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# UNITED STATES ATOMIC ENERGY COMMISSION

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CONFERENCE ON LONG TERM SURVEYS

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AND STUDIES OF MARSHALL ISLANDS

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CONFERENCE ON LONG TERM SURVEYS  
AND STUDIES OF MARSHALL ISLANDS.  
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Room 1201,  
Temporary 3 Building,  
Washington, D. C.  
Monday and Tuesday, July 12-13, 1954

The Conference convened at 9:00 o'clock a.m.,  
Dr. John Bugher, Division of Biology & Medicine, Chairman.

PRESENT:

- DR. JOHN BUGHER
- DR. C. L. DUNHAM
- DR. G. DUNNING
- DR. W. CLAUS
- CDR. E. P. CRONKITE
- CDR. R. A. CONARD
- MR. GEORGE IMIRIE
- CDR. H. ETTER
- DR. V. P. BOND
- MR. H. HECHTER
- DR. C. SONDHAUS
- LT. R. SHARP
- LT. COL. L. E. BROWNING
- MR. P. HARRIS
- MR. S. H. COHN
- MR. J. HARLEY
- LT. SHULMAN
- CAPT. YARBROUGH, MC, USN
- CAPT. ENGLISH, USN
- LT. CHAPMAN, USN
- LT. LOONEY, USN.
- MAJ. HANSEN.



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P R O C E E D I N G S

DR. BUGHER: It falls to me to start things off.

First of all, according to our records, everybody is Q cleared except one gentleman who in the short time we could not put through a special clearance. On the other hand, while we have to observe the technicalities of the situation, AEC would not have them communicated restricted data. So we may have to observe a certain silly routine at times. I don't think actually we get into much in the way of restricted data. Among the military we can discuss restricted data anyway. We may have to observe that minor formality since there was not time to arrange a special clearance.

As far as the purpose of the conference, which you all know, I would repeat that our major purpose is to assist in bringing together all the pertinent data and executing the necessary analyses of that data of the study of the persons who were injured by the fallout of the March 1 shot among the Marshall Islanders. That includes also certain task force personnel who were exposed at that time.

The situation of course is a unique one as far as past history is concerned, because we have no similar episode previously in which whole body gamma radiation combined with extensive skin contamination has been observed in a large group of people resulting from mixed fission products. The only other group of people were involved in the same

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1 detonation, the crew of the Japanese fishing craft, which  
 2 was about 50 miles north and somewhat west of Rongelap Atoll,  
 3 and was caught in the fallout, apparently being to the  
 4 north of the main line of concentration.

5 So that although these people do not come into  
 6 this particular discussion to any great extent, it appears  
 7 that the Japanese had somewhat of the same magnitude of whole  
 8 body exposure as the Rongelap people did, but with somewhat  
 9 more skin lesion as a result of a longer period of contact  
 10 with the skin surface, due to poor washing, fundamentally.

11 The larger group of people are those with whom  
 12 the special medical team dealt. This report, which is  
 13 being evolved, will be an extremely important one from the  
 14 standpoint of the medical information and will be a guide  
 15 unquestionably in many of the military considerations of the  
 16 effect of radioactive fallout material.

17 There is another large element in the picture  
 18 and that concerns the international relationships which have  
 19 been thrown into considerable focus by this event. During  
 20 the last three days of last week, I had to sit with the  
 21 United States Delegation at the UN because this matter is  
 22 now a subject of rather violent and acrimonious discussion  
 23 in the Trusteeship Council. The United States under the  
 24 trusteeship agreement of 1947 holds the Pacific Islands in  
 25 trust, among them being the Marshall Islands. That mandate

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1 is administered by a special trusteeship organization,  
 2 actually under the Department of Interior now. It was  
 3 formerly under the Navy. As such, it is responsible to  
 4 the United Nations and under the original terms, the United  
 5 States held the right to withdraw such lands as might be  
 6 necessary for strategic and security purposes, but beyond  
 7 that, to administer the whole area for the benefit of the  
 8 people concerned.

9 Bikini, of course, was separated from the islands  
 10 of free access before the trusteeship agreement was reached.  
 11 Eniwetok was separated about that time. But in view of the  
 12 commitments that the United States entered into voluntarily  
 13 at that time, there was unanimous approval of the trusteeship  
 14 by the United Nations Trusteeship Council.

15 Now we find that this is being used as one of the  
 16 weapons in the war of maneuver. The Marshall Islands  
 17 petition, which was sent in by a group, particularly  
 18 at Majuro, is used as a club now to establish a case that  
 19 the United States has been false to its obligations as a  
 20 trustee; that it has deliberately destroyed lands belonging  
 21 to the people governed; that it has injured them in a series  
 22 of experiments where, quoting various Congressmen and high  
 23 American officials, we documented that not only did the  
 24 meteorologists find themselves unable to predict anything,  
 25 but the scientists were unable to anticipate what would happen.

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1 being greatly astonished by the results of what they had put  
2 together.

3 This is the theme being pushed by the Communist  
4 group particularly, largely comprised of the Soviet Union,  
5 India and Syria at the present time, in an attempt to get a  
6 resolution adopted which is condemnatory of the conduct by  
7 the United States of the trusteeship of the Pacific islands.

8 One of the strong points in this situation is that  
9 in fact nobody did die, and all the people have apparently  
10 recovered very satisfactorily. Movie films are available in  
11 New York showing the relocation of the Rongelap people on  
12 Madro Atoll in a very beautiful setting in which the new  
13 houses are located, the people obviously happy and healthy.  
14 The Uterik people also shun returning to their homes. So  
15 far I think that film has not been shown because there was  
16 an agenda wrangle immediately which would defer this film  
17 showing until later in these hearings.

18 So that is the atmosphere which exists in the UN  
19 in which this whole thing is being used as a diplomatic  
20 weapon. We are fortunate, indeed, that the prompt response  
21 of the medical groups concerned was so effective in insuring  
22 the medical care of these people, and that the whole thing  
23 has turned out so happily, as far as the welfare of these  
24 people is concerned, apart from the human concern that one  
25 does not like to be responsible for injury to anyone.

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There is a very significant international issue involved here, with the fundamental argument concerning the rights of the trustees.

So that is somewhat the atmosphere in which we are working, and one of the reasons why it is important to get this report, not only in the very best scholarly form that we can achieve, but also to do so in a minimum of time. Eventually I hope we can also declassify the report, so as to have it published as a piece of medical literature with much medical importance to Civil Defense, to people interested in radiation injury, and a lot of other things. So I think we will realize that everybody in the government concerned with this problem is really very grateful to the group that carried on this investigation so effectively and achieved a very high order of scientific cooperation which existed throughout the program. Everyone who was asked to do something did so with very good will and enthusiasm, and turned in the very best job he could. There was no scrambling for position or notoriety in any way. I think it was one of the most satisfactory efforts that anyone could wish for.

You realize, of course, that the study and the report which you will produce is only the beginning; that the report which is in progress of preparation is only Chapter 1 of a larger volume whose termination cannot yet be foreseen.

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1 In other words, these studies will have to continue for  
2 an indefinite number of years. We hope that even after  
3 several years, that we will see pretty much the same group  
4 of people still interested in this problem, and actively  
5 working on it.

6 We will some time later get to the means by which  
7 we hope to carry on the program and to get on with the studies  
8 through the succeeding years. Despite the fact that everybody  
9 has recovered now, and looks hale and hearty, naturally we  
10 have certain reservations about what may happen in the course  
11 of 15 to 20 years with skin areas, which have been affected  
12 by as much radiation injury as occurred here, and whether  
13 or not we will find spermocele carcinoma, one of the long  
14 term sequellae of the lesions. I do not know. It is a  
15 matter of speculation. But obviously it is one of the things  
16 that may give concern.

17 Captain Yarbrough, have you any additional comments  
18 that you care to make at this time before we get every body  
19 to work?

20 CAPTAIN YARBROUGH: I have nothing particularly,  
21 Dr. Bugher, except that this particular incident has  
22 brought to light the fact that it is quite difficult to keep  
23 together personnel in the form of a unit that can be quickly  
24 activated and transported to distant places for studies of  
25 this kind. I am sure that all people in the military at this

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1 time realize that there is a critical situation with regard  
2 to personnel, more critical perhaps among medical personnel.

3 This was a subject of considerable discussion at NRDL  
4 some two weeks ago, where we have made some effort to at least  
5 keep track of personnel so technically trained that with  
6 some degree of efficiency in the matter of time that we can  
7 pull together some of the units again.

8 Essentially we have realized that this is a rather  
9 mountainous problem. I don't know how far we would get  
10 with it, but we intend to continue efforts to at least keep  
11 locators on these people where we can requisition them, or  
12 request that their services be loaned for solution of such  
13 happenings as the recent Marshalese incident.

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14 DR. BUGHER: Thank you very much. We have a plan  
15 to split the various people up into study groups, and give  
16 them about an hour and a half to get their facts and figures  
17 in order, and then return to the meeting. We are just a  
18 little bit behind time, but we will try to make it as  
19 quick as we can. In other words, if you can cut a little  
20 bit under the hour and a half, that is to the good.

21 Did everybody get these agendas or did nobody get  
22 an agenda? I am afraid I am the culprit here. Then one  
23 group is to consider the estimate of external dose, with  
24 Gordon Dunning as group leader, Sharp and Sondhaus to work  
25 with him. You will probably want to get off in some quiet

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1 place if you can find it, and see what you have.

2 Then for the hemologic findings, the dermatological  
3 evidence, and the general clinical studies, Bond as group  
4 leader, Conard, Cronkite, Browning, Dunham and Hechter as  
5 members of the group. That group will need a little larger  
6 room, I take it.

7 The third group for the nature of the fallout,  
8 internal deposition, urinary excretion, body burden of the  
9 long term hazard, we had Merrill Eisenbud as group leader,  
10 but I have not seen him. He is not here. I understand he  
11 is on vacation. Walter, would you act as group leader for that  
12 discussion?

13 DR. CLAUS: All right, I will try.

14 DR. BUGHER: Harris, Cohn, Harley and Imirie to  
15 join in that.

16 The rest of us -- if there are any "rest" -- I  
17 believe there are some more left unattached -- can discuss  
18 as informally as they wish these matters.

19 Now, as to location, I would suggest that perhaps  
20 Bond make use of my office for his group.

21 DR. CLAUS: I think perhaps we can use my office.

22 DR. BUGHER: Gordon Dunning and that smaller  
23 group could use Dr. Dunham's corner. Then we will break up  
24 for that individual group work until 10:45.

25 (Thereupon at 9:45 a.m., a recess was taken until

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11:15 a.m.)

DR. BUGHER: Dr. Dunning, are you ready to report on your group on the dosage problem?

DR. DUNNING: Yes, we are.

ESTIMATE OF EXTERNAL DOSE (SURFACE AND WHOLE BODY)

DR. BUGHER: Would you care to come up here where you have a blackboard and chalk?

DR. DUNNING: No, I don't think so. I would like to call on Dr. Sondhaus to present some of his ideas here first, and then I will try to summarize the committee's findings after we get through with all the "ifs" and "buts", and "whereases", and we will try to come up with specific numbers.

DR. BUGHER: That is what we want.

DR. SONHAUS: What we have considered in NRDL were several points concerning the data on the external doses. The first question was the calibration of instruments used. We have quite a bit of conflicting data to some extent. We chose for the most reliable that of the RAD SAF SCOVEY group on the 8th of March. This was done with more adequately calibrated instruments, and we have data on the performance of the T-1-B.

The second question was the energy distribution of the fallout gamma radiation, and its effect on the meter response. Concerning this, we have some spectral

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1 distribution data, which was taken from fallout samples. On  
2 this we performed a calculation which takes into account  
3 the degradation of the energy due to scattering in the air,  
4 due to the distribution of such fallout on an infinite plane.

5 The next question was the rate of decay of the  
6 fallout mixture. Here again there is a certain amount of  
7 experimental data which seems to indicate that two exponents  
8 should be used over the period of time in which we are  
9 interested, namely, a .8 or .9 exponent during the first four  
10 hours to four days, and from four days until 25 days, roughly  
11 an exponent of about 1.6 seemed to fit the combination of  
12 the Neptunian and fission product combination.

13 The best estimates of the dose rate at the time of  
14 evacuation were computed, using these factors, and the time  
15 of arrival of the fallout, and the duration of the fallout  
16 with the remaining questions considered. Since there is  
17 very little accurate data, except in the case of Rongerik for  
18 the time of fallout, the best estimates possible were made,  
19 and doses were calculated on the basis of either a very short  
20 fallout or the longest possible fallout that could be assumed  
21 to have taken place consistent with the time of commencement  
22 and the dose rates which were read at later times by the  
23 survey instruments.

24 Based on these considerations, we have several sets  
25 of doses which are in substantial agreement with Mr. Sharp

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1 and Dr. Dunning, and I think I will leave that for him to  
2 summarize.

3           There are minor differences in the approaches and  
4 also the numerical values of the parameters, but these do not  
5 seem to lead to any sharply different values. I think that  
6 is all I have to say.

7           DR. DUNNING: As the group can appreciate, there  
8 is a great deal of uncertainty in trying to estimate the  
9 numbers. Different instruments were used by different people  
10 at different times, and different places. Some instruments  
11 were calibrated recently before use, some were not. In  
12 addition to the actual surveys taken, of course, theoretical  
13 computations were made, such as the ratio of formation of  
14 Neptunium and fission products for this particular device,  
15 being of the order of .8, for example, and then trying to  
16 estimate what the relative dose rates would be at different  
17 times after detonation and trying to come up with an  
18 integrated dose for the times of interest.

19           In the case of Rongelap natives, the fifth or sixth  
20 hour after the fallout to the time of evacuation, there was  
21 still some uncertainty as to the exact time of initial  
22 fallout, even uncertainty as to Neptunium contribution,  
23 uncertainty as to where the people were. We had different  
24 dose rate readings at different parts of the island. Where  
25 were the natives? How long did they stay there? Different

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1 dose rate readings inside and outside, but in the case of  
2 natives that was not so important, because in the huts the  
3 dose rate readings are almost as high as outside.

4 In the metal shacks for the Air Weather people  
5 at Rongerik, this was not so. We have such phenomena as people  
6 lying on their mats for their sleeping at night, the fallout  
7 material blowing into the huts, thoroughly covering the huts.  
8 The uncertainty of the contribution of the soft gamma.  
9 As you know, most of these measurements are taken by such  
10 instruments as the T-1-B or T-39, where they have essentially  
11 a cutoff value of some 70 to 80 CEV. You are missing your  
12 soft gammas and your beta.

13 Then I think there is one phenomenon that was  
14 not discussed very much, but which may be important.  
15 Unfortunately we cannot evaluate it. We have experienced  
16 this phenomenon in the Nevada test, for example, in Shot  
17 No. 9, in the Upshot-Knothole series. When you plotted out  
18 the dose rate readings with time, you get a definite hump.  
19 In that case the area under the curve was not too great or  
20 significant. But out in the Pacific, where you certainly had  
21 a relatively high concentration of activity in the air,  
22 lasting for probably many hours, you might have a  
23 significant contribution from sky shine that has not and  
24 probably never can be accurately evaluated. This will not  
25 show up in any of our dose rate readings.

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1 I told you we are going to have a lot of "ifs"  
2 and "ands" but we are still going to come up with numbers  
3 in the end.

4 So taking all these values, the values arrived at  
5 theoretically, values taken by the survey team, using the  
6 various exponents and so forth, it would appear that the  
7 best estimate we can make for the Rongelap natives was about  
8 150 r. This is whole body gamma. This does not include  
9 soft gammas, nor the betas. At <sup>Ailinginae</sup> Elinkani, the data are less  
10 firm, but be that as it may, our estimate is about half, or  
11 in other words, about 75. Utirik, again, is less firm than  
12 Rongelap, but we are not quite so concerned that it is less  
13 firm inasmuch as it would appear that the value is about 15 r.  
14 In other words, we are not concerned in terms of any  
15 biological hazard.

16 For the Air Weather people on Rongerik, again  
17 we have a whole series of survey data, as well as the film  
18 badges. After going overall the survey data taken by  
19 various instruments at various times and different  
20 people, and what have you, it would appear that the firmest  
21 data is to go to the film badges. As you know, some of these  
22 film badges were in an ice box and some were carried. But  
23 for most of the personnel, the film badges were between 40  
24 and 50 r. For one film badge, representing three Army  
25 personnel on the north end of the island, their film badge

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1 read 98 r. However, in checking with their actual movement,  
 2 it would appear that these three Army personnel did not  
 3 remain there all of the time. In fact, they were back at  
 4 the other end of the Island and inside the metal buildings  
 5 for an appreciable amount of time. Therefore, the 98 r  
 6 probably represents the upper limit of our estimate.

7 I would like to give you very firm figures, but I  
 8 think you can appreciate the problem, that this is about as  
 9 firm as you can get. In fact, maybe we already have  
 10 stuck our necks out too far.

11 DR. BUGHER: Do you have any estimate of the range  
 12 here within which the dose probably falls? In other words,  
 13 anything that would resemble a standard error?

14 DR. DUNNING: I was afraid you would ask that.  
 15 Frankly, I don't. As Dr. Söndhaus has indicated, they came  
 16 up with a range. I have deliberately not put one in, because  
 17 I was afraid people would read into that an implication of  
 18 a standard deviation. I just don't think the data are firm  
 19 enough.

20 To make the matter still worse, on this agenda, we  
 21 give an estimate of surface dose. This is getting into the  
 22 problem among other things of beta-gamma ratio, which is,  
 23 of course, exceedingly difficult to evaluate.

24 If I may just mention, we have some very limited  
 25 data on the Japanese fishermen, where we have some material

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1 taken from aboard the ship. I repeat it is very limited.  
2 But be that as it may, making certain assumptions, it would  
3 appear that if the fallout material were to remain in contact  
4 with the skin of the Japanese fishermen for one hour, that  
5 something of the order of 10,000 REPS would have been  
6 delivered to a depth of 7 milligrams per square centimeter.  
7 And if it remained longer than one hour,, which it probably  
8 did in ~~the~~ case of the fishermen, on up.

9 In the case of the natives, we don't even have  
10 that much data to go on. The fact that the natives were  
11 lying down during the evening of March 1, probably contributed  
12 to exposing a larger surface of the body to the soft gammas  
13 and betas. But to come up with any firm number as these  
14 natives received so many REPS, we felt we were unable to do so.  
15 The data would certainly strongly support the conclusion  
16 that these lesions were due to radiation. Of that there seems  
17 to be little doubt. But exact doses I just cannot say.

18 DR. BOND: Can you give us any estimate of the  
19 amount of gamma below KV cutoff?

20 DR. DUNNING: Yes. Dr. Sondhaus, will you tell us  
21 that?

22 DR. SONDHAUS: Yes. I would like to say that the  
23 estimates we have do include the contribution of gamma  
24 below 100 KV in the ~~initial~~ spectrum which we have.  
25 Approximately 8 per cent occurred below 80 KV. When you

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1 translate this into terms of dose, including the effect  
 2 of scattered soft radiation from the higher energy lines in  
 3 the spectrum, the percentage of the dose is still in the  
 4 neighborhood of 16 or 17 per cent. The T-1-B cutoff, I  
 5 have approximated as best I could with data which were taken  
 6 in our laboratory, both recently and a couple of years ago.  
 7 The sensitivity falls down quite strongly at a range of  
 8 60-50 KV. But even making a generous estimate of the  
 9 correction factor, that must be applied to a dose in this  
 10 energy region, the overall correction factor for the T-1-B  
 11 seems to be close enough to unity within the limits of the  
 12 error we can specify here.

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13 The reading of the instrument, I think, could be  
 14 accepted as being accurate. Since the proportion of the dose  
 15 in this region is small, I do not think that we need to consider  
 16 that it departed materially from the total doses estimates  
 17 we have here. The total dose would appear to have resulted from  
 18 three general ranges of energy. One in the 100 KV to 200 KV  
 19 region of about 17 per cent. The majority of the dose in  
 20 the 600 to 800 KV region of perhaps 50 per cent. And about  
 21 15 to 20 per cent in the 1.5-1.6 KV region, with the balance  
 22 of the dose spread out between these three humps. So that the  
 23 exposure could probably be treated as a composite of an  
 24 exposure to each of three separate radiation energies.

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25 DR. DUNNING: Let me ask you again for the benefit

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1 of the group, this material that you used in this experiment  
2 was taken from where?

3 DR. SONDHAUS: The material for this spectrum  
4 determination was a cloud sample which was flown back to  
5 the laboratory, and the spectrum taken at four days.  
6 Naturally this is subject to a great deal of question as to  
7 whether the fractionation was the same in this portion  
8 of the cloud as it was on Rongelap, for example. Also, there  
9 were other samples taken on some of the rafts which were at  
10 various distances out from the lagoon. I think the furthest  
11 one was not more than 50 miles away. We don't have any  
12 direct spectrum determination on Rongelap soil samples as  
13 far as I know at this point. There are some, but this was  
14 the first spectrum taken at the laboratory.

15 DR. DUNNING: I wanted to bring that out. We did  
16 discuss it in our meeting. I think we must realize that we  
17 are talking about cloud sample data, and not the actual fallout.  
18 What the difference would be, I am not prepared to say. I  
19 think this should be remembered.

20 Also, the lower value of exponent of .8 to .9  
21 was from material close in at the Bikini Lagoon. This may  
22 not be the same found at 150 miles away. This is a throwup.

23 DR. BOND: What was the calculated value of dose  
24 for the Americans? What was the dose calculated in the same  
25 manner as for Rongelap?

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1 DR. DUNNING: As I recall it ran between 60 and 76  
2 from the survey team readings. As I say, after considering  
3 so many factors, one, that most of these readings are taken  
4 nine days later, and when you start extrapolating back, if  
5 your exponent is off, you can be off quite a bit. Other  
6 things, how long the people stayed there, et cetera. It  
7 seemed that the film badges worn by personnel, and there  
8 were three, might be as close as one might hope to come.

9 DR. BUGHER: Do you think, Gordon, that the  
10 relationship between the film badge figure, which we are  
11 accepting for the Air Weather Service people, and the  
12 calculated dose which was mentioned here would also hold  
13 for the actual dose that would be shown by film badges, and  
14 that calculated for the Rongelap people?

15 DR. DUNNING: I thought of that, Dr. Bugher. I  
16 don't have the firm answer. I would like to point out this,  
17 however, that the Air Weather personnel had metal barracks,  
18 and they were indoors an appreciable amount of time before  
19 evacuation. The attenuation of these metal barracks -- if you  
20 will just be patient here for a moment -- here is one with a  
21 factor of two, and so forth. So one might expect that the  
22 film badges would show less than the calculated.

23 DR. BUGHER: So the calculated figure here of  
24 60 and 75 did not include a factor for the buildings?

25 DR. DUNNING: No, it does not. I think that is

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1 about the best we can do.

2 CDR. CONARD: Do you have any data at all on the  
3 beta spectrum?

4 DR. DUNNING: I don't. Do you?

5 DR. SONDDHAUS: Not on the beta spectrum. I think  
6 we might be able to make some estimates.

7 CDR. CONARD: That would be nice to know from the  
8 point of view of skin lesions.

9 DR. SONDDHAUS: About 80 per cent of the fallout  
10 was Neptunium-uranium; in four days we could make some  
11 estimates on that basis even though we do not have a  
12 complete spectrum.

13 CDR. CONARD: Anything you could give us on that  
14 would be helpful.

15 DR. SONDDHAUS: Surely.

16 DR. BUGHER: It might be pertinent also, since you  
17 mentioned the figure of 10 REP to skin from an hour's  
18 contact, to give the assumptions on which that was based  
19 with respect to the amount of material on the skin, that is,  
20 the thickness, and so forth. It is probably true that the  
21 estimate there was a much heavier deposition than actually  
22 occurred.

23 DR. DUNNING: If you recall, I tried to be very  
24 cautious and indicate that the estimates were based on very  
25 limited data, and on some very shakey assumptions, you

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1 might say. One assumption is that the fallout occurred in  
2 the third hour after detonation. The second, and probably  
3 one of the most important, that this material was spread out  
4 to provide a thickness of .01 of a gram per square centimeter  
5 about 40 micron thickness. Here is one that is wide open.  
6 The rest of the assumptions, I think, are not too far off.

7 DR. BUGHER: That was also based on the activity  
8 from John Harley's figure.

9 DR. DUNNING: Yes, sir, there is another very  
10 important assumption that would have to be looked at closely.  
11 That is the specific activity was 3.1 times 10 to the 8th  
12 disintegrations per minute per gram on April 7.

13 Then it was just a matter of extrapolating -- I  
14 say just a matter -- back again, assuming 1.2, and then you  
15 come up with a specific activity on the third hour after  
16 detonation. Then with the assumption of so much material  
17 deposited, and using Rossi's calculations as to self absorp-  
18 tion in the skin, we come up with the calculations as to the  
19 dose that 7 milli grams per square centimeter below the surface.

20 DR. BUGHER: What was the activity per gram on that  
21 basis?

22 DR. DUNNING: 3.5 times to the 11th. I believe  
23 this is the figure we want. If you accept 1.2, that is about  
24 the answer. That is in terms of disintegrations per  
25 minute per gram.

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1 DR. BUGHER: That helps. Then we have from the  
 2 Japanese biophysicists by chance from Osaki who got on that  
 3 ship on the 16th, 16 days afterwards, and his estimate was  
 4 a half curie per gram from the materials he scraped up. He  
 5 had first access to it, and he scraped some up and took it  
 6 home. That information never appeared in Tokyo. He included  
 7 it in a memorandum, you will recall, in an addendum to a  
 8 letter his wife wrote to President Eisenhower. That is where  
 9 we got our information. That seemed to check in pretty well  
 10 considering the uncertainty of exponent, and the variation  
 11 of instrument, and everything in a factor of two.

12 MR. IMIRIE: What would be the calculated hard  
 13 gamma dose? In other words, of this 10,000 REP, how much  
 14 would be equivalent to a T-1-B reading?

15 DR. DUNNING: You tell me, and I will pin a medal  
 16 on you. That is a \$64 question, and I am sure you know it is  
 17 a question. Beta-gamma, you just can't come up with a  
 18 number as you well know. Is it beta-gamma ratio in terms  
 19 of function of time after detonation, and what you are  
 20 interested in is the dose delivered to the 7 milligrams per  
 21 square centimeter below the surface, and how can you make  
 22 this relationship? As you know in the Greenhouse work, they  
 23 found a beta-gamma of 157 to 1.

24 This does not represent the dose of roentgens.

25 Mathematical calculations would indicate something like 130

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1 to 1, but again we don't know. I suspect it is lower than  
2 that. How much lower, I am not prepared to say.

3 DR. BUGHER: Does that represent what you have been  
4 able to squeeze out?

5 DR. DUNNING: That is all we could get out of  
6 that lemon.

7 DR. BUGHER: That is very helpful. It is always  
8 startling to find out what gaps in the physical measurements  
9 seem always to exist, even after maximal efforts have been  
10 expended. No matter how much we have, we always want more,  
11 and wish we had something additional to what we do have.

12 I don't know whether anybody did a complete beta-  
13 gamma ratio curve for any standard instrument through this  
14 period.

15 DR. DUNNING: No one did that I know of.

16 DR. BUGHER: We will have to recruit the Marshallese  
17 to do some of these things. Thank you very much, Dr.  
18 Dunning. It is good to see some figures here together with  
19 a discussion with the universities which are involved in them  
20 so that we all remain aware of the inherent area of what I  
21 call disagreement, which would not represent disagreement at  
22 all, but simply a range of estimate from the data that we  
23 do have.

24 Are there any further questions or comments on this  
25 side of the story?

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1 (No response.)

2 DR. BUGHER: I think we all seem to be disposed  
3 to accept the estimate of 150 roentgens for the average  
4 dose for the Rongelap people, with some uncertainty as to  
5 that. The uncertainty is not specified, but I should think  
6 it might very well be of the order of 25 roentgens up or down.

7 DR. SONDHAUS: I should like to add one thing, Dr.  
8 Bugher. In conjunction with considering a figure for the  
9 dose under these field conditions, we should bear in mind  
10 that this quite possibly needs to be interpreted in terms  
11 of the geometry of the exposure. That is to say, that when  
12 a laboratory experiment is performed on an animal, perhaps  
13 with the dose being divided between both sides of the  
14 animals with a bilateral exposure or something of this sort,  
15 the depth dose characteristic is quite different than in a  
16 uniform 360 degree exposure, such as an individual would  
17 receive while standing on an infinite plane. We have begun  
18 some preliminary estimates of this at the laboratory by  
19 trying to simulate a 360 degree exposure with a cylindrical  
20 phantom. The first figures are rough, but one might be  
21 led to the conclusion that perhaps a 40 per cent increase  
22 in the dose in terms of a laboratory exposure would result  
23 from the same skin dose, but with the radiation from all  
24 directions. That is, the exit dose would certainly be the  
25 same as the entry dose in this case, and the volume dose

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1 might be put in terms of a higher figure, differing by about  
2 this much. I am not prepared to say anything more than this  
3 right now. I do believe the point should be made that the  
4 figure, say, of 150 does not necessarily imply the same  
5 biological effect as 150 r divided equally between both sides  
6 of an experimental animal. This should be taken into  
7 consideration.

8 DR. BUGHER: Are we not talking about roentgens at  
9 least 5 centimeters in here when you speak of the whole body  
10 dose of 150 rather than superficial area?

11 MR. HARRIS: It is air dose.

12 DR. SONDHAUS: We have taken the readings of an  
13 instrument in air and integrated with them. So what we are  
14 specifying here is an air dose to which an individual was  
15 exposed.

16 DR. BUGHER: You are not calling it as a whole body  
17 exposure.

18 DR. SONDHAUS: That is right.

19 DR. BOND: It is usually expressed as a whole body  
20 dose. It is a dose in the air given to the whole body.

21 DR. BUGHER: Has the committee any estimate of  
22 dose at 5 centimeters or 10 centimeters or any figure?

23 DR. BOND: It is under investigation, but it has not  
24 been completed. It is being worked on at two laboratories.

25 DR. SONDHAUS: The 5 centimeter dose will certainly

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1 differ between these two cases if you normalize to the same  
2 air dose between the laboratory exposure and the field  
3 exposure.

4 DR. BUGHER: Do you think with your gamma spectro-  
5 metry you will come out with some sort of estimate here?

6 DR. SONDHAUS: That is quite possible, I think.

7 DR. BUGHER: That is the essential thing. We are  
8 not only uncertain as to 150 r; we do not say that the  
9 individual's bone marrow or organs or spleens got such  
10 radiation; is that right? How long do you think it is going  
11 to be before we do come out with a pretty firm estimate?

12 DR. BOND: I think before the final report, Dr.  
13 Bugher, we are working with it on our x-ray machines, and  
14 the cobalt source that is ideal for solving this problem, and  
15 it will probably be solved before the final report is in.

16 DR. BUGHER: Obviously it is a very important  
17 figure to have, and as precise as may be possible. That is  
18 a very helpful comment.

19 Are there any other comments or questions to ask  
20 of this committee? If not, we pass to the second group  
21 report by Dr. Bond on the clinical aspects which include the  
22 hematologic things, as well.

23 HEMATOLOGIC, SKIN, AND GENERAL CLINICAL STUDY

24 DR. BOND: I think perhaps we had less uncertainties  
in our material than the dose group. Obviously the dosage

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1 problem is of tremendous importance to us in an effort to  
2 correlate what we saw with physical estimates of dose.

3 I think we will simply enumerate the major conclusions that  
4 we wish to draw from this study. If there are comments, I  
5 would like to have them at the time, so please interrupt.

6 I think as far as systemic effects are concerned,  
7 the only symptoms that could be ascribed unequivocally to  
8 radiation was the early appearance of mild subjective  
9 symptoms. This was nausea that appeared to a large degree  
10 in the Rongelap people, and with considerably less degree in  
11 Ilinkela, and not at all in the Uterik or American groups.

12 These people were treated identically. They did  
13 not know, so to speak, the correct answers to the questions  
14 that were put to them. Different interrogators obtained the  
15 same results, so we feel that this is a real thing, and  
16 probably ascribable to radiation.

17 Aside from this, there were no other clearcut  
18 constitutional symptoms ascribeable to radiation. There was  
19 no diarrhea or other classical symptoms of whole body radiation  
20 damage. The instance of cold diarrhea and so forth was  
21 equal in the different exposure groups.

22 There is one possible exception to this statement.  
23 Abnormal menses were observed in two women in the Rongelap  
24 group. Whether this can be ascribed to radiation is a  
25 considerable question.

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1           An additional point is that it was impossible for  
 2 the observers to distinguish among the various groups with  
 3 regard to the activities, that is, the spontaneous activities  
 4 they carried on. That is, apparently they played and engaged  
 5 in the same amount of activity throughout the period of  
 6 observation.

7           So much for the constitutional symptoms. As far  
 8 as the skin lesions are concerned in these people, there was  
 9 early appearance of itching of the skin, itching and burning,  
 10 and here again a very large instance in the higher exposure  
 11 group, less in the lower exposure groups. There were no  
 12 further symptoms until the development of the lesions which  
 13 I will go into in a moment.

14           The question has been brought up as to whether  
 15 these are beta lesions or chemical burns. I don't think we  
 16 need to dwell on that except to state that it is the very  
 17 definite feeling that there is no possibility that they are  
 18 chemical burns, and they were due to exposure to ionizing  
 19 radiation.

20           The second large point we would like to make is that  
 21 these were contact burns and were not derived from a field  
 22 of radiation. It was only in areas where there was actual  
 23 contact of the fallout material with the skins that the  
 24 lesions developed or in areas where there was a chance for  
 25 the fallout material to be directly in contact with the skin.

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1 This is borne out by the fact that in general where clothing  
2 covered the body, even a light dress in the case of the  
3 women, burns did not appear. It is also borne out histo-  
4 logically by the fact that there are islands of normal tissue  
5 in between the several affected tissue, indicating the  
6 particular nature of the deposited material, and the fact  
7 that it was deposited material that was responsible for the  
8 burn.

9 One thing that is not clearly worked out, and I  
10 don't know how to explain this. Apparently there is some  
11 discrepancy or difficulty explaining the order of appearance  
12 of lesions. Generally speaking, the lower the dose, of beta  
13 radiation, the later the lesions would appear.

14 This in general was not entirely the case with  
15 these individuals. The feet, for instance, showed very  
16 severe beta lesions. The surface of the anacubicle foci,  
17 the anterior surface of the neck, showed beta lesions.  
18 The scalp and the feet where the skin presumably is thicker  
19 sometimes lesions appeared later, and were more severe than  
20 in the case of the areas with thinner skin.

21 Also the order of appearance of these lesions  
22 in general was different from some reports in the literature.  
23 Also this was apparently a monophasic response as we got  
24 a single appearance on approximately the 14th day. There  
25 was no evidence of erythema or other skin damage. This

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1 differs from previous reports in the literature, but may  
2 be at variance. This may be explicable on the basis that  
3 these people did have dark skins, and the darkness of the  
4 skin obscured the early response.

5           With regard to the severity of the lesions in terms  
6 of incapacity to the individuals, the lesions in some of  
7 these individuals were painful and of sufficient severity  
8 that under all ordinary circumstances, these individuals  
9 would be admitted probably to the sick list.

10           It was the clinical impression in general that  
11 these lesions were quite superficial in nature. We are  
12 unable to determine whether the explanation for this is on  
13 the basis of the total dose received or whether it may be  
14 due to the energy of radiation, that is, with lower energy  
15 betas one might expect more superficial lesions.

16           In general the severity of the lesions observed  
17 correlated well with the amount of fallout presumably  
18 encountered by the individuals. That is the Rongelap people  
19 had the most severe lesions, the Ilinkila with less fallout  
20 and less total dose had the same type of lesions, but less  
21 severe, and generally later in appearance, and healed more  
22 rapidly.

23           With regard to the loss of hair, again this  
24 apparently occurred in areas where material was actually  
25 deposited on the scalp. It was spotty in nature, and

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1 presumably was not the result of a field of gamma radiation.  
2 As I say, it was associated with actual material deposited  
3 at the site. It is difficult to arrive at a dose biologically,  
4 that might have caused this. However, the figure has been set  
5 at the upper limit occurs and recovery is possible, is  
6 approximately 700 r since the hair did grow in on the  
7 individuals later. We can presume that the upper limit  
8 might have been of the order of 700 r.

9 I think it is worthy of note to state that in  
10 general the lesions required no special treatment of any  
11 kind. No so-called specifics were used. Healing in  
12 essentially all cases was entirely satisfactory. Also, even  
13 in the most severe cases of skin damage, there was no systemic  
14 manifestations that could be attributed to the skin damage.

15 With regard to the prognosis of the skin lesions,  
16 here again it is essentially almost anybody's guess. There  
17 are a number of opinions on this. I think it is fair to  
18 say that clinically with fairly large doses of radiation  
19 that recovery has been apparently complete, and that we can  
20 be optimistic probably about the ultimate fate of these  
21 skin lesions. However, because of data in the literature  
22 indicating later breakdown in these lesions, and carcinogenic  
23 changes, it is necessary that we retain a guarded prognosis  
24 and an attitude of watchful waiting.

25 With regard to the skin lesions, I would like to

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1 mention the nail pigmentation. I think most of you are  
2 familiar with that. That appeared at the base of the nail,  
3 a bluish discoloration. Apparently this was an aberration  
4 of pigmentation. I think it has been reported only once  
5 in literature in a single individual.

6           With regard to the hematological findings in these  
7 individuals, here we see no justification throughout in  
8 treating the individuals other than as roots exposed to the  
9 same dose of radiation. There is no physical basis upon  
10 which to segregate them. Even in the case of the Army boys,  
11 it appears that their activities are not too different from  
12 the remainder of the Air Force boys, so these were treated  
13 as a group as with the other exposure groups on the various  
14 islands.

15           A word as to the controls that were used for the  
16 hematological studies. They are, I think, at least as good  
17 and probably considerably better than most clinical studies  
18 of this nature. That is, the control groups were matched  
19 with respect to age and sex to the actual exposure groups.  
20 So that while we must recognize that strict comparisons are  
21 not valid, as we cannot state definitely that they are  
22 homogeneous samples of the same population, still we feel  
23 it is an excellent control group, and will serve very  
24 adequately as a guide.

25           For the control for the native groups, we went to

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1 Majuro and obtained a very large control group, as I say,  
2 comparable in age and sex to the exposure group. For the  
3 Americans we obtained a group of Americans that had been in  
4 the mid-Pacific for a period of at least two months, and at  
5 least to that extent were comparable to the Rongerik Americans  
6 who were out there approximately two months when exposed.

7 The control populations -- the controls for the  
8 Natives were broken down as regards to age and sex. They did  
9 show a difference in response as a function of age. In  
10 general as far as the leukocyte-lymphocyte count is concerned,  
11 the children below five were different than those above five.  
12 With respect to platelets, individuals below 15 were  
13 significantly different than those above 15. So they have  
14 been broken down into these age groups, and I will speak only  
15 of the adults unless I specify children.

16 In the large exposure group in the Rongelap, there  
17 is no question as to the definite change in the hematologic  
18 picture. They did fall and remained at a fairly low level  
19 for a period of weeks, and there are indications that they were  
20 returning towards normal when the group studies were  
21 completed.

22 The change in total white count was reflected in  
23 both the leukocyte counts and lymphocyte counts. The  
24 lymphocyte counts fell immediately to a level of 2,000 cells  
25 and remained throughout the duration of study, and no evidence

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1 of return to normal when the study was completed. The  
 2 neutrophils fell initially. They fluctuated considerably.  
 3 Apparently they were returning to normal toward the end of  
 4 the study.

5 The platelet counts in the Rongelap group showed  
 6 a very definite decrease. I do not have slides of this, but  
 7 I think it is quite evident from the graph, and you can see  
 8 the general trend. Certainly there is a marked fall from  
 9 the normal values. They reached a low on approximately the  
 10 28th day, and returned to a value of roughly half way between  
 11 that low and normal, and perhaps were returning to normal  
 12 at the completion of the study.

13 I might say in passing that in general the platelet  
 14 count at least showed a more regular response than did the  
 15 leukocyte count. The curve is very smooth. It shows a  
 16 definite low and return to normal, while the white count was  
 17 prone to fluctuate as a function of time.

18 The hematologic findings in the Ilingula group  
 19 paralleled almost exactly those in the Rongelap group.  
 20 However, the severity of the changes was not so severe. The  
 21 time trends, however, were the same.

22 With regard to the Americans, looking at the white  
 23 count, the lymphocyte count or the neutrophil count, one  
 24 would be very hard put to say that they had been exposed to  
 25 radiation. The counts are lower than normal, but here again

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1 we get into the control business, and it is difficult to  
 2 evaluate the extent of fall. However, if we look at the plate-  
 3 let count in that group, here again we get what appears to be  
 4 a very definite fall with a low reached at the same time as in  
 5 the exposed native population, and a return towards normal  
 6 towards the completion of the study.

7 A word with regard to children versus adults.  
 8 In the Rongelap people, I think with all end points -- all  
 9 hematological end points, -- the children seemed to show a  
 10 more marked response than did the adults. That is on the  
 11 basis of absolute count. That is, we take the counts  
 12 per cubic millimeter, and the children's counts were lower  
 13 than adults. However, if we take these on the basis of  
 14 per cent of control, this makes a considerable difference,  
 15 particularly in terms of the lymphocyte count. If we take  
 16 it in terms of per cent of control, the children were markedly  
 17 more affected than the adults, which in terms of absolute  
 18 counts they were more affected, but not nearly to the same  
 19 degree.

20 With respect to the time trends in hematology in  
 21 general, they were markedly different than is observed in  
 22 the laboratory with large animals. The fall to the lowest  
 23 point for both the myeloid elements and the platelets was later  
 24 than seemed with animals, and its return towards normal was  
 25 later than has seemed with animals.

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1                    On looking over carefully previous data from the  
 2 Japanese and accidents that have occurred at Los Alamos  
 3 and Argonne, it appears that perhaps this has been observed  
 4 before, although not emphasized. Actually the data previous  
 5 to this has in general been composed of very small exposure  
 6 groups even in the Japanes, while the total exposure group  
 7 followed may have been in the hundreds. Actually the counts  
 8 at a given time were done on a very few individuals, as low  
 9 as two out of the group. So it is difficult to make an  
 10 accurate comparison between the two exposure groups.

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11                    In the case of the Argonne accidents, we have to  
 12 comparw our data with one or two individuals from a comparable  
 13 dose range.

14                    We attempted to make some correlations between  
 15 skin lesions, depilation, and various parameters derived  
 16 from the blood counts. All efforts in this respect were not  
 17 fruitful. We were unable to evolve any correlation at all  
 18 between hematological changes or skin or depilation changes.

19                    One final note on the hematology. The time trends,  
 20 as has been pointed out, are essentially identical to that  
 21 of an individual exposed at Argonne National Laboratory, who  
 22 received an estimated 190 REP of radiation. The prognosis  
 23 for this individual to date has been excellent, and we hope  
 24 that this may be an indication that with these individuals  
 25 also the prognosis will be excellent.

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1 I think those are the main points, Dr. Bugher.

2 DR. BUGHER: Thank you, Dr. Bond. Are there further  
3 comments?

4 MAJ. HANSEN: Did any Americans show they had any  
5 beta burns?

6 DR. BOND: This depends on who looked at them.  
7 I think the consensus would be to the effect that the  
8 lesions seen are not inconsistent with beta lesions.

9 DR. DUNNING: Did I understand you to say that  
10 these were superficial on the natives?

11 DR. BOND: This is the impression clinically,  
12 that they were superficial. It was like a sunburn with  
13 superficial layers peeled off. There is no evidence of deep  
14 involvement, and they healed rapidly.

15 DR. DUNNING: Even those on the feet?

16 DR. BOND: No, I should not say that. This was  
17 most of the lesions. There were occasional lesions that  
18 were deep. This occurred on the feet and occurred on the  
19 back of the ear of one individual, but as a whole, the  
20 lesions were superficial with these few exceptions. This is  
21 not clear as to whether it is a function of total dose or  
22 energy that is responsible for this. A very thick skin at the  
23 heel would probably give you quite a different result than  
24 a very thin skin at areas where the skin is more superficial.  
25 We have no way of knowing how much material was deposited on

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1 the feet as opposed to a greater surface.

2 MR. HARRIS: I don't know whether you looked at  
3 the pathology, but did anybody make a note of possibly at  
4 what level there was fibroplastic proliferation beneath the  
5 surface on these individuals? It appears to me that a good  
6 index of the energy of the situation, and we assume here  
7 this is a 100 kilowatt average energy beta ray which is  
8 doing most of the burning, from what I have seen of burns  
9 using strontium and various high energy beta rays, the level  
10 of fibroplastic proliferation is sharply cut off with  
11 strontium. That cutoff point agrees in general with the  
12 range of the electron from strontium. So that this might be  
13 something to look at if it was in these specimens.

14 CDR. CRONKITE: Essentially there is no detecting  
15 a histologic change between three German octavos, depending  
16 on what part of the body you are at. Greater than 50 MU  
17 is very little detectable.

18 MR. HARRIS: I am not thinking of the depth down  
19 to which, but the closeness to which you come. Essentially  
20 with strontium what you find is the burn area, and below  
21 the burn area is a very thin area of disturbed reparative  
22 action that you will get fibroplastic proliferation up to  
23 the depths from this point, but below that point which is  
24 slightly below the burn itself, you will not have it. The  
25 total depth below the surface of the skin appeared to be

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1 roughly dependent upon the range of the beta ray. This could  
2 be checked experimentally if somebody wanted to know something  
3 else.

4 CDR. CONARD: Most of the damage histologically  
5 occurred in the papillary area.

6 MR. HARRIS: But there was no reparative action  
7 coming from the bottom.

8 CDR. CRONKITE: There was no fibroplastic  
9 proliferation in any that I looked at.

10 DR. DUNNING: I think the work at Western Reserve  
11 pretty well shows that. In case of sulfur 35, if my memory  
12 serves me right, he had to deliver something like 100,000  
13 REP surface dose in order to get a lesion, and then they were  
14 superficial and healed after a few weeks with no persistent  
15 dermatitis.

16 DR. BUGHER: I saw in some of Gene's intermediate  
17 biopsies, not the latest one, the amount of histological  
18 change in the basal layers was of remarkable content. The  
19 amount of response below the base of the membrane was almost  
20 negligible. So I presume we are talking about a very large  
21 beta dose to the basal layers of the epithelium and the soft  
22 gamma dose.

23 MR. HARRIS: What was the depth?

24 CDR. CONARD: Somewhere between 1,000 and 2,000  
25 microns.

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1 CDR. CRONKITE: It was located on the scalp, where  
2 they lost their hair.

3 MR. HARRIS: I was interested in this 700 r.  
4 That is how much of what energy at what?

5 CDR. CONARD: That is medium hard x-ray.

6 DR. BOND: That is another thing; what is the  
7 depilation dose?

8 MR. HARRIS: How about the children that they  
9 depilate all the time for fungus infection. How much is  
10 that? You ordinarily use a soft x-ray.

11 DR. BOND: Yes, with divided doses.

12 CDR. CONARD: Two to three hundred r usually.

13 MR. HARRIS: That is measured in hair. You could  
14 have a relatively small soft x-ray or gamma dose in the  
15 hair follicles, whereas you could have a terrific high skin  
16 dose so far as REPs of beta rays are concerned.

17 DR. BOND: We had a conference with radiologists  
18 and this question was asked: What is the depilation dose,  
19 and the estimate computed ranged from 300 to 1200 r.

20 CDR. CRONKITE: There is one point which I think  
21 Dr. Bond deliberately left out, and all of us wanted to,  
22 but has to be considered to a certain extent, and that is,  
23 how serious are the hematologic changes as observed here?  
24 I think it is my personal opinion that these people were  
25 on the borderline of getting into serious trouble, particularly  
as far as platelets are concerned. I don't think we can

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1 make a really good estimate of the severity and the  
2 potential danger, but I am confident in my own mind with  
3 the counts to have fallen lower, there would have been a  
4 serious question.

5 DR. BUGHER: Yes. It is undoubtedly fortunate  
6 they were not cocoanut hunting in the northern islands on  
7 that date, too. I notice here one of the earlier things  
8 mentioned was itching and burning of the skin. The Japanese  
9 fishermen complained of that, and also very maked burning  
10 of the eyes, actually beginning while the fallout was still  
11 visibly coming down. How did you interpret that sort of  
12 symptology here?

13 DR. BOND: You mean in terms of whether it was  
14 chemical?

15 DR. BUGHER: Yes.

16 DR. BOND: We discussed that. Do you want to  
17 comment on it?

18 CDR. CONARD: I think certainly the fact that the  
19 chemical irritating material was on the skin might have  
20 played some part in the initial symptology. But as far as  
21 production of lesions are concerned, I think it is pretty  
22 definite they are radiation lesions, and not chemical in  
23 nature. There were quite a few that did report the burning  
24 of the eyes, but not nearly so large a number that reported  
25 general itching of the skin.

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1 DR. BUGHER: These people did bathe rather promptly

2 CDR. CONARD: Some of them did, but the majority of  
3 de-  
4 them did not bathe until they were/contaminated on the  
5 destroyers on the way back to Rongelap.

6 DR. BUGHER: The Japanese mostly bathe in teacups  
7 or rice bowls, and their immediate symptoms tended to be  
8 rather severe. They continued. So that those who went to  
9 sleep had some trouble getting their eyelids open. They  
10 were pretty well stuck together.

11 CDR. CONARD: We had no reports of that kind.

12 DR. BUGHER: It would bear on how much of the  
13 calcium oxide had been passed through a hydrated phase to  
14 carbonate. The carbonate in itself would not be irritating  
15 in the slightest.

16 DR. DUNNING: Wouldn't the time between the exposure  
17 and the onset of the burns be so great to speak against them  
18 being chemical burns?

19 CDR. CONARD: Yes.

20 DR. BUGHER: The lesions appearing two two weeks  
21 later are purely beta rays. I am thinking of the immediate  
22 events. The Japanese fishermen were considerably closer  
23 to the detonation site than the Rongelap people. At least,  
24 if they were where they said they were, they were decidedly  
25 closer.

26 DR. BOND: Dr. Bugher, when Dr. Zsuzuki was in

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1 California, he reported that two of those patients had  
2 bleeding, and two had microscopic hematuria. Do you have  
3 any data on that?

4 DR. BUGHER: We know nothing more than we gave us.  
5 He got that information mostly by radiotelephone after he  
6 reached Washington. That was the last he had.

7 DR. DUNHAM: I had a point on the chemical burns  
8 to the eyes and the Japanese fishermen did not develop  
9 late burning lesions whereas they did develop very early  
10 burns. So I think that points pretty definitely to the eyes  
11 in the Japanese probably being on a chemical basis, whereas  
12 the native group had a mild transient itching or burning.

13 DR. BUGHER: One about the sac being continuously  
14 bathed tends to clean itself of material that falls in. I  
15 think there are some other differences, too, between the  
16 Japanese experience, as we know it at least, which is subject  
17 to considerable uncertainty, and the subsequent experience  
18 of these people, probably relating to the different environment.

19 If there are no further questions or comments on  
20 the clinical side, we will turn to the further information  
21 on the problem of the internal deposition of materials,  
22 urinary excretion, and these matters that Dr. Claus and his  
23 contingent have considered.

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1 NATURE OF FALLOUT, INTERNAL DEPOSITION,  
2 URINARY EXCRETION, BODY BURDEN, AND  
3 LONG TERM HAZARD.

4 DR. CLAUS: I approach this report with some  
5 trepidation, because as you know, I was shanghaied into this  
6 group this morning. It is not often, though, that the  
7 shanghaied member of the crew gets to be skipper right away.  
8 I was impressed by the apparently large amount of data  
9 available on this subject, and as the discussion flew back  
10 and forth, I attempted to make a few notes of things which  
11 were perhaps appropriate for this report.

12 The conferees came so well prepared so that the  
13 data can apparently go directly into a report that I don't  
14 believe it is quite either practical or worthwhile to attempt  
15 to summarize the whole business at this time.

16 What I have tried to say here, if it happens to  
17 be in error, I hope my conferees will correct me immediately.

18 DR. BUGHER: They will.

19 DR. CLAUS: As to the nature of the fallout, it is  
20 pretty well agreed that the fallout on the islands consisted  
21 of large particles with radioactivity plated out on  
22 calcium carbonate. In the islands, there, at least there  
23 appeared to be no real evidence of lime burns. It was  
24 interesting that some people observed in the dark room a  
25 transient type of phosphorescence, but rather than ascribe  
that to any extraordinarily high degree of radioactivity, it

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1 is believed that this probably arose from microorganisms  
2 which happened to be in the seawater at the time.

3 There was an extremely high content of Neptunium  
4 in the activity. Two thirds was mentioned, and a few minutes  
5 ago as much as 80 per cent of the activity at the beginning  
6 being in the form of Neptunium. Consequently, most of the  
7 burns were probably due to soft betas, most likely from the  
8 Neptunium.

9 NRDL observed that most of the activity was  
10 concentrated on the smaller particles with approximately an  
11 equal distribution of hard and medium gamma components, a  
12 small amount of soft components.

13 At New York, the laboratory observed as much as 18  
14 per cent of ruthinium in this activity. That would be 18 per  
15 cent of the fission products, I would judge, because between  
16 Neptunium and 18 per cent of ruthinium, there would not be  
17 much of anything left.

18 NRDL has observed activity in the fish caught in  
19 the Rongelap lagoon, and at 116 days there was 35 per cent  
20 of total beta activity in the fish as ruthinium.

21 I might put a few of these figures on the board.  
22 There were 2.7 microcuries of beta activity to fish of two  
23 to three pounds, and 6.4 microcuries of gamma in the same  
24 fish. This was approximately equally distributed among the  
25 viscera, the skeleton, the flesh.

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1 Strontium 89 was found to be quite high in cocoanuts  
2 or in the juice or sap or whatever they call it. My first  
3 thought was the strontium 89 was absorbed through the  
4 fronds, but as it was pointed out, that the material appeared  
5 in the sap, it seems there was an extremely high uptake of  
6 strontium through the roots.

7 NRDL has also made observations in chickens, pigs,  
8 fish and so on, and this material is available for the  
9 published report. As of this moment, I don't have any notes  
10 here on that.

11 For the content of humans, urine samples were taken  
12 in March of the Rongelap natives, Americans in March and  
13 April, Japanese in April, and these samples were pooled and  
14 alpha, beta and gamma breakdowns were observed at Los Alamos  
15 on the pooled samples.

16 The alpha activities, it is rather interesting to  
17 note, that there was no uranium or polonium observable,  
18 and of the plutonium, the body content is interpreted to be  
19 1.6 times  $10^{-2}$  micrograms, or .7 d per m per  
20 24 hour sample which in the business is taken to be  
21 insignificant, as far as body content is concerned.

22 Gamma studies were made with the counter. This is  
23 putting the urine samples in the counter. This Orme counter  
24 is a counter prepared as a liquid scintillation counter in  
25 which the total arm can be placed. In other words, it is a

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1 small version of the counter in use at Los Alamos now  
 2 for studying the content of a whole man. With the 100  
 3 channel analyzer, peaks were found at about 50 KV, 100 KV,  
 4 1945, 210. Most of these, I understand, are not identified.

5 MR. HARRIS: This is just gamma spectrum stuff, and  
 6 this is not extremely good sensitivity in high energy gamma  
 7 rays. There were essential peaks that we could not identify.  
 8 This was 145 kilovolt peak and a 210 kilovolt peak. The rest  
 9 fell in line pretty well.

10 DR. CLAUS: The one at 360 kilovolts, a strong one  
 11 which is iodine 131, one of about 500 as ruthinium, and there  
 12 are others presumably related to the barium, lithium units.  
 13 In addition to the fact they were able to observe iodine as a  
 14 gamma activity. It was a volatile component which could  
 15 be distilled off and observed directly.

16 I think I might now make a table. These were  
 17 the natives, and these were the Americans.

18 Iodine 131 worked out to .56 microcuries and 17.5  
 19 microcuries for the Americans. In this equivalent -- would  
 20 you explain that?

21 MR. HARRIS: The I-131 equivalent at the time of  
 22 fallout is meant the total amount of all the iodine isotopes  
 23 plus the small contributions from the tellurium mothers  
 24 weighted for the beta activities, and put in terms of  
 25 equivalent I-131. Those are millicuries, Walter.

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1 DR. CLAUS: That is right.

2 I should not have drawn my line back so soon,  
3 because these calculate back to a dose of 150 REP to the  
4 thyroid and 50 REP for the Americans. These can be calculated  
5 back in terms of fissions. I will not put these figures on  
6 the board at the moment. In terms of the fissions to  
7 which the natives must have been exposed, in order to come up  
8 with these particular burdens, Strontium 89, 2.2 microcuries  
9 for the natives, and 0.4 for the Americans. Barium 140,  
10 0.34 microcuries for the natives, and 0.27 for the Americans.

11 Calcium 45, 0.19 for the natives, and 0.04 for the  
12 Americans.

13 Ruthinium 103, the short lived one, 0.028 for the  
14 natives, and 0.015 for the Americans.

15 I mentioned the fact that these could be interpreted  
16 in terms of fissions to which the people were exposed. If  
17 you average them out, it amounts to three times 10 to the  
18 13th for the natives and 9 times 10 to the 12th for the  
19 Americans. It is Payne's idea that the best way to interpret  
20 these doses is to go back to fissions as a common denominator  
21 from which you can make a lot of other calculations. I think  
22 one might take a look at this, though.

23 When you add all these up, you find you have even  
24 less than 3 microcuries, and interpreted as the very worst,  
25 strontium 89, still you have very slightly over a permissible

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1 body burden as presently interpreted in terms of very  
 2 conservative terms. So that from this point of view, at  
 3 least, it certainly does not look like this is anything very  
 4 serious in any of the natives.

5           These are all short lived materials, of course,  
 6 and I don't know how one might immediately interpret in  
 7 terms of strontium 90 which they might have picked up. The  
 8 dose to the thyroid is sizeable, but still relatively small  
 9 compared to what we usually think of as the dangerous dose  
 10 to the thyroid.

11           So that from the information that we have presently  
 12 available, I would not be inclined to believe that the  
 13 present body burden is one we need bother much about. The  
 14 external doses to which they have already been exposed are  
 15 much more serious in terms of our usual concepts of radiation  
 16 hazard than the body burdens which they now carry.

17           DR. BUGHER: Those are very nice figures.

18           DR. DUNNING: I think there is another point that  
 19 bears repeating here, that not only is this saying the  
 20 equivalent of 3 microcuries of strontium 89, but that, too,  
 21 is based on the assumptions that you have equilibrium  
 22 conditions. In this you have a one shot affair and with  
 23 an expected half life of 53 days, this makes an even more  
 24 conservative picture.

25           DR. BUGHER: On a one shot basis, this is probably

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1 not more than one per cent.

2 DR. CLAUS: Do you want to talk about your concept?

3 MR. COHN: Yes. Our findings are a little different  
4 perhaps due to the different approach we took. While these  
5 figures on the board represent amounts of body burdens  
6 calculated on the basis of I-131, assuming various assumptions,  
7 our approach was a little different, in that we derived our  
8 estimated body burden extrapolating from animal data. What  
9 we did briefly was to sacrifice two pigs from the island  
10 after getting a very accurate control of their urinary  
11 excretion for 24 hours at 81 days. Then we did a complete  
12 radiochemical analysis on all the separate tissues of this  
13 pig, and also on the urine.

14 At the same time we did a complete analysis of a  
15 human sample taken at just about this time, and extrapolating  
16 from the pig data to the human, we come out with values of  
17 total body burden of beta of .33 microcuries at 81 days.  
18 If we extrapolate this back to 30 days after irradiation,  
19 this is a considerably difficult thing to do. Most  
20 extrapolations are based on animal studies, particularly  
21 Hamilton's work in which a constant falloff of activity is  
22 assumed. We know that this is not the case.

23 The only evidence that I know of in human strontium  
24 inhalation probably is one case at Brookhaven. We based  
25 our data on the rate of excretion of this inhaled strontium

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1 90. While using their figures for biological half life of  
2 this period of 81 days extrapolating back to 30, we come out  
3 with a body burden of 1.4 microcudes at 30 days.

4 Barium comes out .7, Lanthanum is .7. The  
5 remainder of the activity, the rare earth group, comes out .4.  
6 Strontium, barium, and the rare earth group together  
7 constitute about 75 per cent of the total beta activity.

8 We found no evidence of calcium 45.

9 If you want to extrapolate this back to one day --  
10 and this is a very difficult thing to do -- we decided the  
11 best way to do this would be to use the human radium data.  
12 Strontium is known to fall off at the same slope at a lower  
13 level. We have not calculated it for one day, but it will  
14 give a value quite a bit higher.

15 MR. HARRIS: No, I don't think so. I think if ~~to~~  
16 30 day level of strontium, taking in per cent of the total  
17 amount in the body of the dose given, it may come up about  
18 the same as the number which we took back to one day.

19 MR. COHN: We will have to check this further.

20 MR. HARRIS: This can be checked. As I recollect,  
21 this puts us in much better agreement than we were before.

22 MR. COHN: The half life of strontium in the first  
23 three days is quite tremendous. It has a biological half  
24 life of about 4 days. You have to be careful in extrapolating  
25 back. Since we have no sample earlier than 16 days, we have

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1 to be quite cautious.

2 One other point. You mentioned that since this  
 3 is pretty close to tolerance that we don't think it is too  
 4 important. I think we have to be very careful. While we  
 5 may be close to tolerance or a little over, we have a complex  
 6 situation in which we have not only the internal dose of all  
 7 these separate emitters added up to close to tolerance, but  
 8 which have what we think was close to a tolerance external  
 9 dose. I think the effects are more than just additive.  
 10 Certainly it does not affect the acute situation. We did  
 11 individual studies on individuals separately for many days.  
 12 We tried to correlate our excretion in the urine with various  
 13 levels of blood picture curves, the platelets, and white  
 14 cells, and we could not find any correlation. In general,  
 15 and I think we all agree on this, the internal body burden is  
 16 roughly proportional to the external dose that was calculated  
 17 for each group.

18 The Rongelap are the highest. The Ilingina have  
 19 received half the external, and they are pretty close.  
 20 Their mean excretion is pretty close to a half of the Rongelap.  
 21 The American group -- I am not sure what the external dose is  
 22 now -- the internal dose is pretty close to a fourth of the  
 23 Rongelap. I think we agree on that now.

24 MR. HARRIS: This shows a little less than a third  
 25 and assuming all errors I would assign a sigma of about two to

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1 this one over here, and a sigma of 6 to that one over there.

2 MR. COHN: I even go further. The individual  
3 variations within each group are great. Some show  
4 practically none, and some show 3,000 count per 24 hours.  
5 Most of this activity is due to adjusting. This is especially  
6 borne out in the animal data in which we find the highest  
7 amount of activity. GI system and liver and very little  
8 activity in the lungs. As pinpointed out, it is not too  
9 likely that due to the large size of the particle, 6 to 200  
10 microns, that a great deal of inhalation would have occurred.

11 DR. BUGHER: It is very clear that these quite  
12 different approaches have given results that are not too  
13 different, and the results are remarkably close.

14 MR. HARRIS: One other thing that I did not put  
15 on the slip of paper is that so far in our findings in the  
16 Japanes we have had some trouble with the strontium method  
17 on those. But the activities found in beta activity at  
18 these late times indicate that the Japanese were very  
19 similar to the Rongelap natives in the amount of internal  
20 exposure, and a similar number might be postulated as the  
21 native number for exposure to numbers of fish.

22 DR. BUGHER: As I recall, you put a lot of  
23 emphasis on the plutonium excretion measurements, did you  
24 not, using that as one of the approaches to the body burden  
25 story from the excretion rate of plutonium in the urine?

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1 MR. HARRIS: The values were so low that although  
2 we have better human information on excretion at various  
3 times, the amounts we found in the urine were so low that  
4 there is no significance attached to these numbers. We  
5 tried it with small volumes of urine and large volumes of  
6 urine, trying to go as high as three liters of a pool sample  
7 but this does not work because the residual that you get  
8 and the troubles you have with self absorption in counting  
9 these, using the larger volume, negates your result.

10 Especially in this highly concentrated urine --  
11 this is very interesting as a sidelight -- in the standard  
12 procedure at Los Alamos in these urines that they use daily on  
13 all personnel, at the end of the system there is practical  
14 ignition of the residue takes place, and a great flame shoots  
15 out and pieces of glass break up and fall in.

16 On the natives this was really something to see  
17 because of the concentration they had. This plutonium  
18 number you cannot depend on. If we take what is known about  
19 the amount of plutonium made in this particular device, the  
20 university is still too great to use plutonium to come out  
21 with the number of fissions.

22 DR. BUGHER: I take it you did not ascribe those  
23 pyrotechnical displays to radioactivity. The Japanese did.

24 MR. COHN: There were a couple of other interesting  
25 items that I might bring up. One concerns the internal

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1 transfer from the mother to the eggs is, and what the  
2 biological effects of such material would be.

3 DR. BUGHER: Yes, indeed. I hope you continue  
4 those operations.

5 DR. DUNHAM: What fission products were increased  
6 as far as excretion rate is concerned from the EDTA?  
7 Obviously it was not all.

8 MR. COHN: We don't know. We know from previous  
9 animal experiments it was not strontium.

10 CAPT. ENGLISH: How many days after exposure was  
11 this study?

12 MR. COHN: This was the 21st of April, 51 days  
13 after; a considerably long time to expect much result.

14 DR. BUGHER: Were you getting strontium in the egg  
15 shells?

16 MR. COHN: Yes, we have a chemical analysis of the  
17 whole egg, as well as the tissues of all the animals.

18 DR. CLAUS: The shells were formed how long after  
19 the exposure?

20 MR. COHN: These are animals in our laboratory.  
21 45 days after.

22 DR. CLAUS: They expected everything to be pretty  
23 well out of the soft tissues by that time.

24 MR. COHN: Yes, approximately 80 to 90 per cent  
25 of the activity is in the skeleton system.

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1 DR. CLAUS: Indicating a very high turnover of  
2 the calcium like substances in the skeleton in the production  
3 of egg shells.

4 MR. COHN: Yes. The hen has the unusual ability  
5 to concentrate the alkali earth that no other animal has in  
6 this particular physiological situation. We hope the animals  
7 would continue at this high level and perhaps decontaminate  
8 themselves. But they reach a peak and fall off at a very  
9 low level. The eggs are quite normal in every respect in  
10 weight, size, and so forth.

11 DR. BUGHER: This is a new slant on the means of  
12 decontaminating strontium. Are there other comments or  
13 questions here?

14 We have run a little bit overtime. We have come  
15 out on the schedule. Let us see if we can reassemble at two.

16 (Thereupon at 12:50 p.m., a recess was taken until  
17 2:00 p.m., the same day.)

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AFTERNOON SESSION

2:00 P.M.

1  
2 DR. BUGHER: Now we go on to a general discussion  
3 of the material which was presented before lunch, and I think  
4 it might be perhaps wise to take some of the things up in  
5 more or less the recorded order in which they were presented,  
6 that is, considerations of dose, and so on, were touched on  
7 somewhat.

8 Gene, did you have any suggestions in mind here as  
9 to the general direction of our discussion along these lines?

10 CDR. CRONKITE: There is one general thing that I  
11 don't think was realistically approached this morning, and  
12 that is, would anyone venture to make an estimate of the  
13 prognosis as far as the individuals are concerned, both from  
14 the external exposures that they received, and the internal  
15 exposures separately, and then the probable effect of the  
16 combination. It was alluded to, but just what is the  
17 situation as far as these individuals are concerned? I  
18 certainly do not know.

19 DR. BUGHER: That is a short discussion. Our  
20 desire is to get somewhat more extended comment from other  
21 members of the group.

22 MR. COHN: One source of information on this point  
23 may perhaps come out of the animal studies. We brought back  
24 something like 66 animals, and the animals in general  
25 have about ten times the internal body burden of the radio

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1 isotopes, and they have about 50 per cent, or 100 per cent  
2 more external dose due to the longer time they stayed on  
3 the animal. If anything does show up, it will be more  
4 likely to show up sooner in the animals, and would perhaps  
5 give us some idea of the prognosis for the humans over a  
6 longer period of time.

7 DR. BUGHER: What are the animals that you do have  
8 surviving other than the chickens?

9 MR. COHN: 40 chickens, 6 pigs left, 3 from Rongelap  
10 and 3 from Uterik. The pigs had practically all internally  
11 and only about 6 r internall.

12 We also have a cat, three ducks, and I think that is  
13 the substance.

14 DR. BUGHER: Have any of them shown signs of illness?

15 MR. COHN: Six of the hens have died so far  
16 spontaneously, cause of death unknown. On autopsy, we  
17 can find nothing. There was a slight hemorrhage in the  
18 lung of one of the chickens. Nothing that we can ascribe to  
19 radiation per se.

20 The three pigs that we have left are growing quite  
21 tremendously on good feed that they are getting. There are  
22 no symptoms that we can observe as far as temperature,  
23 weight gain and general appearance.

24 DR. BUGHER: Did they show blood changes  
25 comparable to humans?

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1 MR. COHN: That is hard to determine. Their  
2 white cell and platelets fell. Chicken hematology is bizarre,  
3 to put it mildly. They have practically no platelets, for  
4 example.

5 We have done pathology on the chickens that died  
6 or were sacrificed. We sacrificed four or five pigs so far,  
7 and we were not able to say anything likely about any  
8 pathological changes. We do have radio-audiographs on the  
9 animals which might be particularly interesting here. This  
10 is a radio-audiograph of the tibia of one of the young pigs.  
11 The bone morphologically does not appear to be normal. There  
12 is parveculi extending through the shaft which is abnormal  
13 in a mammalian bone. There is a thickening here which  
14 probably indicates a failure of an osteoabsorption and  
15 periosteal-aberration. The particular thing about this bone  
16 is that there are two areas of dense concentration of the  
17 trabecula which corresponds on the radio-audiograph to two  
18 separate regions of high concentrations of radioactive  
19 material. It was the opinion of Dr. Norris, who did this  
20 particular audiograph, that these indicate two separate  
21 and distinct exposures to fallout material.

22 There is a lot of discussion on this, and it is  
23 pretty hard to come to a definite conclusion because we,  
24 one, don't have controls on these animals, and second, there  
25 were quite severe dietary changes in the animals from the

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1 time we collected them and brought them back. There may  
2 also be a finding of some disease which we don't know.

3 DR. BUGHER: Doesn't your bone section show two  
4 zones of more compact trabeculae?

5 MR. COHN: Yes. I don't know whether you can see  
6 it, but the arrows indicate that.

7 DR. BUGHER: Aren't those the two regions of  
8 strontium concentration, too?

9 MR. COHN: I don't know whether it is strontium.  
10 It is mostly like strontium and barium.

11 DR. BUGHER: And the alteration of the bone  
12 construction itself would not be a finding of exposure,

13 MR. COHN: Functionally they appear quite normal.  
14 There were two independent pathologists that came to this  
15 conclusion.

16 In another pig, which is presumably a simile of  
17 this one, we don't find this double layer again. Mostly you  
18 have concentration here, and then you can see a light area  
19 which corresponds to the growth after the animals were removed  
20 from the island, and then the deposit in the still growing  
21 animal.

22 In the mother of these animals, the sow, we get  
23 the deposition here, and what looks like an indication of  
24 perhaps a second deposition in here. You can see this  
25 better in another audiograph.

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1 This is a baby chick that was just born maybe a  
2 week or so after the detonation, and here you have an  
3 abnormal morphological picture. In the audiograph you get  
4 a concentration of radioactive material in the diaphysis  
5 here and practically nothing on the ends where the bone has  
6 grown subsequent to the removal of the animal from the island.

7 Here you have the bone marrow which would presume  
8 to be abnormal and perhaps due to the deposition of active  
9 material here, due to radiation -- and this is another chicken  
10 bone here again, looking abnormally morphological.

11 You have the same thing in a chicken bone. We  
12 have trabecular tissue extending down through the bone quite  
13 a way, which/you do not find normally. This would normally be  
14 reabsorbed here. These are two separate animals.

15 You note there is not the same concentration in each  
16 animal, presumably depending on the dietary pattern. We  
17 have similar audiographs for a number of the other animals  
18 also. The picture of iodine in the thyroid is typical of  
19 the iodine diffusion.

20 DR. BUGHER: Could you make an estimate of the  
21 iodine dose?

22 MR. COHN: Yes. About 15 microcuries was the  
23 estimate calculated back to exposure time. It is considerably  
24 more than the humans.

25 MR. HARRIS: 15 microcuries where?

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MR. COHN: This is in the bone and not the body.

MR. HARRIS: 50 microcuries in the thyroid?

MR. COHN: Yes.

MR. HARRIS: This refers to in humans in reverse to total body of 56 microcuries, of I-131.

DR. BUGHER: Swallowed and absorbed. Is that assuming 100 per cent absorption?

MR. HARRIS: It assumes 100 per cent of the ingested material.

LT. LOONEY: There are a few interesting comments. We have been making studies in Bethesda, who have had thorium, and it is very interesting to see that this thickening of the shaft is something that we have noticed with other minor changes in these people. Over 50 per cent of some 17 that we have studied had that. In some radium patients -- would you like to go into that at this time?

DR. BUGHER: Yes.

LT. LOONEY: I have recently gone over all the clinical data on the luminous dial workers, some 80 patients, 30 of which were studied at Boston, and 50 at the Argonne National Laboratory in Chicago. In relation to this, some 10 per cent of these people developed bone tumors 20 or 30 years after the administration of radium, and this luminous dial material. Some patients which had less than one microgram of radium had severe bone changes or tumor formation,

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1 or others with 10 or 15 micrograms had relatively little  
2 changes. This is a factor of 10 or 15, which must be taken  
3 into consideration as far as permissible levels are  
4 concerned.

5 The other thing is that the excretion studies done  
6 by Norris in Chicago, there was a finding of 2/1000ths to  
7 16/1000ths of one per cent of the radium excreted per day.  
8 This is a factor of four to eight when you estimate permissible  
9 body burdens of radium compared to the more accurate  
10 estimates by measurements.

11 So when we talk in terms of permissible levels, I  
12 think it is very important as far as the humans are concerned  
13 to keep these factors in consideration, that there is a  
14 marked biological variation, and also a marked biological  
15 elimination of these elements. Since these elements are in  
16 the near permissible range, I think these people are extremely  
17 important from a long term study, because we know away above  
18 this we are going to get tumors and away below we are not  
19 going to worry. This is the range which we are interested in.

20 I think these people are extremely important from  
21 a long term study in that respect. I am not familiar with  
22 all the radio elements there that are of biological and  
23 physical half lives. I think Tomorrow I will take the  
24 information and refer it to the studies of the people with  
25 the late effects, if that is agreeable.

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1 DR. BUGHER: If one divides the prognostic problem  
 2 into the immediate and ultimate prognosis, I think the  
 3 immediate problem has already given its own answer. The  
 4 fact that except for two people who are still in the hospital  
 5 -- old people, -- and one woman ready to deliver, all of the  
 6 Rongelap people went happily off to their new location.  
 7 There are no ill effects so far as the immediate situation  
 8 is concerned. So that the immediate prognosis time has  
 9 already given the answer to that.

10 The ultimate long term prognosis problem I think  
 11 would concern itself with two broad aspects. One of the  
 12 internal emitter question, particularly in the skeleton,  
 13 which bears on what you were speaking of, and the other is  
 14 the possibly very much delayed skin neoplasia which would  
 15 not be expected, I should think, to appear in less than 15 year  
 16 or maybe more, if it appears at all.

17 Have you any opinions on those? What do you think  
 18 in your own mind is likely to occur to these people in the  
 19 next 25 years or so?

20 LT. LOONEY: The thing that we have noted as far  
 21 as the relationship of radio element deposition to the  
 22 formation of neoplasia from radium patients was this, that  
 23 in most all of these characteristic of the histological  
 24 findings was the formation of an atypical osseous tissue, which  
 25 was a bone formation, and this was not usual in the areas

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1 of greatest radio element deposition. In fact, we could  
2 make very real correlation between radio element deposition  
3 and histopathological.

4 A few patients that we were able to do extensive  
5 pathological studies on, we could find that there are many  
6 areas -- not many, but in some areas -- in which the  
7 transition from this formation from atypical osseous tissue  
8 and the fiber sarcomas was awfully hard to differentiate.  
9 Dr. Lipscomb at Chicago has reviewed this and some of his  
10 work with plutonium in rats. The feeling is that the most  
11 likely place for the formation of these tumors around these  
12 areas of atypical osseous formation, most of the tumors have  
13 developed, on the ends of the long bones in the cancerous  
14 bones. All of this is supportive evidence that these  
15 conclusions are probably correct.

16 I think this ultimately gets down to what causes  
17 cancer. Is it one cell from the irradiation in these  
18 small areas in which you have the proliferation of this  
19 tissue become malignant? There is a smoldering of this for  
20 years, and then suddenly there is a turnover, and then it  
21 seems to spread throughout the skeleton or even multiple  
22 tumor formation throughout the skeleton.

23 As far as permissible levels are concerned, we have  
24 to interpret that in terms of this pathological finding in  
25 these people. It is to set a level with this marked

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1 biological variation, and I think you have to watch these  
2 individual people, and to see what percentage of these  
3 people develop tumors as compared to a controlled group.

4 DR. BUGHER: Yes, that will be done. Do you have  
5 any feeling yourself for the probabilities involved here in  
6 this group? Would you expect any bone sarcoma to be  
7 encountered in this Rongelap group? We have 84 people, is it  
8 not?

9 DR. BOND: 82.

10 LT. LOONEY: I would certainly like to have a  
11 chance to go over this data much more than I have at the  
12 present time before I would stick my neck out so to speak  
13 on this. But I do think that certainly with this close  
14 permissible level, that these people are extremely important  
15 to see if there is an increase in incident of neoplasia in  
16 this people. I don't know too much about the distribution  
17 of these various elements. Most of it is bone. Chances are  
18 your bone tumors are the most likely thing to occur. I  
19 would not want to hazard a guess.

20 MR. COHN: There is one point that has not been  
21 brought out, and that I think should be stressed, is that  
22 strontium 89 has a considerably shorter half life than radium,  
23 but there are a number of short life fission products that  
24 would have had to be present in high concentrations for an  
25 early interval which we don't pick up after 30 days. The

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1 problem then is what is the effect of a large dose over a  
2 short period of time to the bone or bone marrow in this  
3 early interval, that is, in terms of possible carcinogenic  
4 effects later. This is a problem that has not been explored  
5 to any extent at all. Animals are certainly not humans,  
6 but certainly that we should consider.

7 DR. CLAUS: You would not expect these other  
8 substances to be present in the bone?

9 MR. COHN: Yes, there are a number of other bone  
10 seekers, I have a list of 15, that are present in high enough  
11 fission yield, but due to the fact that the half life is  
12 so short, after 30 days we do not pick them up. But they  
13 were radiating this bone during the interval.

14 DR. CLAUS: Would you hazard any guess how much  
15 there is of that, compared to this?

16 MR. COHN: It could be calculated.

17 DR. CLAUS: If there is any likely tumor  
18 formation from this stuff, and an equivalent amount of small  
19 quantity in the bone for the short periods of time that these  
20 are there, we are in a bad way as far as our permissible  
21 levels are concerned, because this is just a little bit  
22 over what we claim to be a permissible level of strontium  
23 89 for a lifetime.

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24 MR. COHN: Yes.

25 DR. CLAUS: This is for a relatively short time, and

1 we are going all out by saying you can give very sizeable  
2 overdoses for a relatively short time without doing any more  
3 damage than if you spread it out. So if any of our  
4 concepts to date on which we are basing our permissible dose  
5 levels are correct, then there is absolutely no chance, or  
6 at least an awfully small chance of anything developing from  
7 these levels.

8 MR. COHN: I don't think there has been any study  
9 made of high intensities and short exposures.

10 DR. CLAUS: These are not high intensities.

11 MR. COHN: Relatively high intensities. There are  
12 12 other products that are bone seekers, in high fission  
13 yield, that would have to be present based on the present  
14 strontium and barium, for example.

15 DR. BUGHER: What are some that you would have in  
16 mind?

17 MR. COHN: Tellurium, lithium 103, 106, cerium 101  
18 and 144, zirconium 195, which we find in fish, praseodymium  
19 143, yttrium 141, barium 140, and lanthanum 141, and iodine  
20 147.

21 DR. BUGHER: The 106 ruthenium has a year half life.

22 MR. COHN: No, that is only 19 days, I believe.

23 Oh, one year. I am sorry. All of these are fairly long  
24 lived, anywhere from 10 to 60 days, and they are all  
25 present in a fission abundance of from 3 to 6 per cent.

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1 DR. BUGHER: Are most of those excreted rather  
2 rapidly?

3 MR. COHN: Zirconium, cerium, praseodymium are  
4 concentrated in the bone to some extent. I think in this  
5 case their half life is probably much shorter than their  
6 excretion rates. That would be the determining factor.

7 DR. BUGHER: It is obviously unlikely that we will  
8 ever know more quantitatively what is in these people than  
9 we know now; in other words, we cannot really acquire any  
10 more knowledge by deferring consideration of anything  
11 because we really have in our hands now all the evidence  
12 that there is.

13 CDR. CRONKITE: Does the exposure to 150 to 200 r  
14 in relatively a short time change tolerance concepts? Does  
15 this influence the tolerance concept? Has anybody done any  
16 animal experimentation where you crack them with a couple  
17 of hundred r and see if your same tolerance levels will hold  
18 up?

19 DR. BUGHER: The main point there, I think, is  
20 that our tolerance levels are below that for which  
21 experimental results can be demonstrated. In other words,  
22 one has to go much higher levels of the material. There  
23 have been experiments on such things. At the moment I can't  
24 recall the results except that they tend to be additive,  
25 rather than otherwise.

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1 Walter, do you happen to know of any?

2 DR. CLAUS: No, I don't know what you are referring  
3 to there. All of the permissible levels with the exception  
4 of those that are tied in to radium, radium, plutonium,  
5 strontium, are based on a calculated dose to the critical  
6 organ of .3 of a REP per week. So I think that is probably  
7 small enough in comparison with a couple of hundred r dosage  
8 you might give so they could be neglected. If you are dealing  
9 with radium plutonium, you may have a little different  
10 problem on your hand, because those are based on actual  
11 experience, rather than calculated levels. But even there I  
12 think the doses do not exceed the .3 REP per week. They  
13 differ with that level very much.

14 DR. BUGHER: Dr. Dunham, I will explain what the  
15 question is here. In view of the rather small level of  
16 individual isotopes in bone and so on, whether the whole  
17 body exposure of 150 r which has been brought out this morning  
18 is not quite saying What that is to, and whether that would  
19 affect the concept of permissible limit, essentially, in  
20 regard to the expectations of biological accidents and  
21 unfavorable results in the bone from the concomitant gamma  
22 ray exposure.

23 I said as far as the experimental side is  
24 concerned, since the permissible limits are themselves levels  
25 at which one would expect such things anyway, that it is

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1 rather hopeless experimenting in that level. One would  
2 have to go many, many fold up in the concentrations of  
3 isotopes, and there I thought the effects were essentially  
4 additive.

5 Do you happen to remember any of the experimental  
6 data?

7 DR. DUNHAM: I know of no experimental data  
8 that is comparable to this situation.

9 DR. BUGHER: No, nothing comparable to this.  
10 Exposure levels of 1,000 microcuries of strontium with  
11 animals also given x-ray.

12 DR. DUNHAM: I know of no such class data. The  
13 closest would be Fridell's work, where you were concentrating  
14 the effects in different organ systems. He has also given  
15 some whole body radiation. That matter might be re-looked  
16 at in this light.

17 DR. BUGHER: It is pertinent here.

18 DR. CLAUS: I think you could extrapolate from  
19 Fridell's work if he has not actually done it, and say if  
20 you give an animal enough internal emitter so that he is  
21 pretty close to the borderline, and then you add x-ray on  
22 top of that, you will get more than an additive effect,  
23 because the effect due to one isotope is partially  
24 compensated by other organs in the body. Whereas if you  
25 inactivate these other organs, then you will meet more than

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1 an additive effect. Those are for very high levels. I  
2 don't think they are applicable to this situation at all.

3 DR. DUNHAM: Those are at levels sufficient to  
4 knock the bone marrow out.

5 DR. BOND: Those are very high levels. They are  
6 approaching total body lethal doses.

7 DR. DUNHAM: I was just searching my mind for some  
8 data.

9 DR. BUGHER: I think the answer is negative with  
10 regard to the question of whether or not this amount of  
11 material in the bone has any effect whatever on the  
12 general radiological manifestations of the dose that these  
13 people got.

14 LT. SHULMAN: How about the other way around.  
15 The total body radiation, and then the local deposits.  
16 Perhaps the 200 r received at that spot plus the local  
17 deposits may give different local changes than those  
18 calculations based on local radiation.

19 CDR. CRONKITE: In the children where the bone is  
20 growing it gets concentrated in a relatively small area,  
21 so as they continue to grow, if this were an adult, it would  
22 have been distributed relatively throughout the bone.

23 MR. COHN: It still concentrates in a factor of  
24 ten in the adult.

25 CDR. CRONKITE: But it stays concentrated in one

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1 area in the child. Does this give a significantly higher  
2 dose to those areas so that you may have a different set of  
3 standards or think of it as different for a child than an  
4 adult?

5 DR. BUGHER: If you are asking personally, I don't  
6 think so. I think in considering permissible dose, we have  
7 oftentimes thought of the bone marrow being much more static  
8 than it is, rather than regarding it as essentially fluid  
9 tissue of a slow flow rate. The probability is that the  
10 regularities of concentration are not as important as  
11 we have assumed in computation. Usually a factor of five  
12 gets in the picture for irregularities, and nonuniform distri-  
13 bution of the material with respect to bone marrow. But  
14 certainly bone marrow cell structure is a highly mobile one  
15 in terms of comparative bone cells, for example; so it is  
16 quite possible that we over-emphasized the fact of non-  
17 uniformity, and such experiments as we have had in regard  
18 to skin activities would seem to indicate that the non-  
19 uniform situation is actually less of a problem than the  
20 uniform distribution of the same amount of material.

21 LT. SHULMAN: Is there sufficient data to know  
22 whether the local bone dose in children could be suspected  
23 of giving abnormal growth? Do the levels they probably  
24 have come close to the levels that do give abnormal  
25 development, such as in the chickens? That is abnormal

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1 development, and they are only ten times lower. Over the  
2 longer period of time that the development takes place,  
3 children may be the individuals to observe in order to find  
4 that out.

5 DR. BUGHER: There may be a corollary to the  
6 question, and that would be whether or not the blood changes  
7 in the children were not related to the perhaps greater  
8 quantitative bone marrow dose. Does anybody have a comment  
9 on the question of growth disturbance in children, resulting  
10 from these exposures?

11 MR. COHN: We broke down each one of the groups  
12 into various age groups. Below five years old, from  
13 six to 15 and 15 and over. We find in the children we have  
14 a lower mean emitter excreted. What this means is hard to  
15 say. It is not likely that they took up less contamination  
16 than the adults did. They ate as much, and so forth. It  
17 would therefore leave you with the idea that the material  
18 they do take up is fixed more firmly in the bone so that a  
19 lower ratio perhaps is found in the urine. In general,  
20 more actively growing and proliferating tissue is more  
21 radio sensitive. You would expect to find more change in  
22 the children than in the adults.

23 DR. DUNHAM: A youngster two or three years old  
24 does not eat as much as an adult. A teen-ager will eat more.

25 MR. COHN: We analyzed all the food and most of

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1 the contamination was in the water and in the sap of the  
2 coconut tree. There were very high levels of contamination.  
3 The fish was the other high source. Whether it is because  
4 they drink less water, it is hard to think that they took  
5 in less contaminating material than the adults.

6 DR. DUNHAM: I think it is hard to believe that  
7 they took more.

8 MR. COHN: Judging by my own children, they eat  
9 more than I do, although probably less at a time.

10 DR. BUGHER: I think one can say something about  
11 the effect of the general whole body exposure, and the expected  
12 growth rates. In Hiroshima the exposed children to the  
13 bomb within 1500 meters did show some apparent retardation  
14 of growth for a few years, but then in the last two years  
15 they picked up and apparently equal to the controls. Those  
16 were levels which were a mixed grill. Some had levels  
17 sufficient to give radiation sickness and some aplasia, and  
18 others in the same areas had no recognizable radiation  
19 symptoms at all. So it is a statistical comparison. The  
20 difference has been lost now between those two groups.

21 MR. COHN: That is from external radiation.

22 CDR. CONARD: No internal there.

23 MR. COHN: That is right.

24 LT. LOONEY: Sir, in regard to the changes as  
25 far as children are concerned, I remember one of our radium

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1 patients who was working as a luminous dial worker at 15  
 2 had areas of increased intensity around epiphyseal areas  
 3 of the long bones. This, with other data, would suggest  
 4 that we were not too sure whether these developed years  
 5 later or developed with deposition.

6 Gross audio-radiographs were made, and they did have  
 7 a concentration of radium in the epiphyseal area. The big  
 8 trouble with the radium data is that we don't have a roentgen  
 9 grosser so that we can tell these developments of the roentgen-  
 10 ographic lesions, we see in the people 20 or 30 years from  
 11 now. It would seem that these lesions develop years later.

12 As I say, in this one case which ingested radio-  
 13 active materials at 15 died at 40, and she had these areas  
 14 of concentration in the epiphyseal areas. From other  
 15 studies, it would seem that radium is eliminated from the  
 16 more accessible parts of the skeleton.

17 DR. BUGHER: Does anybody else have a different  
 18 thought in regard to the skeletal prognosis here with this  
 19 amount of material?

20 I think the skin prognosis is one which has a  
 21 considerable uncertainty as well, and also equally perhaps  
 22 important. I have to skip over to a Commission meeting, so  
 23 I would like to ask Dr. Dunham to serve as Chairman for a  
 24 while until I get back. You can go on with this prognostic  
 25 side from the skin. I think also there should be some

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1 further consideration of not the skeleton, as such, but  
2 the hematopoietic system with regard to the long term  
3 prognosis, and what we think the problems of leukemia  
4 may be in these people, and particularly with skin carcinoma.  
5 Leukemia from our Japanese experience would be something of  
6 importance much sooner than skin neoplasia, if the latter  
7 occurs at all. If you will excuse me, I will go.

8 DR. DUNHAM: Who wishes to make a contribution on  
9 this point? Vic, do you have any further comments you wish  
10 to make on the prognostications as far as the skin goes, and  
11 the late development of malignant change?

12 DR. BOND: I would like to ask a question. It  
13 was the opinion of David Wood, and others, that looked at  
14 the slide, that in addition to late carcinogenic changes, we  
15 might expect later breakdown of the skin in a period of  
16 months, rather than years.

17 DR. DUNHAM: In other words, you feel that it is  
18 too early to prognosticate?

19 DR. BOND: To really prognosticate. I don't wish  
20 to imply that there is definite evidence for this.

21 DR. DUNHAM: No.

22 DR. BOND: It is a foregone conclusion that it  
23 will occur. However, they saw changes in the manner of the  
24 regeneration of the epithelium which led them to believe  
25 that there are possibilities that this may occur. This is

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1 strictly from animal data, and not from human data. Do you  
2 have any further on that?

3 CDR. CONARD: The lesions as they were when we  
4 last saw them showed no signs of development of true  
5 chronic radio dermatitis. That is, the usual signs of  
6 atrophy and so forth that you normally observe in chronic  
7 radio dermatitis were not apparent. There were some other  
8 changes. Hyperkeratosis was developing, and some overgrowth  
9 of the epithelium forming papule structures which Dr. Wood  
10 seemed to think might account for the large peel like  
11 appearance of the skins which we noted as a later development,  
12 along with hyperpigmentation of the skin. Whether these  
13 changes have any significance to prognosis, I really don't  
14 know. I think that when Dr. Wood comes through with his final  
15 report on histopathology, he may give us some more evidence  
16 of his ideas in that direction.

17 DR. DUNHAM: It is really a little early, because  
18 we don't know how normal this skin will get. If it gets  
19 more normal than it is now, then I think there are grave  
20 doubts as to optimistic prognosis. If it gets more  
21 normal in the next six months or so, then I think one can get  
22 very optimistic again. I believe radiation damage that  
23 leads eventually to malignant degeneration, the tissues  
24 themselves do not pass through a thoroughly normal appearing  
25 stage microscopically ever.

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1 MR. HARRIS: I would like to prognosticate that  
2 for at least six years there would be nothing because in none  
3 of the cases of Los Alamos beta ray burns, there has been  
4 nothing in six years.

5 DR. BOND: What do the skins look like now?

6 MR. HARRIS: They are in much different shape than  
7 what the natives are. They are still breaking down. A couple  
8 of fellows still have to go back to St. Louis once in a  
9 while for a little more plastic repair. Other than that,  
10 they are in fair shape. You don't have the usual skin. It  
11 has the appearance of a cigarette paper type of thing. All  
12 of the fat beneath the skin is gone, and will never come  
13 back apparently.

14 DR. BOND: When you say nothing will happen, what  
15 do you mean?

16 MR. HARRIS: You cannot say that on this basis  
17 these people will not have any carcinogenic indications.

18 DR. DUNHAM: You have to give them at least 20 years.

19 MR. HARRIS: I think probably you might be able to  
20 give them 20 years on the basis of the fact that the Los  
21 Alamos people who have had this exposure, who have had  
22 superimposed exposures on the same skin for the last six  
23 years at least as high as tolerance, and probably higher than  
24 tolerance in some cases.

25 CDR. CONARD: They had 4 to 17 thousand REPs or

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1 something like that.

2 MR. HARRIS: They had maybe 20,000 REP of high  
3 energy beta.

4 DR. DUNHAM: It was full thickness damage.

5 CDR. CONARD: A fission product material?

6 MR. HARRIS: Yes, sir. It was filter papers that  
7 they picked up with their hands. There was a small amount  
8 of Neptunium. I would guess it was only a small proportion  
9 of the total. You can get this number very easily by  
10 comparing it on the Nevada explosions, and if you compare  
11 with any sort of a standard Nevada explosion, you will come  
12 out with the number of Neptunium which would be the same that  
13 they had.

14 CDR. CONARD: As near as I can understand,  
15 practically all skin malignancies develop on top of a  
16 well recognized breakdown of the skin, chronic dermatitis  
17 or the usual chronic changes that occur after radiation. A  
18 vast majority of these people have shown no signs of  
19 developing chronic dermatitis or atrophic changes. There  
20 are a few, one or two. One or two of the foot lesions show  
21 some evidence of scarring and atrophy, and the persistent  
22 ear lesions.

23 DR. DUNHAM: You would give them all at least 20  
24 years?

25 DR. BOND: That is for malignancy.

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1 CDR. CONARD: If they don't develop any chronic  
2 radio dermatitis within the next five or six years, I would  
3 say the prognosis is excellent that they won't have any.

4 DR. DUNHAM: At least some of their lesions are  
5 going to be exposed very heavily to an added insult in the  
6 way of ultraviolet.

7 CDR. CONARD: Trauma, too.

8 MR. HARRIS: Isn't the humidity a little high out  
9 there for having as high an ultraviolet exposure as where you  
10 do get ultraviolet carcinoma? In the west, for example,  
11 where there is low humidity. If the humidity is so high in  
12 the climate that the percentage of ultraviolet is high...

13 DR. DUNHAM: It is awfully common to sea folk in  
14 general. It certainly cuts down what it would be being at  
15 the equator or close to it. Still plenty gets through.

16 CDR. CONARD: There is a great deal more of it,  
17 too, due to the long days.

18 DR. DUNHAM: All year around. It is not just  
19 seasonal.

20 CDR. CRONKITE: The thing that bothers me is  
21 what Dr. Bugher had to say this morning. The establishment  
22 so far as is known of what could be expected from the stand-  
23 point of prognosis with time intervals becomes acutely  
24 important because there are a group of individuals who are  
25 going to have to go out from time to time. It is going to be

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1 one big chore to go out at regular intervals. If there is  
2 no hazard to expect under 20 years, I think we ought to  
3 seriously start thinking about these followup trips. Is it  
4 even necessary to go back four times in this coming year?

5 Being one of the individuals involved, perhaps I  
6 have a personal bias in it. But just as we are talking here  
7 from the standpoint of prognosis, nobody yet has come up with  
8 anything that means anything to me, except that somebody  
9 ought to watch them.

10 DR. DUNHAM: I think what we have been talking about  
11 in these last two discussions are something that would only  
12 happen in 15 or 20 years. I have not been as close to the  
13 planning as you have for the immediate followups. But it is  
14 my understanding, or at least I would think that the  
15 philosophy behind the coming followups was to follow the  
16 blood count back to normal, to find out whether it is  
17 back to normal, say, next August or fall. In other words,  
18 complete the study of the acute phase, and then after that,  
19 if you can develop a reasonable rapport with the trust  
20 territory physician, there should not have to be an awful  
21 lot of expeditions.

22 CDR. CRONKITE: I was thinking not only in terms  
23 of the long term prognosis, but the prognosis for the  
24 immediate future, because someone is committed to making a  
25 trip in August, and again a few months thereafter, in order

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1 to collect more information in order to be in a better  
2 position to plan. But to get any information now that anyone  
3 has collected for planning purposes would be of tremendous  
4 importance to the people that have to go out there.

5 DR. DUNHAM: The other thing is the matter of  
6 leukemia which John asked to have some discussion on.

7 DR. BOND: May I ask something before we get  
8 into that aspect of it? The general question as to the  
9 findings seen in general are commensurate with the dose esti-  
10 mates we found this morning. 150 r is a ticklish problem.

11 DR. DUNHAM: It may be 175, if it was 150 r measured  
12 in the air with a different kind of field, is that right?

13 DR. BOND: This may or may not be.

14 DR. DUNHAM: I believe that. Do you doubt that?  
15 Noting the figure of 150 r, but the fact that there would be  
16 a difference in comparable effect.

17 DR. BOND: I want to get into that in a minute.  
18 This is the problem. Say 150 r and from considerations of  
19 dose rates, say this was given over a period of at least  
20 hours and probably days, as opposed to the usual single  
21 exposure which you would predict would give less effect for  
22 the given total dose. Also, there is a possibility that  
23 some of these individuals were inside structures and did not  
24 get the same total dose that was calculated for the island.  
25 These things would tend to make you suspect that the effect

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1 should be less than what you would anticipate for 150 r.

2 I would like to know if this perturbs anyone?

3 I have talked to a number of people that it has perturbed.

4 In other words, the findings observed are not commensurate

5 with the calculated dose. Are they or aren't they? Is it

6 necessary to go to something like this depth dose business

7 to explain this? Do we have to go to something like

8 combined effects to explain it. Or is everybody happy with

9 the findings of 150 or 175 r?

10 DR. DUNHAM: Gene, you studied this longer than  
11 anybody in the room. Is there any change in the blood picture

12 as you saw in those animals as you would have gestimated on

13 the 28th of February last, as coming from roughly 150 or

14 175 r total body exposure?

15 CDR. CRONKITE: One has to make the assumption on  
16 the basis of this data that was collected that either man

17 behaves differently from what we thought he ought to behave

18 on the basis of large animal experience in the laboratory

19 and with fission spectrums from atomic bombs based on Green-

20 house work, or there is some weird combination of radiation

21 effects that we are not at all aware of to make this

22 difference.

23 It is a very real difference in the time sequence

24 in the platelets in these human beings that occur as has

25 been observed in any laboratory animal.

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Report of [unclear]  
[unclear]  
[unclear]

1 DR. DUNHAM: Is there any comparable data on large  
2 animals?

3 CDR. CRONKITE: Yes, we have 150 r dogs in a large  
4 group. They hit the minimum around 12 to 13 days, and are  
5 beginning to recover at about the time these people are getting  
6 the minimum values. It is an entirely different picture.  
7 I don't know how to interpret these things. It may be  
8 that the life span of human cells is entirely different from  
9 laboratory animals that we are dealing with, or there is  
10 some other weird radiological factor that comes in of  
11 additivity that prolongs the effect of radiation. I am  
12 confused on it.

13 DR. DUNHAM: It seemed to me in our little  
14 discussion this morning we talked about somebody reviewing  
15 the Japanese data, and if it looked as though in those  
16 that survived there was the prolonged effect. In the two  
17 Argonne cases there was prolonged effect.

18 CDR. CRONKITE: The bad effect on Japanese data  
19 is that those who survived the first blood count were taken  
20 in the third and fourth week after exposure. We don't  
21 know what they were doing before that. The Japanese dying  
22 probably received super-lethal doses of radiation, the  
23 behavior is the same as that of a dog receiving super-lethal  
24 dose of radiation. Then there is this hiatus of three or  
25 four weeks where you have to guess what that looks like.

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1 From Argonne there is this one case of a man that  
 2 was exposed to platelets and leukocytes who hit the low  
 3 values at about the same time as the men of this large group  
 4 did. I rather expected that people would be concerned about  
 5 these differences in the time. Is that what a single dose  
 6 of radiation would do to a man or isn't it?

7 DR. DUNHAM: We don't have any evidence to the  
 8 contrary, do we, in man?

9 DR. BOND: May I ask Col. Browning and perhaps  
 10 Commander Etter on this point: Was this actually observed,  
 11 and does this surprise them? Is it 150 r anticipated or  
 12 are there difficulties?

13 COL. BROWNING: I have those records, and I will get  
 14 them up tonight, where people have been given 150 r in one  
 15 dose. But if my memory is not wrong on this, it did go  
 16 down earlier. This was with one MEV stuff.

17 DR. BOND: How about the clinical picture?

18 COL. BROWNING: These people were not well, of course,  
 19 when they received it, which was the reason that we were  
 20 justified in using those amounts. But they showed very  
 21 little in the way of radiation sickness, just about  
 22 comparable to the natives. But the blood did go down earlier  
 23 with the whites and platelets, as I recall it. I will bring  
 24 that stuff in tomorrow.

25 DR. DUNHAM: Did they follow through for six and

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1 eight week periods?

2 COL. BROWNING: Yes, some of them for six months  
3 and a year.

4 CDR. CRONKITE: This data, if it is available, we  
5 ought to get hold of it for comparative purposes. I have  
6 never seen it.

7 COL. BROWNING: I will bring it in for you.

8 CDR. ETTER: What is it?

9 COL. BROWNING: It is the therapy units, one at  
10 Baylor and one at Sloan Kettering. This was a little bit of  
11 everything, including leukemia.

12 DR. DUNHAM: Commander Etter, have you anything to  
13 add to that at this point?

14 CDR. ETTER: No. I think what is bothering  
15 Vic a bit is that in setting up figures for so-called  
16 operational implications in atomic warfare, we in the past  
17 have pretty much considered it to be 100 r probably at the  
18 very low limit of any signs or symptoms appearing with  
19 probably a thought that a group of troops receiving 100 r  
20 could go on with their normal duties. This makes you wonder  
21 if the 150 r is going to result in this type of thing,  
22 whether or not our figures for operational purposes might not  
23 be a bit on the high side, rather than the low side, and we  
24 would have to come down a bit on this thing. I think that is  
25 what Vic is getting at.

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1 COL. BROWNING: Harry, if we can get any  
2 information here from the physicists about the energy, it does  
3 not make us feel too bad. We are quite happy with our 150 r  
4 if this is correct. But if this is the very low energy stuff  
5 then we have not gained a bit of assurance from it.

6 CDR. ETTER: If 150 will do this over a period of  
7 a matter of 36 hours, doesn't this mean 150 delivered in a  
8 matter of a minute or so should not have given a much more  
9 acute picture, which means that 150 may be much too high  
10 for practical purposes in our operational structure?

11 COL. BROWNING: Yes.

12 DR. DUNHAM: How much did these people get the  
13 first 12 hours, Gordon?

14 DR. DUNNING: I don't know whether I can quickly  
15 answer that.

16 DR. DUNHAM: I think this is important in this  
17 consideration. What they got in the first 12 hours is not  
18 going to affect much more difference than three or four  
19 minutes.

20 CDR. ETTER: I picked the 36 hour figure because  
21 of the evacuation.

22 DR. BOND: They got only 30 f.

23 CDR. CONARD: I thought the curve was so steep.

24 DR. BOND: They didn't start their exposure until  
25 the plus 6 hours, at which time you are not on the step

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1 portion of the curve any more, but pretty much on the flat  
2 portion. So the dose rate was not changing as rapidly as you  
3 might suspect.

4 DR. DUNHAM: You would guess they got about one  
5 fifth of their dose in the first 12 hours.

6 DR. BOND: That is right.

7 DR. SONDHAUS: This depends very strongly on  
8 whether you assume the fallout was along one or short one.  
9 If you assume that the fallout was quick, that the dose  
10 built up to a high rate very quickly, then the first 12  
11 hour dose would certainly be appreciably more than if the  
12 fallout was slow and only reached its peak after 12 hours.

13 In either case, I don't think even in the maximum  
14 case you can allow for more than about 30 per cent of the  
15 total dose in the first 12 hours for the 51 hour exposure.  
16 However, in the case of the Rongerik exposure, where the  
17 evacuation was at 28-1/2 hours, I think the first 12 hours  
18 would probably give as much as half the total dose. These  
19 are guesses. They are more than a guess out of thin air,  
20 but they are still not a great deal more than that.

21 DR. DUNHAM: Harry, I stand completely corrected  
22 on that point.

23 CDR. ETTER: How long was the fallout actually  
24 observed by the natives?

25 CDR. CONARD: About 10 o'clock at night.

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1 DR. DUNHAM: About several hours.

2 DR. DUNNING: But that doesn't mean you have  
3 equal quantities of radioactivity coming down.

4 CDR. CONARD: No.

5 DR. BOND: I think the important thing is that  
6 they didn't receive 90 per cent of their dose over a few  
7 hours. It was a relatively slow dosage.

8 COL. BROWNING: Harry's point is well taken. If  
9 they became nauseated at 50 or 60 r, perhaps, and they may  
10 well have done so from these figures, then we are going to  
11 do some thinking about this. But the clinical data we  
12 have doesn't seem to indicate that this happened.

13 DR. SONDHAUS: I think it might be added that Dr.  
14 Dunning's point about the sky shine is important here. We  
15 may not be taking that into consideration at all. All these  
16 calculations are entirely on the basis of fallout. If there  
17 was sky shine in addition this would have to be handled  
18 separately.

19 CDR. CONARD: Can you give us any idea as to what  
20 the additive dose would be from sky shine?

21 DR. DUNNING: I am sorry. By looking up the date,  
22 I can give you some estimate from the Nevada test, but how  
23 you would extrapolate this to out in the Pacific, I don't  
24 know.

25 DR. DUNHAM: What sort of orders of magnitude are

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1 we talking about?

2 DR. DUNNING: We don't know.

3 MR. HARRIS: Were you talking about a cloud of  
4 radiation? Is that what you mean? Or do you mean reflected  
5 radiation from the atmosphere?

6 DR. DUNNING: The actual cloud.

7 MR. HARRIS: This has been simply covered by Parker.  
8 This is the opposite of the Clark Gable problem of big ears  
9 on both sides.

10 DR. DUNNING: You can figure out that r per hour  
11 is 10 times to the third, times the energy of your emission,  
12 if you want to do it mathematically. That still doesn't  
13 give you the answer what happened out there.

14 MR. HARRIS: You could take some numbers if they  
15 are any good, which said so many fissions to which they  
16 were exposed.

17 DR. DUNHAM: I think the thing that baffles we  
18 poor medicos is the lack of certainty on this whole matter  
19 of dose, and the time during which the dose was given, in  
20 order to try to give any intelligent interpretation. I  
21 think you really brought it up when you said that.

22 CDR. CRONKITE: My point is as far as writing the  
23 report is to completely leave out all concepts of dose.

24 Say people were exposed to radiation and this is what happened.

25 As soon as you put a dose down there, people are going to use it

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1 DR. DUNHAM: With things as indefinite as they  
2 appear at this point, it will be more misleading than useful.

3 DR. BOND: It will never be more definite.

4 DR. DUNHAM: I am afraid not with this particular  
5 group of exposures.

6 DR. BOND: I didn't ask that question to get at the  
7 operational aspect.

8 DR. DUNHAM: No, but it is an important one to get  
9 out in the open and get it over.

10 DR. DUNNING: Dr. Dunham, I don't think we should  
11 be too awfully pessimistic. Take the Rongerik people. They  
12 had film badges out there, and they actually read between 40  
13 and 50 r. If you make the same kind of assumptions and the  
14 same kind of calculations for Rongerik as we did for Rongelap,  
15 I say this morning it was 60 to 75 from memory, and looking  
16 at it this noon, I find it is 75. Our calculations using  
17 the same kind of assumptions at Rongerik, says 75, and film  
18 badges said 40 to 50. We know that they were indoors a good  
19 share of the time. To me this gives us a pretty good notion  
20 that we are not at somebody else's ball park.

21 DR. DUNHAM: This is fine from what happens from  
22 fallout. The thing that is bothering some of the people  
23 who are trying to use this material are in terms of other  
24 types of situations where exposure might occur in a  
25 matter of minutes from an external single source as opposed to

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1 this sort of situation. I think it is important that we  
2 find out right now that you are not going to be able to  
3 jump from much of this data to this other situation that  
4 Harry has to work about, and Gene, too. It does not seem  
5 comparable to acute exposure.

6 DR. BOND: I thought it was necessary to postulate  
7 the combination. In other words, can we explain everything  
8 we saw on the effects of giving dosages as we know them now,  
9 or are these inconsistent with present knowledge.

10 DR. DUNHAM: Who has in hand the burros situation?  
11 That is the only thing that is comparable. Do you recall what  
12 course the blood picture took?

13 CDR. CRONKITE: Higher doses. It was similar  
14 to single dose given to dogs.

15 DR. DUNHAM: I was wondering whether they showed  
16 the prolonged curve at the lower doses.

17 LT. LOONEY: There is one thing in going over all  
18 the available information on the use of radium and radon.  
19 I can look this up tonight and go over the hematological  
20 responses, but I remember there is a wide variation in some  
21 of the German literature following the internal use of  
22 radium and radon. This might throw some light or more  
23 confusion. I will give you a report on this tomorrow. I do  
24 remember one case that they said they got an increase in the  
25 red count of something like one million, and I remember

1 trying to make some sense out of the hematological response  
2 that we did find many bizarre responses to the internal use.  
3 This might throw some light on the question.

4 DR. DUNHAM: Any further comments on that point or  
5 shall we move on to leukemia? The reason I mentioned  
6 leukemia before is because we were talking about operational  
7 problems, and if that is going to occur, it will occur in  
8 four or five years.

9 On the other hand, and I think there is general  
10 agreement, these people got no more than 200 r total body  
11 exposure, whether it was given over a period of 24 to 36  
12 hours, it is most unlikely perhaps that there is going to be  
13 a problem. Who wishes to comment on that?

14 CDR. CRONKITE: These numbers up here are very  
15 nice, but is anybody willing to say what that would mean to  
16 the bone marrow over a period of 20 to 30 years in REP?

17 MR. HARRIS: Almost nothing.

18 CDR. CRONKITE: I would agree with you that one  
19 would not anticipate any leukemia at all insofar as the  
20 adults are concerned. What will happen to the children is  
21 highly questionable.

22 DR. DUNHAM: How often should there be blood counts  
23 done on these people after everybody is satisfied the initial  
24 phase is over? I gather we are all agreed that it was not  
25 over at the time Project 4.1 came home, is that right?

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1 CDR. CRONKITE: That is correct.

2 DR. DUNHAM: They will be predicated on what  
3 turns up the next time or two out of course. Say two years  
4 after the initial exposure, from then on, how often would be  
5 useful?

6 CDR. CRONKITE: I don't know. Once a year perhaps.

7 DR. DUNHAM: Does anybody believe that leukemia  
8 will be an important sequella among these people?

9 (No response.)

10 DR. DUNHAM: A bunch of optimists.

11 LT. SHULMAN: Is there any experimental animal  
12 that more closely approximates humans, like some of the  
13 primates, about which radiation exposure data is known?

14 DR. DUNHAM: No data on leukemia in the primates  
15 yet.

16 LT. SHULMAN: As far as dose and blood count change.  
17 I don't know whether it has been studied in a chimpanzee.

18 CDR. CRONKITE: The chimpanzee has been studied,  
19 and the rhesus monkey, and the monkey behaves exactly like  
20 the dog.

21 LT. SHULMAN: That only proves dogs are closer to  
22 man than we think.

23 DR. DUNHAM: Are there any other sequallae that  
24 might be anticipated, or should be at least looked for?

25 Cataracts have not been mentioned.

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1 MR. HARRIS: We have done some work in the last  
 2 few years on mice given single doses of radiation extending  
 3 from 12-1/2 roentgens on up to 5 and 6 hundred, and those  
 4 mice were kept and examined periodically for a period of two  
 5 years. We have done this with x-rays as a control for  
 6 neutron experimentation. We are in the process of pulling it  
 7 all together at the present time. In my recollection of the  
 8 last time I looked at this data to try to pull something out  
 9 of it, the formation of not true cataracts, but detectable  
 10 lens aberrations in the region of the posterior pull of the  
 11 lens probably in most cases is non-vision disturbing if we  
 12 knew what was vision disturbing in mice.

13 There is a definite correlation with the formation  
 14 of these opacities, and the dose that the animals had. To  
 15 the best of my recollection this correlation with opacity  
 16 is better, and the incidence of opacity formation is higher  
 17 than is the incidence of leukemia in animals. Therefore, it  
 18 might be reasonable to continue some studies on these  
 19 people for the detection of these lens aberrations and even  
 20 before you would think of looking for leukemia.

21 As far as leukemia in the animals was concerned,  
 22 it is going to be awfully difficult to analyze statistically  
 23 because/a fair leukemia incidence in the normal population  
 24 of this mouse. The same way with other types of carcinoma.  
 25 I do remember that there is a shift in incidence of leukemia

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1 and carcinoma as you go to higher doses. For instace,  
2 at the higher doses you will find much more leukemia than  
3 carcinoma, because of the time of onset, and the animals die  
4 before they are old enough to get carcinoma.

5 At the lower doses I would guess -- this may not  
6 be the right number -- I would find there is a positive  
7 index for leukemia production in doses above 100 roentgens or  
8 so many. I am not sure that this will be forthcoming when  
9 this is written up.

10 CDR. CONARD: What was the threshold dose for  
11 opacities?

12 MR. HARRIS: At half the year -- these are not non-  
13 vision disturbing capacities -- is in the neighborhood of  
14 50 r for x-ray.

15 CDR. ETTER: Were those mice carefully screened  
16 beforehand for any lens aberrations?

17 MR. HARRIS: Yes, they were. The way they were  
18 run, this was an experiment in which we attempted to  
19 eliminate all bias. All items were coded singly. The  
20 observers over the period of two years never knew what  
21 animal they had hold of. We think it is pretty good statistic-  
22 ally on that basis. There is a fair percentage of visible  
23 aberrations in control animals as you put the data back  
24 together again off the card files.

25 The threshold, if you wish to call it that, or the

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1 50 per cent incident level of these opacities was at 50 r  
2 at the half year. This continues to go down in total dose  
3 at a year, a year and a half and two years.

4 DR. DUNHAM: It was my understanding that the  
5 macaques at Austin, Texas, have failed to show any opacities,  
6 many of whom must have gotten more than 100 r a year after I  
7 heard about it.

8 MR. HARRIS: I talked to the monkey man, and they  
9 are now getting opacities that were exposed to 14 NEV neutrons.

10 DR. BOND: Isn't the threshold for cataracts in mice  
11 usually lower than for other animals? Wouldn't more suitable  
12 data be the Japanese data?

13 MR. HARRIS: This is a definitive cataract you  
14 are talking about. What I am talking about is a smallest  
15 detectable opacity. When you take mice, then for a true vision  
16 disturbing situation in mice, which is really to squeeze the  
17 mouse behind the neck and his eyes pop out, and he looks  
18 sideways, and you can see it. This is certainly a vision  
19 disturbing situation, and the threshold there is similar to  
20 that found in Japan, or the incidence level is similar to what  
21 has been found. It was stated about 500 REM equivalent  
22 and it runs that way for mature cataracts in mice.

23 DR. DUNHAM: These are presumably going to be  
24 gamma ray cataracts, if due to anything.

25 MR. HARRIS: I will have x-ray cataracts and gamma

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1 cataracts and thermoneutron cataracts. The opacity  
2 incidence in x-ray animals and the opacity incidence in  
3 4 MEV gamma animals is about the same level, 50 per cent  
4 incidence. It is almost exactly the same level, although  
5 the lethality of MEV is much less for the 4 MEV animals.  
6 This would be out if it would do you all any good in figuring  
7 out what you are going to look at these people later.

8 DR. DUNHAM: What was the gamma threshold in rabbits?

9 MR. HARRIS: X-ray threshold in rabbits for what  
10 is called a mature cataract, not threshold but 50 per cent  
11 level, was at around 500 roentgens.

12 DR. DUNHAM: What was the threshold for opacities?

13 MR. HARRIS: They were not looking for those.

14 DR. DUNHAM: Certainly that leaves it such that we  
15 are going to have to look, probably the sooner the better  
16 that somebody can get out there and look, and establish a  
17 base line on these people, the better.

18 CDR. CRONKITE: Somebody has looked. We got a long  
19 involved report a few days ago.

20 DR. DUNHAM: This I didn't know.

21 CDR. CRONKITE: We just received it. I had not  
22 known it had been done either. It is something you initiated.

23 MAJ. HANSEN: I think it actually started with the  
24 return of the Air Weather personnel, and the other American  
25 personnel to Tripler at which time we asked Col. Lowry, who

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1 is the chief at Tripler to evaluate all these people to  
2 establish a back line. Dr. Bugher came through at that time  
3 and went over such records as we had, and then went over  
4 with Col. Brennan and talked to Col. Lowry, and I believe  
5 he had a trip set up to go to Japan to look at some of the  
6 Hiroshima and Nagasaki people, and was asked to stop by and  
7 look at these folks at that time. I am sure that is where  
8 it began.

9 DR. DUNHAM: Fine. What does the report indicate?

10 CDR. CRONKITE: I will bring it down tomorrow. It  
11 is about an inch thick.

12 DR. DUNHAM: Did he find that much?

13 CDR. CRONKITE: There were three macular  
14 degenerations. There were a fair number of things observed,  
15 but whether they have any connection to radiation is somewhat  
16 questionable.

17 DR. DUNHAM: Not much in the lens itself?

18 CDR. CRONKITE: No, not more than would be consistent  
19 with some of the older individuals.

20 DR. DUNHAM: And he examined the entire group?

21 CDR. CRONKITE: Yes.

22 DR. DUNHAM: This is fine.

23 CDR. CRONKITE: With a very nice clinical record  
24 on each one of them.

25 MAJ. HANSEN: I might point out that in each and

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1 every American, he found some anticular opacities, but  
2 which he felt were congenital or at least non-significant  
3 from a radiation point of view.

4 DR. DUNHAM: It would be awfully soon to be getting  
5 significance.

6 MAJ. HANSEN: Yes. One of the Air Force personnel  
7 did have an anticular opacity. This is down, and points out  
8 the value of having this. Dr. Lowry was perfectly willing  
9 to state that he didn't feel that it could be due to the  
10 radiation, but at the same time it may bring up a problem in  
11 the future.

12 CDR. ETTER: In that connection, Lesinsky has  
13 screened all the affected crew members, and he has found an  
14 18 per cent incidence in what he calls the normal opacities,  
15 which he contends cannot be distinguished from those which  
16 might be due to radiation. Out of his group he discarded  
17 two individuals who showed marked lens changes, both of whom  
18 had received heavy radiation in adolescence for acne. That is  
19 something that must be considered in their past history.

20 MR. HARRIS: The incidence of congenital opacity  
21 in mice happens to be in the neighborhood of 18 per cent also.

22 DR. DUNHAM: Are there any other possible ultimate  
23 effects? How about aging? Is this population group large  
24 enough to even begin to think about it?

25 CDR. CRONKITE: I don't think it is conceivable to

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1 do any kind of population study on that because in the first  
2 place, you don't know how old anybody is, except the ones born  
3 since the American occupation. It would be impossible to set  
4 up a population study.

5 DR. DUNHAM: Should there be any special looking for  
6 cardiovascular disease, and setting up comparable groups  
7 between the Ureriksand Rongelaps?

8 CDR. CRONKITE: I don't know anything about it  
9 myself.

10 DR. DUNHAM: Does anybody wish to make a statement  
11 because this sort of thing has got to be ironed out because  
12 there are always kibitzers on the side as to why you didn't  
13 run a lipogenic index on this thing.

14 DR. DUNNING: Dr. Dunham, I seem to be alone here,  
15 but the thought came to mind of trying to jibe up the doses  
16 and present condition. As I recall, the events out there,  
17 the fallout was heavy enough so that it made their drinking  
18 water very visibly murky. They continued to drink this  
19 until finally stopped by their local leader. These are  
20 questions, not statements. Could there be anything there  
21 that would cause them to be nauseated as they claimed they  
22 were after the first day? I am trying to jibe up the idea of  
23 their physical condition and the estimated dosage.

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24 Secondly, remember when Dr. Zsuzuki was here, he  
25 made a strong point that he felt the poor condition of the

1 fishermen was due to so greatly their extensive beta burns.  
2 Did those natives have enough burns, or would that be  
3 sufficient to have any effect?

4 In other words, did we have something here in  
5 addition to whole body gamma that might account for some of  
6 these physical conditions? I don't know. These are both  
7 questions. I would like to repeat also that the estimates  
8 were without any estimates of contribution of soft gamma to  
9 beta. I said that this morning, and I say it again, as  
10 well as the sky shine.

11 DR. DUNHAM: As far as the Japanese fishermen, I  
12 don't think the natives have lesions comparable to one or  
13 two of the fishermen whose scalp was a mass of exudation,  
14 from the photograph.

15 CDR. CONARD: I think it was more extensive than  
16 anything in the natives.

17 DR. DUNHAM: This man's scalp was just a mass of  
18 gunk. Certainly I think Ray would go along that there was  
19 nothing unusual in the way of systemic symptoms that could  
20 be related to the second effect of skin burns.

21 LT. SHULMAN: I think you might look at it as a  
22 local sunburn.

23 DR. HARRIS: Could you possibly conclude this  
24 apparently self limiting nausea that these individuals had,  
25 and they had some, did they not very early, could be due to

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1 a local radiation effect? After all, these people got a  
2 fair number of REP to skin. There is no reason why they  
3 didn't get a fair number of REP to the lining of the gut  
4 in the same situation.

5 DR. BOND: Why should they get the same amount of  
6 REP to the gut lining?

7 MR. HARRIS: I mean just from drinking this water  
8 they had.

9 DR. DUNHAM: They were not great water drinkers.  
10 We know that.

11 MR. HARRIS: I know. I doubt whether it is  
12 correlatable, but it is an excuse.

13 LT. SHULMAN: Do you get nausea if you drink  
14 radioactive tracer doses?

15 MR. HARRIS: I don't know. It would seem to me  
16 that even if they didn't absorb too much, they might have  
17 gotten a fair number of REP to the lining of the gut which  
18 is rather sensitive to radiation.

19 CDR. ETTER: But isn't this very comparatively  
20 mild nausea, which they got earlier, consistent with the  
21 marked amount you got later on from a statistical standpoint?  
22 If they got this much blood depression, should you not expect  
23 them to have some nausea to start with?

24 MR. HARRIS: I don't know.

COL. BROWNING: These cases I was mentioning had

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1 the same thing. They got down to 10,000 platelets, and  
2 1,000 white count, and they don't have any nausea.

3 DR. DUNHAM: I think there is more the chance that  
4 nausea was chemical rather than radiological.

5 CDR. CONARD: There is a big psychic element in  
6 evaluating nausea and vomiting. The water was turned yellow  
7 and they were told it was poisoned, and they got immediately  
8 sick if they were told the water was poisoned.

9 DR. DUNHAM: Why were they told that they were  
10 poisoned?

11 CDR. CONARD: Because the water turned yellow.

12 CDR. CRONKITE: It was because they were getting  
13 sick.

14 CDR. CONARD: Either way, or both.

15 LT. SHULMAN: I have some observations on fertility.  
16 Are those to be included?

17 DR. DUNHAM: Dr. Shulman raises the question of  
18 observations on fertility. Does anybody wish to make a  
19 comment on that?

20 CDR. CRONKITE: My feeling toward it is very simple.  
21 We should not attempt to do any studies for fertility  
22 for obvious psychological reasons for natives themselves. It  
23 becomes a fairly personal thing for getting specimens of  
24 semen and prying into these things. It is difficult enough  
25 to get a specimen of urine, and feces, let alone inducing

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1 masturbation on a large scale of Marshallese.

2 DR. DUNHAM: If properly induced. You don't know  
3 who the fathers are. You are dealing with a group where  
4 there is no control. You would have to use the Uterikans  
5 as control.

6 MR. IMIRIE: You could only use the control years  
7 since 1945, because before that it was Japanese.

8 DR. DUNHAM: And up to 1950 there was no  
9 penicillin to clear up the gonorrhoea and keep the tubes open.

10 CDR. CRONKITE: In terms of birth per unit of time  
11 or anything like that, I think it would be meaningful,  
12 because the Navy cured the gonorrhoea, and all the women  
13 are now fertile, as amply demonstrated.

14 DR. DUNHAM: Furthermore, the data in Japan  
15 suggests that as far as live births and so on are concerned,  
16 there are pretty good data on that. A lot of it where  
17 large numbers of people studied both control and irradiated  
18 population, and there is apparently no difference. There  
19 has been a general drop in birth rate in Hiroshima and  
20 Nagasaki, but it is the same in the control population as  
21 in the radiated. This group which has undoubtedly received  
22 all of them, something less than 200 r, I don't think you  
23 would expect to find a thing on overall birth rate. As Gene  
24 pointed out, it is not practical to do sperm counts and  
25 that sort of thing.

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1 CDR. CRONKITE: I would like to ask Capt. English  
 2 whether levels of radiation such as these children  
 3 received possibly were a little increased to the dental  
 4 germinal layer due to soft component, would there be any  
 5 reason to examine these people by, say, yourself, or somebody  
 6 else familiar with the radiation effects on growing teeth.

7 CAPT. ENGLISH: Judging from work we have done  
 8 with swine and rodents, I don't believe this is a sufficient  
 9 dose that you can expect to find enough change in the  
 10 developing teeth, after they reach maturity, that you  
 11 would find any changes. With swine, we were usually up in  
 12 doses of 400 r before we found anything that was very  
 13 pertinent, and with rodents on their continually developing  
 14 incisor teeth, you get up in the nature of 1,000 r, actually  
 15 we used 1500 r, in order to get the stoppage of enamel  
 16 incidence. With the rodents it is a very marked change,  
 17 and you would not have to go that far for record purposes as  
 18 a minimum change.

19 I would strongly suspect that 150 r would not  
 20 show you anything. Particularly would you have the trouble  
 21 of having a group whose nutritional conditions and health  
 22 conditions in general are so varied that even if there were  
 23 some minimal changes, you could not pinpoint it down to  
 24 radiation changes, because hyperplasia can occur from numerous  
 25 things.

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1 I would not want to spend the time to do it myself  
2 in this range. However, I would like to have a selection of  
3 extracted teeth, not to point as far as the health of the  
4 population is concerned, but to see if there were enough  
5 deposited materials to make radio audiographs.

6 CDR. CRONKITE: If somebody were to collect teeth  
7 that had fallen, you would like to have them?

8 CAPT. ENGLISH: Yes, we would like to make  
9 sections of those.

10 MAJ. HANSEN: May I interject here that I was  
11 going to bring this up. Among the Americans we were  
12 fortunate to secure a few teeth that were extracted and save  
13 them. These were sectioned and are on nuclear plates. Dr.  
14 Reed at National Cancer Institute is doing this. His report  
15 should be through in another week or so. We have also been  
16 running control teeth. I had felt that this was a good move  
17 and remembered that these natives do have quite a few  
18 extractable teeth. If there are any taken out, I know the  
19 people at National Cancer Institute would be very glad to  
20 run the radio audiograph. Whether you would like to use  
21 control teeth from natives from other atolls or control  
22 teeth from around here, I think that could be arranged. He  
23 feels very sure that he can detect any level of activity at  
24 all. He has found some in the control already that is  
25 within normal limits, of course.

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1 MR. IMIRIE: I made one observation here talking  
 2 about dose. That is, we have talked about 150 r and yet  
 3 Gene Cronkite has brought up the fact that the blood  
 4 picture did not follow what he expected it to follow. You  
 5 would not expect a large number of people to have nausea at  
 6 150 r. So many things are in disagreement with what you  
 7 would expect from a dose of 150 r. We know on top of this  
 8 there was a large dose of beta radiation. How much no one  
 9 knows, and probably will never find out. I doubt if there  
 10 is actually any laboratory animal experiments that have  
 11 subjected a person to what would be equivalent of 150 r and  
 12 superimposed on this a large factor of very high energies.

13 Isn't it reasonable to assume that if some of the  
 14 other strange things have happened, such as the blood  
 15 picture changing late, and so on, that some of the other  
 16 things, like dental situation, and leukemia and carcinoma, and  
 17 so on, where based on present experience, we would not think  
 18 it would happen, that it may turn out to happen? Therefore,  
 19 I think these people should be watched very closely. This  
 20 is a unique situation that has never come into being before,  
 21 and you don't have any animal comparison.

22 CDR. CONARD: There have been studies of animal  
 23 changes in the blood of animals from beta radiation. There  
 24 are no significant changes.

25 MR. IMIRIE: How about the two together, hard gamma

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1 and superimposed soft gamma and beta on top? This is a  
2 unique situation.

3 LT. SHULMAN: In thinking about getting specimens,  
4 they do have an autopsy room at Majuro, and if somebody  
5 were to die from other causes, it might be worthwhile at least  
6 letting the physician there know what specimens you would  
7 be interested in.

8 DR. DUNHAM: I think this is very important.

9 LT. LOONEY: There is one suggestion with regard  
10 to teeth in autopsy, since we do know there is a marked  
11 variation in urinary excretion, we might be able to tie the  
12 teeth analysis into the people with autopsies and get a  
13 complete termination and indirectly work around to total  
14 body burden from urinary excretion. Maybe you could tie  
15 this down for future information, although it would not help  
16 the Marshall Islands.

17 DR. DUNHAM: Gene, you seem to be about to say  
18 something.

19 CDR. CRONKITE: I was thinking that when Vic or I  
20 or somebody else out there knows ahead of time of the various  
21 things that might be done, and everybody is willing and  
22 agreed to do them, it is fine, but if suddenly on the spur  
23 of the moment, you find yourself out there with dispatches  
24 coming in that everybody is putting on their afterthoughts on  
25 it, I personally would dispatch it up. You can't do it. I

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1 am hoping that the people will get their thoughts on the  
2 record. Something like cremation would be a good idea.  
3 How in the world with the people's burial habits, how can  
4 you sell them on the idea of getting their bodies embalmed  
5 and cremated.

6 MR. IMIRIE: Don't they bury very quickly, the  
7 same day, I believe?

8 CDR. CRONKITE: Within six hours, usually.

9 DR. DUNHAM: Is there any further discussion of  
10 the data with relation to prognosis?

11 CDR. CONARD: One thing we might look for is  
12 possible premature graying of the hair.

13 DR. DUNHAM: I notice we are scheduled for a coffee  
14 break. If the coffee does not materialize any better than  
15 it did this morning, I wonder if it may not be smarter to  
16 go on to Item 5. I have no idea when Dr. Bugher will be back.  
17 I prefer he chair that particular discussion, but the chances  
18 of him being back by five I don't think are awfully good.

19 CDR. CRONKITE: I would like to make a suggestion.  
20 I know Capt. Kellem was unable to come today. He is  
21 particularly interested in Section 5. I know Dr. Bugher is  
22 also. Perhaps it could be postponed until tomorrow.

23 DR. DUNHAM: It is quite agreeable to me. Is there  
24 anything to lift from tomorrow's agenda to shorten that?  
25 I suspect not.

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1 CDR. CRONKITE: I would like to move to knock off  
2 early today.

3 DR. DUNHAM: And work late tomorrow?

4 CDR. CRONKITE: And if one has to work late, to  
5 work late tomorrow.

6 DR. DUNHAM: Let me check when Dr. Bugher is to  
7 come back.

8 (Brief recess.)

9 DR. BUGHER: I take it that the group thinks that  
10 there might very well be certain things resulting over the  
11 years with these people, particularly the Rongelap group.  
12 I presume that you would expect an actuarial contraction of  
13 life span as an expression of the radiation exposure.  
14 Whether one can appreciate that at all would depend upon  
15 good actuarial statistics of the Marshall Islanders of a  
16 sufficiently large population. That may not in fact exist.  
17 But it is reasonable that even with numbers that small, some  
18 difference may be shown. I don't know whether that was your  
19 consensus or not. It is something naturally to watch.

20 What was the opinion about leukemia?

21 CDR. CRONKITE: That was unlikely.

22 DR. BUGHER: On account of the small number of people

23 CDR. CRONKITE: The small number of people, and at  
24 that dose exposure, the incidence would be extremely low,  
25 based on the Japanese experience to date.

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1 DR. BUGHER: The chance of getting a case of  
2 leukemia in 100, those people must be of the order of one  
3 in 100,000, or something of that order. If you had 100  
4 times that probability, the chances of getting it in any one  
5 of 100 people would be quite small. So even if the leukemia  
6 rate were very much increased, you would not expect more than  
7 one case, probably, and if you had one case, you would not  
8 know whether to attribute it to radiation or not. I think  
9 I would agree with that.

10 What has been the feeling of the probability of  
11 skin carcinoma?

12 CDR. CRONKITE: Almost unlikely. There would be  
13 probably very little due to the absence of the deeper effects,  
14 there are no continuing ulcerations and the likelihood of  
15 neoplasia is considered to be rather remote. However, the  
16 fact of the rather continuous exposure of ultraviolet may  
17 increase the incidence somewhat.

18 DR. BUGHER: You would expect that to be much more  
19 likely to be recognized than leukemia, I take it.

20 CDR. CRONKITE: Yes. It would be more likely, but  
21 still probably would not be a major consideration.

22 DR. BUGHER: I don't know what the frequency of  
23 cutaneous carcinoma among these Micronesians is.

24 CDR. CRONKITE: I asked about that when we were  
25 out there, and I was led to believe that of what grossly one

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1 would consider carcinoma of the skin would be infrequent.  
2 They did have some lesions like the one I think you saw on  
3 a man that was there that is a very indolent type of ulcera-  
4 tion, presumably cancerous. They have a lot of internal  
5 cancer, but relatively speaking, very little of the skin.  
6 They only last year started vital statistics in the Marshall  
7 Islands.

8 DR. BUGHER: The population numbers are so small  
9 that it makes it difficult to reach good actuarial  
10 conclusions unless the differences are really huge. I should  
11 think that the probability of skin carcinoma should be fairly  
12 appreciable, and in people living to their fifties or sixties  
13 we may see quite a number of cases. That is merely my  
14 personal reaction to that. I asked Dr. Zsuzuki when he was  
15 here what he thought about that, and he discounted it  
16 completely and thought there was nothing at all of any  
17 interest there.

18 I rather had the impression he had enough worries  
19 now, and he was not going to cultivate any more. I was  
20 rather intrigued at his negative response to that, because  
21 that was one thing that seemed to me to be more likely  
22 recognized from all the changes which might exist from that  
23 level of exposure.

24 CDR. CONARD: I think a lot depends on how the  
25 skins look in the near future, and whether we have any further

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1 breakdowns of the epidermis.

2 DR. BUGHER: Yes, that will be a component there.

3 I suppose now we come mainly to the mechanics of  
4 getting this material into a single report. Gene, I think  
5 inevitably the leadoff on that falls to you.

6 CDR. CRONKITE: Dr. Bugher, I wonder if it would  
7 be permissible to postpone that until tomorrow. Captain  
8 Kellem was unable to come down and he mentioned that is one  
9 thing he is interested in seeing what conclusions you come to.

10 DR. BUGHER: Would you like to take that up the  
11 first thing in the morning?

12 CDR. CRONKITE: Yes, if it were feasible.

13 DR. BUGHER: That is perfectly all right.

14 Obviously we want a report which is complete and lucid, and  
15 which has all the pertinent data. If we can eliminate  
16 restricted data in this report, I think it would be desirable.

17 DR. BOND: Can you tell us, Dr. Bugher, what aspects  
18 of the report are restricted now?

19 DR. BUGHER: When we come to matters that are of  
20 trouble, if we can declassify it in almost the form it is  
21 with possibly the deletion of small sections, it would make  
22 it much more convenient, and will cut down the time delay.  
23 The things that we would have to hold as classified would be  
24 such things as the composition of the material with respect  
25 to Neptunium, any question of fission capture ratios of

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1 neutrons, information which would suggest the content of  
 2 normal uranium of the device, isotope ratios of the short  
 3 half life ones that particularly give information on the  
 4 type of device, and anything that might lead to any more  
 5 clear estimate of yield than has been given.

6 I am aware that the Congress itself compromised  
 7 the yield, that is, members of the Joint Committee in  
 8 statements to the press. So that cannot be regarded as a  
 9 sensitive piece of information as it was. But that is the  
 10 sort of thing that would bear on the questions of design,  
 11 efficiency, proportion of energy released by fission as  
 12 against thermonuclear reaction, and that sort of thing.

13 I don't think that inhibits one from giving the  
 14 isotope analyses in urine, the estimate of body burden, and  
 15 the computations of number of fissions ingested, for  
 16 example, per person, the sort of thing we have on the board  
 17 here. While it is classified now, I think we can declassify  
 18 it without too much restraint.

19 CDR. CRONKITE: I don't think there would be any  
 20 difficulty in writing the report with no restricted data in  
 21 it. After listening to the discussion on dosimetry today,  
 22 I have more or less made up my mind -- I don't know what I  
 23 will be able to talk the other people into it or not -- to  
 24 summarize dose in one table as the best estimate and the  
 25 statement of the uncertainties connected with it, and then

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1 the people that are interested in dose to ask them to write  
2 a separate addendum amplifying the uncertainties.

3 DR. BUGHER: Yes.

4 CDR. CRONKITE: Then we get away completely from  
5 the Neptunium, and the unfortunate statements in the first  
6 report of talking about tritium and lithium and one thing and  
7 another, and our ignorance of whether they were important or  
8 not.

9 DR. BUGHER: Yes, I think that is a good point.  
10 When it comes to the proportions of isotopes in fission  
11 products in the fallout material with respect to those  
12 that are of medical importance, we have essentially released  
13 that information to the Japanese in the following form,  
14 that is, we have told them that the pattern of those  
15 substances followed the bimodal efficient curve for uranium  
16 235 for fast neutron fission with respect to the modal  
17 regions, not with respect to the other. We gave them this  
18 information, that while we were not saying that what we were  
19 dealing with there was a fission reaction completely, that  
20 they could use those parts of the published curves and it  
21 would give them approximately the relative amounts of those  
22 isotopes, such as strontium, cesium, barium, lanthanum,  
23 that appeared to be in the material that fell out.

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24 So that much of the statement is already essentially  
25 public knowledge, because if we have given it to the Japanese,

1 we have given it to everyone. Consequently, it gives us  
2 no difficulty in dealing with those quantities. The approach  
3 there has been that the longer lived isotopes, the ones that  
4 were important after ten days, are no longer capable of giving  
5 sensitive information or information in any sensitive area.  
6 Since it is accessible to anybody who wants to put out flypaper  
7 and do his analyses, it is inherently data that cannot be  
8 classified, or at least will give us no trouble in  
9 declassifying.

10 I see, therefore, no real difficulty in dealing  
11 with the internal emitters here. In fact, I can see some  
12 intelligence advantage to introducing the plutonium business.  
13 It would perhaps throw foreign intelligence services off the  
14 beam somewhat to introduce the problem of some degree of  
15 plutonium ingestion at a very low level. It might or might  
16 not. I don't think it presents a difficulty.

17 The Neptunium matter, if it were brought in,  
18 would be much more pertinent. But as you indicated, it is  
19 not necessary really to go into a detailed discussion.  
20 How the gamma spectrum got that way, the best you can do is  
21 to give an estimate of what it must have been.

22 To some extent we have to make a report to the  
23 United Nations, presumably ahead of the general public  
24 distribution. I think it will make quite an impressive  
25 document in that environment, too. So it may be that when

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1 we come to that sort of thing, we have to produce it in  
2 essentially the form that it will be published.

3 CDR. CRONKITE: Could you say what sort of a time  
4 factor you have in mind with respect to the United Nations?

5 DR. BUGHER: It is the same old story. The faster we  
6 do it, the better, consistent with quality. This is some-  
7 thing we don't want to do any job on that five years from  
8 now you look back and say, why didn't they take a little more  
9 time and put a little polish on this or that paragraph. So  
10 we want really a first class job. The sooner it is  
11 available, the better off I think we are.

12 CDR. CRONKITE: Apropos of that, I am very pleased  
13 that the preliminary report is secret restricted data, but  
14 after re-reading it, I wish there were a lot of things  
15 that were not said or said better.

16 DR. BUGHER: It serves its purpose as a draft.  
17 Do you want to make it top secret now?

18 CDR. CRONKITE: Yes, I would go to top secret.  
19 Under the conditions, and where it was written, it is not  
20 so bad, but it looks bad in Washington now.

21 DR. BUGHER: As a rush draft, it is a very commend-  
22 able job, and it is the kickoff point for a more complete  
23 version. I have read it, and there are spots that you want  
24 to change naturally, and some deletions undoubtedly, but  
25 it is a pretty solid story. So those are the essential things.

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1 I think we can get good help in AFSWAP, and all other  
2 places, in clearing it with reasonable speed.

3 CDR. CRONKITE: There is one thing I want to bring  
4 up again tomorrow when Captain Kelleem is present. When there  
5 is urgency on the report, there becomes a real problem of  
6 discussing with AFSWAP to have just plain stenographic help.  
7 It has become an acute problem. AFSWAP doesn't know whether  
8 they can supply anybody. In the present status of the  
9 classification of the material, you have to have not only  
10 stenographic help, but the cleared stenographic help. The  
11 Institute is not in a position to do things on a rush basis.  
12 It will take a matter of weeks and months to go through MRI  
13 at the present time.

14 DR. BUGHER: How many people do you need for that?

15 CDR. CRONKITE: One person out there for a month  
16 or six weeks could solve the problem.

17 DR. BUGHER: Do you think it would be acceptable  
18 to Captain Kelleem if you people recruited the person at our  
19 expense?

20 CDR. CRONKITE: I think that will probably be  
21 acceptable, but I would prefer to defer that until Captain  
22 Kelleem hears about it.

23 DR. BUGHER: We don't have enough reserve now. We  
24 are short on secretarial help. So it will be a case of  
25 temporary employment of somebody who is cleared and who has

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1 all the other attributes that you need for this. An ability  
2 to type I suppose is one of them.

3 CDR. CRONKITE: The ability and not the classification

4 DR. BUGHER: I am sure we can straighten that out.

5 I presume you are in the same situation?

6 CAPTAIN YARBROUGH: Worse than ever.

7 DR. BUGHER: Are there any other points you would  
8 like to bring up now? If not, I think we can postpone this  
9 item for the morning and adjourn this afternoon. If there  
10 any point which it would be wise to bring up now?

11 If not, we are just about on schedule, and gained  
12 three minutes.

13 (Thereupon at 4:27 p.m., a recess was taken until  
14 Tuesday, July 13, 1954, at 9:00 a.m.)

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## SECOND DAY

TUESDAY, JULY 13, 1954

9:00 A.M.

DR. BUGHER: Let us come to order, please.

We are glad to have Captain Kellum with us this morning, which enables us to take up the topic which was deferred yesterday until he could join us. That is the mechanical problem of getting out a single report, and how to divide up the work to the extent that it has to be divided.

As far as I am concerned, I look to Commander Cronkite, so in that regard I think it is a good idea to ask him to give us what his ideas and suggestions are for getting out the final report.

CDR. CRONKITE: I have been giving this problem considerable thought. I don't know that I have an adequate explanation or solution to the problem. As I understand from your comments yesterday, Dr. Bugher, in addition to the report, we are obligated to make to AFSWAP, to Colonel Browning and the field commanders, a report that would definitely have to be unclassified for the United Nations. Is that correct?

DR. BUGHER: That is what we will come to. I thought the final report preferably should be in a form which is easy to declassify. Perhaps it might then be declassified and either in its full form or with some

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1 deletions to be in good shape to be used as a UN report, as  
2 well as for publication.

3 CDR. CRONKITE: Did I also understand that the  
4 report for the United Nations was to take precedence over  
5 the report for the task force?

6 DR. BUGHER: No. At least I don't think so. We  
7 are obligated here since this is a part of the task force  
8 program, to make the official report through the task force  
9 channels. You remember I talked to Dr. Graves, and he is  
10 agreeable to making these shortcuts which would speed up this  
11 thing, but in the long run he wants to naturally see the  
12 report in the regular way, too. I don't think we are asked  
13 to make a report to the UN prior to the routing of the formal  
14 report through the proper channels.

15 If we have to make such a report to the UN, and I  
16 am sure our delegation at the UN will not be at all bashful  
17 about telling us if they think they will profit by it, then  
18 we would have to do a quick job on our special report and  
19 clear that quickly for that purpose. But as of now, I don't  
20 think that we need to do that.

21 CDR. CRONKITE: Since I have had ample time to go  
22 over the preliminary report we wrote out in Quadjain, and  
23 each time I read it I realize what an unwieldy document it  
24 is and how difficult it is to go through from chapter to  
25 chapter to make any sense. I am not apologizing for it,

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1 because it was written in the field. It is still a pretty  
2 good report. It has a lot of inherent defects that should  
3 be corrected. I have also

4 I think the first I would like to see done is to  
5 take the section which is now Chapter 2 on the dosimetric  
6 considerations, and have that drastically reduced. I would  
7 like to have Dr. Sondhaus, Mr. Sharp, and Dr. Dunning try  
8 to make some very short statement that would be acceptable  
9 to everybody, and preferably of no classified information;  
10 then in addition to make a separate addendum that would not  
11 be in the same volume that would go into all the material  
12 that is inevitably secret restricted data.

13 I think in this way it would improve the report  
14 for the average biological and medical reader so as not to  
15 have to wade through all the "ifs" and "ors" and "buts" and  
16 come out at the end as to whether or not there was a dose or  
17 not from a physical standpoint.

18 The next is the section on excretion and body  
19 burden which represents a tremendous amount of work. It is  
20 always a difficult thing to go through and understand. I  
21 would like to give that the same sort of treatment of cutting  
22 it down for our final report to a very short version,  
23 emphasizing the status or the significance of the excretion  
24 of the material, a statement on probably body burden, and  
25 leave out for this report all of the extensive animal data;

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1 then to ask the respective individuals from Los Alamos, New  
2 York Operations Office, and NRDL, to submit rather complete  
3 addenda to the basic report where they can go into all of  
4 these imponderables that we discussed yesterday.

5 Then so far as the clinical and hematologic and  
6 estimates of the prognosis, and perhaps a discussion of  
7 future handling of this type of incident, I think we should  
8 go into more detail, and it would be primarily up to Dr.  
9 Bond, Conard and myself, and the others, to get this down  
10 in rather intimate detail.

11 I would like to see, if at all possible, the  
12 parts on dosimetry and the part on the excretion and  
13 deposition in the individuals, and our part of it, in firm  
14 form before the 1st of August. I think the addenda will  
15 come along as people can do it, perhaps before the first of  
16 the year.

17 Histomatology of the skin I think should be in  
18 detail whenever Dr. Wood is able to complete it, and be  
19 incorporated with Dr. Conard's section in the report. I  
20 think that takes care of my attitude towards the final report  
21 itself. It will contain no restricted data. I don't think  
22 it will contain any military classified data.

23 COL. BROWNING: No. When you sent that paper over  
24 the first time, there were a very few mentions in there of  
25 material that was really classified as far as we were

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1 concerned. We are more concerned at the present time with  
 2 the timing of the release of this classified or unclassified  
 3 document for obvious reasons. I think it should be done, but  
 4 I would like to wait until some of our friends get through  
 5 insulting us before we give them more information to insult us  
 6 with.

7 DR. BUGHER: If we wait until our friends get  
 8 through insulting us, we will wait a long, long time. I think  
 9 our point of view on these matters that we meet our obligations  
 10 and what is or is not said or done by other nations does not  
 11 cut too much of a figure in that. When we are asked for favors  
 12 by other nations, we expect to be at least couched in  
 13 reasonably printable language. I think the time on this  
 14 report as far as release is concerned should be based on our  
 15 considerations and advantage in complying with our  
 16 obligations.

17 COL. BROWNING: Yes, sir. I would like to say  
 18 perhaps one or two things about this report. Personally I  
 19 would like to see it in one huge volume. As I recall from  
 20 my medical school days, there was nothing that upset me more  
 21 than to be referred to five other books any time when I tried  
 22 to find a particular mention. However, I realize that  
 23 this will be a continuing thing and must be a series of  
 24 reports, rather than one, for some years to come. There  
 25 will be no way to cut it off sharp, and say this is the final

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1 report. There will always be something coming in. For  
2 example, you mentioned the skin studies.

3 CDR. CRONKITE: I see no reason why the addenda  
4 cannot all be put into one volume. We can give you a final  
5 report as I outlined it within a matter of a few weeks.  
6 To get a final report, particularly as far as the excretion  
7 and the animal stuff is concerned, is a long period of time.  
8 I have not had an opportunity to discuss with Dr. Cohn and  
9 Dr. Sondhaus and the others, and Dr. Harley, what their  
10 attitude would be towards what I have just proposed.

11 DR. BUGHER: We can hear from them now.

12 MR. COHN: I think I would go along with the  
13 suggestion. I think I would perhaps want to include some  
14 of the animal studies which are pertinent to our understanding  
15 of the human picture, rather than really discuss the  
16 human picture, and leave off all this auxiliary information  
17 which I think is quite important. I don't think we can in a  
18 matter of two weeks get a complete report out on all the  
19 work we have been doing. I think I would go along with  
20 having the various other laboratories who are connected with  
21 this project submit a detailed report of all the work they  
22 have been doing at a later time. Perhaps to integrate our  
23 conclusions as of now we could do our first report. I would  
24 go along with that.

25 COL. BROWNING: It might be a little more fair to

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1 a lot of these laboratories which have taken on this work to  
2 submit the reports as more or less their own work, rather than  
3 to throw it into this large one. I thought of this a couple  
4 of times in looking through the material that we have gotten  
5 from many other sources.

6 DR. BOND: Do these come out as general reports  
7 or reports from the institute? Would the Los Alamos report  
8 constitute an addendum report?

9 COL. BROWNING: I don't know that much about it.  
10 WT-90, one of the old ones, has just been released now in  
11 the same identical form of the special report of the  
12 laboratory which did the work. So there is no reason why this  
13 could not be done. But it would certainly be valuable to  
14 have all these in such form that they could be added to the  
15 rest of the report.

16 CDR. CRONKITE: One thing I forgot, Dr. Bugher,  
17 if it were acceptable to the people concerned, I would like  
18 strictly from the standpoint of it being easier for me to  
19 have Mr. Sharp get the stuff together on the dose. He is  
20 geographically in the same place I am. Dr. Cohn at NRDL is  
21 in direct contact with Bond. I think it would be easier  
22 for them to take the major responsibility of writing that  
23 part of the report. I have not discussed it with them. I  
24 don't know whether they are willing to accept the  
25 responsibility of doing it. I think it would expedite

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1 completion.

2 DR. BUGHER: I daresay there is no difficulty of  
3 doing the various pieces according to the way that seems to  
4 be most effective.

5 DR. SONDHAUS: I think it would be inevitable that  
6 these addenda would include classified material. It is too  
7 unwieldy to have an unclassified report with a classified  
8 appendix.

9 DR. BOND: The whole thing would be declassified  
10 and you could detach the classified.

11 CDR. CRONKITE: You could separate it and say  
12 pages 1 through 20, retype and send through for declassifica-  
13 tion. What is wrong now, every other page we have a little  
14 bit of secret and restricted data on it. That is about all  
15 I have to say about the report, except for how much pressure is  
16 there from the standpoint of time so far as AFSWAP is  
17 concerned, and so far as you are concerned? This becomes  
18 rather critical.

19 DR. BUGHER: I think our point of view is as I  
20 expressed yesterday, that we would like to have this Part 1,  
21 as you call it, of the report soon, but we also want it of  
22 top quality. If one could accomplish both of those things  
23 by the first part of August, that would be fine. It certainly  
24 would be extremely helpful. We don't want to delay. We  
25 don't want to sacrifice quality of presentation, either, nor

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1 the quality of the reproductions of the illustrations. In  
 2 other words, this report is one of the few which will  
 3 receive a very critical international look, and we want it to  
 4 be altogether to the credit of the United States, not only in  
 5 the scientific content, but in its format and actual  
 6 appearance. Those are the considerations as I see them.

7 Col. Browning, do you have some additional  
 8 considerations from your point of view?

9 COL. BROWNING: No, sir, because in essence we  
 10 have access to most of the information at any rate, and as  
 11 far as our headquarters is concerned, we can always use the  
 12 raw data. However, we are no less anxious than the rest of  
 13 the group to have the thin put out in such form that it can  
 14 be made available to the general medical profession. Our  
 15 stand is not the old hidebound school type. We think this  
 16 should be out so it can be used.

17 DR. BOND: There is a practical consideration here  
 18 if we have the colored metal plates in the report.

19 CDR. CONARD: It will take considerable time on  
 20 those, I am afraid.

21 DR. BUGHER: How much?

22 CDR. CONARD: I don't really know.

23 CDR. CRONKITE: It will be about six to eight weeks  
 24 if we can contract locally. If we have to do it through Los  
 25 Alamos, Lord only knows how long it will take.

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1 DR. BUGHER: Captain Kellum, how does this plan  
2 sound to you?

3 CAPT. KELLUM: This sounds all right, sir. I  
4 would like to make two or three remarks in a general way to  
5 support one or two suggestions that I have a feeling are  
6 acceptable from things that have already been said.

7 Like all other laboratories we are under the  
8 necessity of justifying our existence budgetwise, and one  
9 measure of our productivity is the reports of our scientists  
10 either in our own format or in the form of reprints. I remember  
11 some years ago when this business first started. I was new  
12 at the Institute. I found that roughly a quarter of the  
13 total effort of the Institute was not recorded anywhere.  
14 This went into the Bikini reports, and this was in no sense  
15 a criticism of anybody. It was just the way the thing went, and  
16 people had not thought about these matters. Since then,  
17 there has been more consideration given to what Col. Browning  
18 just mentioned, and that is getting the reports in a form  
19 that they can appear from the laboratory as well as an AEC  
20 report. This I appreciate very much, and I would like to  
21 put in a plea for further consideration of that.

22 The other item that bothers us a little bit, we  
23 don't mind dropping everything to get these people under way  
24 when there is an emergency to do it, but preparing reports  
25 is a bit of a burden for us because we are relatively a

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1 small activity. The clerical force is kept at a minimum  
2 because we are anxious to use our civil service and military  
3 ceilings to best advantage, and probably invest more in  
4 scientific personnel and technicians than we should.  
5 The result is that when we come back with a big push to get  
6 a large report out in first class shape, we are in a  
7 difficult position without a little additional qualified help.

8 I would illustrate what I mean by the comment that  
9 the individual on our staff who is best qualified to carry  
10 the burden of getting this report on paper is currently  
11 fulfilling the functions of chief clerk for the whole  
12 establishment. We obviously can't take her off that job,  
13 because there is not anybody else to do it. I would put in  
14 a plea for some consideration of assistance in this field.

15 DR. BUGHER: I am sure that can be arranged. Cdr.  
16 Cronkite mentioned yesterday the sheer burden of detailed  
17 labor which is involved. There is one place we can assist,  
18 I think.

19 CAPT. KELLUM: I might say we are not looking at  
20 the money balance on this. We have been well supported by  
21 our own budget, and by funds made available for these  
22 occasions. It is the civil service ceiling that get us.

23 DR. BUGHER: Captain Yarbrough, do you have any  
24 comments on this?

25 CAPT. YARBROUGH: I have no comments on this

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1 particular subject. I do want to say something later when  
2 it is posed on the further study, about the utilization of  
3 personnel. We are encumbered with ceilings, as anybody  
4 else, and as far as furnishing secretarial or clerical  
5 help, we are more or less handcuffed by much maligned  
6 ceilings.

7 DR. BUGHER: Are there other comments or suggestions  
8 with regard to this plan of information? This seems to be a ve-  
9 sensible one. This seems to develop a compact straightforward  
10 hardhitting report which carries all of the solid  
11 information and the results of computations and is accompanied  
12 by an addendum which may be more voluminous than the first  
13 section which will include in it all of the classified  
14 material, data, prolonged discussions, and so on, which then  
15 could be made available to those who are interested and feel  
16 the need of going more critically and minutely into all of  
17 the background data.

18 The No. 1 section would be the base report from  
19 which special reports might be prepared, and that itself  
20 should probably be in pretty much a form which would be ready  
21 for publication on being finally declassified and made  
22 available for that purpose.

23 I am sure if something occurs to anyone, we would  
24 be very pleased to have additional suggestions. But it seems  
25 to me that it is a very logical way of going at it.

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1           You, then, Gene, make assignments of division of  
2 labor. There has been no objection to any of those  
3 suggestions. I take it they are generally agreeable?

4           MR. HARRIS: I can't say this is an objection, but  
5 as far as we are concerned out there, we will go ahead  
6 and write a report that will come out as a Los Alamos  
7 document of some sort. I personally don't like to write very  
8 much, so I would be very glad to give you all the data that  
9 I happen to have available, and you might write as much as you  
10 wish about it.

11           As far as the addendum goes, we can offer you an  
12 entire report that you can include as an addendum if you wish  
13 to use it, and then you can discuss it at length if you wish  
14 to do it. But as far as we are concerned, we will discuss  
15 it once, and then forget about it, because we haven't got time  
16 to go over and over it.

17           DR. BUGHER: I think your addendum idea incorporates  
18 all the special reports.

19           MR. HARRIS: Would this be satisfactory as far as  
20 what little we have done? You can take the whole report  
21 and include it as an addendum.

22           CDR. CRONKITE: It is perfectly adequate as far as  
23 I am concerned. My main thing is to get the gist of your  
24 data in Dr. Cohn's hands so he can put up something in  
25 that section of the report.

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1 MR. HARLEY: One problem on this excretion data  
 2 and so on is that so far no one has taken all the data and  
 3 put it together as far as I know. You have looked at  
 4 your data, and we have looked at ours, and everybody has  
 5 looked at theirs.

6 MR. HARRIS: I understand this is Ken's job to do.  
 7 I think this is fine.

8 MR. HARLEY: Somewhere he has got to get this  
 9 before he can do his quick job.

10 MR. HARRIS: As I say, you are welcome to it. As  
 11 long as I can get it out through the various machinery of  
 12 the mailing system at Los Alamos, you can have it.

13 MR. COHN: You will have that for afterwards or  
 14 something that we can use right now. If it is a question of  
 15 two weeks or something, I don't know whether we can wait  
 16 until we get to the front office or not. We have to have some  
 17 time to analyze the data before we write it. This is a  
 18 problem.

19 DR. BUGHER: I think that is something you can  
 20 resolve among yourselves.

21 CDR. CRONKITE: I want to bring a question up  
 22 that may not be quite appropriate, but I have just been  
 23 reflecting on the thing. All of us have understood that  
 24 under the regulations of operating things in connection with  
 25 the task force, that the first obligation is a report to

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1 the test director, and then afterwards you put out your own  
2 reports. If Los Alamos can diverge from that, I think the  
3 rest of us have been getting a rather dirty deal. Why a  
4 report from Los Alamos and not a report to the test director?

5 MR. HARRIS: Because we were using a few facilities  
6 of the test group but we were only using them in a logistical  
7 line. As far as we were concerned, we were not members of any  
8 particular project or any other group at Eniwetok. We were  
9 operating out of our own laboratory, not as a part of J  
10 Division or any of the test groups.

11 CDR. CRONKITE: Just because I am a little concerned  
12 about it, I have heard many times from Dr. Graves that this  
13 is exactly what should never happen.

14 DR. BUGHER: I think from our point of view that  
15 all those concerned in the study were operating as a part of  
16 the joint task force. The program was set up under that,  
17 and there could be no other participation. I don't think,  
18 Payne, as I would see it, that your point of view would  
19 hold here.

20 MR. HARRIS: The thing about it was that we went  
21 out to get these samples, and we had no knowledge of this  
22 whatsoever. We did not know that there was such a project  
23 established until arriving at Quadjalein. We had no  
24 knowledge of this even from our own place.

25 DR. BUGHER: Tom Shipman had knowledge of it from

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1 me over the telephone.

2 MR. HARRIS: I didn't know it.

3 DR. BUGHER: There was no uncertainty there.

4 MR. HARRIS: Whatever way you want to handle it is  
5 all right. As far as the Los Alamos report is concerned,  
6 it is an ordinary Los Alamos document. There have been many,  
7 many reports which have shown up as WT reports from tests,  
8 but also came out as Los Alamos documents before or  
9 simultaneously with the appearance of a test report. That  
10 is what I mean by a Los Alamos report.

11 DR. BUGHER: This is precisely the same as the  
12 chemical samples on cloud samples done at Los Alamos, or  
13 anything that has to do with Operation Castle. It is a  
14 Castle report.

15 CDR. CRONKITE: I am sorry for bringing the subject  
16 up, Dr. Bugher.

17 DR. BUGHER: That is purely a matter of channels  
18 of transmittal. I think there is no question about the  
19 character of the project, and where it belongs in the scheme  
20 of the task force, as all of the material is a part of the  
21 Castle operation under a definite title. That was the  
22 decision of the commander of the task force and scientific  
23 director, Dr. Graves. We concurred in that.

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24 MR. HARRIS: Then this brings up another point of  
25 holding up the release of a report. Doesn't this have to go

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1 through the test director, or somebody like that?

2 DR. BUGHER: That is right.

3 MR. HARRIS: It goes through there before there  
4 can be made any sort of release publicly of this sort of  
5 thing?

6 DR. BUGHER: That is right.

7 MR. HARRIS: This essentially throws it into the  
8 Los Alamos declassification system, is that right?

9 DR. BUGHER: That is correct. The only thing that  
10 has been done which is somewhat irregular, you might say, is  
11 to reach an understanding with Dr. Graves that certain short  
12 cuts will be made at this end in order to get the material  
13 in shape more quickly. But having done that, the document  
14 still clears through the established channels. There is an  
15 attempt here to gain time, for example, on illustrations.  
16 Normally those would be done out of Los Alamos.

17 MR. HARRIS: Don't you think if you talk to Al about  
18 this, he would be very sympathetic towards this procedure  
19 and it might be that he could speed up such things as  
20 declassification of plates, and so on?

21 DR. BUGHER: He will try to, yes. Ralph Smith  
22 is also quite aware of these things. There is every effort  
23 in prospect to accelerate the thing within the framework of  
24 the task force. But it doesn't mean cutting corners and  
25 missing the intersection here.

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1 DR. BOND: How soon can the data be made  
2 available?

3 MR. HARRIS: I can make it available mainly by just  
4 summarizing everything, like I have now. This is the work of  
5 a day, and putting it in a letter form and sending it. That  
6 is all. My holdup is this: If I don't put it in a letter  
7 form and send it out that way, then it bypasses the  
8 classification people at Los Alamos, and they might come back  
9 at me for bypassing them on this sort of information.

10 DR. BOND: Would it be possible to get that at a  
11 very early date? I think the point is that Dr. Cohn is  
12 to do the job of primarily integrating the data, and without  
13 your part, he cannot proceed.

14 MR. HARRIS: All I have to do is write it in the  
15 form of a letter, and I can do this immediately when I get  
16 back.

17 DR. BUGHER: I think that covers that problem, and  
18 undoubtedly from time to time we will have some minor  
19 difficulties, but there should be no trouble in resolving them.  
20 The general procedures, I think, of the task force are quite  
21 clear. Is that enough, then, Gene, on the mechanics of this?

22 CDR. CRONKITE: I have nothing else. It seems  
23 quite satisfactory.

24 MR. COHN: One more thing, Payne. If you are  
25 going to have a summary, you will probably have to have more

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1 than that. We will probably need your raw data.

2 MR. HARRIS: We can talk about this later. There  
3 is no use taking up time here.

4 DR. BUGHER: Now we will turn to the long term  
5 medical care and study problem. I see I am listed for that.  
6 I will tell you what we have done.

7 OUTLINE OF EXISTING PLANS FOR LONG TERM

8 MEDICAL CARE AND STUDY.

9 The situation which arises, of course, is unique  
10 inasmuch as this gets into fields of responsibility and  
11 authority where the lines are not automatically sharp and  
12 clear, and where we have the problem of groups with authority  
13 without capability; other groups with capability and without  
14 authority, a situation which involves us inevitably with  
15 other countries to some extent.

16 Then you have the immediate problem of following  
17 a relatively small group of people who are not familiar  
18 with and do not understand any of these things that I have  
19 mentioned previously.

20 To meet all of these things we have by fairly  
21 general agreement made certain arbitrary decisions in the hope  
22 that they are based on logic, but they have certain degrees  
23 of arbitrariness, as you realize.

24 In the first place, these people are not United  
25 States citizens. The territory on which they reside is not

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1 American territory. The United States under the United  
2 Nations Trusteeship Agreement is the governing authority. It  
3 does not have sovereignty. That is one aspect.

4 The governing authority has an administrative  
5 organization under this trusteeship agreement. That  
6 administrative organization has its home base as far as  
7 Washington is concerned in the Department of Interior after  
8 the transition from Navy to Interior for that function.  
9 The central office of the administrator of the trust  
10 territories is presently at Honolulu, and will probably be  
11 moved either to Guam or Truk within a few months, the idea  
12 being to make it more central. But at least that is the  
13 administrative centers.

14 They have various district centers and administrators  
15 and that is the administrative framework which exists. It  
16 has seemed to us that any departure from that administrative  
17 pattern would run at once into the questions of legality and  
18 even more importantly from the practical standpoint it would  
19 lead to confusion. Therefore, it seemed very important that  
20 the Marshal Islanders themselves, as they look at things,  
21 would see only one agency. That is the one they always deal  
22 with, namely, the Office of the High Commissioner for the  
23 Trust Territories.

24 There we have the example of authority without the  
25 capability. The High Commissioner does not have the scientific

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1 staff, he does not have the logistic resources which would  
2 enable that organization to do any of the things that must  
3 be done here.

4 In the area of medical responsibility, the Atomic  
5 Energy Commission has accepted the responsibility for  
6 continuing studies indefinitely in the same way that we have  
7 the responsibility for the studies in Japan. The Commission  
8 has resources scientifically of varying character, but not  
9 all of them, and does not have in itself the necessary logistic  
10 support in the Pacific Area.

11 So here again agreement first with CincPac that the  
12 Navy would undertake to support as necessary the question  
13 of transport, supplies and so on; in so far as possible  
14 certain of those activities have been charged to, and the  
15 costs recovered from, Joint Task Force 7. But this organiza-  
16 tion, of course, is one that terminates after a time and is  
17 succeeded by another one. So that it is clearly recognized  
18 that the task force could only be economically responsible  
19 for a short period of time, and later on the question of cost  
20 might have to be resolved in some other way in regard to  
21 logistics. However, that is something that is more of a  
22 minor problem.

23 We should also recognize that when it comes to a  
24 question of performance, the capability rests in various  
25 places. It has been our thought that as far as is possible,

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1 the same group of people who have done the basic study should  
2 continue with interval surveys and detailed studies of these  
3 people over the succeeding years.

4 We realize that faces will change. Some of you will  
5 go to other posts, and some may go to other appointments  
6 entirely. But as far as possible we would like to see a  
7 continuity of interests here, and participation.

8 The routine, I might say, normal medical care of  
9 these people will be assumed by the trust territory. For  
10 example, the people at Majuro and the Rongelap people will  
11 be looked at and watched over as far as their daily ills are  
12 concerned by the medical people there, and would have the  
13 services of a hospital. When they go back to their home atoll,  
14 it may be necessary to set up some sort of a special station  
15 there which would make it possible to carry on a dispensary  
16 service on a considerably more elaborate basis than they had  
17 before, which was nearly nothing, and also to furnish a base  
18 of operations for the teams that would presumably go out  
19 at intervals, the intervals perhaps getting a little  
20 longer as time goes on.

21 This latter type of thing could also be carried  
22 on through the trust territory administration. Our job is to  
23 see that it is done, and that the facilities are provided.  
24 Where the High Commissioner gets his facilities is  
25 something between him and the rest of us, actually. But as

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1 far as the people are concerned that is an activity of  
2 the Commissioner. I think there will be no difficulty  
3 about any of those things.

4 The project itself has been one of joint participa-  
5 tion. The Navy, of course, has contributed very heavily  
6 here in the matter of personnel and time and thought, and  
7 it is simply a simple testimony to the fact that the people  
8 who have been interested and working in these fields have  
9 predominantly been in the two Naval Research Institutions.

10 Those are some of the factors in the pattern of  
11 responsibility and organization. Our objective is to maintain  
12 a smoothly working situation so that the continuing medical  
13 studies can go on indefinitely, I think.

14 The discussions yesterday on prognosis emphasized  
15 especially the long term end results which can only be  
16 appreciated by following these people over many years.

17 In a letter to Admiral Pugh, which has come to  
18 the various persons concerned, I outlined the background of  
19 the problem, the way it was handled, the results to date,  
20 and itemized the objectives of continuing investigation as  
21 I think we all pretty much agree at the present time should  
22 be kept in mind. These are as listed here.

23 I am talking now of these interval examinations.  
24 A complete physical examination and interval history.  
25 Second, hematological studies, including quantitative

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1 examinations, such as hematocrite, white blood cell count,  
2 differential count, platelet enumeration and bone marrow  
3 studies.

4 Three, special investigation employing both color  
5 and black and white photograph, as well as skin biopsy if  
6 the latter are indicated.

7 Four, ophthalmological studies with special reference  
8 to the lens. This will obviously come in with a little time  
9 to fit in with the studies in Japan.

10 Five, special growth studies of children, including  
11 attention to the development of dentition. I believe that  
12 was mentioned yesterday.

13 Six, the progress of pregnancies, and the status  
14 of newborn infants. I don't think much comment is required  
15 there except that essentially it be a documentation of  
16 nothing happening in all likelihood.

17 Seven, quantitative studies of internally  
18 deposited radioisotopes by means of urinary excretion measure-  
19 ments, external radiological measurement and localization,  
20 together with such radiography as may be useful. That is a  
21 euphemistic way of saying if people die, we want full  
22 autopsies.

23 Eight, environmental surveys of the affected islands  
24 and atolls and appropriate examination of the animals left on  
25 the contaminated islands. In other words, the project needs

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1 to be pretty much of a rounded one, and include the  
2 continuing environmental study as well as the continued  
3 medical study of the people themselves.

4 Now, our feeling was, too, that various groups of  
5 people have special interests and would like to have sample  
6 material of various kinds. As far as possible, the groups  
7 concerned with the interval study should attempt to provide  
8 those samples. If the Department of Agriculture wants a soil  
9 sample, we should provide it. There is very little real  
10 difficulty about matters of that sort.

11 It is assumed, then, that the financial  
12 responsibility for these studies and investigations is assumed  
13 by the Division of Biology and Medicine of the AEC, and we  
14 work out the details as we go along as far as how we do that  
15 is concerned.

16 I believe the general objectives and so on from  
17 the position of the Surgeon General of the Navy have been  
18 agreeable. CincPac and Admiral Persley has given it an  
19 unreserved backing for this project. The administration of  
20 the trust territory is quite happy at the rather simple and  
21 straightforward relations through their organization. I think  
22 they feel that it bolsters them and strengthens their  
23 standing in their administrative responsibility, rather than  
24 diffusing it.

25 I think as we see it those are the main objectives.

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1 There will undoubtedly be problems arising that will have to  
2 be resolved from time to time. The main thing is that  
3 we keep a project going in continuity more or less  
4 independently of the individual task forces that come and go.  
5 Of course, it would be somewhat associated with each and  
6 every one. Those are the general thoughts, Captain Kellum, I ha  
7 on that part of it. I would like to have your comments, and  
8 Captain Yarbrough's, on the general project.

9 CAPTAIN KELLUM: I think I am not in a position to  
10 speak for the Bureau, but from our own point of view, we are,  
11 of course, very much appreciative of the opportunity of  
12 participation and look forward to continuing our participation  
13 and support.

14 I can't miss this opportunity to comment briefly  
15 on the general spirit of good will which has prevailed  
16 through all of these successive operations, and which has  
17 made possible the smooth cooperation of representatives from  
18 many different agencies with what appear to be first rate  
19 results.

20 DR. BUGHER: Thank you. Captain Yarbrough.

21 CAPT. YARBROUGH: I would like to echo Capt. Kellum's  
22 comments on the affability of the relationships in this  
23 particular endeavor. In fact, I would like to go a little  
24 further and say that I think that it presents an opportunity  
25 for our naval participants perhaps to solve some of our  
problems.

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1           Particularly I refer to the military, where there  
2 is the ever-present problem of affecting continuity for our  
3 research career people. We are always presented with the  
4 requirements of certain of our bureaus to comply with military  
5 regulations with regard to rotation of personnel. More  
6 specifically I refer to the fact that we get a good scientist,  
7 we give him a job while he is in uniform, he gets going on a  
8 job, and when he is beginning to be productive, along comes  
9 the necessity of transferring him someplace else, probably  
10 where he cannot proceed with the same line of work.

11           Therefore, I feel that this perhaps is an  
12 opportunity when we re-visit the scene of this accident, I  
13 suppose is the proper term, that perhaps we can effect a  
14 change of orders for these people where they will be in a  
15 sea duty status. Although the time might not be comparable  
16 to the requirements of certain bureaus, I believe merely the  
17 change from shore duty status to sea duty status will  
18 satisfy the regulations of particularly the Bureau of Naval  
19 Personnel.

20           Secondly, I feel it is an opportunity to further  
21 another desire of ours, which is to somewhat follow the  
22 thinking expressed by Dr. Bugher in the way of continuity  
23 in that we like to keep together people in a unit who are  
24 capable of performing such tasks as this. We do not like to  
25 get them scattered over the face of the naval concentrations.

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1 Perhaps we could use this so to somewhat keep up with  
2 these people and keep them in a group that can be sent out  
3 to do -- I don't like to say the word "crash" studies --  
4 but do a rather complete study on a crash basis, which is  
5 perhaps better phraseology.

6 I think those are most of my thoughts at the  
7 moment, except I think the most logical next consideration  
8 should be the matter of intervals. What is the interval that  
9 we should pursue in making this study.

10 DR. BUGHER: Thank you, Captain.

11 Col. Browning, the AFSWAP participation falls on  
12 your shoulders. Have you comments on this general plan?

13 COL. BROWNING: The conduct of this further study  
14 quite obviously falls within the purview of the AEC, not  
15 only by fiat, but because you are particularly well set up  
16 to do this sort of thing. To carry on a continuing study  
17 that none of the services by themselves or as a group could  
18 possibly manage, in other words. You are the most  
19 appropriate agency also because of your various laboratories to  
20 collate this information and make a continuous study of it.

21 Our interest in this, of course, is, one, that  
22 we get the information that comes out of this, such stuff as  
23 is operational and material that we can use, and we have  
24 another interest at this which is perhaps a bit at variance  
25 with what Capt. Kellum and Eapt. Yarbrough mentioned, in that

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1 we have responsibility to all three services, to try to  
2 continue an interest in all services in this business, and  
3 not look merely to one.

4 With all due respect to the work that Navy has done,  
5 and certainly they did everything they possibly could in this  
6 study, our feeling would be that we would like to inter-  
7 digitate one or two officers of the other services, certainly  
8 qualified people, and not use this as a training situation,  
9 and to interest people in this who perhaps now feel that  
10 they have been arbitrarily shoved aside in this.

11 As I say, this is a continuing problem that we have.  
12 We do feel that all three services must have the capability  
13 of carrying on their own studies and their own work within  
14 their own services.

15 DR. BUGHER: It would be a helpful point if you  
16 would get available or have kept available in the Army, for  
17 example, some of the people who have now years of background  
18 and special training in this field. It would be a very  
19 substantial contribution towards keeping that capability  
20 alive.

21 COL. BROWNING: Yes. I am fully sympathetic with  
22 the Captain's problem here, because I realize that the Navy  
23 has had this situation for some time, and that they are  
24 fighting it. As a consequence, I have kept myself out of  
25 their side of the thing, other than to give them a little

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1 moral support.

2           However, on the Army and Air Force side, this has  
3 devolved in our fight, and we are having exactly the same  
4 problem with the personnel officers, who insist on training  
5 a radiological officer into Lower Slobovia to replace a  
6 general medical officer in Ward I with complete disregard to  
7 the fact that he is not doing his primary function.

8           In the three years he is there, he loses all contact  
9 and much interest in the field. We have spent a lot of time  
10 and taken a lot of the services' time in training these  
11 people, only to lose them. We have found in this regard that  
12 the AFSWAP training course is a good stepping stone into  
13 radiological residencies, and we have lost over 50 per cent  
14 of our people in this because they do achieve a certain  
15 amount of permanence by doing it.

16           CAPT. YARBROUGH: I think you answered a question  
17 I was about to ask. Are you speaking for the Air Force also?

18           MAJ. HANSEN: We have lost many people. Almost  
19 everybody that has gone into the program has gone into  
20 specialty training from this program.

21           COL. BROWNING: Dr. Cronkite, at the end of the  
22 operation, sent a letter through channels concerning his  
23 feelings on keeping these teams together. As usually happens  
24 this went through several offices, and arrived at our place  
25 for some sort of answer. I have been working on this now, and

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1 coordinating it in advance, and it should be coming through  
 2 shortly. It will be our recommendation to know more on  
 3 this situation, and will just about cover the things you  
 4 mentioned, Capt. Yarbrough. It perhaps will help you in  
 5 establishing your position. We do feel, one, that all three  
 6 services should at least have on paper some sort of list of  
 7 people who can be made available on short notice in the  
 8 event any such accident as this occurs.

9           Again we are not trying to get into the individual  
 10 services and tell them what to do in this, but to in effect  
 11 give them the benefit of our experiences recently and  
 12 indicate some of the ways in which this could be better  
 13 expedited.

14           Of course, we also have a little personal interest  
 15 in this, because these three lists will help us in the  
 16 event of an inter-service type of thing forming into an  
 17 interservice team.

18           CAPT. YARBROUGH: It is perhaps obvious that I am  
 19 gathering some ammunition for another submission, particularly  
 20 to the Military Coordinating Committee on Medical Research,  
 21 where our ultimate aim is to combat the current imposed ratios  
 22 by getting a recommendation out of Mr. Quarles, and perhaps  
 23 out of Dr. Berry, that our billets for research people should  
 24 be exempted from the currently imposed ratios.

25           DR. DUNHAM: May I make a comment here, although

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1 this is something in my direct interest. Dr. Bugher will  
2 be back in a few minutes.

3 I hope you people in this battle, as it were, for  
4 keeping some of these highly trained people more or less  
5 together and certainly available, are keeping in mind the  
6 importance of the enlisted personnel, and not just officers.  
7 Watching Gene's team out there, it was obvious that it was  
8 the fact that the enlisted personnel had worked together  
9 before -- boys from Hunter's Point and MRI that really made  
10 the thing click, with all due respect to Gene and the officers  
11 involved. They knew each other and worked well together  
12 right from the very beginning. This is something that is  
13 very important to bear in mind in this consideration.

14 CAPT. YARBROUGH: Particularly I think the isotope  
15 technicians are getting scattered to the four winds, where  
16 people who have spent time and money in training are now in  
17 Lower Slobovia or somewhere else.

18 CAPT. KELLUM: Dr. Dunham, may I make one brief  
19 comment in passing? I think we all recognize the fact that  
20 this last team that went out that was mostly Navy was  
21 largely fortuitous. There is no disposition on the  
22 part of our outfit to try to corral leadership in this field.

23 As a matter of fact, and this is what I really  
24 want to say, from our point of view at Bethesda, we would  
25 welcome, if there is any point in it, from time to time  
the assignment there on duty of people from the Army and

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1 Air Force. I think there is good precedent for that, and if  
2 there is an occasion for that kind of thing, we would welcome  
3 it.

4 DR. DUNHAM: I am sure when Col. Browning made  
5 the statement that some of the other services felt they had  
6 been shouldered aside, he is aware, as I am aware, that they  
7 were not.

8 COL. BROWNING: No, I don't mean on this  
9 particular incident.

10 DR. DUNHAM: As I recall, you made great efforts  
11 personally.

12 COL. BROWNING: This goes back to the same  
13 situation. On each occasion, it would have necessitated  
14 the complete dropping of a particular function. I realize  
15 that the Navy also had this problem, and they were willing  
16 to do so. Because of the time basis on which this thing  
17 came, it was not possible to make all the representations  
18 that were necessary to get these people involved in this  
19 thing. By doing this in advance, we feel that some provisions  
20 can be made to have understudies. I can speak with some  
21 sympathy for the Captain's statement here, because I spent  
22 two years at NRDL, and I look back on it as a very  
23 interesting and very instructive period.

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24 We again would like to see this occur. This is  
25 another one of our recommendations. But we can do no more

1 than recommend and as often or not, it is only from our  
2 position that we can make these recommendations.

3 DR. DUNHAM: Well, good. These are generalizations.  
4 I think everybody is agreed as to what must be in the  
5 future. There is a matter of the return trip out there  
6 coming up fairly soon. I think perhaps this is the point in  
7 the discussion to get down to specifics. I understand there  
8 is actually an existing plan for Dr. Bond to go out with a  
9 group. Do we consider this an accomplished plan?

10 CDR. CRONKITE: May I interject a comment? Dr.  
11 Bond and I made sort of a gentlemen's agreement with each  
12 other providing that it was acceptable to everyone else, that  
13 we would share the responsibility in alternating in  
14 going out there in the first few trips. I would like to twist  
15 Dr. Bond's arm a little bit to take the first one going out.  
16 I think from here on he should be the one, if he is to be  
17 responsible, that is able to select the people that will go  
18 with him, and what of the various things that are proposed  
19 they would be able to do. It becomes a rather acute problem  
20 of a few people for a long time, or relatively large number  
21 of people going out for a short time.

22 DR. DUNHAM: We would appreciate your comments,  
23 both Dr. Bond's and yours, Gene, as to which is the most  
24 feasible, and also useful approach to the problem. What do  
25 you mean by a short time, and a long time?

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1 CDR. CRONKITE: I frankly don't know. My personal  
2 inclination would be to perhaps take more people out with the  
3 idea of doing the work in the shortest period of time possible  
4 so that there will be less disruption of the ordinary  
5 activities at home.

6 DR. BOND: May I bring up this point here. Dr.  
7 Burleys had or included in his list of objectives resurveys  
8 of the islands.

9 DR. DUNHAM: Yes.

10 DR. BOND: The individuals who are most interested  
11 now are located on Majuro. The islands themselves,  
12 Uterik, and so forth, are some five or six hundred nautical  
13 miles away. I wonder because of the geographic setup  
14 and the attendant logistics difficulties, whether it would  
15 not be proper to consider these as two essentially separate  
16 projects that might be coordinated.

17 DR. DUNHAM: It seems to me so.

18 DR. BOND: I would like to know whether we are  
19 including that in the discussion or whether we are  
20 discussing the return at this time.

21 DR. DUNHAM: Before we make the decision on that  
22 I would like Dr. Dunning to make a comment about what he is  
23 aware of in the way of plans for resurveys and any suggestion  
24 he might have as to how best to accomplish that.

25 DR. DUNNING: I am not aware of any definite plans

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1 for resurvey.

2 DR. DUNHAM: Is Donaldson's group going out there?  
3 There is no point in having two or three different outfits  
4 picking up soil samples, flowers and cocoanuts.

5 DR. DUNNING: It would appear to me that the purposes  
6 of this study and for the objectives for which the team is  
7 going out there that it would be of secondary interest at  
8 most to notice what the levels are at the islands now and in  
9 the future. In other words, we have all the data right now  
10 that is going to be of direct interest for determining dose  
11 and so forth.

12 DR. BOND: I was thinking more of the internal  
13 considerations rather than the external.

14 DR. DUNHAM: When it is safe for them to go back  
15 or is it safe?

16 DR. BOND: Along that line, I would like to state  
17 that the individuals at NRDL in the chemical technology  
18 division, of course, are interested in the general problem  
19 of contamination and decontamination. Here we have a situation  
20 in which an area that has vegetation that is used as food  
21 stuff has been contaminated, and these individuals at NRDL  
22 are very much interested in sampling these materials as a  
23 function of time after detonation to determine the  
24 distribution of it. How much of it gets into the edible  
25 vegetation there, and this sort of thing.

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1 We are interested in the sampling and conducting  
2 radiochemical analysis. They are actively interested in  
3 making a survey. They are not completely aware, nor am I  
4 completely aware, of what has been planned or what is to be  
5 done on this score.

6 I would like to put in at this time that if there  
7 are no specific plans, and if it were desirable and  
8 acceptable that there is a group there that would be  
9 interested in taking the primary responsibility for doing that.

10 DR. DUNHAM: As this particular resurvey has medical  
11 implications, I would appreciate your comments as to when  
12 is the best time to make it, and also how often it should be  
13 done. I suspect not very often, but there certainly will have  
14 to be done at least one survey done well in advance of  
15 the first guestimate as to when the Rongelap natives can go  
16 back to Rongelap.

17 DR. BOND: The present plan is that the initial  
18 survey can be conducted as the survey of the people out  
19 there, and depending on what is found at that time, a date  
20 could be set for another resurvey, tentatively six months.

21 DR. DUNHAM: In other words, there would be two  
22 resurveys before they go back to their atoll?

23 DR. BOND: Yes.

24 DR. DUNNING: By whom?

25 DR. BOND: Here is a group that is interested in

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1 doing it. I might elaborate a little bit. They are  
2 radiochemists primarily. However, in conducting the survey  
3 they would want very much to have the cooperation of such  
4 people as Donaldson, perhaps individuals in the trust  
5 territories, and individuals who have worked with the uptake  
6 of radioactive materials in plans, to assure that proper  
7 sampling is conducted, and that they do get the proper  
8 vegetation, and so forth, so that their results are meaningful.

9 As I say, this group would be interested in taking  
10 the responsibility for seeing that the resurvey is properly  
11 accomplished.

12 DR. DUNNING: Dr. Dunham, it seems to me that the  
13 sensible way to go about this is to find out what plans are  
14 in the making. I am sure I don't know all the plans of the  
15 Donaldson group and NRDL, and the carryover from Task Force 7.  
16 We should find out what is in the wind. Again I am not sure  
17 as to where we stand, shall I say, legally. But it would  
18 appear to me again that we need a central agency for someone  
19 to get this thing coordinated. It is just that. It is not  
20 the idea of giving commands, but of coordinating the efforts  
21 just the same as this whole medical team going out. Perhaps  
22 we need another similar program on the physical side of it.

23 DR. DUNHAM: Dr. Bugher, we are currently discussing  
24 the matter of resurveys of the natives and islands. Dr. Bond  
25 has made the suggestion that the two not be considered as

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1 identical efforts necessarily, because the natives are down  
2 at Majuro, and have an entirely different logistic setup  
3 as opposed to returning to the islands.

4 The discussion has gone so far as to Dr. Bond  
5 offering and urging that the NRDL group be permitted to be  
6 the group to resurvey the islands, perhaps in September  
7 and again in March, with a thorough survey of the plants,  
8 soils and food supplies.

9 The question immediately comes up, what other plans  
10 are in the making or actually under way for resurveys of  
11 those islands from a radiological safety standpoint, and the  
12 standpoint of the food chain possibly being contaminated.

13 Is Donaldson's group going to do anything there  
14 that would overlap or duplicate such a proposal?

15 DR. BUGHER: Yes. The existing things, I think,  
16 are these. The marine biological side of it is immediately  
17 in Donaldson's hands. In that capacity he reports to this  
18 Division. However, his work does tie in with some other  
19 aspects of the Pacific Science Board and fans out in various  
20 ways, even including the University of Hawaii.

21 The main responsibility there for the marine  
22 biological situation is in Donaldson's hands, particularly  
23 with reference to the fish.

24 We have also on Eniwetok the small biological  
25 station which we have set up which is available not only

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1 to government organizations, but to university marine  
 2 biologists who may want to spend time studying some aspects  
 3 of the coral atoll. Some of these studies, at least, should  
 4 bear on the environmental thing.

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5 We have in the Division a large program which is  
 6 purely environmental contamination studies which we carry  
 7 under the name of Gabriel. The scope of that program is  
 8 worldwide. The problem of the biological setup of the  
 9 contaminated islands is clearly likewise germane to that  
 10 program. That brings us into close cooperation with the  
 11 Department of Agriculture, because some of the outstanding  
 12 skills in soil composition, soil analysis, and so on, lie  
 13 there. We have an extensive cooperating program there.

14 We also have a very elaborate setup for analysis  
 15 for longer lived isotopes. It is set up in three places, the  
 16 New York Health and Safety Laboratory, the Columbia University  
 17 project, and one in Chicago. So that the environmental  
 18 aspects here are quite broad. Any group that does the inter-  
 19 mittent surveys will have to plan that it will be not  
 20 only wrking for itself, for its own interests, but also  
 21 a service group for various other outfits who likewise have  
 22 very pertinent interests here, and have available skills and  
 23 resources which perhaps would not be entirely available to  
 24 any one particular group.

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25

You all had that problem confronting you with

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1 Quadjalein's operation when Cdr. Cronkite began to feel  
 2 that he was the chief dispenser of urine for the whole Pacific  
 3 area and even suggested a different code name for the  
 4 operation, the name of one of the more popular and decorative  
 5 woods in the Marshall Islands, which I thought was a very  
 6 nice name. The species known as the *Pissonia Jiant*. However,  
 7 we work it for the actual handling for the immediate  
 8 environmental survey, that group is going to have to do a  
 9 lot of specimen collecting for other people who are interested.

10 Our general feeling is that whatever group has a  
 11 legitimate interest and capability we should get the material  
 12 for them and expect from them a report of results to go  
 13 into the hopper here. That is the way it has been working.

14 DR. DUNHAM: I might interject one remark here  
 15 that just occurred to me, Dr. Bugher. Are we to consider  
 16 indefinitely that these surveys have to go through the task  
 17 force report channels, or is there a cutoff point when they  
 18 become sort of on their own?

19 DR. BUGHER: The cutoff point is when Task Force 7  
 20 is no longer active. What is that situation, Colonel?

21 COL. BROWNING: As far as I know, Task Force 7  
 22 will go out of existence some time this summer. It should be  
 23 some time during July, as the last guess on that.

24 DR. DUNNING: The last I knew, Admiral Bunson was  
 25 taking over at the end of July.

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1 DR. BUGHER: The real problem that the authority  
2 outside Eniwetok and Bikini lies in the trust territories  
3 administration. He is the one that in a sense puts on us  
4 the requirements to satisfy his needs. So we all in a certain  
5 sense become a service facility to him.

6 In practice actually he recognizes that the capabil-  
7 ity for planning and all that lies in this general group of  
8 agencies and people. If he finds that he can't answer all  
9 the questions that are asked him, he may ask us to do some  
10 things that we may not have thought of. But generally  
11 speaking, that is our line of authority and our general  
12 responsibility.

13 The point you raise is a good one, especially the  
14 situation while the people of Rongelap are down on Majuro  
15 Atoll, and it may therefore be practical and convenient to  
16 submit the thing, particularly during this period. Is  
17 that what you had in mind?

18 DR. DUNHAM: That is what Dr. Bond was suggesting.

19 DR. DUNNING: Let me ask Dr. Bond in the light of  
20 what Dr. Bugher has just said, would you still give the  
21 same expression of interest and willingness?

22 DR. BOND: I believe so. Of course, they are  
23 interested in obtaining the samples and doing radiochemical  
24 analyses on them, and following the uptake material into the  
25 edible plants. They are willing to do this obviously on

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1 samples that someone else collects or they are willing to go  
2 out and collect the samples, and have stated they would be  
3 quite willing to collect additional samples for other  
4 interested agencies.

5 DR. DUNNING: I am wondering then if one possibility  
6 might be that NRDL actually do the shovel work and someone act  
7 as coordinating agency to see what the needs of the other  
8 people might be?

9 DR. BOND: This may be. Who would that be likely  
10 to be?

11 CAPT. YARBROUGH: I think NRDL has gone a little  
12 further than Dr. Bond is indicating, in that this morning  
13 we have a proposal formulated, and there are quite a  
14 few specific items in it, where they wish to have it in the  
15 form of a project. Inasmuch as I will have to give an  
16 answer one way or another to this proposal, it would be  
17 very interesting to get the consensus of opinion here.

18 They are proposing that it be done at the same  
19 time as the biomedical portion. They propose that USNRDL  
20 carry out these studies in fiscal 1955 at the 2.6 investiga-  
21 tion or man year level. The estimated cost of this will be  
22 some astronomical figure of \$42,000. Since it is envisioned  
23 the program outlined may continue over a period of several  
24 years, it is suggested that while the laboratory will  
25 probably be supported by BuMed and/or BuShips, it may be

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1 desirable to seek funds from USAEC to finance collective  
2 samples in the field. As indicated above, there is an  
3 early schedule to begin followup medical studies with  
4 which the proposed project should be coordinated. It is  
5 therefore requested that subject proposal be reviewed, and  
6 if it is acceptable, that approval be given at an early date  
7 so that prosecution of the program can be effectively carried  
8 out.

9 Incidentally, their details are of the opinion  
10 that surveys will be required at six months intervals.

11 DR. BUGHER: Yes. I think the first year it would  
12 probably be ordinarily at least in part. I think six months  
13 intervals seem reasonable for the first couple of years  
14 anyway.

15 CDR. ETTER: After having read that proposal  
16 that Captain Yarbrought has just briefed, I would like to  
17 suggest that the action by BuMed be that it be forwarded  
18 and readdressed other than it is now to the AEC for their  
19 comments since I think certainly your group should be  
20 coordinating group for all studies of any type which are  
21 going to be done under this long term program. I don't think  
22 that any individual laboratory or activity should take too  
23 much unilateral planning here, except to get things moving.  
24 All these proposals should be coordinated through your  
25 office.

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1 DR. BUGHER: I think it would be presumed that in  
 2 a program of this kind as suggested in NRDL the resources  
 3 of the various other agencies and services would be also  
 4 available. I mentioned the marine biological field. That  
 5 is an area where ONR has a very considerable interest.  
 6 This marine biological station at Eniwetok has developed,  
 7 and while it is AEC financed, ONR has a very real interest  
 8 in it, and has given quite a boost in the way of transport  
 9 and sponsoring of conferences in this general area, and in  
 10 various other ways.

11 So we do have joint interests. We inevitably  
 12 bring in the Applied Fisheries Laboratory at Seattle,  
 13 which is an AEC setup. We bring in the Hanford interests  
 14 in the fresh water biology somewhat -- not so much, of course  
 15 -- but they are a closely related group of people who  
 16 work there. We have a program on tuna fish biology and  
 17 fission product uptake at Cocoanut Island at Hawaii under  
 18 the University of Hawaii. The fish program ties in likewise  
 19 with the Fish and Wildlife service, Dr. Setty, stationed  
 20 at Honolulu, and the Fish and Wildlife Service here in  
 21 Washington.

22 Furthermore, we have a program on Atlantic Ocean  
 23 tuna fish at Beaufort, North Carolina, and cooperative work  
 24 with the Scripps Institution which likewise begins to tie  
 25 in with some naval interests. All of these things are

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1 going on and they have to all come together, which means  
2 that various persons are interested in coming into the  
3 environment of the islands for various reasons and various  
4 groups need specimen material.

5           The particular group immediately responsible for  
6 conducting the surveys and maintaining the records has to  
7 meet the requirements of all the other associated people,  
8 and likewise consult with them on program needs and specimen  
9 needs and techniques. I think as mentioned here it does not  
10 stand alone as you might say, a free floating program, but  
11 rather one that operates closely with a number of other  
12 programs and there is no sharp point at which the interests  
13 end for one and begin for the other.

14           I think the NRDL people are quite aware of that  
15 and probably would make it then more interesting and of  
16 more advantage to them. We would presume that the coordinating  
17 side of this would continue here because we already are  
18 deeply involved in the whole problem of marine biology in  
19 the Pacific area.

20           I have not mentioned a program of sampling of  
21 corals over the entire Pacific area, which is in motion now,  
22 with the objective of doing quantitative strontium 90  
23 analysis to see if we can in that way get an integrated  
24 sample of ocean currents by static sampling. I don't know  
25 whether it will work out or not, but we want to give it a try.

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1 CDR. CRONKITE: Dr. Bugher, I would like to make  
2 a general proposal in view of all this information that  
3 has come to light here, that there be a clearcut separation  
4 of these long term problems into two facets: One a medical  
5 and one a biological and physical. It seems from the medical  
6 standpoint people that are involved are willing and will  
7 continue to carry the ball on that. They would not be the  
8 right ones to carry on the sample collection and any planning  
9 for the work to be done in the field for the continuing  
10 biological-physical work. I think we are in a position to  
11 assure that the medical side is done and not in a position  
12 to be of much assistance or assure that the biological and  
13 physical work will be done.

14 DR. BUGHER: You think you can keep them sharply  
15 separated, particularly after we put the Rongelap people  
16 back on their atoll?

17 CDR. CRONKITE: Perhaps at a later date it might  
18 be logistically practical to merge the two. At the present  
19 time one concern is transportation and time involved for  
20 doing these various things, and that would involve an  
21 inordinate period of time for the medical group for the  
22 sample collection for the other people.

23 DR. BOND: It is quite a distance between the two  
24 locations and the logistics problem is great. The type of  
25 equipment and personnel required are entirely different.

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1 DR. DUNHAM: I think the wishes of CincPac should  
2 be considered here, too, because it might be simpler for  
3 them to treat such an expedition as a unit, even if one  
4 unit went one place, and another another place, and were  
5 separate from the others on down. I don't think they should be  
6 completely isolated activities at this point.

7 CDR. CRONKITE: I didn't express myself well. If  
8 the group doing the medical work are also to do the sampling,  
9 you run into the problem of air transportation out there,  
10 which is very limited. The regulations under which they  
11 operate of not being airborne before it is light and to leave  
12 the lagoons at a time so they can be back before sundown,  
13 which gives you about three to four hours work in an area,  
14 so there will have to be repeated trips. I can visualize  
15 and I don't think it is unrealistic, say a month at Majuro  
16 with all the complications so that the same people would be  
17 out there for two months, if they are both doing the same  
18 thing. I think it is a terrific slice into trying to carry  
19 on work at home, too. Whereas if the group went out to do  
20 the sample collection, perhaps at the same time as the  
21 ones doing the medical study, everybody could get their  
22 work done within a period of three to four weeks.

23 CDR. ETTER: I don't think there have been any  
24 proposals for the same group to do both things. This is not  
25 NRDL's proposal at the present time. They propose an

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1 additional group above and beyond to be separate individuals.  
2 That is the way it now stands.

3 (Brief recess.)

4 DR. BUGHER: We will start again. In view of the  
5 recommendations as to separating the environmental studies  
6 from the medical studies, we agreed at this end to have  
7 considered Item 7 to have been disposed of, and we will  
8 make arrangements for environmental surveys and sample  
9 collections as a separate program from the medical program,  
10 but the actual timing will depend appreciably on the conveni-  
11 ence of the Commander of Quadjæin. Particularly after the  
12 Rongelap people are back home, it might be more convenient  
13 for his point to take the whole thing up and dump them  
14 for a couple of weeks or a month and come back and pick them  
15 up again, and get rid of both groups at the same time.

16 Would that be agreeable all the way around? We  
17 are very favorably disposed towards the NRDL group conducting  
18 the actual survey and sample collection. We can work that  
19 out here with Captain Yarbrough and the others who are  
20 available as to what specific form that would take.

21 I think perhaps that is enough time, then, for  
22 that subject, unless somebody would like to add to it.

23 MR. HARLEY: Dr. Bugher, I have a question. Will  
24 someone like Lyle Alexander be brought into this work for  
25 assistance?

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1 DR. BUGHER: Yes, that is where one of our  
 2 functions come in. Alexander in particular is the soil  
 3 expert for the Department of Agriculture, and who is extremely  
 4 familiar with all the problems right from, you might say, a  
 5 tour out in Nevada, on to the soil collections in Pakistan.  
 6 So this would be one other facet of his interest. We would  
 7 certainly want him to come into the picture.

8 Actually the Commissioner of the Trust Territory  
 9 has in mind a small agricultural experiment station on one  
 10 of the nearby atolls, perhaps somewhat different than the  
 11 usual agricultural experimental station, but we get  
 12 involved in that, too, in some respects. We are supporting it.

13 That will be the function of this office, that is,  
 14 to make sure that all the elements necessary to a complete  
 15 survey be provided, and that the necessary samples are  
 16 arranged for, and that they are adequately documented.

17 We will of course presume that the interests will  
 18 go considerably beyond what the NRDL might itself regard as its  
 19 legitimate and proper interests, Such matters as the ioniza-  
 20 tion of soil constituents is important to us. It might not  
 21 be important to NRDL. They may be interested in radioactive  
 22 components only.

23 We are very much tangled up with the problems of  
 24 calcium movements in coral atoll and the crystalline forms  
 25 in which the calcium salts are found. The equilibrium

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1 reactions which enter into the growth of coral by which  
 2 some of the calcium comes from sea water, and apparently  
 3 a certain amount is recycled from old coral deposits, As far  
 4 as I know, we do not have a measure of that. We think we can  
 5 get it now from some of these environmental studies, that is,  
 6 a quantitative estimate of the various equilibria that come  
 7 into the growth of coral, how much new calcium from sea water  
 8 passes by and how much is previously established calcium.

9 All things of that sort which are important to  
 10 marine biologists might not be important to the NRDL program.  
 11 All of these things have to be put together.

12 I think that is generally agreeable from your point  
 13 of view, Capt. Yarbrough?

14 CAPT. YARBROUGH: Yes, sir.

15 DR. BUGHER: So at this point, let us go back  
 16 to item 6 with regard to comments relative to specific studies.  
 17 I read a list of eight broad items that we have suggested  
 18 to Admiral Pugh, as the sort of thing to visualize in a  
 19 continuing investigation. I should not think, for example,  
 20 that item 1 needs any further comment.

21 CDR. ETTER: That is right.

22 DR. BUGHER: That is standard practice in a thorough  
 23 medical setup.

24 On No. 2, the hematological studies, have you  
 25 any further comments to make?

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1 CDR. CRONKITE: I have one comment on that.  
 2 The regular routine stuff is that you can't do a lot of bone  
 3 marrow aspirations on your people. You soon have  
 4 lost your rapport unless there is a good reason to do it.  
 5 I think they have to be done but I will be frank I do not  
 6 know when they ought to be done, and when would be the best  
 7 time to start doing it. I would like very much the advice  
 8 of somebody who studied the changes in Japan, such as Valentine  
 9 and Lawrence and Maloney, to get the appropriate time when  
 10 to first do it.

11 DR. BUGHER: The Japanese have done bone marrow  
 12 biopsies on their fishermen. I have seen the sections of  
 13 some of those, and they are quite interesting. The bone  
 14 marrows apparently are continuing to show a persistent  
 15 depression even though the blood counts themselves were moving  
 16 upward. That was a few weeks back. In that case the bone  
 17 marrow studies done early are in themselves quite interesting.

18 CDR. CRONKITE: Could that material be made  
 19 available?

20 DR. BUGHER: I can't promise what we can get available  
 21 from those people. They say yes, with the greatest pleasure.  
 22 We don't have it, but we will try to get the material.  
 23 Part of it is an element of barter, too. We trade something  
 24 that we have for something we want from them.

25 CDR. CRONKITE: We did not do bone marrow aspirations

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1 out there. We gave that serious thought and decided not to  
2 do it in view of considerations. There were so many children  
3 present, and it is a rather unpleasant procedure.

4 DR. BUGHER: Have you thought much of the possibility  
5 of tagging procedures to measure red blood cell formation  
6 rates?

7 CDR. CRONKITE: We thought about it.

8 DR. BOND: We thought about it, and thought it could  
9 be done, but wondered what the value of the program would be  
10 and whether we were justified in doing it.

11 CDR. CRONKITE: The problem of a questionable  
12 nutritional status and various things that can interfere with  
13 the iron uptake that would be unconnected with the exposure  
14 to radiation and the difficulty to get a truly unbiased random  
15 sample of normals for comparison. I don't know whether it  
16 ought to be done or not.

17 DR. BUGHER: Have you any comment?

18 DR. DUNHAM: No, I think as far as the nutritional  
19 status is concerned, when you left them it was not bad. I  
20 don't know what has happened since when they are over on this  
21 other island. Are they still going to eat in the style  
22 in which they were eating at Quadjalein?

23 CDR. CRONKITE: I hope not. They will be so  
24 obese that we will never get any blood out of them.

25 DR. DUNHAM: I think if it is not controlled, it

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1 will not be meaningful. If it is controlled, it is more  
2 significant than bone marrow biopsies as far as the red cell  
3 cycle is concerned.

4 DR. BUGHER: Are there any other comments in regard  
5 to the hematological studies, and things that should be done?  
6 If not, then the dermatological side. The skin studies mentioned  
7 included biopsies if the latter are indicated. That is an  
8 evasive case.

9 CDR. CONARD: There are certain cases that have more  
10 severe lesions I think should have further biopsies,  
11 particularly the ones we previously biopsied. It would be  
12 interesting to follow them and see what later biopsies show.

13 DR. BUGHER: You can probably find the old lesion by  
14 the scar of the first biopsy.

15 CDR. CONARD: We know exactly where it is. We  
16 have the color pictures which we intend to take back  
17 further, and take further color pictures.

18 DR. BUGHER: So you think in terms of objective  
19 photographic record with time here combined with some  
20 histological work. I think probably the histology would be  
21 the important thing here, even though there is no grossly  
22 visible change.

23 CDR. CONARD: Yes, sir.

24 DR. BUGHER: Are there other comments?

25 If not, what is your feeling about the ocular

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1 studies? They are mentioned here because the lens changes  
2 in Japan were not really fully anticipated when the original  
3 plan there was set up. It was only after the lens changes from  
4 the cyclotron workers became more important that it was  
5 realized that there might be something in Japan, and Dr. Cogan  
6 conducted such a survey and found in fact that was the case.

7 CDR. CRONKITE: Col. Lowry made the initial survey.  
8 I do not know him personally, but he presumably is a highly  
9 qualified Army ophthalmologist. I imagine for the initial  
10 survey that would be entirely satisfactory. The problem  
11 comes up, when should it be repeated, and who should repeat it.  
12 There are no qualified ophthalmologists in the group out  
13 there originally. At one time Dr. Sinsky was mentioned as  
14 the desirable individual to do it. Is he available now?

15 DR. BUGHER: He can be obtained, I am sure. Col.  
16 Lowry did the first survey. One of the problems here is  
17 not only a technical one of minute examination, but also the  
18 maintenance of a continuing record which somebody else can  
19 look at and interpret. Sinsky did it in Japan finally by  
20 getting an artist to help him, and he painted pictures of  
21 what he saw. Those pictures are over at the Armed Forces,  
22 and they make a very fine record. This is probably what we  
23 can do in this case.

24 DR. DUNHAM: We can use cameras. There are  
25 cameras available for taking lenses that were developed in

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1 the National Research Council Cataract Committee. There is  
2 one floating around in this country now, and I am sure it  
3 could be borrowed any time resurvey is indicated.

4 CDR. CRONKITE: The original examination was an  
5 ophthalmatopic examination.

6 CDR. ETTER: Sinsky contends that it is only through  
7 a slit lamp that you can pick up the early changes.

8 DR. BUGHER: There is no question.

9 MR. HARRIS: Since this interpretation is so  
10 important here, might it be reasonable that on a succeeding  
11 examination if Sinsky did it, that Lowy and Sinsky go  
12 together and do it, so that he would have Lowry's background  
13 from a previous examination? Perhaps this would not mean a  
14 necessary resurvey immediately. In other words, you could  
15 hold off a year or so.

16 DR. BUGHER: Yes, that makes very good sense to me.

17 CDR. CRONKITE: The general consensus is to delay  
18 the further ophthalmoscopic survey for a few months.

19 DR. BUGHER: There is the point here that the  
20 base examination has been made.

21 DR. DUNHAM: There is some question as to whether  
22 it was made by the slit lamp or not.

23 CDR. CRONKITE: Lt. Sharp was there at the time  
24 and says it was.

25 DR. BUGHER: Before it was done, we understood it

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1 would be done that way, so that clears that up. If that  
 2 has been thoroughly done, perhaps another look in six months  
 3 might be adequate, then. Is that what you had in mind about  
 4 that time interval? Within the first year?

5 Mr. Harris. Yes, that is what I was thinking.  
 6 This would be one before their return to their home atoll  
 7 if that year business holds.

8 DR. DUNHAM: I would urge a photographic record  
 9 if possible of these observations.

10 MR. HARRIS: Yes.

11 DR. BUGHER: That ophthalmologic camera is good if  
 12 it is used properly. It gives a picture of the anterior  
 13 portion of the lens, at least.

14 Now, what do you feel about the question of growth  
 15 studies of children, and there is also mentioned dental  
 16 development. One of the things that was mentioned that  
 17 was noticed in Japan was a temporary disturbance of growth  
 18 rate, but also there have been some interesting dental  
 19 anomalies which appeared in young people who were irradiated  
 20 while they had their primary dentition. In other words, that  
 21 is babies or the first years of life. They have shown some  
 22 rather interesting dental changes apparently resulting from  
 23 some degree of damage to the tooth buds of the permanent  
 24 dentition.

25 CDR. CONARD: What sort of doses were involved there

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1 DR. BUGHER: Of the order of probably 100 or 200 r,  
2 something of that sort.

3 DR. DUNHAM: Captain English discussed this with us  
4 yesterday I believe. He was not expecting to find much  
5 but wished to have any teeth that came out spontaneously  
6 or pulled made available, In other words, he didn't believe  
7 that it would be worthwhile to take a special trip out  
8 there to study all the children. Wasn't that the idea?

9 CDR. CRONKITE: That is right. He discussed  
10 this with Commander Loce, who has had a wealth of experience in  
11 dental studies of native populations in the Pacific. He did not  
12 consider the matter of dental changes, and those that were  
13 in utero at the time. But all that were born at this level  
14 of radiation and in view of the extreme difficulty natives  
15 have in their dental growth, he did not think that it would  
16 be possible to get anything out of it. I do not recall him  
17 saying anything about the study of the babies. There are six  
18 babies involved, I believe.

19 DR. DUNHAM: He did wish to make radio audiographs  
20 of any material that became available.

21 CDR. CRONKITE: Yes, and the group at NIH are  
22 interested in that also.

23 CDR. CONARD: Particularly in the insidious  
24 teeth in the children.

25 DR. BUGHER: The administration of the trust  
territory has more or less a peripatetic dentist who would

1 be very glad to help in this sort of thing of collecting  
2 teeth in the intervals when nobody is around.

3           Then pregnancies and status of newborn infants.  
4 Certainly the chance of picking up much of anything  
5 significant is probably small in that. I daresay the occurrence  
6 of pregnancy and the inevitably correlated birth dates are  
7 not going to have much relationship to the time of visits of  
8 the special medical group. So the chances of being able to  
9 study these things on the part of the survey teams are  
10 not going to be too good. However, the resident physicians  
11 can carry out, I think, quite a lot of observations you might  
12 want them to make in the interval.

13           Now, on the quantitative studies of internally  
14 deposited radio isotopes by excretion measurements, radiography  
15 and localization, we include here autoradiography and  
16 autopsy work, I think that might merit some additional  
17 discussion. I think, Dr. Looney, some of the things you were  
18 mentioning really could be brought out here, if you care to  
19 develop them.

20           LT. LOONEY: Yes, sir. In the studies of radium  
21 patients that we made we found that the most consistent  
22 and probably the most valuable clinical finding was the small  
23 changes roentgenographically, and as mentioned yesterday,  
24 those were primarily the result of a formation of atypical-  
25 osseous tissue. It was found that similar changes were

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1 present in bone following yttrium, plutonium, strontium,  
2 radium. These were similar.

3 We were able to pick these up from the clinical  
4 standpoint by areas of increased density which usually  
5 occurred at the cancellous bones at the end of the long  
6 bones. We were able to correlate this with the amount of  
7 retained radium, and it was a more reliable clinical  
8 indicator than any other findings that we found.

9 The other important thing is that in the tumors that  
10 developed in these people, most all of them developed at the  
11 ends of the long bones and a roentgenographic study of the  
12 long bones gives a base line for any future changes, and  
13 also a study for any changes in symptoms which might be  
14 pre-cancerous.

15 All these radium patients follow a rather fixed  
16 pattern, namely, that about 15 years after the deposition of  
17 the radio element symptoms occurred. Then later symptoms will  
18 occur and were consistent at the point where the chamber  
19 develops. This is accompanied by areas of density. This is  
20 a very important aspect as far as the long term study, as  
21 far as the internal emitters are concerned.

22 I know you are interested in radiation as far as  
23 x-rays are concerned. I looked up the data from Brookhaven  
24 on a 40 to 80 KV machine, and found that taking for instance,  
25 a survey of atypical fibula, this would give you a .12  
roentgens to this part. Taking a book on burns, the tibia,

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1 the exterminators were concerned 13 per cent of the body area.  
2 This is figures, but it will give you this idea of .012  
3 roentgens. As far as the roentgenographic changes are  
4 concerned, we found with the exception of only 10 or 20 per  
5 cent of these people that if changes occurred in the long  
6 bones, in the radius of the tibia or fibula, it was almost  
7 always bilaterally. So taking one long bone one year  
8 and another this would minimize the radiation to this and  
9 give us basically clinical data for changes which may occur  
10 three, five, ten or fifteen years hence.

11 I have a chart which I don't know whether you can  
12 see it or not. I just happen to have a chart. This gives  
13 you some idea of the distribution of the tumors that  
14 developed in these radium patients. You will notice that  
15 they are all almost at the ends of the long bones or  
16 near the ends.

17 The roentgenographic changes occur either at the  
18 ends or the middle, so by taking an x-ray of the joint and  
19 probably two thirds of the tibia, this would give us a very  
20 excellent base line study for our future changes which might  
21 develop.

22 This would be very important for any autopsy  
23 material or any biopsy material that we might get when these  
24 people were having operations that could correlate the  
25 roentgenographic, radiographic and histopathologic changes.

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1                   That is another point I would like to bring up  
2 of the technique which we used at Argonne of taking audio  
3 radiographs, and from this to use as a guide for the  
4 detailed ones. We were able to take whole sections of bone  
5 and from this take x-rays and also audio radiographs, and  
6 then in the critical areas, take biopsy material from this  
7 to study detailed audio radiographs in which we could  
8 simultaneously study radio element deposition and histopatho-  
9 logical changes.

10                   This was a simple and satisfactory method of study.  
11 Since strontium is probably your biggest trouble from  
12 long life, I would suspect that this would get a similar  
13 distribution, and also a similar change. I think another  
14 important thing that this may answer is this: We don't know  
15 from the radium study at what time these changes develop.  
16 We have an idea it is five or ten years following deposition,  
17 but with the shorter half lived material, the calcium that  
18 was gotten in here, these changes may develop earlier, and  
19 the malignancies might develop earlier. But this would be  
20 one step ahead of the game if we had this base line study.  
21 I think it is a very important thing to incorporate in a  
22 study of this type.

23                   DR. BOND: May I ask how many individuals would  
24 you wish to x-ray? Would this be the entire group or children  
25 specifically?

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1                   LT. LOONEY: I think you might stagger this and  
2 maybe take ten or fifteen, depending on the facilities and  
3 the situation. That would be my suggestion, to start out  
4 with ten or fifteen, and see how we came out, and to try  
5 to get a control set up, and maybe the following year get  
6 ten or fifteen more. This survey should probably be, one, one,  
7 three, five, ten, fifteen and twenty years, with any  
8 repeat x-rays if patients should develop symptoms or anything  
9 suggestive of malignancy, and take a biopsy as well as an  
10 x-ray.

11                   The base line is one, three, five, ten and  
12 fifteen, or something like that. I don't think they need  
13 to be made as often as the studies if you are going to make  
14 them annually. I would say that probably an x-ray of the tibia  
15 and fibula, the radius and ulna, and the x-ray of the pelvis.  
16 We know from the radium studies that these are the places  
17 that would most likely have these changes, if there are any  
18 changes.

19                   We could omit the pelvis. This gives you one  
20 roentgen of irradiation to an area. I don't know what the  
21 approximate radiation in terms of whole body radiation this  
22 would be. The external radiation is very small.

23                   DR. DUDLEY: I wonder if it has been discussed here  
24 what the level dose is from the internal emitters from  
25 quantitative terms? I put together the two microcuries of

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1 strontium and that gives an infinitive dose of less than one  
2 breadth.

3 DR. BUGHER: It has been discussed in the sense of  
4 extremely small inasmuch as the total activity is probably  
5 much less than tolerance when you think of that over a long  
6 period of time. That is the catch here, I think, and if you  
7 x-ray a bone, you are going to give more of a dose probably  
8 in the course of the examination than the internally deposited  
9 isotope is going to be able to give, which makes it  
10 difficult to arrange a series of examinations to allow for  
11 that factor.

12 LT. LOONEY: Sir, in regard to the x-rays according  
13 to the Brookhaven group, 60 to 70 per cent of the radiation  
14 will be expended in the first three centimeters, and 8 per cent  
15 at 8. So the radiation of the bone would be very small.

16 Another thing I would like to emphasize here is  
17 the marked variation that we found in the radium patients when  
18 estimating body burden from urinary excretion. We found a  
19 factor of eight. This was long range. I would certainly  
20 expect a much greater range from the estimation of the total  
21 body burden from urinary excretion.

22 One of the things is that we can work out the most  
23 practical and sensible means of handling situations of this  
24 sort in the future by this method. Going over this work  
25 with Dr. Cohn, the likelihood of malignancies developing

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1 here are small. But there are many other factors  
 2 that as a clinician I would not be satisfied with the  
 3 estimates and the assumptions made here. I think the final  
 4 proof is the evaluation of these people, and knowing what  
 5 the situation is after ten or fifteen years.

6 DR. BUGHER: Gene, do you have any thoughts as  
 7 to how to carry out this sort of program? For example, is  
 8 Quadjalein itself equipped with these facilities?

9 CDR. CONARD: You were speaking of later studies  
 10 on Rongelap?

11 DR. BUGHER: I was thinking of that.

12 CDR. CRONKITE: They have a good equipment at  
 13 Quadjalein as we have here. It is a first class naval  
 14 dispensary.

15 DR. BUGHER: So it would be a matter of bringing a  
 16 few people over.

17 CDR. CRONKITE: Yes.

18 DR. BOND: It could be done right at Majuro.

19 DR. BUGHER: Down there it is a question of a  
 20 launch ride. It is only about five miles from Majuro Island.  
 21 It is a natural excursion.

22 CDR. CONARD: Is it accessible by air?

23 DR. BUGHER: No, it is a separate island.

24 MR. HARRIS: It would be nice to put some of these  
 25 people under a human counter.

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1 DR. BUGHER: Yes.

2 LT. LOONEY: We considered taking a scintillation  
3 counter out there. I didn't bring this up. I do think your  
4 suggestion is a very excellent one. If the logistics permit,  
5 it should be done.

6 MR. HARRIS: If you did such a thing as this,  
7 the time to do it would be probably during the time of  
8 testing out there when they were hauling out all sorts of  
9 heavy equipment. The human counter weighs approximately ten  
10 tons. That is the Los Alamos human counter. You can split  
11 this up a little bit by draining, but that is also quite a  
12 load.

13 DR. BUGHER: There are some drawbacks to it.

14 MR. HARRIS: However, the arm counter, something  
15 like that, which weighs 3,000 pounds, might be feasible to  
16 do in this case.

17 LT. LOONEY: We have a very sensitive scintillation  
18 counter we have been using on thorium patients which would  
19 certainly be adaptable to the situation if this is something  
20 that should be done. I think that body surface trying to  
21 correlate external measurements with any roentgenographic  
22 changes or radiochemical findings in the skeleton would be  
23 interesting and probably helpful, and give us full information  
24 to try to correlate all this as to the best practical means  
25 of evaluating people in the future.

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1 DR. BUGHER: You may get an answer there on trying  
2 to distinguish between background and the individual counts.  
3 Some of the Air Weather Service people who were on Rongerik  
4 would be fine. In other words, they have much lower levels  
5 so if one could recognize anything on them, then you would  
6 know it would pay off to haul the equipment out.

7 MR. HARRIS: It had been calculated. I think as  
8 far as the Air Weather Service personnel, it was calculated  
9 on the basis of urinary excretion. You might be able to  
10 see this beyond the natural K-40 background. This would be  
11 entirely in the nature of an experiment if it was done,  
12 and not come into routine medical situations as far as I can  
13 see.

14 MR. HARLEY: Where could you make the measurements  
15 that the background from the fallout would not be too much  
16 for you ?

17 CDR. CONARD: I don't think Majuro got any fallout.

18 MR. HARRIS: Our background at Los Alamos is higher  
19 than it is at Quadjalein.

20 MR. HARLEY: Majuro got a pretty good sock.

21 MR. HARRIS: You could not carry any such thing  
22 farther than Quadjalein. This is designed to take care of  
23 high backgrounds. Ten tons, it has to be.

24 DR. BUGHER: The question of autopsy is again  
25 going to be something which will have to be arranged with the

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1 local medical personnel. I do not know how difficult it is  
2 to get autopsies of the Marshallese.

3 CDR. CRONKITE: They have done autopsies at  
4 Majuro. They have to be done immediately. Their custom is  
5 to bury people within six hours after death.

6 DR. BUGHER: So almost certainly you are going to  
7 have to reach an understanding with the medical officer to do  
8 an autopsy and collect the material you wish, and preserve it  
9 in the manner which you desire to have it preserved for ship-  
10 ment to you. The chances of special teams ever having an  
11 opportunity to do an autopsy are not too good.

12 CDR. CRONKITE: These were made originally by  
13 the commander, and after the decision to move to Majuro was  
14 made. It is not clear to me whether anybody talked to Dr.  
15 Kirk at Majuro, whether they are aware of the necessity for  
16 doing autopsies.

17 DR. BUGHER: I think they are vaguely aware of it,  
18 but as far as specific needs are concerned, I am sure  
19 that has not been communicated. That is one of the things  
20 that could be done. I think they are willing to do anything  
21 that is asked of them, if they are able to do it, and will  
22 follow the suggestions quite enthusiastically. I don't know  
23 of any specific request having been passed to them, other  
24 than that they should give the general medical care to people  
25 that under the other plan would have been forthcoming from

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1 the medical officer at Quadjalein. I am sure they will do  
2 these other things, too, if you will just outline to them what  
3 is desired.

4 CDR. CRONKITE: Would that be done by the first team  
5 that goes out there, or should this be carried down through  
6 the trust territory, so that everybody is aware of the need?

7 DR. BUGHER: I think it probably might be a good  
8 thing to prepare that in a set of written instructions of  
9 things that are needed, and we transmit that through the  
10 trust territory administrator so that in case somebody should  
11 die, before the team gets out there, that the opportunity to  
12 get materials would not have been lost.

13 Are there other comments along the lines of these  
14 topics?

15 CDR. CONARD: In addition to that, I think that  
16 it would be nice to have good rapport there on the  
17 observation of skin and any other changes.

18 DR. BUGHER: Yes, I think we assume all through  
19 here that everything that is done is done by the cooperation  
20 with the trust territory people, just as the movement of  
21 the people, for example, has been done as far as form is  
22 concerned, under the general supervision of the trust  
23 territory officer. He is the one that the people themselves  
24 look to, not only during times of special studies, but in the  
25 interim. In that sense, we are simply backing up their

1 people in carrying out these various things. So I think you  
2 will find to whatever extent is useful trust territory  
3 administrative people are available at all times.

4 Are there any other comments or questions here?

5 If not, we have a subsidiary topic called institutional and  
6 individual responsibilities. Have we covered that sufficiently  
7 or do you wish more comment on that?

8 CDR. CRONKITE: There was a statement earlier when  
9 you were out, Dr. Bugher, of the desire of the Army and Air  
10 Force to have people participate in this followup. If these  
11 people could be designated so that they could be split up  
12 between the team that Dr. Bond takes and the one that I take,  
13 it would be most helpful in our planning.

14 DR. BUGHER: Yes.

15 CDR. CRONKITE: I would like to also extent it  
16 not only to the matter of officers, but to enlisted technical  
17 personnel, so that no one laboratory gets hit too badly at  
18 any one time.

19 DR. BUGHER: I think Col. Browning would undoubtedly  
20 keep various groups in the picture. For example, Col. Brennan  
21 and other groups interested in these lines. There are  
22 various others, some of whom have been scattered a bit, but I  
23 think could be recovered on special assignment on things of  
24 this sort. So that in a way what we get concerned with are  
25 individuals who may have special competence and interest

1 here, and that involves any institution with which they may  
2 be associated with at the time. Fundamentally it is the same  
3 old problem of people who are competent and interested,  
4 wherever they may be, if they could be made available.

5 The question on Uterik. The environmental studies  
6 will have to be done at all three atolls. These teams  
7 naturally should pay some attention to the Uterik people, but  
8 I presume the proportion of attention will be pretty much  
9 along the line of proportion that they got in the beginning  
10 which was not very much. In other words, just an overall  
11 surveillance to make sure nothing odd is developing.

12 DR. DUNHAM: Should they be reviewed this year at all,  
13 that is, the Uterik people?

14 CDR. CRONKITE: Practically speaking, I think not.  
15 From an academic standpoint, probably yes. My general  
16 thinking along these lines was that since they had perhaps a  
17 tath of the exposure that the Rongelap people did, if nothing  
18 is showing up in the Rongelap people, there is relatively  
19 little reason for even academic purposes to study the Uterik  
20 people. If something does occur in the Rongelaps, then we  
21 should take a look for both straight medical care and academic  
22 reasons at the Uterik people.

23 DR. BUGHER: They obviously should be visited by  
24 the special team at least as a social call, if nothing else.

25 DR. DUNNING: What do you wear on an occasion like

1 that?

2 CDR. CRONKITE: Mr. Eisenbud expressed an interest  
3 before I left Quadjalein in having urine samples from the  
4 Uterik people. When I do not know, or what intervals he  
5 desires.

6 MR. HARLEY: Are they back now?

7 DR. BUGHER: They are back on their own atoll at  
8 the present time.

9 MR. HARLEY: We would like to get a set of samples  
10 before this project gets going, if we can. We were thinking  
11 of dealing through the trust territory people perhaps to get  
12 a sample certainly in August, and then perhaps another  
13 sample when you get out there on the study, if that is  
14 possible. I think the urine sampling can be done without any  
15 of our personnel there.

16 DR. BUGHER: They are accustomed to it now.

17 MR. HARLEY: Yes.

18 DR. BUGHER: At least the Rongelap people are. So  
19 I think that is probably the balance of the thing.

20 Administrative and logistic support we have already  
21 discussed. Those are administrative problems which we have  
22 to solve among the group here, really. I think that has been  
23 already pretty well clarified.

24 Now, the transportation, air and surface. Air is  
25 MATS, I presume, and surface transportation again comes to

1 Commander, Naval Station, Quadjalein, I believe, for  
2 probably all of it, unless this 10 or 11 ton piece of  
3 equipment, and things of that sort, have to go out. That would  
4 be a surface transportation problem.

5 MR. HARRIS: I was wondering if you had at all  
6 considered the possibility of getting some of your logistic  
7 support from the Eniwetok field office, and their prime  
8 contractor.

9 DR. BUGHER: Yes, we have. We may very well wind  
10 up with a launch over at Rongelap for environmental surveys  
11 and continuing studies of various kinds. But at the present  
12 moment, we have not approached the field office with any such  
13 request. I think in a way we have to wait until the need is  
14 a little more clear than it is now before we make a specific  
15 request.

16 MR. HARRIS: I was particularly thinking from the  
17 point of view of the people who are doing the environmental  
18 studies if they could take an LCU or something of that sort  
19 from Eniwetok to Rongelap, and work off it. They could  
20 perhaps cut down their time of stay from maybe a month down  
21 to a week or something of this sort.

22 DR. BUGHER: Particularly between test series there  
23 is not too much difficulty in getting such equipment. The  
24 question is housing and messing here. That is something  
25 I presume the teams have to solve for themselves.

1 CDR. CONARD: Accomodations on Majuro are very  
2 limited. Before we ate with the Air Force weather group  
3 there. They were kind enough to feed us. But their  
4 facilities are extremely limited. I think we really should  
5 have some concrete arrangements made before we go this time.

6 DR. BOND: On that, NRDL says it will not be too  
7 difficult to contract with the trust territory on a setup where  
8 we can do this to have them house us and feed us, and we  
9 can provide any additional food they might require, and  
10 also provide them with additional personnel they might require  
11 for the preparation of the food. This could be accomplished  
12 very easily on our working level provided the overall  
13 situation were taken care of at the higher level.

14 DR. BUGHER: There will be abundant supplies of  
15 fish and cocoanuts.

16 CDR. CONARD: And we could take some C rations  
17 along.

18 DR. BUGHER: I think those matter we could very well  
19 ask the trust territory administrator to see what he can  
20 provide, and when they reach the limit of their resources  
21 we can supplement them. It is almost as quick to build a  
22 thatched hut as it is a tent, and much more comfortable.

23 CDR. CONARD: The housing is not so much of a  
24 prbblem as feeding. They were unable to take care of our  
25 small group in feeding us. The housing was no particular

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19'

1 problem.

2 DR. BUGHER: That is one of those things to be  
3 worked out as you go along, I think.

4 CDR. CRONKITE: I think what is more of concern to  
5 Dr. Bond and me is who is going to take the administrative  
6 responsibility of seeing that all these things are arranged  
7 sufficiently far in advance so that we don't get into a bind  
8 when we arrive. It is going to take quite a lot of doing.

9 DR. BUGHER: In the first place, you will get into  
10 a bind when you arrive almost inevitably, that is, it always  
11 works out that way. We will undertake to clear through here  
12 a request for what you need as far as you can foresee it,  
13 and with AFSWAP, and the Navy to get all the arrangements  
14 made ahead of you.

15 DR. BOND: Is it permissible to correspond with  
16 the doctor on Majuro in informal correspondence?

17 DR. BUGHER: I think it should be with copies in  
18 here so we know what has been done. When it comes to  
19 something that is specifically asked of the trust territory  
20 people, then we should go through a formal route. I mean by  
21 trust territory administration. If you want food, services,  
22 and things of that sort, then we should put that to the  
23 Commissioner himself. It almost always works out in the end  
24 that it is the Navy that does it.

25 CAPT. YARBROUGH: I just wonder in that respect  
if perhaps some advance information to CincPac could not

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1 be furnished? They are the ones that can effect detailed  
2 arrangements for messing. They will ask the Air Force  
3 facilities, do you have sufficient rations and personnel to  
4 feed so many people. If you don't, Commander, Quadjalein  
5 will probably be directed to furnish the same.

6 DR. BUGHER: That is right. Our procedure has  
7 been all the time that CincPac is always informed of whatever  
8 is going on. We have operated right along on that basis.

9 CAPT. YARBROUGH: But also as usually happens, the  
10 quality of such depends entirely on the diligence of the  
11 individual who is addressed to get these things done. I was  
12 a little disappointed that Clark is leaving, because the  
13 succeeding man won't be familiar with the visiting group.  
14 Admiral Clark may have briefed his successor. I think  
15 perhaps it might help if in addition to what CincPac directs  
16 that personal correspondence to Commander, Quadjalein might  
17 help out a great deal.

18 DR. BUGHER: Yes. Does that help? We will attempt,  
19 then, to make these arrangements through the various channels.  
20 In other words, we can act here as a clearing house. That  
21 means we will work with AFEWAP, with BuMed, with CincPac,  
22 with the Commissioner of the Trust Territory, whatever  
23 channel is appropriate for that particular problem.

24 The AEC field office gets called on, too, for help  
25 here. If we have to have additional housing, for example,

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1 for the venture to Rongelap, we will have it put up. Those  
2 things I believe we can take care of as need arises and  
3 really should not be any source of worry to the group here.

4 DR. BOND: Will it be appropriate for us to supply you  
5 with a list of requirements, dates, and so forth?

6 DR. BUGHER: Yes, I think so.

7 DR. BOND: And what is required you will handle  
8 from that point?

9 DR. BUGHER: Yes, we will put it in the various  
10 places where it needs to be.

11 CAPT. YARBROUGH: The first figure you need is  
12 how many people are going, and how long you are going to stay.

13 DR. BOND: May we discuss that for just a moment? Is  
14 there any opinion on the number of people that should go. I  
15 think we started that discussion earlier, and got sidetracked  
16 into something else. The facilities on the island would  
17 accomodate not more than 15 people without considerable  
18 difficulty. I personally feel we can probably get along  
19 with less than 15. Does anyone have any specific opinion as  
20 to the number that should go?

21 DR. BUGHER: I hope it would be less than 15. The  
22 mere compact group, the more smoothly operating it would be,  
23 and less of a strain on whatever locality it comes to rest in.  
24 Every time you add a man, you add a bed, you add a chair and  
25 table, and piece of roof, and the capital outlay of course

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1 becomes progressively greater.

2 DR. BOND: The point I was thinking of is whether  
3 to take more and stay a shorter time, or take less and stay  
4 a longer time.

5 DR. BUGHER: My point of view is that the fewer  
6 people, the longer time is the more productive sort of thing

7 DR. BOND: Then we will compromise on it.

8 CAPT. YARBROUGH: What will you settle on, say 12,

9 DR. BOND: We can leave it at 10 or 12, and we  
10 can supply in the next few days the specific names. As a  
11 matter of fact, we can do it pretty well right now.

12 CAPT. YARBROUGH: I think if you can quote something  
13 like not more than 12 people --

14 DR. BOND: I think that is a reasonable figure, not  
15 more than 12 people.

16 DR. BUGHER: Is there any other aspect you would  
17 like to bring up in that connection?

18 CDR. CONARD: Do you think these arrangements  
19 could be completed by around the middle of August or some  
20 where thereabouts?

21 DR. BUGHER: I don't see why not. We are going to  
22 have a double problem a bit. That is, one for the medical  
23 people, another one for the environmental people, and the la  
24 may need either a landing craft for a week or ten days, or  
25 it might need that plus a temporary camp. We will see where

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1 we come out there.

2           That seems to cover the Item C, integration of  
3 visits between Marshallese, trust territory, DOD, AEC, and  
4 CincPac. All visits which involve Marshall Islands  
5 people and area, that is, the territory outside of Eniwetok  
6 and Bikni should be cleared through the High Commissioner  
7 of the Trust Territory. It will be up to him then to inform  
8 his people as to when and who is coming, and what is expected  
9 of his people. He will do that with a great deal of  
10 enthusiasm, because he feels very strongly that the work of  
11 this group has fundamentally greatly benefited the conduct  
12 of the administration of the whole trust territory. It has  
13 put the United States Government in a firm position of a  
14 humanitarian interest in people, and in their welfare, which  
15 is worth more than any amount of words. So we can anticipate  
16 no reluctance on the part of the trust territory  
17 administration to advance these studies in any way that they  
18 possibly can.

19           All visits likewise informed to CincPac. In other  
20 words, these plans with the trust territory likewise should  
21 be communicated to CincPac. The various other groups here  
22 which are concerned, also, that is, AFWAP, in general, is the  
23 channel for the information of the services as to what is  
24 going on. Entry to Bikini and Eniwetok will be cleared  
25 also from here through Santa Fe Operations Office, and the

1 Eniwetok field station.

2 Is there any other thing that you can think of in  
3 regard to routine information of channels?

4 DR. DUNHAM: No.

5 DR. BUGHER: Are there any other comments on those  
6 things? What do you think, Col. Brownig, in regard to these  
7 information channels? Have we missed anything that we should  
8 do or have we suggested doing anything we should not do?

9 COL. BROWNING: No, sir, I don't know of anything.  
10 I would like you to put in a plug here for a very firm  
11 commitment through trust as to the housing and messing  
12 because it takes a long time to get extra food out there.  
13 If you send 13 people, it is 40 miles a day, and it is not  
14 quite that easy for them to provide it. This ought to be  
15 well established in advance. If you leave it on the local  
16 level, the local officers, whether naval or whatnot,  
17 are very hesitant on stepping on the trust toes, and rightly  
18 so. They are not in a position to do many of the things that  
19 they might do on a stateside base. Anything that can be done  
20 in the way of administration earlier will help to get things  
21 done in better fashion.

22 I would suggest in that respect, too, that a rather  
23 firm agenda be supplied to the trust so that they will know  
24 who will be where under what circumstances, and leave us  
25 enough slack in it so that there can be made local adjustments.

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1 But again this ought to be done well in advance.

2 DR. BUGHER: Yes, there are two ways of laying down  
3 supplies at Majuro. One is through Quadjalein Naval Station  
4 and another way is essentially privately through the Island  
5 Trading Company, which is due to fade out this fall. But it  
6 still exists and is looking for business. I think the point  
7 you make would hold equally true there. Unless there is  
8 planning well ahead, it will be snafu at that end. So these  
9 requirements will have to be drawn up rather rapidly and  
10 everybody should be informed about them completely.

11 COL. BROWNING: I have a rather large map of the  
12 Majuro area, and it looks as though that particular island  
13 is about two nautical miles right across the lagoon to Church.  
14 I meant to ask you this before. Is that settlement down on  
15 the end of the lagoon?

16 CDR. CONARD: The island with the church on it?

17 COL. BROWNING: Yes. The map shows a church, a  
18 couple of radio towers.

19 CDR. CONARD: That is at the opposite end of the  
20 lagoon, as I remember. The main island is the extreme  
21 southern end of the lagoon. There are a series of islands  
22 there that are connected by causeways. I was asking Dr.  
23 Bugher whether this island was accessible by road, but  
24 apparently it is a separate island.

25 DR. BUGHER: My understanding is that it is not.

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1 From a landing on Majuro to the launch landing to this  
 2 settlement would be five miles. But that is hearsay as far as  
 3 I am concerned.

4 CDR. CONARD: I don't remember this particular island.

5 DR. BUGHER: This was not inhabited previously.

6 COL. BROWNING: The chances are that they have some  
 7 sort of water transportation set up at the present time.

8 DR. BUGHER: Yes, they have two launches there, I  
 9 believe. The trust people seem to have no worry about that  
 10 transportation link there. When we get back to the Rongelap-  
 11 Uterik atolls, then they are in trouble, and they really  
 12 can't move without the Navy moving them.

13 Are there other points that occur to you? Does  
 14 that seem to be adequately covered?

15 CAPT. EELLUM: Yes, it seems to be well covered.

16 DR. BUGHER: The project officer and reports.  
 17 Whoever is the project officer is to be responsible for the  
 18 compilation of the report of that visit. Is that your thinking,  
 19 Gene?

20 CDR. CRONKITE: The main thing I would like to  
 21 clarify is what is the report channel? To whom does one report?

22 DR. BUGHER: To the Division of Biology & Medicine.

23 CDR. CRONKITE: It is not a task force report that  
 24 goes through the WT channel?

25 DR. BUGHER: The task force has terminated, or will

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1 be pretty soon now. So it is a continuing study outside of  
2 the original task force responsibility. These reports, however  
3 will go into AFSWAP. They will go to the then existing task  
4 force so that all the various people who have and will be  
5 concerned with operations there will have this material  
6 available to them. But that would be handled in the normal  
7 way in which AFSWAP takes care of these things.

8           The report itself would come here. We would  
9 arrange duplication at Oak Ridge through the customary  
10 procedure. The main job would be to get the report produced.  
11 After that, the reproduction is not difficult. For example,  
12 when Vic has this next special trip, then the report will  
13 come via NRDL into -- what is the channel there? To you?

14           CAPT. YARBROUGH: Via BuMed to BuShips.

15           DR. BUGHER: And then here to us. If it is from  
16 MNRI, it will come from your office.

17           CAPT. KELLUM: Yes.

18           DR. BUGHER: Depending on where the team is based.  
19 Any service that we can render in helping the thing that  
20 is something we will be glad to do, whatever it may be.  
21 In that sort of function, we are simply trying to help and  
22 not as a matter of authority and command, but naturally expect  
23 everybody to give a lift whenever you can. We come to the  
24 natural adjournment time for luncheon, I take it.

25           After luncheon, I think we should discuss a little  
more some of the things which we should do in the course of

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1 the environmental surveys, and go on to some of the other  
 2 special things which are mentioned here, before we adjourn at  
 3 the end of the afternoon. So in that case, we are only three  
 4 minutes behind.

5 (Thereupon at 12:33 p.m., a recess was taken until  
 6 1:30 p.m., the same day.)

7 -----

8  
 9 AFTERNOON SESSION

1:30 P.M.

10 DR. BUGHER: Let us take up some of these considera-  
 11 tions of the survey which will aid the group that eventually  
 12 has to do it.

13 Attention is called to accomodation for air and  
 14 ground surveys, the distribution material in domestic animals  
 15 and natural foodstuffs, and a long term metabolic study of  
 16 the fission products in those animals and in the flora,  
 17 which would of course involve radio chemical studies.

18 I think perhaps John Harley might have some thoughts  
 19 with regard to the air and ground surveys, and whether an air  
 20 survey would be helpful at the present time or next year  
 21 or whether it should be entirely a ground operation on  
 22 these atolls which would actually be all three atolls,  
 23 Rongelap, Rongerik and Uterik.

24 MR. HARLEY: Our feeling on it has been that at  
 25 least the preliminary survey should be by air, because so

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1 far at least under a given set of circumstances, you should  
2 be able to get good correlation, as we do.

3 Gordon might not always agree, but when we looked  
4 at such places as our estimate of dose, the Rongelap, which  
5 is of the order of 200 r and so on, I don't think that you are  
6 far off. Therefore, as the first step in a survey, I think  
7 it would be done by air. I don't think it should be limited  
8 completely to these particular atolls. I don't know how much we  
9 can do about it now, but on the last shot, for example, we  
10 found rather intensive fractionation of material, when the  
11 separation between spots was only a little over 100 miles.

12 I think the decay rate was more than doubled at  
13 the farther out location. We would like to get more data of  
14 that sort for that purpose. After preliminary aerial survey,  
15 you might be able to decide where to take your ground samples.

16 DR. BUGHER: Would people in the New York laboratory  
17 be willing to do it?

18 MR. HARLEY: We would be very willing to loan out  
19 the instruments.

20 DR. BUGHER: Yes, I know that. There is a question  
21 of uniformity of procedure here. It took quite a lot of  
22 beat-up before the cooperation which was necessary between  
23 the flight crew and the radiological mapping people had been  
24 established.

25 MR. HARLEY: I think you were speaking of the work

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1 on the last couple of shots, were you not?

2 DR. BUGHER: I was thinking of the flight surveys  
3 out of Quadjalein, which were carried on during Castle.  
4 It took quite a background of experience which was built up  
5 during Ivy, which was drawn on to guide that.

6 Again, it would be in an aircraft out from  
7 Quadjalein. I suppose a P-2-V. One would like to get one of  
8 the crews that had previously done this sort of thing.

9 CDR. CRONKITE: I think the P-2-V squadron was  
10 relieved after the operation. It was only there for security  
11 purposes.

12 DR. BUGHER: It was to leave in toto?

13 CDR. CRONKITE: Yes. Admiral Clark mentioned that  
14 one time. They were only there for the security of the group.

15 DR. BUGHER: Not even a Piper Cub left, I suppose.

16 MR. HARLEY: I have no doubt that somebody would  
17 go out, but as far as supplying a full crew, I think that  
18 they would prefer not to if they could. That is, to send out  
19 a man who is a combination maintenance man and so on, if  
20 anything went wrong.

21 DR. DUNNING: Dr. Bugher, I am wondering at the  
22 moment what purpose these aerial surveys might serve. We  
23 are pretty well agreed that we are going to make ground  
24 surveys at the three atolls of immediate interest. Possibly  
25 we might want to make air surveys of some of the more distant

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1 atolls. Again I don't know for what purpose.

2 MR. HARLEY: It was under the impression that you  
3 would be making ground surveys only at three islands, and  
4 not three complete atolls.

5 DR. BUGHER: Three atolls.

6 MR. HARLEY: Three complete atolls.

7 DR. BUGHER: Yes. I think the ground survey would  
8 have to make the whole survey circuit of each of the atolls  
9 here. You see, a monitor getting off one end and plotting  
10 at the other end of the island. I guess he would be picked  
11 up by launch. But I can see miles and miles of footwork  
12 in prospect for somebody.

13 DR. DUNNING: I think that was my point, that  
14 since we are going to send in ground surveys into the areas  
15 of major interest, we have a pretty good notion what the  
16 levels are going to be in the more distant areas, and that  
17 is rather low.

18 DR. BUGHER: I was going to ask that question.  
19 What do you expect?

20 DR. DUNNING: I don't have the data here with me,  
21 but I can dig it up in a hurry. They will be low certainly  
22 in terms of any health hazard. They will be so low in fact  
23 that I begin to wonder whether the accuracy of the air survey  
24 is worth the effort. In other words, why do you want to go  
25 down and make an aerial survey on these distant atolls?

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1 MR. HARLEY: I will ask the question in reverse.  
2 Why do you want to make a ground survey on the unoccupied islands  
3 of these atolls?

4 DR. DUNNING: If we wanted to make a survey, we would  
5 be dealing with relatively small numbers. I mean the radiation  
6 levels would be relatively low.

7 DR. BUGHER: A few MR per island.

8 DR. DUNNING: Therefore, I am wondering how much  
9 confidence we can place in an aerial survey. To repeat your  
10 question, why go in on the ground? I didn't say to go in. I  
11 think this is perhaps a point for discussion, but if you  
12 want in with a ground survey ostensibly it would be to measure  
13 the low levels for scientific reasons and not health. You  
14 are dealing with such low levels of radiation, that is why I  
15 was wondering if the aerial survey would do the job.

16 DR. BUGHER: If one could substitute the aerial  
17 survey for footwork, let us say, in the expanse of the  
18 northern island of Rongelap, then make the ground survey as  
19 a number of spot checks, that would cut down the labor, I  
20 suppose, very materially.

21 DR. DUNNING: I was hoping that the ground survey  
22 teams would go into the northern islands of the Rongelap  
23 Atoll. Those are of the most interest.

24 DR. BUGHER: We have a pro and a con on this. Does  
25 anybody have additional comments?

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1 MR. IMIRIE: There is one thing that comes to my  
2 mind, Dr. Bugher, and I have talked to Merrill Eisenbud about  
3 it, Harley and Dr. Dunning; there has been a question from  
4 every survey group that went out as to what readings were at  
5 various points. Of course, we all know what happened on  
6 these readings. In some cases there were uncalibrated instances  
7 and in other cases they were two feet from the ground or three  
8 feet from the ground or near the water or under a "hot". It is  
9 true that is where the people were. But in addition to that,  
10 there was an aerial survey taken which indicated a little  
11 higher than most of the ground surveys. The aerial survey  
12 would tend to integrate the average dose on the entire island  
13 as compared to searching out hot spots and cold spots. If  
14 for nothing else, it would give an inter-comparison of  
15 one island between another island or one atoll against another  
16 atoll on an average integrated basis.

17 Further than that, two readings of aerial survey  
18 might prove out or disprove the centimeter which was used.

19 MR. HARLEY: We have data here, for example, on  
20 Rongelap taken at 32 hours, one with a T-1-B, and the other  
21 with the scintillator or from the air, and the difference  
22 between was essentially nothing. It is less than 5 per cent.

23 DR. DUNNING: Yes, but I was out there, and the  
24 first comparisons I made were between the air and the ground  
25 and differed by a factor as high as four. I have the raw

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1 data here somewhere. Later, Al came up with a new  
2 correction factor. That brought the two readings in line.  
3 By two readings I mean ground and air. So I think one has  
4 to take a pretty close look at the data to see how valid these  
5 readings are. Maybe before the operation was over with,  
6 maybe he got this correction factor down a little better.

7 MR. HARLEY: There was a little difficulty out  
8 there at the beginning. I think it was merely a misunderstanding  
9 of Al's. The reason I am pretty sure there was a misunder-  
10 standing, even after talking with him, is that he was getting  
11 the difference using the centimeter on the ground and the  
12 air in the height conversion factors. We spent a lot of time  
13 out there after the whole crew was around in re-doing our  
14 conversion factors.

15 DR. DUNNING: Understand, I am not taking a strong  
16 stand against aerial surveys. They were most valuable and  
17 especially in the early times after a shot, when we were  
18 pulling our hair wondering what was going on out there. I am  
19 not sure, but that it should be done. I am just raising the  
20 points that came to us out there, and again say just what  
21 purpose are we trying to serve by these additional surveys.

22 MR. HARLEY: My feeling still is that you probably  
23 would pick Rongelap Island for your ground surveys and stick  
24 to the air for the others, rather than trotting all over  
25 under that hot sun. At the same time, of course, you would

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1 be able to get your cross checks from one to the other.

2 CDR. CONARD: Do these surveys give us any better id  
3 as to what the original dose was by extrapolating back?

4 DR. BUGHER: There would not be decay, and the decay  
5 with time has become more complicated by the weathering  
6 factors which come in.

7 DR. DUNNING: I doubt there would be any additional  
8 data that would turn up at this stage of the game that  
9 would influence our thinking on the original estimation. We  
10 were concerned in terms of the decay constants between  
11 the six hour and the fiftieth hour, which might well be a  
12 different decay than it is now.

13 MR. HARLEY: Your change in total dose would be  
14 slight, no matter what the decay rate was, after the  
15 first few days, because almost all your total dose is in  
16 the first few hours anyway.

17 DR. BUGHER: There is somewhat of a question as to  
18 how to get the most information with the least work here.  
19 Payne, do you have a thought here?

20 MR. HARRIS: When I read this, I personally could  
21 not see any particular reason for doing air surveys unless  
22 it was to continue attempting to calibrate between good  
23 round readings and air readings to get a calibration factor.  
24 I question whether this is necessary to go to Rongelap in  
25 the Pacific to do this. Could not this be continued in

Nevada in the next series of operations?

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1 Other than that, as far as an adjunct to environ-  
 2 mental studies, again I do not see where an air survey applies  
 3 to this. My feeling about environmental studies is that if  
 4 you are going to measure the activity in a cocoanut, you want  
 5 a survey made at the point that cocoanut is picked up off the  
 6 island, or close to it, and not from the air. So what surveys  
 7 were made on other islands than Rongelap, if you got samples  
 8 from those other islands, you would still need the ground  
 9 survey there in order to correlate in your final analysis  
 10 of the data. In other words, an air survey on an island  
 11 which was going to be used for sampling ground I can't see as  
 12 accurate at all.

13 MR. HARLEY: If you are going to be on the ground,  
 14 you might as well take a ground survey.

15 MR. HARRIS: Yes. The only way you can get samples  
 16 is to be on the ground, and take the survey right there.

17 MR. HARLEY: If you are not going to take samples,  
 18 then the question is, should you take an aerial survey or  
 19 should you go in and take a ground survey?

20 DR. BOND: Are these surveys of areas already  
 21 surveyed?

22 MR. HARLEY: Yes.

23 DR. DUNNING: About the only thing you can  
 24 accomplish is to tell CincPac and other people that the

25 activity on these atolls has gone down so much. That is the

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1 only reason I can think of at the moment, and then aerial  
2 surveys would be called for.

3 DR. BUGHER: Another point of view, the only area  
4 where the strontium 90 component would be enough of  
5 consequence is probably in the northern island of Rongelap.  
6 That takes pretty detailed and careful ground sampling of  
7 soil, plants, and the animals and so on.

8 DR. DUNNING: It might be of interest to this  
9 group that according to the calculations there is about half  
10 of microcurie of strontium 90 per square foot up there on  
11 one of the islands, and I am very anxious to see how close  
12 these theoretical figures become because this is getting up  
13 in there, shall I say.

14 DR. BOND: Which island is that?

15 DR. DUNNING: N-a-e-n I believe is the proper  
16 spelling.

17 MR. HARRIS: If you collect enough, you might be  
18 able to sell it for isotope uses.

19 DR. DUNNING: Yes.

20 MR. HARLEY: Or make your own batteries.

21 DR. BUGHER: One other aspect of the aerial survey  
22 is one reason why I asked John if somebody from the New York  
23 lab would be running it, is that if it is done at all, the  
24 calibrations have to be done very carefully and at rather  
25 exhaustively, and the whole thing carefully controlled, or

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1 else the results are not those which would command confidence  
 2 and therefore of limited use. It is not something that you  
 3 just send out an instrument to somebody on Quadjalein, and  
 4 tell him to stick it in a plane and fly it over the atolls and  
 5 send back the record.

6 MR. HARLEY: I would like to add, although I  
 7 don't defend the comparative reliability of instruments, that  
 8 people tend to have a great deal of faith in something like a  
 9 T-1-B, and drag that out and make a measurement and come  
 10 back and that is the fact. Whereas, ourselves, because we  
 11 recognize that they are not particularly stable, we don't  
 12 have quite so much faith. I think that the same calibration  
 13 business has to apply to everything that is used out there.

14 DR. BUGHER: That is very true.

15 MR. HARLEY: We made a check on energy dependence  
 16 out there. Actually we had it made here at the Bureau of  
 17 Standards, afterwards, as you know. There is quite a  
 18 difference between the scintillation unit and, say, the T-1-B.  
 19 We found actually that the T-1-B cuts off higher than people  
 20 seem to think, closer to 100 kilovolts, whereas the  
 21 scintillation is sensitive down close to 40.

22 DR. BUGHER: Yes.

23 MR. HARLEY: So we have to consider calibration  
 24 and energy where both sets of instruments are used.

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DR. BUGHER: That is correct. The standardd

1 calibration of the T-1-B has been with cobalt 60. I  
 2 believe the two instruments calibrated that way, they do  
 3 agree. When you get into the large component of soft gamma,  
 4 the centimeter gives a higher reading by a factor of two or  
 5 so, I thought, early in this fall. It is something that  
 6 is of that order, anyway.

7 I think that is a subject perhaps we ought to give  
 8 a little more consideration to, as to whether the airborne  
 9 survey would pay in view of the fact that we want ground soil  
 10 samples and plant samples from almost the circumference of  
 11 these atolls, which means ground survey anyway, as well as  
 12 sampling. Whether the additional effort which would be  
 13 required to get a good area survey into operation would pay  
 14 is the question. I think perhaps we could discuss this  
 15 somewhat more later.

16 Does anyone have a strong feeling one way or  
 17 another here? We heard the pros and cons.; I don't believe  
 18 there really is much more to say. I am just estimating what  
 19 is the easiest way of getting the necessary data. We do  
 20 want to document all the islands by one means or another on  
 21 each atoll.

22 Let us turn to the question of internal hazard.  
 23 Domestic animals and natural foodstuffs were suggested. On  
 24 Rongelap I think you could say that the domestic animals  
 25 that were there are no longer there.

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1 CDR. CRONKITE: Rongelap Island, they were not  
2 there, but there were quite a few hundred chickens on the  
3 northern island.

4 DR. BUGHER: To the very far north.

5 CDR. CRONKITE: Yes.

6 DR. BUGHER: Do you expect to find any surviving  
7 chickens?

8 CDR. CRONKITE: They were supposed to be there.  
9 Whether they are alive, nobody ever got up there. Which  
10 island did you get to?

11 LT. CHAPMAN: Aniola. That is about five miles  
12 north of Rongelap.

13 CDR. CRONKITE: You didn't get any there?

14 LT. CHAPMAN: There are no chickens there. They are  
15 farther north.

16 DR. BUGHER: The farther north you go, the less  
17 likelihood there will be of a surviving chicken. What was  
18 the estimated total dose on the far north?

19 DR. DUNNING: The infinity dose was 7,800 roentgens.

20 CDR. CRONKITE: Chickens won't survive 1,000 r.

21 MR. HARRIS: Are there any rats left out there?

22 DR. BOND: I didn't see any at Rongelap.

23 DR. BUGHER: I think you have to assume that all  
24 the vertebrate population in the northern islands would be gone  
or not there any more. Chickens and pigs will be put back on

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1 Rongelap when people return. They have been put back on  
2 Uterik now. So the domestic animal supply is going to be  
3 practically speaking animals introduced after the environment  
4 has become acceptable for human habitation. Can you get much  
5 out of that or not? That depends on how much low level  
6 studies one wishes to do over a period of time. It would  
7 certainly appear to be worthwhile to have a certain number  
8 of domestic animals with the idea of sacrificing them after  
9 a time, or lease accumulating bones after a year or so  
10 from the standpoint of their uptake of fission products.

11 DR. BOND: Dr. Bugher, along that line, wouldn't it  
12 be as good or better to return material to the most active  
13 areas? I am not interested in determining how much the  
14 animals pick up from the environment. If we know what we  
15 gave them and how much they took up, we would have valuable  
16 information.

17 MR. HARRIS: Might it be reasonable to suggest  
18 that some domestic animals be put back on the islands on  
19 Rongelap itself, when you go out the next time, and those  
20 animals could be left during this interim which might  
21 possibly give you an idea of what the translocation range is  
22 before the natives come back.

23 DR. BOND: That again is for animals, and will  
24 be eating different food from the human.

25 MR. HARRIS: I am not thinking of extrapolating

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1 to human beings. These people will introduce animals when  
2 they get back there. There may be a concentration of certain  
3 isotopes, such as strontium 90, for instance, in these  
4 animals or in the meat parts of these animals, which would  
5 be subsequently eaten by the natives. If you put animals  
6 back, immediately you would get an idea at measurable levels  
7 of what this translocation rate might be. Remembering that  
8 people are going to eat these animals later on.

9 CDR. CONARD: They won't eat the bones.

10 DR. BUGHER: What about taking Rongelap soil  
11 somewhere else and doing studies?

12 DR. BOND: If you are going to do that, you should  
13 know what you gave them, and not turn them loose at random.

14 It seems it is a pretty haphazard thing of putting  
15 animals there to see if they do or do not take up the  
16 material.

17 DR. BUGHER: The sort of thing you are speaking of  
18 is a matter of past record. It is not the haphazard  
19 situation that you are really interested in.

20 DR. ROBERTSON: I don't think it is a matter of past  
21 record. Things have been given in more or less purified  
22 chemical form, but I don't think they have been mixed with  
23 anything that would compare with Rongelap.

24 MR. HARRIS: Isn't the haphazard normal in this case?

DR. BUGHER: That is the normal.

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1 MR. HARRIS: This is what you are interested in.  
2 I am interested from the point of view of the natives and  
3 getting a practical experiment, rather than a laboratory  
4 experiment out of it.

5 DR. ROBERTSON: Are we asking for both?

6 MR. HARRIS: Personally I am not interested in  
7 either one of them, but I am suggesting that be done.

8 DR. BUGHER: It goes to what you are trying to  
9 establish. If you are trying to document the environment  
10 and what a pig, let us say, at Los Angeles, let us say, might  
11 do with respect to that material thrown into its food supply,  
12 is a matter of rather remote relevance to the island  
13 situation. We have such studies that were made of mixed  
14 fission product from weapons tests, not necessarily from that  
15 atoll. We did have 500 pounds returned, some to Beltsville and  
16 some to Los Angeles and Hanford. We have a lot of work in  
17 Nevada which is concerned precisely with that, and the uptake  
18 from the soils contaminated with fission product outfall.

19 CDR. CONARD: I think if you put some dogs on the  
20 animal, they would be more comparable to the human situation.  
21 They are quite as dirty as pigs and chickens in their eating  
22 habits.

23 DR. DUNHAM: But if you leave them there alone.

24 CDR. CONARD: I mean after they go back.

25 DR. BOND: It has been quite a problem of getting

1 the animals out there, and having to keep them alive for  
2 a stated period of time. There is no one on the island, no  
3 water supply and no natural food supply, It is not an easy  
4 problem.

5 DR. BUGHER: Unless an investigation or experiment  
6 really is relevant to the main issues of giving us sound  
7 information on the character of the environment, I don't  
8 think we should undertake it. Just putting a few dogs on  
9 the island when there are no people there is a fairly major  
10 venture. Those dogs will run about \$5,000 each by the time  
11 you get them on the island. Then you ask the question, what  
12 do you get out of the venture, and I think you would come to  
13 the conclusion that you would not get very much, that would  
14 be descriptive of the island.

15 DR. DUNHAM: What would you expect to get from the  
16 data that would be important to the data of NRDL?

17 MR. HARRIS: I don't know. In one edible part you  
18 might find some concentration. This would be in the liver,  
19 for instance. I assume these people eat the livers of their  
20 chickens. According to the NRDL data, at least in the case  
21 of the fish, there is a fair concentration in the fleshy  
22 parts of the fish that are eaten. I really don't know. This  
23 was just a suggestion that I thought might have some  
24 application in/real long range thing, which is Operation Gabriel

25 DR. BUGHER: Yes.

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1 MR. HARRIS: Then this might have some long range  
2 applications as far as Operation Gabriel is concerned.

3 DR. BUGHER: In this consideration, how do you feel  
4 about simply taking specimens at intervals as the islands are  
5 visited from their pigs, from their chickens and dogs, and  
6 from the people as they die, too, if you can possibly get  
7 the material, without making a special planned location of  
8 experimental animals? That is our Gabriel program which is  
9 essentially an empirical one, soil, plants, and animals,  
10 and locations of fission products. That costs almost nothing,  
11 then, in terms of manpower and time.

12 Wild animals might have been mentioned here. It  
13 is really implied in the fauna. The shell fish and crabs.  
14 Some of these islands have high populations of crabs, or did.  
15 I don't know what the situation would be now. It has always  
16 been an impressive thing that at Eniwetok, certain of the  
17 islands are favored localities for particular species of  
18 crabs. You find large populations of particular species on a  
19 particular island. I believe that holds true on the other  
20 atolls generally.

21 CDR. CONARD: Are these edible crabs you are speaking  
22 of?

23 DR. BUGHER: Yes, I presume they are.

24 CDR. CONARD: I have seen a lot of crabs there,  
25 but I wouldn't eat them, probably.

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1 DR. BUGHER: It depends on how hungry you are.  
2 Is the big cocoanut crab eaten?

3 CDR. CRONKITE: They didn't list that crab, as I  
4 recall, in their list of items that they used. They at  
5 practically everything other than that.

6 DR. BUGHER: There must be some reason for that. In  
7 the surveys, specimen material of these various indigenous  
8 fauna would be desired to these various groups concerned with  
9 these analyses.

10 Under natural foodstuffs, do we mean the plants or  
11 the plants and fish?

12 CDR. CRONKITE: All of it.

13 DR. BUGHER: Specimens have been taken of cocoanuts,  
14 I believe.

15 MR. COHN: Cocoanuts, bannanas, papayas. I think,  
16 however, at the time the specimens were taken, it was too  
17 early to expect any incorporation of the fission products into  
18 the plant material itself. However, it will be desirable to  
19 study this at later intervals. That material does get into  
20 plants. We have pretty good indications of it in the  
21 fact that there is very high activity in the sap of the cocoa-  
22 nut tree. This is bound to be incorporated into the fruit  
23 some time later.

24 DR. BUGHER: You had cocoanut samples, too.

25 MR. COHN: There was no activity found in the edible

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1 portions of any fruit.

2 DR. BUGHER: That is interesting. I had the  
3 impression that the cocoanuts also were showing activity.  
4 But the sap of the palm did, is that correct?

5 MR. COHN: Yes.

6 CDR. CRONKITE: Is there any possibility that those  
7 samples could have gotten mixed up? There was one sample of  
8 juguru that was sitting out in the open, and there were  
9 other samples that were taken from the palm.

10 MR. COHN: We have three samples from Rongelap  
11 and three from Uterik, and they are all pretty consistent.  
12 The Uterik samples are one third of the activity of the  
13 Rongelap.

14 LT. CHAPMAN: In each instance there were two  
15 samples of material that had been exposed for five or six  
16 weeks, and one sample from Rongelap and one from Uterik which  
17 was collected fresh, and they were labeled.

18 DR. BUGHER: No question of contamination from  
19 the container or anything.

20 MT. CHAPMAN: No, sir.

21 CDR. CONARD: Only in the one sample there was no  
22 question of contamination.

23 LT. CHAPMAN: No, we took our own containers.

24 MR. COHN: The activity was of the level of one

25 MR. COHN: There was no activity in the...

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1 contamination.

2 MR. HARLEY: We ran some of those, and the  
3 interesting feature to me was that on the two islands the  
4 water sample and the cocoanut sample were almost identical.  
5 It was just about the same activity.

6 MR. IMIRIE: That is just what I got, too.

7 CDR. CRONKITE: Dr. Bugher, there is a point that  
8 comes up almost you might say in experimental design that  
9 where the method by which the sample is collected is so  
10 important in the interpretation of the results, I just have  
11 a strong feeling that people that are doing it in the  
12 laboratory or someone that is working with them should do the  
13 collection. I presume that this juguru did have radioactive  
14 material in it, but if it were collected in the way in which  
15 the natives ordinarily collected it, I think it would be  
16 difficult to prove that it was coming from the external surface  
17 of the palm, rather than incorporating into the sap.

18 MR. HARLEY: You could tell that from the radio  
19 chemical studies.

20 MR. HARRIS: This is so hard. It is so much  
21 easier to have somebody there on the spot who is doing the  
22 actual collection, and who goes back to the laboratory  
23 and sits down and tells everybody in the laboratory what has  
24 been done. I think you might run into the same thing on the  
25 fish. Dr. Donaldson and those people from the fisheries

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1 lab, will certainly collected plenty of fish, because they  
2 always do, but the ones who are doing the project, like Vic's  
3 group at NRDL, who are going to do this project, I presume,  
4 they should have somebody there at the time these fish are  
5 collected, and they should have a representative sample of  
6 the fish collected to take back and do their own analyses on.  
7 You can't take analyses from another laboratory and correlate  
8 them with those from a previous laboratory, and make a lot of  
9 sense. It is so much easier to have somebody there out of  
10 the operating group at the time of collection.

11 DR. BOND: This is precisely the reason why the  
12 people want to go to the field and collect the samples. They  
13 will then be well aware from where the sample is being  
14 derived.

15 Also, the reason why they wanted a more easier  
16 method of collecting that could be accomplished by air as  
17 accomplished previously, there was a continuous rush,  
18 continuous routing by the pilots to get back.

19 DR. BUGHER: You can't do good sample collecting  
20 under those circumstances. I don't think there is any  
21 argument there.

22 In regard to the plant samples, I think it will  
23 be recalled that this type of information is extremely  
24 interesting to plant physiologists, and bears very much on  
25 the concept of how contamination moves in plants, particularly

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1 those supplying edible things. This very matter of finding  
 2 materials in the sap of the palm and less or little in the  
 3 cocconut at that time, is a very significant thing, and points  
 4 to the critical character of the sample collection. It has  
 5 to be done very carefully, and with regard to rather a great  
 6 variety of interests which other people may have in the  
 7 material.

8 Are there any other comments?

9 CDR. CRONKITE: I recall in the survey group, Col.  
 10 Byers was following the general philosophy on plant life  
 11 that the initial ones would be where most of the naturation  
 12 of the fruit had taken place prior to the fallout. Then  
 13 somebody was going to take the initiative to investigate what  
 14 is the normal life cycle of a cocconut, and these various  
 15 edible things, and then base the subsequent sample  
 16 collection so as to get some that are maturing and some  
 17 that are completely matured, and get a third or fourth  
 18 generation of fruit. It seems that the whole sample  
 19 collection will fall down unless it is tied into the life  
 20 cycle of the fruit.

21 DR. BUGHER: You are speaking of the life cycle  
 22 of the particular piece of cocconut you have on your hand  
 23 or the cycle of the fruiting of the palm? With the cocconut  
 24 it is a continuous process practically. Some are mature  
 25 as others are just coming on in the infleuresence. That

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1 becomes a matter of description more of the specimen at the  
2 time of collection, then.

3 Byer's group did take various specimens. Where  
4 did they go -- to NRDL?

5 MR. COHN: Yes.

6 DR. BUGHER: Are those still in process?

7 MR. COHN: These have been thoroughly analyzed.

8 These are the results just mentioned.

9 DR. BUGHER: There you got a whole cocoanut which  
10 was then opened in the laboratory.

11 MR. COHN: Yes.

12 DR. BUGHER: So you control the matter of how  
13 the material you analyzed was actually taken with reference  
14 to external contamination. Did you get much of anything from  
15 the cocoanut milk?

16 MR. COHN: No, very little activity in the cocoanut.  
17 In the pandana was the only case where there was any  
18 internal activity, and here the question is possibly contamina-  
19 tion by washing. The foods were all washed externally, and the  
20 external wash was analyzed radiochemically. The pandana  
21 has a rough core, something like pineapple, and there is a  
22 possibility that the material was washed into it. But outside  
23 of this, there was no activity.

24 MR. HARLEY: It is very hard to determine how to  
25 clean a pandana.

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MR. COHN: Yes.

DR. BUGHER: Do we need further comment on this phase of the matter? Dudley is here. You have heard this discussion. Do you have some thoughts in regard to the types of samples which should be forthcoming here, and the way they should be handled?

DR. DUDLEY: I think perhaps one should give some consideration to the isotope mainly interested in, which is mainly strontium, but perhaps not exclusively that. One would I think try to collect samples which conceivably would have considerable concentration of that. For example, I believe at Hanford they find comparatively little concentration in fruit. In the tomatoes they find much more in the leaves. I think one should bear in mind the element one is interested in, and what type of plant is likely to concentrate. I think everything should be tied back in case of plants back to the soil.

MR. HARLEY: As far as we are concerned, you would have to have corresponding soil and plant. I think everybody is probably in the same boat. If you are thinking of uptake studies, that is what you would want.

DR. BUGHER: One of the complicating things here is that if you take a coconut palm, the degree of absorption from the leaf surface is something that I have no idea about. Maybe you have some data on it. But assuming that it does

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1 occur, then the material of the palm sap and that which  
2 comes into the fruiting bodies may be derived either from  
3 leaf surface contamination or by way of the roots from the  
4 soil. The palm frond is rather persistent, surviving  
5 for two or three years before it gets old, and then  
6 eventually dies and falls off. The contamination, therefore,  
7 of the frond may persist as a factor in the situation for a  
8 considerable length of time. There may be a discrepancy  
9 between the soil levels and the apparent uptake in the fruit.  
10 There is where I think more precise plant physiologist, the  
11 one who knows a lot about palms, comes to the fore, that is,  
12 in guiding us somewhat on what vegetation specimens one  
13 might take to advantage. It makes a big difference on which  
14 palm frond you take.

15 CDR. CONARD: One thing that might be interesting  
16 to do that is not a great deal of trouble is to take  
17 leaf radio audiographs before the leaves get wilted. It  
18 is very simple to put them between film and enclose them in  
19 paper.

20 DR. BUGHER: That would be a very good guide.  
21 It is an easy technique and thoroughly reliable in its  
22 application. Obviously, then the group taking the  
23 environmental specimens will need to keep in close touch  
24 with a number of other groups and organizations on the  
25 sample collection project.

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Now, we have a topic here of radiochemical studies, the extent to which radio chemistry should enter this environmental analytical picture. John Harley, that seems to be very squarely in your area of interest.

MR. HARLEY: There are a lot of other people involved in that, too. We have been doing some work on things that I am not sure are entirely useful, such as this fractionation -- geographical fractionation of material -- and that is certainly something that we would continue. In other words, our initial work was all on strontium. We now find that we can use cerium moderately well as a long term base line similarly to what they use molly for in short term studies. That seems to be fairly constant.

I think perhaps after some of us can talk this out a bit, it is going to be very-necessary to decide what is run in these different places so we can use the results from one laboratory to another. Certainly I think something like cerium might always be valuable for us in our comparisons.

We know pretty definitely that we may have the ruthinium problem here, and it certainly is present in high percentages. If what the British say is correct, we will be wanting to get a lot of information on that.

We have found that relations are not such that we can get all the information we would like. Therefore, we frequently have to scratch around with other people to work

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1 up procedures that they should be running rather constantly.

2 For example, we had to work out completely new  
3 ruthinium procedures to handle many of the types of samples  
4 we have. I think Payne was mentioning that they were taking  
5 other methods and trying to adapt them. I think sometimes  
6 we have to exchange experiences again in these wider fields  
7 just as we have gone through in the strontium procedure.

8 DR. BUGHER: Yes.

9 MR. HARLEY: We have done an awful lot of our  
10 work on these initial samples on just mixed fission products  
11 in trying to collect total activity. I don't know how many  
12 other people are doing that sort of work. We use it as a  
13 rough guide for a lot of things. If so, we would like to  
14 get together with them, too. I think it is going to require  
15 a certain amount of coordination or the final report is not  
16 going to mean too much. We have to decide both what we do  
17 as a general procedure, and more or less how we do it.  
18 Then individual labs may want to run half a dozen other things  
19 but that is up to them. I think for general procedures we  
20 are going to have to get together. You are thinking then  
21 in terms of strontium, cerium and ruthinium as specific  
22 isotopes.

23 What we would run on any sample now probably  
24 would be strontium, cerium, ruthinium, some of them still  
25 require barium because it is not all gone yet, and in

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1 addition total rare earths and zirconium. With those you  
2 can generally come up with a pretty fair percentage. But  
3 you see when we send you a strontium result and a cerium  
4 result, right away you say what is the rest of it. So somehow  
5 we want to get some sort of a total figure that will  
6 represent more or less what the activity is.

7 DR. BUGHER: The total activity.

8 MR. COHN: We have been doing strontium, barium  
9 and the rare earth group. On the fish we have broken it  
10 down a little further and try to do individual isotope  
11 analysis on zirconium and ruthenium.

12 Further than this we have not gone because of the  
13 difficulty of doing a large number of samples. It is quite  
14 a tedious procedure. Strontium, barium and rare earth  
15 group in most of our samples accounted for 70 to 80 per cent  
16 of the beta activity.

17 DR. BUGHER: How about plutonium in the soil?

18 MR. HARLEY: We have not run any yet. We have  
19 plans to. I don't know about Payne.

20 MR. COHN: We have plutonium outside of the fruit,  
21 coconuts, papayas of the order of 10 to the fourth  
22 micrograms of plutonium.

23 DR. BUGHER: On a fruit, I take it.

24 MR. COHN: Yes. We have also measurements of  
25 plutonium on thatch taken from the top of the native huts,

1 on grass and soil, running about 10 to the third micrograms.  
2 That is at a fairly early interval.

3 MR. HARRIS: You might think of plutonium as one  
4 that you could follow. One thing I have thought of that  
5 would worry me a little bit would be the fact that in  
6 order for a long range application of this to Gabriel, it  
7 means a fairly long time study in which, due to leaching  
8 in transportation, some of the samples are going to go down  
9 in activity relatively fast. Plutonium, however, is one thing  
10 that you can follow for a long period of time, much longer  
11 than you can some of these others, because of its decay  
12 rate, and its longer half life.

13 Another thing that you might think of is this:  
14 Do you have numbers on the coral as concentration of uranium,  
15 and this sort of thing? Do you have those numbers?

16 MR. HARLEY: We have a couple of them analyzed  
17 but we managed to sneak away a few museum pieces.

18 MR. HARRIS: There are numbers available on  
19 that area for blanks on alpha emitters in the coral, and  
20 these can be gotten if you need them.

21 Here is another thing. In some cases, you might  
22 be looking at an alpha, which might turn out to be uranium  
23 or thorium, if it was put on an alpha spectrum analyzer. At  
24 low levels where you get high grass location rates or  
25 high leaching rates, you might run down very soon to the point

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1 where you would need to know what these backgrounds were.

2 MR. COHN: I think I better throw one correction  
3 in here. I said ten to the fourth. Those figures are ten  
4 to the minus fourth, and ten to the minus third.

5 MR. HARRIS: That is what I was thinking, that the  
6 whole island was going to go critical here.

7 DR. BUGHER: That is a lot of material, isn't it?

8 MR. HARLEY: That is per gram --

9 ER. COHN: In the thatch that is five times ten  
10 to the minus third per three gram sample. Soil is about one  
11 times ten to the minus third for a one gram sample of soil.

12 MR. HARRIS: Now you are getting down to the places  
13 close to the background already, and you will have to take  
14 sooner or later such as the natural blank alpha activity.  
15 They are available. The places to get them are from the  
16 radiochemical group at Los Alamos, who has to analyze this  
17 all the time. This has been done out there. There are  
18 other interesting things that might be of interest here.

19 For instance, among this coral that fell down on  
20 the island was an added amount of uranium which was set up  
21 alongside the experimental device to be able to subtract  
22 out the coral blank. **DELETED**

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Various matters like this may have to be taken into consideration. You put so much there that the concentration is so much higher than the coral blank that when you add the coral blank into this mass the error introduced by adding the coral is very small and you can use the concentration that you find as a fraction of how much was set there.

DR. BUGHER: That is what they call keeping environment simple and untouched.

MR. HARLEY: Considered as a tracer.

MR. HARRIS: It was a tracer, yes.

DR. BUGHER: That is very helpful. I think perhaps if any of you have some thoughts from time to time on these things -- that is an important element which I missed entirely before, I don't know anything about the extra uranium being added to the blank situation -- I think all of us could very well spend a little time thinking a bit about things that are needed in this picture, things which should be analyzed for, the limitations, and if you have a thought like that, send it in and we will be glad to circulate it.

MR. HARRIS: These are things that come up and I just

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1 happened to think of this one that occurred. You can also  
 2 get such things as how much plutonium was made in the  
 3 device during the detonation. This knowledge you will  
 4 probably have some use for.

5 DR. BUGHER: We have that, yes.

6 MR. HARRIS: I don't think this can go into  
 7 this unclassified report.

8 DR. BUGHER: No.

9 ~~DELETED~~  
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11 some of these numbers and come up with some better estimates.  
 12 The majority of this information I am certain can be made  
 13 available again by an on the spot situation by people who  
 14 are doing this going to the radiochemical people at Los Alamos

15 MR. HARLEY: One other point along that line. We  
 16 found if you run a sample and find out it has five per cent  
 17 of strontium 89, everyone says how does that compare with  
 18 Hunter's curves. Is the data on fast fission readily  
 19 available now? We have been working through Biology and  
 20 Medicine, and have not been able to get it out of anyone yet.

21 MR. HARRIS: You mean the mass yield ratio and this  
 22 sort of thing? Yes, I think that material is all essentially  
 23 unclassified. The things you would be interested in, such  
 24 things as ratio of uranium to 237 of course would not be. The  
 25 majority of that is unclassified. I asked at one time a

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1 couple of years ago about this situation as far as it  
2 pertained between ordinary 25 and 49. The best guess that  
3 Rod Spence was able to give was that the original curves  
4 which were made from U 235 should hold well for plutonium.  
5 I think that information is available somewhere to you and  
6 probably on an unclassified basis.

7 DR. DUDLEY: I am wondering if the discussion here  
8 of plutonium implies that there is to be a fairly serious  
9 study of plutonium from the point of view of Gabriel?  
10 Is this implied?

11 DR. BUGHER: Yes, it brings it in.

12 MR. HARLEY: That was considered definitely as part  
13 of it.

14 DR. BUGHER: Yes. In contrast to the situation  
15 before, where we had such small amounts that it did not  
16 really significantly come into the picture. Now with this  
17 very large amount of capture, it certainly is something we  
18 will have to go into.

19 DR. DUDLEY: The calculations relative to thermo  
20 nuclear weapons would not be different from the strontium  
21 to plutonium ratios than the original calculations for  
22 straight fission weapons?

23 MR. HARRIS: I think maybe they would be because  
24 of the presence in supers now of a fair amount of normal  
25 uranium which is much higher than the relative amount in

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an ordinary fission weapon.

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MR. HARRIS: You mean half as much captured? I don't know. I haven't got specific figures on it but you could get these from radio chemists.

DR. BUGHER: You are speaking about captured fission ratio?

MR. HARRIS: What was that again?

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DR. DUDLEY: This would change the ratios by per cent and not orders of magnitude?

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1 MR. HARRIS: That would change it in that case in  
2 orders of magnitude.

3 DR. BUGHER: I think the ratio here is not far  
4 from one. The figure we have been using is .9. You  
5 mentioned .8 yesterday.

6 DR. DUNNING: I did.

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13 DR. DUDLEY: I was thinking of the comparative  
14 hazard of the quantity of strontium and quantity of plutonium  
15 produced. Has it been suggested that the hazard may be  
16 comparable?

17 MR. HARLEY: My first calculations were that on  
18 an internal deposition basis, they would be about equal.

19 DR. BUGHER: That is something we have to keep in  
20 mind, and reconsider from time to time. I think that  
21 has been a very helpful discussion. We are coming near the  
22 time of compulsory adjournment.

23 If I can very compactly summarize what we have  
24 covered, we have reviewed the background and the data  
25 obtained from the first study of these people. We have

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1 pretty well agreed that the type of study which was made  
 2 in the acute phase will need to be continued for an  
 3 indefinite time, but with a changing emphasis from what  
 4 might be called acute problems to the long term effects  
 5 which are particularly likely to manifest themselves in  
 6 such things as shortening of life, the occurrence of tumors,  
 7 both superficially and deep, and in bone changes, which may  
 8 be of a minor nature. I think the expectation is that the  
 9 long range results of the exposure of these people are not  
 10 likely to be at all spectacular. One would have to look  
 11 carefully and use rather critical statistical judgments in  
 12 all likelihood to be able to say that anything will have  
 13 occurred strictly due to the radiation. It points to the  
 14 necessity of conducting continued studies in a very  
 15 meticulous manner with precise recording of observations  
 16 and data which will permit the type of statistical considera-  
 17 tion that may be necessary.

18 We have agreed that the medical studies need not  
 19 be tightly bound to the environmental studies; that two  
 20 more or less separate groups can do these two things. I  
 21 think, though, we all concede that everybody is interested  
 22 in what everybody else is doing in this study and it doesn't  
 23 mean that cross information won't be freely flowing. It looks  
 24 as though the NRDL group probably should be called on for  
 25 the first medical study of the Rongelap people, and also

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1 the first environmental study and specimen collection.

2 The minutes here of this conference will give  
3 suggestions as to the types of materials to be collected  
4 and precautions with respect to collecting them. I think  
5 we will be able to further advise the collecting group about  
6 types of material to be sampled and precautions to be  
7 exercised in caring for it, and the places in which some of  
8 these specimens should go for further analytical study.

9 We may well find that two or even three groups  
10 are interested in analyzing for the same thing. Especially  
11 in these low level things I don't believe there is any  
12 objection to that. If we talk about strontium 90, we may want  
13 to send around to each of the participating laboratories a  
14 standard ash, which we do have, containing strontium 90.  
15 It has been useful in checking strontium 90 analysis in  
16 one place as against at another.

17 I think as to the organizational matters we have  
18 really covered that. This Division will attempt to be  
19 a coordinating center and work with the services, with the  
20 trust territory administration, and many of the problems  
21 we encounter we will have to ask for help from one or the  
22 other of the various services that have special facilities.

23 Some points are left somewhat undecided. For  
24 example, whether or not to use aerial survey techniques and  
25 the extent of ground survey. I think we will need to

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1 discuss those a little more extensively.

2 Capt. Yarbrough, can you think of anything which  
3 should be added here?

4 CAPT. YARBROUGH: No, sir, at the moment I have  
5 nothing to add.

6 DR. BUGHER: We will have plenty of detailed  
7 problems and we can solve those as they come up. We hope  
8 that the work on the report now goes along expeditiously,  
9 and we will all try to do our best in helping the people who  
10 have to turn out the report to get their job done. We expect  
11 two sections. Section 1 will come a little before Section 2,  
12 I presume, being a little less bulky. Do you have any  
13 further comment, Gene?

14 CDR. CRONKITE: No. I think it has been most  
15 gratifying to get clear in everybody's mind what the  
16 administrative machinery is and we shall now try to deluge  
17 you through our channels for a lot of things for you to  
18 integrate in the very near future.

19 DR. BUGHER: It will be a single integral, I  
20 hope, and not a double.

21 We appreciate very much your all giving your time  
22 to this program. I hope you realize that our statements of  
23 appreciation are really very much understated.

24 As far as the whole conduct of this program is  
25 concerned, that is true.

Incidentally, the Russian resolution yesterday

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1 was rejected by the Committee on Petitions, the Russian vote  
2 being the only one in favor of it. So at least as it stands  
3 in the UN, the United States doesn't stand condemned as  
4 having been derelict in its duty.

5 There will be another set of resolutions coming  
6 up for consideration tomorrow.

7 MR. HARRIS: One thing you have forgotten. This  
8 name on the conference thing is rather long. I would like  
9 to propose a name for this project. Could you call this  
10 SBCC, the Super Bomb Casualty Commission?

11 DR. BUGHER: Very good. Thank you.

12 We appreciate all these things that result in  
13 shortened labor.

14 (Thereupon at 3:10 p.m., the conference was  
15 concluded.)

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