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The Dilemma of Scientists in the Nuclear Age

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Scientists have made possible the nuclear arms race. The cases of some of the individual scientists are discussed. Most scientists on military work were and are not only justifying their work, but they are enjoying their lives. A general strike of the military scientists against the arms race is an illusion. A pragmatic approach to the problem is need. In any case it is imperative that concerned scientists concentrate on the struggle against the threat of nuclear war. They must interact with the people at large, especially the people in the mass organizations, and help them to judge the situation and to evolve suitable countermeasures. A few words are said about the possibility of world government.



Introduction

In April, 1981, the Austrian group of the international Pugwash Movement on Science and World Affairs, in an Open Letter, drew the attention of the Federal Chancellor, Bruno Kreisky, to the extent of the disaster of a nuclear war, if it were to break out. The Open Letter was signed by 330 Austrian University professors. A few of the data in it may be of general interest.

As pointed out in a document¹⁾ of the Office of Technology Assessment (O.T.A.) of the U.S. Congress, one single large nuclear weapon would be sufficient to blot out a town like Detroit or Leningrad and kill 3 million people. The explosive power of each of the biggest weapons known (60 megatons TNT equivalent) is about that of dynamite with a weight of 10 Cheops pyramids. TNT is the chemical explosive generally used in the two world wars. Fifty thousand nuclear weapons in various sizes are now believed to be in the arsenals. If their total explosive power were divided up equally, one Hiroshima bomb could be exploded somewhere on Earth every second (!) day and night, for two weeks, before the arsenals were exhausted.

Moreover, it is widely feared that with increasing number and precision of nuclear weapons and progress in antisubmarine technology a "first strike" against the adversary may become feasible within the next few years. The temptation to adopt a "launch on warning" policy may then well become overwhelming. In the last consequence this would mean the complete exclusion of humans from the decision process of the country that sees itself as the defender. As soon as the sensors "think" they have detected an enemy attack, the computer so-to-speak presses the red button for the massive counter-attack, and brings civilization in the target country to an end. Another danger is the increased likelihood of preventive war.

This situation would not have arisen without the determined efforts of scientists, and it would not continue to worsen without their ceaseless endeavour. The technologists, in turn, build upon the original ideas of the scientists. The nuclear and other weapons of mass destruction are firmly based on the bold thoughts and solid achievements of many of



the most competent scientists of the world. They are directly in the service of their governments or employed by firms supplying the governments. Interestingly, the leading weapon scientists and technologists were all men.

Einstein and the Bomb

Not all weapon scientists were and are evil. On the contrary, among the men who invented and perfected weapons we find many who were concerned with progress and the fate of mankind. In pre-nuclear times, Paul Langevin, with his work on sonar (submarine detection) during the First World War, may serve as an example. Well-meaning and responsible men like Leo Szilard and Harold Urey were among the pioneers in the work on the atomic bomb. However, the most striking case was that of Albert Einstein.

It is well known that all his life, from 1914 onwards, Einstein²⁾ gave much time, thought and effort to social problems, and that world peace was always a major concern for him. Between the two World Wars he was an absolute pacifist. Yet in 1939 he was persuaded by Leo Szilard³⁾ to urge President Roosevelt to start work on the military, i.e., destructive, applications of nuclear energy. True, contrary to what has been said, he did not ask for the construction of weapons, let alone for their actual use⁴⁾, but it must have been clear to Einstein that nuclear weapons were inevitable as soon as the research work urged by him had led to recognition of their feasibility and efficiency.

Before we return to Einstein's dilemma, attention should be drawn to one general point. Historical experience shows that introduction of any new weapon, provided its value is confirmed, constitutes an irreversible step. The evil spirits cannot be put back into Pandora's box. Thus the consequences of a scientist's action inexorably persist and develop even after the original reason for the action have vanished. In Einstein's specific case the bomb was used against Japan in 1945

after it had turned out that a nuclear threat by Germany or her allies, the original justification, did not exist. The Nazis' astonishing failure in this field has been well described and discussed by Samuel Goudsmit⁵⁾. According to him many nuclear scientists in Germany wanted their weapon project to be successful; but this conclusion has been contested by some of the scientists involved.

Because of Einstein's great sympathy for Japan⁶⁾, dating from his visit there in 1922 when he was welcomed by hundreds of thousands of people, the dreadful death of so many men, women and children in Hiroshima and Nagasaki must have been particularly bitter to him. It would not even be true to say that nuclear bombs would have been dropped on Japan in any case, Einstein's letter or not. The acceleration of the development of nuclear weapons, due to Szilard's efforts and Einstein's letter, was probably sufficient to get the bombs ready in time before the surrender of Japan, which in any case would have occurred in 1945. So Einstein had to shoulder considerable co-responsibility⁷⁾. Later he bitterly regretted his action²⁾. This did not change the fact that nuclear weapons continued to proliferate after the war, long after the end of the Nazi empire, and still do so. In fact proliferation has been speeding up all along.

Scientists Content with Work on Weapons

For most experts, scientists and technologists, who are inventing and improving weapons, an Einsteinian dilemma simply does not exist. They are happy in their work, in which they are supported, honoured and well paid. They do not doubt that they are doing the right thing. They are either convinced that their products are needed for the good in the world, i.e., that it is their own side, and only their side, that is in the right, or they take the position that it is Parliament and Government (both elected by the people, provided elections exist) who have to decide. As long as these bodies say "yes" and provide the means, it is not a matter for the weapons expert to question their



wisdom. So they say. Scientists should be on tap, but not on top, as the quip goes.

On the basis of his incomparable experience, Herbert York^{8,9)} has, in his awesome book "The Race to Oblivion", described the situation in a gripping way:

"The various individual promoters of the arms race are stimulated sometimes by patriotic zeal, sometimes by a desire to go along with the gang, sometimes by crass opportunism, and sometimes by simple fear of the unknown. They are inspired by ingenious and clever ideas, challenged by bold statements of real and imaginary military requirements, stimulated to match or exceed technological progress by the other side or even by a rival military service here at home, and victimized by rumours and phony intelligence. Some have been lured by the siren call of rapid advancement, personal recognition and unlimited opportunity, and some have been bought by promises of capital gains. Some have sought out and even made up problems to fit the solution they have spent much of their lives discovering and developing. A few have used the arms to achieve other, hidden objectives.

Nearly all such individuals have had a deep long-term involvement in the arms race. They derive either their incomes, their profits, or their consultant fees from it. But much more important than money as a motivating force are the individuals' own psychic and spiritual needs; the majority of the key individual promoters of the arms race derive a very large part of their self-esteem from their participation in what they believe to be an essential - even a holy - cause."

More specific is the example of the scientists of Los Alamos. We are not arguing here whether their deathdealing work was justified, or even necessary. The fact is that the majority of scientists and their wives enjoyed themselves hugely in their fascinating job in excellent and stimulating company. Many books of reminiscences appeared where the spirit of Los Alamos is recalled with delight, including the book by Laura Fermi¹⁰⁾, the wife of one of the scientific leaders. Aage Bohr¹¹⁾ also was deeply impressed with the "pioneer character of the undertaking", the "unique intellectual atmosphere" and "the magnificent natural surroundings". We now quote from a review, with the promising title "Intense Living in Secret Cities", of a recent collection of lectures¹²⁾. In this review, by Jane Wilson¹³⁾, we read:

"Los Alamos was an adventure, and some sense of its excitement shines in these lectures ... It was such intense living ... impression that their labours might save civilization ... Los Alamos was the home of heroes - and very young heroes, at that. For him (Richard Feynman) and many another young person collaboration and friendship with older,

established scientists like Fermi or Bethe was a delight. The land itself was enchanted; it had beautiful scenery and exotic inhabitants. Bernice Brode and Elsie Macmillan speak fondly of their relations with the Indian women of the Santa Clara and San Ildefonso pueblos. The work was challenging ... Above all there was a high sense of purpose." To add to the flavour, the readers of the review are treated to a cheerful picture of a Sunday outing with Fermi, Bethe, Rossi, Segrè and others.

Perhaps we should stop for a moment to consider the fact in some miraculous way it almost seems as if there had been no causal connection between the cheerful life at Los Alamos and the cruel death, through blast, fire and radiation, of hundreds of thousands of people far away^{14,15)}. (A horrifying concrete account¹⁶⁾ is contained in a manuscript by a doctor, Shuntaro Hida, who survived at the periphery of Hiroshima. He had to deal with large numbers of victims.) Konrad Lorenz¹⁷⁾ emphasized how small are human inhibitions against committing crimes (or making wars) against humans one does not see. Long ago, the English novelist Arnold Bennett¹⁸⁾ wrote a tale about human insensitivity to suffering that is not noticed directly. Who would refrain from becoming rich if the price were merely the death of an unknown person in China? Clearly such insensitivity applies not only to one person far away, but also to millions.

A recent TV film sponsored by the US government showed an inter-continental rocket silo in the Middle West. One of the soldiers, whose task it would be on Day X to turn the key for the release of the rocket, was interviewed. He was in his early twenties and may have been a farmer's boy. He was not unpleasant. Asked about his feeling, he shrugged his shoulders and said that he just wanted to do his job well. Of course, he was not told what the target of his private rocket is, i.e., what exactly his job would involve. He added that he preferred not to know; he might feel sorry for the people in the target town.

So it depends on the turning of a key, by an unknowing farmer's boy from Texas (or from the Volga), or on the turning of several keys, by several such boys in conjunction, whether a town, maybe in Europe, is changed instantly into a heap of burning, radioactive rubble, a



town that may have been built by thirty generations of engineers, architects and artists and may house millions of peaceful people.

To return to recent history, few members of the lively and thriving community of Los Alamos pondered the fact that the US government had not given any pledge about the use or non-use of nuclear weapons. Leo Szilard was, of course, one of the noble exceptions. He did care, he organized petitions, and he made desperate attempts to prevent the use of bombs against Japan. Again he enlisted Einstein's help, but this time the attempt failed³⁾. Now Einstein could not influence the government.

Nuclear Surrender in World War II?

We return now to Einstein's dilemma in 1939. He was an extreme case - a totally incorruptible man. He would not have enjoyed the Los Alamos atmosphere even if he had been invited to participate - which he was not. General Leslie Groves, Robert Oppenheimer and the other men in power wisely refrained from doing so. Yet, in the light of what was known at the time, could he have acted differently than he did, through his first letter? Was it not necessary to counteract the threat of nuclear arms in the hands of the Nazi criminals? Would Einstein not have seen himself as an unwilling accomplice of Hitler in his murderous onslaught on the world, and more particularly on the defenceless Jews, who soon afterwards were marched to the gas chambers in the East, if he had withheld Szilard's information from President Roosevelt? The situation of lesser scientists than Einstein, who likewise wanted to be effective against Nazi barbarism, was not different in principle from his, even though they could not influence events to a similar extent. The views and actions of the Soviet nuclear scientists during the war are interestingly described by Igor Golovin¹⁹⁾.

Nevertheless, the question must be asked: Would it not, in spite of everything said, have been right during the war to refuse the participation in the development of nuclear weapons? It would be easy

to say "yes" - i.e., that total and absolute refusal would have been correct - in hindsight, presupposing our knowledge that Hitler would have no nuclear weapons. But this could not be known in 1939. And what if the scientists of the anti-Nazi alliance had, in spite of nuclear bombs in German arsenals, nevertheless insisted on the non-construction of nuclear weapons? It could be argued that Hitler, in onesided possession of nuclear weapons, might have forced the world to surrender, but that sooner or later, in one way or another, freedom would have re-emerged. Provided the nuclear refusal could have been upheld, there would then have been a world without nuclear weapons. This world might have given more hope for survival than our present world, where total annihilation of human civilization in the near future is a very real possibility. This hypothetical line ^{of thought} might have led, in present terms, to a slogan like "better brown than dead". Brown was the colour of the Nazi party.

What is the answer to this crucial question? Probably the question cannot meaningfully be asked. Sensibly one cannot assume for 1939, or any other date, a knowledge of the future that just did not exist. Could one take a post-Hitler world for granted in which international tensions would reach unprecedented heights and in which the improvement of US-Soviet relations, undertaken by Roosevelt since 1934, would be totally reversed, for whatever reasons? This is one of the grounds, probably strong enough in itself, why no sufficient support for a policy of total refusal, implying the possibility of nuclear surrender, could have been found among scientists in 1939. In any case, a surrender idea would have been unacceptable to the huge majority of the people who would have suffered from it.

The Intervention of Niels Bohr*

It is interesting to compare Einstein's attitude with that of

* For this section a few sentences have been borrowed from Professor J. Rotblat.



another tower of intellectual and moral strength. Niels Bohr learned about the Manhattan project only in 1943, when he was enrolled, and for some time he stayed at Los Alamos. To judge from his son Aage's report¹¹⁾, he did not hesitate to take part, and it is not evident that he gave much thought to the use of the weapons in World War II. However, at an early date he began to worry about an arms race between the victorious allies after war. In particular, he predicted with prophetic vision the dire consequences of a race in nuclear arms between East and West. Among the radical measures which he felt were essential to prevent such an arms race, he advocated the sharing of the secret of the atom bomb with the Russians. His specific proposal was that the Russian leaders be told about the atom bomb before it was used, that the potentialities of the discovery of nuclear energy be explained to them, with an offer of sharing them, on condition that they would agree to a system of joint management and control of nuclear energy in all its aspects.

President Roosevelt was greatly impressed by Bohr's ideas, which had been conveyed to him, and he advised Bohr to put his case to Winston Churchill. In May, 1944, Bohr had an interview with Churchill and his trusted scientific advisor, Lord Cherwell. This was a disaster of the first magnitude. All that Churchill grasped was that Bohr wanted to give the secret of the atomic bomb to Russia. Not only did he reject the proposal outright, but he even wanted to intern Bohr as a dangerous alien. He wrote to Cherwell: "It seems to me that Bohr ought to be confined or at any rate be made to see that he is very near the edge of mortal crimes."

In August, 1944, Bohr was received with much sympathy by Roosevelt. The President "spoke quite openly of the political problems of atomic energy and expressed his confidence that this new development would make a decisive contribution to the creation of a spirit of (all-embracing international. E.B.) cooperation. He said that it would open a new era in history. Roosevelt agreed that an approach to the Soviet Union of the kind suggested (in favour of a common effort to remove the threat of an arms race. E.B.) must be tried and that he had the

best hopes that such a step would achieve a favourable result." However, much to Bohr's disappointment Roosevelt later gave in to Churchill, and after the President's death Bohr's initiative had no chances any more.

In his famous Open Letter to the United Nations in June, 1950, Bohr²⁰⁾ still desperately argued for international collaboration. But now he put the accent on his claim that complete openness in respect to all national facts would guarantee international security. The serious problem that in an antagonistic world complete openness favours the stronger side was hardly touched by Bohr. To give a somewhat extreme, but clear example: During the Vietnam war the Americans could safely tell the world where they made their explosives, but could the Vietnamese?

The idea that mere openness in military and weapons matters is a way to salvation may lead to bizarre consequences. Thus a full recipe how to make a hydrogen bomb was prepared to be published in 1979, apparently with the best intentions, by a freelance journalist in a periodical meant to be progressive. The US government at first tried to prevent publication, but later gave up. The case for the periodical was supported by physicists of standing. The text of the article is freely available now²¹⁾.

A General Scientists' Strike?

We have thus to face the fact now that the nuclear armaments are here and represent a danger far beyond any power of human imagination²²⁾. Let it not be said that the sheer size of the danger is so enormous that no further significant addition can be made. Not only is the total power of the weapons being increased, but more kinds of weapons are also developed, as for instance the neutron bomb, which lowers the nuclear threshold. Other "progress" leads to an increase of the chances of a successful first strike against the nuclear weapons of the adversary, e.g., the development of cruise missiles, of intermediate



range rockets, and of means for antisubmarine warfare. These developments make the adoption of a "launch on warning" policy more likely.

So the dilemma is still with us, with scientists and technologists (and all mankind). Indeed, because of the enormous size and power of the nuclear establishment, the dilemma is more acute than ever. What should be done? Laymen often ask whether a worldwide strike of weapon scientists (and technologists?) would be possible. In the light of experience, the answer must unfortunately be "no". The large majority of our colleagues in weapons work is tied to it by the mechanisms experienced specifically in Los Alamos and described more generally, mainly in respect to later periods, by Herbert York. For this reason alone a scientists' strike is an empty illusion. Even if the scientists' community consisted of incorruptible Einsteins, the bona-fide beliefs of so many scientists would make common action impossible. Too deep is the conviction of one's own country's justification everywhere.

We must tell our lay friends that scientists are, for better or worse, just humans, even though they have more factual knowledge about modern warfare than others. Scientists are superior neither in sociopolitical insight nor in moral strength. When scientists devote themselves to the common good, we must cheer, as we do with other humans, and help them, but a reversal of the terrible world situation through united action of all scientists is out of the question.

No defeatist attitude is suggested. There are many scientists indeed whose conscience has led them, or will lead them, to a consideration or reconsideration of their place in life. In the case of scientists engaged in war work it is not only rational analysis that produces second thoughts. It is also deeply unsatisfactory to devote one's life to the perfection of means of destruction. In normal, though not all, people the natural instincts are perverted by such activity. Thus there is an emotional as well as a rational component in the resistance against war work.

Many examples of eminent scientists come to mind who combined scientific insight and a critical attitude with conscience and social concern. In addition to Langevin, Einstein, Bohr, Szilard, and Urey,

already mentioned, let us recall men and women like Pierre and Marie Curie, Frédéric and Irène Joliot, Linus Pauling, Bertrand Russell, Piotr Kapitza, Vladimir Engelgardt. Not all these scientists were working in the nuclear field, but they all bravely stood up against the wrong, and worked for a better world.

The effect of activities of such leaders for truth, peace and progress can be large indeed. While scientists, inside or outside military work, will not act as a monolithic block, many scientists can be influenced by respected colleagues with wider views, and made to think critically. Let us hope that this is especially true for younger scientists. These socially-active scientific leaders also played, and some are still playing, an important part in the birth and the growth of organizations of scientists that devote themselves to world progress and peace rather than to the mere representation of their professional interests.

Scientists Addressing the People

Pugwash²³⁾ is an important example showing that socially inspired, essentially peace-directed, activities of scientists can extend far beyond the laboratories. It can affect national and international life. In all countries some social currents seek to improve international relations and maintain peace. (Peace, it may be added, on a more secure basis than that of the alleged equilibrium of terror, an equilibrium easily upset by new technical, political or even financial factors). These currents often include large numbers of devoted, high-minded and self-sacrificing women and men, but generally they are short of expert advice. This can be provided by people in Pugwash or in other groupings of scientists for peace.

As examples let us take Trade Unions or religious organizations. In Austria, for instance, the Unions are closely connected with the Socialist (Social Democratic) Party, and the leading force in religious life is the Roman Catholic Church, but it does not matter that in other



countries the situation may be different in these particular respects. The political parties themselves are also to be considered in this connection. Often such organizations include large parts of the active populations in the countries, but few of the members or supporters have the needed scientific qualification. Hence again and again such organizations either fall victims to wrong views on matters where science is relevant, or their attention is not drawn in good time to matters where the organization ought to take a stand. Thus the failure to respond correctly to need is often not the result of negligence, even less of bad faith, but of ignorance. The most important need, of course, is that of the struggle against the nuclear war threat.

This is the field where concerned scientists in our nuclear age can intervene. They should speak out in public and invite the large organizations to make use of their services. With determination, a positive response will be obtained. In fact, experience shows that after some time a real expert, who also has the skill to express himself clearly and be understood by lay persons, will run into great difficulties in finding the time to provide all the services needed. Conversely, strong mass movements will not fail to awaken more scientists and make them realize their duties. In many ways, scientists ought to learn from the common people.

Some concerned scientists have also found that the mass media can be induced to print, broadcast or display their views - not only in the form of short pieces of information, but also in the form of major contributions. This applies even to media, say, popular newspaper, that one looks at with suspicion. Of course, there are extremes where it would not work. But by and large, even in media that do not normally attract scientifically-minded people, editors can be found that have sufficient sense of responsibility and decency to print the concerned scientists' views. Or they might even consider such action as a clever piece of editorial policy. All this is based on the supposition that the scientist has learned to express himself clearly and easily. It is his duty to do so.

Military Work Permitted?

A few words about the contents of the scientists' message. We take it for granted that he will search for peace; he will try to act against aggressive tendencies, against the perilous policy of strength, and for detente, disarmament and coexistence, leading to cooperation and reconciliation. Now by tradition and habit most people are tempted to argue their own country's political line. On the whole, however, this should be left to others. The essential thing is precisely to explain the other fellow's point of view. The scientist ought to present the technical constraints on each side; often it will be found that there is a rational kernel in the "adversary's" argument. It requires little wisdom to know this, but we must act accordingly. Especially in respect to the nuclear threat, the need of everybody's security, not only of one's own country, must be recognized. The people at large should be shown why "adversaries" must insist on certain points, or reject certain actions of others if they are not to surrender. Only through negotiations on such a basis, preferably supplemented by unilateral actions in expectation of reciprocation, can improvements be obtained.

Finally, the question of rules for the individual professional behaviour of scientists engaged in military work should be addressed. Should one tell all such individuals to get out as quickly as possible and to turn to peaceful occupations? No doubt a move from war work to peace work would command great sympathy among concerned scientists, especially if sacrifices in standard of life, in possibilities of advancement, in prestige, etc., are involved, as will often be the case.

Yet, to one's deep regret it may not be advisable to make it a general slogan for scientists to abandon immediately military research work in all circumstances right now. Situations still exist where such work, unfortunately, must be considered as morally legitimate. Consider the example of some small country, perhaps a country in the Third World, that only recently gained its freedom and that has reason to feel threatened by a major power, maybe its former master. Could one tell the (few) scientists of such a country to stay away from defence? Should



a chemist in Vietnam at the time of the war have stopped making and improving on explosives? Legitimate work may also, in certain circumstances, serve defence against nuclear threats, and therefore it may involve the study of nuclear weapons systems. For instance, work for the improvement of the survival chances of submarines needed for retaliation, and therefore for deterrence, may be justified at the present moment.

Admittedly it could be taken as sheer hypocrisy when scientists on military work preach disarmament and peace. A lot of tact and understanding is required. The military-industrial complex and the hawks will exploit real of seeming inconsistencies.

Criteria for Decisions

It certainly would make life easier and solve our dilemma if hard and fast rules could be given to a concerned and responsible scientist, who wants to act for peace, as to what is allowed and what is not allowed. If only there were a superior moral authority which could lay down such rules! But general rules do not exist. On the contrary, each scientist must in the light of the knowledge available determine for himself what should be done, and what not. Here again the situation of scientists is not really fundamentally different from that of other persons. But the effects may be more far-reaching.

These last considerations should not be interpreted as a plea for easy relativism or for irresponsible permissiveness. The problems of the scientists are desperately serious. The action or inaction of each individual can have the gravest consequences, for evil or good. Thus the problems must be pondered in real depth by the scientists. Consultation with their fellows and organizations is also required. In our age, people do not act in isolation. The judgement cannot be that of the famous lonely lighthouse keeper, mentioned and envied by Einstein.

On the positive side, scientists ought to urge work on possible paths to disarmament and also on its techniques. For instance, assuming

international agreement for the destruction of nuclear weapons being achieved, we would not even know how to do it. Dump them on the sea bottom? Explode them underground? Convert the material to nuclear fuel? Dilute the uranium-235 with uranium-238? And what about plutonium? Certainly these problems can be solved, but much study will be needed to find the solution.

Prevention of nuclear war is the common task of all mankind. This need transcends all contradictions that otherwise exist. There is no challenge whatsoever that would justify the first use of nuclear weapons.

Finally, a brief view on the idea of world government, so dear to Einstein, though this is not the place for a discussion in detail. World government will be a necessity. The thought is absurd that our Earth will remain divided in antagonistic States in all future. Yet we must not underestimate the tremendous difficulties. For instance, will each one of the 600 million Indians have as much say in world government as each one of 6 million Swiss? Will there be an equal right to vote for all? In any case, enmity, force and oppression do not lead to world government. It can be approached only through decrease of tension, removal of distrust and barriers, abolition of the threat of nuclear war, through rapprochement and collaboration. These are the objectives to aim at now.



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