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SCIENCE AND NATIONAL DEFENSE[1]

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IN this discussion of the present position of science and research in National Defense I will confine myself to two points. The first concerns the form of organization under which the scientists of this country are working. The second, which is very brief, has to do with the spirit with which the task is undertaken. As to the work itself I can not, of course, be specific at the present time.

Details of the organization have been made known, but I think they are not well understood generally. In June, 1940, there was formed, by order of the Council of National Defense, a group called the National Defense Research Committee (NDRC), for the purpose of supplementing the work of the Army and Navy in the development of devices and instrumentalities of war. This new organization was intended to function in an executive, not an advisory, capacity. The advisory function was being adequately cared for by the National Academy of Sciences, which has been in existence since the Civil War period, having been created by Act of Congress for the express purpose of advising the government on its scientific and technical problems. There was, however, need for a civilian group with executive powers to supplement the scientific and technical work of the Army and Navy, for,

[1] From an address delivered at the joint luncheon of the Acoustical Society of America, the Optical Society of America and the Society of Rheology in New York on October 24, 1941.

in the emergency, an expansion of the scientific attack on war problems was essential, and the Army and Navy could not themselves undertake this immediately and fully. This need resulted in the formation of the NDRC as a means for enrolling a large number of civilian scientists to assist in research on problems of national defense as promptly as it could be done. The NDRC was formed as an operating part of the emergency governmental machinery, in contrast with the position of the National Academy of Sciences, which is an independent organization, operating under a congressional charter which defines its obligation to render advice when called upon by government agencies. The NDRC thus is intended as an emergency organization and is not of permanent character as is the Academy.

Let me say in passing that, in order that the Academy and the Research Council may most effectively carry on their exceedingly important work, it is very essential that they maintain their independent status, for this gives added force to their opinions on scientific problems as expressed to agencies of government.

NDRC consists of six civilians (including the President of the National Academy of Sciences and the Commissioner of Patents), an officer of the Army, and an officer of the Navy. Initially it was organized in four divisons: one under R. C. Tolman, of the California Institute of Technology; one under K. T. Compton, president of the Massachusetts Institute of Technology; one under F. B. Jewett, president of the National Academy of Sciences; and one under J. B. Conant, president of Harvard University. There are now about 60 sections in these divisions, composed of voluntary part-time and full-time workers, plus a few technical aides who are paid by the government.

The committee operates primarily by means of contracts with universities, colleges, research institutes and industrial laboratories. These contracts are initiated and supervised by the various sections and there are now about 450 of them in operation with nearly 120 contractors. These contracts are drawn with the intent that the contractor, whether university or industrial laboratory, shall neither gain nor lose financially through participation in these defense research activities. Such an aim is difficult to achieve, of course, but we are now making a careful study of the situation to see how close we have come to this goal.

The NDCR has tried to carry out its work with a minimum of interruption to the regular affairs of the universities. Of course it is not possible to proceed without disruption and inconvenience, but that has been held down as far as possible. Many a physics department throughout this country has nevertheless been put to very great stress. The men who have carried on under a heavy overload, continuing the work of the university in order that some of their colleagues might participate directly in the defense program, are contributing no less to the national interest than are those immediately engaged in the sections of NDRC or otherwise.

The number of people involved in the work of the committee is rapidly increasing. There are now about 500 individuals in the NDRC organization who serve as members of sections, consultants, and so on. About 2,000 scientific men are engaged in defense research in connection with NDRC contracts, and probably there is an equal number of helpers.

The NDRC spent about ten million dollars during its first year, and it had nearly as much for the second year, beginning July 1, 1941. If the President signs the bill which was passed by the Senate yesterday, another large sum will become available. I feel quite sure that if a bottleneck should develop, it would not be caused by the number of problems that are important and should be worked on, nor by lack of funds with which to carry on the work, but by a shortage of available personnel. For example, a recent study indicated that, of the available physicists whose names are starred in "American Men of Science," about 75 per cent. are now engaged in war research in one way or another. I think the other 25 per cent. who are still available will soon be called upon. The call for chemists has not been so great as it was in the last war—about 50 per cent. is the corresponding figure. In addition, many engineers are thus engaged, but in their case it is not easy to arrive at a comparable figure.

Effort has been made to spread the work, but that has not been possible in some instances. For some problems it has been necessary to gather an outstanding group in one place in order to provide the advantages of a concentrated attack. Such concentration has occurred under several universities in this country, men having been brought from other institutions for that purpose. Within this next year, however, we hope to spread the work much more than was practicable in the great haste of initiating activities in the summer of 1940.

The special function of NDRC, as previously stated, is to supplement the work of the Army and Navy in the development of devices and instrumentalities of war. Let me say immediately that, in spite of difficulties due to lack of funds in the years preceding this emergency, the Army and Navy, in my opinion, have done a very fine piece of work in research, in development and in proceeding toward advanced instruments of war. We are supplementing previous work, not starting anew, in almost every field in which we operate.

There is very close liaison with the Army and Navy, each section of NDRC having its own liaison officers.

These officers represent some of the brightest, keenest men in the armed services on the technical front. Relations have been cordial, and I believe that many a scientist has gained, through his work with the Army and Navy, a new respect for the burden being carried and for the quality of the men who are carrying it. I think, too, that many an officer in the Army and in the Navy has gotten a somewhat different idea, in the course of the past year, of the scientists of the country. They have found that the scientist is not necessarily a person with "long hair," but that he can attack a problem in a practical way, and that he can work long hours and take it with the best. As a result, there has developed a mutual respect which is very heartening.

There has been interchange of scientific and technical information with Britain on an excellent basis. Dr. Conant went to England and established a London office of NDRC, and this is now in charge of Mr. Hovde. Likewise, the British have a Central Scientific Office in Washington. There is complete and free interchange with the British on every aspect of the scientific attack, and this is proving of mutual advantage.

Having thus given you the salient points in regard to NDRC, I will now tell you of a new organization. Last June, after just one year of operation by the NDRC, the President, by Executive Order, established the Office of Scientific Research and Development (OSRD), of which I am director, to coordinate all defense research wherever it might occur. The OSRD has two major divisions, one being the National Defense Research Committee, which continues as before, except that Dr. Conant succeeded me as chairman and Dr. Roger Adams has taken over Dr. Conant's previous duties. In addition, there is a business office under Dr. Stewart and a liaison office under Mr. Wilson, the latter being principally engaged in handling our relations with the British.

The second major division of OSRD is the newly-formed Committee on Medical Research, of which Dr. Richards, of Pennsylvania, is chairman. This committee is constituted in much the same way as the NDRC, and it shares with NDRC the funds furnished OSRD, in order to conduct medical defense research. It works primarily with the Division of Medical Sciences of the National Research Council, which had already been active in this field and had organized committees necessary to carry on such work, of which there are about 50. The Committee on Medical Research has close relations with the U. S. Public Health Service, as well as with the Surgeons General of the Army and Navy, having in its membership a representative from each of the three offices.

The OSRD has an Advisory Council which includes the chairman of the two main groups, Dr. Conant and Dr. Richards, and the chairman of the National Advisory Committee for Aeronautics, which for twenty-five years has been bearing the principal burden of aeronautical research in this country for the Army and Navy. That the NACA is a very active organization is shown by the fact that its budget for the present fiscal year is about six million dollars for operation, plus about twenty-four million available for new construction. Also on the Advisory Council is a Special Assistant to the Secretary of War, who is charged with keeping the Secretary apprised of the status of research and development throughout the War Department. He has also the duty of maintaining relations with organizations outside the department, on matters of research and development, through his connection with OSRD. The Navy is represented on the Council by the Coordinator of Research of the Navy, who has similar duties in the Navy Department to those just described for the War Department representative on the council.

We have, therefore, in the OSRD Council a definite way of bringing together the groups that are concerned. The new office is charged with the duty of mobilizing the scientific effort of the country by providing a focus at which all defense research is considered; supplementing the work of the Army and Navy, directly through its own organizations, by research on instrumentalities and materials of war on the one hand, and by medical research on the other; advising the President as to the status in this country of scientific research and development in their relation to defense; initiating, in cooperation with the Army and Navy, broad programs of research where needed; carrying on such research as may be requested by those countries whose defense is considered by the President to be essential to the defense of the United States. With our close relation to Britain, I am quite sure that the requests will be many. For example, Britain has been forced to drop much important medical research. British physicians are too busy with immediately urgent matters, and we must pick up that burden.

The OSRD is aided by many organizations that are not directly concerned in the activities of its two main groups. I mention, for example, the National Roster of Scientific and Specialized Personnel under Dr. Carmichael, which, together with the National Research Council, is undertaking the very important task of locating competent personnel. There is also the National Inventors Council, formed under the Department of Commerce for the purpose of evaluating the very large number of suggestions coming from the

public. The Inventors Council has a difficult and somewhat thankless task, but is doing it very well indeed. The wheat they sift from the chaff is passed on to the Army and Navy for development as needs arise.

Thus there exists in the organization of the Office of Scientific Research and Development the basis for an effort commensurate with the importance of science in modern war, which is a very high order of importance indeed. Of the work itself I can not of course tell at this time, but it will be a striking story when it is finally revealed. With 60 active sections in the NDRC and 50 committees in the CMR, the range of work is obviously large. I can, however, mention one thing that has already been made public. When the Battle of Britain took place in August, September and October, 1940, invasion failed for two reasons: First, the British fighting forces in the air were courageous, skillful and well equipped, better equipped than were the invaders in many ways; secondly, radio detection, developed by a group of devoted British scientists working from 1935 on, at times without much encouragement, offset the element of surprise. This one development may have saved the isle of Britain. It is one field of obvious importance; others undoubtedly occur to you.

Most of the matters that OSRD handles are quite naturally clothed with the mantle of secrecy, for every precaution must be taken in dealing with military matters of great potential importance. The various sections are working in specific fields, and the affairs of the organization have been compartmentalized in order better to follow the general policy of permitting a man to learn confidential things only to the extent that is necessary in order that he may function effectively. Another rule is that, in working with people outside the organization, OSRD members listen and do not talk. It is not the most agreeable way of working; it is not natural for a scientist, but it is necessary under present circumstances. Appointments to posts in the organization are made only when the Army and Navy, after careful investigation, have indicated that they have no reason to suspect that there is not complete loyalty.

I said that there were two points to be considered. One is the organization, but organization is very little. The spirit in which the work is conducted is much more important. There is no unanimity in this country as to how or when or where or to what extent the power of this nation should be exerted to defend our way of life. But there is unanimity on the thesis that the power of this country must be increased at once and to the maximum possible extent.

The scientists of this country have done more than speak on this subject. They have taken off their coats and gone to work, and much academic research has been postponed in the process. The matter of credit has been utterly forgotten. They have shown a willingness to work under necessarily rigid restrictions, as well as with a reasonable tolerance of the petty inconveniences and annoyances that are inevitable in the confusion of adapting themselves to military ways. They have shown that they are willing to go into a strange ball park and learn the local ground rules. In only a year they have done things. Ordinarily, it is at least three years from an idea in the laboratory to its use, and yet I say to you that results are being obtained, and they are taking form in copper and iron. Those of you who are privileged to participate in this work, as I am, will find therein a deep satisfaction, even though it substitutes for a thing we held more highly: the privilege of contributing to the growing knowledge of the race. Those of you who are not participating directly, but are holding the fort in order that your colleagues may participate, or who are carrying on in a field where the thread of growing knowledge might otherwise be broken in the present distress of the world, will also look back some day to this period, not only as a time of stress, but as a time when we were all privileged to participate in one thing on which we could become united: the defense of the country to which we owe our allegiance. The scientists of this country are united, and they are obtaining results.

ATMOSPHERIC-ELECTRIC DISTURBANCES ACCOMPANYING THE BRIGHT AURORAS OF MARCH 25, 1940, AND SEPTEMBER 18, 1941

By Dr. HARLAN T. STETSON

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IN an article on "The Present State of Solar Activity and Associated Phenomena" printed in SCIENCE two years ago,[1] the results of an investigation of the brighter aurorae observed at the Blue Hill Observatory during the last 35 years indicated a lag of about one year between the occurrence of a sunspot maximum and the period of the greatest auroral activity.

[1] Harlan T. Stetson, SCIENCE, 90: 2343, 482–484, November 24, 1939.