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THE UNIVERSITY OF ROCHESTER

Manhattan Project

Contract W-7401-eng-49

Report for the Month of August, 1946
Division of Radiology and Biophysics

William F. Bale -- Division Head

DEPARTMENT OF ENERGY DECLASSIFICATION REVIEW	
SINGLE REVIEW AUTHORIZED BY: DOE/HQ/OD Appt 1/1/8	DETERMINATION [CIRCLE NUMBER(S)] 1. CLASSIFICATION RETAINED
REVIEWER (ADD):	2. CLASSIFICATION CHANGED TO:
NAME:	3. CONTAINS NO DOE CLASSIFIED INFO
DATE: 8/16/96	4. COORDINATE WITH:
	5. CLASSIFICATION CANCELLED
	6. CLASSIFIED INFO BRACKETED
	7. OTHER (SPECIFY):

August 15, 1946

Submitted by: Andrew H. Dowdy, M.D.
Director

Report received:

Issued:

Classification Cancelled

~~Or Changed To~~

By Authority Of Div. of Classification

By JK Hawbsock / CB Date 5/10/79

8005212

1. Instrumentation

Section Head -- John B. Hursh

1.1 Instrumentation

1. Wallace Fenn has succeeded in splitting off mica sheets of 0.15 mil thickness suitable for 1.75 inch diameter G-M counter windows. A completely satisfactory method for mounting such windows has not yet been developed.

2. An electrometer bridge circuit built by Dr. Enns has been tested and adjusted so that it may be used as a replacement for equipment now in use for foil measurement.

3. Jack Mohney has extended his search for a more sensitive method of measuring radon samples by conducting experiments involving the collection of the electrically charged products of radon decay on the surface of a metallic foil cylinder concentric with a cylindrical container. A difference of potential of the order of 800 volts is impressed on the two cylinders. Preliminary results indicate approximately 50% recoveries.

4. The modified Neher-Pickering quenching circuit that has been used with several G-M counters was investigated by John Bonner. Double pulses originating in the quenching circuit were eliminated as a cause of trouble by returning to Neher-Pickering circuit as originally published with the single change of using a 250,000 ohm dropping resistor for the screen bias rather than the 45 volt battery.

5. The blocking oscillator supply developed for use with portable counters was modified for use with A.C. operated apparatus and further tests of its properties are being carried on.

1.2 Routine Service and Analyses

1. Project radioactivity measuring apparatus was maintained in operating conditions.

2. The following analyses were made:

   a. 2048 industrial film badges for beta, gamma, and neutron radiation.
   b. 9 breath samples for radon.
   c. 3 air samples for radon
   d. 155 foil samples for alpha activity.

3. Personnel from another area were instructed in film badge procedures and in collecting and reading dust samples.

8005213

2. Tracer Chemistry

Section Head -- Robert M. Fink

2.1 Analytical Studies on Serially Sacrificed Rats to which Polonium had been Administered

Tissue analyses for polonium have been completed in a serial sacrifice study on rats. The rats used were a homogenous group of males from Wistar Institute, and were given a single intravenous dose of 10 or 20 microcuries of polonium per kilogram of body weight. They were all injected from the same solution within a short period of time, kept under the same conditions after injection and sacrificed (ether) and dissected in as similar a manner as possible and in a pre-arranged order, randomized with respect to order of injection. Since excreta were not analyzed it was not possible to estimate the dosage from the total amount of polonium recovered as has been done in the metabolism experiments. As the closest possible approach to putting the data from the two sets of experiments on a comparable basis the dosages for the serial sacrifice group were taken as 92% of the values determined by the dummy injection since 92% was the average recovery obtained in all the metabolism experiments where complete analytical data were available.

That the two sets of data are apparently reasonably comparable is indicated by Fig. 1, where the per cent of the dose retained in the serial sacrifice group is plotted around the average retention curve derived from excretion data in the metabolism experiments. Since it was not possible to correct the dosage for individual animals according to the individual recoveries the data show a fairly wide scatter, but the group averages in general show a good fit to the previously determined retention curve. Groups of four animals, two at 10 and two at 20 microcuries/kg. were sacrificed at ½, 1, 2, 3, 7, 14, 21, 28, 60, 90 and 160 days after injection. No individual tissues were analyzed in animals which died before they were scheduled for sacrifice, but data on total retention in these animals are included in Fig. 1 and in general averaged (in data presented on chart as crosses) with the closest regular sacrifice group. The three animals which died between 90 and 160 days were averaged as a special group.

The complete analytical data on the animals which were sacrificed are given in Table 1, expressed as per cent of dose per gram, and in Table 2, expressed as per cent of body content per gram. The average data have also been plotted as per cent of dose per gram in Fig. 2 and per cent of body content per gram in Fig. 3.

The pathological and hematological findings in this experiment will be reported later.

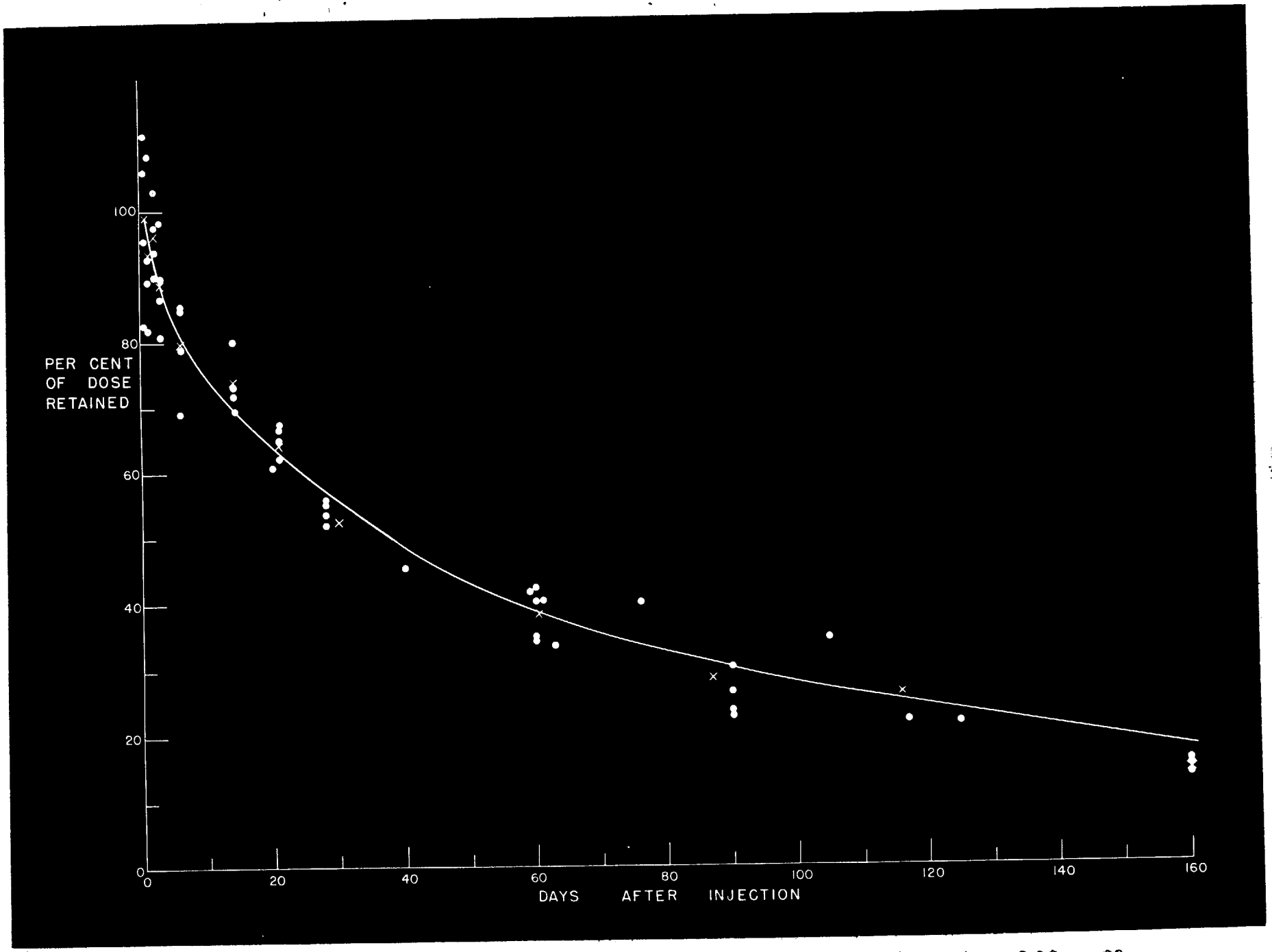

Fig. 1. Retention of polonium by rats following intravenous administration of 10 or 20 μc of polonium chloride per liter.

("%Dose" calculated as if half life of polonium were infinite. Absolute amounts retained were less than those indicated in the curve by the amount of radioactive decay.

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Table I

Percent of the dose per gram in tissues of male rats sacrificed serially following intravenous administration of 10-20 μc/kg of polonium[a]

Days after inj'n.	Rat No.	Retention % of Dose	Percent of the dose per gram wet weight in								
			Spleen	Kidney	Liver	Lung	Cervical Nodes	Omental Nodes	Bone	Testis	Muscle
	222	83	4.6	3.2	1.47	0.87	0.91	0.41	0.26	0.13	0.06
	223	112	7.3	2.9	1.20	1.74	1.03	0.92	0.35	0.18	0.13
0.5	254	106	10.3	3.4	2.24	1.10	0.99	0.57	0.39	0.21	0.12
	255	96	6.7	2.3	1.49	0.78	0.70	1.23	0.25	0.12	0.11
	Ave.	99	7.2	2.9	1.60	1.13	0.90	0.78	0.31	0.16	0.10
	224	82	7.7	2.5	1.65	1.05	0.86	2.02	0.26	0.15	0.12
	225	108	6.9	3.4	2.17	1.10	1.26	1.71	0.35	0.21	0.10
1	256	93	7.6	2.7	1.58	0.94	1.25	2.04	0.26	0.17	0.11
	257	89	8.1	2.5	1.46	0.80	1.98	0.53	0.23	0.14	0.10
	Ave.	93	7.6	2.8	1.71	0.97	1.33	1.58	0.28	0.17	0.10
	226	97	7.2	2.6	1.45	0.83	0.91	2.7	0.33	0.21	0.15
	227	103	7.9	2.6	1.35	0.45	0.90	1.05	0.38	0.18	0.14
2	258	90	10.8	3.2	1.51	1.02	0.87	3.4	0.32	0.24	0.13
	259	94	8.4	3.0	1.66	0.79	lost	2.7	0.27	0.18	0.15
	Ave.	96	8.6	2.8	1.49	0.78	0.89	2.5	0.33	0.22	0.14
	228	81	12.5	3.6	0.82	1.05	1.98	1.47	0.34	0.25	0.18
	229	98	12.5	3.6	1.23	1.71	1.35	4.2	0.35	0.21	0.14
3	260	90	10.1	2.9	1.37	0.74	1.34	3.3	0.34	0.21	0.14
	261	87	11.3	3.2	0.86	1.01	0.84	3.5	0.29	0.15	0.13
	Ave.	89	11.6	3.3	1.07	1.12	1.38	3.1	0.33	0.21	0.15
	230	85	12.4	4.2	0.83	0.85	1.71	1.84	0.35	0.24	0.14
	231	79	10.5	3.9	1.02	0.61	0.90	2.4	0.21	0.24	0.12
7	262	85	8.8	3.1	0.80	0.70	1.11	2.0	0.31	0.10	0.14
	263	69	9.6	3.0	0.79	0.71	1.25	4.0	0.24	0.18	0.13
	Ave.	80	10.3	3.5	0.86	0.72	1.26	2.6	0.28	0.19	0.13
	232	70	7.1	3.0	0.53	0.58	2.4	1.15	0.20	0.21	0.09
	233	80	7.5	2.9	0.63	0.65	2.3	1.35	0.23	0.31	0.11
14	264	72	7.6	3.1	0.48	0.61	1.02	3.4	0.21	0.18	0.12
	265	73	5.3	3.7	0.78	0.53	2.0	3.6	0.21	0.21	0.13
	Ave.	74	6.9	3.5	0.61	0.59	1.92	2.4	0.21	0.23	0.11
	234	65	3.7	2.9	0.50	0.53	1.47	2.1	0.24	0.30	0.12
	244	68	7.1	2.9	0.49	0.63	3.7	3.6	0.24	0.33	0.16
21	266	62	4.7	2.9	0.48	0.51	1.00	4.5	0.21	0.20	0.11
	267	67	6.1	3.5	0.50	0.67	2.2	2.7	0.30	0.20	0.13
	Ave.	65	5.4	3.0	0.49	0.59	2.1	3.2	0.25	0.25	[illegible]
	236	52	5.3	2.6	0.41	0.59	1.53	0.82	0.21	0.33	0.110
	237	54	5.8	3.6	0.46	0.55	4.4	2.3	0.24	0.26	0.096
28	268	56	4.2	2.2	0.35	0.37	1.84	3.6	0.12	0.21	0.078
	269	55	3.4	2.5	0.33	0.39	2.7	2.7	0.16	0.14	0.079
	Ave.	54	4.7	2.7	0.38	0.48	2.6	2.3	0.18	0.23	0.090
	238	42	1.59	2.14	0.36	0.28	0.40	0.36	0.089	0.82	0.080
	245	40	2.8	2.5	0.41	0.43	0.84	1.62	0.120	0.82	0.088
60	270	34	2.08	1.57	0.24	0.35	0.66	0.54	0.076	0.58	0.069
	271	35	1.98	2.00	0.21	0.32	0.51	2.21	0.097	0.51	0.066
	Ave.	38	2.11	2.05	0.30	0.34	0.60	1.18	0.095	0.68	0.076
	248	24	1.94	0.92	0.18	0.24	0.63	0.57	0.066	0.40	0.054
	249	23	3.4	1.45	0.25	0.25	0.77	1.28	0.065	0.73	0.044
90	272	26	1.76	0.95	0.21	0.36	0.39	0.86	0.042	0.30	0.055
	273	30	1.58	1.21	0.21	0.29	0.49	0.48	0.076	0.51	0.066
	Ave.	26	2.17	1.13	0.21	0.29	0.57	0.80	0.062	0.48	0.054
160	252	15.1	0.74	0.46	0.22	0.16	0.030	0.095	0.033	0.27	0.024
	274	14.5	0.67	0.22	0.17	0.16	0.20	0.15	0.036	0.34	0.024
	275	13.2	0.75	0.20	0.10	0.14	0.11	0.22	0.027	0.43	0.021
	Ave.	14.3	0.72	0.29	0.16	0.15	0.11	0.15	0.032	0.35	0.023

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Table 2

Percent of body content per gram in tissues of male rats sacrificed serially following intravenous administration of 10-20 µc/kg of polonium[a]

Days after inj'n.	Rat No.	Percent of body content per gram wet weight in								
		Spleen	Kidney	Liver	Lung	Cervical Nodes	Omental Nodes	Bone	Testis	Muscle
	222	5.6	3.9	1.78	1.05	1.10	0.50	0.32	0.16	0.08
	223	6.5	2.6	1.66	1.56	0.93	0.83	0.31	0.17	0.12
0.5	254	9.7	3.2	2.11	1.04	0.93	0.53	0.37	0.19	0.11
	255	7.0	2.5	1.56	0.82	0.73	1.28	0.26	0.13	0.11
	Ave.	7.2	3.1	1.77	1.12	0.92	0.79	0.32	0.16	0.10
	224	9.4	3.0	2.02	1.29	1.05	2.5	0.32	0.19	0.15
	225	6.3	3.1	2.00	1.01	1.16	1.57	0.32	0.19	0.09
1	256	8.2	2.9	1.70	1.01	1.35	2.2	0.28	0.19	0.12
	257	9.1	2.9	1.63	0.90	2.22	0.60	0.26	0.16	0.11
	Ave.	8.3	3.0	1.84	1.05	1.45	1.72	0.29	0.18	0.12
	226	7.3	2.7	1.48	0.85	0.94	2.8	0.33	0.21	0.16
	227	7.7	2.6	1.31	0.43	0.87	1.02	0.37	0.18	0.14
2	258	12.0	3.5	1.68	1.14	0.97	3.8	0.35	0.27	0.14
	259	9.0	3.2	1.77	0.85	lost	2.9	0.29	0.20	0.16
	Ave.	9.0	3.0	1.56	0.81	0.93	2.6	0.34	0.22	0.15
	228	15.5	4.5	1.01	1.30	2.45	1.82	0.42	0.31	0.23
	229	12.7	3.7	1.25	1.79	1.37	4.3	0.35	0.21	0.14
3	260	11.2	3.2	1.52	0.82	1.49	3.7	0.38	0.23	0.16
	261	15.1	3.7	0.99	1.17	0.97	4.0	0.34	0.18	0.15
	Ave.	13.6	3.8	1.19	1.27	1.57	3.4	0.37	0.23	0.17
	230	14.6	5.0	0.97	0.99	2.00	2.2	0.41	0.29	0.17
	231	13.4	4.9	1.30	0.77	1.14	3.1	0.26	0.30	0.15
7	262	10.4	3.6	0.94	0.82	1.30	2.3	0.37	0.11	0.17
	263	13.9	4.3	1.15	1.02	1.81	5.8	0.35	0.27	0.19
	Ave.	13.1	4.5	1.09	0.90	1.56	3.3	0.34	0.24	0.17
	232	10.2	4.3	0.76	0.83	3.4	1.6	0.28	0.30	0.13
	233	9.3	3.7	0.79	0.81	2.8	1.7	0.33	0.39	0.14
14	264	10.7	4.3	0.67	0.86	1.44	4.8	0.29	0.26	0.17
	265	7.3	5.0	1.07	0.73	2.7	4.9	0.28	0.28	0.18
	Ave.	9.4	4.3	0.82	0.80	2.6	3.2	0.29	0.31	0.16
	234	5.7	4.5	0.77	0.82	2.3	3.2	0.37	0.47	0.18
	244	10.6	4.3	0.72	0.93	5.4	5.4	0.35	0.48	0.24
21	266	7.6	4.7	0.77	0.82	1.61	7.2	0.33	0.31	0.17
	267	9.1	5.2	0.75	1.01	3.2	4.1	0.46	0.39	0.20
	Ave.	8.3	4.7	0.74	0.89	3.1	5.0	0.37	0.39	0.20
	236	10.2	5.0	0.79	1.13	2.9	1.57	0.39	0.63	0.21
	237	10.9	6.7	0.85	1.03	8.2	4.4	0.45	0.49	0.18
28	268	7.5	2.9	0.62	0.66	3.3	6.5	0.21	0.37	0.14
	269	6.2	4.5	0.59	0.71	4.9	4.9	0.30	0.26	0.14
	Ave.	8.7	4.8	0.71	0.88	4.8	4.3	0.34	0.44	0.17
	238	3.8	5.1	0.85	0.67	0.95	0.85	0.21	1.93	0.19
	245	6.9	6.2	1.03	1.08	2.1	4.0	0.30	2.03	0.22
60	270	6.0	4.6	0.70	1.01	1.93	1.58	0.22	1.68	0.20
	271	5.7	5.8	0.60	0.92	1.47	6.4	0.28	1.47	0.19
	Ave.	5.6	5.4	0.80	0.92	1.62	3.2	0.25	1.78	0.20
	248	8.2	3.9	0.78	1.01	2.7	2.4	0.28	1.70	0.23
	249	14.6	6.3	1.09	1.09	3.4	5.6	0.28	3.2	0.19
90	272	6.7	3.6	0.78	1.36	1.48	3.2	0.16	1.15	0.21
	273	5.2	4.0	0.68	0.97	1.62	1.59	0.25	1.69	0.22
	Ave.	8.7	4.5	0.83	1.11	2.3	3.2	0.24	1.93	0.21
	252	4.9	3.0	1.44	1.08	0.22	0.65	0.22	1.80	0.14
160	274	4.7	1.50	1.20	1.13	1.35	1.05	0.23	2.3	0.15
	275	5.7	1.48	0.74	1.07	0.82	1.64	0.25	3.3	0.16
	Ave.	5.1	2.0	1.13	1.09	0.80	1.11	0.23	2.5	0.15

(a) Rats 222-253 inclusive received 20 µc/kg; rats 254-275 inclusive received 10 µc/kg.

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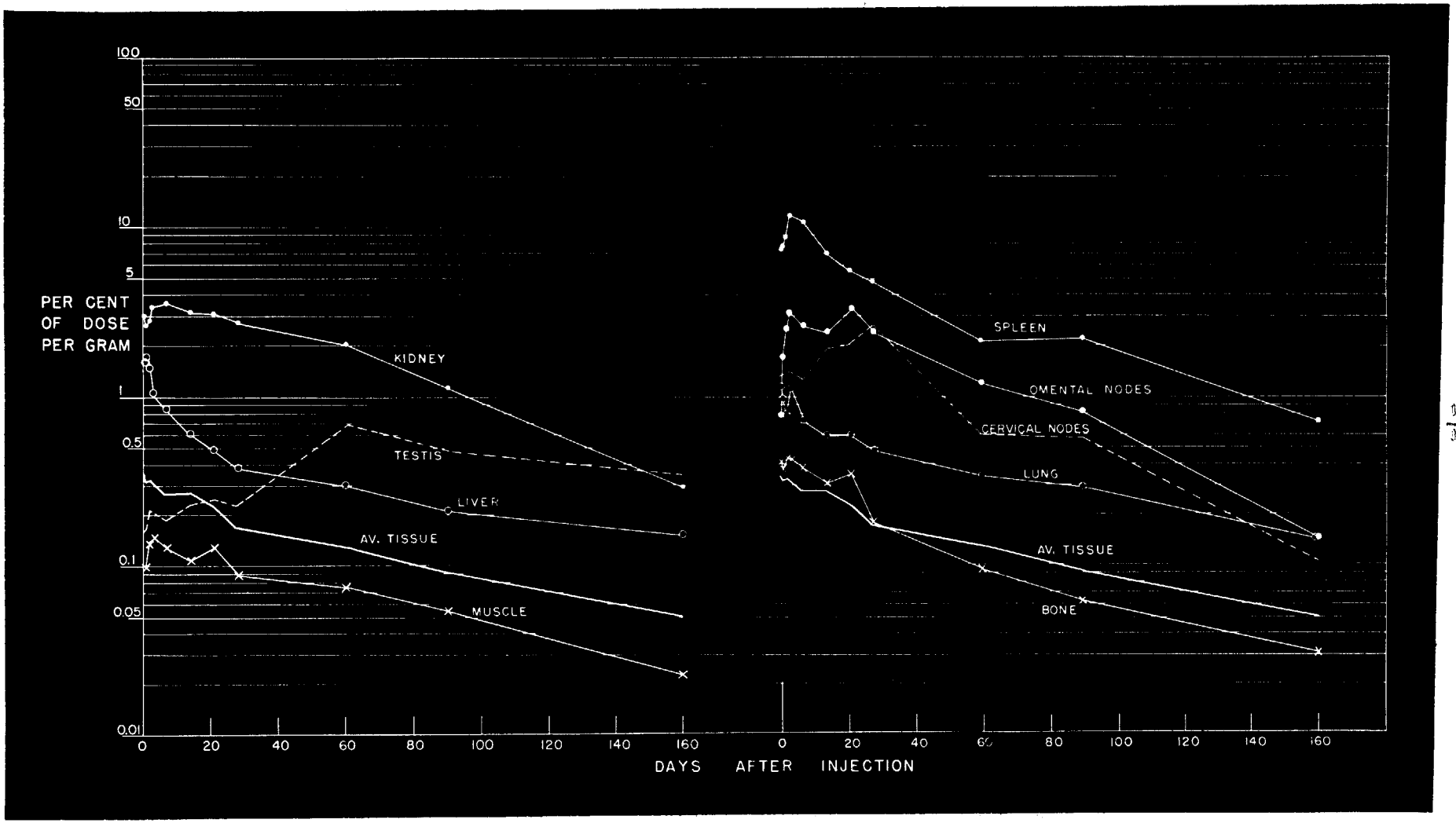

Fig. 2. Polonium distribution in rat tissues, expressed as average percent of dose per gram.

("Dose" is calculated as if half life of polonium were infinite. Absolute amount of polonium found was less than indicated in the curves by the amount of radioactive decay.)

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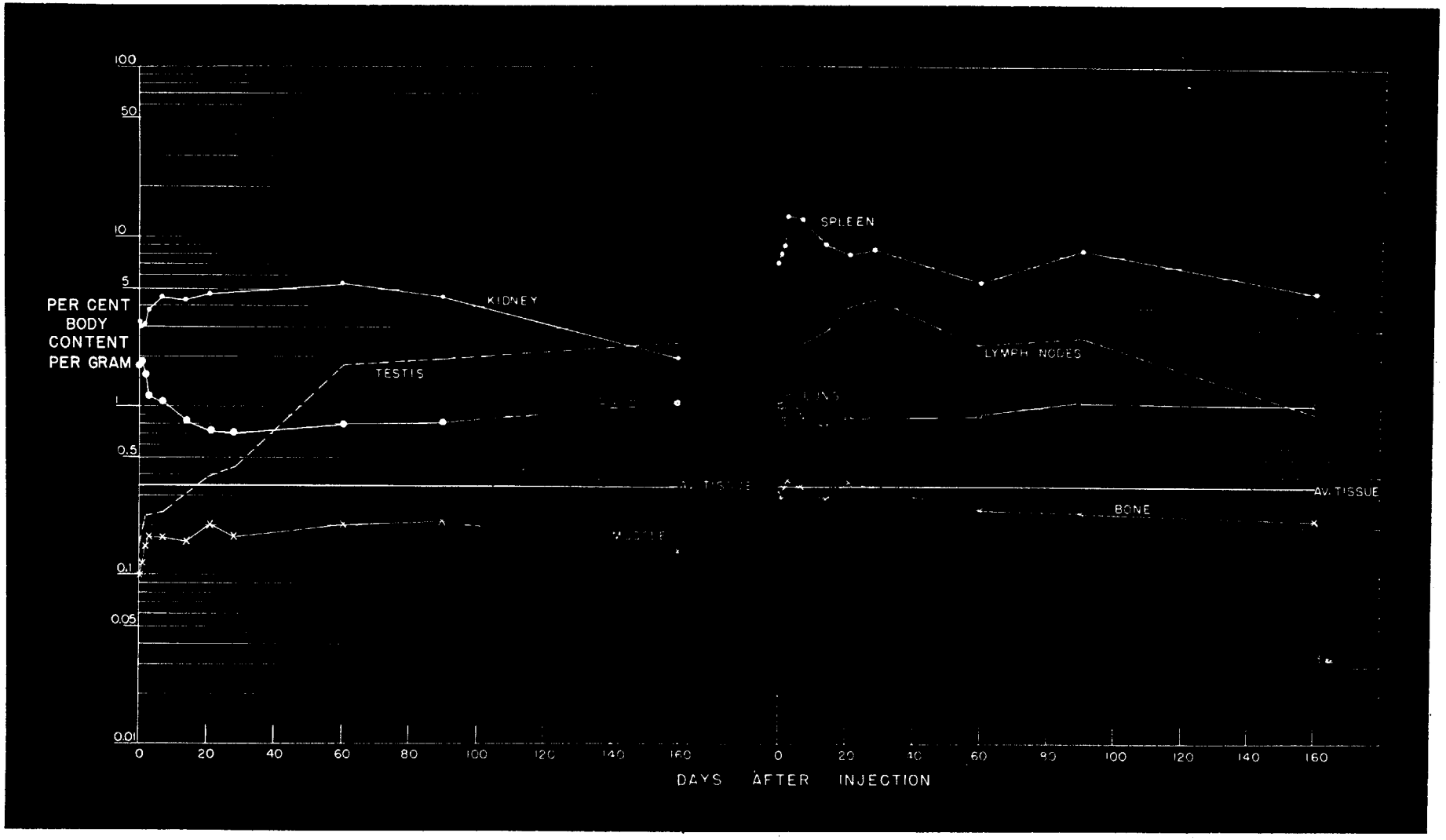

Fig. 3. Polonium distribution in rat tissues, expressed as % of body content per gram.

8005219

2.2 Effects of Irradiation on Tissue Nucleic Acids Studied with Radioactive Phosphorus

1. Summary of the literature

A brief summary of the literature on the effects of irradiation on tissue nucleic acids indicated that results of various workers are not in complete agreement although it may be a consequence of different experimental conditions. Hevesy (Review of Modern Physics 17, 102, 1945) after X-irradiation of Jensen's sarcoma in the rat with the rat otherwise shielded from the X-ray beam, found 1/3 to ½ as much newly formed desoxyribose nucleic acid in the tumor as compared with unirradiated controls.

Also normal rats which were exposed to 1480-3000r whole body irradiations, injected with P^{32} and sacrificed two hours later, contained from ½ to 1/3 as much newly formed desoxyribose nucleic acid in liver, spleen, and intestinal mucosa as the corresponding controls. Radiation also was found to inhibit the formation of desoxyribose nucleic acid in the growing tissues of 3 to 4 day old rats. If the rat was sacrificed immediately after exposure to X-radiation, the newly formed desoxyribose nucleic acid was 1/10 of its normal value. About three-fourths of the inhibiting effect produced by X-radiation ceased in the first two fours after exposure.

Tuttle, Erf, and Lawrence (J. Clin. Inv., 20, 566, 1941) found less P^{32} was retained in the nucleoprotein fraction of the spleen, liver, lymph nodes, and carcass in both normal mice and mice with lymphoma when 80 microcuries P^{32} (lethal to 20 gm. mice in two weeks) were given than when 8 microcuries were given. The mice were sacrificed at ½, 1, 1½ and 2 days after the administration of the P^{32}. The nucleoprotein fraction consisted of the tissue residue after lipid, acid and water soluble P were removed and contained ribose nucleoprotein, desoxyribose nucleoprotein, and phosphoprotein.

Marshak (J. Gen. Physiol., 25, 275, 1941) used mice with 13 day old lymphomas which were given 200r X-radiation, P^{32} injected ½ hour later, and sacrificed at 2, 3, 6, 12, and 24 hours after irradiation. The P^{32} concentration of liver tissue and isolated liver nuclei was not much affected. The P^{32} concentration of the irradiated tumor tissue was slightly less than the control tumor, while the concentration in the irradiated tumor nuclei was about 60% greater than the control 2 hours after irradiation and from 10-20% greater than the control at 5-24 hours. The irradiated lymphoma cytoplasm had 20% less than the control at 2 hours and decreased to 40-60% less than the control at 5-24 hours. Nucleoprotein and nucleic acid fractionation were not done on the tissues and nuclei from the irradiated mice, so it is not certain whether the P^{32} changes in the nuclei may be attributed to the desoxyribose nucleic acid phosphorus. Marshak has shown that about 90% of lymphoma nuclear phosphorus is in the nucleoprotein fraction, and desoxyribose nucleic acid is believed to constitute from 97-100% of the nucleic acid fraction of nuclei.

Mitchell (Brit. J. Exper. Path., 23, 296, 1942) found an increase in absorption of ultra-violet radiation (2537A°) of cytoplasm of proliferating and

differentiating cells after therapeutic doses of Roentgen radiation, which he attributed to an accumulation of ribonucleotides in the cytoplasm. No change was found in the concentration of desoxyribose nucleic acid.

2. Experimental data

The data have been completed on the four groups of four rats each, which were given approximately 200 microcuries per kilogram of radioactive phosphorus. The phosphorus was administered intravenously and the two experimental groups were exposed to 600r and 1600r X-radiation for two hours immediately after the phosphorus was administered. Immediately after the irradiation was terminated, the testes, liver and spleen were removed under ether anesthesia, immersed in a freezing mixture of dry ice and alcohol, and were kept frozen until the extractions were begun. The two control groups were treated the same as the experimentals with the exception that they were not exposed to X-radiation. The tissues were analyzed for total nucleic acid phosphorus, ribose nucleic acid phosphorus, and desoxyribose nucleic acid phosphorus according to the procedure of Schmidt & Thannhauser (J. B. C., 161, 83, 1945). The radioactive phosphorus in each of the three fractions was measured by means of a Geiger counter. The specific per cent activity, i.e., the per cent of the injected dose per gram of total phosphorus, was calculated. The ratios of the specific per cent activity for the nucleic acid fractions in the experimental groups and their corresponding controls indicated little change as a result of the irradiation under the conditions of the experiment outlined. The ratios for all three fractions of phosphorus were close to unity, with three exceptions. The activity was depressed about 30 per cent in the desoxyribose nucleic acid fraction in the testes of the 600r and 1600r groups and in the liver of the 1600r group. Not much significance can be attached to the calculated depression in these three instances, since the amount of radioactive phosphorus counted in these cases (and only in these three cases) was close to the background count.

In order to give some indication of the relative activities of the three fractions, and the three tissues, the per cent of injected dose per gram of phosphorus, and the ratios of the activities in the experimental and control group are given in Table 3 for the 600r experiment.

8005221

Table 3

Tissue	% injected dose/gram P		Ratio
	600r	Control	600r ÷ Control
Testes			
Total nucleic acid	6.0	6.3	0.95
Ribose " "	10.1	9.7	1.04
Desoxyribose nucleic acid	0.7	1.08	0.65
Liver			
Total nucleic acid	93	83	1.12
Ribose " "	106	99	1.07
Desoxyribose nucleic acid	22.3	22.2	1.00
Spleen			
Total nucleic acid	76	77	0.98
Ribose " "	136	140	0.97
Desoxyribose nucleic acid	34	39	0.88

The activity of all three fractions was lowest in the testes. The liver and spleen showed fairly similar activities. In all three tissues the activity of the desoxyribose nucleic acid phosphorus was considerably lower than that of the ribosenucleic acid fraction.

The study of the activities of the two nucleic acids as influenced by irradiation should be extended. No pronounced change was observed in the two experiments at 600r and 1600r, but it appears that the route of administration of the radioactive phosphorus, and the time of injection with reference to the time of irradiation may be important. Injection of the phosphorus intravenously before radiation was started as was done in our experiments may very likely give results different from those in which it was administered after radiation was begun or after radiation was terminated.

Marshak had administered the P^{32} intravenously after the injection was completed. Hevesy injected the P^{32} subcutaneously after the radiation was terminated, or interrupted the radiation to make the injection. In the case where he obtained the most pronounced inhibition, he stated that "the P^{32} was not administered after irradiation, the rat, however, being exposed to Roentgen rays throughout the experiment." It was assumed by us, that this meant the P^{32} was injected just before radiation.

2.3 Human Tracer Studies with Uranium 234, 235

During August, one human tracer study was carried out in collaboration with the Metabolism section and the division of Pharmacology. The radioactivity analyses were carried out by Dr. Albert Frenkel using essentially the methods outlined in the monthly report for July.

Subject: Male, aged 32 years, admitted to the Metabolism Unit on August 2, 1946 and discharged to Municipal Hospital on August 15, 1946.

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The patient was in the hospital because of rheumatoid arthritis and urethral strictures. General condition remained satisfactory throughout the period of study.

Examination: T. 37, P. 70, Ht. 171.5 cm., Wt. 60.5 Kg., B. P., 110/75. Both ankle joints swollen and tender. Left knee joint swollen, tender and contains fluid, right knee tender, urethral stricture demonstrated on catheterization.

Injection of Uranium Acetate: On August 9, 1946, he was given 385 µgm. uranium acetate enriched in U. 235 and 234 intravenously. The uranium salt was contained in 5 ml. of sodium acetate buffer (1.15%) at pH 4.5. The dose was therefore approximately 6.3 µgm. per kilogram of body weight. No reaction was experienced by the patient or noted by observers.

Analysis of Blood: 21 ml. of whole blood was withdrawn 4 hours after injection. No activity was observed. It was calculated that if the blood volume were 4,600 ml. at least 6.5 µgm. of uranium would have to be present in the blood stream before the amount contained in 21 ml. could be detected. It seems safe to assume that less than 2% of the total dose remained in the blood at the end of 4 hours.

Uranium in urine and feces: Quantitative collections of urine and feces were made both before and after the injection. Analyses were carried out by both the fluorescence and the plating and alpha counting methods. Only the results of the counting method are available for this report. No uranium was found in the control specimens. Tables 1 and 2 reveal the rate of excretion in urine and feces respectively.

Effect of Renal Function, Blood Count and Blood Chemistry: The amino acid N-creatinine ratio did not increase in the post injection period (Table 3) probably because the dose of uranium was too small. Dr. Dounce did not find a significant increase in urinary protein or catalase. Data on other clinical tests follow:

Clinical Tests

	Before Injection		After Injection
Urea Clearances	8/5/46		8/13/46
Standard	102%		Standard 100%
Maximum	115%		Standard 91%
Blood Counts	8/2/46		8/12/46
R.B.C.	5.5	million	5.3
Hb.	13.8	gm/100/ml	13.8
W.B.C.	6,800	cu mm	8,850
Differential Count			
Neut.	66	percent	64
S. L.	6		15
L. L.	13		5
M.	9		11
E.	1		2
Deg.	5		3
Blood Chemistry	8/5/46		8/12/46
Icterus Index	5	units	5
Sugar	66	mg %	62
N.P.N.	31	mg "	31
Total Protein	7.2	gm "	7.2
Alb/Glob.	4.3/2.9	gm "	4.4/2.8
Inorganic P.	4.3	mg "	4.5
Alk. Phosphatase	2.3	Bodansky Units	2.5
Carbon Dioxide	70	vols. %	63.
Chloride	-----	meq/liter	94.

These tests likewise indicate a negative effect at the present level of dosage.

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Table 1

Excretion of uranium in urine of Human Subject # 1

Date	Time after injection in hours.	µgm. Uranium in specimen	% of dose excreted in specimens	% of dose excreted per ml. of urine.
8/9/46 1:45 p.m.	3	204.70	53.27	.154
2:45 p.m.	4	37.22	9.66	.047
8 p.m.	9¼	59.67	15.50	.062
10 p.m.	11¼	8.03	2.08	.017
8/10/46 8 a.m.	21¼	7.00	1.82	.004
8/11/46 " "	45½	8.76	2.27	.0015
8/12/46 " "	69¼	3.76	.97	.00043
8/13/46 " "	93¼	less than .77	less than .20	less than .00014
8/14/46 " "	117¼	" .79	" .20	" .00009
8/15/46 " "	141¼	" .27	" .07	" .000045
Total excretion:		330.57	86.07	
Excretion during first day (21¼ h.)		316.22	82.33	.0599
Excretion during five following days.		14.35	3.74	.0004

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Table 2

Excretion of uranium in feces of Human Subject # 1

All analyses on feces yielded less than one count per minute over background (equivalent to approximately .05 ugm.) which we consider the lower limit of analysis of our plating and counting method, utilizing only the emission of alpha particles to determine the amount of uranium present.

The following table gives the maximum values of uranium which might have been present in the feces. The values are not constant because fecal excretions varied and the size of the aliquots was not always the same.

	Time after injection	Maximum total uranium in µgm.	Maximum total uranium in % of dose	Maximum uranium in % of dose per gm. feces, wet wt.
8/10/46	21½ h.	less than .40	less than .10	less than .00055
8/11/46	45¼ h.	" " .60	" " .15	" " .0013
8/12/46	69¼ h.	" " .40	" " .10	" " .00037
8/13/46	93¼ h.	" " 1.21	" " .32	" " .0016
8/14/46	117¼ h.	" " .40	" " .10	" " .0010
8/15/46	141½ h.	" " .40	" " .40	" " .0003

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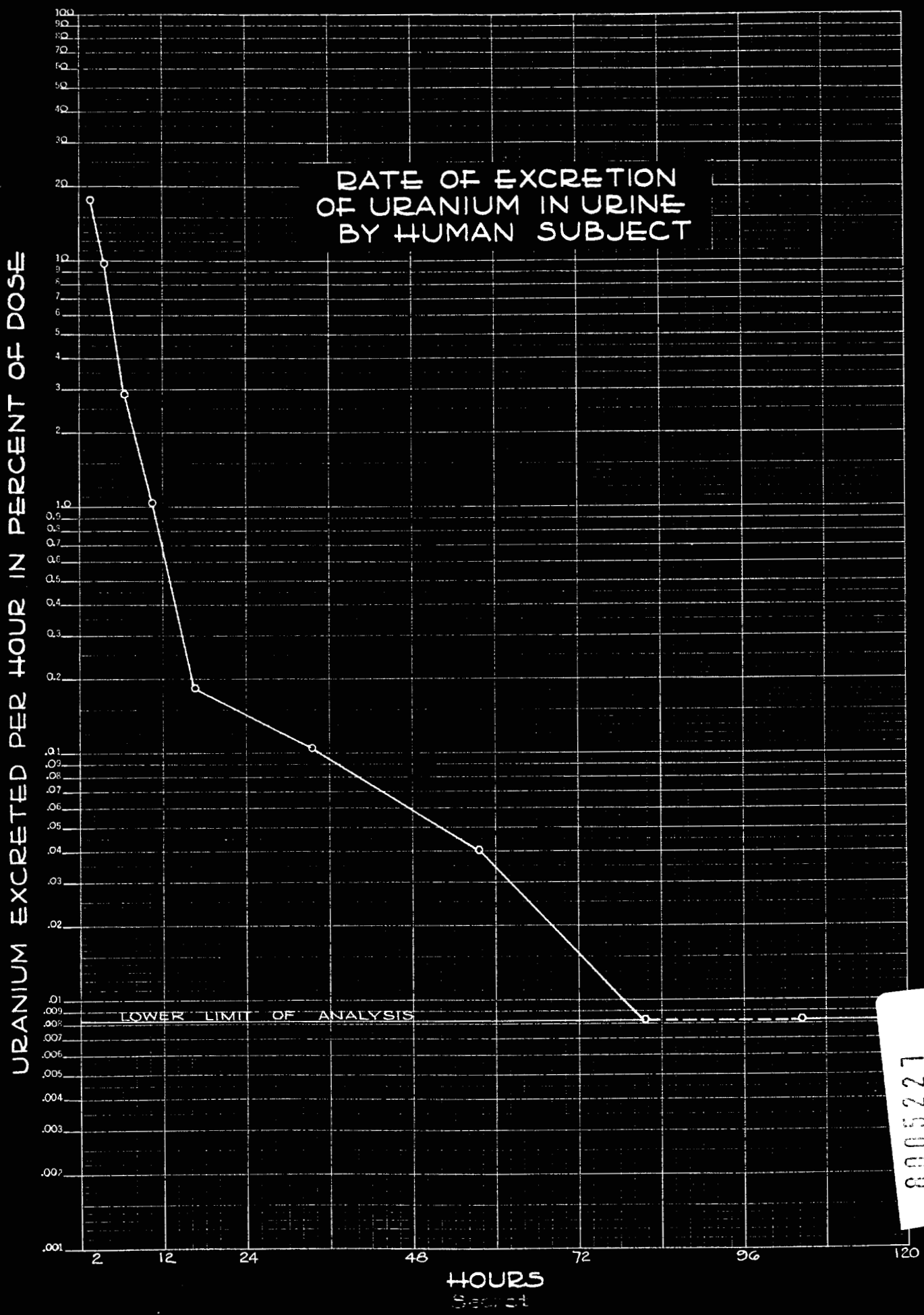
RATE OF EXCRETION
OF URANIUM IN URINE
BY HUMAN SUBJECT
URANIUM EXCRETED PER HOUR IN PERCENT OF DOSE
100
90
80
70
60
50
40
30
20
10
9
8
7
6
5
4
3
2
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
.01
.009
.008
.007
.006
.005
.004
.003
.002
.001
LOWER LIMIT OF ANALYSIS
2
12
24
48
72
96
120
HOURS

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Table 3

Creatinine and Amino Acid N Analysis on Urine of Human Subject # 1

Date	Analyses by Myrtle Crossman.			Analyses by Harry Berke		
	Creatinine in mg. %	Amino Acid N in mg. %	Amino Acid N / Creatinine.	Creatinine in mg. %	Amino Acid N in mg. %	Amino Acid N / Creatinine.
8/5/46	34	10.62	.312			
8/6/46	102	46.1	.451			
8/7/46	88	40.6	.462			
8/8/46	75	34.0	.454			
8/8/46	88	35.5	.404			
8/9/46	100	40.3	.403			
Uranium Administered.						
8/10/46	111	46.6	.42	112	41.1	.37
8/11/46	92	35.3	.38	97	40.3	.41
8/12/46	78	21.6	.28	74	25.5	.34
8/13/46	88	29.3	.33	82	32.8	.40
8/14/46	49	14.4	.30	42	14.1	.34
8/15/46	42	13.7	.33	41	10.6	.27

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3. Radiation Physiology

Section Head -- Thomas B. Noonan

3.1 Studies on death caused by very high (10,000-75,000r) single doses of X-radiation are in progress. Preliminary results on survival times -- vs -- dosage are given in table below:

Dose	Survival Time (Hours after start of treatment)	
	Rats	Hamsters
10,000 r	72-96 (8)*	_____
20,000 r	62-90 (8)	_____
40,000 r	6 & 8 (2)	_____
54,000 r	2.5 & 3 (2)	58 & 28 (2)
75,000 r	_____	3 & 8 (2)

* Figures in parentheses indicate number of animals used.

3.2 Studies on temperature effects have been unsuccessful to date. Efforts to induce hibernation in hamsters have not been successful to a degree that would permit these animals to be used for study of radiation effects. It has been learned that goldfish are easily killed by ice box temperatures so that the protective effect of cold against radiation damage is not easily studied in this species.

3.3 Sixty rats are being chronically irradiated at levels of 10r and 20r daily preparatory to determining their susceptibility to acute radiation.

3.4 Some of the personnel of this department have been cooperating with Mr. Bishop in a study of radiation effects.

4. Radiation Chemistry

Section Head -- Kurt Salomon

4.1 Most of Dr. Salomon's time has been spent since his arrival on August 1, as follows: Revising the office and laboratory set-up adapted to the research planned, looking for personnel, and familiarizing himself with the literature concerning problems of radiation chemistry.

5. Spectroscopy

Section Head -- Luville T. Steadman

5.1 Insufflation Experiments with U_3O_8 -- E. E. Thompson and L. T. Steadman

[illegible] insufflation experiments by [illegible], reported in 1944, the work that was done with the uranium oxides was limited in two respects as

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follows. The dose was always about 100 mg. of the compounds UO_2 or U_3O_8, and the duration of the experiment was not longer than six days because of the way in which the tracheotomy operation was performed. At that time the respiratory tract was isolated to insure that no part of the dose reached the esophagus. Analyses showed that uranium appeared in the kidneys and disappeared from the lungs and that about 75% remained in the respiratory tract at autopsy. The interpretation of the data was that U_3O_8 could be absorbed by the lungs and this finding constituted the main results of the experiment.

In the recent tests with U_3O_8, mentioned in the last report M 1884, a different plan was followed. The dose was 10 mg. of U_3O_8 and the tracheotomy was completed so that the animal recovered from the operation, breathed normally through the nose and mouth, and lived for more than a month. In this series animals were also sacrificed at seven and at fourteen days. The analyses of the lungs from these showed, however, that only microgram quantities of U were present. On the other hand, the nitrate experiments showed that the animals would succumb in fourteen days to 5 mg. of uranium absorbed from the lungs. This led to the suspicion that possibly the relatively insoluble oxide could be in part expelled from the lungs by way of the mouth and would appear with the saliva and be swallowed. This route was not found to be very important with the nitrate.

To test this conclusion, a similar tracheotomy experiment was performed using 100 mg. U_3O_8 and then a cannula was fastened in the esophagus and the saliva collected for ten of the ensuing thirty hours. In this one test 16 mg. U_3O_8 were recovered in the saliva. These tests are being repeated.

6. Radiation Mechanics

Section Head -- Francis Bishop

6.1 The large electronic microscope is being overhauled and new pumps from the district are being installed to free present pumps for the small model electron microscope. The reconversion of Room 112 is about 75% complete. Some 200 rats are in process of being irradiated for the time-intensity experiment.

6.2 One hundred twenty-eight 25 KV $\frac{1}{2}$ mfd condensers are being shipped from the district to be used in the construction of a high power condenser discharge X-ray machine to work in the split second range.

7. Metabolism

Section Head -- Samuel H. Bassett

7.1 Collaborative work on a tracer study of uranium in a human subject is covered in (2.3) of this report.