

The Uniform Turns To Science

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Last March in St. Louis Admiral Bowen and I had the pleasure of addressing the American Association for the Advancement of Science. Shortly after that meeting your president requested one of us to speak at the fall meeting of the Indiana Academy of Science. It is with a great deal of pleasure that I accept. It gives me an opportunity to explain, at least from a naval point of view, why the uniform needs all of the assistance it can get from you men representing all fields of science.

By way of review, on May 19, 1945, the Secretary of the Navy acting under the War Powers Act established in his Office the Office of Research and Inventions. In August of this year the President signed a bill creating by law and permanently establishing the Office of Naval Research. Admiral Bowen was appointed the first Chief. I am one of his Assistants. Hereafter I refer to the Office of Naval Research instead of the former Office of Research and Inventions although the personnel and ideals are the same.

Before we get too involved, let me frankly state that there is nothing spectacular in this talk. My Office does not subscribe to this so-called "Buck Rogers" thinking. We are interested in fundamentals, and cold, sound basic facts which you gentlemen can provide for us.

The atomic bomb, guided missiles, supersonic air speeds, and all the fantastic developments of modern war have created an intense interest in scientific work in human minds throughout the world. The man in the street is interested in science as never before. The man in uniform is vitally interested, not only through curiosity, but because he feels that the future safety of the nation depends on maintaining a close working partnership between the Navy and the best scientific minds available in this country.

Therefore, the uniform has turned to science because the tremendous scientific achievements of the past few years have put us in a position in which we are unable to protect our country without scientific help. We ask for a partnership with science because we cannot protect our people, our resources, and our industry unless such a cooperative venture is established and maintained.

Not only do we know that the nation's safety depends on the uniform keeping ahead in scientific knowledge, but we also know that we in the Navy are the ones who will be called upon to operate the creations of that knowledge.

Push-button war is, I believe, an unfortunate term because it gives the layman the idea that modern war is a simple affair. Guided missiles, rockets, and jet engines are complicated devices which only highly skilled technicians and trained engineers can operate.

The day is past when a few specially educated and qualified officers could operate the fleet with the assistance of crews distinguished more for brawn than brains. The Navy of today must have alert, nimble-witted and better than average educated men in all ranks. The training and direction of such high caliber men will require leadership of the highest degree.

It is not necessary to define to this audience the words "basic", "applied", and "development" used in scientific work. We break a project into three parts: first, the search for new facts; second, the assembling of those facts to a point where something might result and; third, the development or the engineering phase to produce a piece of hardware. The first and second are the concern of the Office of Naval Research while the latter, the engineering phase, normally falls to the large material bureaus in the Navy.

Assume, for instance, that we want to know more than we do now about the energy level spectra of radioactive nuclei. The Navy, with all its facilities, is not equipped to undertake such research work, and does not have the Nation's outstanding experts in science in its organization. Therefore, we make a partnership agreement with, let us say, Professor Alan Mitchell of Indiana to undertake this work. The contract states, in effect, that the research facilities and brains of Indiana University will be put to work on the particular project under discussion, and that Navy funds will finance part of it on a non-profit basis, that progress reports will be sent to the Chief of Naval Research, and that findings may be published, if desired, through the usual scientific channels. Remember that we look upon these contracts as partnership agreements.

In other words, we do not want to control research. We want research to be free and untrammelled, unhampered by restrictions of military security, or any other restrictions, free to pursue new knowledge in the researcher's own surroundings, where, by his own choice he can work best, and where his associates and associations are adapted to his special needs.

In actual fact, the vast majority of our contracts were proposed to us by the representatives of universities and not by us to them. As of October first the Office of Naval Research had over 90 basic contracts, more than 70 of which are with universities or other private concerns, the whole representing over 200 different research tasks. The contracts and research tasks range through the fields of nuclear physics, electronics, mathematics, geophysics, flight, propulsion, chemistry, medical sciences, physics, mechanics and materials.

In Medical Science, tasks range through all the basic fields such as Protein Synthesis, Effects of Irradiation on Animal Tissues, Nutrition, Cancer Research, Rehabilitation of the Blind, Diet in Mouth and Tooth Deterioration, Isotope Research, Psychology, and many others.

It is easy for us all to see that a broad research program in medicine is not going to be limited in its benefits to Naval personnel alone. I hope that I will be here five or preferably ten years from now so that I can say, "I had some small part in that program," because I feel that the research partnership sponsored by my Office in medicine is going to be of inestimable benefit to humanity over all the earth, regardless of uniform, race, creed or color.

One of the important and interesting programs of the Medical Branch has to do with the Polar regions. Much work has been done in tropical medicine but little attention has been paid to the territory of the North where living conditions are as unusual and different from the major areas of our country as are the tropics.

One of the most urgent needs at the moment is the assembling all of the knowledge of the Polar regions into appropriate centralized form. An encyclopedia of the regions is being compiled. A master list of persons who know enough about the Polar regions to be classed as experts is being assembled.

We must obtain the basic knowledge needed to develop medical techniques, correct diets, efficient clothing, housing, and the other human needs peculiar to this tremendous section of the world. Any basic information which we obtain will be available to anyone in our country who can use it.

In some fields, other than medicine, the connection between benefits to people as a whole and the military are not so apparent, but a little reflection on the past turns up many such connections. It was basic research in radio wave propagation undertaken by the Naval Research Laboratory and others in the early 1920's, which led to long-distance high-frequency radio broadcasting which now gives us round-the-world on-the-spot newscasting. Going back further, the need for a domestically produced armor plate, led to negotiations between the steel industry, and the Navy with a subsidy for research and development being granted in 1881, which, of course, was a start toward the opening of our enormous industrial expansion.

If, in the future, metals or plastics are developed through Naval research that will withstand temperatures now unheard of, those materials will benefit civil enterprise in the same way they do the military. Lighter weight power plants improve the efficiency of industrial machinery quite as much as they do the Navy's. It may well be that the advances in atomic energy uses and the discovery of new properties of metals will of necessity go hand in hand. Without science we cannot expand the frontiers of new knowledge.

Let me briefly indicate some of the projects underway here in the middle west. At Notre Dame, the rearing of germ-free animals being done by Professor Reyniers, and grain growth in metals by Dr. Beck; at Chicago, high speed X-ray technique by Dr. Hodges; at Illinois, studies on high blood pressure by Dr. Wakerman, studies of aromatic fluorides by Dr. Reed and Dr. Finger, metal fatigue and critical studies of methods of selecting materials by Professors Wilson, Dolan and Newmark; at Ohio State University, investigation of new high calorimetric

methods; at Michigan, mathematical studies in connection with guided missiles work by Drs. Kaplan, Copeland and Thrall; at Northwestern, psychomotor skills by Dr. Seashore, fundamental work on basic differential equations by Dr. Stutzman; and at Purdue, studies in jet propulsion. There are many more about to get underway which would take several pages to enumerate.

Looking ahead to next year the program will go into studies of inorganic, high energy fuels, as well as the physics and chemistry of surfaces. We want to know more about sun spots. We want investigations to determine heat transfer coefficients and related problems at high Mach numbers and the studies of the fundamental mechanical properties of solids in terms of the forces between component atoms. We want a broad theoretical nuclear research program based on the study of elementary particles and their interactions, the study of nuclear reactions, and the study of the structure of the various nuclei. We need to know more about acoustics, especially ultrasonics. These are only a few of the future plans and needs.

You have probably been wondering how the small college can participate in this research program we have been discussing. An examination of the program will show that we already have both large and small colleges participating. In some cases, the larger institutions were ready sooner than the smaller. We have avoided paying for facilities except where such a facility did not exist in the country, or where what few there were, were heavily over-taxed. We have always desired to place several speculative projects in untried or untested places. We feel the gamble would yield results. It would certainly include the small colleges. The small college can also take advantage of sub-contracts with larger neighboring institutions, since the large university may need facilities and personnel to assist them in certain phases of a program. Such arrangements are better for the small school because the business arrangements can be made simpler for them than by dealing direct. It may well be that the small school faculties can get a far broader picture of over-all problems by devoting part of a year to a personal service contract with our Office. I guarantee their vision will be broadened and their thoughts stimulated. The furnishing of ideas is another method of helping. True, it may not be remunerative, but it can be of service to science. The facilities at the small colleges may not be adequate. The staff may not be adequate and yet I know from experience that each of you scientists obtains a great deal of professional satisfaction if you can present an idea and have it worked on even if by someone else. The important thing is to get the knowledge out where it can be used. I will mention another method, that is, to constantly pressurize the high schools to provide adequate science facilities for the young high school student.

The war, unfortunately, had the effect of depleting our reserve of scientific manpower. Dr. Vannevar Bush in his report to President Roosevelt entitled "Science—the Endless Frontier," puts the present deficit in trained scientists at 18,000.

The Office of Naval Research is of course vitally interested in remedying this deficit of trained research workers. Recently, working through the Science Service Organization there were selected in five major cities 110 high school students who showed promise as future scientists or were outstanding students. These boys were given trips to air stations and a cruise out to sea for a period of four days. This was a program of encouragement, not to join the Navy, but to adopt a scientific career in order to build up our scientific deficit.

Strange as it may seem we found that we did not have to provide an incentive to become interested in science. The complaint of the boys themselves was about their schools and the science courses being offered them. I point out to you men and women a great many of whom are in the educational field, that you must take the lead and see to it that the high schools in this area have appropriate scientific courses for those boys who have a scientific bent. Some day they will become your students and only by giving them the opportunity that they ask can we hope to build up sufficient numbers of scientists in this country.

The Academy is particularly suited to lead in this important field of service. Indiana is fortunate in having a distribution of highly reputed colleges which blanket most of the State. These colleges are not only centers of formal higher education but exert wide influence on the diffusion of knowledge to the total population of the area they serve. Three methods occur to me by which your colleges may stimulate the improvement of science instruction in secondary schools and larger enrollments in science courses. These methods are not new. They are: first, the Science Day at each college; second, meetings for high school science instructors; and third, the Science Club movement in secondary schools.

A number of colleges have found that a Science Day for high school students and their parents makes the challenge of science real and personal to them and provides an incentive to young people to embark upon the serious study of science.

We all recognize that the level of science instruction in secondary schools needs to be greatly raised. Local colleges can make a direct and immediate contribution in this direction by arranging occasional meetings for high school instructors three or four times a year. At these meetings the problems of teaching high school science can be discussed, simple demonstrations presented of the type which these instructors can use in their own classes with the equipment available to them, and demonstrations and lectures on some of the newer developments in science which will stimulate these teachers to more adequately prepare themselves with graduate study in science fields.

The Science Clubs of America movement offers a means of keeping high school students actively at work in the study of science and the pursuit of science hobbies. These clubs can be fostered by Academy members and the science facilities of the colleges of your State, by furnishing speakers who may be faculty members or graduate students, by loan of exhibits, models, demonstration kits, motion pictures and the like for use in science club meetings.

The Office of Naval Research is particularly interested in cooperating with the Academy of Science in doing what it can to assist in this important project of attracting the best young minds to careers in science, and aiding the colleges to develop these young people into our most able research scientists of tomorrow.

We are also interested in the fastest way to train men, to what type of appeal does the mind most readily respond, and why? Also, what qualities of mind and body contribute to leadership? Ohio State University is doing research work on leadership under a Navy contract, the results of which should prove of interest to executives in all walks of life since the need for leaders is certainly not restricted to the Navy.

Is the uniform dominating science? Far from it. By law the Navy has a Research Advisory Council composed of outstanding scientists, ten of whom have been appointed by the Secretary of the Navy. They are Dr. L. A. DuBridge, Drs. Karl T. and Arthur H. Compton, Mr. Richard J. Dearborn, Dr. Detlev W. Bronk, Dr. William S. McCann, Dr. Philip M. Morse, Dr. Warren Weaver and Rear Admirals Lewis Strauss and Luis de Florez, U.S.N.R., now on inactive duty. It held its first meeting in Washington on the 14th of this month. This Committee will assist in coordinating the Navy's research program and will advise the Chief of Naval Research and the Chief of Naval Operations on research matters. It is hard to believe that such a committee would permit the Naval service to dominate and hamper scientists and to so control science that there might be a future danger as to trends in these fields.

There has been so much comment recently to the effect that the military arms are taking over science that I hope I will be forgiven for dwelling on the subject. As I said earlier, in the basic work sponsored by the Office of Naval Research, the scientists are free to work as they choose in their own laboratories.

It seems to me that who provides the funds for research work is immaterial. The important point is that the work is being done. Fundamentals are fundamentals. No one can guide those discoveries or the trends which they may take.

The Navy is in favor of the proposed National Science Foundation and we feel that if and when such an agency is set up it will certainly take over some of the programs now being sponsored by us. In addition, a National Science Foundation would make available a central agency for the assembling, indexing, and storing of research information which would be available not only to the military service but to all. Any knowledge we may have gained in the meantime will of course find its way into this national research storehouse. I strongly suspect the Foundation will pattern its policies and organization along the same channels that we have started, but let's not forget that the Navy will always have to participate in science because only in participating can it understand science and utilize the fruits that it provides. Even with a National Science Foundation the Navy still has the responsibility of preparing the Navy for national security.

Many people do not realize that during the war years, we were withdrawing from our bank account of fundamental scientific knowledge

without making any deposits. And the bank of knowledge is one from which it is impossible to overdraw. That bank account must be brought to the point where it is the greatest depository of scientific knowledge in the world, and so maintained. The Office of Naval Research, through its partnership with scientists, is helping to restore our bank account and we hope not only to continue to help but to accelerate our rate of deposits. We believe that each new piece of knowledge put in the bank will stimulate more new thinking, which in turn, will stimulate more, and so on. In other words, this bank account will draw a high rate of compound interest.

It is my hope that I have given you an idea of the scope of the Navy's basic research program, the largest Federally-financed research program ever undertaken in its history. More important, I hope I have shown you how we are operating, and why. Who we want as partners, and why it was vitally necessary for us to get this program underway at the time we embarked on it, more than a year ago.

We are, I believe, all agreed that the seeking of new knowledge in this country must not slacken. Therefore, the details for whom the work is being done are not important as long as all of us interested in scientific research understand the problems involved, and understand each others' aims and ideas. Such meetings as this provide invaluable opportunities for such understanding.