DRAFT
RAY/MCCRAW:bh
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RAD.ATIO. [illegible] AND [illegible]

Because the [illegible] of results from the 1978 survey of the [illegible] complete, the quantitative statements contained [illegible] followed later by more precise predictions an[illegible].

First, we need a [illegible] radiation exposures in the Marshalls. A good [illegible] "Radiation - A Fact of Life," which [illegible] our environment wherever on earth we may [illegible] naturally occurring radiation vary from [illegible] sense cannot be controlled. What [illegible] individuals or populations to man-caused [illegible] occupational and medical exposures and [illegible] nuclear facilities and their associated ope[illegible] Medical use of radiation for both diagnosis and th[illegible] its own risk-benefit discipline. The [illegible] limitations on the releases of radioactivity [illegible] are subjects of international and U.S. Fed[illegible] accepted and applied. These guidelines for [illegible] in units known as rem (roentgen equivalent, [illegible] the thousandth part (1/1000) of a rem. [illegible] Federal guideline prescribes that [illegible] should not exceed 170 mrem per year. No [illegible] 500 mrem (1/2 rem) per year and 30 year cumulat[illegible] These limits are over and above the [illegible] and from medical procedures.

As noted in the enclosed pamphlet (page 6), typical radiation exposures from natural sources in mainland U.S. locations are about 300 mrem per year. About half of this exposure (about 300 mrem per year) is external, i.e., due to cosmic rays plus radiation from naturally occurring radioactive elements in the earth's crust. The other half is "internal" exposure from naturally occurring elements taken into our bodies in food and water and in the air we breathe. This natural radiation exposure in the U.S. is about the same value as the Federal guideline for control of exposures of the public to man-made radiation.

On a Pacific coral island several things combine to make exposures to naturally occurring radiation significantly lower than in the U.S. The low latitude, low elevation, low levels of naturally occurring radioactivity in the soil result in an external exposure of about 30 mrem per year in the Northern Marshalls. (The coral formations are quite remote from the earth's crust and thereby very low in concentrations of naturally occurring radioactive materials such as uranium and radium.) The external exposure of 33 mrem per year in the Marshalls, including Rongelap, is compared with about 100 mrem per year for the U.S. rain land.

Measurements of radioactivity in the body of Rongelap residents indicate that the naturally occurring radionuclide that contributes most of the internal exposure, gives about 18 to 20 mrem per year. Thus, naturally occurring radiation contributes a total exposure (external plus internal) of about 53 mrem per year on Rongelap, compared to about 300 mrem per year in the U.S.

As with locations in the U.S. mainland, there are quantities of fallout in the soil of land areas in the Pacific as a result of past atomic testing in the atmosphere. Radiation from these fallout radionuclides are an additional source for both internal and external exposures for people living in the

U.S. and in the Pacific. It would appear meaningful to compare the radiation exposures from fallout, both external and internal, to those from naturally occurring sources that have been quantified above.

The levels of external radiation at Rongelap Atoll have been measured repeatedly since 1954. These measurements show a steady decline since that time. Through radioactivity decay and weathering of residual fallout radionuclides in the soil, external radiation levels on Rongelap Island (corrected for natural background) have decreased to about 28 mrem per year in 1985. The major contributor to this exposure is a radioactive substance in the soil known as Cesium-137. This level of exposure will continue to decrease with time.

For internal exposure due to fallout, the picture is somewhat more complex, but can be simplified. Small amounts of fallout are distributed in the soil of the island and in the sediments in the lagoon. The levels are slowly declining with time. These radionuclides are transmitted to man through food, water, and air. Internal radiation exposure through the terrestrial food pathway, i.e., use of foods grown on the island, is strongly dominant and again, Cesium-137 ~~(Abbreviated ^{137}Cs)~~ is the major contributor. Other radionuclides such as Strontium-90, Cobalt-60, and Plutonium-239 are present, but their contribution to exposure is less than that of Cesium-137. Cesium-137 in the body is relatively easy to measure. A bioassay program, covering a number of locations in the Marshalls, has been conducted since 1954. One of the techniques used is called whole body counting. An instrument is used that can measure radiation coming from the body. Since the various nuclides emitting this radiation can be identified and quantified, the results of these whole body measurements, radiation exposure from Cesium-137 and Cobalt-60 can be (and are) accurately calculated. The amounts of Strontium-90 and Plutonium-239 are determined by analysis of urine and fecal samples.

For Rongelap, sufficient [illegible] data are available to provide for reliable estimates to be made of internal exposure. The total internal dose due to fallout for residents of Rongelap [illegible] to fallout is calculated to be 30 mrem per year. This, added to the previously discussed external exposure of 28 mrem/year, leads to a total whole body exposure of approximately 58 mrem per year.

By comparison, the average exposures in the U.S. mainland due to fallout are less than at Rongelap. External exposure is about 2.8 mrem per year and internal exposure is about 1 mrem per year. Thus the total external plus internal exposure is about 4 mrem per year.

For ready comparison all of the exposure figures just described are presented together in the table that follows. It indicates that in the U.S., radiation exposure due to naturally occurring radiation is higher than that due to fallout. The total in the U.S., natural plus fallout, is ~~20~~ 203 mrem per year. At Rongelap, the exposure due to fallout is about the same as that due to natural radiation. The total in the U.S., natural plus fallout, is about two times the total at Rongelap, i.e., 203 versus 108 mrem per year.

Exposure Comparisons [illegible]
mrem/yr

	Natural			Fallout***			Natural & Fallout
	Int.	Ext	Tot.	Int.	Ext.	Tot.	Tot.
U.S.	100	100**	[illegible]	[illegible]	2.8**	4	203
Rongelap	20*	33**	[illegible]	3	25***	58	108

U.S. Standard
Population [illegible]
Individual [illegible]

* Due to Potassium-40. Body burdens of K-40 are about the same at Rongelap as in the U.S.
** No shielding factors included.
***References:
Rongelap values - BNL 5125
U.S. values - ORP/CSD 72-1

For Utirik, evnironmental concentrations of fallout are lower than those at Rongelap, while the levels of natural radiation are the same. External radiation due to fallout on Utirik is about [illegible] per year.

Environmental levels in Ailuk are something less than a third of those at Utirik, leading to still lower estimates of [illegible] exposures for residents of that

Now, what does this all mean to a Peace Corps worker in the Marshalls? As noted above, exposures in the range of [illegible] per year (exclusive of occupational and medical exposure) are quite common in the United States, where naturally occurring radioactive elements are more abundant than on a low-lying tropical atoll. Thus, the Peace Corps worker spending two years on Rongelap will very likely sustain a radiation dose which is no larger than the same worker might have received in his own hometown. Serving on either Utirik or Ailuk would, as noted, reduce this exposure far below the U.S. mainland experience.

And, finally, if we assume that the Peace Corps worker makes the round trip to the Marshalls from his east coast home by jet aircraft, his exposure to cosmic radiation during the hours he spends in flight will be about equal his exposure to radiation from all sources over two or three weeks on Rongelap.