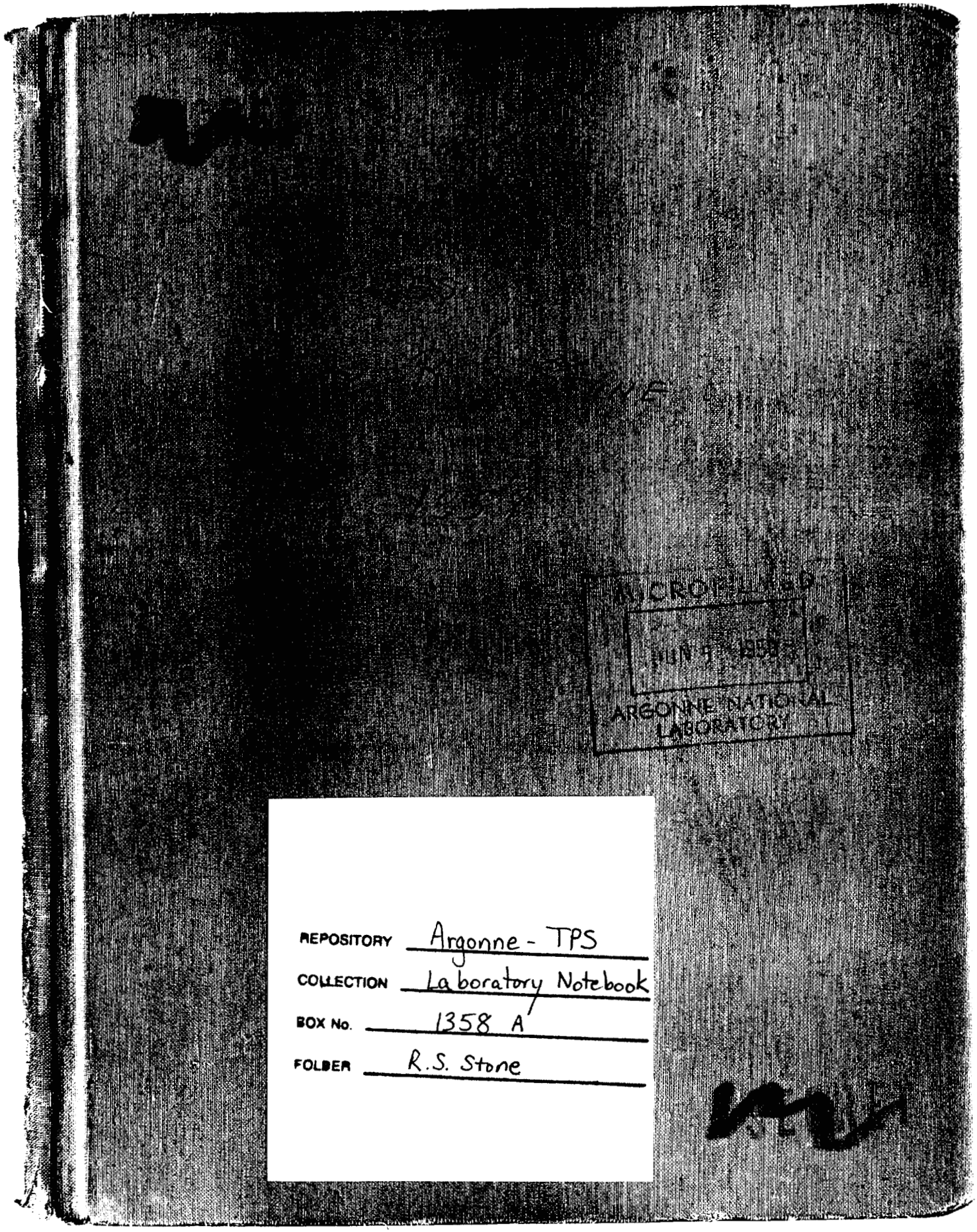


REPOSITORY Argonne - TPS
COLLECTION Laboratory Notebook
BOX No. 1358 A
FOLDER R.S. Stone

Xenon - CH259

1) Time saturation of body [illegible] 40 min

2) Desaturation at same rate

Under saturation conditions each cc of tissue will contain $\frac{1}{2}$ the no of atoms of each cc of gas breathed.

1 Reports for Health Division to Mr Compton
for final report by April 15th
500 word maximum
Each OSRD contract to be separate. { printer April 13 } | 4[3]
In simple direct language

2 One page summary of health activities to Director
by ~~March~~ 25th of each month
Sat of this week

3 Cole to order aluminum tubes if needed/
Cole - have you arranged c Nixon re: space in Pile Room

4 Site X Protect Wall
7 feet Concrete
1 foot high grade on each side
5 feet low grade mixed c Barytes in center.

5 List of all equipment for each room as soon as possible

6. Contamination of Water of a) Creek
b) River — island 1 mile
10^{-4} C/cupft
7 Toxicity of Hexe

+3.

Grazelle – Cleveland (Dupont subsidiary)
Hot dipping + electroplating.

Wolverine Tube Co. – Detroit
Aluminum Tubes.

Responsibility
1) Univ of Chicago – with Health Div as representative. Can use help of Dupont. Smith is Duponts man in charge of Safety.
Bugbee is in charge of Instruments.

See Compton re Bloom
Batelle – extruding metal.

Academic Training	1 pt for year up to 7	
Prof. Experience	1 " " " "	
Ability + Industry	1 to 5 points	
Responsibility	0 to 10	
Salary before coming to project – 1 point for each $500 beyond $5000.–		

Rel[illegible] { Div's chiefs – 9.10
Sec Chiefs 6-7-8
Group Leaders 3-4-5 | 7 Pts | 47
Junior Engineers 1 2 3 | 180 | 900.–

$18.00 per point for 7 to 47

delay.

0024447

For Monday April 12th 1943
National Cancer Institute

Progress of Experiments

Experiment I – Exposures continuous for 8 hours out of every 24

To determine effects of 8, 4, 1 and 0.1 r for 8 hours out every 24. γ-rays from Rad.

Already have results on 24 hr continuous irradiation on another strain of mice which showed that continuous exposure to a maximum of 4 r per day for 8 mos totalling 1000 r (some) No changes in blood picture or hemopoietic system that could be attributed to irradiation. Now want to see what similar exposure in 8 hours will do a higher

In other words does intensity ~~have effect~~ cause any changes.

Females at 4 r per day were sterile after 106 days
Males at 4 r per day were fertile " " "
No evidence of inherited chromosomal changes.

Experiment II a Adding 12.5 and 50 r/5 hrs to above.

To determine whether acute doses of 50 r and 12.5 r give greater effects on mice exposed to the Exp. I type of chronic exposure than on mice not exposed to chronic exposure

In other words, are animals living in a field of radiation exposure that does not cause observable effects more vulnerable to small acute exposures than those not so exposed.

If no effects are observed further acute exposure [illegible] given

III Breeding experiments in 8 hr/24 hr fields and continuous 24 hr fields.

Object - to see effects on fertility + genetic effects of 2 rates in 2 strains.

At 8 r/24 hrs w/ F 300 + 400 r

4 r/24 hrs w/ L 100, 200 & 300 r

2 r/24 hr w/ L 100 r

All animals have been fertile + litter sizes normal.

Ovaries + Testes show no changes.

C_3H mice showed changes at 4 r level. Diff may be (1) strain difference (2) age - new groups are younger.

6 Generations of C_3H mice were born & raised in the 1 and 0.1 r fields. No inherited abnormalities were observed. Wt. general appearance & life spans were comparable with controls.

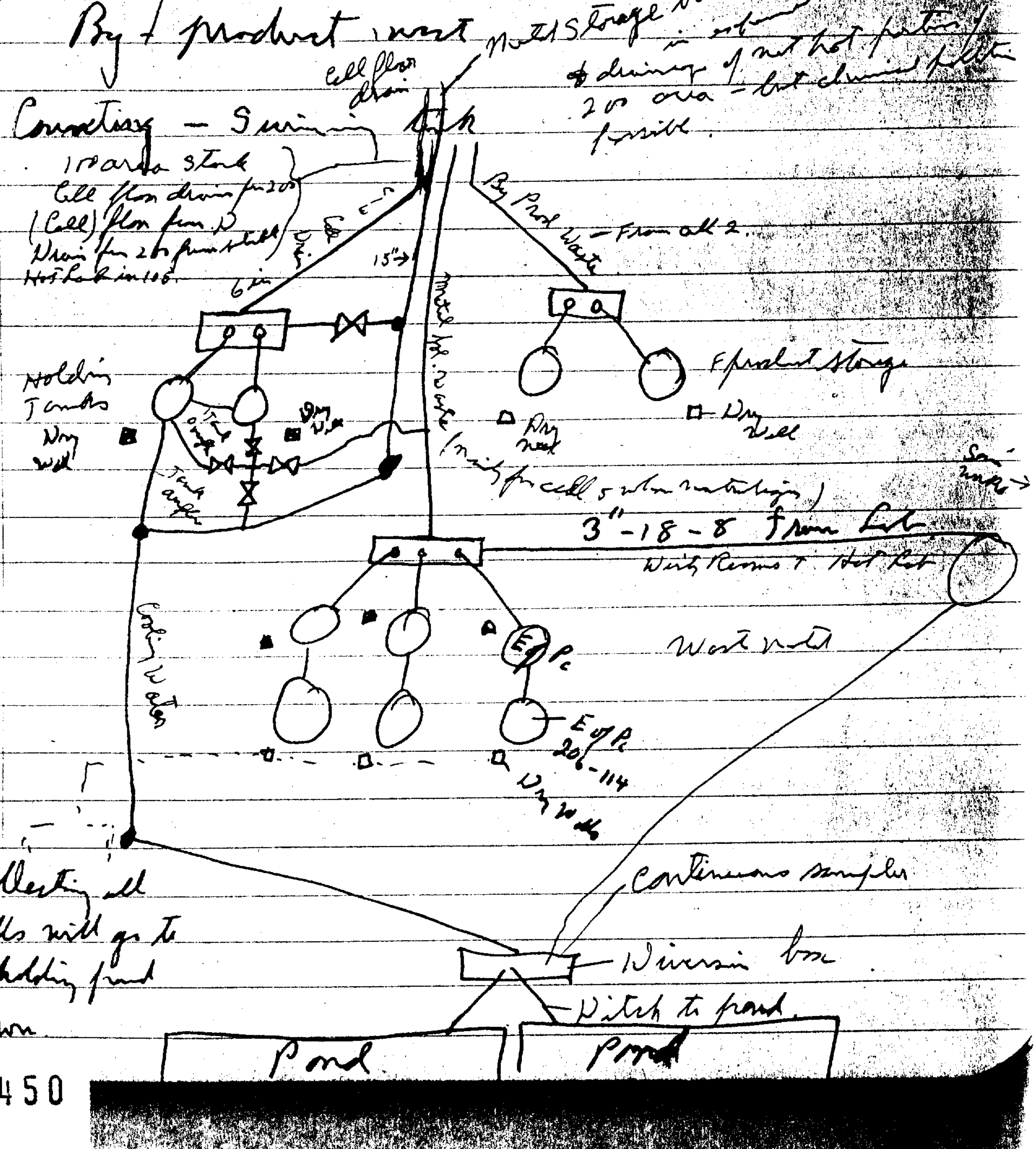
Measuring

1. Amt of water flowing into cooling pond
2. Radiation of water.

2 Counter sets for waste waters — in Extraction Room.

Sources of Water

By-product waste



Drain collecting all dry wells will go to small holding pond of its own

1/10 r per hour

1200 Pen type
6 chargers

20 Integrators 0 – 0.1 r
25 Standard Portables 6 Standard c screens.
2 Portable 0 – 50 r c detached chamber
~~2 Portables~~
All meters one scale only
All ~~[illegible]~~ meters in roentgens
All rate meters in r/hr.

April 14th
Dates Pile Bldg July 15, Pile Aug 15th Start work Sept 1st.

(A) From hot lab in 1 or more drain to storage tank + then to cell floor drain to be disposed of as to activity.

Sampling Points
(1) Overflow tank from Stack of 100 area (Routine Sample)
(2) Closed tank from hot lab. of 100 area (Batch Sample)
(3) Manhole where drain from metal storage basin comes to 200 area (Routine)
(4) Vent from floor drain of each cell (Used for tracing [illegible])
(5) 206-102 + 103 Hold up tanks (Batch sample)

Radio Iodine

MUC-HG 68 revising MUC HG 74

Tolerance Concentration

2.5×10^{-13} Curies/cm^3 for an 8 hr exposure during

1.75×10^{-12} curies/cm^3 for an 8 hr " one week.

Iodine Concentration at 60 days = 190 C/ton : Xenon = 37 C/ton.

Uranium Hexafluoride

C.H.B. - 16

British report showing of fire risk to 1:50 000 (300 mg. per m^3) for 30 seconds in the 10 m^3 chamber. Conc. Uranium Hexafluoride is non-existent in a concentration of 1 in 50 000 J. Howard Wilhelm

Lead Tolerance in Air

0.15 mgms lead dust per cubic meter

(U. S. Public Health Service

+ Illinois Industrial

Salary Rating

Academic Training

1 point up to 7 for College or University to Doctorate

Prof. Experience

1 Point for each years of Prof. Experience up to a max equal to twice the employees present salary in thousands of dollars. (If 20 years $4000 = 8 pts)

(If 20 years + 10 000 = 20 pts)

Ability + Industry. Poor 1 Fair 2 Average 3 Above Av. 4 & 5

Responsibility (on project) 0 - No supervision 1 & 2 Minor supervision

3, 4 & 5 - Group leaders 6, 7, 8 Section Chiefs 9 + 10 Div. Directors.

Max Salary = Points $25 = salary per month.

Water Activity

Wande :- 10^12 Watts of active material per cc of river water safe for man a fish. (Quote W della letter)

Have Control look into heavy water toxicity.
Look up radio-active springs + influence on fish.

5/1/43

J. N. Wilson to F.B. Vaughan

Ponds tested q 2 h.

24 hr integrated sample of all water going to creek.

Stack Meters Dr W. R. Kann

both diluted + undiluted to be tested.

500 cc/sec for undiluted

500 cc/sec for diluted.

Stack Disposal

Mr. D. H. Johnson has joined Engineering group - has had experience with disposal of 20 tons per day of nitrogen from stacks 70 feet high.

Is to study stack disposal.

Precipitation from The metal γ rays

Parker calculates intensity for ½ infinite sphere

I not over 0.625 r/8 hours.

What about 4 new [illegible] with [illegible] low blast cut

10 0-20 mil [illegible] with [illegible]
20 0-100 milliamp [illegible]
[illegible] 15
10
6

5 V [illegible] [illegible] 2 on ~~4 foot pile~~ [illegible]
Site X
100 area = Material testing & processing 101 & 102
103 - Material storage vault
105 - Pile
115 - Fan house
200 area = 205 Separation
206 Gunite waste storage
500 area = electric substation
600 area = Roads, fences, guard towers etc
700 area = 701 Gate house & Clock alley
702 Telephone
703 main office
706 A Chem lab 706 B Physics lab
719 first aid sta
etc.

Long life γ Radiators.
60 days - Columbium Zirconium.
1 month - Strontium.

Iodine - Xenon Chain.

51 Sb - 133
↓ 10 min
52 - T_e - 133
↓ 60 min.
53 - I - 133
↓ 22 hrs
54 - X_e - 133
↓ 5.6 days
55 - Cs - 133
Stable.

Clinton Lab

1000 kw operating power = 3.3×10^{16} fissions/sec.
5×10^8 γ's per sec = 1 r per sec
3×10^8 neutrons/sec = 1 r per sec

Activities of Soil, Air, Water + Normal Human Tissue

S. Russ Br. J. Rad. XVI p. 7, Jan 1943

Observers	Test Specimen	Grams Radium or Curie equivalent per gram
Satterly	Cambridge soil	10^{-17}
Eve	atlantic Water	10^{-15}
Lazarus - Barlow	Normal Human Tissue	10^{-14}
Joly	Ocean Waters	3×10^{-14}
Rajewsky	Free air	10^{-13}
Strutt	Igneous Rocks	5×10^{-12}
	Industrial air	10^{-10}
MacKenzie	Buxton Waters	10^{-9}
"	Buxton enclosed gas	10^{-8}
Ramsay	Bath, King's Well gas	3×10^{-8}

Mg^{27} - half life of 10 min.

argon. 1) Reduction of 1 million in intensity of neutrons measured by cadmium filter by concrete 5 feet i.e. for 2.3×10^{8} cuts to 1.8×10^{2}

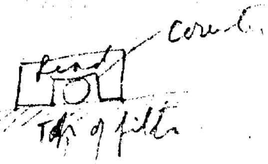
2) Wood 3 9/4" reduced to one

r/KWH $1 \cdot 10^{-4}$ at 10 feet from shield.

Hole in shield plugged by Wood x bomb.

18.7×10^{-4} r/KW Hr.

Top of pile 26×10^{-4} r/KW Hr.



Shielding at X - Iron.

	Ind. Foil	Ratio	BF_3	γ counter	Ratio	r/KW hr
0	730	149		649	2.87	3.89
7.6	4.91	14		226	11.1	
17.1	.358	3.6		20.3	10	
26.7	.098	3.3		2.02	5.4	
36.2	.027	1.93		.37	2.9	
46.7	.014	1.75		.128	2.2	
55.2	.008	2.3		.056	2.67	
77.6	.0034			.02		$.12 \times 10^{-3}$

Radiation Hazards from Metal Storage & Waste Disposal Systems - Site W.

M.U.C. J. BM-55 May 22 1943

By Wende

From Metal Storage Basin, Hot Vat Disposal tanks & Sky Shine Assuming storage were to go dry.

Distance in feet at which Ionization level is 0.1r/8 hrs.

Source	Direct Exposure	Sky Shine at Limiting Angle $P_0 = 5.7°$	$P_0 = 3.0$
Metal Storage Basin			
100 Tons of hot metal a) In buckets	4000	3300	1700
b) Spread out	5000	4300	2400
100 Tons 60 day metal a) Buckets	3000	2300	1100
b) Spread out	3700	3000	1500
Waste Disposal			
(a) 50 ft dia Tank & waste metal sol	600	300	150
(b) Tank a is boiled	950	500	250
(B) 50 ft Tank waste metal + by product	950	500	250
(d) Tank g is Boiled	1300	850	450
(1) Tank 50 ft by waste metal	2000	1500	850
Tank E waste metal + by-product	2500	2050	1200

W River Water 35 000 cu ft./sec flow
70 cu ft./sec pile cooling rate

Water Tolerance 0.1 r/24 hrs.

$10^{-[illegible]}$ Watts/cm^3

3×10^{-7} Watts/cu ft

$\frac{1.6 \times 10^{-9}}{E(\text{Mev.})}$ curies/cm^3 — 4×10^{-10} curies/cm^3 for 4 MEV.

$\frac{5 \times 10^{-5}}{E(\text{MeV})}$ curies/cu ft.

Fission Products analysis Coryell – after 90 days

Coryell Table from CN 576 (in part)

Sr
Zr
Cb
Ru
Te
Ba
Rare E + UX
Ux
Ce
La, Y, Pr

Element	Half Life	β Half Thickness Al	Curies at 60 days (from 1 ton of [illegible] in water)
Sr	55 d	~200	62,000
Y	57 d	93	63,000
Zr	60 d	11.5	49,000 (γ)
Cb	35 d	2.8	63 000 (γ)
Ru	30 d	4	34000 (γ)
Ru	200 d	~300	
Te	32 d	60	2300
Te	90 d		2,100 (γ)
Ba	12.5 d	45	8,700
La	40 h	85	9,600 (γ)
Ce	28 d	17	70 000 (Ce, both)
Ce	340 d	~250	
Pr	13.5 d	46	8,300

0024458

Dosage by thermal Neutrons - ℏ Way
(Weekly report of Section Div of Dupont for week ending 5/1/43 R-11 in Chicago X file.

Case I Man at a distance from the pile which is small in comparison with his own dimensions (multiple reflections of neutron back + forth important)

Dosage in 0.01 r = 3.42×10^{-3} { No. of thermal neutrons emerging per sec. from a cm² of the pile face nearest to observer.
per 8 hr/day

Case II Man at a distance from pile which is small in comparison with pile dimensions but large in comparison with his own dimension (multiple reflection negligible)

Dosage in 0.01 r = 0.71×10^{-3} { No of thermal neutrons emerging per sec from a cm² of the pile face closest to observer.
per 8 hr day

Case III Man at a distance from pile which is large in comparison with pile dimensions.

Dosage in 0.01 r = 0.41×10^{-3} { $\frac{\text{Total no. of neutrons from pile per sec.}}{4\pi (\text{distance from pile to man})^2}$
per 8 hr day

Shield calc.

Thickness (70 diam graphite)

W 25 000 KW

Seconds in day

conversion factor = 7 X 10^9

		n/cm^2 sec+KW	γ
Thermal unit	0	1.7 X 10^6	1.1 X 10^6
~	26.7 cm Fe	1100	3400
X 1.5 for moment	add 19 cm CH_2	30	2700
	add 18.1 cm Fe	.3	47
	add 15.2 cm CH_2	7	40
	add 10.1 Fe	.01	4
	add 10.1 Fe		.3
	10.1 Fe	(.005)	.02

.14 X 10^9 = .1r/8 hrs } per pile

.1n (8 hrs)

Masonite (Armstrong) is not as good as paraffin. Need ½ again as much.

Site X. Radiation thru 2" hole through shield.

Shield 7 feet thick. 3 feet space between pile face + shield.

Dosage from an Unplugged 2" Loading Channel Through the Shield.

Condition	Kind of Rad.	Dosage Rate	Time to get 0.1r
Pile Operating at 10^3 Kw	Neutron	28 r/sec	0.0036 seconds
1 min after shut down	Neutron	~ 0.03 r/sec	~ 3 seconds
30 min	γ ray	8 X 10^{-4} r/sec	2 Min
2 hours	γ-ray	4 X 10^{-4} r/sec	4 Min
1 day	γ-ray	2 X 10^{-4} r/sec	8 Min.

(Note "r" of neutrons apparently = same amt of Ionization.

1000 KW operating power = 3.3 X 10^{16} fission per sec.

5 X 10^8 γ's per sec. per cm^2 = 1r per sec.

3 X 10^8 neutrons per cm^2 and per sec = 1r per sec.

0024460

Site X Disposal

White Oak Creek – average discharge 10^6 cu feet per day

Clinch River = 2×10^9 cu feet per day. Minimum

Assuming 1000 G.P.M. plant waste = 2×10^5 cu feet per day

1 lb metal (30 days) requires 3×10^4 cu feet of water for dilution to

3×10^{-7} Watts (= 0.1 r/hr ~~loss~~ 2×10^4)

Pounds of order of ~~100 000~~ cu feet.

Site X Surface temp of Slags

405 tubes from slags ē temp. Temp. < 200° F 43%

557 " " " " " " " > 200° F

No surface temperatures over 310°

Military Use

10^6 Curies of γ radiation is sufficient to develop 100 r per day over an area of one square mile. It could be made available in a volume of the order of 1 – 2 cu feet.

French & Compton – Recovery + Use of Fission Products – See C.S. 658

$_{92}U^{235} \xrightarrow[\alpha]{7\times10^{8}\,y.} UY^{231}$

$_{90}UY^{231} \xrightarrow[\beta-]{1d} {}_{91}Pa^{231} \xrightarrow[\alpha]{3.10^{4}\,y}$

$_{92}U^{238} \xrightarrow[\alpha]{4.5\times10^{9}\,y} {}_{90}UX_1^{234}$

$_{90}UX_1^{234} \xrightarrow[\beta-]{25\,d} {}_{91}UZ,\ {}_{91}UX_2 \xrightarrow[\gamma]{1\,min} {}_{92}U^{234}$

Spontaneous fission of $U^{238} \xrightarrow[10^{16}\,yrs.]{Half\text{-}life} Kr + Te + 2n$

10 n/sec/kilog.
= 5 events/sec/kilog.   4 Ton U = 4×10^{6} kg = 1.6 curie

Robley Evans – The Toxicity of Small Doses of Neutrons & Other Radiations. (In file in "[illegible]"

Page 5 footnote "In air the specific ionization per mm. of path length is in the neighborhood of 5 to 15 ion pairs for electrons, 200 to 1500 for protons, 3000 to 6600 for α particles, and the order of 10 000 or more for carbon, oxygen & nitrogen recoil nuclei. The specific ionization per micron of path in water or living tissue is approximately the same as the specified ionization per mm of path in air.

Page 6 1.5×10^{-9} gms of radium per gm of dry bone may produce sarcoma in 10 yrs.

1 r = 83 ergs per gm. of living tissue
1 r = 2.0×10^{-6} Calories per gm of living tissue
1 r = 1.6×10^{12} ion pairs per gm. of living tissue.

Phone call from Dr Gelman

Three new Companies come under Dupont

1) Baker Brothers Inc. Toledo Ohio
Machining metal – Starting Jan 7th

2) Copperweld Steel Co. Warren Ohio
Cold Straightening Process.

3) Aluminum Co. of America – Canning.
New Kensington Pennsyl.

Dr Warren says that Capt Ferry of Manhattan District office is to cover plants.

1 Cu per 500 gm
5 [illegible] gm per cc 5×10^{-8} Cu per CC = 1 part per million
1/10 parts per million would give radiation tolerance

—— 11 ——

Remelting scrap – At Brush.
Radiographing – At M.I.T.
Rolling bars – Joslin

Outgassing – At Batelle – Heat in vacuum to 500 ± 150°C

Coating – Mid-West Mfg. Co. –
Wolverine –
Midwest –

Tensile Properties – Ames.

Beryllium Metal – 200 tons per year   150 lbs of Beryl. per month
450 lbs of Beryllium per month possible.

Brush/ Beryllium – working a beryllium metal.

Water Situation at Site X
Minimum guaranteed flow of Clinch river 200 cu ft per sec or 2×10^7 cu ft per day

Normal Discharge rate of Clinton Laboratory
1000 gal/min (2×10^5 cu feet per day)

initial

Look up C.S. 764
Wait Warren for ... ...

mi (.02) "r" equivalent.
.08

Fast 1. Wollan's chamber for survey or ground
Will have 2 ...
Neutrons 2. Jesse's chambers – ... chamber 1 fast person
4 with followers.

Slow 1. BF_3 – Large Chamber 2
One with recorder.
Neutrons
150°C 2 Wollans – Survey ...

Defining set up of X – March 10th 1943 Council Meeting

...

Strontium & Phosphorus – Friedell Intravenous
10 m.c. Sr. given at one time might kill someone.
20 m.c. Sr. might kill 75% of people & damage the remainder.

P^{32} Given Intravenously – in 3 week period. Friedell
30 to 40 mc P^{32} would kill half the people.

[illegible] 26 Coryell's group.
Ruthenium – may distill out of 10 N HCl in presence of oxidizing agent.

Lethal Doses – f-prod.
Oral 100 – 200 mc. < Sr / [illegible]
Lungs 1 – 10 mc < Alk. Earths / Rare Earths → Bone Rare RE / Zn. Cd. → lungs
Injection 5 – 10 m.c.
10 – 100 μc. cm^{-2}
10 mc = 1 gamma
Man Breathes 30 liters per min
2000 liters per hour walking around.
2/100 γ per liter
(

5 X 10^8 [illegible] [illegible] 1 sq cm = 1 r 2 MEV

[illegible] 28 – Look up reports on P 9 pile so as to not [illegible].

Clinton Laboratories
Martin D. Whitaker, Director
Box 1991 Knoxville

Clinton Laboratories Employment Office.
311 – 315 (Knoxville Tenn.
Cumberland Ave.) Knoxville 4-1858
4-1859

Form to Write up Experiments.

I Statement of Problem.
Clear + short. Concise

II Reasons for Investigation
Why being done
Why being done here and now. i.e. Connection with other work.

III Experimental Methods
How it is to be done

IV Experimental Equipment
What material needed
What apparatus needed + for how long

V Program + Scheduling
When you think it should be done.

VI Present status of Problem.

VII Assignment – Who is responsible
Who will assist him.

Aug 10th (1) Have W. Allan review plans & W file for protection features. Must be approved.

(2) Section chiefs - must go through plans & decide who else should see.

Research Assistant	175 - 250
Junior	225 - 275
Assoc	250 - 350
Chemist	
Senior	
Principal	
Chief	

f-p Dangerous Doses

Gerard - 5 to 35% of particles on lodging 4 or 5 layers inside the alveoli of the lungs.

1 mc deposited in lung would yield 100 r/day

Most effective chemical agent at present available causes 50% mortality ē 5 γ/L 3 PPM.

Sr dust 10^{-4} γ/L would irradiate lungs ē 20 r/day

1 megacurie of f-p would produce 100 r/day over 2 sq. miles

From Warren Data - using Arabian.

Spray 50 r/day 3' above ground requires 50 mc per sq foot.

or 10^6 C spread over .7 miles^2 = 50 r/day at 3' above ground.

Powder - Na^{24} + lime.

10^6 C powdered over ½ sq. mile = 50 to 100 r/day at 3' above ground

Values obtained from small patches.

(Bush estimated 10^6 C would produce 50 r/day 1 mile above 2.75 miles^2 of rolling ground covered with trees)

Dry Weight of F.P. per megacurie of gamma radiation would be 60 lbs. & Volume = 1/3 ft.^{3}

8/17/43 Compl. – Lab Cumul.
F – Material 50 days cooling
250 days cooling
Bactivity 46% Ce
14% Sr.
14% Y
7% Zr
4% Cb } of activity each
4% Ru
2% Cs

Volatility of Ruthenium
Rate of activity of Ru/10 is lost in gas over dissolver.

Salt Tablets 7½ gr
21 = 157 gr = 1 gm
Co tablet as 5 gm may give that.

1/10 r accumulated over surface of body
Complete mortality ~ 500 r within 3 weeks.

600 r 1 Kwh = 250 r
120
1500 r.

Sept 4th

Tolerance for fast neutrons ≅ 200 n/cm^2 sec.
PW Ollers instrument measures 1 to 3 n/cm^2 sec.

Franck suggests catalyst measure of [illegible]
10^{14} – 10^{15}/cc + Rankers. Need H_2O_2

Beryl – fuse in electric furnace; run out as a liquid into water — some vapor formed here.
This granulates the slag.
Slag treated c H_2SO_4 forming Beryl SO_4 which is filtered removing most of impurities.
$BeSO_4$ evaporated till crystals form – allowed to cool + $BeSO_4$ separates as it crystallizes in centrifuge.
$BeSO_4$ heated to drive off SO_3 + leave BeO
Make BeO. \ Copper – Beryl. alloy | (Met. Beryl)
95%

BeO + C + Met Copper in carbon arc at very high temp + vapor is formed.

To make Met. Beryl forms double fluoride of Beryl from BeO. – reducing this to Beryl in a fused bath by adding metallic Mg.

0024470

Tri-calcium Phosphate – 10 grms per day.

11-2-43 Oral absorption

I, Co. } 100% absorbed Thyroid 20% Muscle 40%

Sa, Br } 10% – 20% Skeleton = 99%

Fission m. 2 – 5% Skeleton > 90%

Yt, Zr, Cb, Ru < 0.5%

La Ce Pu Np

Pulmonary Retention

Zr – Cb 60 – 80% Half life > 200d.

Y, Ru, Ce, Pr 25 – 60% Half life 10 – 20 days

Np 20%

Absorption from Lungs.

Mo, Y, Zr, Cb, Ba, La, Ce, Pr } Clear very slowly Mean Life ½ life.

Pm, Np 25 – 70% – mostly 50% in Skeleton

Fission Pm, 30 – 70% go for days

Kidney Ru,

Xenon — M.U.C. JOM 39

G.E. Co concentrate Xe from Xe – N_2 mixture from 1/120 000 000 to 1/20 by adsorption on silica gel at temp of boiling O_2 (−183°C) run at boiling CO_2 (−78°C)

2/15/44

Burton Actinometer

$(NH_4)_2 C_2O_4$
$HgCl_2$

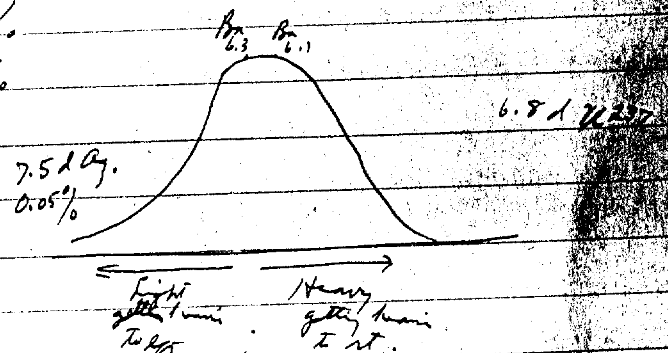
} Reacts now to 2 r at rate of with 2 1 r / hr.
Quantum yield 10^5

2/15/44

Sugarman 6.1% prod. of 12.5 d Ba
Ba activity per fission 190 Mev/fission

	Yield
86 min Ba^{139}	6.3%
12.5 d Ba^{140}	6.1%

Yield curve



Question from
Meeting of March 6th

1) Laessig – is it a security problem or Health Hazard

Fish in Col. River will perhaps concentrate 25-75 x that in water.

138 000 α particles per min per µg. of Pu.
24 000 years 1/2 life Pu

Allison's Tolerance
5×10^{-6} α/cc/sec in air – Working Tolerance ≤ 1/10 intensity of Cosmic rays ionization.
1.4 α/cc/sec in air for disaster.

2/44 Hamilton's Smoke – Uranium Chloride
Grind/powder oil drip to get dust
Wash with Carbon Tetrachloride to get free from all traces of oil.
For every 1000 pts by wt of dust put in 410 pts by wt of C_2Cl_6 and 100 pts Ammin Perchlorate (NH_4ClO_4) + 100 pts ammonia Chloride
To Fire:-
Platinum Foil 4 x 1.5 cms of 1 mil plat. foil.
Put for across bar contacts –
Use about 300 ampere current to heat to yellow-just below melting point of platinum.

2/44 For Dust in lungs.
Hamilton suggests

Zirconium for β-rays because soft βs that would allow use of small animals. Soft γ's could be neglected since ratio β/γ in air (extrapolated back to zero absorber) 168/1.

The energy for disintegration 5 to 6 x as much as for Columbium daughter 170/1 β/γ ionization in Lauritsen electroscope extrapolated to zero absorber.

Objects to Sr as too penetrating β rays for small animals.

Suggests use of silica for dust.

Uranium Content of Human Body:-

1 J. Hoffmann, naturwiss. 30, 279, 1942

3/20 Monitoring Laundry started in a "test" way.

3/18/44. Pardue is training 2 men at Armory on how to do it.

To test material going out — and that coming back.

Memorial Hosp. Cases up to Jan 1943

Bertha Richards	11/6/42 - Dead.	Pauline Shapiro 6/24/43
Seymon Cohen	11/2/42 - Dead	Alive + well few
Edwin Pierce	12/11/42 - Dead	months later.
Wm Williams	4/28/43 - Dead	

Failla – X-ray Dosimeter
Leeds + Northrup
Mr. I. M. Stein,
Director of Research
4901 Stenton Ave.
Phil.

3/21/44 Seaborg
γ ray 10^{-4} / α disintegration for product
i.e. 1×10^{-4} γ rays per α ray as product decays.
Some β's probably present & α's of different energies.
γ Energy 0.5 – 1 Mev (0.6 Mev)
1 X-ray / 10^2 α

Methods of T Determination.
Wollan present. 15 min Thurs. Aft.
Purdue "
Tomlinson "

Snell 4/4/44 Kamen

Prev. Belief Xe^{133} 5.3 days
Cs^{133} (n p) Xe^{133} 3.9 day some as [illegible] 3.1 days
Ba (n α) Xe 5.3 days. Kamen gets 4.2 days.

1.4 α/cc/sec can breath for 1 min

1 mc is ½ gal water

Use thin wall tubing

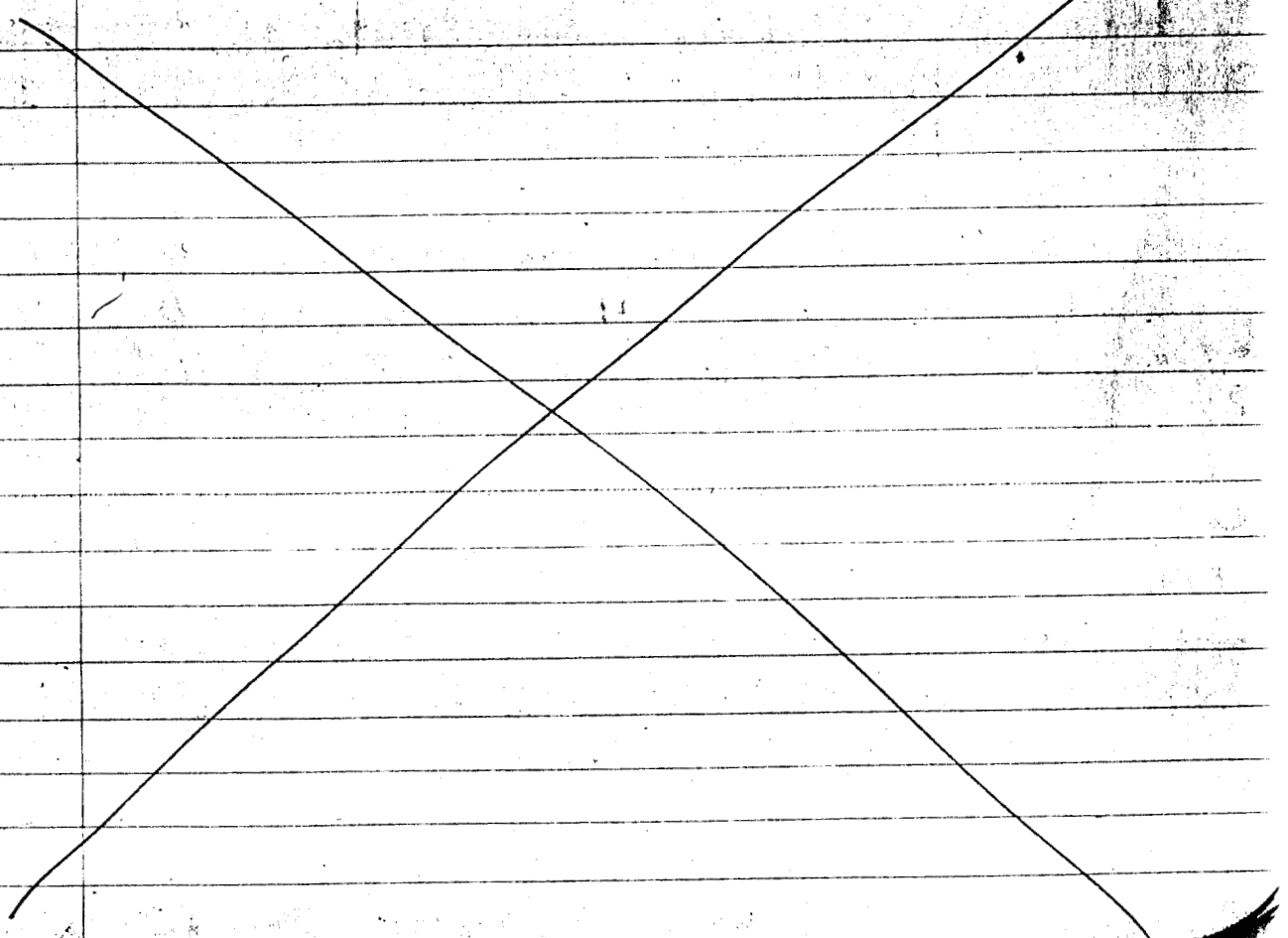
How about alvarez apparatus?

Fitzhugh Marshall —

Van Nuys Bank $10,000

$25 for 4 hours

$100 for 24 hours



27.

Sent for Hamilton

Distribution of Absorbed

June 5/44 +3, +4 + +6 Pu per os

By intra-muscular, Lung, Intra-venous

admin. 4 day after injection

	+3 IM	+3 LUNG	+3 IV	+4 IM	+4 LUNG	+4 IV	+6 IM	+6 LUNG	+6
% Abs.	20	65	100	2.0	6.2	100	26	78	100
Skeleton	53	81	41	90	6.7	14	66	88	37.
Liver	5.5	6.6	36.5	3.5	10.4	71.5	14.0	4.5	28.
Kidney	1.4	.64	1.38	1.40	1.58	1.37	2.0	.71	1.52
Spleen	.39		.70	.39		.86	.37		.51
Marrow	.54		.72	.65			.38		
Fecus	7.5		10.9	5.12			7.5		
Lungs	.23			.17			.33		

Activity + Elements in Clay of X

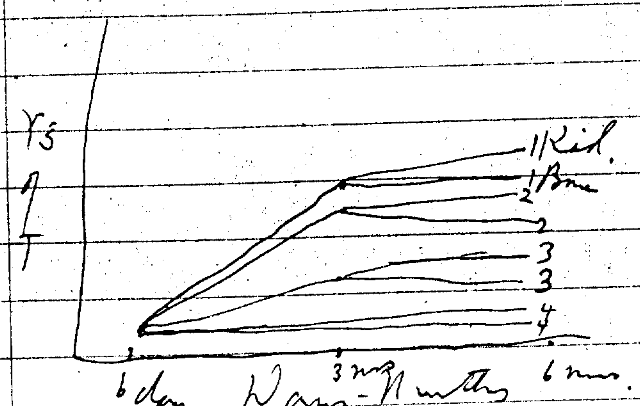
for gram dry wt.

Area in Percent

	2	4	5	6
Ba+Sr	70	88	98	1.4
ZR	55.2	46.7	47.2	41.3
Cb	28.4	34.8	32.5	32.9
Ce	11.8	18.8	13.7	13.3
Y+Pu	7.0	4.7	5.5	5.6
Mn	.194	.229	.037	.0069

Jan 5/44 T ammonium

		Wt.	Most	Unit T/time	Mostly in Bone or Kidney
+6 most Toxic	1T O_2F_2 (TF_4)	affected	Some lesions	Considerable	
	2T NO_3				
100	3T Cl_4				
37.					
28.	4T $_3O_8$	Not affected	No lesions	Very little	
1.52 Not very	5T F_4				
.51 Toxic	6T O_2				



Serum Metals for use with slow neutrons

Be — very short or 10^3 yrs activities

C

Mg 10.2 min ½ life. activation cross section .0054

Al

Si

V

Cr — σ .00014 1.3 hr ½ life

Fe

Ni — 2.6 hrs cross sect. .02

Sn — lots of activities but cross section for all low.

Bi — 5 day activity but no γ rays.

Cd not 2.75 hrs 2.5 days cross sect .01 43 day – No γ rays.

Take up with Parker about need of direct reading meters for use at Hanford.

7/3/44 Hamilton

Long term excretion of Prod. .25% / day mostly in feces.

W 6 Liquor	Ba + Sr	0.35	Te	4.50
	Y + Pr	0.42	Cs	1.40
	Zr	.54	Ce	1.90
	Cb	26.5	Th(U.X.)	3.38
	Ru	1.7	49	0.1 c/sec/cc

i.e. 1+ gm Prod in White Oak Creek.

7/3/44 Cupp

YT + Ce — take up not like Sr + Ce & not affected by Ca before taking up material.

1×10^{-9} μgm/cc 1×10^{-12} μgm/cc

7/4/44 Hamilton

Product — Half value in body 7200 d.

Rate of Excretion Per day

	+3	+4	+6
Urine	.02%	.04	.06%
Feces	.8% - 3%	1 - 3%	.8% - 4%

8/8/44 Need for Folic Acid – shall we get a stock-pile?

8/10/44 Personnel Problem
Total Technical Allowable 20[?] Total Aug 1st 148 = 53 No. allowable.
Cole Has – Aug 1st 81½
Estimates he will need 119 by Jan 1st = 38 more
Rose has Aug 1st 7 needs 13 more
Tannenbaum has 3 needs 3 ?
Nielsen needs 3
57

Sept 30th Conference.

Spectroscopic —

Lines 288.9, 288.7, 288.6 } Found line on instrument.

Platinum line

Interfere
Vanadium — impurity in Cu.
Manganese — in diet ∴ steel

Hodge — Ingestion Rats — Based on Wt.

TO_2	Not toxic 20%		350 – 394 days.
TF_4	Very slightly		111 – 253 days.
TO_2F_2	Very Toxic	(F lumi)	350 days.
TNO_3	Similar "	110 to 5 / Died a lot day	315 days.

Toxicity based on Ingestion Equiv. T

1 TO_2F_2

2 { TNO_3, $Na_2T_2O_7$, TO_4

3 { TCl_4, TO_3

4 { TF_4, T_3O_8, TO_2

Based on Equiv. amt of Compd.

1 TO_2F_2

2 { TO_4, $Na_2T_2O_7$

3 TNO_3

4 { TCl_4, TO_3

5 { TF_4, T_3O_8, TO_2

Oct 1st

Dr Roberts :-

Catalase appears first after T poisoning

Phosphatase next

Proteins - last

Brooks 32 liters / min 15 mg

50 mm H_2O pressure.

Best: Stokings
Comfo respirator with all dust filter

" metal fumes.

Chicago Eye shield to dust mask.

For TF_6 & TCl_4 - need cannister for acid gas + filter for dust.

Dr Barron - work up cyanide test of amt of dust (colorimetric) to easily detect dust + amt (Dr Neuman)

Detect in people by catalase test of Rochester Group (i.e. Oxygen collection)

When trouble found use Citrated Water (Lemonade!)

Alkalinize people + get rid of T.

also reducing agent.

Donnice Na Citrate

Need constant infusion

Treatment :- Dogs (Roberts) got Na_2CO_3 twice a day

Ausger suggests Sod bicarbonate + sod. citrate.

0024482

Hydroxy dispartic acid (drugs) has not been used yet but should be used.

Practically :- Flood person with fluid.
Alkalinize c̄ $NaHCO_3$
Get — urine PH 7.5 + 8 [illegible] Keep it ~~there or fast~~
Citric acid (lemon ~~[illegible]~~)

3 gms T in body = Radium poisoning for Radiation

.15 mgms per Cu meter.

Parker 4 gms T = .1 μg radium.
With 100% retention in lung
10% from lungs to body
100% from body to bone   Take 10 gms to get 4 gms in bone.
0 excretion.

Visitors Sept 30 - Oct. 1 meeting

Vennan

Capt. Metcalf Rochester (Pogan)
Dr. Adelbert H. [illegible] Rochester
Dr. Harold C. Hodge Rochester
Mr. M. J. Wantman Rochester
Francis J. Hayen Rochester
Alexander Gaynes Rochester
Eugene Roberti J. Rochester
Herbert E. Stokinger Rochester
Lt. Fred A. Bryan Rochester
Dr. Wm. F. Newman Rochester
Dr. John F. Flagg Rochester
Dr. A. T. Steadman Rochester
Dr. Carl Voegtlin Rochester
Capt. John P. Ferry Oakridge

Dr. L. Hempelman Site Y ✓
Dr. W. H. Norwood (Sunday) W ✓
J. E. Wirth Y
Col. S. L. Warren Oak Ridge
G. Failla (Sat.) New York
Commander Pierce Montreal
Dr. Mitchell Montreal
Dr. Earl Miller ✓

0024484

I Situation re hazards.
New Chemistry - adequate - Product + F.P.
Inadequacy - change house with showers should be

West Stands - Product + F.P.
Not adequate in semi-works.
217 - Has been very bad.
Clean-up + ventilation being made.
Area never safe.

No one has been known to be over-exposed.
Product hazard at same level as New Chem
use of soft

Site B.
Totally hazard
Localized to 2 floor + furnace room - all
too much material on floor + roof.

Room 135 Above tolerance 5 mos.
Site B - ammo not ventilated
Armory O'Donnell - getting ventilation
Crusty room - still not ventilated.
Rest of Armory - below tol.
Ryerson + Eckhart
Dr Zachariasen - 1 r/hour.

In General - Difficulty in getting recommendations into effect.

Mr Rose:–

Records inadequate for past.

Pocket chambers inadequate. Wearing inadequate.

Films read + thrown away.

Surveys more adequate.

Comments
Part of Pocket
Hand counter

Low priority on Health Instrument Manufacture.

Neutrons – no satisfactory instrument for past.

Recommendations

1. Document recommendations of Health Div., replies etc. – final action.

2. Could we remove some Tabbing workers from their jobs + observe effects on [illegible] in urine

Dr Watson's Suggestions.

1. Immunology studies for detection of radiation effect.

2.

More attention to Product in Urine
" " " Detection of X-ray Changes.

Mixed Rats
Sr^{89} 5-8 μ gm / gm body wt.
Damage to G-I tract
& mostly to Bone.

Fission-Neutron 15 μc / gm
Larger amt of G I damage to bone damage.

Na^{24} Fish accumulates at a linear rate for 3 days.
Av. concentration in fish is 25 X that in water.

Rats Survival
25 r / day 7-10 mos.
12.5 r / day 8 out of 10 still surviving

What is value of Mustard Gas comparison

	Product [illegible]				Product X O_2 for [illegible]		
[illegible]	0	4	16	64	0	1	4
Lungs	38.7	44.4	24.5	8.44	35.8	33.0	29.8
G I	.67	2.39	.46	.058	1.23	18.8	1.4
Head	54.7	.12	.47	.28	59.2	6.08	.51
[illegible]	1.30	.57	.48	.46	.64	2.54	.92
[illegible]	0	52.7	73.6	89.5		36.9	66.7

T Mtrs + F P

	0	1	4
Lungs	14.3	9.14	6.43
G I	.15	15.1	.80
Head	83.5	5.61	1.26
[illegible]	.35	1.65	.82
[illegible]		65.5	87.7

Oct 2nd Dr Hamilton

Entry

Oral – $Sr^{25\%}$ $Ba^{25\%}$ $Te^{25\%}$, $I^{10\%}$, $Cs^{100\%}$ (P_x < 0.05%)

Lung – P_x Zr Cb Ce Y Pr + Pu (all insoluble elements ... ~100% ... lung)

Wound – P_x all F.P.

Areas of Damage (Substance arranged in order of damaging effect)

Lung P_x Zr Cb Ru Ce Y Pr + Np

Skeleton P_x ~~all F.P.~~ Sr, Ce, Y, Pr Zr Cb Np 238 + 239

Liver ? P_x Pr Ce

Kidney ? P_x Te

Thyroid I

Total Body Ce Te I

Local Effect on GI Tract

	500 r	Lethal in 1 yr (daily dose 10 r/d⁻¹) 48 hr transit time 10 kg wt.	Daily dose Safe level 0.1 r/d
F.P.	100 mc	4 mc	40 μc
1 μc = 200 r/gm/d⁻¹ Product	10 (7.5) mgms.	5 mgms.	50 μgms

Oral Absorption

29.8	Sr^{89}	HL 53 days	10 mc	100 μc	1 μc
1.4	25% abs. Sr^{90}	30 yrs	6 mc	20 μc	0.2 μc
.51	Ba^{140} La^{140}	12.5 d	12 mc	250 μc	2.5 μc
.92	100% absorpt. Cs^{135}	30 yrs.	100 mc	5 mc	50 μc
66.7	25% abs. Te^{129}	32 d	40 mc	3 mc	30 μc
	100% abs I^{131}	8 d	500 μc	10 μc	0.1 μc (To thyroid)

~~1 ...~~

Dr Warren area of GI tract 1 sq ft.

0024488

Hamilton

Lungs

	HL	HL in lungs	500 r acute	Dose to be lethal in 1 yr ($10\ r\ d^{-1}$) 48 hr tissue tim	Safe level ($0.1\ r/d^{-1}$)
Y	60 d	15 d	1.5 mc	5.0 μc	0.5 μc
Zr	60 d	50 d	5 mc	100 μc	1 μc
Cb	30 d	30 d	10 mc	200 μc	2 μc
Ru	30 d	30 d	10 mc	200 μc	2 μc
Ru	300 d (5 yr)	30 d	.8 mc	30 μc	0.3 μc
Ce	28 d	20 d	10 mc	200 μc	2 μc
e	340 d	20 d	17 mc	25 μc	0.25 μc
Pr	28 d	15 d	7.6 mc	200 μc	2 μc

Product 8.4 Ergs / gm / d^{-1})

Assume Live WT 2000 gms

$1\ \mu c = 15\ \mu gm = 250\ r\ d^{-1}\ gm^{-1}$

Dgms =

To give 200 r / gm = 8 μc

0.1 r to lungs = .8 μc = 12 μ gms

Assume 1. Total Deposition (But less than 25% deposited in lung)
Hence 4 X 12 μ gm could be inhaled

2. No excretion - (But there is at least some excretion right ?)

3. Equal distribution - Probably true

For a Tol 0.025 r = 3 μ gms

with 25% retained in lung = 12 μ gms in lung

Excretion Hamilton

Urinary excretion 1/10 of fecal activity

Fecal excretion .2% of what is in body

Urine .. ~.02% " " " "

.01% more likely since feces contaminate urine

Safe level 0.025 rep ([illegible])/d

10 Kg Bone in body of man

1 μc = 250 rep/day/gm

for 10 000 gms 1 μc = 0.025 rep/day = 15 μ gms Product

Wounds

Most ret of absorbed Fraction after injection (wound) = ~50%

I-M Injection $P_x Cl_3 \rightarrow$ ~25% (4 day abs.)

$P_x Cl_4 \rightarrow$ 2–5%

$P_x O_2(Cl)_2 \rightarrow$ ~60%

Rule / lab. Any open wound should not be allowed in product lab.

Amt of injected dose stored in bone = 5% ~~30 μ gms~~

Hence tolerable injected dose = 30 μ gms.

Absorption in lungs of Sol Px Compounds

$P_x^{4+} < P_x^{3+} < P_x^{6+}$

To skeleton <33% >35% >50%

Lungs Retain ~10-25% 10-15% 5-10%

∴ of soluble compounds going into lungs 30 μ gms would be safe (~~50%~~ 2 × 15 μ gms)

50 wks x 7 days x 8 hrs x 60 min

= 168,000 min x $\frac{5}{7}$ (cubic ft/min) = 120,000 cu ft x 2 yrs

= 240 000 cu ft

$\frac{12}{240\,000} = 5 \times 10^{-5}$ μ gms Cu ft air

2.5 μ gms.

$\frac{2.5}{1,000} \times 3 \quad \frac{1.2}{2.5}$ μ gms. $= 1.2 \times 10^{-2}$ μ gms

.012 μ gms

Overall Program - Warren.

		Hist	Hematol.	Chem.	Excretion	Monitoring	ML 50%	Ch. Gen. Eff. / Med Mech
α	Bone	+						
~~β~~	Lung	+						
	Kidney	+						
β	Skin							
	lung							
	bone							
	Kidney							
γ + X-rays								
Fast Neutr.								
Slow Neutr.								
~~Est.~~								

2 yrs

Estb. - If F prod. distribution same in toxicity levels as in tracer levels.

ML 50% α { Ra, 49

β

γ

X rays < low, high

n < slow -, fast -

0024492

For Therapy

Nicotinamide } should both be tried.
ascorbic acid }

Rabies

0.5 µc/gm mice Rats = of Pasteur LD 50

Parathyroid

2 µg/gm mice – Killed all 3.6 µg/gm mouse alive
3.6 µg/gm mouse killed none.

Test Vaccine

1st Injection studies ē 3 various dates 5 mg. regimen for each volunteer

Mice 20 mice at higher levels.
40 " " lower levels.

Rats 5 " " higher levels
10 " " lower levels

Beagle dogs – for excretion studies, blood studies etc.

Inhalation

Both mice + rats.

Oct 7th 1944

Sugarman <1m Te → 6.6 h I → 90% β 9.4 h Xe → Cs? ; 10% β 12 min Xe ↑ → (20-30 yr Cs) → Ba | 4.1% yield

Nov. 6 — Schwartz

Brings up question of value of using Catalase as test for chronic T poisoning. Looks as if it might be good for acute cases but not for chronic.

T is found in urine that shows no Catalase but do show coproporphyrin.

Abrams

.3 μg deposited in lung = .01 r — possible lung lesion

Cole 11/6/44

	I	Sr	Y	Zr	"Cb"	+4	+3+6
Ret	10%	10%	17%	25%	11%	~10%	10%
50%	~1m	–	<1d	7h	4d	14d	14d
10%	~3m	<2h	7d	21d	23d	75d	40d

5 μc / gm lethal

Nov 5 Hamilton

X_2O_3 Smoke

Time in days	0	1	4	16	64
Lungs	37	33	35	27	11
Head	57	6.1	.38	.47	.21
G. I.	1.3	19	1.9	.41	.08
Bone	.89	2.5	.81	.56	.34
Excreta	—	37	63	71	89

T_3O_8 + S-P Smoke

	0	1	4	16
	12.5	9.1	5.4	6.9
	80	5.6	2.4	.35
	.23	15	1.1	.17
	.37	1.7	.95	.81
	—	66	89	80

Av. Daily Rate of Elimination of X following inhalation of X_2O_3 Smoke

1 day	37%
3 day	7.3%
10 day	1.2%
24 day	.47%
40 day	.12%
56 day	.024%

Composition of algae from Settling Pond:

Cs — 24	
Ba + Sr	3.9%
Ce	30.2%
Zr + Cb	50.7%
Ru + Te	9.7%

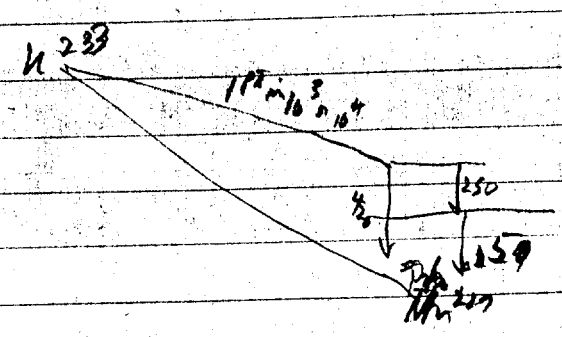
Minimum 1/2 life of 6 mos.

11/21/44 Sugarman

$6.7\,hs.\ I \rightarrow 9.2 \pm 0.2\,hs\ Xe \rightarrow Cs \rightarrow Ba$ (15 mg/cc)

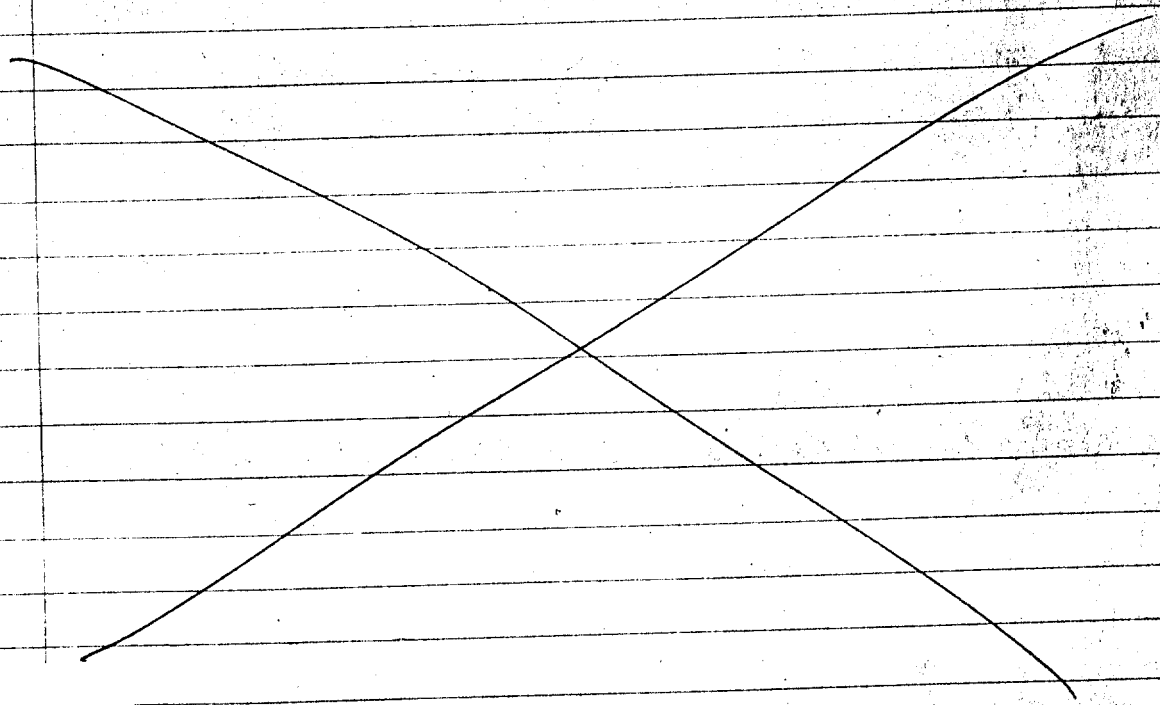
11/21/44 U^{233} 420 250 150 MV

91 17



$_{93}Np^{237} \rightarrow {}_{91}Pa^{233} \rightarrow {}_{92}U$

$_{92}U^{233} \rightarrow \alpha \rightarrow Th^{229} \rightarrow \alpha \rightarrow Ra^{225} \rightarrow Ac^{221} \rightarrow P_o \rightarrow P_b$



Product.

12/5/44 Chicago to do:-

See if

Lower levels of lethal Dose of Product

Equals lower level of " " " Radium

Is it liver or Is it priming Neoplastic damage.

(How about Porphyrin studies on stool & urine.

If Radium & Product are the same

Use + 6 P, I V to get L D 50

DO NOT USE ALL VALENCE STATES.

DO NOT USE INTRAPERITONEAL OR

INTRAMUSCULAR Till further Conference.

Thom + 6. IV in Rhesus: Blood Urine Stool + Bone

Hamilton - Tracer ē citrate for dist^n + Excretion rate

Templeton Tracer ē citrate for distribution Rats

Nau Rats for excretion with Citrate + Nitrate

to see if any diff in rates

Bale - + 6 IV for L D 50 in rats

On them get urine Stool + Blood

+ Distribution at autopsy.

Conf^ce 12/6/44

1. Continue Essential Tasks.
2. Prepare recommendations for work to be continued after 30th June 1945 (To be in by [illegible])
3. Prepare technical reports by June 30th 1945.

12/8/44
Intramuscular

1st Experiments :- June
a) To get levels
b) To get technique & test recovery.
c) Hematology & survival in 3 rabbits + 3 rats still alive.

1.8 μg/gm
0.18 } all IC + IV | .01 μ gm/gm to rabbits – [illegible]
0.018 | .25 μ gm/gm to rats Both IC + [illegible]

Abrin son +4 Cl [illegible] atomizer 0.1 μ gm/animal rat – for [illegible] all distribution – during summer. 21 rats [illegible]
Also +3 Nitrate + 6 Nitrate (and +4 [illegible]). All [illegible] to [illegible]
Trace. All given same [illegible] in lung (+4 slightly slower)
1 Carbon arc smoke 3 weeks ago all killed
Mouse traces with +4 Chloride – 24 animals.

Inhalation

Finkle Tracer +6 Intracardial for 4 day distribution / recovery.
Exp. Stomach Tube
3 rats +4 } [illegible] at 5 days – absorption for gut. <.15%/gm
3 rats +6 } Remains not 100% [illegible]

Toxicity Series – Rats & Mice
Mice +6 Intramuscular — 2 Strains + 2 sexes

		Mortality
10 μ gm/gm	6 mice	100% – 2 weeks
5	11–12 mice	100% 2 weeks
2.5	"	100% 2 weeks
1.25	"	100% 3 weeks
0.5	"	1 dead before 4 weeks
0.25	"	0 dead 4 weeks
Controls	"	No controls within 4 weeks

from other series 1 μ gm/gm 17 or 18 animals 90% in 1 mos

Fink [illegible]

0024498

Xe in ThO at 800° in vacuum
particles about 1 μ in size 50% came off.

4/3/45 New Progs.

Cooper
1. Six (Fourteen) Piles each 100 000 K.W.
2 Treated water capacity 90 000 GPM. (50 000 Wagner)
(Equiv. to 3 W piles)
3 49 in piles at any time 180 Kg (120 Wagner)
In separation 30
4 Th in pile 50 tons
Separation 50 "
New Th req/yr 50 "
5 Chemical separation plant for 49 equivalent to 2
W canyons and accessories
6 Cost 23 recovery plant 1/3 W

Hamilton 1-15-45 All Values Product

days	Liver	Kidney	Spleen	Bone	
4	7.7	1.6	.39	66	Intra-muscular studies
16	3.9	1.1	.35	67	
64	3.2	.87	.34	58	
256	1.6	.36	.26	41	

Excretion Per day Product

	%
4	1.6
16	.57
64	.27
256	.10

	+3	+4	+6
256	.11%	.095%	.094%

1/2 of what was given is there at 256 days
1/2 life of that after 256 days is 2 years.

	Smoker x a - x no.				x mice					Tmice				
	0	4	16	64	0	4	16	64		0	1	4	16	64
L														
Lungs	39	44	25	11	33	33	30	29	(11)	13	9.1	5.2	7.4	5.6
Z-9	.7	2.4	.5	.08	1.9	19	1.4	.49	.11	.23	15	1.2	.15	.05
Head	54	<.20	.31	10	63	6.1	.18	.27	.05	80	5.1	2.3	.07	<.10
Bone	.89	.91	.64	.45	1.3	—	.79	56	.13	.49	2.2	1.3	1.4	1.5

Half life 6 mos. Half life 2 mos.

1	~37	~33	~48
2-4	6.4	7.5	10
5-16	1.4	1.5	.92
17-32	.48	.68	.26
33-48	.21	.32	.15
49-64	.026	.21	.11

Dog. 7.4 Kg. (7400 gms)
Dose .36 μgms/gm = 2669.7 μg.
Injection Saphenous vein. + 6 Nitrate pH 2-3.

Abrupt change on 12th day. Body temp ↓. Heart rate ↓. Both legs
Wkt. cut down.
15th day — very low.
Killed on 16th day when moribund.

Urinary Excretion
5.5 hrs after inj. 6.22%
.15% per day thereafter
Total 6.58% in the 16 days.

Fecal Excretion 3.27% Total

Established level of Excretion when fluctuation ceased { .018% Urine per day
.041% Feces per day

	μgms/gm		μg/gm
Femur	.841	Sternum	1.07 μg/gm
Pelvis	.36	Rib	1.14 μg/gm
Mandible	.65		
Cortex	.064		
Marrow	.93		

Total in Skeleton 44% (by estimate)

Tell Central for Parker
Zimm agrees to use of ther[illegible] column in room NV = 6 × [illegible]

For Lung [illegible] μg deposited + [illegible]
Insoluble 10 μgm inhaled for total of 0.025 [illegible]
Soluble 12.5 μgm in skeleton tolerance
hence 25 μgm inhaled ē 50% transferred to bone to [illegible]

For Lung 1 μg deposited } Insoluble
will result from 10 μgm inhaled. } Oxide [illegible]
Soluble
5 μgms in bone tol
50% of inhaled gets to bone hence 10 μgm inhaled

Rats
Rad [illegible] 0.25 0.5 for 30 day [illegible] [illegible]
Monroe?

Employed March 15

March 16th Personnel

Administration (Bloom, Jackson, Costily — 1) Ceiling [4] 4

Nickson:–

Nickson	4	(5 new but 1 [illegible])		
Rose	22			
Russell	13	(14) (including [illegible])		
	39		Ceiling [38]	~~37~~ 40

Jacobson

Hunt	~~18~~ 17			
Schwartz	23	(including 2 replacements)		
Bann	7	(include replacements)		
Allen	9			
	56		Ceiling [54]	~~57~~ 55
	109	111 + 4 [illegible]		

Zinn / Morgan

Cole				
N.C.I.	7	6 + 1R		
Ceiling 124 (including NCI)	116	117	Ceiling [124]	117
		11 / ~~128~~ 125	124	
			219	~~217~~ 216

+ De Bruyn

Total 220

Bird 65 April-1
+ 9 Committees on April 1
+ [illegible] NCI

50% [illegible]
126 Not yet employed
4
124

$780.00

390

Met. Lab. — 40 %
Met. Lab. — 25 %
— 35 %

loyed
4 15
4
740
7 55
1
7
6

March 1st Agreement with Tannenbaum
3 mgms of 23 to be delivered in 3 installments of 1 mgm each
To be used in mice & 1 Dog to check
1. Previous results checked by non radio-active isotope
Sub cutaneous inj with study of tissue Dist.
10 + 20 μg per animal
2. Radio autographs — can get much better with 23
3. More accurate excretion studies — 5 Dog Several Mice
20 μg each
4. Radiation Effects
23 roughly 1/6 as active as product
∴ accurate knowledge of dist.ⁿ — important
20 μg per dog might be cut without of radiation
and same dist.ⁿ as product.
1 μg 28 1.5 d/min
1 μg 23 ~~23,000~~ 21,100 d/min (21,100 d/min Rose)
1 μg 49 140 000 d/min
23 better than ~~14,500~~ x more active than 28
23 has .104 g/c
April 18 — 20 μc

Cole Ceiling 124
\+ Arnold 4
\+ Bloom 1

0024504

April 3rd 1945

Estimated Personnel at Clinoc

Administration	300
Shops + Services	200
Physics + Chemist	130
Health	216
	846

Neutron Research Tower

20 dogs	.1	r "equivalent"
60 rabbits	.5	"
250 rats	1.0	" 50 000 for 6 mos.
	10.0	"

Neglect Decontamination Studies CN 1879 + supplement

April 6th 1945

Russells Group:-

Routine Tissues (mouse, Rat)	4
Routine Necropsy	2½
Bird Research (Volume state. (in tissues etc	1½
Dog work	2
Administration	2½

April Meeting of Health Div. — Biol First, Med Second, Physics Third, Misc — Proj. Council: Med First, Physics Second, Biol. Third

April 1st Finkel

		30 days	90 days	150	
+6 NO3 IV		1.0 mg/k	.75	.75	[illegible] 50%
Ra	IP	1.0	.4	.2	
Ratio MLD Ra / MLD Pu		1.0	.55	.27	

Rats

	30 days	90 days
Pu	1.5	0.5
Ra	7.1	0.5
Ratio Ra/Pu	1	1

Threshold effect Prod. .075

50% more than 5

Wash 15%

Apply Tourniquet
Wash out with water
apply suction

Failla Threshold with Radon

	7.5 mc	per no filter	2000 r
		.16	800 ?
		.75	
		1.00	
	830 mc	2.00	1500 r

66

5 mr

[Ellinger]

$Pu\ O_2$	Lung
$Pu\ O_2(NO_3)_2$	Early Lung Lite. Bone
$UO_2 + f\ p$	Lung
$Pu\ O_2 + f\ p$	Lung
$f\ p$ (FM)	Lit Bone

Report I read

MTec-82* Atmospheric Pollution by a Fission Plant

CH Nov 2, 1944 G W C. Tait.

5/1/45 Division of Effort of Biol. Research Lab

(Cole, Brown, Bruno)

1. Product 55% — Acute or Short Term 50%
   Long Term 50%
2. Fission Products 30% — Short Term 40%
   Long Term 60%
3. X-rays 15%

5-1

5/

5-

0024507

64

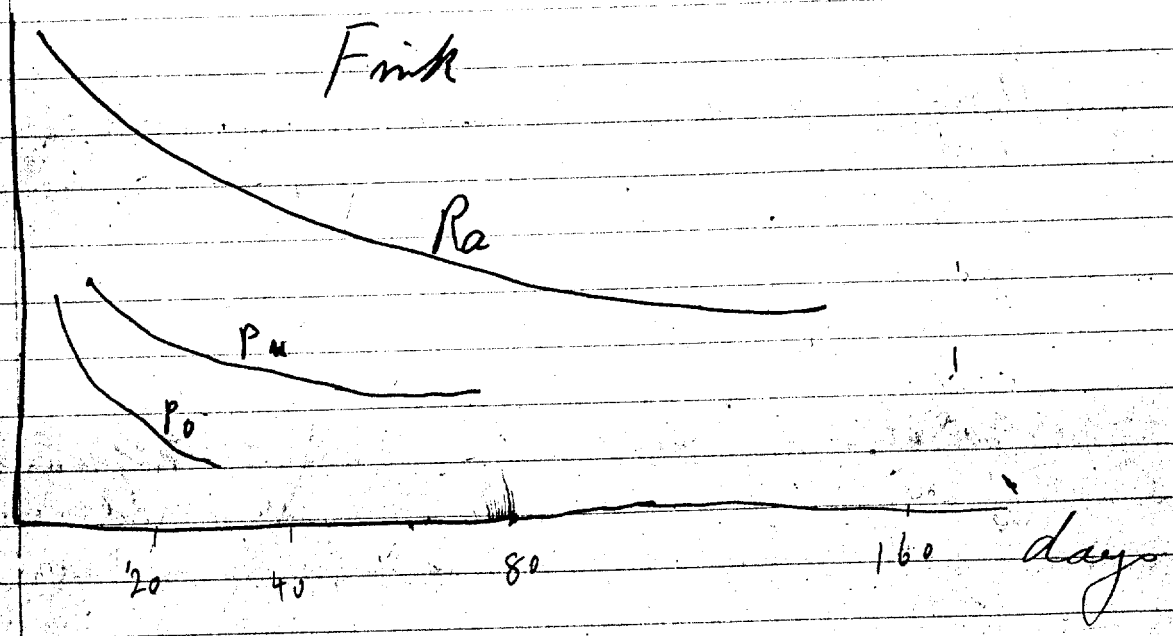
5-14-45

Oral → NO_3 Ca (Oxide) 3 Values
← Sol. compds. not abs. Amounts < 0.05%
IM
IV
Sub cut.
Pul
Principal Deposit – Skeleton 35% to 70%
Excretion – Feces h256 days Tolerance 1/10 day

75% of material inhaled is retained in body

5/14/45
Watson – must use more Dogs to get
physiology
Valentin Dogs

5-15-45
Po 15 μc/gm liver 50 days + (Rabbit at 50 days)



Ekhard

	10	20	30	40
Ra	8000	4000	2300	1400
Pm	200	141	116	90
Pb	110	45	30?	?
Ra	40	29	21	16
Pm	1	1	1	1
Po	.55	.32	.27?	?

	10	20	30	40
Ra	8000	4000	2300	1400
Pm	3000	2200	1900	1400
Ratio	2.67	1.8	1.36	1.0

From Y - Wright Langham
Frank Pittman

May 16th 1945 Abstract
Monthly Report - Much shorter + neater
Terminal Reports - more uniform [illegible]
No information meeting next month
June meeting in Chicago 18 19 20 251
July " " Clinton
Aug " " Chicago - General meeting [illegible]

Transfer
Cole 3
Prosser
~~[illegible]~~
Cantril 1
Hempelmann 1

Curtiss - 2
~~Jacobson~~ Stone 1
Hamilton 1
Nickson 1

Allardyce 1
Col Warren 1
Wirth 1
[illegible] 1

(14)

Technical Files
1 Clinton Central File
1 Chicago Tech. File

May 29th
All Day meeting June 19th (Tuesday)
No meeting in July.
All day meeting in August.

Nuclear Research 5/30
Total To Date - 53,718.00
Spent to March 22,322.00
31,000.00
Next 3 mos 6,000
After July 1st 25,000.00

Dec 2,200
Jan 1300
Feb 1644
March 2000

0024510

6/19/45 Slow n. meters — Dr Hamilton wants 2 or more.

Ab Bonus.

μg/Rat	no. anim	Dead of tent (45 days)
0	32	2
7.5	22	0
24.0	22	3
70.0	22	9 (LD50?)
210.0	11	10
504.	9	8

At 14 days 21% of admin. dose in lung = 30 μg/gm = 10^5/lu
2.7% in carcass
2.2% in bone = 0.6 μg/gm = 10^5/day 2 lung.

Lung 4×10^-5 ×10^5/lu

Standard

Lung	1000 gms
Kidney	300
Liver	1500
Skeleton	10 000
Marrow	500
Spleen	150
Testicle	40
Muscle	40 000
Blood	4500
Thyroid	25
Thymus	20
Lymphoid	150

G. I. — ?
Skin — 2 Kgms for entirety of 12 thing 24

Standards

Respiratory Rate 1 Cu m/hr
= 8 Cu m/8 hr day

% of particles in — Air 100%
of 1μ or less. — Head 50%
— Lung 25%

Co 67% in 1st 24 hrs of intramuscular dose absorbed.
64% in 1st 3 hrs of " "

Hamilton

7.5% I 2.5% of What was in Inhaled air

exp. air
2 4 64 days $PuNO_3$ + Cl .2 – .3% consigned to lung
Nitrate

Nitrate Oxide

Excretion per day of Lung Retention

8 days	5.25
16	3.14
32	.78
64	.89
96	.82
128	.98
192	.55
256	.36

~~May 14th~~ 6/19

$Pu^{239} + Pu^{238}$ 5 μ gm equiv. to 50 μ gm Pu^{239}

Man at 4 days	% per organ Rat		% per gram
Bone rib	87.2		.01
Cortex			.0072
Periost			.00481
Marrow			.019
Apex			.032
Spleen	.22	1 day .32 2 day .15	.0019
Blood	7.49%		.0013
Cells			.00028
Plasma			.0023
Liver	Rat 2%	~~Rat~~	

Tuesday 17th

9–10 C. L. Whit

9.00–9.30 Chem Johnson

15 min what has been done
10 min what is to be done
5 min

9.30–10 — Technology Rev.

10.00–11 M. Cal

Chem

11 —

2 pm Policy Mtg.

3.30–5.00 Discussions between

Wed 18th

Program built around Clinton Lab.

Cole

Coles June Report

4 mc/K significantly reduced growth rate [illegible]

8 mc/K - had doses ranging from 17% [illegible]

July 7th 1946 Ceilings

				Entries March 15	July 4
Section H I	Jacobson	Old ceiling	54		
		Add Jacobson (was admin.)	55	55	
H II	Cole	Old Ceiling	124	(including N.C.	7
		add Bloom (from admin.)	125	117	
		Temporary annex [illegible]	4		
~~H III~~					
H III	Nickson		38	40	
	Administration (Took away Jacobson Bloom)		2		

71

Nickson
1st Plutonium in Human Urine
2nd Method of Plutonium

Cole aerosols.
1st Freon explosion bomb —
2nd Wire explosion —
3rd Explosion of foil —

Lung absorption
1 Intubation Exp. — Transfer of citrate to bone typical.
Hypo Salt + Citrate in lung — no removal.

Blood — Dunning
Plu Mice 0.018 µg/g — No — 18×10^{-3} 70×10^{3} 1.26 m
0.05 µg/g

0.125 µg/g Slight
0.18 µg/g def
Rats — 0.05 µg/g gives effect
0.02 µg/g " no effect.

Cole Again Ra. — Calcification.
Dogs —
High Level Ingestion — Mice 1 mouse, +4 ...
6.2 mgm Stom tube 275 µg/g
0.06% on 25th Day
0.025% of ... contaminant

Barron Rats

1 μg/g Inject 5 days 15 days
Lungs 77.6% 41.9%

In lungs QO_2 normal. Some increase
Some inhibition of oxid. of succ. during

Spleen 0.014 0.037
QO_2 inhibition 10-20% Size of spleen
QO_2 pyruvate 18-35% diminished
from normal 2.8-2.5%
Adrenals - not appreciably diminished to 2.3-1.9%
Thymus 5-18% inhibition

Liver 0.94 0.77

10^{-3}
10^{3}
m.

Kidney 0.081 0.103
QO_2 glut decreased,
QNH_3 decreased

Blood count

Schwartz
Urinary urobilinogen increased in all products
Bilirubinemia in early state of liver damage.

Hamilton Rats - given 50 μgm Pu^{239} +6 Nitrate.
Oral absorption avg. .0007%

Intml

Curtiss

Escarini Wheel

Gives a measure of function

Rem/hr

Slow Neutrons

$N^{14}(n,p)C^{14}$
$H^{1}(n,\gamma)H^{2}$
$P^{31}(n,\gamma)P^{32}$
$Na^{23}(n,\gamma)Na^{24}$

} These are 99% of energy absb

	Nmm	Nha
	75%	50%
	50%	50%
P	12	%
Na	4	
K	2	
C	1	

1%

$$R.H. = \frac{\sigma_A \cdot F \cdot E}{at.\ Wt.}$$

Tolerance Dose for rm

9×10^3 sn/cm²/sec for 8 hrs.

22 ors

49 ors

Effects

Blood Pressure of Rabbits

48 rabbits 97.5 ± 7.4

3 controls −5.6

Trans. ½ group −26.4 (about ½ pressure drop)

5 − 11 drops −16.7 (−9.0 if exclude a big drop)

74

Myosin

$ATP \rightarrow ADP + H_3PO_4$

Same for 1 week.

1 r	inhibits	30%
5 r	"	52%
10 r	"	55%

With Fresh Myosin

10 r	"	10%
50 r		20
100 r		32
500 r		65
1000 r		95

HEW 11 000 tons of Ra – in radiation level of piles at equilibrium.

T pure Zero		T_0	1 yr later	
	Isotope	% Act	Isotope	
α emitters	Th^{232}	49.2	Th^{232}	21.9
	$RaTh^{228}$	49.2	$RaTh^{228}$	15.5
	I_0^{230}	1.5	ThX^{224}	15.5
β emitters	UX_1^{234}	96.3	~~Th A~~ Tn^{220}	15.5
	U_Y^{231}	3.7	ThA^{216}	15.5
			ThC^{212}	5.2
			ThC'^{212}	10.3
			I_0^{230}	.65
			~~Ra^{228}~~	
			Ac^{228}	
			ThB^{212}	

β activity even after 10 yrs is very little in Biol effect.

T α 3×10^{-15} C/cc air for Thorium.

Th .1 μc total in body.

		Tantalum γ	Cadmium γ
	K		
4 hr	1150 r		
30 min	850 r	840	
		830	

Plutonium absorption from G.I.)

5 μg/g

3×10^{-3}% absorbed

3.35 μg/g

.06%

0024519

Plutonium Threshold.

30 day lethal 1.0 mg/K

0.25 Bone tumors 10% / 35%

↓ [illegible] Liver disease — die about 300 days

(0.05) [illegible] 400 days 10%

Testicular atrophy dose 20.03

Human 3 mgs — liver + bone

2 mgs — testicles

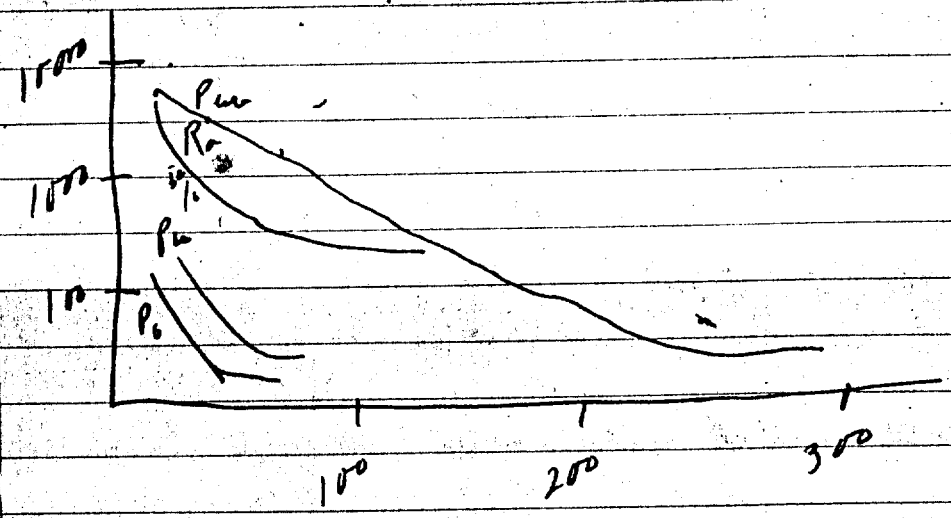
Mrs Rendell — Mrs Williams

$100 1900 46.?

1/15/46 Agreement with Capt Chapman, Lt Mahoney of Al Tammelin. In reporting results with 22 & 23 he is to use the term

Results obtained with artificially produced isotopes of uranium of greater activity than natural uranium.

Polonium Conference 12/11/45



Pw Rad. $\frac{1}{90}$ as toxic as Pa - at 20 days.

Relative Toxicity - Injected dose to kill in given days

	15 days	25 days	50 days.
P_o	1	1	1
P_w	1.4	1.6	1.9
R_a	34	40	28

From Herrman Subjects

Urinary % Excreted / day 0.05

Only during 1st Day 0.07 to 0.8 % dose average .3 24 hr.

During 1st week ave. 0.06 0.24 (average .13)

" 2nd " 0.04 0.08

At 70 days .02

7% remaining at 130 days.

Human Fecal Study

1st week 2.0 % injected dose/day

0.56 % " "

2nd week 0.73 " "/day

at 7 days 0.25 % " "/day

Rat	1	10	50
Spleen % injected dose	3.6	8.5	1.3
Kidney " "	2.5	4.1	2.5
Liver " "	1.2	1.3	0.2
Bone Marrow " "	1.0	2.0	0.7

Lung Ret. Rats

	0	1 day	3 day	10 days.
Lung	100%	44	35	31
	100%	61		11

5.6 μc total body.

if 0.05 % excreted per day .025

.01

.15

.7

-4 hr.

LD 50 (μc/Kg)

15 da. 60

25 da. 45

50 da. 32

10 r/day decreases W.B.C. 70% in 10 days
8 μc Po/Kg does the same
Hence 10 r/day is eq to 8 μc
.1 r/da $\simeq \frac{8 \times 1}{150}$ = .08 μ/Kg
= 5.6 μc Total Body.
= 6000 dis/min in 24 hr

1-11-46

Special Dates

Request for Xanon appropriation of alloway 3/30/44 AH to KDN 3/?/4
letter RBB to AHC. (File Proj. Dec...)
Request to Parran for Wells 6/12/44.

Dr Barron cleared about Nov 1943

First Trip to H.E.W. about Nov 11th 1943

Factories visited
Baker Bros Toledo. J.J.N. 6/21/45 for report

Adv. Committee of ... Sci. ...
set up in Oct 1944 Bloom, Hodge
Harrison Wilson Brunschwig Wright

Earl Miller's appointment - before Nov 1944

THIS IS TO CERTIFY THAT

PAGES 84 THROUGH 189

IN NOTEBOOK A - 1358

ARE BLANK.

Paul A. Schulze.

Signature

0024525

Blank pages destroyed 97 thru 168
9-11-59

M. L. Alayn

Symposium on Legal + Industrial Medicine
Med Clinics of N.A. Vol 25 No 2 1941

Film Method of Measuring Tolerance

a) Radium Protection: Measurement of Exposure to Rays
Fricke & Williams
Radiol. ~~Am. J. Roent.~~ 34: 560 – : 1940
Shows variation of film response
0.5 400 KV Rm. filt = 1.0 r 200 KV 2mm Cu = 4 r Ray 6.8 Cu Rm

b) J. R. Wilkins – of Eastman Kodak
Worked on dental films

THIS IS TO CERTIFY THAT

PAGES 192 THROUGH 197

IN NOTEBOOK A-1358

ARE BLANK.

Paul C. Schulze

Signature

0024528

140 000 d/min / µg Pu

0.01% in urine = 14 d/min / liter urine

1500 ccs urine per day

1 d on ½ c for 100 ccs.

200

Page

5 National Cancer Institute report April 12th
7 Drainage System for Lot X
9 Radio - Iodine
9 Uranium Hexafluoride Release
9 Uranium (Lead) Release in air
9 Salary Rating.
191 Bibliography
13 Radio-activity of "Normal" Air, Soil, Water Human Tissue
14 Radiation from Waste Disposal Tanks, + Metal Storage Basin Site W - with Plastic. Visitors to reduce to 0.1 r/8 hrs.
25 F-P Dangerous Doses
23 Form of Write up of Experiments.

73 Manpower Ceiling Distribution