Natural Stability or Instability of the Chain Reaction.

If a chain reaction is maintained in a homogenous mixture of uranium and the element which has the function of slowing down the neutrons, such a system has a natural stability, i.e. if we have such a homogenous mixture in the form of a sphere or a spherical shell, and if the radius has been so chosen that at a given temperature it just corresponds to the critical radius, it has just the critical value at which the neutron output becomes practically infinite. A rise in temperature will increase the critical radius so that the actual radius will become smaller than the critical radius and the neutron output will drop to a small value.

This natural stability cannot be understood by considering the multiplication factor, i.e. the behavior of a chain in an infinite mass of uranium. It is due to the fact that, if we have a sphere, the radius of which is approximately equal to the critical radius, the fraction of the thermal neutrons which escape at the surface of the sphere without reacting with the uranium increases with increasing temperature.

???? It is easy to see that this fraction is proportionate to the temperature, and the effect on the increase of the critical radius with temperature is the greater the smaller the absorption of thermal neutrons in the mixture.

Conditions are however very different if we have a lattice of uranium containing bodies embedded in an element the function of which is slowed down by the neutrons. These bodies may have a strong absorption for thermal neutrons so that they may be considered as black from the point of view of thermal neutrons. The change in temperature will then lead to an increase αx in the ratio of the neutrons absorbed by uranium and the neutrons absorbed by carbon, and this ratio will be proportionate to the temperature. This means that we have a natural in-

stability of the chain reaction, i.e. that a sphere of such a mixture of carbon and uranium, the radius of which is below the critical radius for a given temperature, will have to be (?) above the critical radius for a higher temperature.

Artificial Stabilising of the Chain Reaction.

It has been suggested by Adler and Halban to admix cadmium to the uranium in order to stabilise the chain reaction. While this may be of advantage in certain specific cases it would seem to me that it is unnecessary if a homogenous mixture of carbon and uranium is used, and insufficient if a lattice of uranium containing bodies, which are black to thermal neutrons, is used.

This can be done for instance by shifting sheets of absorbing material automatically in the direction of increased absorption whenever the chain reaction becomes more intense, and in the opposite direction whenever the chain reaction becomes less intense. The crucial question in this connection is the time element, i.e. how fast such a regulating action has to follow a change in the intensity of the chain reaction, or, to put it in a different form, a change in the critical radius. In order to form an opinion on this point

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