

# Bulletin of the **Atomic** **Scientists**

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June 1978, Volume 34, Number 6, pp. 12-14

Prepared for University of Chicago Libraries (128.135.73.92)  
on April 14, 2006 at 6:49 pm GMT

When the June 1978 issue was published, the Doomsday Clock remained at 9 minutes to midnight, where it had been since September 01, 1974 when sALT talks reach an impasse, and India develops a nuclear weapon. "We find policy-makers on both sides increasingly ensnared, frustrated, and neutralized by domestic forces having a vested interest in the amassing of strategic forces."



# Nuclear and the

A. D. Sakharov

*This article by the distinguished Russian physicist, Andrei Sakharov, came to me in the following way.*

*I observed during 1976-77—and am still observing—with growing discomfort the explosion of anti-nuclear activities in Sweden, West Germany, Great Britain and France. I was shocked by the lack of accurate information and the political shortsightedness of the anti-nuclear activists. These observations brought me into the debate.*

*I had been trying not only to explain that nuclear energy is much less dangerous and much more healthy than the energy produced from fossil fuels, but also to convince the critics that nuclear energy is a conditio sine qua non for the political freedom and independence of the West and for the creation of a more favorable international political climate.*

*In several discussions I had been asked: "What is the attitude of Andrei Sakharov toward nuclear energy?" My reply was not very convincing; I could merely guess that his view would be similar to my own. Therefore, I sent the text of my lecture to Sakharov with an invitation for his comments. The following article is Sakharov's reply, which I received in December 1977.—František Janouch*

**Editor's note:** *Professor Janouch is now working in Stockholm. Formerly, he was head of the theoretical nuclear physics department at the Nuclear Research Institute in Prague, professor of theoretical physics at Charles University and Vice-Secretary of the European Physical Society.*

One often hears on the radio or reads in the press about demonstrations involving thousands of people, about speeches by well or not well-known statesmen, about various campaigns in the Western countries—all directed against the development of nuclear energy production, against construction of nuclear power stations, against breeders, etc. Although I felt rather amazed by this and even somewhat indignant, for a long time I restrained myself from any public statement, especially since, naturally, nothing of this kind takes place in the USSR. Gradually, however, I came to the conclusion that this subject deserves attention and that I have something to say about it.

The basic reason for anti-nuclear feelings among people is probably the fact that they do not have sufficient information about the complex and very specialized problems involved. Due to this lack of information, the natural and legitimate concern of contemporary man for preservation of his environment is misdirected.

# energy freedom of the West

It is difficult to explain to a non-specialist (though it is actually true) that the nuclear reactor of a nuclear power station is nothing like an atomic bomb, that the power station burning coal or oil offers much greater danger and harm to the environment as well as a biological threat to people than does a nuclear station or breeder reactor of the same capacity rating.

Many responsible statesmen of the West, industrial leaders and nuclear scientists have now come to understand (though belatedly) that it is necessary to bring the basic technical facts to the attention of the public. They now understand the need for large-scale scientific and technical propaganda. This is truly very important. Hans Bethe, Nobel laureate in physics, wrote an excellent, well-argued article on "The Necessity of Fission Power," which was published in the *Scientific American* in January 1976. Bethe is the author of theoretical works on thermonuclear processes in the stars, on quantum electrodynamics and nuclear physics. His works are a

part of the history of physics. European readers probably know also the name of the physicist F. Janouch who has repeatedly expressed himself on the same subject.

I am in complete accord with the reasoning of these and many other authoritative writers.

The development of nuclear technology has proceeded with much greater attention on the problems of safety techniques and preservation of the environment than the development of such branches of technology as metallurgy, coke chemistry, mining, chemical industry, coal power stations, modern transportation, chemicalization of agriculture, etc. Therefore, the present situation in nuclear power is relatively good from the point of view of safety and possible effects on the environment. The ways to improve it further are also quite clear. The basic peculiarity that distinguishes nuclear technology from that using chemical fuels is the high concentration and small volume of the dangerous by-products and the small size of the process as a whole. This makes it

easier to solve the safety and environmental problems for a nuclear power station than it is for a power station using coal, oil, etc.

At the same time it is obvious that it is necessary to force the pace of development of nuclear technology, since it is the only economically feasible method—available in the next few decades—of replacing the use of oil. (According to most estimates, oil will become both too expensive and scarce by the end of the century due to the exhaustion of convenient deposits and increased extraction costs.) Moreover, it is very important not only to construct "conventional" nuclear power stations working on enriched uranium, in which the rare uranium isotope uranium-235 is used, but also to solve the problem of producing fissionable material from the main uranium isotope and eventually from thorium.

This will make it economically feasible to utilize poor uranium ores, large deposits of which are found in the Earth's crust. Later this will make it possible to utilize thorium ores,

the deposits of which are even more abundant. As is well known, fast neutron reactors (breeders) are only one of the possible solutions of this problem. Both their engineering design and the development of safety measures are well advanced. Apparently, in the near future it will become necessary to start building industrial fast-neutron reactors. Naturally, maximum attention to safety measures will be called for.

I have already written about one possible alternative solution to the problem of producing fissionable materials, and I would like to mention it here. (I have also emphasized that I am not the originator of this idea.) I am speaking about a proposal to build a large underground chamber (probably with a hermetically sealed, heat-proof, corrugated shell) in which explosions of especially prepared thermonuclear charges of minimal power are caused to occur periodically. The products of such explosions are subsequently withdrawn from the chamber and processed. With charges of this kind, very effective production of fissionable material can be attained by letting the neutrons from the thermonuclear reaction be absorbed by uranium or by thorium. Of course, attractive as this idea is, there are many serious difficulties in its implementation.

One other problem, much discussed in the literature, is the possible theft of fissionable materials from a power station or from a reprocessing plant. The stolen materials could be used to produce a primitive atomic bomb. As far as the possibility of theft is concerned, I think that proper organization and technical security measures will make such a possibility minimal. Besides, one can hardly envy the thief who would dare to steal a fuel rod from a nuclear reactor: most likely he himself will perish and the plutonium contained in one rod will not be sufficient to produce an atomic bomb.

As far as the possibility of producing a "do-it-yourself" atomic bomb is concerned, I am bound by security regulations, as Bethe evidently is. However, like Bethe, I can assure readers that this is a very complex

procedure, not easier than, for example, building a "do-it-yourself" space rocket. In addition, one can assume that the individual obtaining a working atomic bomb will be handicapped by the denaturing of plutonium and other fissionable materials with neutron-active additives.

The whole problem of nuclear energy production should be considered from more than just the economic and technical points of view. In the rest of this article, I want to discuss the international and political implications of this problem. When I had already started working on this article, I happened to hear on the radio a broadcast about a book by the English astrophysicist Fred Hoyle. I have not read this book but judging from the broadcast, Fred Hoyle's point of view and his apprehensions are close to mine.

Policy-makers always assume, not without reason, that one of the many factors in determining the political independence of a country, its military and diplomatic strength and its international influence is the level of economic development of a country and its economic independence. This assumption is doubly valid in the case of two world systems opposing each other. But the level of a country's economy is determined by its energy technology: that is, by the utilization of oil, gas and coal at present; of uranium and thorium in the near future; and, perhaps, deuterium and lithium in the more distant future, when the very complex technical problems of controlled thermonuclear synthesis will have been solved.

Therefore I assert that the development of nuclear technology is one of the necessary conditions for the preservation of the economic and political independence of every country—of those that have already reached a high development stage as well as of those that are just developing. For the countries of Western Europe and Japan, the importance of nuclear technology is particularly great. If the economy of these countries continues to be in any important way dependent on the supply of chemical fuels from the USSR or from countries which are under her influence, the West

will find itself under constant threat of the cutting off of these channels. This will result in a humiliating political dependence. In politics, one concession always leads to another and where it will finally lead is hard to foresee.

I have already had an opportunity to tell about a statement of an important Soviet official which I heard in 1955 when I still could be considered "one of the boys."\* He was talking about the reorientation of Soviet policy in the Near East, about the support of Nasser in order to create an oil crisis in Western Europe and thus obtain an effective lever for exerting pressure on her. Now the situation is much more complex and full of nuances. But some parallels undoubtedly exist. There exists a political interest on the part of the USSR in exploiting energy shortages in the West.

Is the present campaign against the development of nuclear power inspired by the USSR (or other countries of Eastern Europe)? I know of no reliable facts supporting this. If this were so, then insignificant and unnoticeable efforts are sufficient substantially to influence the dimensions of this campaign because of widespread anti-nuclear prejudice and lack of understanding of the inevitability of the nuclear era.

I must end this article on the same note that I started it. People must have the opportunity, that is, the knowledge, and the right to consider the mutually connected economic, political and ecological problems involved in the development of nuclear power, as well as the problems involved in alternative ways of economic development. And they must have the opportunity to consider these issues soberly and responsibly, without unfounded emotions and prejudices. What is involved here is not just comfort, or preservation of the so-called quality of life, but the much more fundamental problem of economic and political independence, and the preservation of freedom for their children and grandchildren. I am sure that in the end a proper decision will be reached. □

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\*See Sakharov, *My Country and the World*, Knopf, 1975.