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RESIDUAL CONTAMINATION OF PLANTS, ANIMALS, SOIL,
AND WATER OF THE MARSHALL ISLANDS ONE YEAR
FOLLOWING OPERATION CASTLE FALL-OUT

Research and Development Report USNRDL-454
NS 081-001
NM 006-015.04

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12 August 1955

by



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J. A. Seiler
W. H. Shipman
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U.S. NAVAL RADIOLOGICAL DEFENSE LABORATORY

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Effects of Atomic Weapons

Technical Objective
AW-7

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ABSTRACT

The amount and distribution of radioactive material remaining on several atolls and incorporated into the flora and fauna of the Marshall Islands was determined one year after their contamination by fallout from the March 1, 1954 nuclear detonation of Operation Castle.

Significant amounts of radioactive contamination were found in animals, food plants, water and soil samples. The highest concentrations of internally deposited activity were found in marine specimens taken from the northern Rongelap lagoon. Most of the activity in the marine specimens was contributed by Zr^{95} - Nb^{95} and Ru^{106} - Rh^{106} . No fractionation of Sr^{89} - Sr^{90} occurred in the tissue of the fish analyzed.

Residual soil contamination was confined to the top several inches of soil, with movement indicated down to the lens water.

The major radionuclide found in the tissues of land animals and plants was Cs^{137} . The island soil and lagoon water were contaminated principally by the rare earth elements, Ru^{106} - Rh^{106} and Zr^{95} - Nb^{95} . The amount of activity in the specimens analyzed was generally proportional to the external gamma reading in each of the areas.

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SUMMARY

Problem

The problem was to determine the amount and distribution of radioactive material remaining on several atolls and incorporated into the flora and fauna of the Marshall Islands one year after their contamination by fallout from the March 1, 1954 nuclear detonation of Operation CASTLE.

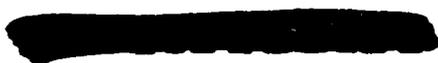
Findings

Significant amounts of radioactive contamination were found in the Marshall Island animals, food plants, water and soil samples. The highest concentrations of internally deposited activity were found in marine specimens taken from the northern Rongelap lagoon. Most of the activity in the marine specimens was contributed by Zr^{95} - Nb^{95} and Ru^{106} - Rh^{106} . No fractionation of Sr^{89} - Sr^{90} occurred in the tissue of the fish analyzed.

Residual soil contamination was confined to the top several inches of soil, with movement indicated down to the lens water.

The major radionuclide found in the tissues of land animals and plants was Cs^{137} . The island soil and lagoon water were contaminated principally by the rare earth elements, Ru^{106} - Rh^{106} and Zr^{95} - Nb^{95} . The amount of activity in the specimens analyzed was generally proportional to the external gamma reading in each of the areas.

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ADMINISTRATIVE INFORMATION

This is the final report of the Atoll Resurvey Project. The resurvey was made by this Laboratory together with Applied Fisheries Laboratory of the University of Washington, under the joint sponsorship of the Bureau of Ships and the Atomic Energy Commission, Bureau of Ships Project Number NS 081-001 and Bureau of Medicine and Surgery Project Number NM 006-015.04, Technical Objective AW-7.

The work was done jointly by the Chemical Technology and the Biological and Medical Sciences Divisions of this Laboratory.

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ACKNOWLEDGMENTS

The following men assisted in the analytical work described in this report:

J. A. Boyle, HN
G. A. Marquardt, HM1 (SS)
C. F. Vaught, HMC (SS)
H. R. Gleason, HM1
W. L. Milne

Sample collection was expedited by the work of the following personnel on field trips:

P. E. Zigman
E. C. Evans III
LTJG G. M. Neuffer
W. G. Murray

The authors gratefully acknowledge the help of all the individuals who assisted with the preparations for the field trips.

Dr. E. R. Tompkins was concerned with administrative and logistic support during the initial phase of the project.

Mr. Jarvis Todd assisted in the preparation of this report.

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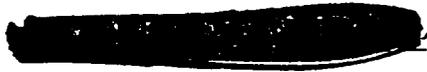
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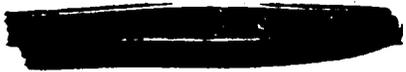
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CHAPTER 1

INTRODUCTION

As a result of a nuclear detonation in Operation CASTLE, several atolls in the Marshall Islands were accidentally contaminated by radioactive fall-out to such an extent that evacuation of the inhabitants was necessary.¹ Plants, animals, water, and soil were collected from the islands one month after the fall-out occurred. The animals not sacrificed at the site were sent to this laboratory and radiochemical analysis was made of their tissues to provide information on the internal radiation hazard. A report² of this study has been published.

As a follow-up to the original study a resurvey of the contaminated Marshall Islands was undertaken one year after the fall-out. Radiochemical analysis of food plants, fish, water, soil, coral, algae, and birds was made to determine the nature and extent of the internal and external radiation hazard created by the residual contamination on the islands. A gamma dose-rate survey was conducted to determine the external radiation hazard extant. Such data were necessary to determine the possibility of re-occupying the islands. The present report presents the data obtained from the resurvey of the contaminated islands.

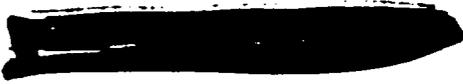
1.1 OBJECTIVES

This work was named the Atoll Resurvey Project, entitled "Follow-up Determination of the Extent and Distribution of Fall-out Contamination on Rongelap and Other Atolls in the Marshall Group." Its specific objectives were:

- a. To provide data upon which a decision can be based as to when the evacuated islands may be safely re-occupied by their former inhabitants.
- b. To provide information about distribution of the residual contamination on a land area which had been heavily contaminated by fall-out.

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CHAPTER 6

SUMMARY

6.1 CONCLUSIONS

Significant amounts of beta and gamma activity were found in the tissues of Marshall Island fish and marine invertebrates collected one year following exposure to the fall-out from Operation CASTLE. The highest concentrations of internally deposited activity was found in marine specimens taken from the northern Rongelap lagoon; lower concentrations of internal activity were found in specimens from the southern lagoon. The crabs, clams, and snails contained considerably higher concentrations of radionuclides than were found in the fish from the same area. Most of the activity in the marine specimens was contributed by Zr^{95} - Nb^{95} and Ru^{106} - Rh^{106} . There was no fractionation of Sr^{89} - Sr^{90} in the tissue of the fish analyzed.

Residual soil contamination was primarily contained in the top several inches of soil with movement indicated down to the lens water. The activity is being slowly leached off the islands by ocean tides. The major radionuclide found in the land food plants and in the tissues of land animals was Cs^{137} . The lagoon environment contained principally rare earth group elements, Ru^{106} - Rh^{106} , and Zr^{95} - Nb^{95} .

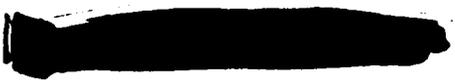
Radioactivity was found in all food plants on the contaminated islands. Supporting plant systems also contained a large reservoir of activity available for future incorporation into the plants.

The amount of activity in the specimens analyzed was generally proportional to the external gamma reading in each of the areas.

6.2 COMMENTS ON FUTURE WORK

In the event that future work is carried out along the lines initiated during this project the following suggestion may be helpful.

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Sampling of coconut tree sap, pandanus, and breadfruit would be greatly expedited by scheduling the major survey during the end of the rainy season, preferably in November. This would also allow a better study of the effect of rainfall on the leaching of activity from the soil into the lens water and from there into the lagoon or ocean.

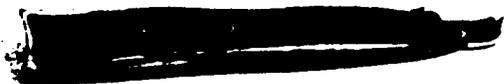
Studies on the movement of activity into the supporting plant systems might be broadened to forecast the transfer of more hazardous nuclides into reproductive fractions of the plants.

Approved by:



P. C. TOMPKINS
Scientific Director

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1. Cronkite, E. P., et al., Study of Response of Human Beings Accidentally Exposed to Significant Fallout Radiation, Naval Medical Research Institution and Naval Radiological Defense Laboratory, Operation CASTLE Project 4.1 Final Report No. WT-923 (Confidential) October 1954. Also, J. Am. Med. Assoc. 159:430 (1955).
2. Cohn, S. H., et al., Study of the Internal Radioactive Contamination of Human Beings and Animals and Contamination of the Environment Resulting From Fall-out in Operation CASTLE, Naval Medical Research Institution and Naval Radiological Defense Laboratory, Operation CASTLE Project 4.1 Addendum Report No. WT-936, (Confidential) 1955.
3. Hunter, H. F., and Ballou, N. E. Fission Product Decay Rates, Nucleonics, Vol. 9, No. 5, pp c-2 to c-7, November 1951.

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