

program of science instruction supported in a unified way by scientists throughout the nation. The large educational and biological societies of America have the opportunity and the obligation of leadership in placing the judgment as well as the talent of science and biology at the disposal of the nation in peace as it has been in war.

To be effective in the implementation of biological programs, however, we now need a unified and aggressive parent organization, one which recognizes that many small societies are necessary for professional specialization but which compensates the diminishing social effectiveness of small groups by their

affiliation with a large assemblage of biologists with certain common needs and purposes. Unification of small groups on the basis of mutual interests which transcend specialization in biology is the basis of professional prestige and scientific effectiveness. As scientists, we owe it to ourselves and to the nation which supports us to organize on a comprehensive basis for the early formulation and rigorous implementation of programs for pure and applied biology in institutions throughout the nation. Our schools, government and industry stand ready to consider any educational program for science and biology which represents the consensus of scientists themselves.

## POST-WAR MILITARY RESEARCH<sup>1</sup>

By Rear Admiral J. A. FURER, U.S.N.

COORDINATOR OF RESEARCH AND DEVELOPMENT, U. S. NAVY DEPARTMENT

I AM glad of the opportunity to address the Industrial Research Institute on the subject of "Post-War Military Research" because I believe that you, as an organization and as individuals, can play an important part in the work that should be done during the peace period following this war to develop the weapons for the next war. You will note that I did not say, "If we should ever again be called on to fight another war." That was the customary phrase used after World War I in speaking of anything connected with preparedness. I think that Americans are now ready to face the fact that the war to end all wars has not yet been fought. I believe that the country realizes that we have had a very close call and that we must never again take the chances which we took after the last war.

The Secretary of War and the Secretary of the Navy, some months ago, requested Mr. Charles E. Wilson to head a committee, consisting of four scientists, four representatives of the Army, and four representatives of the Navy, to study the subject of post-war research and to make a report on how best to keep military research in the forefront of national preparedness. Frank Jewett, president of the National Academy of Sciences, Karl Compton, president of Massachusetts Institute of Technology, Jerome Hunsaker, chairman of the National Advisory Committee for Aeronautics, and Merle Tuve, of the Carnegie Institution, were the scientists on this committee. General Echols, of the Air Forces, General Waldron, of the Ground Forces, General Weaver, of the Service Forces, and General Tompkins, director of the Special Planning Division, were the Army representatives. Rear Admiral Cochrane, the chief of the Bureau of Ships, Rear Admiral Hussey, the chief of the Bureau

of Ordnance, Rear Admiral Ramsey, the chief of the Bureau of Aeronautics, and I, as Coordinator of Research, represented the Navy. We have made our report, and I believe you will be interested as much in the considerations which led the committee to its conclusions as you will be in the recommendations which were made.

In attacking the problem of how best to keep post-war military research in the forefront of national preparedness, we began with the assumption that the Army and Navy must continue to carry the major responsibility for such work, especially in times of peace. The Army and Navy are employed to do just that job, and it is hardly conceivable that the country, and Congress as representative of the country, would be willing to relieve the Armed Services of that responsibility. Experience with the Office of Scientific Research and Development during the past four years has, however, demonstrated that scientists in civilian life when given the opportunity are capable of making outstanding contributions to the invention, development and operation of all manner of instrumentalities of war. In other words, that a scientist need not be a professional with years of experience in the armed services, in order to contribute effectively to the solution of the many problems that confront the Army and Navy in making war. Obviously the Government can not, after the war, continue to employ on military research all the scientists who were mobilized under the Office of Scientific Research and Development for such work during the war. The great majority of these men would not even be willing, after the war, to devote their time to work of this kind. Nevertheless, it is our belief that a way should, and we hope can, be found to keep the country's outstanding scientists interested in military research after the war, so as to give the Army and the Navy the continued benefit

<sup>1</sup> Address before the Industrial Research Institute, Atlantic City, October 6, 1944.

of their thinking and of their assistance. The essence of the plan we have recommended is, therefore, to make the highest level of scientists in the United States available to the armed services in time of peace as consultants, planners and collaborators on military research.

The committee decided that the best device for carrying out this plan is a permanent board composed of civilians of distinction in science, engineering and industry, and of officers of the Army and Navy who have important responsibilities in connection with research and development work. We already have a precedent for a successful agency of this kind; namely, the National Advisory Committee for Aeronautics, which has for almost thirty years rendered invaluable assistance to the War and the Navy Departments in dealing with the scientific problems of aviation.

The principal objection to a board of this kind is that it must be rather large in order to be representative of all the technical services and bureaus in the War and Navy Departments having major responsibilities for research. A large board is always unwieldy. Nevertheless, without complete technical representation, the Armed Services are likely to lose interest in this form of assistance and there will not be that close and active liaison between the Services and the civilian scientific world which has been found so valuable during the war. The civilian representation must also be adequate to provide a cross-section of high-grade talent for the formation of subcommittees as policy advisers and collaborators in the many fields of science that are involved in modern warfare. In order to offset the working handicap of a large board, a small executive committee is proposed which, acting under general rules made by the committee and approved by the board, will administer and supervise the activities of the board.

The executive committee might consist of as few as five members; namely, three civilians, one of whom would be the chairman of the board, and of one Army officer and one Naval officer actively engaged in the coordination or general direction of research and development in the War and Navy Departments, respectively. It is proposed to have the civilian members of the board selected by the president of the National Academy of Sciences, acting with the advice of the council of the academy.

The importance of prestige in persuading qualified men to give their time to public service is generally recognized. Sponsorship by the National Academy of Sciences we believe carries with it the maximum in the way of prestige as no body of men in the United States ranks higher for integrity, talent and individual achievement than the members of the academy. The president of the National Academy will

have a heavy responsibility in making the right selections. It will, perhaps, be even more difficult to persuade those who are selected as the best qualified to accept appointment on the board. It goes without saying, of course, that civilians appointed to the board will not be restricted to academy members. Whether the right kind of men can be kept interested and can be persuaded to devote time to the problems of national security after the war on a board of this kind is the question that will spell either success or failure for the plan. Just as in the research laboratory itself, where no scheme of organization can ever dispense with talent, thorough basic training, individual curiosity, and individual initiative—so in the broader field of overall planning and collaboration by such a board the individuals are more important than the organization.

There are two ways of creating such a board. It can be set up under the charter of the National Academy of Sciences or it can be established as an independent agency by Congressional legislation. The composition and method of selecting the personnel of the board, its organization and the general procedure for its operation would be identical under either arrangement. The difference between the two lies principally in the method of financing the research work which will be carried on by the board. Such a board can be set up under the National Academy immediately by request of the Secretary of War and the Secretary of the Navy, whereas a good deal more time will be required to set up an independent agency because of the normal delays in getting legislation through Congress.

As many of you no doubt know, the National Academy does not obtain money direct from Congress. Its administrative overhead expenses are defrayed largely from the income received from private endowments. The cost of any work which it does for government departments is covered by transfer of funds from the appropriations of such departments to the academy, based on formal contracts entered into between the two. The academy as such would exercise no control over the purposes for which the board would spend its money, nor over the manner in which the expenditures are made. Its function would be to pay the bills out of the funds received from the War and Navy Departments. The academy would, in other words, do the housekeeping for the board. The fact, however, that the board under this arrangement would be dependent for its funds on the annual Army and Navy appropriation bills might result in reduced appropriations for research in future years when recollection of the war has receded in the memory of the public and of Congress. There will probably be no lack of money for military research for a number of years after the war, but if the past is any guide

to the future, a period of retrenchment will again set in which will affect research as well as the other items in the budgets for the Army and the Navy. It may be that an independent agency will be in better position to obtain money direct from Congress than a board whose funds must be included in the annual appropriation bills for the Army and the Navy.

There would be some advantage in postponing legislation for an independent agency until we have had a few years of post-war experience with the more flexible and easily modified or discontinuable form of setup such as the academy's charter permits. Any plan for an independent research agency taken up with Congress now may also find its place in a group with similar post-war plans and might come out of Congress in a form unacceptable to those charged in the Services with the development of combat equipment. It seemed wise to take account of all these factors and to recommend a plan which so far as possible would protect the post-war planning of research from the various vicissitudes to which new organizations of this character are always subjected. The Wilson Committee, therefore, recommended that the National Academy of Sciences establish immediately a Research Board for National Security along the lines that I have described and that at the same time Congress be requested to establish the board as an independent agency in accordance with the draft of a bill prepared by the committee. The board can be transferred bodily from the National Academy to the independent agency as soon as suitable legislation is obtained. This places the War and Navy Department in the sound position of not having to accept legislation that is not suitable, as the board can carry on under the National Academy until satisfactory legislation is obtained.

The suggestion has been made that a board or agency of this kind is needed to take over the unfinished business of the Office of Scientific Research and Development when that organization goes out of existence at the end of the war as contemplated by the law under which it was created. This is the least of the reasons for setting up such a board. In fact, we believe that the board will inherit only a very small part of any unfinished work that is left by the Office of Scientific Research and Development. I may mention in passing that the plans for the winding up of the Office of Scientific Research and Development contemplate that practically all its short-term projects will be completed before it closes up and of the things that are not completed the cognizant service in the Army or the Navy will either take over the contracts with the laboratories actually carrying on the work or will absorb the work into their own laboratories. There will be a small residue of long-term activities,

some of which may possibly be taken over by the board.

As to actual research, we visualize that the board will concern itself principally with long-range, continuing projects, particularly those not falling under the cognizance of any one technical activity of the Army or the Navy; in other words, largely with exploratory work leading to specific research. The normal development and improvement of weapons and countermeasures will continue to be the responsibility of the Armed Services. There may, of course, be calls from the Services for help on specific problems just as the Office of Scientific Research and Development has been called on by the Services during the war to work on specific problems pressing for solution. Long-range continuous explorations having no particular service sponsorship will demand attention especially in connection with research on the frontiers of science.

Perhaps a hypothetical case will illustrate what I mean. Expansion of the field of operations in warfare has been due largely to the extension of the range of two of man's senses; namely, the sense of sight and the sense of hearing, and to the great increase in the speed of moving men and materials from place to place. Development has pressed along these lines because distance is the greatest natural defense against an adversary in battle whether the adversary be an individual or a group of individuals such as an army or a fleet of ships. The evolution of many weapons and countermeasures to weapons has therefore been in the direction of increasing their range. This has in turn resulted in various inventions to extend the range of man's senses of sight and hearing in order to maintain contact with the adversary. The senses of touch, smell and taste have not to any great extent entered into the warfare between humans, but they play an important part in the struggle for existence between animals of the lower orders. If a discovery were made radically increasing the sensitiveness and range of man's senses, such a discovery would be immediately explored by the board to ascertain its applicability to war problems as no one technical service in the Army or the Navy might have the talent or the desire to take up such an investigation. Another hypothetical case that suggests itself would be the discovery of some phenomenon in a band of the electromagnetic spectrum which is at present relatively unexplored but which might have important military applications on further study. This also would be a logical subject for exploration by the board.

To come down to something more immediate and practical—intensive interest is at present being taken in jet propulsion. There are certain fundamental aspects of this subject which need a great deal of intensive research. Such basic exploration may

benefit any number of technical branches of the War and Navy Departments. A board such as we visualize would be in better position than any of these technical services to attack the problem in a comprehensive and well-coordinated manner. It is quite probable that some of the tasks which the board should undertake will require years of continuous high talent research.

In this connection, I wish to mention a conclusion reached by the Wilson Committee, *viz.*, that such a board should not operate laboratories of its own but should have its research done by contract with existing organizations. This for several reasons, the first and most important being that operation of its own laboratory or laboratories would almost certainly narrow its field of interest. We believe, however, that the charter of the board should be broad enough so that it can, if necessary, establish laboratories for specific purposes and then turn them over to an appropriate agency for operation. This to cover cases where there are no suitable facilities available for carrying on special work.

So much for the purely scientific work which we believe the board will do. There are many other problems which may be broadly termed the human relations problems, which such a board should study and on which it should advise the Services. For example, a study should be made of the kind of problems which pressed for immediate solution when we entered World War I and World War II—the kind of machinery which was available to solve the problems and the additional machinery that was found necessary. Were the steps taken satisfactory? Are there any lessons to be learned from these experiences which can be applied to the next emergency? It can be assumed that no matter how much advance planning is done, no democracy will ever be completely ready for a war. Only the totalitarian nation, preparing for a war of aggression, can be ready for every eventuality before the war begins.

A study should be made of the incentives that motivate scientific and technical men, and appropriate mechanisms should be worked out to provide these in-

centives. This is a very broad field and includes the financial rewards of scientists in Government service as compared to the rewards in private life. The question of restraints imposed on laboratory workers as compared, for example, to the mechanics or the white collar worker should be studied. The relationships between scientists in the laboratory and operating personnel in the field are deserving of study, especially the relationships between the professional officers of the Army and Navy and the civilian scientists. The degree to which the parallel attack under independent direction is desirable, especially in so far as it affects the morale of the laboratory worker, is deserving of much thought.

In conclusion I want to mention the great personal interest that the Secretary of War, Mr. Stimson, and the Secretary of the Navy, Mr. Forrestal, are taking in post-war military research. There is a growing belief that important as it may be to maintain after the war ground forces, air forces and sea forces of a size commensurate with our national responsibilities, it may be even more important to keep the weapons and the matériel in general which we supply to these forces in step with the advances of science. Stocking our arsenals with the weapons of this war is no guarantee that we can win the next war with them. In fact, that may be the quickest way of losing the next war. It would be wiser to maintain arsenals of only modest size whether we are speaking of ships or guns or aircraft and to use the money saved thereby to continually replace the old things with the new creations of the research laboratory and of American inventive genius. Our industry should be kept alert to begin quickly the production of the vast quantities of materials needed when war threatens; and this readiness should concern itself especially with the new things. We hope for your aid in supporting this position among those who are engaged in research. No matter what organizational mechanisms may be provided to bring this about we should adopt the policy and adhere to it that expenditures for research must henceforth be a substantial part of our peace-time preparedness program.

## OBITUARY

### CHARLES B. LIPMAN 1883–1944

CHARLES BERNARD LIPMAN, professor of plant physiology and dean of the Graduate Division in the University of California, died in Berkeley, California, on October 22, 1944, shortly after he had suffered a heart attack. He was a distinguished biologist, an esteemed teacher, a successful administrator and a felicitous writer, whose stimulating influence on botan-

ical science and on graduate study in all fields was far-reaching.

When he joined the staff of the University of California in 1909 he was associated with the late Professor E. W. Hilgard and devoted his chief attention to soil bacteriology, a subject in which his brother, the late Jacob G. Lipman, of New Jersey, was also interested. He was appointed professor of soil chemistry and bacteriology in 1913, dean of the Graduate Divi-