SUMMARY

It is shown that a divergent chain reaction may be maintained in a system composed of uranium and carbon. Conditions particularly favorable for a chain reaction are obtained if ~~instead of using a homogeneous mixture of uranium and carbon~~ one uses a large number of rather small spheres of uranium metal ~~are used~~ embedded in a mass of graphite. The small uranium spheres may form a close-packed ~~hexagonal or cubic~~ lattice and may be embedded in a large sphere of graphite. The average number of fast neutrons emitted by uranium for one thermal neutron absorbed by uranium is calculated from known experimental data and is found to be about 2. In our system conditions for a chain reaction become more and more favorable as the temperature increases and it is shown that we could expect a chain reaction ~~to be self- generating~~ in such a system at about 900° C. even if the cross-section of carbon were as high as 0.01, its present experimental upper limit. ~~As~~ Since the intensity of the chain reaction increases with increasing temperature the system is thermally unstable. It can be controlled artificially. The time within which the control would have to respond is found to be longer than one second. As much as 100 tons of graphite ~~and 30 tons of uranium~~ might perhaps be required in order to reach the point of divergence at which nuclear transmutation will go on with an intensity limited only by the necessity of avoiding over heating. ~~But in so far~~ Inasmuch as the capture cross-section of carbon is likely to be below 0.01 the amount of material required will probably be smaller.

Divergent Chain Reaction in Systems
Composed of Uranium and Carbon

A-55

SUMMARY

By L. Szilard Copy 9

It is shown that a divergent chain reaction may be maintained in a system composed of uranium and carbon. Conditions particularly favorable for a chain reaction are obtained if instead of using a homogeneous mixture of uranium and carbon a large number of rather small spheres of uranium metal are used embedded in a mass of graphite. The small uranium spheres may form a close-packed hexagonal or cubic lattice embedded in a large sphere of graphite. The average number of fast neutrons emitted by uranium for one thermal neutron absorbed by uranium is calculated from known experimental data and is found to be about 2. In our system conditions for a chain reaction become more and more favorable as the temperature increases and it is shown that we could expect a chain reaction to be self- generating in such a system at about 900° C. even if the cross-section of carbon were as high as 0.01, its present experimental upper limit. As the intensity of the chain reaction increases with increasing temperature the system is thermally unstable. It can be controlled artificially. The time within which the control would have to respond is found to be longer than one second. As much as 100 tons of graphite and 30 tons of uranium might perhaps be required in order to reach the point of divergence at which nuclear transmutation will go on with an intensity limited only by the necessity of avoiding over heating. But in so far as the capture cross-section of carbon is likely to be below 0.01 the amount of material required will probably be smaller.

SUMMARY

It is shown that a divergent chain reaction may be maintained in a sys. composed of uranium and carbon. Conditions particularly favorable for a chain reaction are obtained if instead of using a homogeneous mixture of uranium and carbon a large number of rather small spheres of uranium metal are used embedded in a mass of graphite. The small uranium spheres may form a close-packed hexagonal or cubic lattice embedded in a large sphere of graphite. The average number of fast neutrons emitted by uranium for one thermal neutron absorbed by uranium is calculated from known experimental data and is found to be about 2. In our system conditions for a chain reaction become more and more favorable as the temperature increases and it is shown that we could expect a chain reaction to be self- generating in such a system at about 900° C. even if the cross-section of carbon were as high as 0.01, its present experimental upper limit. As the intensity of the chain reaction increases with increasing temperature the system is thermally unstable. It can be controlled artificially. The time within which the control would have to respond is found to be longer than one second. As much as 100 tons of graphite and 30 tons of uranium might perhaps be required in order to reach the point of divergence at which nuclear transmutation will go on with an intensity limited only by the necessity of avoiding over heating. But in so far as the capture cross-section of carbon is likely to be below 0.01 the amount of material required will probably be smaller.

SUMMARY

It is shown that a divergent chain reaction may be maintained in a system composed of uranium and carbon. Using the present upper limit for the capture cross-section of carbon for thermal neutrons we find that if a large number of spheres of uranium metal of a rather small radius ~~which may form, for instance, a close-packed hexagonal or cubic lattice~~ is embedded in graphite we obtain a system in which at 900 $^\circ$C. the number of neutrons produced will exceed the number of neutrons absorbed. The number of fast neutrons emitted by uranium per absorbed thermal neutron is calculated from published experimental data and is found to be about 2. There is hope that the capture cross-section of carbon is considerably smaller than its upper limit and consequently it is probable that the point of divergence may be reached with about 100 tons of graphite and 10 tons of uranium. It is shown that the intensity of the chain reaction will increase with increasing temperature and a method is ~~indicated~~ described for controlling it. ~~the chain reaction.~~