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Status of GABRIEL Studies as of

February, 1953

Report by the Director of Biology  
and Medicine  
The Purpose

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1. To ~~This statement reviews the status of fall-out studies presently grouped under the generic name of GABRIEL as regards the history, the status of present studies, and attempts to set up additional studies.~~ *for the Commission*  
*GABRIEL studies from the stand point of*

2 In 1949, Dr. Nicholas M. Smith, Jr., a physicist at Oak Ridge, was asked to undertake a study to estimate the number of atomic bomb explosions which would result in large-scale secondary disasters as a result of the toxic effects of ~~the~~ bomb debris. Smith revised his report in 1951 in order to include pertinent data from the Ranger and Greenhouse tests, and arrived at the number of 100,000 explosions of nominal bombs as being critical.

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3, In November of 1951 an ad hoc committee was assembled by the Division of Biology and Medicine to consider these reports and to give further attention to the questions of both long-range and short-range residual hazards which might be attendant upon the explosion of a large number of atomic bombs in warfare.

4, On the basis of ~~this~~ discussion, *Dr. Smith's* the Biophysics staff summarized ~~these reports and discussions,~~ *the* of the ad hoc committee, included data from the Huster-Jangle series, and extended the studies to calculations of short-range effects, under three possible conditions:

*a. b.* A high air-burst without rain or snowfall. Under this condition, it was believed that ~~the bomb debris~~ would be so widely spread

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through the atmosphere that the only significant effects to be anticipated from fall-out are those resulting from many bombs used either concurrently or serially.

- <sup>e</sup> 1. A low air-burst, surface burst or underground burst. In these cases, a large fraction of the debris may be expected to deposit on comparatively large soil particles, assuring fall-out of much of the radioactivity within a hundred miles.
  
- <sup>e</sup> 2. An air-burst with simultaneous or early rain or snow. One may speculate that large fractions of the bomb debris would be brought down in a relatively small area. ~~This possibility is presently undergoing intensive study by a group at Rand Corporation.~~

5. The tentative conclusion of the Biophysics staff study was that for relatively long-range effects, as with air-bursts in clear weather, and with some distribution of bursts in time and space, the hazard due to the ingestion of strontium tends to predominate over the hazard due to either inhalation or external radiation.

6. On the other hand, short-time fall-out or rain-out of large quantities of debris in a small area would result in external radiation as the predominant factor - leading to the possibility of surface bursts being useful in terms of radiological warfare in addition to their destructive effects.

7. These conclusions were presented to the General Advisory Committee early in 1952. The GAC apparently was of the opinion that the subject matter is of too far-reaching importance to depend upon a single analysis,

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and it recommended to the Commission that two additional independent studies be conducted.

We attempted to persuade Rand Corporation, and an operational analysis group at M.I.T., to undertake this work. Rand Corporation accepted a research contract last June, but M.I.T. had no suitable personnel available.

8 We should point out that the subject is extremely tenuous: what are the secondary hazards attendant upon the detonation of atomic bombs? Reduction of this question to specific objectives, which can be studied objectively and quantitatively, is very difficult. The question seems to divide itself naturally into two phases: (1) the intensive, short-time hazard to residents of areas relatively close to points under attack with near-surface bursts or air-bursts in rainy weather; (2) long-time hazards to large areas of the world due to the detonation of many bombs (or to the careless disposal of radioactive wastes from reactors).

9 The first phase (intensive short-time hazards) is under study by the Rand group. Whereas our own analysis was carried out in less than a week, and without benefit of much meteorological knowledge or of the large amount of data which now exist in numerous reports, the Rand group is utilizing this information. Their first results indicate that they will be able to show a priori statistical distributions of heavy rain-out for many points on the earth's surface. If weather conditions can be chosen, or are known, they will be able to calculate rain-out effects with much greater accuracy.

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10 With regard to the second phase (long-time wide-spread hazard), although no one inclusive project is under way, the Division of Biology and Medicine is supporting a number of research projects which have a bearing on the problem:

- a) During the past two series of tests in Nevada we have conducted extensive measurements to ascertain the pattern and intensity of fall-out in areas adjacent to surface and near-surface bursts, and also nation-wide and world-wide monitoring to study distant fall-out as a function of air movements. More such studies are in progress for Upshot-Knothole.
- b) Inhalation experiments and theoretical calculations are under way to study the inhalation hazard due to fission products.
- c) Experiments are under way to determine the uptake of fission products by plants grown on soil containing radioactive material, as a measure of ingestion hazard.
- d) We have made calculations to compare the strontium/calcium ratio in normal human skeletons with the average strontium/calcium ratio in the soil. Under equilibrium conditions, the soil could be contaminated with 25 curies of Sr-90 per square mile before the human skeleton would contain a maximum permissible amount of one micro-curie. To contaminate the soil to this extent would require an initial detonation of more than one million nominal bombs, and 35,000 more each year to replace the radioactive decay.

|| If we ~~insist on~~ another full-scale analysis, <sup>were considered necessary</sup> at the present time, we ~~have~~ <sup>there are</sup> several possibilities:

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- a) To find another operations group similar to Rand, competent and willing to undertake the project <sup>considered</sup> - a virtual impossibility.
- b) To find one person with an analytical mind, and to furnish him with one or two assistants and a panel of consultants which would meet regularly to discuss the problem in all its ramifications of fact and fancy. Dr. Robley Evans of M.I.T. has been approached with this idea. He believes one of his recent Ph.D's would be suitable for such work, under his (Evans') general supervision, although the program could not get under way until June or July. Evans believes it should be at least a two-year study.
- c) To persuade the U. S. Weather Bureau's Special Projects Group to undertake the study, perhaps, with additional specialized assistants, since this Group already has some experience in our fall-out analysis. On the other hand, this Group is now supplying data to the Rand project, and would have to go over much the same ground the Rand group has just covered.
- d) To find one or more persons who will take the present Gabriel study (plus our extensions of it) and analyze it in all its assumptions and calculations to determine its soundness, particularly in the light of new experimental data continually being evolved. A variation of this plan would be to send copies of the study to selected groups among our contractors' personnel and request them to give their serious criticism and constructive

