# Some thoughts on Science in t

*By E. U. Condon*

The following is an address given by Dr. Condon on September 25, 1951, less than one week before his resignation as director of the National Bureau of Standards became effective. His talk was prepared for delivery at the National Academy of Sciences in Washington.

AS MY NEARLY SIX YEARS of service as Director of the National Bureau of Standards draw to a close, it seems that an important final part of that service would be to set down some over-all views concerning the scientific work of the Federal Government growing out of that experience. Our governmental institutions are so close to us that I had some experience with them before entering Federal service full-time, especially during World War II, and likewise I expect to have association with such matters in the future while in private employment.

It seems to me that the scientific research activities of the Government are on the whole good but nevertheless, like all things human, capable of improvement, and it is to some suggestions for improvement that I will principally turn my attention.

The first general point I wish to make is the very obvious fact that the whole complex of modern material civilization arises from application of scientific knowledge. All modern engineering and industry, agriculture and medicine is based on the results obtained by consciously planned laboratory experimentation within the last three centuries, and largely within the last century. It is this new type of activity which has in the last century made greater changes in our material ways of life than have occurred in thousands of years before. The improvement of the conditions of life through the lightening of burdens by the development of mechanical power from flowing water and from fuels, the improvement of our homes and clothing by modern products of applied science, the more effective production of foods and the use of refrigeration for their large-scale preservation and wide distribution, the increased knowledge of nutritional principles, the improvement in all kinds of techniques of medicine and surgery—all these may be counted as great blessings to mankind resulting from the cultivation of science and its application to our material needs.

Even greater perhaps than all those material benefits, however, is the benefit that comes from the freeing of men's minds and spirits from the oppressiveness of superstitious belief and the growing realization that we live in a world of law and order that is intelligible to us if we will but discipline ourselves to the effort necessary to understand its structure and workings. Certainly this spiritual blessing, in common with the material blessings already mentioned, should combine to produce in all of us the recognition that scientific study is one of the most rewarding fields of human endeavor possible in the world today.

Science is a method by which we learn to know in ever wider ways and with ever greater precision about the world in which we live. The study of science can make genuine and wholesome contributions to char-

Federal Government...

*Ewing Galloway photo*

acter development not the least of which is an uncompromising demand for truth and honesty in all the affairs of life and a proper humility before all the many wonders which surround us. But great as I think are the values which science has brought and will bring to humanity, I would not wish to leave you with the impression that man can live by science alone, for science does not provide him with the ethical guidance nor the spiritual insights which are needed to realize our ideal of the good life.

Not all of the consequences of this enormous increase in man's knowledge of the world have been beneficial nor can it be said that we are effective in making the fullest use of the knowledge we already have. We have been slow to bring about a widespread distribution of these benefits to all of the population of even a wealthy and favored nation like the United States. While steady progress is being made—at a lamentably slow pace—the fact is that we have done very little toward slum clearance in our major cities or toward providing adequate schools and hospital service for all of the population. We are doing very little to assist the underdeveloped countries to bring the benefits of modern applied science to improve the welfare of the hundreds of millions of their population.

We talk of bold new programs in this direction, and we feel uneasily that much more needs doing than we have undertaken so far, and still we do essentially nothing about it. Our carelessness here is storing up great trouble for us in the future. We in America and in Western Europe are a small minority among the world's peoples. Other hundreds of millions of persons, chiefly in Asia, have caught a glimpse of what modern science can do for them and they are determined to have it. If we help them we can have their friendship as equals. If we do not, they will get these benefits for themselves anyway in the course of time, and on terms which will involve a great deal of strife and difficulty for us. It is true we have done much to assist in the reconstruction of Western Europe, but we have done practically nothing to assist the development of Asia and Africa. We have not even made effective plans for relief and reconstruction in the devastated areas of Korea.

The effort in this direction that I feel is necessary will be very great but it is my sincere conviction that effort of this kind is the most important thing we can do to preserve and extend the kind of Christian democratic civilization which we believe in. I believe that this kind of constructive effort to assist in bringing the

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benefits of modern science to the whole world is the only kind of effort which will accomplish the construction of the kind of world in which peace and goodwill can reign. I do not regard this required effort as a burden but as a great opportunity which has been presented to us which we should be grasping with eagerness and enthusiasm.

While it may be necessary, under present conditions, to use our scientific knowledge and our industrial productive capacity largely for building up our military strength, I am convinced that we are, perhaps unconsciously, placing too great an emphasis on this, as if it would give us the means of solving the difficult social problems with which we are confronted. All that we can hope for from military strength is that it will enable us to preserve a situation in which Western civilization will have an opportunity to share its wealth-producing techniques with the other peoples of the world, instead of having them snatched from us by angry hordes of men who outnumber us ten to one and who will have come to resent bitterly the seeming hypocrisy of our attitudes toward them. I will not therefore go so far as to say that under present conditions the building up of military power on which we are again engaged is now avoidable. But this course of action by itself may prove fruitless unless it is accompanied by a very great program—one whose scale of effort is at least as great as that we are putting into building up our armaments—that is designed to help all peoples of the world who are willing to work with us, to achieve the benefits of modern science which we enjoy. If we do this we shall derive great spiritual benefit from the increased happiness of these millions of God's people and material benefits from our participation in the contributions which their intelligence can bring to our unsolved problems.

THERE IS ANOTHER ASPECT of recent tendencies in development of military armament which we need to consider very carefully. War at best is an evil thing in which peoples resort to force to impose their will on each other instead of using love and compassionate efforts at mutual understanding to arrive at a solution of their difficulties. The opening years of this century were marked by all kinds of efforts in the way of agreements for the humanitarian treatment of prisoners, in agreements to confine the fighting to organized military forces, and even in agreements to avoid the use of certain particularly horrible weapons such as dum-dum bullets. In the two world wars of recent years, and in the military rearmament which is now going on, such ideas have become quaintly old-fashioned.

No longer do we give the slightest consideration to the distinction between military and civilian populations. In World War II both sides gave very little regard to avoiding destruction of the civilian population of their enemies, and enormous damage was done to other than strictly military objectives. A minute part of this terrible destruction was made by the use of the bombs based on the fast neutron fission of uranium and plutonium. The loss of life in Japan **alone** due to fire raids using napalm was much greater than that due to atomic bombs.

A large part of our organized effort in modern science goes today into putting enormous teams of men to work on developing even more deadly and destructive weapons than the world has ever seen before. We talk openly of germ warfare and nerve gases and we almost never hear of these being criticized as inhumane and revolting to the consciences of Christian men and women. No, we hear them criticized because it is difficult to produce germ cultures or gases in sufficient quantity or concentration to wipe out the whole population of a city as their proponents would say is possible and therefore we should devote our attention to the creation of some other fiendish thing like the hydrogen bomb. This, in turn, we hear criticized, not in terms of revulsion that men would use such things against each other, but that maybe its destructiveness is too concentrated and that the same effort put on more conventional types of atomic bombs would enable destruction to be carried out over an even greater area.

At San Francisco a few weeks ago the President spoke unspecifically of fantastic new weapons too horrible even to describe. The press was thereby filled with all kinds of science fiction speculations about what these horrible new wonders might be. Within a few days Congress increased the already enormous appropriations to the Air Force by five billions. In a matter of hours the Congress gave five billion for fantastic new weapons of which it knows next to nothing—the same Congress which after long debates finally cut one billion dollars out of the foreign aid program, the same Congress which by its long delays did much to nullify the effects in promoting goodwill of our finally supplying a credit (not a gift) for $190 million for grain to alleviate severe famine in India; the same Congress which refuses to provide $300 million in Federal aid to our overcrowded and inadequate school system, the same Congress which has lopped off the paltry appropriation of $14 million for the National Science Foundation which was intended to give some slight nourishment and sustenance to the fundamental scientific research on which rests the whole structure of modern industry, agriculture, and medicine.

Some may think that in referring to $14 million for the National Science Foundation as a paltry sum I speak like one of those terrible bureaucrats who has no regard for the burdens which the taxpayer must bear. I am concerned about taxes but I also want us to show some sense of proportion. Congress is this year spending $60 billion of new money or a total of about $100 billion of available funds on the Department of Defense. It has just increased this by another $5 billion for "fantastic" new weapons which the newspapers say can "conquer the atmosphere," whatever that means. It is spending $6 billion on foreign aid much of which is for rearmament rather than economic development.

Included in the military appropriations is about $1.5

billion for military research and development, a staggering sum of money which, if invested at 6% interest, would produce annually as much money as Congress has appropriated to the National Bureau of Standards in the entire fifty years of its existence. But it cannot spare $14 million next year for strengthening basic scientific research.

Today every activity of Government is being adjudged solely on the basis of its contribution to defense. I doubt whether such vast sums can be spent wisely for the purpose intended, and whether it is wise to put so much of our reliance on military strength while thinking so little about peaceful and constructive solutions of the difficult domestic and international problems before us.

If so much of our scientific effort is directed toward military weapon development, it must necessarily mean neglect of the basic science on which future progress must be built and neglect of the application of modern science to improving human well-being in our own and other parts of the world. There is another reason why we might be disturbed at the extent to which science is devoted to military purposes today. Although it seems to be very little in evidence at the moment I believe that deep in the consciences of men and women there is a horror and revulsion at the terrible means and methods of modern warfare which will some day find expression in a new and powerful and constructive determination to live together peacefully, and effectively to renounce war as an instrument of national policy. If in the years to come science and the scientists are closely identified in the public minds as the wizardry and the wizards who have made all the fantastic new weapons of mass destruction that Governments are now so eagerly urging them to produce, this horror and revulsion of war may, in that illogical and irrational way that so many things go in politics, be extended to science and the scientists. If this were to happen it would be bad not only for the scientists, but it would be bad for society, for a rejection by society of the method and power of scientific inquiry will stop progress in understanding and tend to retard the extension to all mankind of its beneficial applications. If men's consciences reawaken to the absolute necessity of abolishing warfare, then there may be serious danger that science may be the baby which is thrown out with the bloody bath which is War.

This situation poses very difficult problems for scientists in general and especially for those in official positions in our Government. Speaking personally, all of my friends know with what strong conviction I hold the general views which I have tried here, rather inadequately I am afraid, to outline. When I came to Government service at the close of World War II, I hoped and believed that there was to be an era of peace in which fundamental research in science would flourish and be supported by society as a whole as a worthy intellectual activity and for the constructive benefits to man's well-being which it can bring. At that time, only six years ago, the United Nations had just been born and many of us believed that the experience of wartime alliance had taught the lessons which would gradually enable the growth of a mutual confidence and trust between Russia and the United States and other principal nations of the world which would remove any basis for future war of major proportions. In such a setting one could hope for a steady reduction of national armaments, with the enormous economic waste which they imply, and their replacement by an international police force. In such a setting we hoped that all efforts in the field of atomic energy would go to peaceful purposes in chemical and medical research and in making available new sources of power.

At this time it seemed that Congress and the people of the United States, impressed by the contributions which applied science had made during the war, were prepared to support a National Science Foundation in a really adequate way—by this I mean to the extent of several hundred million dollars a year—and that science in other countries would be aided by a major program of the United Nations Educational Scientific and Cultural Organization as well as by local efforts in those countries.

During my first year in Washington, 1945–46, my attention was largely taken up with assisting the Special Senate Committee on Atomic Energy of the 79th Congress, as scientific adviser, when it was developing the Atomic Energy Act of 1946 by which the present Atomic Energy Commission was established.

During that first year the Senate held extensive hearings on proposed legislation for the National Science Foundation and passed a bill, but this was allowed to die in the House when the situation became confused by behind-the-scenes lobbying of those who insisted on a large part-time board for the Foundation. Otherwise the National Science Foundation probably would have started operating five years ago with an annual appropriation of about two hundred million dollars. If this had been allowed to happen we would have been incomparably better off than we are today from every point of view. Fortunately, the vacuum thus left was quite well filled by the enlightened scientific research program of the Office of Naval Research. This was conducted as liberally and as intelligently as any purely civilian program could possibly have been conducted and has made a wonderful contribution to the development of basic science in America during the post-war period.

SOON AFTER THAT FIRST post-war year it became clear that expenditures for scientific research for military purposes would be maintained at a high level and expanded above the minimum reached in the demobilization period. Work in this field has always been an important part of the program of the laboratories of the National Bureau of Standards. The Bureau has a long history in meeting such military needs, having first developed the optical glass industry in World War I, having initiated the atomic bomb project in World War II, and also having played a large part

in the development of proximity fuzes, having developed the only fully automatic guided missile to be used in warfare thus far, and having done much to improve knowledge of long-distance radio transmission on which the continuity of military communications depends. This latter service was initiated during World War II and organized as a permanent service in the Bureau during the first post-war year. Congress has been willing to support this work reasonably well and has made provision for splendid new laboratories for the radio work of the Bureau to be built in Boulder, Colorado. This radio work is, however, essentially the only new activity of the Bureau for which it has been possible to get direct financial support from the Congress during the post-war years.

In this period, to be sure, and particularly during the last year, there has been a great expansion in the level of activity of the Bureau. But this has not been by direct Congressional support, but rather by doing project work in Bureau laboratories for the armed services and with funds provided by them from their own appropriations. For example, this fiscal year the Bureau will operate on a total budget of some 60 million dollars, less than $10 million of which is directly appropriated by the Congress, nearly all of the rest being paid by the military for work done for them. To get some idea of the disparity of figures involved it is interesting to note that this year the Bureau will spend on electronic ordnance developments alone about 50% more money than the $14 million which the House has refused to give the National Science Foundation for Federal support of basic science.

The amount of military work done by the National Bureau of Standards has increased almost by a factor of seven during the time that I have been Director. Provision has been made for expanded facilities for such work in Washington, in Boulder, Colorado, where large new Bureau-operated laboratories are being built for work of the Atomic Energy Commission, and also in Corona, California where some unused former Naval hospital facilities have been converted into a splendidly equipped development laboratory for guided missile work for the Navy. Another Bureau development of military importance has been the establishment of a department of applied mathematics with facilities both in Washington and Los Angeles, and the development of an important electronic digital computer, the SEAC, which has been in service for more than a year on military problems. These are just highlights of a program which involves dozens of research projects of specifically military interest some of which relate directly to fantastic new weapons which cannot even be mentioned. I think therefore that the National Bureau of Standards is in a stronger position than ever before to make important contributions to military needs.

Turning to the fundamental support of the civilian program of the Bureau the situation is far from satisfactory. The National Bureau of Standards is a Cinderella whose Prince Charming has yet to come along. In spite of its long record of splendid accomplishments, its scientific program was crippled by severe budget cuts in 1933 as one of the economy acts of the Roosevelt administration. Valiant efforts were made by my predecessor, Dr. Briggs, to hold an effective staff together in spite of this short-sighted action but the Bureau is still suffering from the effects of that decision.

Except for the expanded radio work the direct support available for the Bureau in the post-war years has remained nearly constant, as expressed in dollars, and therefore has declined steadily in real purchasing power for goods and materials. This is a most serious situation, for it has occurred at a time when there has been a steady growth in the amount and complexity of the needs for standards of precise physical measurement.

Every kind of physical quantity is being measured, in connection both with scientific research and with more accurate control of industrial processes, with greater precision than before, and over a wider range of extreme conditions, and the need for exact calibrations of measuring instruments arises from a much greater number of research laboratories and industries than ever before. This has put a burden of work on the National Bureau of Standards with which it is quite unable to cope within the framework of its present appropriations. Try as we will we have not been able to keep up with the demands for such services. The result is, of course, that much money is wasted by others in duplications of calibrating set-ups which the Bureau should have and that many scientific jobs are done with a lower grade of accuracy than desirable and than would be possible if the National Bureau of Standards were allowed to render an adequate service.

I confess that I do not know how to do a better job of bringing this need to the attention of the Government. It has received a great deal of my attention in the last five years but with essentially no results. I hope that my successor in office will be able to do better on this than I have. Here it is important for him to realize that not all of the difficulty is with Congress. The budget of the National Bureau of Standards has to pass four hurdles before it is approved. It must first be approved by the budget officers of the Department of Commerce. It comes before them as a peculiarly difficult-to-understand technical item which amounts to less than two per cent of the total budget requirements of that Department. Since it is such a small part of the Departmental budget it is only natural that these budget officers have no scientific and technical background. At this stage efforts to get even what increase is necessary to keep abreast of the declining purchasing power of the dollar are pretty well nullified because these men are working under a general over-all limitation as to what the Department of Commerce itself may have.

After the Department of Commerce has finished its consideration, the Director and his staff must write up the whole thing again in great and specific fiscal detail for the Bureau of the Budget. This is supposed to show that the whole program of proposed work has been very thoughtfully considered. Having filed all this data with

the Bureau of the Budget, several hours are spent explaining the needs to staff officers of the Bureau of the Budget. Here again because scientific research is diffused over the whole structure of the government one is dealing with individuals who have very little background either in the over-all needs of the Government for scientific research, or in the accomplishments of the National Bureau of Standards in particular, or for the methods and aims of physical science in general.

This process goes on intermittently during the first half of the fiscal year preceding the one for which the budget is being prepared. Out of it comes an official determination by the Bureau of the Budget of what each governmental agency will be allowed to ask for in going before the Appropriations Committees of the House and Senate. The end result of this process when carried out for all the agencies of the Government appears in a large document which is printed and transmitted to Congress as the President's Budget. This is now official, and sometime in the spring the Director and his staff are summoned down to present the Bureau's part in the President's Budget to his subcommittee of the House Appropriations Committee and then to the Senate Appropriations Committee. Before doing this, however, his own staff of budget officers have had to rework completely the elaborate document by which the plans for the coming fiscal year were submitted to the Bureau of the Budget.

It is hard to convey any idea to persons outside of the Government of the extent to which the working agencies are called on to supply over and over again statistical reports about their work which cover essentially the same ground in slightly different forms.

Each agency sends up a large budget document to the Congress for the use of the Appropriations Committee in advance of the hearings. At the hearings the questioning often indicates that the Congressmen have very little understanding of the particular scientific needs of a technical agency and that perhaps they have not had time to look at the contents of the elaborate budget document which was prepared for them.

SOME OF MY most treasured memories of Government service are connected with incidents which occurred in these appropriations hearings. One feels rather nervous and tense on these occasions for on their outcome hinges the whole fate of the Bureau's work.

One time while waiting our turn outside the committee room, the budget officer of the Patent Office came out of the door looking pale and fell on the floor of the hall in a dead faint. We bustled around administering first-aid and when he came to partially he muttered deliriously, "It's awfully hot in there." Later, when it was my turn to go in, I found that he was right. That was during the Eightieth Congress at a time when the Alsops referred to the House Appropriations committee as a bunch of blind men pruning a jungle.

I remember one time one Congressman had me quite upset because he was scowling through the whole of my presentation. When it came his turn to ask questions he asked me, "Doctor, where *is* the National Bureau of Standards?" I told him it was out on Connecticut Avenue and he said excitedly, "Is *that* what that place is?" and became quite friendly.

On another occasion a Congressman was questioning the chief of the Bureau's radio division, who had been talking about the scarcity of space in the radio frequency spectrum for the many needs of communication services. He said: "Doctor, I understand that among you scientists there are two theories: some say space is finite, others say it is infinite. I want to know, where do you stand?" The witness started to explain the limitations of using very low and very high frequencies but the Congressman interrupted him to say, "No, I mean space, you know, *space,*" making a large and globular gesture toward the part of the three-dimensional continuum in front of him.

The witness squirmed and looked at me for guidance, quite willing to make it finite or infinite for the sake of the budget, but I could only indicate with a gesture that I did not know which was the preference of that particular Congressman. So he gulped hard and said, "I think it's infinite." "Thank you very much, Doctor, that's all I wanted to know", replied the Congressman and passed on to another topic.

When these hearings deal with science they are apt to be rich in non sequiturs. For example, only yesterday I was reading the Senate defense appropriation hearings (p. 1177) where an Army colonel is asking for funds for an electronic computer for logistic planning. A Senator asks him: "Now, is there any relationship between the number of equations that have to be developed and the time the machine is in operation?" And the colonel replies: "Electricity travels 186,000 miles per second, sir, so it is an infinitesimal difference."

There would be no point in describing this procedure in such detail unless I had a suggestion to offer. I do have.

I am convinced that the over-all importance of scientific research in Government has become so great that it requires careful attention and study by a new standing committee of the Congress. It is at least as important as atomic energy which has a permanent Joint Committee, affording an organized means by which Congress can study these problems. A similar means is needed for scientific research broadly if we are to get intelligent action and focus attention on unwise actions or inactions. Such a committee would study and deal with legislative problems affecting scientific research.

In addition it would be very desirable if the Appropriations Committee of the Congress would find a formal way to give some unified over-all attention to the scientific research requirements of the Government. A legislative committee on science in the Congress would not be enough unless the Appropriations Committees were also prepared to have a look at the whole program of all the large variety of specialized agencies in the government which are doing scientific work.

The most natural way for the Congress to deal with

science in a unified way would be for the scientific agencies of Government to be gathered up into what would be in effect a single Department of Government. I believe that the general importance of scientific research in the Federal Government has become so great that this should be done. If it were not considered desirable to establish a new Department of Scientific Research then I would recommend that the Smithsonian Institution be used for this purpose. I believe that the new Department or enlarged Smithsonian Institution should include all of the scientific agencies of Government including the major military research laboratories, the research laboratories of the Atomic Energy Commission, the National Bureau of Standards, the National Institutes of Health, the laboratories of the Department of Agriculture, the Weather Bureau, and the Bureau of Mines, the Geological Survey, the National Advisory Committee for Aeronautics, and, of course, the National Science Foundation.

Whether a new Department of Scientific Research in the Executive Branch or an enlarged assignment of responsibilities for the Smithsonian Institution represents the better proposal I am not prepared to say. But it seems clear to me that a unified administration of the scientific affairs of the Government, including unified treatment of them by the Bureau of the Budget and by appropriations and legislative committees of Congress, would surely be an improvement over the present situation. I am inclined to favor the adaptation of the Smithsonian for this purpose over the creation of a new Department, for the reason that each cabinet member is on the board of the Smithsonian and thereby the relation of science activities to the other government activities they support would be preserved while giving scientific research as a whole a coordinated administration.

The suggestion that the Bureau of the Budget should have a special staff for study of the needs of scientific research is not a new one, having been made as a recommendation in the Steelman report, entitled "Science and Public Policy." But it has never been acted upon, I suppose, because of the difficulty of finding properly qualified individuals to do the job and the Budget Bureau may feel that it is better to do it not at all than to do it badly.

If there is any merit in the general suggestions I am making I would like to see the Bureau of the Budget call on the National Academy of Sciences for a study and recommendations and also to ask the Academy for its help in reviewing the budget of the existing agencies. The Congress too should recognize the many ways in which it could get help on scientific problems from the Academy and call on it for help more often on large broad issues than it has in the past.

As part of such a plan, the National Academy of Sciences, the National Research Council, the American Association for the Advancement of Science, and the specialized scientific societies would retain the independent status which they have now but would work in close cooperation with the new science administration to make sure that the Government's research program is effectively carried out in a way best suited to serve the national interest in relation to the professional needs of the scientific work in the universities and in industry.

ONE OF THE MOST REMARKABLE omissions in the report of the Hoover Commission on the reorganization of the Government was its almost complete lack of any recommendations for improving scientific research in the Government. This is hard to understand for surely the men who developed that report appreciate the importance of science today in Government, and cannot have felt that the present diffusion of responsibility over many separate agencies is a form of organization which cannot be improved upon.

It seems to me all the more important that a unified central body for science in Government be set up because research is a very fashionable thing these days and every new agency feels it must do research in order to have status in the world of bureaucracy. While it is very difficult to get adequate support for the established research agencies, it is always possible to set up a research program as a small part of a general need to which assent has been given and by indirection to obtain vaster sums of money than the established agencies can get for research. For example, it would be extremely difficult the way things are now to get a modest increase in the funds available to the National Bureau of Standards for research on synthetic rubber in spite of a splendid record of past achievement, whereas a quite substantial amount of support is carried along by the Government as an incidental to the operation of the Government-owned synthetic rubber plants. But I am convinced that when the work is carried on in this way, with uncertainty as to its continuance, and therefore an unusually high personnel turnover, it is not nearly so effective as if it were part of an over-all coordinated scientific program supported on a more stable basis.

Another example of an agency of Government which has recently entered the field of science is the Department of State. It has established a science liaison office and looks forward to having scientific attaches serving in various of our embassies in leading capitals of the world. I believe that there is an important service to be rendered in fostering international relations in the field of science. But I do not believe this can be done effectively under circumstances where it is just one minuscule activity under the supervision of men who are so busy with so many other matters that they are unable to give it their attention. All such activities of the United States Government could probably be better handled by a general science agency, of the kind suggested.

Another recent venture in organization of Government science that many feel could be improved is the Research and Development Board of the Department of Defense. This was established by one section of the National Security Act of 1947, the law which estab-

lished a single Department of Defense and was intended to be the means for bringing about a close coordination of the scientific research and development work sponsored by the Army, the Navy, and the Air Force. Experience has shown that it has not been a very effective tool for doing this. I think that this outcome might have been foreseen from the outset and for the reason that the Research and Development Board was set up as a purely advisory body, without operating responsibilities. Operating responsibilities for research continue to belong to the three services and their individual bureaus. Because the RDB lacks direct responsibility it is not an attractive place for scientists of real ability to work, so it has been unable to attract staff of sufficient competence to cope with the very difficult problems presented by an extremely complicated situation. I am convinced that the RDB cannot perform a useful function as long as it functions in a purely advisory way, and that the situation could be greatly improved by putting all of the military research laboratories completely under civilian management of a Department of Scientific Research or a new Smithsonian Institution.

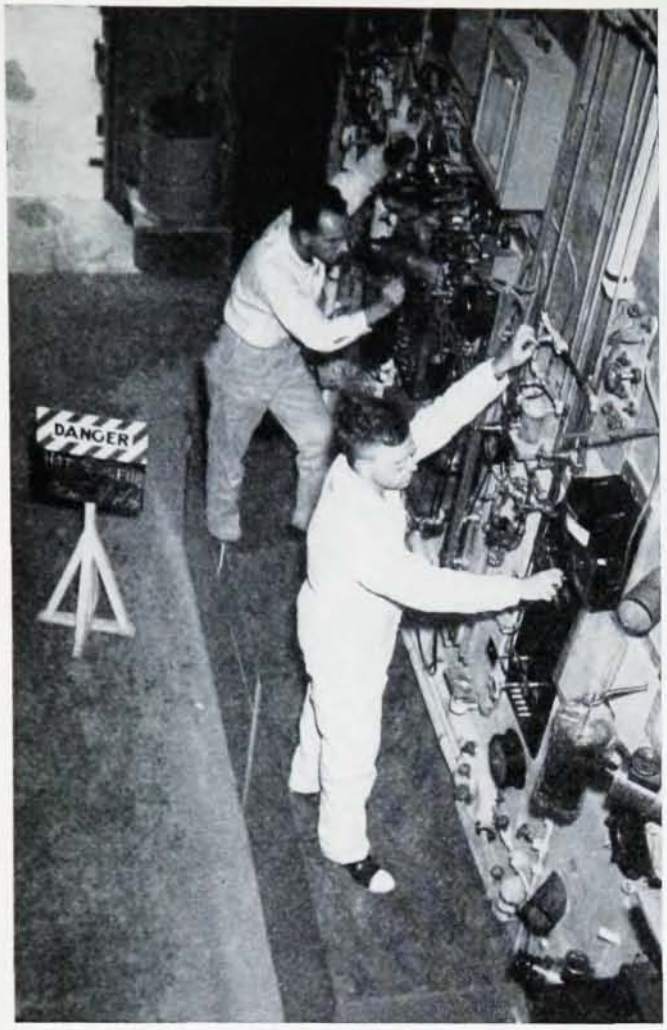
Next I would like to make a few observations on the Federal Government as an employer. Uncle Sam is a reasonably good employer so far as salaries, retirement plan, vacations, and the like are concerned. But the salaries paid for positions of major responsibility are in no way commensurate with the rewards which can be obtained in private life for similar services. Some curious inequities develop in this way. The tax position of many corporations is such that it costs the Government more in decreased tax revenues paid by the private employers to have a man work in private industry than the salary which the Government will pay that man to work full-time for the Government.

The curious thing about the low salary scale which the Government pays to scientists is that one way and another the Government is finding it impossible to compete with itself in securing the services of the men it needs. Many private employers of scientists use them on Government contract work on a cost-plus basis so the Government pays the man's full salary at higher than Civil Service rates as part of the cost of the contract. This possibility has, in the post-war years, led to a new development which is having devastating effects on the ability of Government operated laboratories to recruit qualified staff. More and more there is a tendency to assign Government research programs to *ad hoc* groups organized as private corporations solely for the purpose of taking a Government contract and even in some cases for the purpose of staffing and operating a Government-owned facility. In this way Government money is used to pay salaries in excess of Civil Service rates and all manner of operational red-tape is avoided, but the Government finds itself paying much more for the same services than it would pay if the work were done in its own laboratories This is not good for the morale of loyal Government workers. The proper remedy would be to improve the rules affecting the Civil Service instead of inventing ways to evade them.

Aside from questions of salary alone, some members of Congress so often give expression to attitudes of contempt and distrust toward the thousands of dedicated, conscientious, and intelligent citizens in the Government service that they have to be quite thick-skinned indeed not to have their morale in some measure impaired by such treatment. No private employer would think of saying the kinds of things about his employees which are often said about Government employees and expect to retain any of their loyalty or devotion. This situation has been greatly aggravated in recent years by the use of dishonest smear tactics in Congress giving rise to an artificial hysteria which has led to widespread injustices toward Government employees carried out in the name of the Loyalty Program. Everyone in Washington knows dozens of stories of great suffering caused by silly and trivial accusations in this connection. For example only recently I heard of a labor relations expert who was employed by our Government in Japan to work to diminish communist influence in labor unions there, who was officially commended for his work, and then later had to defend himself before a loyalty board against the charge "that when you were in Japan you evinced a great interest in Communism". I know of a case of a woman who was accused of disloyalty on the grounds of sympathetic association with her own husband. I know of another who was charged with acquaintance with a scientist who is in fact the man who is entrusted with a major role in the hydrogen bomb development.

Not the least of the evils associated with the actual functioning of the Loyalty Boards is the slowness with which they operate. Often a person is kept in a state of nervous suspense for months after a hearing is held before he gets word of a decision. In general the processes are carried out in an altogether too formal and unsympathetic manner. No man can become a psychoanalyst until he himself has been analyzed. I think the situation would be improved if no one served on a Loyalty Board until he had a laboratory course in the Golden Rule by having himself been given a protracted experience with a Loyalty Board.

In conclusion let me thank you for your courtesy in listening to this rather too dogmatically expressed recital of opinions of one who sincerely believes in the importance of Government service and of science in the modern world of affairs and who only hopes that some of these thoughts may make a slight contribution toward working out some improvements. No one who has ever been entrusted with major governmental responsibility can fail to be impressed with the importance of the American government and of strengthening the American contribution to the welfare of all the peoples of the world. I am not an old soldier and I hope not to fade away. I leave the Government service happy in the friendships and experience it has given to me and hoping that I may still in private life be responsive to the duties of citizenship in this our beloved America.




Fission product separation process at the Oak Ridge National Laboratory, one of the main research centers of the Atomic Energy Commission. *U. S. Army Signal Corps photo*

The following article, by the director of the Atomic Energy Commission's division of research, is based on an address presented before the Conference on Applied Physics of the American Association for the Advancement of Science which was held on December 27, 1951.

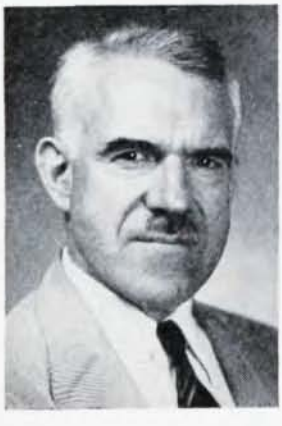
# *physics in the*

*By* ***Thomas H. Johnson***

IT WOULD BE no more possible to have a symposium on applied physics without reference to the atomic energy program, than it would to talk about atomic energy without reference to physics. The atomic energy program was initiated by physicists; it is based on a recent discovery in physics; its future course will follow the developments in physics; through the program the government is giving physics its most substantial support; and the results of the program will be an outstanding achievement of physical science. Moreover the areas of physics which bear this close relationship to the program are so extensive and so new that most of what we call basic physics finds some application, and applied research often turns out to give basic conclusions.

The Atomic Energy Commission and its staff are keenly aware of their dependence upon a vigorously growing science of physics and, as the program expands, it will have to call upon an ever increasing body of physicists. That the Commission would have to lean heavily upon physicists was recognized by those who framed the Atomic Energy Act of 1946, for this act provides the Commission with the authority and the responsibility to foster applied and basic research both in private and in federal laboratories, and to train people in many fields of physics. The program also involves chemistry, metallurgy, geology, engineering, and a host of other sciences and technologies, but here we are concerned with physics, though many of these remarks would apply equally well to other sciences.

Many people, and especially some scientists, have been disturbed that the atomic energy program is too much concerned with destructive weapons. However, if one reads the Atomic Energy Act, he finds that, except for the clause "all other aims are subject to the paramount objective of assuring the common defense and security," the program is clearly designed to operate in a peaceful world. Unfortunately, world conditions have made it necessary in these first years of the program to lay principal emphasis upon the development of



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