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ADMINISTRATIVE FILES-STAFFORD WARREN
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300, SUBSERIES 500
BOX NUMBER
25
FOLDER NAME
ATOMIC BOMB + ATOMIC ENERGY-1949
NOTES
1 of 7
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RADIUM BONES DATA

On September 2, 1949 three bone half sections were received via Dr. Bryan from a radium poisoning case with a request to make radioautographs and spectrographic analyses. (Later information indicated that the bones had been given to Dr. Warren by Dr. Francis M. McKeever, orthopedic surgeon, who had removed by amputation the shoulder, girdle, and arm of the patient, . The patient had received radium water tonic in 1931 and died during the month of August 1949. No autopsy was performed. Dr. Robley Evans had performed breath analyses.)

I. Radioautographs

After a series of exposure tests, a radioautograph was made of the three bones placed in direct contact on a 14" x 17" x-ray film. The exposure required was 80 days. (Due to the uneven surfaces involved the 'gross' radioautographs indicated the approximate locations of the higher concentrations of radium and its radioactive daughters.)

Attached are photographs of the bones and their radioautographs. These reproductions are approximately one-half the actual size of the bones.

II.

The bones and radioautograph were turned over to Dr. N. S. MacDonald of the Bone Deposition Section for continued study, on February 3, 1950. His report was as follows:

"A small fragment was removed from the proximal epiphysis of one of the radii of the deceased patient. Radioautographs had shown this location to be richest in the radioactive element. The fragment was ignited at 600°C, ground to approximately 140 mesh and the diffraction pattern obtained in the symmetrical back reflection camera. The bone salt appears quite

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normal as far as crystalline structure is concerned.

Planes	Normal Human Rib from 38 yr old Female Spacings	Radium Bearing Human Radius Spacings
.456	.7748 Å	.7746 Å
.048	.7934	.7931
.098	.8056	.8052
.157	.8180	.8177
.446	.8240	.8240
.554	.8299	.8297

Unit Cell Dimension

a_o = 9.4736 Å (±0.0007) a_o = 9.4721 Å

c_o = 6.8835 c_o = 6.8816

The smaller values of the cell dimensions in the radium bone are not too significant because variations of this order of magnitude have been found to occur among bone samples of normal individuals."

III.

The sample of ashed bone used for the x-ray diffraction studies were returned to Health Physics for counting. The 0.0195 gm sample was given a preliminary count in the β-γ counter (10% geometry) and results indicated 0.47 cts/sec over the background. (Bgd = 0.269 c/s) This is equivalent to 240 d/sec/gm of ash. This same sample was returned to the counting unit for an absorption curve determination. It was also planned to obtain additional counting data.

IV.

The remainder of the ashed bone sample was turned in to Dr. Nusbaum of the Spectroscopy Section for analyses. Their report follows.

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"A sample of bone ash was received from the Health Physics Section. This bone was from a patient who had died from radium poisoning. A quantitative examination was made of this sample in comparison with a normal human bone sample obtained from the Bone Deposition Section of the Division of Pharmacology and Toxicology. The following results were obtained as of June 14, 1950:

	Normal Bone	Radium Bone
Na	0.15	0.40
K	0.03	0.85
Ca	36.0	23.0
Sr	0.02	0.016
Ba	< 0.03	< 0.03
Mg	0.61	0.24
Fe	0.02	0.02

The radium bone compared to normal bone indicates higher percentages of sodium (Na) and especially potassium (K), and lower percentages of calcium (Ca) and magnesium (Mg)."

V.

A final compilation of all the data obtained was to depend upon more history data on the bones which Dr. MacDonald was to get by contacting Dr. McKeever. Special information regarding the identity of the patient and whether any special treatment was given prior to decease in order to attempt removal of the radium.

VI.

1) A very thin sample of the bone ash was mounted upon scotch tape for alpha

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counting. 24 mg were spread over an area of 10 sq cm. The results from the alpha scintillation counter indicated 164 α c/m/24 mg sample (Counter geometry = 20%). Thus the bone ash indicates 3.42×10^4 α d/m/gm. Assuming that the activity in this bone ash sample is radium in equilibrium with its decay products (sample is ≤ 1 year old) there are approximately 4 alpha counts produced per radium disintegration.

Then:

$$\frac{3.42 \times 10^4}{4} = 8.55 \times 10^3 \text{ d/m/gm}$$

Or:

$$\frac{8.55 \times 10^3}{2.2 \times 10^{12}} = 3.9 \times 10^{-9} \text{ curie/gm of ash}$$

According to Krebs (Strahlentherapie 72:164, 1942), he found that 'average normal body content of radium equivalent to 1.4×10^{-8} gm, ranging from 1.9 to 17.9×10^{-12} gm/gm of ash.' He further suggests that 'accumulation in excess of this amount, if it should reach the concentration of 10^{-10} gm in any tissue, may lead to serious injury and ultimately to death'. This figure for total body content of radium was rechecked at the Rochester Project during the war by Fink and coworkers (Fink, National Nuclear Energy Series, VI-3, pg 174) and found to be within 0.01% of Krebs' figure.

2) This same thin sample was counted in a β-γ counter which gave 0.84 c/sec (Geometry 10%) or for the 24 mg sample equivalent to

$$\frac{0.84 \times 10^3}{0.10 \times 24} = 350 \text{ d/s/gm ash}$$

$$= 2.1 \times 10^4 \text{ d/m/gm ash}$$

An absorption curve determination was done on this particular sample and the attached (Fig. 3) indicates the type of curve obtained. The steep drop off at the start of the curve with the insertion of the paper filter on top of the sample indicates that

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we are counting some of the alphas when there is zero added Al filter since the G-M tube window is 2.8 mg/cm^2 and we are within 1 cm of the window.

VII.

An analysis to determine amount of Ra^{226} free from other natural activities that is present in the bone will be done as soon as time is available for this project.

L. B. Silverman

L. B. Silverman, Chief
Health Physics Section
7 April 1952

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FIGURE 1.

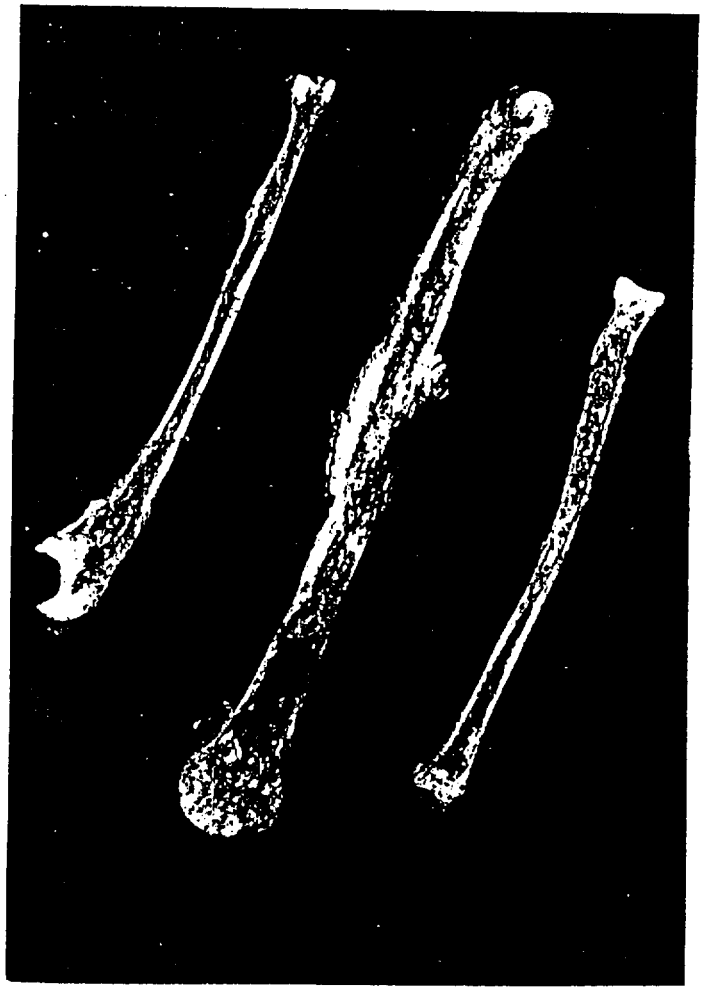

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FIGURE 2.