

Plutonium Studies at the  
Center for Human Radiobiology (CHR)

In 1945 a study was initiated to develop information about the metabolism of plutonium in man. The results of this study were described in LA-1151, Distribution and Excretion of Plutonium Administered Intravenously to Man, by W. H. Langham, S. H. Bassett, P. S. Harris, and R. E. Carter. This manuscript, dated September 20, 1950, was originally classified "Confidential"; subsequently the classification was changed to "Official Use Only".

The manuscript stated that "Need for the above information was recognized several years ago. It was also recognized that such information could be obtained only by administering small tracer amounts of plutonium to persons with a relatively short life expectancy. The first tracer study was initiated April 10, 1945 (12). Shortly thereafter, both the Chicago and Berkeley groups initiated similar studies (13), (14)."

We also note that: "The life expectancy of the individual was carefully considered as a basis of selection of subjects for study. As a rule, the subjects chosen were past forty-five years of age and suffering from chronic disorders such that survival for ten years was highly improbable."

The data gathered together in LA-1151 were reviewed in a manuscript prepared by Patricia W. Durbin, of the Division of Biology and Medicine, Lawrence Berkeley Laboratory, for publication in the 1972 symposium volume, Radiobiology of Plutonium. In her manuscript, entitled "Plutonium in Man: A New Look at the Old Data," Durbin clearly defines the purpose of the study: "If urinalysis was to be a reliable assay for Pu, characterization of its behavior in man was essential. For this reason, 18 hospitalized persons were injected with tracer amounts of Pu in 1945 and 1946." She also indicated that case Cal-3 was "Alive and well 7/17/68, 21 yr. post injection."

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In subsequent discussions with Dr. Durbin, we learned that several other cases were still alive. In order that these cases might be studied in detail, she turned over to the Center for Human Radiobiology all of the information that she had gathered on these cases. The records were delivered to us by Dr. Durbin on a visit here on 12/13/1972.

Our records of the 12/13/1972 visit show that Dr. Durbin advised us that:

- 1) There was an immediate need for financial support of a metabolic study (to obtain blood and excreta) of three surviving cases presently living in the Rochester, N. Y., area.
- 2) Christine Waterhouse, M.D., of Strong Memorial Hospital would make arrangements and provide medical supervision for a stay in the metabolic ward. She regularly saw two of these patients in her clinic at Rochester.
- 3) Dr. Waterhouse did not want these patients upset by mention of their injection with plutonium. Dr. Stehney replied that this should be handled by the Rochester human use committee, if needed; our part would be to analyze excreta.
- 4) Dr. Durbin had previous discussions with Dr. Wright Langham (Los Alamos) and Louis Hempelman, M.D. (Univ. of Rochester), and said she had an obligation to ensure the participation of the Los Alamos Scientific Laboratory in the radiochemical analyses.
- 5) Dr. Durbin had discussed the funding of these studies with Joseph Goldstein, M.D. (AEC-DBER).
- 6) Dr. Durbin, with the help of George LeRoy, M.D. (Univ. of Chicago), had identified two of the three Chicago cases.

Our records show the following activities with respect to these cases:

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- 12/21/1972 Memo R. E. Rowland to H. A. Schultz (CHR). Transmits case records to CHR Records Room. Mention of plutonium is specifically prohibited outside of CHR.
- 1/3/1973 Meeting of CHR staff to discuss plutonium cases. Responsibility assigned to M. S. Littman, M.D., to work with Dr. Waterhouse; A. F. Stehney to arrange financial details.
- 1/4/1973 Letter R. E. Rowland to Christine Waterhouse, M.D. Confirms and expands on details of metabolic studies.
- 1/26/1973 R. B. Holtzman (CHR) visited Strong Memorial Hospital to arrange details of collection and shipment of metabolic samples.
- 1/28/1973 Case HP-3 was in Strong Memorial Hospital from 1/28/1973 to 2/18/1973.
- 2/1/1973 M. S. Littman, M.D. (CHR) visited Strong Memorial Hospital to see patient HP-3 and to meet Dr. Waterhouse and discuss details of examinations of patients.
- 2/8/1973 J. Rundo (CHR) visited Strong Memorial Hospital to attempt an in vivo measurement of plutonium on patient HP-3. No plutonium was detected.
- 3/7/1973 A. M. Brues, M.D. (CHR) wrote to a physician in Italy, Texas, about contacting patient Cal-3 for study at Rochester.
- 4/24/1973 A. F. Stehney wrote to M. M. Shanahan at MIT transmitting copies of CHR information on 10 dead cases with instructions to locate relatives for permission to exhume.
- 6/11/1973 Case Cal-3 was at CHR for physical examination and radio-activity measurements (none detected).

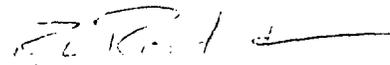
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- 6/13/1973 Case Cal-3 was at Strong Memorial Hospital 6/13/1973 to 6/26/1973.
- 6/21/1973 Case HP-6 was in Strong Memorial Hospital 6/21/1973 to 7/1/1973.
- 9/--/1973 Urine samples from HP-3 and HP-6 were measured and found to contain  $^{239}\text{Pu}$ .
- 9/24/1973 Case HP-4 exhumed and brought to CHR. Bone definitely contains  $^{239}\text{Pu}$ .

In the future we would like to bring case HP-8 into Strong Memorial Hospital for excreta collections. The urinary plutonium content of the three HP cases should then be published with a model showing the urinary elimination as a function of time from injection to some 10,000 days after injection.

We would like to arrange for at least one, and preferably all, of the living cases to will their bodies to the Center for Human Radiobiology. We will continue our efforts to exhume additional cases. Studies of exhumed cases and willed bodies will provide data on the organ contents at long times after acquisition of plutonium. Autoradiography of bone will provide extremely valuable insights as to the rate of burial of surface-deposited plutonium by additional layers of new bone, data much needed to extrapolate the known toxicity of plutonium in dog to man.

For reference, a summary of the injection cases, as known to us today, is attached.



R. E. Rowland  
November 8, 1973

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Table 1. Basic data on transuranyl injection cases (November 8, 1973)

Case No.	Sex	Birth	Injection			Material	Cause	Death		Notes
			Date	μCi				Date	Survival	
Cal-1	M		Gastric carcinoma	5/14/45	5.2	238 Pu (VI) 239 Pu (VI)	Heart disease		20.8 yr.	Gastroectomy and splenectomy. Cremated, loan of ashes under investigation.
Cal-2	M		Osteogenic sarcoma	4/26/46	0.17	239 Pu (VI) Nitrate			8 mo.	Deceased Australia. Do not have death certificate.
3	M		Chondromyxo sarcoma l. leg	7/18/47	0.095	238 Pu (VI) Nitrate			Living	Injected in leg which was amputated 4 days post inj. CHR exam 6/11/73 and Rochester metabolic study 6/13 - 6/26/73. Buried in Austin, Texas. No kin have been found.
Chi-1	M		Buccal epithelioma	4/26/45	0.40	239 Pu (VI) Citrate	Cancer of chin, lungs		160 days	Cremated, ashes may have been scattered.
Chi-II	F		Metastasing carcinoma of breast	12/27/45	5.8	239 Pu (VI) Citrate	Metastatic carcinoma breast		17 days	Cremated, ashes may have been scattered.
Chi-III	M		Hodgkin's disease	12/27/45	~ 5	239 Pu (VI) Citrate			> 160 days	Not identified; "young adult" at injection.
H,-1	M		Duodenal ulcer, gastro-intestinal hemorrhage	10/16/45	0.28	239 Pu (IV) Citrate	Broncho pneumonia		14.2 yr.	Exhumation being sought.
HP-2	M		Hemophilia, hypertension, heart disease	10/23/45	0.31	239 Pu (IV) Citrate	Heart disease		2.5 yr.	Exhumation being sought.
HP-3	F	~	Hepatitis Hypoproteinemia	11/27/45	0.30	239 Pu (IV) Citrate			Living	Recent Rochester metabolism study, 1/28 - 2/18/73.

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Table 1. Basic data on transuranic injection cases (November 8, 1973)

PRIVACY ACT MATERIAL REMOVED

Case No.	Sex	Birth	Injection			Material	Cause	Death		Notes
			Date	$\mu\text{Ci}$				Date	Survival	
HP-4	F		Cushing's Syndrome	11/27/45	0.30	<sup>239</sup> Pu (IV) Citrate	Cushing's Syndrome		2.2 yr.	Exhumed 9/24/73
HP-5	M		Amyotrophic lateral sclerosis	11/30/45	~0.3	<sup>239</sup> Pu (IV) Citrate	Bronchic pneumonia		5 mo.	Exhumation permission refused.
F-5	M		Addison's disease	2/01/46	~0.3	<sup>239</sup> Pu (IV) Citrate			Living	Recent Rochester metabolism study, 6/21 - 7/1/73
HP-7	F		Rheumatic heart disease	2/08/46	0.39	<sup>239</sup> Pu (IV) Citrate	Pulmonary failure		8.6 mo.	Exhumation permission improbable at present.
HP-8	F		Scleroderma and duodenal ulcer	3/09/46	0.40	<sup>239</sup> Pu (IV) Citrate			Living	Refused study at Rochester (Feb., 1973).
HP-9	M		Dermato-mycosis	4/03/46	0.38	<sup>239</sup> Pu (IV) Citrate	Broncho pneumonia		1.3 yr.	Exhumation being sought.
HP-10	M		Rheumatic heart disease	7/16/46	0.38	<sup>239</sup> Pu (IV) Citrate	unknown			No kin have been found.
HP-11	M		Alcoholism, cirrhosis of liver	2/20/46	~0.4	<sup>239</sup> Pu (IV) Citrate	Bronchic pneumonia		6 days	
HP-12	M		Osteochondromatosis	4/10/45	~0.3	<sup>239</sup> Pu (IV) Citrate	Status unknown			Record destroyed by a fire at Oak Ridge hospital.
Cal-A	M		Osteogenic sarcoma	6/10/47	0.25	241 Am			11 mo.	Buried in San Francisco

1) Cal-1, 2, 3 were injected at U. of California at San Francisco hospital.  
 Chi-1, II and almost certainly III were injected at Billings Hospital, Chicago.  
 HP-1 to 11 were injected at Rochester, probably Strong Memorial Hospital (10 of these cases were maintained on the SMH metabolic ward).  
 HP-12 was probably injected at Oak Ridge Hospital, Tennessee.  
 Cal-A was probably injected at UCSF.

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