

## What Can the Scientist Do?

*From Science, Liberty and Peace*

"SCIENCE" is an abstract word, and when we are trying to think about concrete political and economic problems, it is best to talk concretely, not of science but of the people who work in the various scientific fields, from the fields of uncontaminated theory and disinterested research into basic problems to those of applied science and technology. Assuming that the abolition of war is desirable, we proceed to ask ourselves how scientific workers can help to achieve this end.

1. As individuals or in organized groups, scientific workers can take three kinds of action against war. There is, first, the possibility of negative action in the form of a refusal, on conscientious grounds, to collaborate in any project whose purpose is the destruction or enslavement of human beings.

2. Negative action is good so far as it goes, but it needs to be supplemented by action of a positive and constructive kind. Such positive action may be classified under two heads: (a) action which takes its start in politics, to end in the field of science, and (b) action which takes its start in science, to end in politics.

a) In recent months several suggestions have been made for the political control, in the interests of humanity, of the activities of scientists and technologists. Thus, in the course of an interesting two-day debate in the House of Lords, Lord Vansittart urged the necessity of subjecting all German laboratories, whether attached to universities or supported by the state or by private industrialists, to strict supervision over a long term of years. Only in this way, he claimed, could the danger of a war of revenge, waged with new "secret weapons," be avoided. More realistically, Lord Brabazon proposed that this supervision of scientific developments should not be confined exclusively to the defeated nations—nations whose opportunities for the large-scale manufacture of new weapons would, for many years at least, be small. His suggestion was that, under the final peace treaties, an international committee of inspection should be constituted, having authority to enter laboratories and factories in any part of the world. In Lord Brabazon's view, the only alternative to such

a scheme of international inspection would be an armament race between Britain and the United States on the one hand and the rest of the world on the other. By intensive research the Anglo-Saxon group might hope to obtain the lead in such a race, and so discourage attack by other powers. Lord Brabazon's speech was made before the dropping of the first atomic bomb. As things now stand, the United States and Britain already possess an enormous lead in the postwar armament race. For a few years they may keep that lead. Then other nations (unless, of course, they are previously blown to bits by the present possessors of the bomb, or unless reason, surrender of absolute sovereignty and world government come to replace nationalism) will be supplied by their scientists with the same or even better methods for manufacturing atomic missiles. Meanwhile the desirability of an international inspectorate charged with preserving humanity from the triumphs of science is even greater now than it was before Hiroshima. The existence of an international inspectorate would involve the adoption of another security measure, advocated in the course of the same debate by Lord Strabolgi—namely, the pooling of all scientific discoveries considered by competent experts to be actually or potentially a danger to mankind.

Similar suggestions have been made on the other side of the Atlantic, and it remains to be seen whether, and to what extent, the United Nations will act upon them. Meanwhile Messrs. Truman, Attlee and King have decided to keep such secrets as their scientists and engineers still possess until "enforcible safeguards" against their use for destructive purposes can be devised. What is to be the nature of those "enforcible safeguards"? As yet, it would seem, nobody has any very clear idea. In principle, the proposals for a pooling of dangerous knowledge and for an international inspectorate are excellent; and, to some, the theory of an "international police force" seems attractive and even workable. But, alas, from principle to application and from theory to practice the road is long and hard. Two disturbing questions inevitably propound themselves. First, will the various national governments concerned agree to act upon these suggestions? Second, if they do agree, will they and the men of science they employ consent to play the game according to the internationally imposed rules? In attempting to answer these questions one must weigh the power of enlightened self-interest against the power of nationalistic passions and prejudices. Enlightened self-interest will unquestioningly vote for world government, international inspection and the pooling of information. But unfortunately, in some of the most important issues of life, human beings do not act from considerations of enlightened self-interest. If they did, we should now be living in some-

thing very like paradise. In the field of international politics, as we have seen, the gravest decisions are always taken, not by reasonable adults but by boy gangsters. Despite the lessons of Hiroshima and Nagasaki, it is quite possible that some national governments will refuse to allow their laboratories and factories to be inspected—and, of course, the refusal of even one government will entail the general abandonment of the scheme. Alternatively, the principle of international inspection will be accepted; but at first some and then (when suspicion has been aroused) all the governments concerned will conspire with the scientists in their employ to carry on research in caves or forests or mountain fastnesses, where no prying eye can see what they are up to. It may perhaps seem unlikely that workers trained in the methods of science should support their political bosses in machinations so manifestly senseless, as well as immoral. But it is not because men have learned to behave rationally in the laboratory that they can be trusted to behave rationally toward foreigners and unpopular minorities, or even toward their own wives and children. Until a very few years ago the best scientific and technological education available was given in Germany; but most of the persons who received that education not only worked for the Nazi bosses, but believed in their doctrines and were swayed by the nationalistic passions which they so skillfully exploited. The case of Germany is not unique. In all countries nationalistic passions (of the same kind as were manifested in Germany, but at a somewhat lower level of intensity) are almost as common among scientists and technicians as in other classes of society. In spite of their training (perhaps, indeed, owing to the narrowly specialized character of that training, because of it), scientists and technicians are perfectly capable of the most dangerously irrational prejudice, nor are they immune to deceitful propaganda. The same men who reject as superstitious the belief in a transcendent and immanent spiritual Reality beyond and within phenomena prove by their actions that they find no difficulty in worshipping as a supreme god whichever one of the world's fifty-odd nations they happen to belong to, and in accepting the infallibility of the local Foreign Office and the quasi-divinity of the local political boss. In view of all this we need not be surprised if the plans for an international inspectorate and the pooling of scientific knowledge should fail in practice to produce the good results expected of them.

b) We must now consider the specifically scientific action which might be taken by men of science and technicians with a view to diminishing the probability of war and so to increasing the sum of human liberty. Such action can only be taken on the plane of applied science. Basic research is essentially disinterested. Men undertake it because, in the

words used by the boy Clerk Maxwell, they want to find out "what's the go" of things—to discover how nature works and how its parts are related within a causal system. What is subsequently done with the results of disinterested research is something which the researcher cannot foresee, and for which he is not responsible. Thus, Clerk Maxwell's own adult curiosity to find out the go of such things as light and magnetism led him to certain conclusions, and these conclusions have since been utilized by technicians for the development of instruments, which are now used, in the main, for the dissemination of maudlin drama, cigarette advertising, bad music and government-sponsored or capitalist-sponsored propaganda. Clerk Maxwell would probably have been horrified by all these uses of the radio, and he is, of course, in no way to blame for them. In practice, it would seem, basic research cannot be planned, except perhaps to the extent of subsidizing inquiry into branches of knowledge which, for whatever reason, appear to have been unduly neglected. If the facilities for research are supplied, men and women with an overpowering desire to find out the go of things will always be forthcoming to make use of them. The planning of scientific activity with a view to achieving certain predetermined political, social and economic ends must begin at the point where the results of disinterested research are applied to the solution of practical problems. Individually and through their professional organizations, scientists and technicians could do a great deal to direct that planning toward humane and reasonable ends.

In theory everyone agrees that applied science was made for man and not man for applied science. In practice great masses of human beings have again and again been sacrificed to applied science. The conflict between science, as it has been applied up to the present, and human interests was clearly stated by Thorstein Veblen in his *Science in the Modern World*. In this essay Veblen distinguishes between what he calls the pragmatic and the scientific point of view. Pragmatically human beings know pretty well what is good for them, and have developed myths and fairy tales, proverbs and popular philosophies, behavior patterns and moralities, in order to illustrate and embody their findings about life. The findings of science—especially of science as applied for the benefit of the holders of centralized economic and political power—are frequently in conflict with humanity's pragmatic values, and this conflict has been and still is the source of much unhappiness, frustration and bitterness.

When science is applied in such a way as to create a form of production, which cannot be run efficiently without coming into sharp conflict with fundamental human values, and which therefore continually calls for the

intervention of a governmental authority having power to "integrate" the conflicting persons and points of view, it may be fairly presumed that the application of the results of disinterested research has been, humanly speaking, misguided and undesirable. Up to the present time applied science has not been used mainly or primarily for the benefit of humanity at large, or (to put the matter less abstractly) for the benefit of individual men and women, considered as personalities each one of which is capable, given suitable material and social conditions, of a moral and spiritual development amounting, in some cases, to a total transfiguration; rather man has been used for applied science, for the technicians who enjoy designing more and more complicated gadgets, and for the financial and governmental interests which profit by the centralization of power. If applied science is henceforward to be used for man, technicians and scientists will have to adopt a professional policy, consciously and deliberately designed to serve fundamental human needs and to forward the causes of peace and personal liberty. Such a policy could not be worked out in detail except by an international organization of scientific workers, highly trained in their respective fields, so that each could contribute his or her share of skill or information toward the realization of the common end—namely, the welfare, liberty and peace of the individuals composing the human race. It would be absurd for me to try to anticipate the findings of this hypothetical group of experts; but it is possible, without too much presumption, to indicate in a general way a few of the lines which their discussion would have to follow.

Humanity's primary requirement is a sufficiency of food; but it is primarily by considerations of power that the policies of national governments are at present dictated. The ruling minorities of the world invariably contrive to have enough, and (to judge by the disgusting descriptions of recent diplomatic banquets) more than enough, to eat; consequently they tend to take food for granted and to think first, and at times almost exclusively, in terms of the questions: Who shall bully whom? But the great majority of the men, women and children on this planet are in no position to take food for granted. Their first and often their exclusive concern is the next meal. The question as to who shall bully whom is of hardly more than academic interest to them. They would like, of course, to be left in peace to go their own way; but they know by bitter experience that, under the present dispensation, there will always be a ruling minority to order them about, to bully and badger them in the name of the divine Nation, the omniscient Party, the sacred Principles of this or that political doctrine. They are therefore unable to take much interest in the national and international policies, which are the prime

concern of the well-fed power lovers at the top of the social pyramid at the top of the social pyramid.

At the San Francisco Conference the only problems discussed were problems of power. The basic problem of mankind—the problem of getting enough to eat—was relegated to an obscure international committee on agriculture. And yet it is surely obvious that if genuine international agreement is ever to be reached and preserved it must be an agreement with regard to problems which, first, are of vital interest to the great masses of humanity and which, second, are capable of solution without resort to war or the threat of war. The problems of power are primarily the concern of the ruling few, and the nature of power is essentially expansive, so that there is not the least prospect of power problems being solved, when one expanding system collides with another expanding system, except by means of organized, scientific violence or war. But war on the modern scale shatters the thin, precarious crust of civilization and precipitates vast numbers of human beings into an abyss of misery and slow death of moral apathy or positive and frenzied diabolism. If politicians were sincere in their loudly expressed desire for peace, they would do all they could to by-pass the absolutely insoluble problems of power by concentrating all their attention, during international conferences and diplomatic discussions, on the one great problem which every member of the human race is concerned to solve—the one great problem which not only does not require military violence for its solution, but which, for the world at large, is wholly insoluble so long as the old games of militarism and power politics continue to be played. The first item on the agenda of every meeting between the representatives of the various nations should be: *How are all men, women and children to get enough to eat?*

It is fashionable nowadays to say that Malthus was wrong, because he did not foresee that improved methods of transportation can now guarantee that food surpluses produced in one area shall be quickly and cheaply transferred to another, where there is a shortage. But first of all, modern transportation methods break down whenever the power politicians resort to modern war, and even when the fighting stops they are apt to remain disrupted long enough to guarantee the starvation of millions of persons. And, secondly, no country in which population has outstripped the local food supply can, under present conditions, establish a claim on the surpluses of other countries without paying for them in cash or exports. Great Britain and the other countries in western Europe, which cannot feed their dense populations, have been able, in times of peace, to pay for the food they imported by means of the export of

manufactured goods. But industrially backward India and China—countries in which Malthus' nightmare has come true with a vengeance and on the largest scale—produce few manufactured goods, consequently lack the means to buy from underpopulated areas the food they need. But when and if they develop mass-producing industries to the point at which they are able to export enough to pay for the food their rapidly expanding populations require, what will be the effect upon world trade and international politics? Japan had to export manufactured goods in order to pay for the food that could not be produced on the overcrowded home islands. Goods produced by workers with a low standard of living came into competition with goods produced by the better-paid workers of the West, and undersold them. The West's retort was political and consisted of the imposition of high tariffs, quotas and embargoes. To these restrictions on her trade Japan's answer was the plan for creating a vast Asiatic empire at the expense of China and of the Western imperialist powers. The result was war. What will happen when India and China are as highly industrialized as prewar Japan and seek to exchange their low-priced manufactured goods for food, in competition with Western powers, whose standard of living is a great deal higher than theirs? Nobody can foretell the future; but undoubtedly the rapid industrialization of Asia (with equipment, let it be remembered, of the very latest and best postwar design) is pregnant with the most dangerous possibilities.

It is at this point that internationally organized scientists and technicians might contribute greatly to the cause of peace by planning a worldwide campaign, not merely for greater food production, but also (and this is the really important point) for regional self-sufficiency in food production. Greater food production can be obtained relatively easily by the opening up of the earth's vast subarctic regions at present almost completely sterile. Spectacular progress has recently been made in this direction by the agricultural scientists of the Soviet Union; and presumably what can be done in Siberia can also be done in northern Canada.

The opening up of the Arctic will be undoubtedly a great good. But it will also be a great temptation for the power politicians—a temptation to exploit a natural monopoly in order to gain influence and finally control over hitherto independent countries, in which population has outstripped the food supply.

It would seem, then, that any scientific and technological campaign aimed at the fostering of international peace and political and personal liberty must, if it is to succeed, increase the total planetary food supply by increasing the various regional supplies to the point of self-sufficiency.

Recent history makes it abundantly clear that nations, as at present constituted, are quite unfit to have extensive commercial dealings with one another. International trade has always, hitherto, gone hand in hand with war, imperialism and the ruthless exploitation of industrially backward peoples by the highly industrialized powers. Hence the desirability of reducing international trade to a minimum, until such time as nationalist passions lose their intensity and it becomes possible to establish some form of world government. As a first step in this direction, scientific and technical means must be found for making it possible for even the most densely populated countries to feed their inhabitants. The improvement of existing food plants and domestic animals; the acclimatization in hitherto inhospitable regions of plants that have proved useful elsewhere; the reduction of the present enormous wastes of food by the improvement of insect controls and the multiplication of refrigerating units; the more systematic exploitation of seas and lakes as sources of food; the development of entirely new foods, such as edible yeasts; the synthesizing of sugars as a food for such edible yeasts; the synthesizing of chlorophyll so as to make direct use of solar energy in food production—these are a few of the lines along which important advances might be made in a relatively short time.

Hardly less important than regional self-sufficiency in food is self-sufficiency in power for industry, agriculture and transportation. One of the contributing causes of recent wars has been international competition for the world's strictly localized sources of petroleum, and the current jockeying for position in the Middle East, where all the surviving great powers have staked out claims to Persian, Mesopotamian and Arabian oil, bodes ill for the future. Organized science could diminish these temptations to armed conflict by finding means for providing all countries, whatever their natural resources, with a sufficiency of power. Water power has already been pretty well exploited. Besides, over large areas of the earth's surface there are no mountains and therefore no sources of hydroelectric power. But across the plains where water stands almost still, the air often moves in strong and regular currents. Small windmills have been turning for centuries; but the use of large-scale wind turbines is still, strangely enough, only in the experimental stage. Until recently the direct use of solar power has been impracticable, owing to the technical difficulty of constructing suitable reflectors. A few months ago, however, it was announced that Russian engineers had developed a cheap and simple method for constructing paraboloid mirrors of large size, capable of producing superheated steam and even of melting iron. This discovery could be made to contribute very greatly to the decentralization



of production and population and the creation of a new type of agrarian society making use of cheap and inexhaustible power for the benefit of individual small holders or self-governing, co-operative groups. For the peoples of such tropical countries as India and Africa the new device for directly harnessing solar power should be of enormous and enduring benefit—unless, of course, those at present possessing economic and political power should choose to build mass-producing factories around enormous mirrors, thus perverting the invention to their own centralistic purposes, instead of encouraging its small-scale use for the benefit of individuals and village communities. The technicians of solar power will be confronted with a clear-cut choice. They can work either for the completer enslavement of the industrially backward peoples of the tropics, or for their progressive liberation from the twin curses of poverty and servitude to political and economic bosses.

The storage of the potentialities of power is almost as important as the production of power. One of the most urgent tasks before applied science is the development of some portable source of power to replace petroleum—a most undesirable fuel from the political point of view, since deposits of it are rare and unevenly distributed over the earth's surface, thus constituting natural monopolies which, when in the hands of strong nations, are used to increase their strength at the expense of their neighbors and, when possessed by weak ones, are coveted by the strong and constitute almost irresistible temptations to imperialism and war. From the political and human point of view, the most desirable substitute for petroleum would be an efficient battery for storing the electric power produced by water, wind or the sun. Further research into atomic structure may perhaps suggest new methods for the construction of such a battery.

Meanwhile it is possible that means may be devised, within the next few years, for applying atomic energy to the purposes of peace, as it is now being applied to those of war. Would not this technological development solve the whole problem of power for industry and transportation? The answer to this question may turn out to be simultaneously affirmative and negative. The problems of power may indeed be solved—but solved in the wrong way, by which I mean in a way favorable to centralization and the ruling minority, not for the benefit of individuals and co-operative, self-governing groups. If the raw material of atomic energy must be sought in radioactive deposits, occurring sporadically, here and there, over the earth's surface, then we have natural monopoly with all its undesirable political consequences, all its temptations to power politics, war, imperialistic aggression and exploitation. But of

course it is always possible that other methods of releasing atomic energy may be discovered—methods that will not involve the use of uranium. In this case there will be no natural monopoly. But the process of releasing atomic energy will always be a very difficult and complicated affair, to be accomplished only on the largest scale and in the most elaborately equipped factories. Furthermore, whatever political agreements may be made, the fact that atomic energy possesses unique destructive potentialities will always constitute a temptation to the boy gangster who lurks within every patriotic nationalist. And even if a world government should be set up within a fairly short space of time, this will not necessarily guarantee peace. The Pax Romana was a very uneasy affair, troubled at almost every imperial death by civil strife over the question of succession. So long as the lust for power persists as a human trait—and in persons of a certain kind of physique and temperament this lust is overmasteringly strong—no political arrangement, however well contrived, can guarantee peace. For such men the instruments of violence are as fearfully tempting as are, to others, the bodies of women. Of all instruments of violence, those powered by atomic energy are the most decisively destructive; and for power lovers, even under a system of world government, the temptation to resort to these all too simple and effective means for gratifying their lust will be great indeed. In view of all this, we must conclude that atomic energy is, and for a long time is likely to remain, a source of industrial power that is, politically and humanly speaking, in the highest degree undesirable.

It is not necessary in this place, nor am I competent, to enter any further into the hypothetical policy of internationally organized science. If that policy is to make a real contribution toward the maintenance of peace and the spread of political and personal liberty, it must be patterned throughout along the decentralist lines laid down in the preceding discussion of the two basic problems of food and power. Will scientists and technicians collaborate to formulate and pursue some such policy as that which has been adumbrated here? Or will they permit themselves, as they have done only too often in the past, to become the conscious or unconscious instruments of militarists, imperialists and a ruling oligarchy of capitalistic or governmental bosses? Time alone will show. Meanwhile, it is to be hoped that all concerned will carefully consider a suggestion made by Dr. Gene Weltfish in the September, 1945, issue of the *Scientific Monthly*. Before embarking upon practice, all physicians swear a professional oath—the oath of Hippocrates—that they will not take improper advantage of their position, but always remember their responsibilities toward suffering humanity. Technicians and scientists, proposes

Dr. Weltfish, should take a similar oath in some such words as the following: "I pledge myself that I will use my knowledge for the good of humanity and against the destructive forces of the world and the ruthless intent of men; and that I will work together with my fellow scientists of whatever nation, creed or color for these our common ends."