RADIATION LABORATORY
BERKELEY 4, CALIFORNIA

November 20, 1947

179

To: Dean Stafford L. Warren

From: Joseph G. Hamilton, M. D.

The following report is the result of a number of discussions between Doctors Roy Overstreet and Louis Jacobson with Mr. Kenneth Scott and myself, concerning the over-all problems of radioactivity as it apparently now exists in the area adjoining the site of the atomic bomb test at Alamogordo, New Mexico. The deductions which have been made and the suggested recommendations for further action must be considered highly tentative in character due to the very incomplete nature of the available information at present.

The samples of soil specimens, plants, and the droppings from cattle show fission product activity at the approximate range of from 5×10^{-3} microcuries per gram to 5×10^{-4} microcuries per gram, expressed as dry weight and corrected for self absorption. It is of interest to note that most of the activity in the soil is found to be confined to the first one centimeter layer. Another observation of importance is that the activity per gram dry weight of the plant material as well as the cattle droppings were on the average of one-tenth of the radioactivity of the soil samples. In view of the lack of time and personnel, together with the difficult nature of the terrain and somewhat incomplete monitoring data, any accurate estimate of the over-all contamination of the area under consideration, which is approximately 100 square miles, must be considered as of a qualitative rather than quantitative nature. It is of interest to note that the radioactivity of the plant material investigated was very nearly equal to the droppings of cattle. It would appear reasonable that the average total concentration of activity in the soil over large areas may not be very different from the amount of material noted for the cattle droppings since the cattle cover large areas while feeding and the limited number of soil and plant samples may not be as representative. Moreover, it must be remembered that the cattle pick up no inconsiderable amount of dirt while feeding. It would seem likely therefore, from these speculations, that the total activity per square centimeter of surface soil will be of the order of 5×10^{-4} microcuries, it being recalled that the activity is confined primarily to the first centimeter of the soil surface. This value gives a total of 1500 curies of radioactivity, assuming the material to be deposited uniformly over the 100 square mile region. This value of 1500 curies is roughly 10% of the total amount of fission product activity which one would expect to be remaining two and one-half years after the initial combustion of 1 kilogram of plutonium. In other words, the estimated level of contamination, namely 5×10^{-4}

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microcuries per square centimeter appears reasonable for it is known that a considerable amount of activity came back to the earth at much greater distances and it is almost certain that areas adjacent to this 100 square mile strip must contain not an inconsiderable portion of the total fission product activity produced by the bomb.

The activity in the plants showed that 75% was due to Ce^{144}, 14% to Sr^{90}, and 4.7% to Cs^{137}. This proportion is probably not very different from that present in the soil, for which on the basis of half-lives and fission yields, one would expect approximately 75% cerium and 12½% each of strontium and cesium at this date. The remaining radioactivity which is found to be present, notably the Zr^{95} and Cb^{95} pair, is not significant in view of the relatively short half-lives of these two radioactive elements. No quantitative data is as yet available concerning the fission product distribution in either the soil or cattle droppings. However, it is quite likely that no high degree of disproportionation will be found that might be of practical significance to the over-all problem.

In view of the quite sketchy information which has been summarized above, it would appear that the program of effort that should be devoted to the problem of the radioactive contamination of the area may be divided into two distinct categories. First, the actual surveys and determinations which will be necessary to answer with confidence the immediately practical questions which relate to possibilities of biological injury to flora and fauna of the area and to man, so as to provide whatever data may be necessary to meet any medical legal considerations which may arise at any time. The second, and probably far more important field of study, is the accumulation and analysis of sufficient data to make possible the predictions of some of the various chains of events which may take place following the contamination of large land areas with the release of fission products; whether such a situation may arise from some accident or as the result of military action.

In order to meet the more immediate problem, the most important information, which is as yet unavailable, is the amount of radioactive elements in cattle and other live stock in these contaminated areas. It would appear urgent to secure an adequate number of representative organs and tissues from these animals as soon as possible so that this very important question may be answered qualitatively as well as quantitatively. Obviously, the single most important structure to study is the skeleton for two of the three fission products which are the major contributors to the radioactivity now present, are selectively localized in the skeleton. In addition, a careful survey should be made for the presence of plutonium in the samples of soils, plants and live stock as it can be estimated that something of the order of 1 kilogram of this radioactive element is probably spread over the 100 square miles of area under discussion. The existing monitoring data for the surface activity of the entire area should be summarized so that immediate steps may be taken to supplement this knowledge with whatever additional information

may seem desirable to acquire. In particular, it is important that care be observed to ascertain the presence or absence of high concentrations of radioactive materials as the result of the run-off from the high regions of the terrain into the lower areas where the active mud from the superficial layers of the ground may accumulate in the stream beds and other points where such material can settle out. The presence or absence of detectable amounts of radioactivity in the water from wells, springs, and rivers of the entire area should be established. Further work should be done to determine more accurately the range of radioactivity in these plants which are feed material for the stock that this area supports.

Until data of this general character is in hand and has been carefully evaluated, it will be almost impossible to give any definitive judgement with respect to the necessary control measures which may have to be applied to these contaminated areas. In other words, at the present time it is not possible to state with any degree of certainty how active a given region must be in order to make it either undesirable to permit the grazing of stock or to allow people to live in such areas.

From the long range point of view, it would appear most important to follow and to secure as wide a fund as possible of general information about this contaminated region and any adjacent area which may possess a comparable degree of radioactivity. Major items that should be studied in considerable detail include the distribution of fission product activity in a large number of samples of the different varieties of plant life in this area as well as the distribution of these radioactive elements in the live stock. The same type of analytical information should be obtained from soil samples and in particular the soil data should be correlated with the topography of the terrain. Should there be in this area any appreciable amount of cereal plants, notably wheat, rye, barley, and corn, these plants should be studied in considerable detail for both their content of radioactivity as well as the distribution of fission products during the various stages of their development. If any activity be found in the tissues of the live stock in this region, then the same type of radio-chemical investigation should be pursued. All of the points listed in this account of the long range studies must have as their foundation, the data that was indicated as highly necessary for the immediate survey and analytical requirements. There will be a great deal of information which will be obtained from this rather detailed study which will be most difficult to duplicate on the small laboratory scale. The situation in general with respect to all of these studies is somewhat analogous to the experience following the Bikini tests in developing methods for decontamination of radioactive vessels after test Baker, namely the knowledge gained for the future, probably outweighed in value the solution of the immediate problem at hand.

The amount and character of information available at present, makes it difficult to state with any degree of practical accuracy what

the policy should be with respect to the use and habitation of the area under consideration as well as any adjoining regions which may show a comparable degree of radio-activity. It is probable that all of the biological organisms, whether they be plants or animals will have by now received a large share of the radiation injury that they will ever get, assuming that such plants and animals have been in this region continuously since the test, and it is apparent that demonstrable injury has occurred in this region. One cannot state until data is available concerning the presence or absence of radioactivity in the tissues of animals in this area, whether or not grazing stock brought into the region might be subjected to radiation injury. After the survey data is complete with respect to the elimination of the possibility of areas of high levels of concentration, the possibility of injury to humans in this area does not seem great. It would appear that the medical legal status of this entire situation will remain obscure until more information is available. Certainly, a very adequate radiation survey of the ground contamination and the degree of radioactive contamination of the grazing stock must be in hand before any very firm defense can be made of the government's position in case of suit. It would appear desirable not to open any new areas for grazing until two points are settled. First, the degree of uptake of radioactivity by the live stock; second, adequate monitoring of all areas which may be contaminated by fission product and plutonium activity.

The problems presented by this situation make apparent the necessity for fundamental studies in the fields of soil chemistry and plant physiology, using the various radio-elements produced by fission. While many small scale laboratory experiments cannot be extrapolated with quantitative accuracy to what may take place in the event of large scale release of radioactive materials, the basic knowledge gained from such studies is indispensable to an evaluation of what the future may bring and the steps which may be taken to meet these problems. Likewise, much of the information which can be gained from the contaminated areas of Alamogordo cannot be directly used as an accurate yardstick of what may occur, under similar circumstances, in more fertile areas of the country. However, if an adequate and accurate understanding can be achieved of the facts and factors surrounding these two areas of effort, namely the laboratory research and the field studies of the Alamogordo desert, then the problems of the future can be approached on an intelligent and practical basis.

Joseph O. Hamilton, M. D.

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Copy 1 - 5 of 5 - F. L. Warren
6 of 7 A - Mrs. A. Overstreet and L. Jacobson
7 of 7 A - J. O. Hamilton

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BERKELEY 4, CALIFORNIA

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For the U S Atomic Energy Commission
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Document No. JJH-2
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Series A. Contains 4 Pages

November 20, 1947

(143)

To: Dean Stafford L. Warren

From: Joseph G. Hamilton, M. D.

The following report is the result of a number of discussions between Doctors Roy Overstreet and Louis Jacobson with Mr. Kenneth Scott and myself, concerning the over-all problems of radioactivity as it apparently now exists in the area adjoining the site of the atomic bomb test at Alamogordo, New Mexico. The deductions which have been made and the suggested recommendations for further action must be considered highly tentative in character due to the very incomplete nature of the available information at present.

The samples of soil specimens, plants, and the droppings from cattle show fission product activity at the approximate range of from 5×10^{-5} microcuries per gram to 5×10^{-4} microcuries per gram, expressed as dry weight and corrected for self absorption. It is of interest to note that most of the activity in the soil is found to be confined to the first one centimeter layer. Another observation of importance is that the activity per gram dry weight of the plant material as well as the cattle droppings were on the average of one-tenth of the radioactivity of the soil samples. In view of the lack of time and personnel, together with the difficult nature of the terrain and somewhat incomplete monitoring data, any accurate estimate of the over-all contamination of the area under consideration, which is approximately 100 square miles, must be considered as of a qualitative rather than quantitative nature. It is of interest to note that the radioactivity of the plant material investigated was very nearly equal to the droppings of cattle. It would appear reasonable that the average total concentration of activity in the soil over large areas may not be very different from the amount of material noted for the cattle droppings since the cattle cover large areas while feeding and the limited number of soil and plant samples may not be as representative. Moreover, it must be remembered that the cattle pick up no inconsiderable amount of dirt while feeding. It would seem likely therefore, from these speculations, that the total activity per square centimeter of surface soil will be of the order of 5×10^{-4} microcuries, it being recalled that the activity is confined primarily to the first centimeter of the soil surface. This value gives a total of 1500 curies of radioactivity, assuming the material to be deposited uniformly over the 100 square mile region. This value of 1500 curies is roughly 10% of the total amount of fission product activity which one would expect to be remaining two and one-half years after the initial combustion of 1 kilogram of plutonium. In other words, the estimated level of contamination, namely 5×10^{-4}

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Dr. Joseph G. Hamilton Records

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