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INTER-OFFICE MEMORANDUM

DATE April 25, 1945

TO: J.R. Oppenheimer

FROM: J.O. Hirschfelder

SUBJECT: STRATEGIC POSSIBILITIES ARISING IF A THUNDERSTORM IS INDUCED BY GADGET EXPLOSION.

In a previous memorandum (April 23 by J.M. Hubbard and myself), it was pointed out that it would be feasible, if desired, to choose the proper weather conditions for delivery so that the gadget explosion would induce a thunderstorm. Because of the high potential temperature of the hot air, the active material and fission products would surely rise to heights of the order of 10,000 feet (in a time of three minutes) before the thunderhead would develope. With even a light wind the major portion of the active materials would be carried away from the area of blast damage (for a 15 mile an hour wind, one mile in four minutes) and the products would rain down on ~~xxxxx~~ an area which has not been severely damaged by the blast (the radius of A damage for blast is considerably under one mile). A simple calculation shows that the radiation from the active material and fission products would be sufficient to render an area of from one to one-hundred square kilometers uninhabitable. Calculations which I have made on the smoke column would indicate ~~that the~~ radius, ~~xxxxxxxxxxxxx~~ ~~area~~ of our smoke column would be of the order of 500 to 1000 meters therefore we could not expect to poison an area of more than a few square kilometers.

The following calculation was made with the help of A. Turkevich and agrees with a similar calculation made by L. Hempelman. Assume that the gadget is 5% efficient so that ~~one~~ two moles of fission products are formed. Then according to a formula of Fermi's, after one day the rate of emission of gamma rays is

$$\frac{.15 f}{t} = \frac{.15 \times (6 \times 10^{23})}{(24 \times 60 \times 60)} = 10^{18} \text{ gammas/second.}$$

If the active material is spread over one square kilometer of surface, there will be emitted $10^{18}/10^{10} = 10^{8}$ gammas/sec/cm^2, or $I_0 =$ $.8 \times 10^{6}$ gammas/sec/cm^2/unit solid angle. But since the mean free path of gammas in air is of the order of 140 meters,

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at a height, h, equal to one meter above the ground the flux of gammas is approximately

$$I \approx \pi I_0 \log_e\left(\frac{\lambda^2}{h^2}+1\right) = 28 I_0 = 2.2\times 10^8 \text{ gammas/sec/cm}^2$$

And since one R unit corresponds to 10^9 gammas/cm² ~~xxxx~~, we could therefore expect

.2 R/sec or 720 R/hour

within this area of one square kilometer one day after the explosion

I do not believe that there would be any lessening of the blast damage if we delivered the gadget in weather conditions favorable for the formation of the thunderstorm (conditional instability, humidity above 60%) and therefore the radiation effects ~~xxxxxxxxxxxx~~ might cause ~~xxxxxxxxxxxxxxxxxx~~ considerable damage in addition to the blast damage ordinarily considered.

If you are interested in this possibility, we should try to work out more explicit details; how long it would take before the rain started, how predictable would be the area on which the active material was dumped, etc.

cc: Parsons
Bethe
Ramsey
Bainbridge
Penney
Hubbard
Fermi

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