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L. A. Notebook
S 36

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FORM 410

00132727.004

W. Langham Group A-6

Phone 97 or 83

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00132727.005

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Feb. 24 Outline of A9 Experiment for Group A-6

The problem as presented to me was to check the following results on metabolism of 49 by the rat body:

1. Make a general check on Hamilton's work.
2. Determine the rate of excretion of 99 when injected as
   (a) + 4 Nitrate
   (b) + 4 citrate complex
   (c) + 6 Nitrate
3. Determine which of the above three states gives the maximum localization in the bone and a minimum in the liver.

General Plan

The general plan as I would like to see it is to have a minimum of 12 animals for each dosage. Each animal to be injected with 15 γ of 49 in about .3 ml of solution via the jugular vein. The animals are to be housed in groups of 2 in metabolism cages. At intervals of 4, 16 + 69 days 4 animals from each dosage group will be sacrificed. Feces + urine samples will be taken for each group. After sacrifice the following organs + tissues will be analyzed for 49, all tissues being analyzed separately for each rat

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Schematically the general plan is tabulated as follows

Dosage	Days after injection when Sacrificed 4	16	64	Total no rats
15γ + 4 citrate	2X2 HP-1-L	2X2 HP-2-P	2X2 HP-3-S	12
15γ + 4 nitrate	2X2 HP-4-Q	2X2 HP-5-g	2X2	12
15γ + 6 nitrate	2X2	2X2	2X2	12

For each dosage data will be obtained on 12 rats at + up to 4 days, 8 rats up to 16 days and 4 rats up to 64 days.

Detailed Plan

1. Feces - Up to the end of the 4th day after injection pooled samples of ~~2 rats~~ each metabolism cage will be taken at 12 hour intervals because this is the time of rapid change in excretion rate. This will mean that every 12 hours 18 samples will be taken, which will be 144 samples at the end of 4 days.

At the end of 4 days 4 rats from each group will be sacrificed and the sampling rate will drop to a 24 hour basis. This will mean 12 samples every 24 hours up to the end of 16th day this making 144 samples between the 4th + 16th days. At end of 16 days 4 animals from each group are [illegible] 12 animals in 6 cages

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At this time the sampling rate can be dropped to 36 or 48 hours in the latter case there would be 6 samples every 48 hours from 16th to 64th days making a total of 24 x 6 = 144 samples. Tabulated this is as follows:—

Days	4	16	64	Total
No Samples	144	144	144	432
64 Day gr. mly	48	48		

Tentative method.

The feces samples will be dried in an oven at 100° for 24-48 hours ~~ground~~ ground thoroughly and mixed. From this will be taken a 5-8 g sample of dry matter which will be dry ashed, dissolved in del HCl, supernatant drawn off and silica residue fumed into soln with HF + H_2SO_4. The cucibler contents then dissolved and added to supernatant. The acidity will then be adj. and the sample extracted with cupferron.

This is subject to modifications which will be given later.

Two possible modifications possibly eliminating the cupferron extraction are as follows

(1) Hexone extraction - Take the sample solution make 1.5 - 3 N with HNO_3 and 10 M with $Al(NO_3)_3$ and extract 3 times with a vol of Hexone 1/4 larger than the aqueous phase having first added 1/2 ml of .1 N $KMnO_4$. Combine the hexone-phases and extract three times with small volumes of water containing about .05 N Hydroxylamine. This should transfer the 49 to the aqueous phase on which a LaF_3 ppstn can be carried out.

(2) Trifluoroacetyl ~~acetone~~ extraction - The sample solution might possibly be extracted with TFA according to CN 2486 and the 49 back extracted from the benzene using 2N HNO_3 ~~from~~

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This solution a LaF_3 ppt may be carried out. This will require considerable experimentation to establish conditions and accuracy.

2. Urines

The problem in this case is essentially the same as for feces except for the method of preparing the sample solution.

The sampling schedule is the same as for feces. The aliquot collected from the two rats in each metabolism cage is of course a pooled sample of two rats.

During the first 4 days samples will be taken at twelve hour intervals, there being 18 cages. The total samples at the end of 4 days will be 8x18 = 144. At this time 6 cages will be sampled every 12 samples every 24 hours until the end of 16 days. This will give 12x12 = 144. At the end of 16 days 6 more cages will be sampled and the sampling schedule will drop to 48 hours. The number of samples will then drop to 6x24 = 144.

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Margaret Martinez

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Prepn Of Solutions for Rat Expt.

20.7 mg of pure metal was dissolved in 100 λ of 6 N HCl in a 2 ml vol. flask. After the soln was complete .5 ml of of 8 N HNO_3 was added and the soln warmed gently until oxidation of the +3 to +4 seemed complete. D.I. was to 2 ml. giving 2 N in HNO_3. An aliquot of this solution was taken for assay and a Spectrophot. Curve was run with special attention given to the regions of +3 and +6 peaks.

Assay Results ——

Spectrophotometric Results ——

λ	Opt D	λ	Opt D	λ	Opt D	λ	Opt D	λ	Opt D	λ	Opt D

Results in E. Andersons Note book III page 40.
No indications of +3 or +6 were obtained.

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3/8/94

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20 Preparation of standard plate for [redacted]:
25λ of a solution in 2N HNO_3 (assay .100λ = 4530 c/m
was transferred to a plate of 10 mil platinum.
The plate was counted three thirty minute periods
on each of our proportional counters and three
thirty minute period on Wall's counter.

Proportional counter #38021 - voltage 2050, gain 80
Room MH 2

period	counts/min
30 min	1197
30 "	1194
30 "	1206
Average	3|3597
	1199 ± 4 c/m (S.D.)

Proportional counter #37843 - voltage 2050, gain 90
Room MH2

period	counts/min
30 min	1219
30 "	1191
30 "	1215
average	3|3625
	1208 = 4 c/m

Proportional counter #37591 - voltage 2200, gain
Room MH1

period	counts/min
32 min	1200
30 "	1224
30 "	1211
Average	3|3635
	1212 ± 4 c/m

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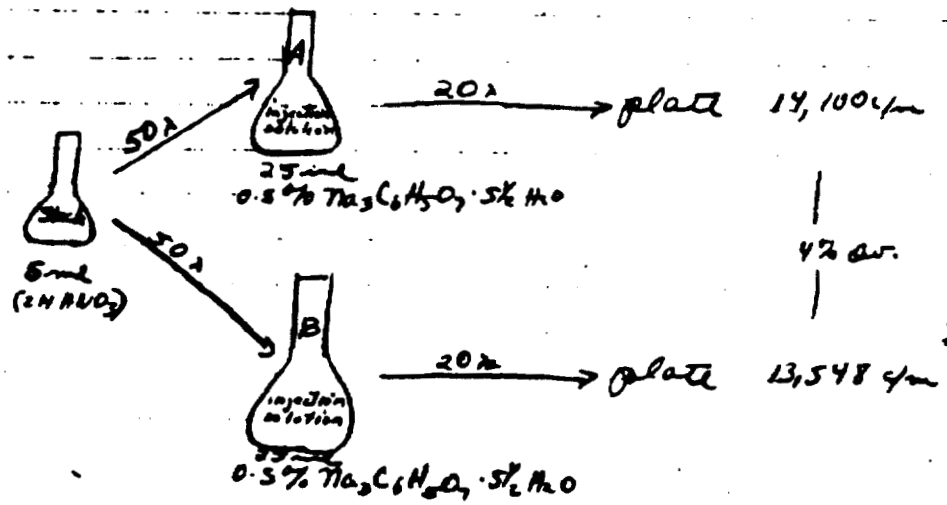
Wallace counter
Linear amplifier Type A Serial # 151
Geiger-Müller Counter Type B Serial # 207
Galatron Specialties Co. Moraga Calif
Main 30-2 Kilovolts 1.5 (Obj. 5)

period	counts/min
30 min	1187
30 "	1195
30 "	1205
average	3/3587

1196 + 15 coincidence correction = 1211 ± 44%

Dripe preparation of injection solution:
Stock solution was prepared in "D" Bldg. by Dunham. Assay group reported solution contains 4.98 mg/ml. Results of spectrophotometric curve showing solution to be all in 14 state are given below.

22 Method of Dilution:



average = 13,824

$\frac{13824}{20} = \frac{x}{500}$

x = 3,456,000

500λ = 4.94 γ

pH A = 6.39
pH B = 6.41

checked WDM - 9-11-67 OK

1256
250
64300
2572
321500

4.6
7000

322,000

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Assay of solutions from [redacted]: all plates counted 23
2 -15 min periods on Counter # 38021

Injection solution P-4b for [redacted]

20γ → plate ~~13,752~~ c/m 12,661 c/m — Av ~~13,786~~ c/m — Dev. (~~.48%~~) (.23)

20γ → plate ~~13,820~~ c/m 12,691 c/m — 12,676

$\frac{12,676}{70000} \times \frac{500}{20} = 4.38\,\gamma/0.5\,ml$

Dummy injections [redacted]

				Av.	Dev from av. inj.	Plate Dev.
[redacted] DI-2 25cc	100γ → plate	1293 c/m		1305 c/m	(1.5%)	(1.8%)
	100γ → plate	1317 c/m				
[redacted] DI-3 25cc	100γ → plate	1297 c/m		1307 c/m	(1.6%)	(1.4%)
	100γ → plate	1316 c/m				
[redacted] DI-4 25cc	100γ → plate	1295		1304 c/m	(1.4%)	(1.4%)
	100γ → plate	1313				
[redacted] DI-5 25cc	100γ → plate	1250		1229 c/m	(4.4%)	(3.5%)
	100γ → plate	1207				

average Dummy injection = 1286 c/m/100γ
Max dev. from av. = 4.4%
Mean " " " = 2.2%

Total injection = $1286 \times \frac{25000}{100} \times \frac{1}{70000} = \underline{\underline{4.593\,\gamma}}$

Dev of av. total inj. from 0.5 ml injection sol = 4.8%

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Injection sol. for [redacted] P-4e → 20γ → plate 13,752 c/m av. 13786 c/m (dev. 0.49%)
→ 20γ → plate 13,819 c/m

$13786 \times \frac{500}{20} \times \frac{1}{70000} = 4.923\gamma$ / 0.5 ml

Dummy injections [redacted]

				Dev Plate	Dev from av. inj.
[redacted]-DI-1 25cc	100γ → plate 1438 c/m; 100γ → plate 1378 c/m	1408 c/m		(4.2%)	(0.50%)
[redacted]-DI 2 25cc	100γ → plate 1416; 100γ → plate 1404		1410	(0.8%)	(0.64)%
[redacted]-DI 3 25cc	100γ → plate 1350; 100γ → plate 1329		1340	(1.5%)	(4.4%)
[redacted]-DI 4 25cc	100γ → plate 1454; 100γ → plate 1439		1447	(1.0%)	(3.3%)
[redacted]-DI 5 25cc	100γ → plate 1386; 100γ → plate 1412		1399	(1.9%)	(0.14%)

average Dummy injection = 1401 c/m/100γ — Max dev from av. = 4.4%; Mean dev from av. = 2.2%

Total injection [redacted] = $1401 \times \frac{25000}{100} \times \frac{1}{70000} = 5.004\gamma$

Dev of av. total inj. from 0.5 ml inj sol = 1.6%

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Dummy Inj. Solns. 3 ([redacted])

Solns 4 ([redacted])

Solns 5 ([redacted])

(1) 3-1 (25 ml) → 100 λ — 1281.6
1396.1
1438.7
1405.4

2 (3-1)

1319.8
1312.1
1347.4
ave 1326.4

(1) 3-2

1418.0
1407.3
1402.7
ave - 1409.3

(2) 3-2

1343.7
1367.8
1370.2
1360.6

(1) 3-3

[illegible]
1334.1
1362.9
1361.6
1352.9

(2) 3-3

1403.8
1398.0
1370.6
1390.8

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(1) 3-4

1367.6
1390.4
1381.1
1379.7

(2) 3-4

1402.7
1401.2
1422.3
1408.7

(1) 3-5

1360.4
1359.5
1350.6
1356.8

(2) 3-5

1348.8
1375.6
1353.1
1358.5

overall average 1374.9

1374.9 x 10 x 25 = 343,725

4.98

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Dummy Injection #4 ([redacted])

(1) 4-1

1393.3
1390.2
1363.3 – 1350.5
1374.3

(2) 4-1

1375.2
1383.4
1366.8
1375.1

(1) 4-2

1394.7
1402.8
1412.4
1403.3

(2) 4-2

1412.7
1413.0
1392.8
1406.2

(1) 4-3

1387.7
1385.4
1368.0
1380.4

(2) 4-3

1359.4
1343.6
1352.2
1351.7

(1) 4-4

1318.4
1305.0
1308.4
1309.9

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(2) 4-4

1407.4
1412.3
1393.5
ave. 1404.4

1376.8 × 10 × 2.5 =
344,200

-4.98

(1) 4-5.

1351.4
1356.3
1325.2
ave. 1344.3

Overall ave. use
1376.8

(2) 4-5

1409.6
1434.3
1411.6
ave. 1418.5

Dummy Injection #5 ([redacted])

(1) 5-1

1457.0
1460.4
1416.7
ave. 1444.7

(2) 5-1

1374.6
1342.5
1336.4
ave. 1351.2

(1) 5-2

1438.4
1466.4
1434.6
ave. 1446.5

(2) 5-2

1386.5
1389.5
1378.2
ave. 1384.7

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(1) 5-3

1418.9
1435.4
1453.4
ave - 1435.9

(2) 5-3

1418.1
1438.3
1429.8
ave. - 1428.7

(1) 5-4

1434.4
1421.6
1419.8
ave - 1425.3

(2) 5-4

1421.6
1432.1
1429.5
ave - 1427.7

(1) 5-5

1371.0
1395.4
1375.1
ave - 1380.5

(2) 5-5

1414.7
1424.8
1425.5
ave - 1421.7

Overall average - 1414.7

1414.7 x 10 x 25 = 353,675

- 5.058

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Dummy Injection [redacted]

[redacted] Dcl-1 25cc
- 100λ → Plate 1488 c/m
- 100λ → Plate 1492 c/m

Av. 1490

[redacted] Dcl-2 25cc
- 100λ → Plate 1371 c/m, recount 1440 c/m
- 100λ → Plate 1499 c/m

Av. 1470

[redacted] Dcl-3 25cc
- 100λ → Plate 1476 c/m
- 100λ → Plate 1483 c/m

Av. 1480

[redacted] Dcl-4 25cc
- 100λ → Plate 1412 c/m
- 100λ → Plate 1489 c/m

Av. 1450

[redacted] Dcl-5 25cc
- 100λ → Plate 1488 c/m
- 100λ → Plate 1511 c/m

Av. 1500

Av Dummy inj = 1478 c/m / 100λ

Total inj = $1478 \times \frac{25000}{100} \times \frac{1}{76000} = 5.28\,\lambda$ (369,500 c/m)

4b Dummy Injection [redacted]

[redacted] Dl-1	100γ	1750 c/m	av. 1758 c/m
	100γ	1766 c/m	
[redacted] Dl-2	100γ	1786 c/m	av 1785
	100γ	1784 c/m	
[redacted] Dl-3	100γ	1764 c/m	av 1752 c/m
	100γ	1740 c/m	
[redacted] Dl-4	100γ	1747 c/m	ave. 1760 c/m
	100γ	1772 c/m	
[redacted] Dl-5	100γ	1729 c/m	1729 c/m
	100γ	—	
		av. Dummy inj 100γ	1757 c/m

Total injection = $1757 \times \frac{25000}{100} \times \frac{1}{70000} = 6.27\gamma$ (438,250 c/m)

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9/16 Dummy injection [redacted]

[redacted] Del-1 $\xrightarrow{100\gamma}$ 1853 c/m
$\xrightarrow{100\gamma}$ 1803 av 1828 c/m

[redacted] Del-2 $\xrightarrow{100\gamma}$ 1831
$\xrightarrow{100\gamma}$ 1871 av 1851 c/m

[redacted] Del-3 $\xrightarrow{100\gamma}$ 1789
$\xrightarrow{100\gamma}$ 1791 av 1790 c/m

[redacted] Del-4 $\xrightarrow{100\gamma}$ 1823
$\xrightarrow{100\gamma}$ 1782 av 1802 c/m

[redacted] Del-5 $\xrightarrow{100\gamma}$ 1793
$\xrightarrow{100\gamma}$ 1842 av 1818 c/m

av. Dummy dry 100γ = 1828 c/m

Total dry = $1818 \times \frac{25000}{100} \times \frac{1}{70000} = 6.49\ g\ (454{,}500)$

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Dummy injections [redacted]

[redacted] Dcl-1 25 ml — 100 λ → ~~1781~~ 1774 c/m; 100 λ → 1795 — av. 1785

[redacted] Dcl-2 25 ml — 100 λ → 1772; 100 λ → 1752 — av. 1762

[redacted] Dcl-3 25 ml — 100 λ → 1765; 100 λ → 1772 — av. 1769

[redacted] Dcl 4 25 ml — 100 λ → 1779; 100 λ → 1744 — av 1762

[redacted] Dcl 5 25 ml — 100 λ → 1716; 100 λ → 1784 — av 1750

av inj 100 λ = 1766

Total inj. = $1766 \times \frac{25000}{100} \times \frac{1}{70\,000}$ = 6.31 λ (432,000 c/m)

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7/1

Dummy Injections [redacted]

[redacted] Ol 1 $\xrightarrow{100\lambda}$ 1818 c/m
$\xrightarrow{100\lambda}$ 1815
av 1817

[redacted] Ol 2 $\xrightarrow{100\lambda}$ 1878 c/m
$\xrightarrow{100\lambda}$ 1852
av 1865

[redacted] Ol 3 $\xrightarrow{100\lambda}$ 1894
$\xrightarrow{100\lambda}$ 1894
av 1894

[redacted] Ol 4 $\xrightarrow{100\lambda}$ 1830
$\xrightarrow{100\lambda}$ 1852
av 1841

[redacted] Ol 5 $\xrightarrow{100\lambda}$ 1856
$\xrightarrow{100\lambda}$ 1868
av 1862

Av Dummy Inj 100λ = 1856

Total Inj = $1856 \times \frac{25000}{100} \times \frac{1}{70000} = 652\lambda$ (464,000)

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Dummy injections [redacted]

3/9

[redacted] Del 1 — 100λ → 1699 cpm; 100λ → 1733 cpm — av. 1716 c/m

[redacted] Del 2 — 100λ → 1718 cpm; 100λ → 1676 cpm — av. 1697 c/m

[redacted] Del 3 — → 1732 cpm; → 1681 cpm — av. 1706 cpm

[redacted] Del 4 — → 1664 cpm; → 1682 cpm — av. 1673 c/m

[redacted] Del 5 — → 1716 cpm; → 1661 cpm — av. 1689 c/m

average Del 100λ = 1696

Total injection = $1696 \times \frac{25000}{100} \times \frac{1}{70000} = 6.06\lambda$ (424,000)

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Margarita Martinez

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CH-379 Overstreet, Ray; Jacobson, Louis; Scott, Kenneth; Hamilton, Joseph G.
"Metabolism of Fission Products"

Crude studies with radio-yttrium without the presence of inert yttrium carrier have demonstrated that following the intraperitoneal injection of this substance half the radio-yttrium becomes deposited in the bones where its release is extremely slow. Ingestion experiments show practically no absorption while inhalation shows a considerable degree. Preliminary inhalation experiments with radio xenon show highest concentrations in fat.

CH-396 Compton, Arthur Holly
"Health Report for December 15, 1942"

Uranium oxide and ~~city~~ uranyl nitrate toxicity discussed. Distribution studies of yttrium and strontium indicate that fission products are localized rather quickly in the bone.

CH410 Cantril, S.; Jacobson, Louis; Nickson, J.
"The Effects of Irradiation on the Blood and Blood Forming Tissues"

A review of the literature of the effects of irradiation on the blood and blood forming tissues. The survey includes (1) the origin and differentiation of the blood forming tissues (2) the life cycle of the lymphocyte after irradiation (3) the life cycle of the erythrocyte after irradiation (4) the effect of irradiation on platelets (5) radiation death

-H 459 Compton, Arthur H.
"Health Report for February 9, 1943"

Animal experiments with x ray dosages from 12.5 r to 500 show tissue changes but apparent recovery in a few weeks. Fission products given as chloride to rats are found to be largely deposited in the bones with lower concentrations located in the liver and spleen. The behavior of the fission products also depends on manner of entrance to the body.

CH 498 Compton, Arthur H.
"Metabolism of Fission Products"

Radio yttrium is deposited in bone to extent of 50% after intraperitoneal injection. Orally injected yttrium remain unabsorbed after two days. Intraperitoneal injection of radio strontium results in a deposit of 75% in the bones. The rate of loss not determined but indicated greater than yttrium. Oral administration shows 10% to be absorbed. Radio zirconium shows little absorption from any manner of injection and no specific localization. Unseparated fission products show skeleton as single most important organ of retention. Liver and spleen also show high retention for first four days but quick drops considerably by sixteenth day. Elimination is slow but somewhat more rapid than for yttrium. Oral administration shows 1.6% absorption. Method of analysis -

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CH 554 Compton, Arthur Holly
"Health Report for March 15, 1943"

Radio lanthanum injected intraperitoneally & intramuscularly. Significant portion unabsorbed after eight days - liver & skeleton showing highest % of absorbed material. Absorption by way of digestive tract is small ~~when~~ whereas La^{140} introduced in lungs is largely ~~fixed~~ in lungs. Radio-cerium behaves as La^{140} intraperitoneally & intramuscularly. Sodium citrate, parathyroid hormone, ammonium chloride and strontium chloride all enhance removal of Sr^{85} from the body.

CH 633 Stone, Robert Spencer
"Health Division Program, May 10, 1943"

Detailed programs of ~~[illegible]~~ various groups in medical division are given. Studies on metabolism of fission products outlined (J. H. Hamilton)

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CL-697

Wollan, E.O.

Project Handbook Chapter XIII "Radiation and its Biological Effects" May 1945

Element	Valence	Half life	Oral absorption	Distribution of absorbed element	Half time of retention of absorbed element	Long-term retention at 1 day	Fraction of initial energy of radiation at 66 days after 100 day
Sr^{89}	+2	55d	15%	Bone 50%	~200d	<1%	10.6%
Sr^{90}	+2	~5yr	15%	Bone 50%	~200d	<1%	0.43%
Ba^{140}	+2	12.5d	18%	Bone 60%	~200d	<1%	7.7%
Y^{91}	+3	57d	<0.2%	Bone 70%	~500d	20%	4.0%
La^{140}	+3	40hrs	<0.3%	Bone 35%	>16d	20%	<0.05%
Ce^{141}	+3	28d	<0.05%	Bone 35%	~50d	35%	5.7%
Ce^{144}	+3	340d	<0.05%	Bone 35%	~50d	35%	11.5%
Pr^{143}	+3	13.5d	<0.5%	Bone 40%	~40d	20%	1.0%
Zr^{93}	+4	65d	<0.01%	Bone 50%	~80d	75%	19.7%
Cb^{93}	+5	35d	<1.0%	Bone 20%	~50d	50%	27.1%
Ru^{103}	+4	42d	<0.01%	Kidney 1.5%	~20d	60%	4.4%
Ru^{105}	+4	330d	<0.01%	Kidney 1.5%	~20d	60%	1.3%
Cs^{135}	+1	36yr	100%	Muscle 30%	~10d	<1%	0.27%
I^{131}	(-1)	8d	100%	Thyroid 20%	~30d	<1%	0.05%
I^{125}	(0)	54d	Iodine content at equilibrium range from 2 to 0.1 time conc. in air		~1hr	<1%	<0.1%
Te^{127}	+4	30d	25%	Kidney 6%	~15d		0.47%
Np	+3		<0.1%	Bone 50%	>150	1%	<0.1%

Summary. The alkaline earths, rare earths, Zr, Np and Cb when introduced into the body are deposited primarily in the skeleton where average retention is about 50% of initial absorbed quantity. Retained fraction is eliminated at rates less than their rate of radioactive decay with exception of 340 day Ce and possibly Sr^{89}. The remaining five long-lived radio-elements, Ru, Te, Te, I, Cs do not show any significant localization in the skeleton and in addition there is no striking deposition in other tissues except I in thyroid. The rates of elimination are much greater than their rates of radioactive decay with exception of Cs. The members of long-lived fission product groups absorbed by digestive tract include alkaline earths, Te, I, Cs. High degree of retention in lungs following direct intrapulmonary administration has been observed for rare earths, Zr, Cb, Ru, Np. The pulmonary retention observed for alkaline earths, Te, I, and Cs is negligible under conditions of the experiment.

00132727.035

1167190

CH-708 Compton, Arthur Holly

"Health Report for June 7, 1943

1. Unseparated fission products - intramuscular results parallel intraperitoneal data - most of activity found localized in skeleton and liver. 16 day pulmonary indicated that 1/5 to 1/3 mixture introduced into lungs retained and almost all that absorbed was present in skeleton. 16 day oral studies show 3%-5% absorbed and 70% absorbed found in skeleton.

2. Ruthenium - only 4 day results given. Intraperitoneal & intramuscular muscle had high conc. in kidney (thus different from alkalic and rare earth groups) Chief channel elimination is kidney. Large portion remained unabsorbed in lungs when introduced directly that absorbed conc. in kidney. No significant absorption from GI tract

3. Barium - no results

4. Radio-autographs - 1. Day fission mixtures after 4 days spotty distribution in lungs
2. Ruthenium retained by lungs to high degree and distributed evenly throughout pulmonary tissue -

CH-769 Compton, Arthur Holly

"Health Report for July 7, 1943

① Radio autographs - U.C. Radiation Laboratory - Following intrapulmonary administration of Cerium, Ruthenium & fission mixture after 16 days indicate large amt. retained in lungs and even distribution throughout pulmonary tissue - no evidence of selective deposition.

② Metabolic studies a) Ruthenium - 16 days after ip or im. injection highest % found in kidney. next highest were spleen, liver & skeleton which ranged from 1/4-1/6 that in kidney. Eliminated rapidly - 30% by kidneys during first 24 hrs. 45% first 4 days - then digestive tract become higher than kidneys - 72% excreted by 16th day. Absorption from digestive tract <.05% after 4 days. At four days 60% fixed in lungs when introduced directly. Still 60% after 16 days.

b) Barium - Similar to Sr. 10% from digestive tract - almost all deposited in skeleton 70% in skeleton after ip injection on a four days. Elimination slow chiefly by digestive tract.

③ Decontamination studies - Cathartics not valuable in preventing absorption of Sr from gel tract. Dc sodium phosphate [illegible] [illegible] [illegible] [illegible] - [illegible]

00132727.036

1167699

CH775 Hamilton, Joseph G.

"Summary of Metabolism of Carrier Free Fission Products in the Rat"

Element	Oral absorption	Retention at 4 days parenteral	Excretion, route & daily rate	Retention in days intrapulmonary
Sr^{85}	4D = 1.5% 64D = 1.0% (Sk = 95%)	Sk. 70% (50% 64D) other tissue < 1%	64D = 50% U = 12%, F = 38% 4D rate = 1.5% 30D " = 0.3%	
Y^{86}	4D = 0.2%	Sk. = 60% Li = 13% 64D - Sk = 95% Li = 0.5%	64D = 33% U = 6%, F = 27% 4D rate = 1.5% 16D " = 0.4% 64D " = 0.09%	2D Lng 40%, Sk 40%, Li 5% 4D " 25% " 35% " 7%
Ru^{105}	4D = < .01%	Sk = 7%, Kid = 2.5% Li = 2%, 16D - Sk = 5%, Kid = 1.4% Li = 1.5%	16D = 73% U - 38%, F 35% Rate 4D = 4% 16D = 0.8%	4D Lng 65% Sk 2% Kid 5% 16D " 58% " 7% " 7%
Cd^{131}	Normal human intra - 100% - 20% in thyroid. 1D 20% - 30D no conc. [illegible]		4D ~ 60% all via U (human)	
Ba^{133}	4D = 8% Sk > 90%	Sk 70% other tissue total < 1%		1D Lng < 1% Sk > 90% Li < 0.1%

continued on page 57

CH843 Compton, Arthur Holly

Health Report for August 7, 1943

Nothing on toxicity or metabolism of fission products or 49

00132727.037

1167500

CH-848 Hamilton, Joseph G.
"Metabolism of Fission Products"

Radio cerium Ce^{140} given to animals as $CeCl_3$ by different routes - behavior resembles that of yttrium and lanthanum although more poorly movilized(?) when administered directly into lungs or parenterally. In this respect it resembles zirconium. Radio strontium without carrier found deposited chiefly in skeleton whether given orally or intraperitoneally. 15% absorbed when given by mouth and 20% retained when injected. Rate elimination less than rate of decay for Sr^{89}

CH-880 Stone, Robert Spencer; Wollan, Ernest Omar
Health. Report for May 15, 1943 (Health Division), Health Physics Section. Clinton Laboratories."
Circulation Strictly Limited

CH-908 Compton, Arthur Holly
"Health Report for September 4, 1943"

Biological Research - Metabolism of fission products
yttrium - Lung experiment - 60% retained at one day, 29% at four days, 3% at sixteen days - absorbed fraction almost entirely in skeleton. Lung retention far less than with La and Ce. Radio autograps reveal very diffuse distribution probably due to more rapid absorption as compared to Ce, Ru, Raw fission products and Zr.

1167501

CH 775 continued from page #5

Ce^{144}	0.3% (almost all in liver)	Sk 25% Li 28% SD Sk 25% Li 20%	SD: 27% U: 2% F: 25% RES 40D 3% SD = 6%	? 20 Lng 30% Sk 28% Li 9% 40D " 65% " 11% " 12%
Ce^{140}	<.05%	Sk 25% Li 10-20% 6ND Sk 25% Li 8%	6ND = 56% U: 3.1% F: 52.3% RES 40D = 3% 16D = 1%, 8D = 0.5%	40 Lng 73% Sk 8% Li 6% 8D " 59% " 15% " 13% 16D " 36% " 30% " 17%
Pure fission mixture	9D = 47% (Ce = 42%) 16D = 35% (Ce = 9%) 6ND = 6% (Ce = 90%)	4D Sk = 37% Li = 11% 16D Sk = 39% Li = 6% 6ND Sk = 47% Li = 2%	16D = 32% U = 7%, F = 25% RES 8D = 37% 16D = 1%	40 Lng 38% Sk 36% Li 6% 16D " 21% " 61% " 7% 6ND " 7.5% " 74% " 35%

CS-926
Laboratory Council (Health) Sept 14, 1943

CH-957 Compton, Arthur Holly
Health Report for September 25, 1943

Metabolism of fission products: Radioautographs of lungs after intrapulmonary administration of Neptunium resemble those after Ruthenium and fission mixture in that fine structure deposition of Ruthenium and irregular spotty deposition of mixture were encountered. Columbium - 16 day intramuscular animals - deposition like Zirconium except soft tissue higher. Excretion chiefly by digestive tract. 30% excreted after 16 days as compared to 2% for Zr. Neptunium - ~~ultra~~ intramuscular - deposition similar to rare earths in that bone principal organ of deposition and that liver & kidney were next. Excretion, chiefly by way of kidney (in contrast to rare earths, Zr and Cb) was rapid 37% excreted in 8 days. Retention in lungs following intrapulmonary administration much less than for Zr, Zr, Cb, Ruth, and Ce. Absorption from GI tract <0.1%

Decontamination studies Parathormone not useful alone. Short term raised retention of Sr^{89} in carcass by 25% (Sr^{89} administered intraperitoneally)

00132727.039

1167502

58

CH-1005 Compton, Arthur Holly

"Health Report for October 23, 1943"

Metabolism of fission products: Yttrium - next to bone, kidney liver & skin show greatest deposition. Ant in soft tissues ranges from ½ bone at one day to 1/16 to 1/30 th at 11 days. Bone autographs show similar to Sr - after 4 days primarily in periosteal layer and epiphyseal regions. Cesium - preliminary results similar to potassium in that evenly distributed throughout tissue. Praseodymium - preliminary results like Lu - at 1 & 4 days liver had as much as bone (70-80% of absorbed material in these two organs

CS-1030

Laboratory Council Nov. 2, 1943

Information Meeting (Health)

1161503

CH 1049 Compton, Arthur Holly

Metabolism of Fission Products: Progress Report for October 15, 1943

A. Unseparated fission products
B. Radio Ruthenium
C. Neptunium (48 days)
D. Radioautographic studies

} detailed report of preparation and deposition in various organs after intramuscular, intraperitoneal, intrapulmonary and oral administration. (1-64 days)

1. Method - one lung removed, fixed in formalin (zenker-formol mediator) Paraffin sections of 8-10 micron thickness were cut and mounted on glass slides. The paraffin was washed off with xylene and slides dipped in colloidin and allowed to dry. Prepared section placed in contact with Agfa No-Screen X-ray film, wrapped with light proof black paper, and placed under lead blocks to keep film in close contact with sections. 2,000,000 - 10,000,000 beta particles/sq cm film gives good exposure (1-64 days in these). After several radioautographs prepared sections were stained. Typical examples of radioautographs and corresponding photomicrographs are given.

CKN 1059 Nickson J. J. and Chipman J.

Metallurgy of Product and Safety Precautions

Nothing on metabolism

00132727.041

1167564

CH 1086 Compton, Arthur Holly

Biological Section. Report for November 27, 1943
Clinton Laboratories. November 27, 1943

Hazards of ingestion fission products in drinking water at Clinton. Calculations show Radio Sr to be only hazard - May precipitate active Sr out of waste solution with sulfate.

CH 1089 Compton Arthur Holly

Health Report for November 29, 1943

Radiautographic studies - no ~~complete~~ complete results given.

1167505

CS-1128
Laboratory Council
Information Meeting (Health) Dec. 7, 1943

CS 1193
Laboratory Council K
Information Meeting (Health) Jan. 4, 1944

CH 1238
Health, Report for January 22, 1944 Compton, Arthur Holly

Biological effects of radioactive isotopes
High Ca diet before oral administration of Sr to rats
decreased absorption from 58% to 2%. Low
Ca diet increased absorption to 60%–70%.

00132727.043

62

CH1260 Compton, Arthur Holly

Health Report for January 22, 1944 Feb 11, 1944

Nothing on metabolism

CH1297 Compton, Arthur Holly

Biological Section. Report for Feb 29, 1944 Clinton Laboratories

Nothing on Metabolism

CS1329

Laboratory Council

Information Meeting (Health) Feb. 1, 1944

1167507

00132727.044

CH-1405 Compton, Arthur Holly
Biological Section. Report for March 15, 1944
Clinton Laboratories

Metabolism of fission products - no complete results

CH 1416 Compton, Arthur Holly
Weekly Report for March 29, 1944

Nothing

00132727.045

1167500

CHN-1429 Lacassagne, A.; Latters, J. and ~~[illegible]~~ Lavendan, J.

"Experimental Studies of the Biological Effects of Polonium Introduced in the Organism"

Translation of J. de Radiologie et d'Electrologie 4:1-14 & 67-82 1925

CH1433 Compton, Arthur Holly

Health Report for April 29, 1944

Metabolism of fission products - Nothing

CH 1452 Compton, Arthur Holly

Health Report for March 6, 1944

Fission product studies - Nothing

CH1459 • 1470 Compton, Arthur Holly
Health Report for Feb. 29, 1944

Nothing on Metabolism - results of various chemical tests given - colloidal gold, cephalin cholesterol, urine coproporphyrin, urobilin, white cell phosphorus.

CH1460
Metabolism of Fission Products Report for Feb 15, 1944 Compton, Arthur Holly April 11, 1944

Complete results of intramuscular, intrapulmonary and oral administration of Pr^{143}, Ce^{139}, Ce^{135}, Ce^{143}, Ba^{133}, Ba^{140} are given.

CS1462
Laboratory Council Information Meeting (Health) March 7, 1944

1167510

00132727.047

66

CJ 1550
Laboratory Council
Conformation Meeting (Health) April 4, 1944

CH-1560 Compton, Arthur Holly
"Health Report for March 25, 1944."

Nothing on Metabolism

1167511

00132727.048

CH 1562

Compton, Arthur Holly

Seattle Report for March 31, 1944. Project Wise activities in Chemical Medicine, Medical Research and Biological Research.

Nothing on metabolism

00132727.049

1167512

CH 1572 Compton Arthur Holly
Metabolism of Fission Products. Report
For March 25, 1944

J. G. Hamilton
Tracer studies with product - first preliminary report.
Dose - 150/rat - 3 rats to a group. Indication so far are
that product in any valence state (3, 4 & 6) is < 0.05% absorbed from yt.
+4 poorly absorbed after ~~im~~ i.m. injection 4 days 4.2%, 16 days 12.4%.
30% of absorbed material found in ~~[illegible]~~ skeleton, smaller
amounts in liver and kidney. 1% eliminated during first 4 days
at 16 days 95% was retained by lungs after intrapulmonary
injection and 80% of that absorbed was in skeleton (similar to
Zr after oral, im & ipul administration)
at 16 days after im injection skeleton retained ~55% of absorbed
dose. 32% +3 absorbed from site, 67% +6. 27.8% absorbed
dose of +6 was excreted at 16 day - digestive tract chief channel
Following ipul administration at 4 days 50% +3 retained
by lungs and 80% absorbed dose was in skeleton. 32%
+6 retained in lungs and 90% absorbed dose was in
skeleton (+3 & +6 following im and ipul injection resemble
Yt and +3 Np. Fluoride method used. Two assays
for each tissue had to check better than 5%
Total recovery for few completed animals >95%

CH 1619 Compton Arthur Holly
Health Report for May 29, 1944

Nothing on Metabolism

1167513

CT-1648 Compton, Arthur Holly
Health Report for June 1944. Clinton Laboratories

CH1649 Compton, Arthur Holly
Health. Report for June 29, 1944. Clinton Laboratories
Health Physics and Biology

CH 1659 Compton, Arthur Holly
Metabolism of Fission Products. Report for April 15, 1944

Complete results on Sr, yttrium and cerium
which are summarized in handbook (page 53 this book)

00132727.051

1167514

70

CS 1665
Laboratory Council
Conference Meeting (Health) May 2, 1944

CH 1673 Compton, Arthur Holly
Health Report for April 25, 1944

H.S. Cole - uses intracardiac & iv vs tail vein injection to study distribution of fission products.

Skeleton	23-35% injected dose	pooled results of 1, 3 & 7 day studies
Liver	25-40%	
Urine	7-11%	
Feces	2-15%	

CH 1674 Compton, Arthur Holly
Health Report for April 30, 1944. Project Wide Activities in Clinical Medicine, Medical Research, and Biological Research

Nothing on metabolism

1161515

00132727.052

Compton, Arthur Holly CH1679
"Metabolism of Fission Products" Report for
April 25, 1944

Radioautographic studies with +3 & +6 product started
Differences in rate of elimination of 3 valence state
following intramuscular injection have been observed.
at 16 days excretion is as follows: +3 - 45%,
+4 - 15.2%, +6 - 27.3%. Digestive tract is chief channel
+3 long studies at 16 days indicate 8% of retained
activity held by lungs and most of absorbed
material was deposited in the skeleton.

1167516

00132727.053

CH 1742 Compton, Arthur Holly
Health Report for May 31, 1944

Nothing on metabolism

* CH 1759 Compton, Arthur Holly
Health. Report for May 31, 1944 (Progress Report on Product Studies

J. G. Hamilton - +4 radioautographs of lungs show spotty retention throughout alveolar tissue at 6 y age. Series of iv. experiments have been set up.

1167517

00132727.054

CS1773
Laboratory Council
Information Meeting (Health) June 6, 1944

CH -1835 Compton, Arthur Holly
Health Report for June 30, 1944. Project under
Activities in Clinical Medicine, Medical Research
and Biological Research

Nothing on metabolism

00132727.055

1167518

74

CH 1862 Compton, Arthur Holly

Health Report for July 29, 1944. Clinton Laboratories, Health Physics and Biological Section

Nothing on metabolism

CH1896 Compton, Arthur Holly

Health Report for June 30, 1944. California Project and National Cancer Institute

Preliminary results of oral administration of +6 Po showed very low absorption from GI tract. Following intramuscular injection 1/3 remained at site 1/3 was eliminated and 1/3 absorbed at 4 days. Absorbed fraction distributed like Po +4

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tal indicate this procedure may be more reliable than intramuscular or intravenous injection. At 64 days following intramuscular injection retention at site of injection was +4-69%, +3-42%, +6 65%. Not figures for +3 & +6 are not much different from 16 th day. Little +4 is absorbed between 16 th & 64 th day. Probable that following intramuscular injection +3 & +6 Po are slowly converted to +4 Po. Rate of elimination +3 & +6 after 16 th day is about 0.4% / day and remains relatively constant. Digestive tract is chief channel of elimination.

00132727.056

1167519

S-1907
Laboratory Council
Information Meeting (Health) Jan. 16, 1945

CH1910 Compton, Arthur Holly
Health Report 704 June 30, 1944. California Project

Pu Cl₃ aerosol exposure K. S. Cole

Swimming animals in detergent bath after exposure removed 98.7% material from fur. Immediately after 55 minute exposure 4.4×10^{-6} gm deposited in lungs - fragments unchanged after 2 days - fallen slightly after 8 days. Incomplete results for 3×10^{-6} gm $PuCl_3$ given by stomach tube indicate gut cleared in 20-40 hrs and less than 4% was absorbed from G.I. tract. Procedure - wet tissue dried 12 hrs at 110°C, followed by 24 hrs at 200°C. Then placed in muffle at 550°C for 48 hrs. Ash dissolved in 2N HNO_3 - 0.5N hydroxylamine to make sol. of 20 mg/ml ash/ml. A 0.5 ml aliquot is transferred to centrifuge cone and .44 coprecipitated with 0.43 mg La_3. Overall loss for soft tissue 15% for bone 20%.

Radioautographic studies J. G. Hamilton

Difficulty with +3 & +6 long radioautographs found due to leaching by formaldehyde fixation.

Tracer studies J. G. Hamilton

Four day intravenous studies complete. Distribution like in (CH1922) except more in liver (28% +6, 36.5% +3, 71.5% +4) Notably due to filtering out of small colloidal particles. 16 day experiments on animals receiving material subcu. in tail followed by amputation of

00132727.057

1167520

76

CS 19A
Laboratory Council
Conformation Meeting (Health) July 4 (1944)

CH 1991
Health Report for July 31, 1944. Compton California Project.
Nothing on 19 metabolism

1167521

00132727.058

CS 1947
Laboratory Council
Information Meeting (Health) Aug 8, 1948

CH2001
Health Report for July 31, 1948. Compton Project wise activities in Clinical Medicine Medical Research, and Biological Research.

Nothing on 49 metabolism

1167522

00132727.059

78

CH 2023

Health Report for August 31, 1944 (Health Division, Health Physics Section and Biological Section) Clinton Laboratories — Compton

Nothing on 44 metabolism

CH2057

Health Report for September 28, 1944 (Health Division, Health Physics Section and Biological Section) Clinton Laboratories — Compton

Nothing on 44 metabolism

1167523

00132727.060

CS 2129
Laboratory Council
Information Meeting (Health) Sept 5, 1944

CN 2132 Compton
Health. Report for August 31, 1944. Problems Relating to Product.

Radioautographic studies J. G. Hamilton

Preliminary survey of lung radioautographs prepared from alcohol fixed tissue indicate general trend of distribution same as for formalin fixed specimens although some cracking occurred with formalin. Deposited throughout entire bronchial tree as well as in alveolar sacs after exposure to PuO_2 smoke.

Arsenic Studies J. G. Hamilton

Exposure to PuO_2 smoke produced by arc of carbon arcs resulted in following distribution: Immediately after exposure 54.7% of total activity in animal in lead (assumed in upper respiratory tract, 32.4% in skeleton, and 38.7% in lungs. At 16 days - 0.57% of material originally present was in lead, 0.97% in skeleton, and 31.7% in lungs. Almost all remaining activity was in feces. From these results it seems that a large fraction of inhaled material was fixed in lungs and that, this fixed activity was subsequently absorbed and deposited in other parts of body, or was removed from the lungs by ciliary action and eventually swallowed.

1167524
00132727.061

80

CH2189
Health. Report for October 31, 1944. Compton Clinton Laboratories

CH 2202
Health Report for November 30, 1944. Compton Clinton Laboratories

CH2225
Health. Report for December 31, 1944 with

Nothing on Metabolism

1167525

00132727.062

CH2227 Compton
Health Report for September 30, 1944 (California)

Nothing on metabolism

CH2238 Compton
Health Report for September 31, 1944 (Problems Relating to Product)

1. CR-1 column method for determination of 49 in urine is described (100cc urine used) J.J. Nickson, J.E. Rose

2. Tracer studies K.S. Cole
After exposure to $PuCl_4$ ~30% activity originally deposited in lungs was absorbed and deposited in skeleton. From 50-75 days lung activity remained roughly constant at 10% of initial value.
Correction factors for mass absorbtive after LaF_3 method are urine 1.35, feces 1.45 and bone 1.20. Overall recovery for skikes is 97±3%. Five rats injected intracardially sacrificed after 4 days - 13% excreted in 4 days (7% feces, 6% in urine) Skeleton >60%, liver ~12%

3. Radioautographs J.G. Hamilton
Lung radioautographs of animals inhaling PuO_2 smoke produced by volatilization of $PuCl_4$ or $Pu(NO_3)_4$ in electric arc completed for intervals from 0-16 days. Immediately after inhalation considerable deposition in both bronchial tree and alveolar sacs. 96 hrs later almost all material removed from bronchial tree - then no further change to 16 days.

Tracer studies J.G. Hamilton
64 days after exposure to PuO_2 smoke 80% of material originally alveolar tissue was eliminated from lungs. PuO_2 in bronchial tree rapidly removed. <1% ant. initially inhaled found in other tissue, sk, li, bd etc.

00132727.063

CS2244
Laboratory Council
Information Meeting (Health) October 3, 1944

CH2268 Jacobson, Louis; Overstreet, Ray; and Chaikoff, Israel Lyon

Metabolism of Fission Products - Radio Tellurium
Complete results for +4 & +6 Te. contrary to CH1894 - both valence states are absorbed from G.I. tract. Elimination of both valence states is rapid - ½ time retention ~16 days. Principal organs of deposition are blood, liver and kidney.

CH2311 Compton
Health, Report For October 31, 1944 (California)

Studies of Uranium in Urine George D. Price & Renato Ferretti
fluorophotometric method in fused NaF

Nothing on metabolism of 44

CH2312 cont.

Rate of Excretion

	+3	+4	+6
64 days	0.2%	0.05%	0.15%
144 "	0.1%	0.025%	0.05%

apparent ½ period of retention for Pr absorbed ~ 2 y

00132727.064

1167521

CN2372 Wrapton 83

Health. Report For October 31, 1944 (Problems Relating to Product)

Urinary Excretion of Product J. F. Nickson, J. E. Rose

study of methods: cupferron chloroform, $Di PO_4$, $Zr PO_4$, $Ta Z_3$ absorption column, hexone & N-Butyl Phosphate extraction

Tracer Studies K. S. Cole

No difference in absorption from rat lung of +3, +4 & +6. Rate at which product leaves lungs is not proportional to amt. present but is decreasing function of time.

After receiving +4 & +6 by stomach tube rats absorbed 0.2% administered dose after 5 days. (+4 & +6 ~ same)

Bone radioautographs of mouse injected with 360 product and fixed 36 days later are given - show product deposited in endosteum

Tracer Studies J. G. Hamilton

~10% inhaled PuO_2 smoke remains in lungs at 64 days and is thereafter released very slowly; same metabolism shown for PuO_2 from burning metal as for PuO_2 from burning $PuCl_4$ & $Pu(NO_3)_4$.

CS-2372
Laboratory Council
Information Meeting (Health) Nov. 7, 1944

00132727.065

1167028

CN2383 Compton

Metabolism of Product. Report For Oct 15, 1944

Completed results of three valence state injected intramuscularly, orally intravenously, intrapulmonarily, and subcutaneously - J. S. Hamilton, H. Scott, H. Fisher, O. Axelrod, J. Crowley, A. J. Barber.

Detailed report of method of analysis is given - also method of preparation of injection solutions. Animals received 15 γ each.

Distribution after intramuscular injection

Organ	+3						+4						+6					
	4 days		16 days		64 days		4 days		16 days		64 days		4 days		16 days		64 days	
	% injected dose	% absorbed dose	% injected dose	% absorbed dose	% injected dose	% absorbed dose	1	2	1	2	1	2	1	2	1	2	1	2
Liver	1.12	5.52	.84	3.46	1.72	2.77	.070	3.52	.19	5.24	.56	2.62	3.58	14.0	1.89	2.72	2.24	4.18
Kidney	.30	1.48	.10	.41	.27	.43	.030	1.39	.078	2.16	.11	.51	.50	1.96	.47	.68	.91	1.70
Testes			.065	.27			[illegible]		.010	.32					.10	.14		
Spleen	.079	.39	.095	.39	.22	.35	[illegible]	.39	.014	.39	.03	.14	.097	.37	.22	.32	.28	.52
Muscle	.47	2.32	.83	3.42	2.96	4.77	[illegible]	1.36	.10	2.76	.60	2.81	.66	2.57	1.25	1.80	.80	1.56
Skin	.51	3.02	.62	2.56	.49	.79	.20 [illegible]	9.23	.083	2.28	.17	.79	.67	2.61	.60	.87	.61	1.19
Fetuses	6.15	30.4					[illegible]											
Stomach	.064	.32	.025	.10	.0005	[illegible]	[illegible]	.08	.0035	.097	.014	.065	.17	.66	.057	.082	.078	.15
Intest.	.25	1.24	.23	.95	.078	.13	.050	2.43	.045	1.24	.11	.81	.59	2.30	.50	.72	.26	.19
Bone	10.76	53.0	18.64	76.8	32.5	52.2	1.52	70.7	2.16	59.4	13.7	64.0	19.14	66.5	44.93	64.9	31.3	58.3
Lungs	.046	.23	.056	.23	.087	[illegible]	.0037	.17	.006	.17	.025	.12	.084	.33	.10	.14	.085	.16
Brain	.0043	.021	.0073	.030	.009	[illegible]	[illegible]	.037	.0007	.019	.0026	.012	.018	.031	.0089	.012	.0057	.11
Blood (8% B)	.53	2.62	.26	1.07	.15	.24	[illegible]	2.38	.0058	.16	.053	.25	.19	4.58	.22	.32	.17	.32
Unab. injy	77.13		68.05		38.2		95.7		86.9		68.1		70.34		28.78		34.6	
Balance	3.11		3.26		4.62		2.43		1.17		2.35		6.74		3.81		4.51	
Urine	.11	.54	.19	.78	.97	1.56	.014	.65	.037	1.05	.69	3.23	.098	.38	5.51	7.98	2.30	4.48
Feces	1.53		.74	3.04	19.5	34.4	.11	5.12	.43	11.9	4.70	22.0	1.95	7.58	12.37	19.3	14.1	26.3
Recovery	97.68		92.92		99.66		100.25		91.92		90.56		101.97		100.35		91.28	

Distribution of Pa +3, +4 & 6 4 days after intravenous injection

Organ	+3	+4	+6	Organ	+3	+4	+6
Heart	.063	.061	.14	Intestine	2.57	2.22	1.27
Liver	38.0	73.3	29.1	Bone	33.5	14.4	46.0
Kidney	1.84	1.43	2.8	Lungs	.049	.27	.16
Spleen	.68	.95	.42	Brain	.0069	.011	.012
Muscle	.26	.18	1.58	Blood	.56	.26	.65
Skin	2.29	2.22	1.76	Balance	3.09	3.83	3.66
Stomach	.041	.18	.19	Urine	.68	1.72	3.86
				Feces	10.2	13.4	16.3
				Recovery	93.88	110.9	105.05

<.05% absorbed from Sd that. Results intrapulm also given in this report.

00132727.066

1167529

CH 2446 Compton
Health Division. Report For November 30, 1944

Toxicology of uranium

CH 2458 Compton
Health. Report For November 30, 1944 (Problems Relating to Product)
Product Experiments H.S. Cole

1. Development of Aerosol Methods - as alternative to using organic complexes in ferron should be possible to use Pu^{+6} in dimethyl ether for bomb method of dispersion
2. Acute toxicity of Product in rats & mice
   Some results of lethal experiments reported - material injected intravenously & state (.25 - 100 γ/gm wt) 5, 10, 25, 50, 100 & 200 γ/mouse) [illegible] at least one of each strain (CF1 & ARC) in [illegible] dose [illegible] 10 γ group died. [illegible] 5 or 6 [illegible].
3. Acute toxicity of Radium in mice
   Some results of lethal experiments reported - material injected intraperitoneally. [illegible] 1, 2, 5, 10, 20, 40 μC/mouse or .005-.20 γ/gm on 20th day appears 1 μC/gm is fatal but 0.5 μC/gm is not.
4. ~~[illegible]~~ Methods for determining Product in urine
   U-R-4, U-R-1, $BiPO_4$, LaF_3, $Zn_3(PO_4)_2$-LaF_3, extraction methods

CS 2482
Laboratory Council
Information Meeting (Health) ~~[illegible]~~ Dec. 12, 1944

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CH2510 Compton

Health Division. Report For December 31, 1944

Nothing on Product Metabolism

CH2546 Compton

Health. Report For December 31, 1944 (Problems Relating to Product)

I Clinical Medicine & Medical Research - Effect of $PuO_2(NO_3)_2$ on Tissue Metabolism of Rats. (Pyruvate metabolism by liver markedly affected)

II Biological Research - a) Improved $Zr_3(PO_4)_4$-LaF_3 method

b) Inhalation Exposure to Product c) Acute toxicity of Product in Mice - at levels of 10, 5 & 2.5 mg/kilo mice died in two weeks. at 1.25 mg/kilo deaths were slower (24 days); at 0.5 mg/kilo & 0.25 mg/kilo deaths rare

d) acute toxicity of product in rats - 2 mgs/kilo killed all rats in 9-11 days lower levels deaths were not frequent. A dose of 0.25 mg/kilo appears to be on border line but data over range 0.125 - 1.0 mgm/kilo are not consistent. e) subacute toxicity of product in ~~mice~~ mice

f) Histological effect of product on mice - Changes in bone, bone marrow, notes. ~~So~~ also changes in lymph nodes & testis. g) radium toxicity in mice - mid lethal dose 1st 50 days lies between 0.5 and 1.0 mc/kilo. h) radioautographic distribution of radium and product in bone - Has been suggested that high toxicity of product compared to that of radium may be chemical and may be distributional - radioautographs show difference in distribution. Radium is in bone, particularly at ends. Product not distributed throughout bone but conc. at endosteal regions, some in periosteal regions and some in marrow.

III Medical Industrial Hazards Section - a) Product in urine - CR-1, $Zr_3(PO_4)_3$-LaF_3 method. b) Product in feces - no human work yet

IV Tracer Studies - J. G. Hamilton

PuO_2 smoke produced from burning metal gave same results as smoke from burning PuO_2 & $Pu(NO_3)_2$. 10% inhaled fixed in lungs at 64 days

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CH2587 ~~Compton~~ 87

Curtis, H.J.; Morgan, K.Z.; Wirth, J.C.

Health. Report For Month Ending February 15, 1945 (Health Division and Biological Section of the Research Division)

Nothing on metabolism of product
Gamma and x ray
Biological action
Breeding
application to human protection

Great variation in closely related species makes it impossible to draw definite conclusions. Permissible dose of .1r per 8hr day set.

CH2588 Lorenz, E.K.; Eschenbrunner, A.B.; Dirnhofer, M.K.; Hilton, W.B.

Health. Report For January 15, 1945 (National Cancer Institute)

~~Circulation Combined~~

Gamma and x rays

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88

CH-2597 Wirth J.E.; Morgan, K.Z.
Eertie, M.J.

Health. Report For March 15, 1945

Neutrons, Beta and Gamma rays - nothing on metabolism of product.

CH 2654 Jacobson, L.O.

Health. Report For January 15, 1945

~~Uranium in urine, inhalation studies with Rev. Y~~

Inhalation studies Ce & Pr,
Injection of Sr^{89}

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CH2736
Health. Report for February 15, 1945 Anon.

Uranium in urine. Chelation studies with Ru & Y.

CH2740
Health. Report for February 15, 1945 (Problems Relating to Product) Anon.

next page

CS 2700
Laboratory Council
Information Meeting (Health) Feb. 20, 1945

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CH 2777 + Daily, Mary, Wender, Irving, Abrams, Richard, Siebert, Henri, Potts G.M., Painter, E.E.

Tracer Studies with Inhaled Eight Day Iodine

CH 2740 cont.

4. Detection of Product in Urine & Feces — Russell, Motta

Routine analysis continued. No satisfactory fecs method

5. Analysis of tissue — Taylor — detailed report of aerial counting and SaF_3 procedure generally use 85% as recovery and correct accordingly.

6. Radioautographic studies — Bone radioautographs of rats injected with 49 showed selective deposition in endosteal & periosteal regions and within bone marrow. Aut in cortex is negligible. Prepare studies with Pu^{238}.

7. Distribution in groups of 3 rats 16 days after 13 & $Pu(NO_3)_4$ alone and complexed

Tissue	$Pu(NO_3)_4$ alone	Oxalate mg/.25cc	Citrate mg/.25cc	Tartrate mg/.25cc
Liver	2.97	3.86	3.67	2.27
Kidney	.44	.45	.37	.35
Spleen	.23	.44	.30	.21
Bone	54.9	57.8	57.0	55.0
Urine	15.2	8.24	2.93	13.7
Feces	19.8	34.0	35.3	26.5

~~[illegible]~~ ~~[illegible]~~

CH-2740

Health Report For ~~[illegible]~~ Feb 15, 1945 (Problems Relating to Product)

Biological Research Section — W. S. Cole, H.

1. Stability of +6 Product — P.C. Zoonkins

<5% reduced to +4 in 1N HNO_3 (.81 mg/ml) in 83 days

2. Inhalation of Pu solutions — R. Abrams, H. Siebert

Material given through tube. $Pu(NO_3)_4$ left lung slowly and showed little tendency to be deposited in liver or skeleton (1% at 120 hrs). $Pu(NO_3)_4$ left lung somewhat faster (liver & bone 4% at 120 hrs). Addition of citrate abolished difference in +4 & +6. Both rapidly absorbed (80% in 20 hrs) deposited in liver & skeleton (>20% in each by 50 hrs)

3. Radium lethality in Rats — R. Finke, W. Norris

Received from 0.02 – 0.50 μgm/gm body wt. At 29 days 2 deaths in 0.50 g group & 1 in 0.25 g group. ∴ Radium is ~twice as toxic as product. In mouse at 30 days radium ip and product iv are ~equally lethal. At 100 days radium appears to be twice as toxic.

Mid lethal doses 30 day +6 in mice are 0.5–1 μg/gm for iv injection, ~4.5 μg/gm for subcu, and >4.5 μg/gm for intramuscular.

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CH2785 Anon.
Health Report for March 1945
Inhalation RuO_4, Ce. Excretion of Sr. γ Rays, Slow Neutrons

CS 2790
Laboratory Council
Information Meeting (Health) March 20, 1945
Available from Mr. Oppenheimer

CH2801
Circulation limites

00132727.073

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92 CH 2808 Wirth, J. E.; Morgan K. Z.; Curtis, H. J.
Health Report For April 15, 1945 (Health Division and Biological Section of Research Division)

Beta rays, Gamma rays, Neutrons

CH 2812 X Cantril, S. T.; Parker H. M.
The Tolerance Dose

X and gamma	0.1 r per day
Beta external	0.1 rep per day
Fast neutron	0.025 rep per day
Radon conc. in room	1×10^{-14} curie/cc
Radium in body	0.1 microgram

r = X or gamma liberating 1 esu per unit vol. per = 83 ergs/gm tissue
rep = 83 ergs/gm tissue
= 1.61×10^{12} ion pairs/gm tissue

CH 2820 X Wirth; Morgan; Curtis
Health Report For May 15, 1945 (Health Division and Biological Section Research Division)

H 2838X Morgan; Curtis
Health Report For June 15, 1945 (Health Division and Biological Section of the Research Division)

Beta rays

CH 2844X Lang, H.C.; Terese, J.
The Metabolism of Short Lived Air Borne Fission Products May 1945

SH 2904 Anon.
Health Report For April 1945

Beta, gamma, x rays - fission products

00132727.075

1167538

94 CN 2905 Hamilton, Joseph G.

Health. Report for April 1945 (Problems Relating to Product)

1. Radium Toxicity in Rats K. S. Cole, A. L. Prosser

At 80 days 0.5 mg/kilo of radium killed 50% rats, 0.25 mg/kilo 15% Depression of body wt at 0.13 mg/kilo. At 0.062 mg/kilo rats gained as controls. Following ip injection rats excreted 20% in first day, another 10% by 25th day. Av rats retained 10% less.

2. Toxicity and Metabolism of Pu in rats K. S. Cole, A. L. Prosser

50% of rats receiving doses of 0.26 and 1.0 mgm/kilo died but only 17% of 12 rats at 0.5 mgm/kilo died (140 days) Median lethal dose ~ 0.5 mgm but is not well defined. At 14 days livers contained about 20%. Livers of 8 animals which died between 70th and 126th day contained 1.5 to 11.8% (av. 5.7%) injected dose. Part migrated to sk. On 57 days 10-30% initial dose excreted in feces and 4-10% in urine. After 57 days rate constant at 0.01% urine 0.08% feces. As noted previously Pu more than 1/10 a toxic as radium from body wt. curves product is 1/4 as toxic, from mortality data product and radium about equally toxic

3. Metabolism of freshly prepared Pu - no evidence for difference as reported in CN 2786 - At 14 days livers contained 6-11%, at 24 hrs contained 16-21%. Suggests 14 day half-time for Pu in liver.

4. Wound Decontamination - rapid washing necessary - complexing agents little better than water. 15% left by best technique. Only 50% left in wound after 24 hrs (unwashed)

5. Effect of Pu on Dog - two dogs which received dose just below lethal are excreting .01% in urine and 0.02-0.03% in feces after 2 months

6. Detection of Pu in feces - Motta - wet ash, partial hydroxide, LiF_3 methane gone autoscopic. J. G. Hamilton strong probability that chief site of localization of product

7. in bone is in osteoblasts of endosteum. Distribution of Pu from metal containing F.P. in given - relative [illegible] of sk. [illegible] for Pu & F.P.

CS 2916

Laboratory Council

Information Meeting (Health)

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4 2991 Compton, Arthur Holly 95

Health, Report for May 1945

Drugs • fission products.

CH2992

Health, Report for May 1945 (Problems Relating to Product) Compton

1. Phospholipid Turnover in Pu Poisoned Animals (G.S.G. Barron) - There was an inhibition of the rate of removal of phospholipid from the liver. Metabolism of other tissues studied.

2. Inhalation of Pu (R. Abrams) Arc Aerosol - Rats given mixture of Zr and Pu. Half time in lungs ~8 days for Zr and ~17½ days for Pu. Indications that not more than 20% of what ... the lung (at 10 days) finds its way into body. Rest is excreted. Nasal Intubation - Tables giving complete results to 15 days after intubation of Pu(IV) nitrate, Pu(III) nitrate, Pu IV citrate, Pu III citrate and Pu IV Hexametaphosphate are given. Lung absorption with Pu VI or complexed Pu (III or VI) occurs rapidly during first days and then subsides to a rate characteristic of Pu III. With Pu VI liver is maximum in 1st to 5th days (20%) and falls to 7% at 15 days; deposition in sk reaches 30% in 1 day. Addition of citrate greatly facilitates absorption from lungs.

3. Acute Effects of Pu on Peripheral Blood of Mammals - Jordan, Simmons

4. Histological Effects of Radium

5. ~~Dep~~ Development of Methods for Pu in Urine - Schubert, Russell. UR-1 column tested with urine containing albumen found satisfactory. Also tested with one human urine run simultaneously by another method and recovery was 85%.

6. ~~Asking Rat Tissue~~ Pu tissue assay - M. Taylor, C. Brown, W. Monroe. Data on LaF_3 method. ~~Si~~ $Zr_3(PO_4)_4$ - LaF_3 method for high ash tissue. Hexane extraction and $BePO_4$ ppt for high ash tissue

7. Tracer Studies J. S. Hamilton

Procedure developed to determine what % inhaled Pu is under retained. 75% deposited, 25%

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CN 3076 Anon.

Health. Report for June 1945

Metabolic Studies of Plutonium J. S. Hamilton

1. Osteomyelitis with sclerosis, calification cycle studied by radiautography
2. Long term inhalation: Pu(O) smoke reported (5% Pu) 5% in lungs. Clinicians 0.5%/day
3. Human trace experiment - received - Sym Pu as +6 nitrate of 10 in isotonic sol pH 4. Sample contained Pu^{239} to increase activity to equivalent of 50 g Pu^{239}. 4 days later gastrectomy operation on equal. of rib, spleen, tumor, omentum, entire tissue and skin obtained also blood sample.

Distribution ~ 8 μg gms Pu 40 days

	% per gm			
Cortex	.0072	Bone	.0057	
Marrow	.014	Blood	.0013	(.0008 plasma)
Liver	.032	Plasma	.0028	
Muscle	.0045	RBC	.00028	
Vertebra	.010	(17.2% μg gram)		
Spleen	.0019	(.22 μg/gm or gm)		
Tumor	.0011			
Omentum	.00043			
Skin	.00045			

Excretion

day	%	day	%
1	.18	10	.026
2	.15	11	.026
3	.12	12	.021
4	.031	13	.017
5	.030	14	.017
6	.014	15	.013
7	.017	16	.016
8	.016	17	.0086
9	.013	18	.010 .017
	.012	19	.012 .010

see page 98

CN 3190 Jacobson, Leon O.

Health. Report for July 1945

Metabolic Studies of Plutonium J. S. Hamilton

1. Radiautographs - Careful survey indicates Pu is not deposited within apatite structure of bone but is concentrated in the region of the osteoid matrix and is presumably held in combination with organic material of calcified, possibly in the protein.
2. Human - Daily Rates of Excretion

	Day	% Dose/Day
Feces	29 + 30	.0018
	39 + 40	.00273
Urine	20	.00455
	21	.0077
	22	.0050
	23	.00905
	24	.0076
	25	.0105
	26	.0071
	27	.0043
	28	.0073
	29	.0043
	30	.0069
	31	.0077
	32	.0063
	33	.0073
	34	.0084
	35	.0068
	36	.0078
	37	.0063

average level for urine ~ .0087%/day. Fecal excretion about one-fourth that.

3. Summary of D.D.U for recovery of Product from Human Feces & Urine given

CN 2786
Health Report For March, 1945

1. Studies on Mechanism of Pu Intoxication - Barron, G.; Mentz, J.
Pu nitrate migrates with beta-gamma globulin when proteins separated by electrophoresis (.0001 M Pu) On ultrafiltration of serum protein-Pu mixture 24% Pu found in ultrafiltrate, with plasma 15%. No difference in amt. Pu in ultrafiltrate between dialyzed and undialyzed samples - indication that Pu does not form firm complexes with anions of blood plasma.
Effect of product on Dogs - Russell, Delaney, Motta
2. Two dogs injected with +6 citrate - one iv with 0.286 mg/k and other im with 0.401 mg/k. Both excreted more than had a dog injected with nitrate but all three reached equilibrium daily excretion of ~ 0.01% injected dose. Total excretion at 2 wks were 15.3% for im, 24.4% for iv and 10% for dog injected iv with nitrate. Equilibrium blood levels were about 0.01 µg Pu/ml blood. Practically all Pu in blood was attached to beta globulins
Metabolism of "Freshly Prepared" Product Solutions - H. S. Cole
The injection of product +6 nitrate iv immediately (3-8 minutes) after dilution of strong acid stock resulted in no decrease in liver content at 24 hrs. over that obtained in previous experiments where diluted sol. was allowed to stand ~3½ hrs. Throughout all experiments involving iv injection of nitrate or citrate ~20% dose collected in liver. Wide range (3-50%) <5% values rare.
4 Inhalation of Plutonium H. S. Cole
Pu solutions can be delivered quantitatively to the lungs of rats by allowing animals to inhale several drops through a glass tube inserted in trachea. Pu +4 was absorbed slowly from lung with half time ~13 days. Pu +6 or complexes of Pu +4 with citrate or calgon were absorbed rapidly at first but after 1 day rate became same as for uncomplexed +4. No difference in absorption of +4 or +6 citrate. Mg mean citrate reduces +6 to +4. Pu +4 deposited in liver and sk slowly; Pu +6 and citrate faster - calgon rate between +6 and citrate. As soon as rapid absorption ceased liver lost activity after 15 days citrate liver and +4 liver ~ same - similar phenomenon with sk.

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98 CH2796 cont.

5. Detection of Product in Urine — Jackson, Russell
no new results

6. Detection of Product in Feces — Motta
Partial hydroxide - LaF_3 method

7. Radioautographic Studies — J. G. Hamilton
Endosteum and cancellous bone are principal sites of deposition of 49 in skeleton

8 Tracer Studies — J. G. Hamilton
Inhalation of $PuO_2(NO_3)_2$ spray results in initial retention of ~ 50% of inhaled product by lungs. At 17 days - 20% inhaled material in skeleton. Size of particles of PuO_2 smoke and $Pu_2(NO_3)_2$ spray indicated by electron microscope to be uniform from 0.10 to 0.30 microns in diameter. Rate of elimination at 6 months after inhalation of PuO_2 smoke is ~1% per day of retained material. Rate constant from 2nd to 6th month.

CH3076 cont.

Comparison of Excretion of Pu (in dose/day) in Rat and Man after iv injection of +6 Nitrate

Day	Rat Urine	Rat Feces	Man Urine	Man Feces
0-1	.32	1.39	.48	
1-2	.15	2.83	.15	.076
2-3	.06	1.54	.12	
3-4	.033	1.92	.031	
5-8	.023	1.35	.020	.0026
9-16	.031	—	.028	

Hexone extractive method of Scott given - not in detail

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Feces Samples

June 25

[redacted] F1 Blank
~~wt. of xble 64.6~~

[redacted] F6 wt of xble + aliquot 162.4 g
wt. of xble 61.2
wt. of aliquot 101.2
wt. of xble + dried samp 67.8

[redacted] F7 wt. of xble + aliquot 203.6 g
100.2
wt. of aliquot 103.4
wt. of xble + dried samp 105.6

July 25

[redacted]

wt. xble + samp. 202.5 g
wt. xble 92.7
wt. of samp. 109.8
wt. xble + dried samp 115.7
wt. xble + ashed samp 94.7

8/1 Result : 21.5 c/m

The contents of this Notebook
have been reviewed for
patentable subject matter.

9/6/67 RM

Date Reviewer

00132727.083

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102 Thru 103
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LA Note Book
836
Marianita Martinez
3/4/94

Prep. of Sample

Took a shiny piece of metal and weighed it analytically. It weighed 0.1467 grams. It was placed in a 5 ml. volumetric flask. 6N HCl was added ~~to this~~ dropwise, waiting ~~between~~ after each drop until the hydrogen evolution had ceased. It required eight drops ≅ ± to 1-1½ ml dissolve the metal. 1.25 ml of 8N HNO_3 was then added. The solution turned a bright green; however on heating mildly with an infra red lamp, it became brown in color with a slight greenish tinge. The solution was made up to volume with distilled water and was submitted for a radio assay. The report showed a concentration of 30.54 mg ^{49}/ml.

In order to prepare 5 ml of solution containing 5 mg 49/ml, 25 mg of 49 were necessary which ≅ 0.8186 ml of the concentrated solution. The density of the solution was determined by using a weight pipet. The volume of the pipet was found by filling it with mercury. Two determinations gave 180.60 λ. The weights of the full buret were 198.71 and 198.69 mg (Av. = 198.70)

$$\text{Density} = \frac{198.70}{180.60} = 1.1002$$

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The amt required of the conc. soln 0.8186 me X 1.1002 (density) = 0.90062 grams of the solution required.

From the weight burette the solution was carefully weighed out.

1st Portion	2nd Portion	3rd Portion	4th Port	5th Port
1.21141	1.21139	1.21143	1.21137	1.12194
1.01351	1.01335	1.01337	1.01381	1.01270
.19790	.19804	.19806	.19756	.10924

44

.19790
.19804
.19806
.19756
.10924
.90080 grams of solution added

(The vol. flask had previously been calibrated. The solution was diluted to volume with 2N HNO_3. The concentration of this solution was 4.98 mg/me as determined by radioassay. By the spectophotometric curve

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CC-167 . - Wexler, Jal and Boyd, George
"Radium and Radon: Pathological Effects and Protection"

CH 237. - Compton, Arthur Holly
Health. Report for Aug 15, 1942

A sensitive Geiger counter alarm system is diagrammed and described. Abstracts of reports of the radioactive poisons and their effects are included.

CH 225 . - Rajewsky, B
"Physical Diagnosis of Radium Poisoning. Report on a series of Investigations"

The methods of diagnosing radium poisoning and determining amount of radioactive material present in various parts of the body are discussed for living persons and for post mortem determinations. A description of detectors used in diagnosis is given

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Margarita Martinez

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L A . NOTEBOOK

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