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29 May 1974

TO: Drs. J. L. Liverman, S. Marks, and Walter Weyzen  
U.S. Atomic Energy Commission  
Division of Biomedical and Environmental Research

FROM: Marvin Goldman, Radiobiology Laboratory, Univ. of Calif., Davis

SUBJECT: Scientific Potential of Plutonium Exhumation Proposal

On May 22, 1974, an ad hoc committee consisting of Dr. Betsy Stover as chairman, and including Drs. Eugene Cronkite, Roy Talmadge and Marvin Goldman, was convened at AEC Headquarters to provide recommendations to DBER on the scientific merit of studying the fate of plutonium in 10 deceased persons who had received injections of plutonium in the period 1945-1947.

Drs. Liverman, Weyzen and Marks summarized the current status and some of the history relating to these exposures, and detailed the sensitive nature of the study and some of the problems associated with obtaining permission to exhume bodies.

Dr. Rowland summarized ANL efforts to date and indicated that he had a program underway for exhumation as well as for physical examination of the survivors. Of the 18 people exposed, 4 are still alive (3 in Rochester) and another 3 are apparently lost to followup. Studies on two of the Rochester survivors in January 1973 included analyses of urine and feces. The fecal to urinary ratio was about 1:3 and the urinary level appeared to be quite low relative to prediction. The other individual in Rochester (HP-8) has not yet been studied. The fourth case, now in Texas, received an injection of plutonium-238 into a limb prior to amputation.

Rowland noted that, based on radium experience, it is unlikely that cadavers buried in the twenties and thirties could be recovered. However, those that died in the last 30 years are probably in reasonably good shape. He made a plea for getting information on skeletal Pu distribution as well as organ content, particularly of liver and spleen. He wants to get "burial" rates of Pu in bone mineral and thinks it is related to risk: i.e., the "deeper" the plutonium is buried, the less the fraction of the burden that will be in a cell-rich surface region of "high risk." Rowland is very interested in obtaining autoradiographs of the bones and presumably will exploit the track-etch method. He provided some preliminary pictures of good quality based on one case that had been examined, with bone deposition and concentration potential fairly obvious. He also mentioned in passing that, although analyses to date consisted primarily of muscles, other soft tissues could also be analyzed.

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The charge from DBER to the four of us was to assess the value of the potential for scientific information from an exhumation program. Inherent in this is an assessment of the value of the information to the existing plutonium standards and the fundamental question about whether the information gained will offset the potential bio-political or public relations problems associated with its disclosure.

On the basis of the information presented to us and a brief review of the entire situation, the committee left behind a unanimous endorsement of an exhumation program whose benefit included:

1. Verification of the "Langham equation" which attempts to relate urinary and fecal excretion rates to body burden of plutonium. The fact was noted that these are the very persons on whom the equation was based. This degree of uniqueness entered into the committee's assessment. This is one of the fundamental pieces of information that has been utilized in establishing the secondary standard for plutonium contamination in occupationally exposed persons. The excreta predictions are almost universally utilized by radiation protection specialists in estimating the plutonium body burdens in occupationally exposed people.
2. The potential exists for determining the microscopic distribution of plutonium not only in bone but for assessing the content and concentration in soft tissues and bone marrow for which little information is currently available in man.
3. There may be support to the idea that AEC might be considered remiss if it did not attempt to obtain these data.

Thus, in summarizing the advantages, however limited they may be, one of the main goals of the proposed exhumation project is to determine the magnitude of certain parameters useful in interpreting data from extensive animal experimentation on plutonium metabolism and toxicity as it may relate to man.

Limitations and problems associated with the practicality of the proposed project may not have been appropriately emphasized in the May 22nd draft.

1. In addition to the obvious statistical limitations on analyses performed on an exceedingly small number of individuals (even with total recovery from all tissues), the problems of the mixture of ages and the serious medical problems present at the time of injection do limit, perhaps severely, the ability to interpret the data as a quantitative representation of a "normal" population.

2. The ravages of chemical reactions in the grave may lead to incorrect interpretations if the integrity, completeness, and condition of the remains are inadequate for satisfactory recapitulation of the total plutonium present at death.
3. There is very little scientific potential in the recovery and analysis of cremated remains.

It was my assumption that sufficient "intact" remains would be potentially available and that the legal, moral, and ethical consents and permissions for such a program would be completely implemented. In this case, the scientific benefit to be derived from such a project would appear to outweigh any disadvantages.

On further study of the true potential for exhumation that now exists, I am not certain that the total benefit can be realized if the number of successful recoveries is only 2 or 3. It could be a further serious detriment if the recoveries did proceed and the uniqueness of the material were not appreciated, and should it be handled in ways to preclude further analysis at a later date if desirable. What really concerns me is that the only case for which permission has been granted was a person who had been cremated. The scientific advantage to be gained from pursuing this particular case, in my view, is very limited and should not be encouraged. The remaining two cases have been identified and if the next of kin consent, the potential exists for obtaining data on Pu retention and distribution 5 days and 160 days after injection. I believe that the scientific information to be derived from these two "early" points is not as valuable as information derived at long intervals after the initial exposure. The most valuable exhumation studies would be for those who carried their body burdens for the longest time. It appears that the next of kin for those that have been identified (five cases to date) have uniformly refused permission for exhumation and study. Of these cases, only one (HP-1) would provide a significant burden time for study. Those for whom follow-up data consisted of less than 2-1/2 years are, in my opinion, probably more limited in scientific value.

Based on the above, I cannot make an exceedingly strong scientific case for obtaining "at all costs" the remains of those whose next of kin refuse to consent. From the information available to me, my personal inclination is to endorse a program for exhumation; however, I must add that the information derived from only two or three additional analyses will limit and temper my enthusiasm for such a program. Specifically, "errors" in the excreta prediction equation are most easily identified and rectified with samples or information obtained at very long times after exposure; that is, in excess of 3 or 4 years. Since the number of potential exhumations is limited and in some instances may present serious ethical-legal problems, the total number available does not justify a maximum effort.

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I believe that it is very important that the appropriate steps be taken to notify and study the survivors of this project, as they represent far greater potential for the verification of the quantitative applicability of the Langham equation to handling body burden and "risk" estimation. It is the latter point that has first priority in my view. Of scientific importance but of secondary priority is the determination of the relative Pu distribution between hard and soft tissues and the microdistribution of residual plutonium within these.

For this reason, I would suggest omitting the word "mandatory" and substituting the term "desirable" in recommending that the effort proceed on the exhumation project.

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cc: B. J. Stover, Univ. of North Carolina  
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