

THE FUTURE OF ATOMIC ENERGY

By E. Fermi

The attention of the public in the problems of atomic energy has been centered so far primarily on the military side of the development. It is natural that it should be so, since on one hand the military use is to the present time the only application that has attained practical results. On the other hand, the issues raised by it for the national and international policies are novel and difficult and call for a quick solution. There are, however, a number of possibilities for the peace time uses of atomic energy which in the long run may prove more important than the bomb.

If we try to look into the future, and we take the optimistic point of view that mankind may succeed to organize itself so as to eliminate the fear and the danger of the destructive potentialities of atomic weapons, one might speculate as to what may happen to atomic energy as a constructive new force.

Any such speculation, of course, can be at the present time only very sketchy. One might point out to some probable developments, but it would be impossible to make the list even approximately complete. An attempt to do this would be now as difficult as it would have been one century ago to guess the development of electricity.

PRODUCTION OF POWER

The first point that I propose to discuss is the use of nuclear reactions for the production of controlled and usable power. Chain reacting "piles", in which energy is produced at an easily controllable rate, have been operated for over three years. Starting with the first pile, which was run only up to 200 watts, the power has been stepped-up in successive units by enormous factors. The piles operated at Hanford for the synthesis of plutonium produce energy in amounts comparable to that of the largest hydroelectric plants. The energy that is produced in the piles built until now, however, is delivered at such a low temperature that it is of no practical use. In the Hanford plants it actually is wasted for the extremely unconstructive purpose of heating, by a small amount, the waters of the Columbia River.

The physical basis of the chain reaction is the fission of uranium. This is a violent disintegration of the uranium nucleus that takes place when a neutron strikes it. The original nucleus separates into two approximately equal fragments, which fly apart with an enormous velocity and a relatively extremely large release of energy. What makes the chain reaction possible, however, is not the fact that a large amount of energy is released but the fact that in the process also some neutrons are emitted besides the two fragments. If we assume, for the purpose of this discussion, that two neutrons are emitted in each fission and we assume further that the conditions are such that practically all the neutrons originating into the system end up by giving rise to fission, we have the conditions that would lead to