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DATA ON SOIL SAMPLES COLLECTED ON THE ISLANDS OF THE PACIFIC FOLLOWING THE FIRST DETONATION AND ALSO THE DOSE RATE READINGS AT THE SAME LOCALITIES.

Attached (Annex I) are data on soil samples collected on the islands of the Pacific following the first detonation and also the dose rate readings at the same localities. One method of evaluating such data is to try to establish relationships between different units if possible. One useful relationship would be the conversion of disintegrations per minute per gram of soil to milliroentgens per hour of gamma radiation at a three-foot height or vice versa.

Larson's work with soils around NPG during the spring 1953 tests indicated the following relationship: 10 µc/sq.ft. beta counts of soil (after absorption and geometry corrections) ⟶ 1 mr/hr gamma at 3 feet. He found that essentially all of the activity was in the first one inch of top soil.

In collecting soil on the Pacific Islands good care was taken to collect one square foot of surface (in fact, templets were made for this purpose). It was impossible, however, to scoop up the soil to a uniform depth so the rule followed was to collect to one inch or greater. If the fallout activity in the Pacific Islands also was contained in the first one inch, the additional soil below this contributed mass but little activity to the sample. By taking the disintegrations per minute per gram (after a thorough mixing) and multiplying by the total number of grams for each sample one should arrive at the activity per square foot.

The plot of beta disintegrations per minute per gram of soil versus mr/hr of gamma at 3 feet is shown on the attached graph. The correlation is not too good. For references, several curves are arbitrarily drawn on the graph. The data strongly suggest that less than 10 µc/sq. ft. is equivalent to 1 mr/hr. For lower levels of activity the data are more of the order of 2 µc/sq. ft. ⟶ 1 mr/hr and for higher levels of activity less than 1 µc/sq.ft. ⟶ 1 mr/hr. If one is justified in trying to fit a curve to such widely scattered data, then 1+ µc/sq.ft. ⟶ 1 mr/hr is a very rough approximation. Another possibility but not probability is a more complex curve shown by the solid black line.

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Based on calculations made in Annex II it would appear that about 10 $\mu c/ft^2 \longrightarrow 1$ mr/hr gamma at 3 feet. If one accepts the figure of 2 beta emissions for each gamma photon (Effects of Atomic Weapons) then 20 $\mu c/ft^2$ (beta) $\longrightarrow 1$ mr/hr gamma at 3 feet.

Knowing the difficulties of collecting, handling, packaging, shipping and counting the samples, it is probable that some of the data are not entirely valid. The information shown in this memo suggests that further carefully controlled studies must be made before a more firm conclusion may be reached.

Attachments 3
- Annex I
- Annex II
- Graph (w/cy 1A only)

DISTRIBUTION: copy 1A - Dr. Bugher
2A - Dr. Dunning
3A - Bioph.Br. Reading File
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ANNEX I

Comparison of Soil Activity to Dose-rate Readings

Location	Date of Collection	No. Grams	d/m/gm (same date)	Total Act. ($\mu c/ft^2$)	mr/hr (survey) (meters)
Likiep	6 March	2,400	23,000	2.5×10^1	~3
Jemo	"	1,060	13,000	6.2	~3
Ailuk	"	2,160	23,000	2.2×10^1	3 - 15
Mejuit	7 March	1,360	30,000	1.8×10^1	3 - 10
Ormed	5 March	1,325	15,000	9.0	3.5
Erikub	5 March	1,720	4,300	3.3	1.5
Kaven	6 March	1,335	5,500	3.3	1.8
Wotho	6 March	1,490	2,400	1.6	~0.8
Ealap	7 March	965	950	0.4	0.5
Rongelap (Northern)	8 March	703	290,000	9.2×10^2	440.0
(Central)	"	815	1,600,000	5.9×10^2	280.0
(1 mile N.Village)	"	1,630	100,000	7.6×10^1	340.0
(South Cistern)	"	1,040	140,000	6.6×10^1	220.0
Eriirippu	"	810	9,000,000	3.2×10^3	2,200.0
Eniwetok	"	2,010	780,000	7.1×10^2	900.0
Kabelle	"	1,470	4,500,000	3.0×10^3	2,000.0
Utirik	9 March	1,140	1,100,000	6.9×10^2	40.0
Bikar	"	1,030	85,000	4.1×10^1	140.0
Eniwetak	10 March	1,050	135,000	8.8×10^1	280.0
Sifo [redacted]	"	1,060	14,000	6.7	100.0

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ANNEX II

Calculations of Dose Rate at Three Feet Above A Plane Surface

For point source (0.3 - 3.0 Mev range)

$$\text{Dose rate (r/hr)} = \frac{6CE}{d^2}$$

where: C = activity (curies)
E = energy in Mev
d = distance in feet

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$$\text{Dose rate} = \frac{6EA\, 2\pi x dx}{h^2 + x^2}$$

where: A = activity/unit area
h = height above surface (feet)
x = distance in feet

$$\text{Dose rate} = 6EA\, 2\pi \int_{R_1}^{R_2} \frac{x dx}{x^2 + h^2}$$

$$= 6\pi EA \ln \left[\frac{h^2 + R_2^2}{h^2 + R_1^2} \right]$$

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The mean free path for 0.7 Mev in air is about 360 feet so that essentially all of the dose will be contributed from a surface 1,000 feet in radius.

Let $A = 10 \times 10^{-6}$ curies/ft^2
$E = 0.7$ Mev

$$\text{Dose rate} = 6\pi(0.7)(10 \times 10^{-6}) \ln \left[\frac{9 + 10^6}{9} \right]$$

$$\cong 2.2 \text{ mr/hr}$$

Since this formula assumes no absorption and also a uniform plane surface, an estimate is that

$$10\ \mu c/ft^2 \longrightarrow 1\ mr/hr.$$

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