	4316	2491
Paints and Plastics	Lt.Comdr.H.A.Ingram	3349	753 or 772
Ship Models-Model Testing	Capt.Lewis B.McBride, Carderock Model Basin	Oliver 8436	
Magnetic Detection and Mine Sweeping	Lt.Comdr.E.C.Craig	4203	72 or 692
Underwater Sound and ASV Devices	Lt.Comdr.M.K.Kirkpatrick	4303	770

Bureau of Ordnance			
Research and development (Director)	Capt.G.L.Schuyler	3144	286
Rocket applications and ballistics	(Comdr.G.C.Hoover) (Comdr.S.R.Shumaker)	3146	735
Aviation Ordnance	Comdr.M.F.Schoeffel	2615	215
Explosives	(Lt.(jg)F.R.Drake	3145	2127
	(Lt.Comdr.J.A.Snackenberg (ordered)		
Fire Control	Lt.Comdr.M.E.Murphy	3146	2128
Fire Control, Microwave Applications	Lt.Horacio Rivero	3123	13
Guns, Mounts and Turrets	Lt.Comdr.H.B.Brumbaugh	3145	2118
Subsurface warfare	Comdr.J.L.King	Ord.Temp.Bldg.	19

Bureau of Aeronautics			
Research and Development (General)	Comdr.L.C.Stevens	2835-A	533
Microwave and Communications	Lt.Comdr.G.B.H.Hall	4933	448
	Lt.J.A.Moreno	4933	448
	Lt.Comdr.M.P.Hanson	4933	448
Materials	Comdr.D.S.Fahrney	2829	2268
	Lt.Comdr.J.E.Sullivan	2834	2574

Office of Naval Operations

Microwave and Communications	Lt.Comdr.F.R.Furth	2630	838
Codes and Signals	Lt.Comdr.G.B.Myers	2628	117
Special Liaison (Frequency Allocation)	Comdr.J.R.Redman	4813	555

Naval Research Laboratory

Navy Dept.Liaison Officer	Comdr. R.P.Briscoe	Lincoln	8076
Microwave	Lt.Comdr.D.R.Hull	"	"
Communications	Lt.Comdr.W.B.Goulett	"	"
Chemistry,Metallurgy, and Mechanics	Lt.Comdr.R.W.Dole	"	"

NATIONAL DEFENSE RESEARCH COMMITTEE

1530 P Street NW.

Washington, D. C.

June 14, 1941

TO: All Committee Members, Division Vice Chairmen, Section Chairmen, and Technical Aides

SUBJECT: Supplemental List of Navy Department Liaison Officers

This memorandum is supplemental to the list of Navy Department Liaison Officers (as of May 1, 1941) sent to you with Office Memorandum No. 34.

Div. of Fleet Training and the Interior Control Board	Name	Room	Ext.
Surface Gunnery	Lt. Comdr. C.H. Lyman	2807	328
Antiaircraft Gunnery	Lt. Comdr. P.E. McDowell	2811	457
Fire Control	Lt. Comdr. M.E. Miles	2810	393
	Lt. Comdr. A.B. Leggett	2810	393
	Lt. Comdr. C. H. Lyman	2807	328
Optical Rangefinding	Lt. Comdr. P.E. McDowell	2811	457
Aircraft Ordnance	Lt. Comdr. E.C. Ewen	2811	457
Sound	Lieut. J.R. Waterman	2817	365
Interior Control	Lt. Comdr. M.E. Miles	2810	393
	Lt. Comdr. A.B. Leggett	2810	393
Mines and Minesweeping	Lt. Comdr. R.S. Moore	2805	490

The name of Lt. R.L. Densford will replace that of Lt. Comdr. G.B. Myers in the Office of Naval Operations, Codes and Signals.

IRVIN STEWART, Secretary

PROVISION FOR INTERCHANGE WITH BRITISH SCIENTISTS

The full exchange of scientific information with the British has contributed greatly to the effectiveness of NDRC's work. By this means, American scientists have been enabled to attack defense problems with a background of battle experience and the knowledge of present day tactical requirements. Moreover, they have been handed the accumulated results of the research and development done by the numerous teams of British experts working on battle-tested devices. In return, our scientists have been able to give all possible aid from their present knowledge, and much needed help on urgent problems. Even more important is the opportunity to divide the burden, leaving American research men largely free for the vital task of perfecting those instruments of technological warfare on which next year's battles may depend.

This exchange of scientific information with the British, Canadian, and Australian Governments has been handled by the Liaison Office of NDRC, and by its London Mission. The latter consists of a small permanent staff at the American Embassy in London, which maintains close relations with the British Ministries and their research establishments, as well as with the American Military and Naval attaches in London. Relays of experts from various divisions of NDRC have been sent to England for direct consultation with British scientists. There is also continuous interchange by report and cable. In Washington, very close liaison relations exist with the Central Scientific Office of the British Supply Council. Also exchange of information with the Canadian and Australian Governments is handled largely through this same office. There are many exchange visits by

Canadian and NDRC scientists. By these several means, research workers in this Country are kept fully informed concerning work in these British Countries and pertinent results obtained here are quickly communicated to the British.

In charge of the Liaison Office in Washington is Mr. Carroll L. Wilson, with Dr. C. P. Haskins and Dr. F. S. Cooper as Assistant Liaison Officers. At the request of the President, Dr. James B. Conant headed the first NDRC Mission to England in February. The most cordial cooperative relationships were established with members of the British Government and with British scientists, and these have been very competently maintained and furthered by Mr. Frederick L. Hovde, who is in charge of the London Mission.

Since February of this year, fifteen experts from NDRC have visited England in small groups for periods of about a month, establishing contacts with British research workers in their specialized fields. These experts have consulted frequently with the Military and Naval attaches, and each group has been able to be helpful to the other. Experts sent thus far have covered such subjects as explosives, war gases, chemical defense, radio detection, fire control, proximity fuses, and anti-submarine developments.

The British Central Scientific Office in Washington, of which Dr. Charles Darwin is Director, succeeds Sir Henry Tizard's British Technical Mission. Both personally, and through his technical staff, Dr. Darwin is in touch with NDRC work and can bring to this work the benefit of the British experience. The Liaison Office also has close relationships with the National Research Council of Canada, and with the Scientific Attache at the Australian Legation.

One of the greatest handicaps to effective liaison with the British has been the delay both in transportation of personnel and diplomatic mail. Although few sea-borne pouches have been lost, the time for transit between Washington and London has been from four to eight weeks. The recent establishment of adequate air-ferry service should greatly reduce delay.

There is also a growing realization of the mutual benefits to be derived from British-American interchange on the part of American scientists and of the Service people with whom they are associated. This has resulted in an increasing number of personal contacts and of visits by NDRC personnel to British laboratories. Coupled with eased conditions of transport and communication, this attitude should lead to an even more effective exchange of technical and scientific information in the future.

June 28, 1941

Contractor	Number of Contracts
Academic	
Brooklyn Polytechnic Institute	1
Brown University	1
California Institute of Technology	8
University of California	10
Carnegie Institute of Technology	3
Carnegie Institution of Washington	8
University of Chicago	9
College of the City of New York	1
Columbia University	5
Cornell University	1
Cornell University Medical College	1
University of Delaware	1
Drexel Institute of Technology	1
Franklin Institute of the State of Pennsylvania	2
Harvard University	13
University of Illinois	6
Iowa State College	4
Johns Hopkins University	3
Massachusetts Institute of Technology	20
University of Michigan	4
University of Minnesota	3

Contractors	Number of Contracts
University of Missouri	1
National Academy of Sciences	3
University of Nebraska	1
University of New Mexico	1
Northwestern University	3
Ohio State University Research Foundation	3
Pennsylvania State College	5
University of Pennsylvania	3
Princeton University	10
Purdue Research Foundation	1
Rensselaer Polytechnic Institution	1
University of Rochester	2
Rockefeller Institute for Medical Research	1
University of Southern California	1
Stanford University	3
University of Virginia	2
Wesleyan University	1
University of Wisconsin	5
Woods Hole Oceanographic Institution	1
Yale University	2

41 Contractors - 155 Contracts

Contractor	Number of Contracts
Industrial	
Air Reduction Company, Incorporated	1
American Locomotive Company	1
Bakelite Corporation	1
Carson & Carson	1
Central Scientific Company	1
Ethyl Gasoline Corporation	1
General Electric Company	1
General Radio Company	1
Gulf Research and Development Company	3
Hazeltine Service Corporation	5
Monsanto Chemical Company	1
National Cash Register Company	1
Polaroid Corporation	1
Precision Castings Company	1
Raytheon Production Corporation	2
RCA Manufacturing Company	7
Standard Oil Development Company	1
Edward Stern & Company, Incorporated	1
Union Switch & Signal Company	1
United Shoe Machinery Corporation	1
Western Electric Company	17
Westinghouse Electric and Manufacturing Co.	2

22 Contractors - 52 Contracts

Academic	41 Contractors	155 Contracts
Industrial	22 Contractors	52 Contracts
Total	63	207

In addition to the signed contracts listed above, the Committee has authorized contracts covering approximately 100 additional items contracts covering which are now being negotiated.

These contracts cover the development of a variety of new equipment and reports upon a wide range of subjects related to mechanisms and devices of warfare. Among the more important subjects covered by the contracts are the following:

Microwave equipment
Anti-submarine devices
Fire control equipment
Uranium
Rockets
Terminal ballistics
Fuses
Explosives
War gases
Defense against war gases
Oxygen storage and measurement
Fuels
Communication devices
Improvements in tanks
Bridge designs
High intensity sounds
Recognition devices
Infra-red equipment
Night vision devices

ORDER ESTABLISHING THE NATIONAL DEFENSE RESEARCH COMMITTEE

STATUS OF CONTRACT FUNDS

June 30, 1941

Allocated to National Defense Research Committee		$6,500,000.00
Appropriated through June 12, 1941 meeting:		
Chairman's Office	$187,000.00	
Uranium	50,950.00	
Cryptography	20,000.00	
National Academy of Sciences	40,000.00	
London Mission	50,000.00	
Contract Travel	889,459.00	
Division A	1,104,935.00	
Division B	775,582.00	
Division C	3,471,910.00	
Division D		
Gross Total Appropriated		$6,570,816.00
Less: Amounts restored through cancellation of authorizations or through writing contracts for less than authorized amounts		273,169.00
Net Total Appropriated		6,290,647.00
BALANCE		$ 12,353.00

ORDER ESTABLISHING THE NATIONAL DEFENSE RESEARCH COMMITTEE

Pursuant to authority vested in it by section 2 of the Act of August 29, 1916 (39 Stat. 649), the Council of National Defense, with the approval of the President, hereby establishes as a subordinate body of the Council a committee to be known as the National Defense Research Committee. The following persons shall be members of the Committee: Dr. Vannevar Bush, who shall be Chairman, Dr. James B. Conant, Dr. Richard C. Tolman, Dr. Karl T. Compton, Dr. Frank B. Jewett (as President of the National Academy of Sciences), Conway P. Coe (as Commissioner of Patents), one officer of the Army to be designated by the Secretary of War and one officer of the Navy to be designated by the Secretary of the Navy. Vacancies occurring in the membership of the Committee shall be filled by appointment by the Council with the approval of the President. The members of the Committee and of such subcommittees as may be formed by the Committee shall serve as such without compensation but shall be entitled to actual and necessary transportation subsistence, and other expenses incidental to the performance of their duties.

The Committee shall correlate and support scientific research on the mechanisms and devices of warfare, except those relating to problems of flight included in the field of activities of National Advisory Committee for Aeronautics. It shall aid and supplement the experimental and research activities of the War and Navy Departments; and may conduct research for the creation and improvement of instrumentalities, methods, and materials of warfare. In carrying out its functions, the Committee may (a) utilize, to the extent that such facilities are available for such purpose the laboratories, equipment and services of the National Bureau of Standards and other Government institutions; and (b) within the limits of appropriations allocated to it, transfer funds to such institutions, and enter into contracts and agreements with individuals

educational or scientific institutions (including the National Academy of Sciences and the National Research Council) and industrial organizations for studies, experimental investigations, and reports.

The Committee shall promulgate rules and regulations for the conduct of its work, which rules and regulations shall be subject to the approval of the Council and the President.

Louis Johnson
Acting Secretary of War

Lewis Compton
Acting Secretary of Navy

Harold L. Ickes
Secretary of Interior

H. A. Wallace
Secretary of Agriculture

Harry L. Hopkins
Secretary of Commerce

Frances V. Perkins
Secretary of Labor

Approved:

Franklin D. Roosevelt

The White House

June 27, 1940