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RECORD GROUP 181:

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BOX S54

FOLDER All/Castle 0010546

(11)



$$I = I_1 \left( \frac{t}{t_1} \right)^{-a}$$

where I is the intensity or dose rate at time t, I<sub>1</sub> is the measured dose rate at time t<sub>1</sub>, and a is the decay exponent.

Total dose for each exposed group was obtained by integrating the decay function between the limits of fall-out time and time of evacuation.

Clinical Findings: A large percentage of individuals in the Rongelap group were nauseated the day of the fall-out, and a few vomited. In the Ailingnae group only one was nauseated and none vomited. In the remaining lower-dose groups there was no nausea or vomiting.

Aside from skin and hair manifestations to be described below, there was no further clinical findings in any of the groups that could be unequivocally attributed to radiation. Sick call was held at least once daily and the usual variety of common diseases was seen in all groups. All illnesses were treated as they would have been in unexposed populations, and at no time were antibiotics or other drugs given prophylactically because of the radiation received. In general there was no malaise or lethargy that could be ascribed to radiation.

Skin findings, depilation: Itching and burning of the skin on the night of the fall-out was reported by the Rongelap group. Skin lesions and depilation appeared during the early part of the third post-exposure week in this group, and within a few days essentially all persons evidenced skin lesions and/or depilation. Depilation was spotty and was confined to the scalp. Skin lesions were confined almost exclusively to areas where the fall-out was in direct contact with the skin, and were common in the scalp, neck, axillary, antecubital fossae and dorsal foot areas. The lesions were superficial in nature, and progressed to desquamation followed by rapid healing in essentially all cases with a tendency to hyperpigmentation.

Biopsies of these lesions showed very superficial changes characteristic of beta lesions. These findings, coupled with the long latent period before their appearance, and the close correspondence between scalp lesions and depilated areas, indicate conclusively that the etiology of the lesions is associated with radiation and not chemical damage.

The Ailingnae group showed skin findings and depilation similar to those of the Rongelap people. However the incidence and severity was considerably less, and lesions appeared later and healed more rapidly. There were no skin lesions in either the Rongerik or Utirik groups ascribable unequivocally to radiation, and no depilation occurred in these groups.

A bluish discoloration of the nail bed was a frequent finding in the Rongelap group, less common in the Ailingnae group. In the Rongerik group, only the four negroes evidenced this finding.

Hematological Findings: The Rongelap group showed severe depression of the total white count, the lymphocyte and neutrophil counts, and of the platelet counts. The lowest mean platelet count occurred in the fourth and fifth

post-exposure weeks, and many counts fell below 100,000/mm<sup>3</sup>. The total white count was severely depressed into the fifth and sixth week, with some neutrophile counts below 1000. The lymphocyte count fell early to a level of 2000/mm<sup>3</sup>, which was maintained throughout the period of observation.

Hematological changes in the Ailingnae were similar to those in the Rongelap group; however, all changes were considerably less severe. Blood counts on the Utirik group were lower than control values; however, it is doubtful that the small changes seen are of significance statistically.

Internal Hazard: Insufficient data are as yet available to evaluate the extent of internal contamination. Beta and gamma activity was present in the urines of all exposure groups. Animals recovered from Rongelap Atoll showed extensive deposition of beta and gamma emitters in the long bones. This problem is under intensive study.

Conclusions: Although final conclusions cannot be drawn until data are completely analyzed, it is certain that the results of this study will bear heavily on a number of problems of military importance. A very preliminary discussion of some of these problems follows:

1. Gamma radiation from fall-out obviously can be a very serious problem. A northern island of the Rongelap Atoll, where these people frequently live for weeks at a time, received total gamma doses in excess of 1000 r. Had these people been on that island at the time of fall-out, 100 per cent mortality would have been virtually certain.

2. Serious fall-out can occur 7 hours or more after the detonation, and at great distances. At this late time, the early, very-steep fall in dose rate has already occurred and the dose rate is relatively constant. Hence there may be adequate time for countermeasures. Early evacuation or other effective evasive action will reduce the total dose by a large factor.

3. Beta radiation from fall-out can definitely be a problem in the absence of lethal doses of associated gamma radiation. Although late in appearing, some of the skin lesions seen in the Rongelap people were sufficiently serious such that they very probably would have been admitted to the sick list under ordinary circumstances. Of equal importance, however, is the ease with which such lesions can be avoided with simple countermeasures. All lesions apparently resulted from material deposited directly on the skin; none from beta radiation on the ground, bulkheads or even clothes. A single layer of very thin cloth was sufficient to protect. Thus it would appear that adequate covering, or early skin and hair decontamination, would completely eliminate this hazard.

The skin lesions were superficial, healed rapidly and gave no indications of deep involvement. This was borne out in the histological sections. Also, some clinical evidence, and especially hematological data, indicated a large component of penetrating gamma radiation. There was no clinical or laboratory evidence of an appreciable contribution from radiation of energies between these two extremes.

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The degree to which these findings apply to fall-out in general, or to the Bravo shot only, should be investigated. The high relative Neptunium activity in the Bravo fall-out material may have been responsible for the beta lesions observed. In addition, the decay exponent of 0.92, used instead of the usual 1.2 in calculating the total doses, was derived from considerations of the growth and decay of Neptunium over the time period of interest. These considerations are under study at present.

4. Although data are very preliminary, some degree of internal contamination occurred in all exposure groups. It is in a sense fortunate that there were two exposure groups, both receiving approximately the same total gamma dose from fall-out (Ailingnae and Rongerik groups), whose actions following the fall-out were entirely different. The Ailingnae took essentially no precautions, and ate and drank obviously-contaminated food and water. The Rongerik individuals ate and drank only from closed containers. It is hoped that a careful study of these groups may shed light on the ingestion problem and perhaps yield information on the inhalation problem as well.

5. The degree of hematological change, and the presence of nausea in the group calculated to have received 117 r do not appear to be commensurate with that dose level. It is possible that further study will indicate that a decay exponent closer to 1.2, rather than the 0.92 used, should be employed. This would raise the calculated dose by some 30 r. Also, the degree to which internal contamination could have contributed to the findings remains to be evaluated. A further difficulty is that the exposed individuals received the total dose over a period of many hours at a low, but constantly changing dose rate. There are no previous comparable studies on man or animals with which the present findings can be strictly compared.

6. It is significant that at dose levels high enough to give severe hematological changes, there was no impairment of functional ability and no increase in the incidence of infections that could be ascribed to radiation. As with other clinical leukopenias, the individuals feel quite well until infection is contracted. The infection then may be quite severe and debilitating. The relative absence of infections in the present studies should not be generalized to indicate that infections in irradiated populations may not be serious. Although not hospitalized, the Marshallese were maintained in clean quarters. There was no lack of excellent sanitation, and water was available for frequent showering. The Marshallese are meticulously clean. In addition, the chance of exposure to pathogenic organisms was minimized by their physical location on a relatively isolated and clean Pacific Atoll.

7. The mean platelet count decreased and returned towards normal in a more regular fashion than did other peripheral elements. The relative merits of this endpoint as an index of the degree of exposure in a group deserves investigation.

8. The significance of these studies with regard to radia instrumentation requirements should be evaluated. In particular, the studies bear on the energies an instrument should record, on whether a dose-rate or integrating meter is most useful under the conditions encountered, and on whether an estimate of beta-ray dose would be useful.