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TO
By Murray L. Nash
S. Warren 4/5/50
Name Title Date
by R. Elms

23 November 1949 BY: DICK KOOGLE 6-12-87

CONFIRMED TO BE UNCLASSIFIED
DOE/OFFICE OF DECLASSIFICATION
M. L. KOLBAY, A.D.C. DATE: 11/7/97

Mr. Carroll Wilson
Atomic Energy Commission
1901 Constitution Avenue
Washington, D. C.

Dear Mr. Wilson:

The initial report on Project Gabriel by Dr. Nicholas M. Smith, Jr., dated May 21, 1949, the revised copy dated November 12, 1949 and a Top Secret letter from Drs. Latimer and Hamilton dated October 4, 1949, are transmitted herewith. These reports have been checked by Drs. Teller and associates at Los Alamos, Dr. Latimer and Dr. Hamilton, Dr. K. Z. Morgan and Dr. G. Failla.

Mr. Deal of our office has acted effectively as liaison officer and has aided in the calculations. These reports as evaluated by the individuals mentioned and myself may be summarized as follows:

(A) Limitation on numbers of bombs. By effects of ingested material.

1. Plutonium and strontium^{90} plus yttium^{90} are the elements of importance.

2. The particle size resulting from an explosion ranges from a few micra in diameter downward with a higher proportion of the very fine particles as the cloud gets farther away from the point of burst.

3. 3. The debris from a single air burst is expected to settle out almost entirely in a path of 700 to 800 miles. Assuming that the cloud is 500 miles wide, the average density of material deposited per square mile normalized to 1 gram of original bomb debris is 3×10^{-6} grams per square mile.

4. Owing to the prevalent stratospheric winds, bombs detonated on the West Coast would largely thus effect only the arid mountain regions; bombs detonated in the Middle West would also involve the East Coast; and East Coast bombs would essentially be ineffective as regards fall-out due to deposition of the bulk of material in the ocean.

5. If one assumes a local fall-out area to measure

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approximately 500 x 700 miles, the fall-out density of fission products and plutonium would be 7.2×10^{-3} grams per square mile per bomb. Assuming that 200 persons are supported per square mile of arable land, the $strontium^{90}$ and $yttium^{90}$ ingested per person would be less than 8×10^{-10} gram per person per crop* in the local (350,00 square mile) contamination area and the amount of plutonium, while contributory, would be relatively unimportant.

6. If we assume the integrated lethal dose of $strontium^{90}$ plus $yttium^{90}$ to be 40 microgram years, which may be in error by a factor of 4, the number of bombs detonated per local area of 350,00 square miles to reach the lethal threshold in that settling area would be between 1×10^{5} and 2×10^{3}, assuming that the uptake occurred in one crop only. On the other hand, if the crop uptake is assumed to be continuing and activity decaying exponentially with the natural half-life of $strontium^{90}$ and a continuing human consumption, the numbers would be between 3×10^{3} and 40 bombs. These figures are based on exposure during a life span of 47 years. If one considers a 200-day period for exposure, the figures become between 3×10^{6} and 4×10^{4} bombs in the case of a single crop and 4×10^{4} and 600 in the case of continuing uptake by crop plants.

7. All these figures must be interpreted with the warning that we do not fully understand strontium metabolism in man and that factors of absorption and excretion may eventually have to be altered.

<u>Conclusion</u>: If one assumes this limited area and single crop contamination, it is obvious that a determined people aware of the danger could either migrate or obtain food from other sources.

(B) Hazard from inhaled particulate matter.

1. There is little question but what there is real danger to inhaling particulate radioactive matter in such finely divided particles as to be retained within the lung. Clear-cut data on this are not yet available and await evaluation of experiments initiated sometime ago in connection with the pile particle problem.

2. Assuming plutonium particles 2 micra in diameter are inhaled, the small mass of tissue irradiated would receive 390 roentgen equivalents physical per day or 7800 roentgens biologic equivalents per day. This amount of radiation would be sufficient to cause significant damage to the lung tissue immediately adjacent (involving up to 100 cells) and quite possibly to cause carcinogenic change.

3. In the case of beta radiation from fission products, the dose from such a particle integrated up to 7 days would be 72 roentgen

* For example, 1 harvest of corn, wheat, or other staple.

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equivalents per day.

4. The probability is that at least 10^6 bombs would have to be exploded in the U.S.S.R. to give a probability of 1 that a person in the U.S.A. would receive one particle, based on somewhat simplified calculations.

5. The significance of a single particle has yet to be determined. It is my personal feeling that it would be relatively slight and that multiple particles would be required before producing either significant necrosis of the lung or pulmonary cancer.

Conclusion: The pulmonary hazard cannot be evaluated at the present time.

(C) Absorption of plutonium following inhalation and subsequent deposition in the skeleton.

1. This cannot be evaluated at present and is probably much less of a hazard than either (A) or (B).

(D) External radiation from the fission products.

1. This is negligible except in immediately local areas. Studies made previously indicate fantastic numbers of bombs would be required for significant effect.

RECOMMENDATIONS

1. In the light of present knowledge 3×10^3 bombs should be taken as the number which will probably cause serious damage to personnel through crop contamination if detonated within one growing season and within an area of 350,000 square miles.

2. Obtaining of further experimental data on the significance of radioactive particles within the lung and on the metabolism in humans of $strontium^{90}$ plus $yttrium^{90}$ should have high priority.

3. At a subsequent test air burst detailed studies of particle size and the long-range movement of particles should be made.

Sincerely yours,

Shields Warren, M. D.
[redacted] Director, Division of Biology and Medicine

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