Science and Security

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THE CONFLICT OF INTERESTS WHICH arises from official secrecy regarding military applications of science and that freedom of inquiry which is necessary for the continued growth of science represents one of the most important problems of science today. By virtue of the intimate relationship between science and technology, the problem also, and inevitably, becomes one of great importance to the national welfare.

Before considering this topic, let us state what we mean by science and ask: What is its meaning for modern life? Science is the process of studying and the results of study of the facts of experience derived from a conscious program of observing, while systematically varying the factors of a given situation in order to arrive at a rational understanding of the observational data so obtained.

The scientific method is a very powerful thing. It is a new thing in human history. Its power has only gradually won recognition during the past three or four centuries of human existence. Its fairly widespread development is a phenomenon of the last 100 years. Even today the use of the scientific method is not really widespread. Vast numbers of human beings, not only in so-called backward countries but also in so-called civilized countries, have only a most imperfect understanding of what it has done and can do.

The scientific method is also restricted in its use in another way: there is still a great reluctance, even in the civilized countries, to accept and extend its use in the fields of sociology, economics, and politics. Even more important for mankind than further development of the physical and biological sciences will be, I hope, in the years to come, the full acceptance and use of the scientific method in the social sciences.

The progress we have made in the physical and biological sciences has created and revolutionized engineering technology, agriculture, and medicine. The resulting changes in the material circumstances of life have brought about enormous changes in our material way of life with respect to food, clothing, shelter, health, urban development, transportation and communication, and even the social institutions by which productive effort is carried on.

Science is also largely responsible for the techniques by which war has become vastly more destructive and all-encompassing than ever before. Today, as we have seen, major warfare requires the complete mobilization of every human and material resource of the nations that engage in it. And it results essentially in complete wreckage of the countries in which the war is fought. Let us not underestimate the destructiveness of war as it was practiced "this time," even without the use of the atomic bomb. All the death and destruction which reduced much of Europe to a shambles was wrought with old-fashioned chemical bombs.

We Americans simply do not realize what modern war would mean to us, and I am afraid that, despite all warnings to the contrary from every quarter, many of us simply do not believe the next war will mean destruction of our cities. Kingsley Martin, a distinguished British editor, was recently quoted as saying: "The fact is that for us another war is just unthinkable. I can't help believing that Americans indulge in speculation about war as freely as they do just because they are not completely terrified by the idea. They feel that there is at least a chance that it will be fought at a distance, but here we know that another major conflict means obliteration for most of us and the final destruction of Britain. We must assume, therefore, that war will be avoided in order to keep sane and get on with our jobs."

Now this situation does confront us with a difficult problem for this reason: the increasing destructiveness of wars is a terrifying thing, and the prospect of an atomic war is even more terrifying. When people are really frightened, they are less likely to act rationally than when they are serene. And we believe that rational behavior is essential to a successful approach to all our problems. But what are we to do if the facts of the situation really *are* frightening? Shall we then refrain from talking about these facts or facing the truth? I believe there is no way to deal with this greatest threat of modern war to our security than to face the facts, as calmly and courageously as we can, but also to face them squarely and honestly, trying to work out solutions to our problems in a rational way.

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The danger of producing irrational reactions by a plain statement of the facts can be minimized if we state them in a calm and dispassionate manner. We can face up to them squarely without giving way to hysteria. In the meantime we must face the fact that we live in a world in which not much progress has yet been made toward achieving stable international relations. We are committed to a policy in which we depend on military strength to reduce the likelihood of war. This requires that a large part of our scientific effort be devoted to ends which directly or indirectly increase the military potential of this Nation. In this connection arise the difficult problems of conflict between scientific research and restriction of information about research which we wish to discuss here tonight.

The Concept of Security

The motivation behind the restriction of scientific information is simple, but the whole problem has become unnecessarily complicated and confused as a result of loose terminology, confusion as to what might be attained through a classification program, and the present fears prevalent throughout the world. Unless the problem is carefully considered and understood, however, we stand in grave danger of defeating through ignorance or stupidity the very ends which we seek to gain.

One of the ideas most closely associated with the classification of information is "security," and much of our confusion stems from the indiscriminate use of this word as well as from an ignorance of what constitutes security in the more common sense of the word. The dictionary meaning of the word security is "freedom from fear, anxiety, or care; confidence of power or safety." This is what the average man thinks of, and this is really the basic thought behind any program linked to the word.

However, there are at least two other uses of the word which are responsible for the confusion I have mentioned. The first of these is the expression "military security." Here what is meant is, clearly, the attainment of national security through military strength. In short, military security is equated to military strength. Military strength in modern society depends to a large extent on developments in science and their applications in technology. Thus, advances in science and technology are largely responsible for any security that might be achieved through military strength. This means, from this point of view, that such advances must be fostered.

The second sense in which the term "security" is now being used has to do with the classification of information, referring to the establishment of categories of secrecy and the establishment of such measures and procedures that certain types of information do not come into the hands of unauthorized persons.

This matter of keeping scientific information classified is a complicated one, and I very much fear that the public does not understand the basic problem involved in it. I cannot stress too strongly that, if we are to attain those limited objectives of security through military security, we must progress in the sciences, because military strength rests on science and because the "secrets" of science are open to any investigators anywhere if they will put forth the requisite effort. However, the subject matters of the different sciences are related, and rapid advances cannot be made unless there is considerable interchange of information among scientists in this country. Moreover, undue classification and compartmentalization may mean that large groups of scientists are working needlessly on problems which have been solved by other groups. This is an obvious waste of scientific effort and may mean a fatal delay in some particular development.

These facts are recognized by competent individuals in the National Defense Establishment and in the Atomic Energy Commission, and the declassification of information by these agencies is one indication of such recognition. However, the very real danger in the situation is that unless the public comes to realize the nature of the problem and the very sensible approaches to its solution, the public itself may guarantee our falling behind in science, jeopardizing the very security about which it is so sensitive.

The basic conflict may be stated thus: Restriction of information is designed to conserve a static position based on present knowledge. Science can grow and develop only by a wide distribution of information about its results in order to bring new young minds to bear on its problems. Although science for its own sake is a good thing, I here want to focus attention only on the slowing down of possible military application which a stagnation of science would produce. Therefore, if we adopt policies that are too restrictive with respect to our present knowledge, we stifle the growth of that knowledge. The price we have to pay in order to grow in knowledge is some giving up of present knowledge in order that we may continue to grow. From the strictly military point of view it is just as important for us to have some new secrets to keep as it is for us to hold on to the old ones. Scientific secrets deteriorate when stockpiled.

There is another point which is important with regard to this country's position in particular. If we adopt policies that are too restrictive about scientific knowledge, other countries will also do the same.

As Charles Kettering, of the General Motors Corporation, has put it, "When you lock the doors of the laboratory, you lock out more than you lock in." This result could be especially weakening to America, for we have not thus far been very productive in truly fundamental science. On the other hand, we are very well equipped to make rapid progress in exploiting technological uses of such fundamental knowledge. For these reasons we have to guard against policies that are so narrowly restrictive that we stifle our own development.

It would be most unfair if anyone who has heard me say what I have just said were to go out and say that I talked against secrecy, or that I advocated giving away the so-called secret of the atomic bomb. I do not now, and never have, held such a position. In particular, I have never advocated giving away any information about our precious atomic bomb. I have, however repeatedly stressed the point that what we could learn by research with the aid of our British friends and many valuable refugees from Hitler's Germany and Mussolini's Italy can also be learned in time by any group of scientists. And therefore, whether we like it or not, we cannot found any policy on the belief that we have anything but a very temporary monopoly in this field. It does not follow, however, that we should not hold onto this temporary advantage for what it may be worth. In the last analysis the problem of restriction is one requiring a delicate balance between the benefits of disseminating and restricting information, which only experts can determine.

Attitudes Toward Scientists

My second main point is this: Scientists are not deserving of, nor should they get, any *better* treatment than the rest of our citizenry with regard to procedures of investigation designed to pass on their probable personal integrity and reliability. On the other hand, it ought also to be admitted that scientists should not be regarded as intrinsically or à priori less reliable than the rest of our people. Yet there are those who seem to start with the assumption that a scientist is a peculiarly unstable fellow with no sense of responsibility or capacity for living according to the rules. They seem to start from the false assumption that he is guilty of incapacity in this direction unless he can prove himself innocent.

The question of personal investigation for loyalty or discretion is one on which there seems to be a great deal of confusion. I first heard the word "clearance," as a jargon word meaning permission for an individual to have access to official secrets, in the fall of 1940, when the microwave radar work was organized under the National Defense Research Committee. We all filled out long questionnaires and went to work. What was done with those I do not know. As the war went on and I became associated with other projects, I filled out more questionnaires and was fingerprinted again and again. I do not object to that, although I venture to say that millions of dollars were wasted on useless duplication of such procedures. My own position has always been that I have nothing to conceal, and if I have omitted to tell anything about myself, it was either because I thought it was irrelevant or because I could not find anybody willing to listen. A lot of the investigating that is going on today is in extremely incompetent hands and, for that reason, a waste of the taxpayers' money.

One thing that never seems to occur to some of those who worry so loudly about the discretion of scientists is that the information in question, in many instances, was not given by the Government to the scientists in the first place; rather, it was given by the scientist to his government, and, as many of us know from personal experience, it was sometimes most difficult to get the Government to listen.

The history of the atomic bomb project is an interesting case in point. News of the discovery of uranium fission reached this country from Germany in January 1939. Within a short time quite a few American physicists recognized the possibility of useful release of atomic energy and of making an atomic bomb. Then started a process of trying to interest the Government with no apparent action resulting. We physicists in the meantime voluntarily adopted secrecy policies which kept this information from the public and from other countries. After some months of frustration a direct appeal to the President was made and he saw to it that a program of work was started under the general supervision of my predecessor, Dr. L. J. Briggs. The secret was so well kept that most of the staff of the National Bureau of Standards were unaware of the existence of an atomic bomb project prior to the official announcement.

I know of no example anywhere in which a group of persons behaved in a more loyal and discreet manner than did this group of American physicists who, without clearance or loyalty probes, kept secret this important information and fought their way to the Chief Executive in order to get action. Later, of course, they were all fingerprinted and checked and rechecked before they were allowed to know these things which they had so long kept secret and about which they had to work so hard to arouse any official interest. I do not object to their being investigated this way; but I cannot help wondering what we could have done about it if we had found that some of these individuals could not be "cleared."

Compartmentalization in Science

Detailed practices were quite different in different projects. I can only speak from first-hand knowledge of two of them: microwave radar and the atomic bomb. This brings me to the subject of *compartmentalization.* By compartmentalization in the jargon of secrecy policies is meant the policy of not allowing a man to know any more than he needs to know in order to play his part in the working organization.

The theory back of this, I suppose, is that if somehow, he should fail to be reliable, the less he knows, the less he can tell. The idea is easily applicable in military operations. Very few need to know the over-all war plans: others will be given orders covering their part when their time comes. It is conceivable that a Navy gunner does not need to know anything about the radio on his ship, and so on.

It is likewise quite true that a minor employee in a scientific research laboratory does not need to know what the over-all objective of the laboratory is. If it is his job to wire up and adjust some specialized electronic gear according to fairly explicit directions, he is not hampered in his work by not knowing what the gear is for.

The difficult problem here is to know where to draw the line. I am strongly of the opinion that the research scientist needs to feel free to get any information he wants from other branches of the research organization. There is a certain small extra risk if the man proves to be unreliable, but one more than makes up for it in the increased effectiveness with which he can work.

That there is no general agreement on policy here is shown by the fact that there are a great variety of opinions on this subject which have found official acceptance. For example, the British seem to have followed the policy of giving high-level personnel free access to anything whatever. The men, were, of course, asked not to waste their time by unnecessary visiting around, but each individual was allowed to be the judge of that. The contrast between the American and British systems was especially striking on the atomic bomb project, after our British friends came over in large numbers in the fall of 1943 to give us their help on the job. The Americans were bound by strict rules of compartmentalization. It was extremely difficult to get information from one part of the project if you were on another part, even though a clear need existed. What made matters more difficult was the fact that because of such secrecy one often did not know whether the desired information existed or where to go to ask for it. The fact that the British had no such rules was a great benefit to us Americans, for the British were able to supply badly needed data, the lack of which might have seriously delayed our work in several phases of the project. The moral here is self-evident: excessive compartmentalization threatens our own goals.

There was another amusing contrast between early British and American policies on atomic energy. In America there was for a long time a tendency to exclude all foreign-born scientists from work on the project. In Britain, however, it was felt that the atomic bomb was a very long-range project with chances of success so remote that the native British scientists could not be spared for it. So in Britain the project was at first put almost entirely in the hands of the refugee scientists.

Likewise, there was remarkable contrast between the degree of compartmentalization in the microwave radar field and that in the atomic bomb field as practiced in our American laboratories. With the microwave field at the Radiation Laboratory in Cambridge, Massachusetts, there was no compartmentalization whatever—at least, none of which I was ever aware. More than that, there were frequent secret conferences on special topics, attended by hundreds of staff members. People in all parts of the subject went to a great deal of trouble to keep those in other parts fully informed. I believe that a great deal was gained by this lack of compartmentalization in the field of microwave radar. I also think that we would have had a much harder time with the atomic bomb project had our British friends not short-circuited compartmentalization for us.

The Disclosure of Scientific Secrets

This brings me to my next point—one that has often been stressed by other students of this subject. It is the *extreme difficulty of giving away scientific secrets.* I have never tried to do it, so I have no first-hand knowledge in this context. I should imagine, however, that it would be rather like teaching. All of us have experienced the teaching process as receivers, and some of us have also tried to serve on the transmitting end. Of course, if the secrecy goes so far as to include the mere fact of the existence of a project on a certain subject, such a secret can be given away without difficulty. But the amount of essential detail, even with regard to principles and especially with regard to specific designs, that inheres in any modern scientific military device is fantastically great. To give away such secrets one would have to transfer vast quantities of drawings and documents. Even those are usually so unclear without explanation that the receiver would need to be given a special course of instruction in their meaning, and this, to be really effective, requires the receiver to be a man of high scientific and technical training.

This is not to condone indiscretion or carelessness but simply to point out that giving away technical secrets is not as easy as it might seem to the uninitiated. I feel sorry indeed for any modern Mata-Hari who might be assigned to get the secret of the atomic bomb by working her wiles on a young Army sergeant.

That brings us to another point of interest. What is the actual state of espionage with regard to scientific matters? At the beginning of the war all of us scientists were warned about spies and to be careful, and I know of no one who did not take such warnings with the utmost seriousness. We were seriously in the war and were trying to help win it in every way. I do not know what experience others may have had, but, throughout the war and since, there was only one occasion on which a person attempted to obtain from me information which he was not authorized to have. In that case a foreign visitor in 1944 asked me point-blank if we were working on a uranium bomb, and I lied to him, saying that I knew of no such project.

I first heard of the Canadian spy cases soon after coming to Washington. I heard about them before the situation became public and from the President himself, who was deeply concerned about the reports he had received from Ottawa. I do not wish to condone or excuse in any way the behavior of those whose guilt was established after careful investigation and after a fair trial had been conducted in accordance with established judicial procedures. The fact that such misconduct could occur on the part of certain persons who had access to official secrets is a shocking thing. Equally shocking is the fact that the intelligence services were completely unaware of what was going on and that the cases developed only as a result of the confession of a clerk who had a most difficult time getting someone to listen to his confession. He had almost as difficult a time as did our atomic scientists in interesting their government in atomic energy in 1939.

This question of espionage in our scientific laboratories is one of the utmost seriousness. It certainly cannot be dealt with simply by assuming that every foreign visitor is a spy, unless we are prepared to cut ourselves off completely from all sources of scientific information from other countries. Moreover, we cannot follow the policies of scientific and cultural cooperation with other countries which Congress had laid down in the Fulbright Bill and the Smith-Mundt Bill and at the same time refuse to accept properly accredited scientific visitors from abroad. What needs to be done is to handle these visitors in such a way that they do not gain access to restricted information, while at the same time making their visit the occasion for building up friendly good will. It is a delicate problem which cannot be handled by sledge-hammer methods.

There has always been a great deal of romantic talk centering around espionage which seems to stem from the spy fiction which is printed in our pulp magazines. The real facts are hard to get at, because naturally this is a matter about which publicity is not helpful for those who have counterespionage responsibilities. There is one important bit of over-all information available, however, which goes beyond whatever inferences may be drawn from my own lack of personal experience with spies. It is the espionage part of the atomic bomb story that appears in the book, *Alsos,* written by Samuel Goudsmit. This book, as you know, deals with the American intelligence mission which went into Germany on the heels of our Army with the assignment of discovering what the Germans were doing about atomic bombs. Such a high priority did this mission have and so fast did it move that there were times when it might be more accurate to say that it moved in on the toes of our Army rather than at its heels.

During the war we who merely worked in the laboratories always believed that the Germans too were making a tremendous effort and that they might produce the atomic bomb before we did. This belief was a great spur to our efforts, although it is hard to say just what foundation we had for it. Knowing, however, that the Germans started with the same kind of knowledge we did and that they had been pretty good in science, at least before the Nazi regime took over, it was natural to suppose that they would work hard and effectively on this project. In addition, we heard German propaganda statements from time to time about marvelous new weapons, and we interpreted these as references to the atomic bomb. I never heard any more than that during the war, but so general was the conviction that we were in a close race that we all supposed that the people in the so-called higher echelons really had information about the situation from their intelligence reports.

The facts were quite otherwise, as Goudsmit's book discloses. The Nazis, by their methods of political terror, had so completely neutralized their best scientists and had put the management of important projects so completely into the hands of incompetents that their actual progress in this field was unimportant and negligible. So trivial was it that some of their scientists have since tried to hide their ineffectuality behind the claim that they were not trying to make an atomic bomb. This part of Goudsmit's story is pretty familiar material.

But the part of his story that I wish to call to your attention in connection with our discussion of scientific espionage is that (a) our own intelligence services

were, in fact, totally lacking in factual information about the German effort, prior to the invasion of Germany, and (b) the German scientists in charge of their project were totally lacking in knowledge concerning our effort. When Goudsmit saw them and all their official records in May and June of 1945, they had no more knowledge of our project than we had of theirs. Like us, they supposed we were working on it but lacked concrete information as to what was going on.

What lesson are we to draw from this? Espionage on both sides was certainly ineffective with regard to the atomic bomb project. Does that mean that this topic was neglected by intelligence officers, or that it was not neglected but incompetently handled, or that getting information about scientific matters by traditional intelligence methods is too difficult to be useful? I am inclined to think that the last explanation is nearest the truth.

While I am not surprised that the Germans were unaware of any specific details about our work on the atomic bomb project during the war, I am frankly quite surprised when Goudsmit tells us that they really did not even know about the Manhattan Project or what its general object was—for that was known to literally thousands of Americans.

Both for the sake of emphasis—for this is an important and serious matter—and for the sake of establishing firmly my own thoughts on the subject, let me summarize these remarks on the disclosure of scientific secrets:

First, it is extremely difficult to give away scientific secrets. The mere principles of modern scientific military developments are extraordinarily complicated, and the really valuable working details are even more detailed. To betray such secrets would require, in all probability, not only the transfer of vast and bulky quantities of reports and documents and the careful and lengthy "coaching" of an extremely well-trained scientist by an expert, but also the actual training of many men.

Second, American scientists have shown themselves singularly conscientious and discreet. In the case of the atomic bomb, we witnessed their effective and voluntary self-imposition of secrecy long before they could even get the military or the Government interested in the project. Moreover, there has not been to my knowledge a single case of breach of confidence or indiscretion by any American scientist.

I most emphatically do not say, because of our good fortune thus far, that classification and clearance measures are unnecessary, nor have I ever said this. On the contrary, I maintain that such measures are wise. I only believe that every aspect of the problem should be examined and appraised, and my comments are constructive in the sense that I believe the objectives of this Nation would be defeated if we allow *unnecessary* or *needless* regulations to hamper our progress. It is again nothing more or less than the question of balance. At one extreme there is the position of complete regulation in which, carried to its logical absurdity, every scientific development is secret and every scientist, in effect, stagnates in a vacuum-like cell of isolation—a position meaning nothing less than total disaster. At the other extreme there is the position of complete absence of regulation—a position probably most beneficial to scientific advance but unwise where military matters are involved. The sane position at present lies between the two, as our military men realize and as their policy indicates. In this, not only is advance in science involved, but also its application, for unless these advances are incorporated rather rapidly in industry, there is little benefit to the armed services. My comments are thus merely a declaration of the aspects of the problem, aimed primarily at the public which does not have the information which both scientists and our military leaders possess. Misinformed public opinion, in the present atmosphere of anxious concern, may create a situation in which our progress is impeded. It is important, then, that the public be properly informed as to the problem. This is a responsibility of scientists, of our military leaders, and of the officials of our government.

Security in the Broader Sense

Let me return briefly to "security" in its more general and civilian sense: "freedom from fear, anxiety, or care; confidence of power or safety." What a splendid thing is security, and how eagerly do all human beings crave it! Considering that every kind of human maladjustment, be it real or arising from erroneous beliefs or misinformation, gives rise to fear, anxiety, or care, we see that nearly all human difficulties could be resolved if we would only find out how to achieve security.

Kinds of security are best classified in terms of the kinds of insecurity which deprive us of feeling secure. These may be grouped into four main headings: (1) anxiety of the individual concerning his place within the social groups to which he belongs, (2) anxiety of minority groups concerning their place in the national community, (3) anxiety of the national community as a whole concerning avoidance of economic depression, and (4) anxiety of the national community concerning avoidance of war with other such groups.

All of these are very real, often bitterly tragic, anxieties. Perhaps the most bitter and the most compelling one now is the last—in a period which has

seen two major wars and scores of so-called "minor" wars in less than half a century. This anxiety today weighs down every civilized human being in the world; it is this anxiety beside which all others seem trivial.

Security with regard to avoidance of war cannot be assured by purchase of military equipment or any amount of research in applications of physical and biological science to military technology. This is not to argue against such efforts, but to warn against too exclusive a reliance on their efficacy. The entire documented history of man stresses the danger and folly of such reliance. The only way to security in international relations lies in a devotion to study of the social problems confronting mankind as a whole. This calls for an undreamed of development of all the social sciences and their application to social problems in a spirit of high responsibility. It calls for an approach to such problems which is not limited by traditional thinking in terms of group rivalries of any kind. It will not be easy, just as it is not easy to develop supersonic jet planes and guided missiles.

Getting down to the particulars of the present situation, we should recognize that there is no defense against the atomic bomb. There is no defense against ordinary bombs, for that matter, as the cities of Europe clearly attest. The old cliché that there is always a defense to every weapon of offense should be revised to read "there is an *attempted* defense to every weapon of offense."

What kind of attempted defenses against the atomic bomb have been proposed? These are: (a) neutralization of use by fear of retaliation, which is the commonly accepted view as to why poison gas was not used in World War II, (b) interception of the means used for delivery, which there is at present no reason to hope will be much more effective than in the last war; and (c) decentralization of our cities, to reduce the size of targets and make the use of atomic bombs "uneconomic" for the attacker, which would call for a complete revision of all real property values and complete dictatorial control in order to effectuate such decentralization. I have no confidence in any of these. Psychological neutralization is an unstable and uncertain hope, wholly dependent on errors of calculation and whims of judgment on either side. As to interception, there is negligible possibility of effective interception of such weapons smuggled in in peacetime and little hope of effective interception of delivery by bomber planes. To make decentralization of cities effective would require that Americans submit to government controls during peacetime, long in advance of outbreak of actual war, such as they have never submitted to even in wartime; and therefore it simply will not be done in the kind of America which we hope to preserve.

In short, the greatest contribution to real security that science can make is through the extension of the scientific method to the social sciences and a solution of the problem of complete avoidance of war.

This means that we must be willing to invest the time, the people, and the funds in developing and applying these methods. If we feel the short-range security that military strength provides valuable enough to spend approximately 17 billion dollars next year, we should be prepared to sacrifice in a commensurate manner for those activities which alone give hope of the avoidance of war. Thus, we should not balk at $0.3 billion for Federal aid to education, which promises us better, wiser, more productive citizens; or at $0.010 billion for a National Science Foundation, designed to embrace fields presently overlooked; or at $0.007 billion for UNESCO. In the years since the end of hostilities in August 1945 we have seen a steady deterioration in certain parts of our foreign relations and a gradual resignation to the point of view that another war is, if not inevitable, at least probable. It is reasonable to ask, at this junction, the question which John Winant asked his audience at his last public appearance before his death last autumn: "Are you doing as much today for peace as you did for this country and civilization in the days of war?" "I'm not," he answered for himself and committed suicide two weeks later.

Perhaps man, with his relatively short history, has neither learned his lessons well nor progressed far enough intellectually and spiritually. Perhaps his history for some time to come will be an unhappy and tragic one. This is our problem. It will not wait, nor can it be evaded.