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1979 Summary (2/28/80)

The Brookhaven National Laboratory Marshall Islands Study has been a longitudinal prospective follow-up of 245 Marshall Islanders inadvertently exposed to fallout radiation in 1954. This population is unique in that they received both external gamma and internal gamma and beta radiation from a mixture of radionuclides. This report will cover the period from 1 March 1979 to 1 March 1980, the 26th anniversary of the accident.

On 1 March 1954 the second thermonuclear device tested by the United States was detonated from a tower about 4:00 A.M. on the ~~Island~~ of Bikini in the Marshall Islands (Fig. 1, map). The weapon yielded about 15 megatons, more than twice its predicted yield, and the fireball rose to well over 100,000 feet where an unexpected windshear carried the fallout over a large elliptical area to the east. The nearest atoll, Rongelap (100 miles east), noted the onset of a heavy particulate fallout within 4-6 hrs. The 64 people of Rongelap (3 in utero) along with a party of 18 Rongelap (one in utero), who were on a trip to the nearby atoll of Ailinginae, were evacuated over a period of 50 to 58 hrs. A U.S. military weather-monitoring team of 28 men was stationed on Rongerik, 135 miles east of Bikini. They were evacuated within 29 to 34 hrs. The next atoll, almost directly east of Bikini, was Utirik at 270 miles. This group of 159 Marshallese was evacuated within 55 to 78 hrs. In addition, a Japanese fishing vessel, The Lucky Dragon V, was about 90 miles due east of Bikini with a crew of 23 who received significant radiation (Ref. 1, Appendix 3).

The details of the extensive initial work-up of the irradiated population is presented in the monograph, "Some Effects of Ionizing Radiation on Human Beings", of July 1954 (Ref. 2). Subsequently, Dr. Robert A. Conard assumed the responsibility as principal investigator for the study and retained that position until his retirement from BNL on 1 January 1979. At that time Dr. H.S. Pratt assumed the role of Principal Investigator.

This report will discuss only those findings pertinent to the 26th year of observation. The attention of the reader is directed to the 20 year report (Ref. 1) and to the 25th year report (in preparation).

OBJECTIVES OF THE STUDY:

I. The comprehensive medical follow-up of those Marshallese exposed to the acute effects of fallout on 1 March 1954.

II. The early detection and care of any conditions thought to be related to radiation effects.

III. A comparison of the morbidity/mortality of the acutely-exposed population with a "comparison" population selected from an unexposed Rongelap kindred that returned to the island of Rongelap in 1957 with the exposed group.

IV. The ancillary provision, whenever possible, for primary care of medical problems unrelated to radiation in cooperation with the Trust Territory, now the Marshall Island Government, medical care system.

WORKING HYPOTHESIS:

The acutely-exposed study population received both external and internal radiation, as previously reported. The dosimetry is discussed in detail in previous reports (1,2,3-14). The external gamma calculations seem fairly reliable and uniform for the population. The initial, individual internal body burdens of nuclides, especially a number of short-lived iodine isotopes, show much greater variation and uncertainty, even though radiochemical urinalyses were performed within 15 days on the pooled urines of the exposed population. On the 7th, 23rd, 24th, and 47th days post detonation, 24-hour urine collections from each individual from Rongelap and Ailinginae were sent to the New York Operations Office (AEC) for analysis. The quantification of the shorter-lived isotopes of iodine, particularly $^{133-134}$ - and ^{135}I , would be impossible to measure. Two of the younger (1 yr old at the time of exposure) Rongelap children (Studies No. 3 and 5) were noted to be clinically myxedematous at age 9. Subsequent evaluations have revealed almost total ablation of their thyroids (Case 3 greater than Case 5). This would suggest a thyroidal dose of at least 2000 rem, possibly more. Therefore, the dose to the thyroid in this small study group probably has a much wider standard error than was previously appreciated. The potential magnitude of this standard error imposes severe constraints on the statistical analysis of those data dependent on organ-specific dosimetry.

The enclosed tables present a synopsis of the significant data obtained during calendar year 1979. During this period 14 patients underwent thyroid surgery. The spectrum of the surgical pathologic opinions is presented in Table III. This is a greater divergence in the determination of carcinoma vs. benign tumors than presented in previous years. Because of this divergence, we are in the process of impaneling a formal Thyroid Pathology Review Group, representing a cross section of opinions from some of the country's best surgical pathologists.

For each case a majority and a minority report (as indicated) will be developed and suitable statistics will be developed for each position. Since the subgroups of the study population are so small, the assignment of a single case to the cancer or benign category will have a profound impact on the incidence, and/or period prevalence, risk/rad ratio, etc.

TABLE I

1979

Locations of Marshall Islands Groups under Study

Group	R	U	E	M	K	L	W	Other	Total
Rongelap + Ailinginae exposed	18	-	20 ³⁰	11	1	-	-	5	55
Rongelap unexposed	204	-	360	111	4	-	2	72	753
Utirik exposed	-	54	17	30	-	-	1	10	112
Utirik unexposed	-	264	29	169	-	-	-	16	478
Bikini	4	-	4	159	24	-	6	31	228
Wotje	-	-	-	-	-	-	155	-	155
Likiep	-	-	-	-	-	149	-	-	149
TOTAL	226	318	430 ⁴⁴⁰	480	29	149	164	134	1930 ⁴⁰

R = Rongelap

U = Utirik

E = Ebeye

M = Majuro

K = Kili

L = Likiep

W = Wotje

TABLE II

SUMMARY OF ALL 1979 EXAMS

MAIN STUDY GROUPS

	No. in/group	Examined	% Examined
Rongelap + Ailinginae exposed	65	64	98.4%
Utirik exposed	112	107	95.5%
Rongelap "matching" unexposed	143	124	86.7%
TOTALS	320	295	92.2%

TABLE III -

1979 - Surgical Cases - Pathologic Diagnosis (9 Reviewers)

Patient	Reid (Cleveland)	Oertel (AFIP)	Warren	Meissner	Woolner	Ackerman	Legg	Hawk	Vickery	Ratio	
										ad	ca or Nor
Adenoma = ad Occult = oc.											1/9
	ad	Ca	ad	ad	ad	ad	ad	ad	ad		
	ad	Nor.	ad	ad	ad	ad	ad	--	Nor.		0/8
	ad	ad	ad	ad	ad	ad	ad	ad	ad		0/9
	ad	Nor.	ad	ad	ad	ad	ad	ad	ad		0/9
	atyp. Tumor	Ca Occult	ad	ad	Ca Occult	ad	ad	oc.Ca	ad		3/9
	ad	Ca	ad	ad	oc.Ca	Hyper- plasia	ad	ad	ad		2/9
10	ad	Ca	ad	ad	oc.Ca	ad	ad	ad	ad		2/9
9	atyp. ad	ad	ad	ad	Papillary (Pap)Ca (noninvas)	ad	ad	ad	ad		1/9
6	Nor.	Nor.	Nor.	Nor.	Nor.	Nor.	Nor.	Nor.	Nor.		0/9
	ad	ad	ad	--	ad	ad	ad	--	ad		0/7
106	ad	ad	ad	--	ad	ad	ad	--	ad		0/7
	ad	follicular foll.Ca	ad	--	oc.Ca	ad	ad	Ca	oc.Ca		4/8
	ad	ad	ad	--	ad	ad	ad	--	ad		0/7
*	Ca	Ca	Ca	Ca	Ca	Ca	Ca	Ca	Ca		9/9

*Have had surgery previously.

PRIVACY ACT MATERIAL REMOVED

TABLE IV

AGE ADJUSTED - THYROID PATHOLOGY

1979 (Cumulative)

Group: Rongelap Exposed*

Thyroid Abnormalities

Age 1979	Number	$\frac{X}{\text{Hypo-}} \\ \text{Thyroid}$	$\frac{Y}{\text{Benign}}$	$\frac{Z}{\text{Ca}}$	Rate X/n	Rate y/n	Rate L/n	Total $\frac{X+Y+Z}{n}$
25-29	15	2	10	0	.13	.67	0	.80
30-34	6	0	5	1	0	.83	.17	1.00
35-39	7	0	1	0	0	.14	0	.14
40-44	5	0	1	1	0	.20	.20	.40
45-49	4	0	0	1	0	0	.25	.25
50-54	6	1	2	1	.17	.33	.17	.67
55-59	0	0	0	0	0	0	0	0
60-64	5	2	0	0	.40	0	0	.40
65-69	1	1	0	0	1.00	0	0	1.00
70-74	3	0	0	0	0	0	0	0
Total	52							

Age adjusted rate - .47

*Include only people currently alive as of December 1979.

TABLE V

Group: Ailinginae Exposed*Thyroid Abnormalities

Age 1979	Number	$\frac{x}{\text{Hypo}}$	$\frac{y}{\text{Benign}}$	$\frac{z}{\text{Ca}}$	Rate x/n	Rate y/n	Rate z/n	Total $\frac{x+y+z}{n}$
25-29	4	0	1	0	0	.25	0	.25
30-34	4	0	0	0	0	0	0	0
35-39	0	0	0	0	0	0	0	0
40-44	0	0	0	0	0	0	0	0
45-49	1	0	1	0	0	1.00	0	1.00
50-54	0	0	0	0	0	0	0	0
55-59	1	0	1	0	0	1.00	0	1.0
60-64	1	1	0	0	1.00	0	0	1.00
65-69	1	0	0	0	0	0	0	0
70-74	0	0	0	0	0	0	0	0
75-79	1	0	0	0	0	0	0	0
TOTAL	13							^{.30} Rate .20

* Include only people currently alive as of December 1979

TABLE VI

Group: Utirik Exposed*

Thyroid Abnormalities

Age 1979	Number	$\frac{x}{\text{Hypo}}$	$\frac{y}{\text{Benign}}$	$\frac{z}{\text{Ca}}$	Rate x/n	Rate y/n	Rate z/n	Total $\frac{x+y+z}{n}$
25-29	34	0	0	1	0	0	.03	.03
30-34	19	0	1	0	0	.05	0	.05
35-39	10	0	2	0	0	.20	0	.20
40-44	9	0	0	1	0	0	.11	.11
45-49	4	0	1	0	0	.25	0	.25
50-54	10	0	1	0	0	.10	0	.10
55-59	9	0	3	0	0	.33	0	.33
60-64	6	0	1	1	0	.17	.17	.33
65-69	6	0	0	0	0	0	0	0
70-74	3	0	0	0	0	0	0	0
75-79	2	0	1	0	0	.50	0	.50
Total	112						Rate $\frac{7}{112}$	

* Include only people currently alive as of December 1979

TABLE VII

Group: Rongelap Unexposed*

Thyroid Abnormalities

Age 1979	Number	$\frac{x}{\text{Hypo}}$	$\frac{y}{\text{Benign}}$	$\frac{z}{\text{Ca}}$	Rate x/n	Rate y/n	Rate z/n	Total $\frac{x+y+z}{n}$
25-29	41	0	0	1	0	0	.02	.02
30-34	17	0	1	0	0	.06	0	.06
35-39	13	0	0	0	0	0	0	0
40-44	12	0	1	0	0	.08	0	.08
45-49	21	0	2	0	0	.10	0	.10
50-54	12	0	1	0	0	.08	0	.08
55-59	7	1	0	0	.14	0	0	.14
60-64	7	0	0	0	0	0	0	0
65-69	6	0	0	1	0	0	.17	.17
70-74	4	0	0	0	0	0	0	0
75-79	1	0	0	0	0	0	0	0
80-84	1	0	0	0	0	0	0	0
85-89	1	0	0	0	0	0	0	0
Total	143						Rate .05	

* Include people only currently alive as of December 1979

TABLE VIII

Group: Utirik Unexposed*

Thyroid Abnormalities

Age 1979	Number	$\frac{x}{\text{Hypo}}$	$\frac{y}{\text{Benign}}$	$\frac{z}{\text{Ca}}$	Rate x/n	Rate y/n	Rate z/n	Total $\frac{x+y+z}{n}$
25-29	9	0	0	0	0	0	0	0
30-34	7	0	0	0	0	0	0	0
35-39	7	0	0	1	0	0	.14	.14
40-44	8	0	0	0	0	0	0	0
45-49	5	0	0	0	0	0	0	0
50-54	3	0	1	1	0	.33	.33	.67
55-59	4	0	1	0	0	.25	0	.25
60-64	8	0	0	0	0	0	0	0
65-69	2	0	0	0	0	0	0	0
70-74	2	0	0	0	0	0	0	0
75-79	4	0	1	0	0	.25	0	.25
80-84								
85-89								
90-94	1	0	0	0	0	0	0	0
95-99	1	0	0	0	0	0	0	0
Total	61						Rate $\frac{9}{61}$	

* This group has had at least a research protocol exam

TABLE IX

Medical Team

January-February 1979 Survey

Participants

H. Pratt	1/10/79--2/22/79	T. Cronkite	1/11/79--1/27/79
W. Grant	1/12/79--2/16/79	B. Brown	1/29/79--2/22/79
B. Boccia	1/11/79--1/27/79	D. Clareus	1/29/79--2/21/79
B. Dobyns	1/11/79--1/27/79	J. Kabua	1/13/79--2/16/79
H. Evert	1/11/79--1/27/79	S. Shoniber	1/14/79--1/24/79
R. Nicoloff	1/29/79--2/18/79	J. Iaman	1/18/79--2/16/79
J. Nicoloff	1/29/79--2/18/79	L. Elanjo	1/14/79--2/16/79
M. Deckle	1/29/79--2/18/79	K. Gideon	1/14/79--2/16/79
W. Scott	1/6/79--2/23/79	N. Zetkeia	1/14/79--2/16/79
P. Heotis	1/8/79--2/16/79		

Majuro examinations	1/13/79--1/17/79
Ebeye examinations	1/18/79--2/1/79
Rongelap examinations	2/2/79--2/7/79
Utirik examinations	2/8/79--2/14/79

TABLE X

SUMMARY JAN-FEB 1979 EXAMS

Honolulu Exams

Rong. exposed 3

Majuro Exams

Rong. exposed 7

Utirik exposed 38

Rong. unexposed (matching) 10

Other unexposed 3

Ebeye Exams

Rong. exposed 29

Utirik exposed 15

Rong. unexposed (matching) 57

Other unexposed 30

Rongelap Exams

Rong. exposed 23

Rong. unexposed (matching) 31

Other unexposed 42

Utirik Exams

Utirik exposed 47

Other unexposed 62

TOTAL EXAM: 397

TABLE XI

MEDICAL TEAM

May-June 1979 Survey

Participants

H. Pratt	5/9/79 → 6/18/79
R. Conard	5/13/79 → 6/13/79
D. Paglia	5/13/79 → 5/24/79
P. Sullivan	5/11/79 → 6/13/79
J. Robbins	5/24/79 → 6/13/79
B. Dobyns	6/8/79 → 6/12/79
W. Scott	5/3/79 → 5/23/79
S. Pratt	5/9/79 → 6/18/79
P. Heotis	5/9/79 → 6/8/79
J. Kabua	5/12/79 → 6/8/79
S. Shoniber	5/15/79 → 6/10/79
L. Elanjo	5/15/79 → 6/10/79
N. Zetkeia	5/15/79 → 6/10/79
K. Gideon	5/15/79 → 6/10/79
J. Aiman	5/21/79 → 6/10/79
Helmar Emos	5/25/79 → 6/8/79
Majuro Exams	5/15/79 → 5/20/79
Ebeye Exams	5/21/79 → 5/24/79
Rongelap Exams	5/26/79 → 5/28/79
Utirik Exams	5/29/79 → 6/4/79
Wotje Exams	6/5/79 → 6/6/79

TABLE XII

SUMMARY MAY-JUNE 1979 EXAMS

	<u>Majuro</u>	<u>Ebeye</u>	<u>Rongelap</u>	<u>Utirik</u>	<u>Total</u>
PEDIATRIC EXAMS (age <u><</u> 14)	95	71	87	37	290
ADULT EXAMS	69	14	5	5	93
THYROID, LAB, X-RAY	10	19	8	1	38
TOTAL	174	104	100	43	421

TABLE XIII

SUMMARY MAY 1979 MAJURO EXAMS

<u>GROUP</u>	<u>Age < 14</u>	<u>Age > 14</u>
Bikini	48	54
Rongelap Unexposed (150 series)	0	5
Children of above	6	0
Rongelap Exposed	0	1
Children of above	10	0
Utirik Exposed	0	7
Children of above	18	0
Utirik Unexposed	0	2
Children of above	13	0
	<hr/>	<hr/>
TOTALS	95	69

TABLE XIV
MEDICAL TEAM

Sep-Oct 1979 Survey

Participants

H. Pratt	9/5/79 → 10/11/79
M. Mandlekern	9/15/79 → 10/8/79
M. Stary	9/5/79 → 9/20/79
M. Territo	9/5/79 → 9/24/79
H. Heidinger	9/20/79 → 10/8/79
A. Krotoski	9/13/79 → 10/8/79
W. Krotoski	9/13/79 → 10/11/79
D. Paglia	9/6/79 → 9/22/79
W. Scott	9/4/79 → 10/11/79
S. Pratt	9/5/79 → 10/11/79
M. Makar	9/5/79 → 10/11/79
R. Brown	9/4/79 → 10/11/79
P. Heotis	9/5/79 → 10/5/79
J. Kabua	9/7/79 → 10/5/79
S. Shoniber	9/9/79 → 10/7/79
L. Elanjo	9/9/79 → 10/7/79
M. Kabua	9/15/79 → 10/7/79
H. Enos	9/21/79 → 10/5/79
Neamon	9/17/79 → 10/5/79
Majuro Exams	9/9/79 → 9/14/79
Ebeye Exams	9/15/79 → 9/20/79
Rongelap Exams	9/22/79 → 9/26/79
Utirik Exams	9/28/79 → 10/3/79

TABLE XV

SEPTEMBER - OCTOBER, 1979 - MARSHALL ISLAND EXAMS

	<u>M</u>	<u>E</u>	<u>R</u>	<u>U</u>	<u>Total</u>
PEDIATRIC EXAMS	53	49	7	45	154
PEDIATRIC SICK CALL	-	1	25	17	43
ADULT EXAMS	34	18	-	1	53
ADULT SICK CALL	9	5	11	43	68
DIABETIC SAMPLING	13	16	-	4	33
THYROID, LAB, X-RAY	9	3	3	4	19
DENTAL	-	19	27	66	112
TOTAL	118	111	73	180	482

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