Intra-Laboratory Correspondence
OAK RIDGE NATIONAL LABORATORY

To: File

21 February 1951

From: T. H. J. Burnett

Subject: Skin Decontamination Studies Program

A meeting was held beginning 9:30 AM February 15, 1951 attended by K. Z. Morgan John Gest, H. J. McAlduff and T. H. J. Burnett of the Health Physics Division, C. D. Watson of Chemistry Division, J. Shilling, Jr. from Y-12 and Dr. I. B. Parsons, Assistant Research Director of Lever Bros. Soap Company, Cambridge, Mass.

The Atomic Energy Commission has approached Lever Bros. to interest them in undertaking a research contract. The field of research would be skin decontamination studies with the immediate objective, sponsored by the Army Chemical Corps, being the development of a skin decontaminant for military field usage.

The military aspects of the proposed research problem are predominant. The source of contamination is assumed to be the result of an underground or underwater explosion of a fission bomb. Radiological warfare agents while not ignored are tentatively assigned a status of lesser concern. Lt. Col. Chas. Robins would like to get the research underway at as early as possible and has requested their proposal and bid by March 1. Lever Bros are endeavoring to determine the scope of work involved so as to plan how to program this research and estimate its cost. It was estimated that from 12 to 18 months would be required for the completion of this study and that the first three months probably would be spent in the assembly and correlation of currently available information. It is recognized that very little of the information is presently organized and is widely scattered through the project.

Discussions were initiated with the topic of various methods for determining the amount of radioactivity to which the skin is subjected in the contamination tests, specifically, how this should be measured. It was suggested that one very worthwhile approach would be to take sections of test skin checking the different layers for the study of penetration under different conditions. One source of variation would be the extent to which skin tissues were oily and it was pointed out that this oil content varied from person to person. While ordinarily the oil film on the surface of the skin normally is protective it may, in certain conditions, be harmful, such as the case of a contaminated solvent. The ease of decontamination varies both with the type of skin and its condition. Abraded or roughened skin is both more easily contaminated and more difficulty decontaminated because of greater surface area.

Factors to be considered are the difficulty of removal of a contaminant, the concentration expected, since this will affect the extent absorbed, and the permissible residual contamination which sets the upper limit to the amount that can be left by the decontamination tested. Dr. Morgan stated that some one at the laboratory would be available for assistance for a limited time as a consultant in these problems to the company conducting the research. A short discussion followed in which it was pointed out that alpha contamination would behave differently

from fission products in its removal characteristics. Emphasis that what was being sought was a single shot treatment for all type of contamination led to an inquiry as to weight limitations etc. In answer, the final product should be usable by field personnel after the manner of the Army "all purpose bar". Dr. Morgan mentioned possible sources of information based on experience in skin decontamination such as the radium spill at Hunter's Point and early work done with plutonium and wounds. The discussion then briefly dealt with the subject of contamination and injuries and absorption into the system from such a site.

As an item of general information needed for such research, it was pointed out that the tolerance levels for skin contamination were based on the concept of energy dissipation in tissue. It was pointed out that if a minimum skin thickness of .07 mm is assumed, this requires an alpha particle have energy of 7 Mev for penetration. While most alpha emitting materials do not possess this energy, it was pointed out that due to the very minute quantities permissible in the body plutonium was a major source of concern in several ways. First, its compounds seem to have considerable ability to penetrate the skin. Further the inhalation of soluble compounds into the lungs is quite hazardous. Also, the aspects of ingestion by the transfer of contamination from the hands, etc. to food, cigarettes or water are quite serious.

Considering beta and gamma activity, most beta radiation will penetrate the skin since they usually possess more than the 75 Kv energy required of particles to penetrate the .07 mm thickness. Usually this produces only the irradiation of surface tissues, however, in the periods very early after a bomb explosion there are more of the "harder", more penetrating beta particles hence, such contamination is a more serious hazard then than later.

It was suggested that it would be most profitable to begin a general study of the problem by tabulating the different isotopes of concern and considering their fission abundances and the relative probability of their occurrence after an explosion. In this connection, one must bear in mind the possibility of some selective absorption process which might lead to conditions of abnormal concentration. The next step would be the consideration of these various elements on the basis of their permissible concentration and resultant hazard. Comparing the two tabulations, it is probable that one would find that only a relatively small number of specific components need be studied. Dr. Morgan pointed out that health physicists were well aware of the need for such a study and are most glad that the AEC is endeavoring to have it done.

In carrying on such a study it is necessary to consider the suitability of different radioactivity measuring instruments and it was suggested that radio-autograph and film techniques would be quite useful. Dr. Parsons was referred to a Dr. Boyd at the Oak Ridge Institute as a possible consultant on this problem. Discussion followed regarding the relative desirability of approaching the study of skin decontamination from the standpoint of basic science, the chemistry of the skin, etc. versus the empirical engineering or Edisonian approach. In the discussion of the factors of basic skin chemistry which are unknown yet pertinent, the first

mentioned was pH. It was pointed out that the skin was fairly well buffered, tending somewhat towards acid. However more information is needed regarding the effect of pH on the amount of contamination which is initially affixed to the skin as well as its effect on the decontamination. Another problem is the presence or extent of a saturation effect, whether additional concentration produced an increased contamination. It was pointed out that in the studies to be made the contractor would need the services of a fairly competent radiochemist to supplement his staff of skin biochemists. Dr. Parsons said that they were presently carrying on various tracer studies on detergent action, etc. and felt that this experience would be quite valuable. As an additional factor, the effect of perspiration was mentioned and it was stated that experience here had shown decontamination to be more successful in the summer than in the winter. The consensus seemed to be that an empirical approach, accompanied to whatever extent possible by basic study, would be most satisfactory and productive.

Speculation on the mechanism involved in skin contamination was that this would be affected by complex chemical factors. Some creams which have been tried from the standpoint of "protective sheath" usage have been found to possess a completely negative advantage. Apparently the contamination associated itself with some of the organic constituents of such creams to penetrate the skin more readily. Instances were cited where the sebaceous glands seemed to have a specific affinity for any surface oiliness and, absorbing this, would swell up increasing the subsurface concentration in contact with the lymph system. A comprehensive program of basic study was thought probably to involve as much as a decade of work.

In the succeeding discussion, it was brought out that there existed a qualitative effect of skin contaminant which was related to the site of final deposition in the body compared with the quantitative effect of the dosage to the skin produced by the contaminant. In the course of decontaminating skin, one reaches a point of diminishing returns where the relative damage to the skin by further decontamination efforts is as much or greater than the damage produced by the dosage received. In discussing the chemical severity of the decontaminant to be used, it was pointed out that a natural adaptation phenomena was customarily found such that a tolerance would be built up to any irritant qualities of the detergent.

One possibility suggested for skin decontaminants is the use of highly absorptive muds such as bentonites, etc. Such would have a relative absorption for the contaminants stronger than that of the skin, causing the contaminant to relocate from the skin. Not discussed here, but pertinent in this connection, is the experiment of using very fine mesh ion exchange resins as skin decontaminants by A. H. Emmons. It was mentioned that there are a number of improved sequestering agents now available much superior to versene. This led to a number of comments on the effectiveness of versene. The consensus of the group was that there was much promise in the development of preventative coating or barrier layer which would be effective and could be used in those cases where risk of contamination was known to exist.

A classification of the quantity of contamination on the skin was made, separating the activity into three categories:

Probably the largest fraction of the contamination is that which is readily removed with plain water or a wide number of cleansing agents. The remainder which is not so removed may be separated into two parts, one which is affixed to the skin, staying put and giving a surface dosage to the tissues adjacent. The other is that fraction which relocates to the interior of the body causing subsequent damage there. Some evidence exists that the fraction which relocates does so in a very short period of time, emphasizing the need for early treatment.

THJB:em

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