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SCIENCE, PROGRESS AND DESTRUCTION

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Lecture at the Nobel Symposium 1978 on
Ethics for Science Policy

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Abstract

During its development science has passed three different phases: During the first one science was essentially a synonym to "natural philosophy". The second phase was characterized by a symbiosis between science and technology. During the third (present) phase both these aspects still exist but the dominating characteristic is the destructive aspect of science, which has caused science - as an essential part of the military-industrial complex - to become a threat to our survival.

The scientists as a group cannot take the whole responsibility for this, but neither can the arms companies, the military, the capitalists, the communists, or the politicians. We are all parts of a mindless machinery which when once put in motion is very difficult to stop. It is more important to study the social mechanism of the arms race than to try to find scape-goats.

The fiasco of the disarmament conferences and negotiations shows that this approach is useless. It is important to try to find more promising new types of initiatives. Two such initiatives are tentatively suggested.

Science, Progress and Destruction

Lecture at the Nobel Symposium 1978 on Ethics for Science Policy
by Hannes Alfvén

The relations between science and society have changed drastically during the ages. We may distinguish three phases:

First phase: Science as Natural Philosophy

From its birth in ancient Greece up to about 100 years ago science was essentially a synonym for "natural philosophy". The main purpose of this "pure science" is to clarify the relation between man and his environment, to investigate the structure of the world we live in, to explore the properties of matter and energy. One of the important results of this activity has been a general picture according to which man is not created by some gods but is a product of cosmical forces and biological evolution.

By necessity an activity of this kind brings science into conflict with religious dogmas. Hence science can exist only in societies with at least some degree of religious tolerance. We are all familiar with the conflict between religion and philosophy - including natural philosophy - in ancient Greece and how a wave of religious fanaticism compelled philosophy to hibernate as an "ancilla fidei", a servant of religion, during medieval times. Science reappeared during the late Renaissance and was essential for the liberation of Europe from medieval religious repression and the inauguration of the age of Enlightenment. This victory of science over dogmas is certainly not final. Today we find new dogmas, new fanaticism, appearing in several forms. According to tradition the ethics of science requires all scientists to share the responsibility for the freedom of scientific thinking.

Even if today science also has got other functions pure science is just as important now as it ever was. Our society is complicated and the interaction between it and our environment is also complicated. As an example, take the atmospheric conditions. We do not know why the earth has an atmosphere which makes life possible - the atmosphere of Mars is too thin and cold and that of Venus too thick and hot. We do not know how precarious the atmospheric balance is. Is there a risk that we destroy it by burning fossil fuel or by supersonic aircrafts, or does

this result in a "better" climate? Political decisions of the utmost importance must be made without the knowledge of what they really imply, because of our neglect of a basic scientific problem. It is easy to give a large number of similar examples of our ignorance due to the lack of support for basic science.

Second phase: Symbiosis between science and technology

During the early phase of scientific development there was also a technological development, but to a large extent this was independent on the scientific development. It was in the hands of artisans who made new inventions and innovations but who in general had little contact with philosophy, including "natural philosophy". In ancient Greece, for example, technology was largely an activity of slaves which was clearly separated from the philosophical thinking.

During the ages the contact between science and technology increased, first perhaps in the field of chemistry. However, when the industrial revolution started, technology still received only a limited inspiration and help from the scientists. It was not until the end of the nineteenth century that science became an important factor in the industrial development. Perhaps the real symbiosis between science and technology started when every electrical engineer had to learn Maxwell's equations.

The symbiosis made the industrial revolution avalanche. The scientific-technical development produced an unprecedented increase in the standard of living in the industrialized countries. However, it also meant that man broke his intimate contact with nature and began to create his own environment with an often ruthless exploitation of nature. This new epoch gave an important role to the scientists and their number increased even more rapidly than the industrial output. Science became very prestigious, scientists were considered to be the inaugurators of an epoch of unlimited abundance in the history of mankind.

The price science had to pay for this was its soul: its role changed. The industrials and the politicians were much more interested in the exploitation of science than in its philosophical and ethical aspects. When they paid salaries to the scientists and supplied them with research equipment they wanted

as rapid and large a profit as possible from this investment. If a scientist spent his time in fundamental research, this was equivalent to stealing their money. It was actually worse than doing nothing, because a scientist might find that some industrial product of the company which employed him was poisonous and dangerous to the consumers and this result might decrease the profit of his company. Or the scientists may find that a political decision made by the government which paid him his research grant was silly or even harmful. This was bad in itself so basic research should not be promoted. It was even worse if the scientist tried to blow the whistle. Such scientists can expect considerable unpleasantness - and this holds today both in dictatorial and democratic countries.

This constitutes the second ethical problem to scientists. In other words, in the same way as during medieval times philosophy could survive only as a servant of religion, it is difficult for it to survive today unless as a servant of the economic and political establishments. In both cases the spirit of science is lost. The essential difference is that during medieval times the repressive establishment was religious-political whereas now it is economic-political. Perhaps also that at least in some cases the establishments of today are not so stable that it is impossible to challenge them. But so far all the important whistle blowers have been native Americans (like Rachel Carson, Linus Pauling and John Gofman). In part this is due to the scientifically leading role of the USA, but in part also because a whistle blower there has a higher chance of survival than in any other country.

Third phase: The destructive aspect of science

During the last few decades it has become evident that the scientific-technological development also has a destructive aspect. The result is that the scientists as spearheads of technology are now increasingly considered as a threat to mankind. Examples of this new aspect are the discovery of nuclear fission and its application to nuclear arms and to the so-called peaceful application of nuclear energy, the production of a large number of chemical substances which unexpectedly have turned out to be poisonous, further the general destruction of the environment by large-scale technology, and most recently also

genetic engineering. However, the most serious threat to our survival derives from the systematic military applications of science. Between 40 and 50% of all scientists work on military problems, many of them designing increasingly sophisticated means for killing and destruction. This is the third ethical problem of the scientists.

The arms race is to a large extent a result of the application of science. As we all know the nuclear arms race is now a real threat to the survival of mankind (or at least to culture as we know it).

What could we do in order to prevent science from being a threat to our survival? To give a background, let us briefly recapitulate the development by which the nuclear arms race started and see what mistakes - if any - were made.

The origin was the discovery of nuclear fission. This was an unavoidable result of progress in nuclear physics, which certainly was a most important activity for clarifying the structure of matter. The only possibility to avoid the ominous discovery would have been to stop nuclear research altogether but as only a few years earlier Rutherford himself had declared that nuclear science could never have any technological application there was no reason to do so.

Soon after the discovery it was concluded that fission gave a possibility to release large quantities of nuclear energy, which might give us a new source of peaceful energy but also might result in the construction of a very devastating new type of bombs. At this stage it was possible in principle to predict that the new discovery might be a serious threat to the whole mankind. However, because of the war the conclusion that was actually drawn was that in the hands of the nazis it would be a serious threat to all other people. The initiative to the Manhattan project came from the scientists. Without a strong pressure and a devoted work of the most prominent scientists of this century, the construction of the atomic bomb would not have ~~occurred~~ in the extreme atmosphere of a war fought to rescue the world from nazi domination.

In retrospect we can state that the Manhattan project was a tremendous overreaction to an essentially non-existing threat. As we know now the nazis did not have enough scientific manpower to construct an atomic bomb (perhaps partly because most of their best scientists, who had not emigrated, were not very enthusiastic nazis), nor did their industrial capacity suffice. But this was not known to the scientists working on the Manhattan project, perhaps partly because they devoted all their energy to the short-time project of making the bomb so that there was little time for analysing the general situation and the long-time consequences.

The US construction of the atomic bomb caused the Russians to do the same. Also this was perhaps an overreaction. In principle an agreement to avoid nuclear escalation might have been possible, but the cold war atmosphere was not favourable for this.

How the arms race has escalated since then is well-known, especially from H. York's book "Race to oblivion".

Could the scientists stop the arms race now? In principle, yes - if all scientists in the world refuse to develop new weapons. This will not necessarily lead to disarmament, only to not making a bad situation worse. But the scientists as a group have no unique position. The companies and other organisations producing the arms play actually a more important role, and also the workers in these industries. If they all strike and refuse to manufacture means for their own oblivion this would in principle stop the race to oblivion.

What actually happens, however, is just the opposite. The directors of the companies or organisations compete for military contracts, their scientists do all they can to devise more efficient arms to help them and the trade unions use their political influence to avoid the risk of unemployment in case the company does not get the contract.

Even if it is generally known that the nuclear arms race is a threat to the survival of mankind, most people consider the threat from another country - "the enemy" - to be more serious: Right or wrong my country! They may even consider the threat of another company getting the contract to be still more serious:

Right or wrong my company (or my lab)!

The reason why the efforts to stop the nuclear arms race have been unsuccessful is thought to be the mutual mistrust between the countries. But to dig a little deeper, the mistrust is fuelled by the military-industrial establishment of which the scientists are an important part. However, it would be an exaggeration to claim that the mistrust is altogether generated by this. In some cases there are real reasons for a mistrust. Hitler's ascent to power was possible because his future victims had too little of mistrust.

Every political leader in the world - in democracies as well as in dictatorships - claims that everything he or she does is for the benefit of the people, often even for the benefit of the whole mankind. There are few knowledgeable people in the world who want an "omnicide", and still the present political and military development will necessarily lead to an omnicide. Why? Every political leader ought to give the omnicide problem the highest priority, but very few political leaders seem to care very much. Or are they incompetent?

4. The social role of the scientific community.

If we want to clarify the general role of the scientists in our society the nuclear arms complex is not a very suitable case to study because military secrecy and nationalism will necessarily obscure the issues. It is easier to discuss the closely associated problem of the "peaceful" nuclear energy. In principle this should be considered as a purely commercial enterprise : in order to satisfy the need of energy (in reality not energy but exergy) of our society we have to choose between coal, oil, nuclear, solar - including wind and biomass - geothermal and tidal sources. For every item on this long list we should ask: is this source available also in the future, is it economically competitive, and is it acceptable from an environmental point of view?

The only reason why the energy problem has concentrated so much on the question "going nuclear or not going nuclear" is historical. At the time of the Manhattan project there was a general credo (at least among the scientists) that all new discoveries necessarily were beneficial to mankind. The bad conscience which many of the

Manhattan scientists had for making the nuclear bomb compelled them to believe that nuclear energy for civil purposes should give such an enormous benefit to mankind that this should compensate the terror of the nuclear arms. With this rather naive excuse the "atoms for peace" projects got an enthusiastic support from the nuclear physicists who rightly had the reputation for being the brightest and most influential of all scientists of that time.

Many governments reacted favourably to the pressure of the scientists, perhaps mainly because they were interested in the military application. The "peaceful" use of nuclear energy gave them an excellent opportunity to keep the military option open and still officially do nothing but sponsoring an extremely fascinating commercial project. The cost of nuclear energy was not important - it seldom is for military or quasi-military projects - but in order to make it commercially attractive it was claimed to be cheap.

The development of nuclear energy had proceeded successfully and almost undisturbed for a quarter of a century when a few biological and medical scientists blew the whistle, claiming that its environmental impact was unacceptable. The nuclear establishment immediately realized how dangerous this criticism was and tried to suppress it. How the controversy has escalated during the last ten years is well-known to everybody. The nuclear industry, supported by most nuclear physicists (right or wrong my science!) claim that no serious competitors exist, the environmentalists that nuclear energy is dangerous, that there are several more attractive alternatives which in reality are cheaper. Especially important is of course the connection between the spread of nuclear technology and the proliferation of nuclear arms. As mentioned already, 25-35 years ago governments in some industrialized countries invested heavily in "peaceful" nuclear energy mainly because they wanted to keep the atomic bomb option open. The same is done today by several developing countries.

5. The threat from physics, chemistry and biology.

When discussing the scientists as a threat to society we should not exclusively speak of the nuclear scientists (although the nuclear arms race is no doubt at present the most terrifying threat). The chemists are daily synthesising new products which are mixed in our food, administered to us as medicine, or let loose in the environment as in insecticides. Too often it happens that after some time

it is demonstrated that some of these are poisonous. But there seems now to be a possibility that molecular biology, especially the field of genetic engineering, may be even more dangerous to our survival.

All this gives us a most unpleasant impression that there are certain fields of science which are extremely dangerous. New development in nuclear physics (e.g. new and easy methods of enriching U 235), often motivated by their use for "peaceful" nuclear energy, show that there are so many not yet utilized ways of manufacturing means of destruction, and the same may be true in the field of genetic engineering. We may be compelled to conclude that in certain fields scientific knowledge itself is dangerous. In other words, in certain fields knowledge and power of destruction are so intimately coupled that we have to accept both or limit the research or even close down these fields of research. If we accept this conclusion we cannot claim an unconditional right of freedom of research in all fields of science.

In the discussion of these problems there are a number of people who present a fatalistic and defeatistic view: it is impossible to solve these problems so obviously we are running towards a catastrophe, there is nothing to be done, let us enjoy life and not listen to the irritating dooms-day prophets, business as usual especially as the business of destruction is very profitable. Like all predictions of the future such a view has a tendency to be self-fulfilling. However, a catastrophe which may not necessarily lead to an extinction of the human race, does not solve any problems. When perhaps humanity recovers after the catastrophe, it will have to face the same problems again. This means that we should do what we can to solve them without a catastrophe.

6. The machinery of progress.

So let us again put the question: what - if anything - could the scientific community do to stop the increasing threat of science to society? First of all it is doubtful whether there exists a scientific community which can act as a body - the nuclear debate which to some extent is a fight between different groups of scientists demonstrates how strongly the scientists disagree on a vital issue. But even a unified scientific community would be only one cog - certainly an important one - in the great machinery of scientific-technical-economic development. This machinery was built up during a century or more in order to generate welfare and a high standard of living and indeed it has been efficient in

doing so. It still is a very efficient factor for progress and has a large role to play perhaps especially for giving the developing countries the same economic benefits as the industrialized countries enjoy today. But this machinery has no brain, no soul. It works automatically according to the economic and technical "laws". Like the broom in Goethes "Der Zauberlehrling" it has now got out of control. We need a Zaubermeister to prevent it from destroying us. But Zaubermeisters exist only in the tales.

7. Two possible initiatives.

By profession scientists have a special training for clarifying complicated problems and the problem how the industrial development should be prevented from running amok and destroying us all is certainly very complicated. It belongs to sociology and the political sciences, but so far these sciences seem not to have paid enough interest to it. A research project for clarifying this problems should not concentrate on some detail problems - although such problems are important in some respects - but on large-scale problems. On the other hand it should not be so large and complicated that it is impossible to handle. Especially important is that the project is not run by establishment people who a priori will claim that everything is well and that nothing can be done.

May I suggest as a possible pilot problem, which may demonstrate in miniature those scientific, economic and social forces that drive the arms race, that a study be made of the development of nuclear energy in Sweden. The reason for this is that the nuclear program (per capita) is the biggest in the world and consequently the nuclear establishment is unusually powerful. Further the nuclear controversy has led to an unprecedented polarisation of the society (including the scientific community) and it has become important in party politics - some people claim that it was a decisive issue in the parliamentary elections in 1976. As Sweden is a half socialized country the merits of a market economy versus a socialized economy for handling large-scale technical problems will also receive attention. Further the international relations have turned out to be decisive. On one side the Swedish nuclear technology is essentially imported from the USA, on the other hand it has also been necessary to import critical experts from the USA because few Swedish experts dare to antagonize the powerful establishment. And finally - Sweden is a small country so the group of the actors in the drama is numerically not very large.

A project of this type may facilitate the understanding of the relations between the scientists, a powerful establishment, and society. It may help us to diagnose the case of the nuclear arms race. Among other things it may clarify why the disarmament conferences and committees have been nothing but what Alva Myrdal calls a "game of disarmament", a show which is not very important because the real decision-makers do not take part in it and do not pay much interest to it. Hopefully it will also indicate a more realistic approach to the arms race problem.

The second suggestion I should like to make is that the Nobel Foundation follows up the very important initiative it has taken by organising the symposium. A possible next step would be that the Nobel committees should carefully study how Nobel wanted his prizes to be distributed. It is clearly said that they should honour those who "shall have conferred the greatest benefit on mankind" ("gjort mänskligheten den största nyttan"). At the turn of the century it was generally believed that all scientific discoveries were necessarily to the benefit of mankind. Hence it was quite legitimate to interpret his will as meaning that the scientific significance of a discovery should be the only criterion which the Nobel committees should apply. Now this has changed, and the criteria for the prizes should change accordingly.

In retrospect, could we consider the prizes for the discovery of the nuclear fission or of the element plutonium to satisfy Nobel's stipulations? Shouldn't we consider the prize to Dalén for his construction of a new type of lighthouses to be one of the most appropriate choices? In the present situation shouldn't, for example, the development of renewable pollution-free energy sources be in the focus for the prizes in physics and chemistry, whereas some biologists who has demonstrated the dangers of nuclear energy should get the prize in medicine? By modifying its policy the Nobel Foundation would use its prestige for directing scientific exploration away from the fields in which the destructive aspects dominate towards fields where science really stands for progress.

Conclusions

In summary we have discussed three serious ethical dilemmas for the scientists.

1. Should we claim that the search for knowledge is legitimate also in those cases where knowledge may be a threat to the survival of mankind? If we try to restrict research in such fields we will antagonize powerful commercial interests.
2. How important is it to manufacture new substances even before they have been tested so carefully that we feel convinced that they are not dangerous? More generally; to what extent and how rapidly should we break our symbioses with nature and instead live in an environment that we create ourselves? If we try to slow down this process we antagonize powerful commercial interests.
3. Should we try to reduce the role the scientists are playing in speeding up the arms race? If we do so, we will antagonize powerful commercial interests.

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The scientists as a group cannot take the whole responsibility for this, but neither can the arms companies, the military, the capitalists, the communists, or the politicians. We are all parts of a mindless machinery which when once put in motion is very difficult to stop. It is more important to study the social mechanism of the arms race than to try to find scape-goats.

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Key words: Science, progress, destruction, arms race, nuclear holocaust, military-industrial complex, responsibility of scientists, ethics and science, machinery of progress, machinery of arms race.