The following article is the text of an address given by Commissioner Smyth in Cleveland on December 28, 1950 at the 117th Annual Meeting of the American Association for the Advancement of Science.

The Stockpiling and Rationing of SCIENTIFIC

ON December 16 the President declared a state of national emergency. Such a declaration, and the facts behind it, naturally influence all our present thoughts and plans. Some of us are filled with emotion and can think only in terms of immediate action. This is not good enough. Regardless of the outcome of the situation in Korea, this country now faces the necessity of planning not only for the coming months but for the coming decade and the decade after that. We may not have to fight a full-scale war. We profoundly hope that we shall not. But we know now that we must prepare to resist aggression with all our strength for the foreseeable future. We shall have to increase greatly the armed forces of this country, using our material resources and our manpower in the wisest possible way. In every aspect of civilian life the first concern of each citizen must be the long-range value to the country of what he is doing. In the period ahead of us, no citizen can be deferred from national service in this sense.

It is not good enough to boast that we will fight for freedom. We must think for freedom, and this is much harder. As we prepare for possible war, we shall inevitably have to delegate increasing authority over our lives and actions to the national government. At the same time we must be vigilant to maintain our fundamental rights of independent thinking, criticism, and free discussion.

The Dangers We Face

It has become clear that our survival is at stake. Not just our material survival, but our survival as a society of free men and women. If our cities are destroyed, we can rebuild them. Our spiritual destruction would be still more fearful. It is not numbers, nor buildings, nor wealth that make a people great. It is their freedom and their vigor. We might lose our freedom, we might even lose our passion for it. This could happen through armed attack and conquest by our enemies, or it could happen from our own stupidity and short-sightedness. If we are forced into a major war, we must remember that armed victory is only a means to an end and that the years after the war gauge the reality of victory. If the methods we use to win a military victory should destroy our moral position in the world, or

MANPOWER

By ***Henry D. Smyth***

our own self-respect, or change our free society into a totalitarian one, we shall not have won the war. On the other hand, if our hatred of war and our desire for peace lead us into the acceptance of an alien and barbaric conqueror, we shall have lost more completely. We shall then have given up our freedom and be the serfs of a police state imposed by men who neither understand nor respect the ideals that have made us great. These dangers are real and must be faced squarely. I believe we shall overcome them.

A third danger remains. We may be drawn into a war for which we are not adequately prepared and we may fight it less skillfully than it needs to be fought. It is to one phase of this specific danger that I want to address myself today.

Scientists as Tools of War

Men of science, traditionally peaceful, internationally minded, and nonpolitical, have become a major war asset. It is important that they be used to the greatest advantage. Therefore, I am asking you as representatives of science to consider carefully how you and your fellows can be most useful to our country in the years to come. I believe that we are facing dangers so great as to make the comfort and convenience of any group trivial in comparison to the contribution such a group can make to our survival. For that reason, I have chosen a somewhat grim title for this speech—"The Stockpiling and Rationing of Scientific Manpower". For that reason, I am speaking of scientists not as men who enrich our culture but as tools of war needed for the preservation of our freedom. I hope you will understand why I am willing to consider the group to which I belong in this objective and impersonal way.

Twenty Years of Tension

To plan the stockpiling and rationing of any war commodity requires some assumption about timing.

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If we are discussing how scientists can be used most effectively as tools of war, we must ask when such a war will be fought. This is a question Americans cannot answer with any exactness, for we will not be the aggressors. But it is now clear that if the free society of the West is to survive, we must be prepared to meet at any time a large-scale attack upon us or our allies. It may come soon or it may not come for years. In considering scientific manpower as a major war asset of this country, I assume a twenty-year period of tension with the possibility of major or minor wars occurring at any time in that period. This is indeed long-range planning, but the events of the last five years have forced it upon us. We must now face these realities with courage and intelligence.

Nature of Total War

The forces involved in a future war will be as important as timing. In every war this country has fought for the last hundred years, we have been able to crush our enemies by sheer weight of numbers and materiel. It is unlikely that we can do so again. In any future war we shall probably be outnumbered, and by men who are physically tougher than we are. Our natural resources may be no greater than those of our enemies. We may be fighting with much longer and more vulnerable lines of communication. We shall win only by being cooler, cleverer, and more skillful than our enemies, and by using the resources at our command with foresight and judgment. We must understand the nature of modern total war. Every citizen will be involved in it, whether he is in or out of uniform. We must get over the idea that men in uniform are automatically more valuable than the same men in civilian clothes. The men in uniform may be in greater danger, though even this is doubtful in view of the large number who are never in combat and the probable dangers to a civilian population in a future war. Each man's usefulness should be the sole criterion of his value to his country.

Use of Scientists in Preparation for War

On these assumptions as to the timing and nature of a possible war, how shall we best use our scientific manpower? First of all, let me say what I mean by scientists. For purposes of this discussion, I mean men who have had at least some graduate study (or equivalent experience) in the physical or natural sciences. This definition arbitrarily excludes most medical men and engineers, although much of this discussion applies to them also. Of course their value is comparable, but the problem of their use differs enough in detail to require separate treatment which I will not attempt at this time.

Based upon our experiences in World War II, I believe we can say that science contributes to our effectiveness in war and preparation for war at six levels. First of all, scientists are needed to provide fundamental knowledge, adding to our basic understanding of the laws of nature. In World War II, for the first time in history, we pushed our development of weapons close to the limit of our basic knowledge. Discoveries in science less than five years old were put to use in the atomic bomb and in other weapons. This may happen again, but only if there is new knowledge to put to use. Basic research is so near the forefront of knowledge that no specific use can be foreseen for any part of it, nor can it be specifically directed. But if there is doubt in anyone's mind about the military value of work of this sort, it could be set at rest by the Atomic Energy Commission. If secrecy permitted, I could cite examples of postwar research in basic science that have already been put to use in our weapons program.

The second level where science is essential is intermediate between what is clearly basic research and what is clearly development. At this level possible utility is borne in mind in a general way and may dictate a choice of field but not a choice of problem. An example of this level is the study of certain areas of organic chemistry by chemists working for a plastics company or the study of ferro-magnetism by the physicists of the telephone company.

A third level of scientific usefulness is in applied research where a specific question is posed and an answer sought. The development involved may be that of a new chemical process, a new material, or a new weapon, but always to meet a specific need.

The last stage in development work and a fourth scientific level is testing of prototypes under field conditions and getting into production. The amount of labor and ingenuity required in this last stage is often very great and the cost correspondingly so.

Once new weapons are produced, they must have operators. Generally speaking, scientists are rarely required as operators, but experience in World War II proved that they were needed to instruct operators. They were also needed to inspect the actual use being made of weapons in the field so as to understand weaknesses which should be corrected and to explain the capacities of the weapons to their

military users. This work constitutes the fifth level where scientists are valuable.

Finally, but of great significance for a prolonged crisis, we must have new scientists educated. The education of a new generation of scientists cannot be done quickly. They must have a minimum of four years' special training, and in many cases ten to fifteen years of training and experience. To produce such men, we must continue to have teachers and universities.

Neither Business Nor War as Usual

These are the jobs we have to do—all of them necessary if the country is to excel in the techniques and weapons of modern war over the next twenty years. All these levels of work have been carried on during the last five years of peace. In the period now facing us, we can expect only to shift the emphasis or to increase the effort, or both. Some peacetime activities can perhaps be curtailed. These are most likely to be found in the middle of the spectrum that ranges from basic research to weapons development. For example, work on improvements of nonessential industrial products or processes certainly could be curtailed. On the other hand, applied research on weapons or on industrial processes bearing on weapon production needs to be accelerated. Vast sums of money will be available to the Services for research and development. I hope this money will not be squandered on doing things in triplicate or on hiring able scientists for pet projects that have little bearing on either science or war. Money does not create brains, nor the expenditure of millions of dollars alter the laws of nature. Our ignorance of these laws is still so great even in advanced fields like nuclear physics that basic research must go on. On the time scale I have suggested, our success in basic research is necessary to our survival.

All this adds up to slight curtailment and considerable expansion. It may sound as if I were recommending business as usual. I am suggesting that we cannot have war as usual. We cannot win another war by a mere outpouring of men and resources. We can only beat our enemies by being much brighter, much shrewder, much cooler, and more farsighted than they are. We must use our weapons and men more skillfully than they. In particular, scientific men are important because the novelty and effectiveness of our weapons depend on them. If we are to expand our scientific efforts, we must examine closely our stockpile of scientific manpower.

Present Scientific Manpower

Have we the scientific men we need? If not, can we get them, and how can we best use them? I could quote to you statistics that have been gathered by many painstaking studies in the last few years. These statistics show we do not have the men we need. But the lack is obvious even without statistics. We trained almost no scientists between 1941 and 1946; and since 1941, needs have developed like that of the Atomic Energy Commission which now employs directly or through contractors as many physicists as there were in the whole country in 1920. The lack is also obvious to anyone who has recently been trying to hire first-class senior scientists. Therefore, I will omit statistics at the risk of being considered unscientific by those who believe numbers less fallible than words.

Can we do anything in this period of emergency about the shortage of scientific personnel for war work? As I have suggested, some diversion from present industry is possible. For example, I will venture to single out two areas that might supply scientists. I suggest that most of the chemists from the cosmetics industry and most of the physicists from the television industry could have their abilities used in ways that would be more likely to insure the survival of this Republic. In such industries as these, a fair number of qualified senior scientists could be found and a considerably larger number of men who could work under direction.

Yet it is clear that taking men from industry will do little or nothing to strengthen the basic research which will continue to be vital. Nor will it furnish very many senior men capable of directing bold and imaginative work in weapons research itself. Evidently, there is such a shortage that each man must be used wisely and more men must be trained in science by holding many students and teachers in universities.

The problem then is clear and has two parts. First, to use the scientists we have as effectively as possible; second, to train more. Before making some suggestions for the solution of these problems, it may be well to review how we tried to meet them between 1940 and 1945.

Experience in World War II

Dealing first with the question of use, let us recall what happened during World War II. It is easy to say that we misused our scientific talent in that war. I hardly think that is a fair statement but certainly better use could have been made of them.

Among the older men, recruitment for various projects was usually carried out by a kind of chain letter system. The initial group brought in men they knew. These new men brought in their friends, their former students, or other scientific acquaintances, and so on. Had the supply been unlimited, this would have been an excellent system. In practice, however, different projects soon came into collision so that individuals had to choose between offers from different laboratories without having the necessary information to make the choice wisely. Not infrequently the advice of the top people in the Office of Scientific Research and Development had to be sought. Except insofar as it was counteracted by OSRD, this system tended to strengthen projects that had started early and were already strong. Vested interests were built up and it was difficult to man new projects or to deflate projects when they had essentially completed their missions.

This system also had the disadvantage of stripping men from universities and stopping basic research almost completely. Quite apart from the removal of students by the draft, it was psychologically almost impossible for a man to continue basic research, since there was no one to tell him it was important and the recruiting officers of every war research project were continually telling him it was not. In the scientific community, the last war began in the summer or fall of 1940, but full mobilization was not reached until sometime in 1942 and lasted only about three years. Nevertheless, its effects on training and basic research were very serious. In the period of sustained tension that may now be facing us, effects of the kind I have mentioned could be disastrous.

I have been referring to the scientists who were used as civilians in various war laboratories of the OSRD or the Services, men who were above draft age or whose deferment was relatively easy to obtain. For the younger men, the situation was much more unsatisfactory. Either they were deferred by a process often painful and temporary or they went into the Services.

When young scientific men were drafted or volunteered, they became enmeshed in a system designed to train and use men for combat. This is no place for me to discuss the wisdom of using military uniforms and ranks for the many jobs a modern war organization has, in which the work to be done is much more like civilian work than it is like fighting. I can only say that a research laboratory is probably the most inappropriate place in the world to have military organization. Fortunately, ordinary common sense usually came into play in laboratories such as Los Alamos where there was a large detachment of soldiers who were more familiar with slide rules than guns. The men were given positions and responsibilities determined by their scientific qualifications regardless of their scale of pay, or the color of their suits, or buttons. This is one reason our war laboratories produced results.

In general, the Services did try to use men of scientific background in places where their training was appropriate, but there were many cases where such men were entirely wasted and many more where they could have been used more effectively. The Selective Service System was not designed with this objective in mind and could hardly be expected to function successfully.

On the whole, we can find little satisfaction in the methods of using scientists of any age in World War II. As for stockpiling, it practically stopped. Almost no new scientific men were trained between 1940 and 1945. In preparing for a possible future war, we must do better.

Danger of Regimentation

When one tries to work out solutions of this scientific manpower problem, one immediately runs into a contradiction. It is a contradiction inherent in the nature of a free society and perhaps accentuated in the particular section of society made up of scientific men. Free men cannot be treated like inanimate tools. They will do their best work if they retain initiative and responsibility, and this is above all true of men doing scientific research. We cannot have completely centralized government control of science without losing much of the strength we are trying to preserve. At the same time, the country has a right to expect that young scientists of military age will be as much at the command of their government as other young men of the same age. If we are to avoid the mistakes of the last war, we must propose a positive kind of service to replace the policy of deferment for young men in scientific work. No course of action to accomplish this will seem attractive to men used to complete freedom of choice, for science—like other fruitful products of men's minds—has known its best fulfillment in the free atmosphere of peace. But today we face a possible struggle for survival and so our first concern as scientists must be to ask how we can serve this country, and to accept whatever plan seems to fulfill that purpose. I urge you to listen carefully to the suggestions I shall put forward, and to improve upon them. They are not original with me, but I am responsible for the form in which I present them.

Proposal for a Scientific Service Corps

I propose the establishment of a Scientific Service Corps directed by a Scientific Manpower Board and based on a national roster of scientists. These organizations would be concerned only with scientists who have completed their education, not with students. Nevertheless, two categories are concerned: men of military age, normally subject to call for military service, and older scientists. Both categories would be under the general supervision of the Scientific Manpower Board and both would be listed in the roster. At present, only the scientists of military age would be required to join the Scientific Service Corps, and only the members of this Corps would be subject to orders from the Scientific Manpower Board. For older scientists the Board would act in an advisory capacity only.

This Scientific Service Corps would be a civilian organization without ranks or uniforms. I believe it would be most effective if it were guided by that curious mixture of cooperation and discipline that characterizes most civilian organizations in this country. The principal function of the Board in charge would be to get the right man in the right job and often this man's own judgment should carry great weight. The Scientific Manpower Board, although a civilian organization, would need to have real authority over the members of the Service Corps. It would need power to keep them out of the Army, Navy or Air Force, or to put them in. It should have power to return men from military to civilian service or vice versa, or to shift them from one project to another, or to return them to universities. But I hope that most of the orders issued by this Board would be merely formal endorsements of voluntary agreements. Cooperation will serve us better than force.

For scientists not in the Service Corps, the Scientific Manpower Board would act only in an advisory capacity. With information on the full scope of national defense research projects, it could be an invaluable guide for men who wanted to be sure they were making the best use of their abilities.

The Scientific Manpower Board should be responsible to the President, not to the Department of Defense. The quality, wisdom, and powers of this Board would be the key to the success or failure of the whole scheme. Their ideal should be guided cooperation with the scientists, not rigidly organized direction of them. The Board members and staff would require access to complete information on all technical and scientific phases of our military activities and of the supporting civilian economy. They would also have to know the scientific community—not just the names and numbers in a card file, but the men themselves. This suggests the need for regional branches of the Board.

Students

Turning to the question of stockpiling, that is, the training of new scientists, we have quite a different problem. Various schemes have been proposed for the deferment of students. Most such schemes do not make it clear that we are aiming at a positive goal, not a negative one. We are not interested in helping individuals escape the duty of military service just because they are bright boys or happen to have played with chemistry sets as children. We are interested in developing a group of men with trained minds and disciplined imaginations who can strengthen the country over the next twenty years. That some of them will be doing very nearly what they would choose to do in peace time is irrelevant except insofar as it may make them more effective.

Can we not have something more positive than draft deferment for brilliant students of science, medicine, and engineering? The continuance of their education in such times as these, implies obligation, not privilege. I propose a student scientific corps with enrollment beginning in the freshman year and continuing through graduate training. The requirements of native intelligence and industry in such a student corps would be high and the requirements of sustained performance higher still. Students who did not keep up would be continually weeded out. Men of excellent technical competence but lacking in imagination and originality would be carried only through their undergraduate training and then released to the armed services or to industry. Others would be continued through graduate training. Some recruits should occasionally be added to the student corps from the Services or industry or project research to receive more education.

Administration of this student scientific corps should be, it seems to me, decentralized as much as possible. Professors in the universities would be best fitted to take the responsibility of making judgments within the established criteria. No amount of statistical data, intelligence tests, or examinations can replace the intimate knowledge a university professor should have of his good students. The student scientific corps or training program or whatever it is called should perhaps be under the general jurisdiction of the National Science Foundation. Cooperation with the Scientific Manpower Board and with Selective Service would be essen-

tial but the problems are sufficiently great and sufficiently different to suggest separate authorities.

Effects of Universal Military Service

Although the programs I have discussed are intended to meet both short-range and long-range requirements for scientific manpower and are not meant to be dependent on the present system of recruiting under the Selective Service Act, they may appear in conflict with other proposed systems of recruiting for the armed services. One such system is the plan to put all eighteen year old men into military service. It is estimated that if these men were kept in service for two years, the country would have a total of three million men constantly under arms and would shortly build up a large trained reserve. Once their period of service was over, these men could feel confident that they could pursue their education and begin their professional careers without interruption unless large-scale war broke out.

The first effect of this proposal on the training of young scientists appears to be bad. All men now eighteen would defer their education two years with a corresponding interruption in the supply of engineers and scientists four to eight years later. To some degree these effects could be counteracted by acceleration or by special training of men still in service or by reduction of the length of service for obviously talented men. On the good side would be the smaller probability of interruption for men already started on their professional careers. In the long run, that is, the ten or twenty year period I have been talking about, these effects would largely disappear, with one exception: the dozen or so students of really outstanding brilliance who appear each year—and there are seldom more—might be lost to science or have their early and most productive years spoiled.

There is another danger. The young men who had been in service might be kept in some sort of reserve; in fact, they should be, or much of the point of their military service would be lost. However, they constitute a whole generation of manpower, the manpower that is needed for the innumerable civilian activities as essential to success in total war as the Army or Navy or Air Force. It would be wise to put the control of this reserve manpower in civilian hands at the highest level.

As to the use of mature scientific manpower, this 18–20 service proposal seems to have only secondary effects. It might relieve the pressure for direct military service on some of the younger scientists. In the long run, it might help stabilize the universities. It does not remove the need of a Scientific Manpower Board, a Scientific Service Corps, or a student corps. While I believe the Scientific Manpower Board should be vested with great authority from the first, the proposed military service for eighteen year olds might lessen the danger of too hasty and too arbitrary exercise of that authority.

Summary and Conclusion

I have tried to put before you the problems of stock-piling scientific manpower and rationing it, in the best interest of the country, just as we would any other essential resource. I have proposed for this purpose a student scientific corps to insure a continuing supply of scientists. For men of military age, I have proposed a Scientific Service Corps to be directed by a Scientific Manpower Board. For men above the age of military service, I have suggested widespread voluntary cooperation with the Scientific Manpower Board.

These may not be the best solutions to this problem, but they are possible ones. Any system to be established must obviously be flexible and subject to change with experience and with changing international conditions. Either the organization I have suggested, or a better one, should be set up now before we repeat the errors of the last war.

I believe there is real danger that nothing will be done or that a system will be set up and will fail. Scientists can best understand the nature of this danger. They know very well that a thoughtless bureaucracy with centralized control can threaten the independence, imagination, and clarity of mind needed for creative work. Scientists know also that a haphazard system of recruitment can lessen their value to the country. I suggest that the members of this audience and their associates throughout the country have a peculiar duty to work for the adoption of a sensible system for the wise use of scientific manpower, to talk to their friends of the need for such a system, and to make such a system work. You know what needs to be done. Give the foresight and leadership to achieve it.

Such questions as these cannot be left entirely to the government. They are everybody's business. What John Curran said in 1790 is still true:

> "It is the common fate of the indolent to see their rights become a prey to the active. The condition upon which God hath given liberty to man is eternal vigilance; which condition if he break, servitude is at once the consequence of his crime and the punishment of his guilt."