

UNITED STATES TRANSURANIUM REGISTRY

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ANNUAL REPORT

OCTOBER 1, 1975 TO OCTOBER 1, 1976

TO ERDA DIVISION OF
BIOMEDICAL AND ENVIRONMENTAL RESEARCH

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UNITED STATES TRANSURANIUM REGISTRY
ANNUAL REPORT OCTOBER 1, 1975 TO OCTOBER 1, 1976
TO ERDA DIVISION OF BIOMEDICAL
AND ENVIRONMENTAL RESEARCH

by

B. D. Breitenstein, Jr., M.D.; W. D. Norwood, M.D. and
C. E. Newton, Jr.

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U. S. TRANSURANIUM REGISTRY
ANNUAL REPORT
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SUMMARY

The U. S. Transuranium Registry (USTR) is a center for collecting precise information about the occupational effects of transuranic elements on man. To date 13,943 past and present transuranium workers have been tabulated. Health, mortality, causes of death and transuranic organ depositions are being studied.

Bryce D. Breitenstein, Jr., M.D. was named Director of the Registry in July 1976.

The Los Alamos Scientific Laboratory is directing the epidemiological portion of a plutonium worker health study with George Voelz, M.D. and Louis Hempelmann, M.D. serving as principal investigators. The USTR is affiliated with this study.

USTR statistical data shows progressive acquisition of information for 1975 and 1976.

ERDA contractor and NRC licensee activities at participating sites are discussed.

Preparation of the input format to record and store USTR data has been completed and is ready for trial operation.

USTR educational and informational activities were extensive and varied. Many queries arose from the use of published Registry autopsy data by Ralph Nader's associate Dr. S. Wolfe.

There was continued cooperation with representatives of the British Atomic Energy Authority in their efforts to develop a plutonium registry.

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INTRODUCTION

This report covers activities of the U. S. Transuranium Registry (USTR) for the period October 1, 1975 to October 1, 1976.

PURPOSE AND SCOPE OF REGISTRY

The primary purpose of the Registry is to protect the interests of workers, employers and the public by serving as a national focal point for the acquisition and provision of the latest and most precise information about the effects of the transuranic elements on man. This is being done with the cooperation of participating Energy Research and Development Administration and Nuclear Regulatory Commission contractor and licensee nuclear facilities by (a) Establishing the occupational population at risk. To date, 13,943 U. S. transuranium workers have been so tabulated. (b) Accumulation at nuclear projects, on a continuing basis, of the best current estimates of the amount and location of any internal deposition of any of the transuranium elements in employees and improving these determinations by reconciliation with actual burdens found in various organs at autopsy or by alternate methods. (c) Following such employees clinically, and (d) Participating with epidemiological studies to evaluate the effects of such deposits on health or longevity.

REGISTRY MANAGEMENT

Bryce D. Breitenstein, Jr., M.D. became Director of the Registry July 1, 1976. He will spend half time in this activity. C. E. Newton continues as Associate Director, while W. D. Norwood, M.D. will continue his affiliation with the Registry as a consultant.

The Los Alamos Scientific Laboratory is directing a U. S. plutonium worker health study with George Voelz, M.D. and Louis Hempelmann, M.D. serving as principal investigators. A separate advisory committee assists them in the study design and interpretation of findings.

Battelle Northwest (BNW) works closely with the Registry, especially in the field of biology, so that animal results may be closely correlated with the human studies.

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U. S. TRANSURANIUM REGISTRY STATISTICAL DATA

Table I indicates the number of transuranium workers identified, health physics and medical releases obtained, autopsy permissions obtained, autopsies completed and autopsy reports completed. Table II lists the same data but for the previous year so that comparisons may be made.

It will be noted that 4634 additional transuranium workers were identified at Hanford during this fiscal year. This was due to completion of a study to identify transuranium workers who were employed at Hanford prior to 1958 but who left employment before January 1, 1976. Sixty-three transuranium workers were identified among licensees. Sixty-one of these were Babcock & Wilcox workers. Oak Ridge identified 13 workers as having an estimated Pu deposition of a few percent and have been asked to identify transuranium workers in accordance with the Registry definition. If this is accomplished, it will greatly increase the number of identified workers at risk.

Eleven authorities for autopsy were obtained, five by Rocky Flats, one by Hanford and five by licensees. This brings the total to 851.

Ten autopsies were done, bringing the total to 65, while three autopsy reports were completed for a total of 44. (See Appendix G)

CONTRACTOR AND LICENSEE ACTIVITIES

Hanford

Epidemiology - The USTR is interested in evaluating the available data on Hanford plutonium workers as a continuation of the study of Hanford plutonium workers with depositions presented at the workshop on the Biological Effects and Toxicity of ^{239}Pu and ^{226}Ra in Sun Valley, Idaho, October 6-9, 1975. A protocol is in preparation and will be discussed with ERDA Division of Biological and Environmental Research (DBER) as a USTR project or one which the USTR may give assistance to at Hanford Environmental Health Foundation.

Autopsies - With 62% of the authorizations for autopsies at Hanford, it was not surprising that seven of the last ten autopsies were obtained at Hanford.

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1976

TABLE I

	Transuranium Workers Identified			Health Physics and Medical Releases			Authority for Autopsy			Autopsies Obtained			Autopsy Reports Complete		
	Mo. Sep	CY to Date	Total to Date	Mo. Sep	CY to Date	Total to Date	Mo. Sep	CY to Date	Total to Date	Mo. Sep	CY to Date	Total to Date	Mo. Sep	CY to Date	Total to Date
Contractors	4634	4648	6966	0	12	2146	0	1	525	2	7	22	0	2	10
Hanford	19	141	1913	19	139	1750	0	5	177	0	2	36	0	0	30
Rocky Flats	0	0	3024	0	0	257	0	0	127	0	0	4	0	1	2
Los Alamos	9	9	1576	0	0	0	0	0	0	0	0	0	0	0	0
Savannah River	0	0	333	0	0	8	0	0	9	0	0	1	0	0	1
Mound	13	13	14	0	0	0	0	0	0	0	0	1	0	0	1
Oak Ridge	4675	4811	13,826	19	151	4161	0	6	838	2	9	64	0	3	44
Subtotal															
Licensees															
Richland Energy Lab	0	0	13	0	0	9	0	1	2	0	1	1	0	0	0
Exxon Nuclear	0	1	42	0	1	32	0	1	8	0	0	0	0	0	0
Babcock & Wilcox	0	61	61	0	61	61	0	2	2	0	0	0	0	0	0
Nuclear Fuel Services, Inc.	0	1	1	0	1	1	0	1	1	0	0	0	0	0	0
Total	4675	4874	13,943	19	214	4264	0	11	851	2	10	65	0	3	44

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U. S. TRANSURANIUM REGISTRY
1975

	Transuranium Workers Identified			Health Physics and Medical Releases			Authority for Autopsy			Autopsies Obtained			Autopsy Reports Complete		
	Mo. Sep.	CY to Date	Total to Date	Mo. Sep.	CY to Date	Total to Date	Mo. Sep.	CY to Date	Total to Date	Mo. Sep.	CY to Date	Total to Date	Mo. Sep.	CY to Date	Total to Date
Contractors	2	37	2367	2	37	2174	0	8	533	0	0	14	0	0	8
Hanford	0	40	1772	0	40	1611	0	6	173	1	4	34	0	0	28
Rocky Flats	0	2765	3024	0	0	257	0	0	127	0	2	3	0	0	0
Los Alamos	0	8	1567	0	0	0	0	0	0	0	0	0	0	0	0
Savannah River	0	0	333	3	4	8	3	4	9	0	0	1	0	0	1
Hound	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Oak Ridge	2	2850	9063	5	81	4050	3	18	842	1	6	53	0	0	38
Total															

TABLE II

Rocky Flats

USTR contacts have been close with Rocky Flats throughout the year. One hundred forty-one additional transuranium workers were identified during the year. Dr. Breitenstein visited this installation for discussions. Rocky Flats has obtained nearly half (36) of the total number of autopsies to date.

Los Alamos

Los Alamos Scientific Laboratory (LASL), which is affiliated with the Registry as the designated facility to make the study of health and mortality of U. S. plutonium workers, has worked closely with the Registry. No new transuranium workers were identified during the year. In the past, 127 have authorized autopsy and four autopsies have been obtained. Current discussions with the LASL medical staff suggest that a greater degree of participation is likely in the near future. A number of autopsies were done before Los Alamos began participation in the Registry. It is expected that these will be added to the Registry.

Savannah River

While Savannah River has identified a large number of transuranium workers (1576) they are just beginning to request autopsy authorizations and medical and health physics releases of information. Dr. George Poda has been very helpful in assisting the USTR program at Savannah River.

Mound Laboratory

No additional transuranium workers were identified at Mound and there was no increase in degree of participation. USTR personnel plan a visit to Mound Laboratory early in 1977.

Oak Ridge National Laboratory

Oak Ridge identified 13 transuranium workers who have estimated depositions greater than a small percent of the maximum permissible. In the coming year it is hoped that they will identify all transuranium workers now working at Oak Ridge National Laboratory or who have terminated such work at Oak Ridge and who meet the definition of a transuranium worker.

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Argonne National Laboratory

Argonne has been asked to identify past and present transuranium workers, including workers at the old Metallurgical Laboratories. Increased USTR communication with the Argonne National Laboratory is planned.

Licensees

Following visits to Babcock & Wilcox and Nuclear Fuel Services, Inc. and culminating several years of visitation and discussions, these companies agreed to participate in the Registry program if Registry representatives would explain the program to their employees and solicit their individual participation. This was done and resulted in three authorizations for autopsies and identification of 62 transuranium workers.

Kerr-McGee agreed to participate when and if they reopen their plant. Exxon Hanford and Richland Energy Laboratory have been participating. This makes a total of 5 licensees who are cooperating with the Registry.

REGISTRY DATA COLLECTION AND PROCESSING

Preparation of the input format to record and store USTR data has been completed and is ready for trial operation.

Identified Transuranium Workers - As indicated previously, intensified study resulted in the identification of an additional 4,634 transuranium workers at Hanford. The total number identified as transuranium workers at Hanford (6966) is about half of the total identified at all sites.

EDUCATIONAL AND INFORMATIONAL ACTIVITIES

1. Wolfe Analysis of Registry Data

Many queries resulted from Dr. Sidney Wolfe's unpublished comments* that an article in Health Physics by W. D. Norwood and C. E. Newton, Jr., October 4, 1974, showed a higher incidence of cancer in the first 30 Registry autopsies than expected, when compared to U. S. population statistics. This, he states, indicates a need to decrease the established permissible body deposition by a large factor. The comments received

* Dr. Wolfe has submitted his material to the British Journal Lancet.

wide publicity in several media such as the New York Times, June 5, 1976; the American Medical News, June 14, 1976 (Appendix A); the Bulletin of the Atomic Scientists, September 1976; the Denver Post, June 20, 1976. Dr. Norwood sent letters to the editors of the American Medical News and the Bulletin of the Atomic Scientists stating that Dr. Wolfe's conclusions were unjustified. These letters, as published, are shown in Appendixes B and C. The Registry received many phone and written inquiries and supplied copies of our published rebuttal (Appendix B) and additional material, including published reports which show that autopsies detect one-third more cancers than are diagnosed before death. (Journal of the American Medical Association, September 25, 1972, Vol. 221, No. 13).

Specific discussions were as follows:

- (1) Conversation with Robert L. Fleisher of General Electric resulted in an article refuting the Wolfe conclusions (Appendix D).
- (2) Discussion with Mr. David Burnam of the New York Times.
- (3) Discussion with Fred Gillies of the Denver Post.
- (4) Talk by Dr. Breitenstein to Hanford Environmental Council.
- (5) Local television interview of Dr. Norwood was given in the Tri-Cities.
- (6) Dr. C. Lushbaugh, Oak Ridge Associated Universities was supplied with information.
- (7) Mr. Sherlington of the Australian Embassy, Washington, D. C., asked if conclusions drawn by Dr. Wolfe were not a distortion due to small numbers involved and bias due to methods of selection of autopsy cases. The Registry confirmed this.
- (8) Dr. A. C. Upton, Professor of Pathology, State University of New York, Stony Brook, N. Y., who is involved in evaluation of Pu risks, asked for clarification of the New York Times article re Dr. Wolfe's analysis of the Norwood, Newton Health Physics article.
- (9) G. Klingsberg, EPA (New York Office), Dan Kane, Council on Energy Independence, Chicago, a Westinghouse manager in atomic work and Bruce Hutchins, General Electric San Jose plant called

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re the New York Times article and were given information.

- (10) Discussion with Dr. W. W. H. Weyzen of DBER, re rebuttal of Dr. Wolfe's analysis.
 - (11) A copy of Dr. S. Marks' commentary (Appendix E) on Dr. Wolfe's allegations was furnished Dr. J. P. Sokal of Westinghouse Electric Corporation Advanced Reactor Division at his request.
 - (12) Mr. Robert Livingston of the Atomic Industrial Forum called and discussed Dr. Wolfe's comments with Dr. Norwood and Mr. Newton.
 - (13) A copy of comments to the Editor of the American Medical News was sent to Mr. O. J. Gorman, a health physicist at Ontario Hydro, Ontario, Canada.
2. People Concerned with Proposed State Nuclear Safeguard Initiatives:
- (1) Dr. Forrest Rieke and son John of Portland, Oregon discussed the atomic health and safety programs at Hanford.
 - (2) Messrs. L. Wallace and E. Kurtz of General Electric Vallecitos Nuclear Center were sent copies of annual report and paper "Health of Hanford Plutonium Workers."
 - (3) In answer to an inquiry, Bruce Hutchins of General Electric was advised by the USTR that we could find no statistical difference in suicide rate among Hanford radiation workers and those in other industry.
 - (4) Information to Mark Arndt, on request, for debate on Nuclear Safeguard Initiative in State of Washington.
 - (5) Dr. Norwood led discussion of toxicity of plutonium in local church whose national stand was unfavorable to atomic power production. He also answered questions re plutonium from Margaret Maxie representing the national division of this church.
 - (6) Queries were answered from a Massachusetts Land Use Committee re Pu toxicity.
 - (7) Dr. Norwood answered queries of Dr. John Wiley, San Jose, General Electric atomic project re Pu deposition in gonads.

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- (8) Dr. Norwood discussed Registry activities with Charles Wells, editor of national church bulletin "Between the Lines."
- (9) L. Wallace and E. Kurtz, General Electric, Vallecitos, were given advice re malignant tumor in Pu employee who has no evidence of Pu in body.
- (10) Ms. Suzanne Rhodes, School of Public Health, Johns Hopkins Medical School, requested information on Registry activities and was sent the last summary report and a copy of "Health of Hanford Pu Workers."
- (11) Ms. Libby Bianchi, writing an article covering hazards of Pu for use in nuclear reactors for publication in a New York newspaper, asked questions about the Registry and was sent a copy of "Health of Hanford Pu Workers."
- (12) The USTR was asked by the Director of the "Washington Citizens Committee Against the Ban on Nuclear Power" to give some data in lay terms to indicate effect on Hanford employees of Pu and other radiation exposure. The Registry assisted in a coordinated response with the local ERDA office and Battelle Northwest.
- (13) Professor Merril Eisenbud, Department of Environmental Health, New York University Medical Center, requested general information about the Registry. The last annual report to ERDA was sent to him.

3. Annual Letter

The annual newsletter (Appendix F) was sent to the more than 800 workers authorizing autopsy. Many favorable replies were received and one registrant offered to will his body.

4. Communications - Government Agencies

- (1) Annual report for July 1, 1974 to October 1, 1975 sent to ERDA and to the USTR mailing list.
- (2) At his request, information re Pu toxicity given to R. F. Nowakowski, who is preparing a bulletin on this subject for lay readers at the request of ERDA.

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- (3) Dr. A. Brodsky was given approval to use paper "Health of Hanford Plutonium Workers" in opposing Dr. Gofman's suggested revision of Pu allowable deposition in lungs.
- (4) The General Manager and other members of ERDA, Richland office were kept continuously advised of Registry activity of interest to them.
- (5) At request of Sidney Marks, M.D., DBER, information re Registry activities was sent to Mr. William Ellett of the U. S. Environmental Protection Agency (EPA), Radiation Standards Division and to Dr. Helen Caldicott of the Children's Hospital Medical Center in Boston.
- (6) At the request of Dr. Dave Bruner of ERDA, five copies of the Registry last annual report to DBER were sent for relay to English nuclear industry authorities.
- (7) Upon request, two copies of the latest USTR annual report were sent to R. E. Alexander, U. S. Nuclear Regulatory Commission, Office of Standards.
- (8) Susan Higgins of GAO Washington requested information about the USTR to give to U. S. legislators. Numerous questions were asked and answered.
- (9) Information on the composition of the Registry Advisory Committee was supplied to Bert Crist of Rocky Flats ERDA office for the Monitoring Committee for the Governor of Colorado.
- (10) At his request, Dr. W. W. H. Weyzen, ERDA, Washington was supplied with data on the Registry's ability to identify Pu deposition cases at all participating sites and additional detail on USTR autopsy cases.
- (11) In response to a request from Dr. Stewart Rae, Assistant Medical Director of the National Radiological Protection Board, Oxfordshire, England, the Registry agreed to pool data and compare results on autopsy cases. Information on U.K. cases was included in a summary of autopsy data furnished Dr. W. W. H. Weyzen, ERDA, Washington.

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5. Newspaper Error Corrected

A local Washington state newspaper quoted authoritative sources as saying that anyone who ever has Pu in the bloodstream was sure to have malignant disease. The Registry advised the paper that this was an error and the paper retracted the statement and indicated Registry findings.

6. Visitors to U. S. Transuranium Registry

- (1) Mr. Peter Smith, epidemiologist, Oxford University, England, visited HEHF to discuss the Registry and Health and Mortality studies in preparation for similar studies to be made in the British nuclear energy program. He is a consultant to Dr. Geoffrey Schofield, Medical Director of the Windscale plant. He made suggestions regarding controls for the Hanford study of present health, mortality and cause of death of Pu workers.
- (2) Mr. A. Lobel from Oak Ridge National Laboratory visited with Drs. Breitenstein and Norwood and Mrs. Kirklin. He is providing service to Dr. Lushbaugh, Director of the Oak Ridge Associated Universities, in relation to the ERDA Health and Mortality Study.
- (3) Dr. Forrest Rieke and son of Portland, Oregon, visited with Dr. Norwood, RL-ERDA and Battelle scientists for a briefing on health and safety programs at Hanford.
- (4) Drs. George Voelz and Louis Hempelmann and Mr. Donald York met with HEHF and Registry representatives to discuss ways and means for the Registry to cooperate with the Los Alamos Scientific Laboratory in the epidemiological study of health and causes of death of Pu workers.
- (5) Dr. Donovan Thompson, professor of Biostatistics, University of Washington, a special consultant to the Registry, spent the day being briefed by Registry workers on the Hanford data base and proposed Pu worker epidemiological study. He made several helpful suggestions for improvement of the protocol.
- (6) Dr. Osamu Matsuoka, Division of Radiation Hazards, National Institute of Radiological Sciences, Chiba, Japan, who is interested in the possibility of a registry in Japan, visited the

Registry and HEHF during his attendance at the 16th Annual Hanford Biology Symposium on "Pulmonary Macrophage and Epithelial Cells."

7. Visits to Plants and Scientific Meetings Attended

(1) Meetings attended by Dr. Bryce D. Breitenstein, Jr.

February 4 - 13, 1976 - Denver, Colorado

ERDA Health Protection Meeting;
DTPA Symposium;
Health Physics Society 9th Midyear Topical Symposium;
Meeting of ERDA major contractor health physicists to standardize health physics input to Pu worker health study.

March 24 - 31, 1976

Pinellas, Florida - ERDA Contractor Occupational Medicine Meeting;
Visit to Savannah River Plant to review USTR activities;
ERDA Headquarters, Germantown, Maryland, Advisory Committee Meeting of U. S. Plutonium Worker Epidemiology Study.

September 27 - 29, 1976

Sixteenth Annual Hanford Biology Symposium "Pulmonary Macrophage and Epithelial Cells," sponsored by BNW and ERDA.

(2) Dr. W. D. Norwood

September 27 - 29, 1976

16th Annual Hanford Biology Symposium on Pulmonary Macrophage and Epithelial Cells.

(3) Dr. W. D. Norwood and Mr. C. E. Newton

May 25, 1976

Nuclear Fuel Services, Erwin, Tennessee.

May 26, 1976

Babcock & Wilcox, Nuclear Materials Division, Apollo, Pennsylvania.

(4) Mr. C. E. Newton

February 11 - 13, 1976

Meeting in Denver, Colorado with members of Registry Health Physics Committee, observers and ERDA representatives.

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AMERICAN MEDICAL NEWS
June 14, 1976

Cancer death rate among plutonium workers was almost twice as high as the cancer death rate for all white males, according to recent study reported by Ralph Nader's Health Research Group. The study of government statistics showed that virtually all of the men who died had been exposed to doses of plutonium below the levels established as safe by federal regulations.

AMERICAN MEDICAL NEWS, July 19, 1976

Cancer death data clarified

Your June 14, 1976, article concerning an increased cancer death rate among plutonium workers is based on an analysis of data collected in the U.S. Transuranium Registry. The analysis by Ralph Nader's Health Research Group was made without consulting personnel of our registry with respect to the suitability of our data for the type of statistics that they developed.

As a matter of fact, the data were not suitable. Mortality rates for cancer or other diseases are valid only if they are based on an unbiased sample. The Transuranium Registry, which collects information concerning the distribution of plutonium in tissues and, thereby, checks the validity of *in vivo* estimates of plutonium deposition in workers, makes no pretense to obtaining those cases in an unbiased manner. On the contrary, we know that both investigators and families of workers have been more diligent in obtaining autopsies for cancer cases than for cases of less interest or concern. For that reason, the Health Research Group's comparison of this biased autopsy series with relatively unbiased nationwide mortality rates is unjustified and is likely to lead to erroneous conclusions.

W. D. NORWOOD, MD
U.S. Transuranium Registry
Richland, Wash.

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March 1976). Yet, he and others fail to evince any definitive knowledge of the very system they endeavor to salvage—the price system. A price system is any social system that effects its distribution of goods and services by means of trade based on commodity evaluation and employs any form of debt token or money. All social systems on the globe today are price systems; they buy and sell, accounting transactions in dollars, pounds, francs, yen, rubles or marks.

In a price system, wealth derives solely from the creation of debt. In other words, wealth consists of stocks, bonds, etc., debt claims against the operation of the physical equipment and its resultant. Exhaustion of resources translates into erosion of our industrial base. When the requisite resources are no longer available to sustain that operation, the whole financial house of cards collapses and with it the price system. This basic knowledge is omitted from Benoit's assumptions.

J. Cozzy Graham
St. Clair Shores, Mich.

Clear but Perturbing

The September issue article by Dr. Robert Jay Lifton on "Nuclear Energy and the Wisdom of the Body" is a clear exposition of the psychiatry behind most objections to nuclear power. Unfortunately, the artwork you have chosen to accompany Lifton's article (a "mushroom" cloud over the profile of a power station) is an altogether too frequently held misperception that a journal of your eminence should not promulgate further. It is, nevertheless, an apt expression of the visceral tenets that probably constitute "the wisdom of the body." Lifton's case is not denied by the fact that this body of wisdom is comprised of perceptions rather than realities but it is important to keep this distinction in mind.

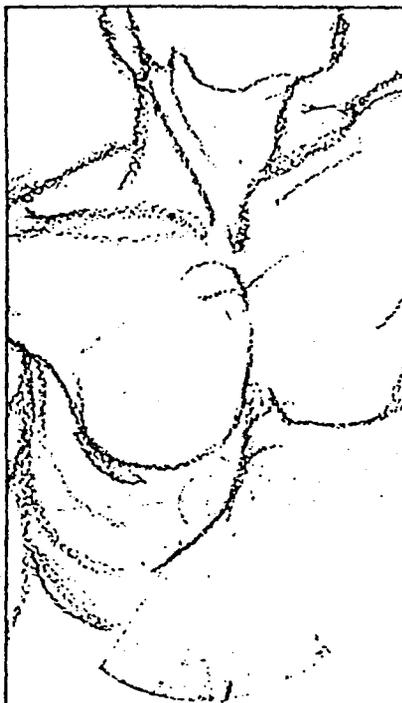
Despite my belief that there is no viable alternative to nuclear energy in the near term (less than 25 years), I find the *Bulletin* to be consistently interesting and educational reading. However, I must admit to a bit of annoyance at having my morality repeatedly impugned by reference to the "enlightened" resignations of four engineers. Lifton at least relegates this to a footnote but my perturbation persists. The thousands of similarly qualified technologists who remain in favor of nuclear power are not aberrant amoralists.

Thomas A. McNary
Minerva, Ohio

Plutonium Toxicity Data Misinterpreted

The item in the article by John T. Edsall in the September 1976 issue of the *Bulletin* concerning an increased cancer death rate among plutonium workers was based on data collected in the U.S. Transuranium Registry. (See W. D. Norwood, M.D., and C. E. Newton, Jr., "U.S. Transuranium Registry Study of Thirty Autopsies," *Health Physics*, 28 (June 1975), 669-675.)

The analysis by S. M. Wolfe of Ralph Nader's Health Research Group was made without consulting with Registry



personnel to determine the suitability of our data for the type of statistics which they developed. Actually the data was not suitable. Mortality rates for malignant disease or other diseases are valid only if they are based on an unbiased sample. The Transuranium Registry determines the deposition of plutonium in tissues at autopsy and thereby checks the accuracy of estimates of plutonium deposition in workers made before death.

The Registry makes no pretense to obtaining these cases in an unbiased manner. On the contrary, we know that both investigators and families of workers have been more diligent in obtaining autopsies for cases of malignancy than for those of less interest or concern. For that reason, the Wolfe comparison of this small biased autopsy series, with

relatively unbiased nationwide mortality rates, is unjustified and is likely to lead to very erroneous conclusions.

To provide suitable data for the calculation of disease incidence and mortality rates, the U.S. Energy Research and Development Administration (ERDA) recently started a large-scale epidemiological study of past and present plutonium workers in the five ERDA facilities where meaningful exposures have occurred. The study, which is coordinated by the Los Alamos Scientific Laboratory, will provide incidence rates for major diseases among living workers and mortality rates for the deceased. The investigation will be a suitable source of data for the calculation of incidence and mortality rates.

W. D. Norwood, M.D.
U.S. Transuranium Registry
Richland, Wash.

The author replies: In view of Dr. Norwood's letter, and of similar information from Dr. Sidney Marks, associate manager of the Environmental and Safety Research Program at Battelle's Pacific Northwest Laboratories in Richland, Wash., I agree that the 30 autopsies at the U.S. Transuranium Registry provide no significant evidence concerning the toxicity of plutonium in man in view of the biased character of the sample. The epidemiological study described by Dr. Norwood is obviously of great importance, and is to be welcomed.

Exaggerated Danger

Dr. Edsall speaks with foreboding of the 25,000 year half-life of plutonium-239; but my study (to be published in *Health Physics*) shows that most of the harm done by plutonium dispersal is done in the first few minutes by the dust cloud; second to this is the next few months when it is easily resuspended by winds; and the remaining harm, integrated over the tens of thousands of years it spends in the soil, is a poor third. Plutonium in the soil is an order of magnitude less dangerous than radium per curie according to anybody's calculation; and there is more radium in each foot of depth of the earth's crust than there would be plutonium-239 in existence if all the world's power were derived from fast breeder reactors (only a tiny fraction of this plutonium would escape).

I don't understand why Dr. Edsall refers to my calculations as tentative. They are simple and straightforward; and I have sent over a thousand copies

(continued on page 8)

of my paper to plutonium experts, nuclear critics, and anyone who has requested it. The paper has passed Nuclear Regulatory Commission reviews and journal refereeing (in contrast to the papers by Tamplin Cochran, and Golman which Dr. Edsall treats so much more kindly). Through all of this there has been no criticism that would substantially alter the conclusions in my paper, other than suggestions by critics that I use the hot particle or Golman theories.

Bernard L. Cohen

University of Pittsburgh
Pittsburgh, Pa.

Meaningless Comparison

The conclusion drawn by Edsall is not supported by the evidence he presents. His conclusion is that the use of plutonium in power reactors will involve an unacceptably high health risk. The article includes a credible review of the laboratory data on the toxicity of plutonium, but Dr. Edsall fails to carry through with a meaningful estimate of the actual risks that would be involved.

The basis of his conclusion is a comparison of the risks associated with the "maximum permissible lung burden" for plutonium workers (MPLB) and a general statement on food additives issued by a Food and Drug Administration panel. In the 30-year history of the nuclear weapons industry, the maximum permissible lung burden has been exceeded by less than 100 workers, all resulting from industrial accidents. The vast majority of the more than 10,000 plutonium workers have lung burdens that are not measurable and orders of magnitude less than a maximum permissible lung burden. In the power industry, exposures during normal operation will be even less because of improved procedures and the necessity for remote operation. Thus, Dr. Edsall has compared a guideline that applies to industrial accidents, which are exceptional and rare occurrences, with a guideline for a food additive, which involves a common and continuous occurrence. The comparison is logically meaningless!

A meaningful risk estimate could have been made by Dr. Edsall by considering the amounts of plutonium to be processed, the fraction that would be released, and the uptake by humans. The most thorough analysis of this type was performed for the environmental statement for the liquid metal fast breeder reactor (LMFBR) program.¹ The result was only 0.0004 estimated lung-cancer deaths from plutonium and other actinides for each year of operation of one, 1,000-megawatt (electrical) liquid metal fast

breeder reactor, and its supporting fuel cycle facilities.

It is easy to determine how this result would change if Dr. Edsall's toxicity estimates had been used. His maximum permissible lung burden risk estimate was based on the results of Bair and Thomas.² The toxicity values used in the analysis of the liquid metal fast breeder reactor, as well as those of Bair and Thomas, are as follows:

Plutonium Toxicity in Human Lungs

	(Cancer Deaths 10 ⁶ Person-Rads)
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LMFBR Environmental Report	1,000
Bair and Thomas	180

It is seen that the toxicity value used to estimate risks for the liquid metal fast breeder reactor is actually 6 times greater than the value Dr. Edsall chose from the data evaluations. Use of Dr. Edsall's value would reduce the estimated lung-cancer death-rate to less than 0.0001 per reactor-year. By comparison, it is estimated that up to 100 deaths per year result from air pollution caused by one, 1,000-megawatt (electrical) coal plant operating with sulfur dioxide scrubbers.³

The liquid metal fast breeder reactor analysis was purposely designed to provide an over-estimate of the cancer rate from plutonium. Even if it were too low by a factor of 1,000, plutonium usage in a large number of power reactors would not pose a serious cancer threat to the nation or the world.

Bruce A. Hutchins

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Notes

1. Final Environmental Statement—Liquid Metal Fast Breeder Reactor Program. U.S. Energy Research and Development Administration (ERDA-1535), Dec. 1975.

2. W. J. Bair, I. M. Thomas, "Prediction of the Health Effects of Inhaled Transuranium Elements from Experimental Animal Data." IAEA Symposium on Transuranium Nuclides in Environment, San Francisco, Calif., Nov. 17-21, 1975.

3. L. D. Hamilton, S. C. Morris, "Health Effects of Fossil Fuel Power Plants," Proceedings of 8th Midyear Topical Symposium of Health Physics Society, Knoxville, Tenn., Oct. 21-24, 1974. CONF-741018.

The author replies: I question Cohen's view that the hazards of plutonium are small compared to those of radium. Certainly there is a great deal of radium in minerals underground, and if it stays there it is only a minor risk. But plutonium will be above ground, several tons of it in each large breeder reactor. It will be transported for installation and for re-processing. At every stage there will be risks of failure of containment, from human error and human malice. The amount of plutonium in low-level wastes, exposed in open trenches as at

Maxey Flats, Ky., is actually greater than in the high-level wastes that are supposed to be strictly contained.¹ All this constitutes a very different problem from that of the radium that is imbedded naturally in the soil.

As to the risks from exposure to plutonium and other toxic substances, one must distinguish two questions: (1) What is the probability of harm to an individual receiving a "maximum permissible dose"? (2) How many individuals will in fact receive such a dose (or more)?

My discussion was directed to the first question, which is difficult enough. The answer to the second question depends, not only on the future scope of the nuclear fission program, but on the extent of human carelessness, incompetence, and (for a few individuals) downright malevolence. The environmental statement for the liquid metal fast breeder reactor program inevitably ignores or minimizes such factors, which are indeed impossible to quantify. I take a much darker view of the weaknesses of human nature than Hutchins or Cohen, and consider these factors terribly important.

I think it is relevant to compare the risks from plutonium and those from food additives. The consideration of what constitutes acceptable risk has been compartmentalized among different agencies. We should take a broader look at the whole situation; the book, "Of Acceptable Risk: Science and Determination of Safety," by W. W. Lowrance, is a first attempt to do this. In my judgment we have been far too tolerant of the hazards of toxic substances in industry generally.

My personal conclusions, on avoiding a plutonium economy, of course do not follow as a logical consequence of the facts presented. They are based on my judgment from a much wider range of evidence, as I briefly indicated. I acknowledge, of course, that the mining and burning of coal can do great damage; it was not my job to discuss this in an article on plutonium. Very large-scale increases in energy consumption, in practically any form, are bound to raise serious pollution problems. I would stress the primary role of a much more drastic program of energy conservation than anything attempted up to now;² it can be achieved without sacrifice of living standards or economic productivity, and with enhancement of the quality of life.

Notes

1. F. H. Pigford and K. D. Ang, "The Plutonium Fuel Cycles," *Health Physics*, 29 (1975), 451-468.

2. Denis Hayes, "Energy: The Case for Conservation," *Worldwatch Paper 4* (Washington, D.C.: Worldwatch Institute, 1976).

1009925

THE NEW YORK TIMES, July 1, 1976

Plutonium Peril: 'Wrong Conclusions'

To the Editor:

A June 6 news story headline implied that plutonium has caused cancer in men who had previously worked with that substance. However, the reasoning quoted in the story was invalid, and the conclusions therefore were wrong.

The Times article presented excerpts from an unpublished study by a Dr. Sidney M. Wolfe, a member of a group established by Ralph Nader to examine public health questions. The study was a commentary on autopsy data published last June in *Health Physics*, giving the cause of death of thirty former plutonium workers, a limited number of cases but all that we know of in this country.

Both of the major statements attributed to Dr. Wolfe showed failures in logic. The death rate from one type of cancer, leukemia, was "nine times" higher than the national average, he said. The original article shows that statement to be based on only two cases. I quoted that reasoning, without commentary, to my two teen-age daughters, who promptly and appropriately dissolved in laughter. Clearly, when considering a total of only eleven cases of cancer, some types will be more abundant than average, even if only one or two cases occur. Others will be totally absent. By reasoning similar to Wolfe's it could be said that working with plutonium led to a total absence of cancers of the rectum, prostate, pancreas, and esophagus. This commentary

would be as misleading as was Wolfe's original statement.

Wolfe stated that the total death rate (based on eleven cases) was almost "double" the national average for white males; but the men studied were not average. Thirteen cancers would be expected if one allows for the high incidence for middle-aged men and the extra, otherwise unrecognized cases that are discovered by autopsy (as noted by Dr. W. D. Norwood, who presented the original data). The proper conclusion again is not that working near plutonium diminishes cancer but that there is no evidence that plutonium has caused cancer deaths in man.

The reason for this letter is not to minimize the hazards of plutonium and similar elements. These are potential dangers that require extremely careful control.

However, of the thirty cases studied by Norwood and C. E. Newton Jr. three contained plutonium in excess of the maximum body burden generally regarded by health physicists as permissible; thirteen were above 1 percent and 27 above 0.1 percent of that value. None of these groups showed a statistically significant excess of cancer. These data cast considerable doubt on the view that the permissible burdens have been set too leniently by a large factor. They imply that with proper precautions plutonium can be used safely.

ROBERT L. FLEISCHER
Schenectady, June 11, 1976

COMMENTS REGARDING CANCER INCIDENCE IN PLUTONIUM WORKERS

In an article in the New York Times on June 6, 1976, David Burnham stated that the "death rate from cancer found among a small group of plutonium workers was almost twice as high as the cancer death rate of all white males, according to a study of government statistics." The study of the government's data referred to in the article was conducted by Dr. Sidney M. Wolfe of the Health Research Group, which "was established by Ralph Nader, the consumer advocate, to undertake research on the government's handling of public health problems."

Dr. Wolfe based his conclusions regarding increased cancer mortality in workers exposed to plutonium on 30 cases included in the U. S. Transuranium Registry. A report of the 30 cases, which listed the causes of death, was published in June 1975. However, the Registry was not designed to be a suitable source of data for analyzing the incidence of particular diseases. Analyses relative to incidence or mortality from individual diseases are valid only if carried out on unbiased samples. In the accumulation of material for Registry, no attempt was made to avoid biases in the selection of cases. For that reason, any conclusions about the percentage of cases of a disease or category of diseases in a series of cases recorded in the Transuranium Registry is likely to be misleading.

A primary objective of the Registry is to obtain data on the distribution of plutonium and other transuranic elements in the various tissues of the body after occupational exposure. This may provide a means of establishing routes of movement of the isotopes within the body from the site of initial deposition to those organs where the elements may be present at death. The Registry has also provided valuable information on which to base comparisons of plutonium amounts estimated to be present in a person's body during his lifetime with the quantity calculated to be present after death, based on analysis of organs and tissues. This activity, which checks the accuracy of in vivo estimates of body burdens, has demonstrated that the in vivo estimates are conservative in most cases by a factor of three to five. These have been the principal activities in the Registry program to date.

Certain biases have been inherent in the selection of cases that appeared in the Registry report. At least two-thirds of the 30 cases were not included in the Registry prior to death but were considered of sufficient interest later to be incorporated into the Registry and to have the appropriate analyses performed on the organs. For the most part, those were cases in which an individual with an illness was under hospital treatment, so that the Registry contact was made aware of the death in time to arrange for the collection of appropriate specimens.

Cancer was prominent among the diseases encountered in this class of persons. In certain cases, either the investigators or family or both may have sought to have a cancer patient included in the Registry because of interest in the possible relationship of radiation exposure to cancer. Such biases are common in autopsy series but are so highly variable in different hospitals or sets of individuals that no truly representative statistics with respect to cancer incidence in autopsy series are available to be used as a basis for comparison with the exposed group.

For the above reasons, an epidemiologic study of the incidence of various diseases was started recently on a large group of individuals exposed occupationally to plutonium. This study is coordinated by the Los Alamos Scientific Laboratory and will involve the follow-up of several thousand individuals, including both exposed persons and unexposed controls from five major plants where plutonium has been handled in significant amounts. These are the Hanford, Los Alamos, Mound Laboratories, Rocky Flats, and Savannah River facilities. The cause of death will be sought for all individuals who have died at the time of analysis, thereby eliminating the selection bias. This process will then be repeated at intervals in the future. Data on the incidence of disease in the living population will also be acquired and analyzed. This study will not only provide substantial numbers of cases as a basis for more reliable statistics than are now available, but, by obtaining the cause of death from death certificates, will avoid the bias introduced in autopsy series. The purpose of this study is to provide meaningful results concerning the incidence of diseases, including cancer, in plutonium workers. This contrasts with the objectives of the Transuranium Registry, which are to study the distribution and concentration of plutonium and other transuranic elements in tissues of the body after death.

Comments prepared by Sidney Marks, M.D.
at the request of ERDA Division of
Biomedical and Environmental Research
June 11, 1976

1009928



UNITED STATES TRANSURANIUM REGISTRY

March 15, 1976

ANNUAL LETTER TO EMPLOYEES REGISTERED FOR AUTOPSY

Each year the U. S. Transuranium Registry will be sending you a letter similar to this one to serve several purposes. One such purpose is to update our records on the current location of our participants. If you have moved or would like to ask any question about any phase of the Registry program, we would appreciate it if you will complete and mail us the enclosed change of address card. Also enclosed is another Registry card which should be signed and carried with you if you have misplaced or damaged your original one.

To keep you informed as to the Registry activities (another purpose of this letter) we want you to know we have just completed a study of the health, occurrence of cancer and other serious disease, and causes of death of some 450 plutonium deposition cases occurring at Hanford from 1944 to 1975. The personnel, who averaged about 20 years of either potential or actual deposition, were divided into two groups. One group had small depositions estimated as less than 5% and the other group had depositions estimated as more than 5% of the maximum permissible body burden of plutonium (40 nanocuries). The result was that no significant differences could be found between the two groups.

Such studies are continuing and expanding as the use of plutonium also expands and the increase in the number of participants in the Registry continues. It is your continued participation and cooperation in the Registry that makes our program possible and therefore will make it possible for us to more fully understand and learn as much as possible about the entry, distribution and the very long-time effects of plutonium in the human body. The Registry appreciates your participation in this vital program.

Sincerely yours,

W. D. Norwood, M.D.
W. D. Norwood, M.D.
Acting Director

P. O. BOX 100 RICHLAND, WASHINGTON 99352

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Operated for the U. S. Atomic Energy Commission by the Hanford Environmental Health Foundation

USTR AUTOPSY CASES

The Registry has a total of 79 autopsy cases, fourteen of which were received from the United Kingdom. Of the 65 U. S. autopsies, radioanalyses of tissue samples have been completed for 44. The most recent results are being analyzed and consolidated for subsequent reporting. There are very few health physics in vivo chest results in the Registry records and those that exist tend to underestimate the deposition found at autopsy. A number of the lung and lymph node autopsy samples from occupationally exposed personnel for whom health physics systemic and/or chest burdens were estimated as negative were found to contain plutonium in amounts greater than have been reported for autopsy samples from those nonoccupationally exposed (presumably from fallout). The highest concentrations continue to be mostly in the lymph nodes, lungs and liver while the lowest concentrations continue to be mostly found in the kidneys, muscle and heart. Seldom is the highest concentration found in the bone. It has been noted that the health physics systemic deposition estimates made during the occupational exposure periods continue to exceed those extrapolated from tissue analysis.

The fourteen autopsy cases received by the Registry from the United Kingdom have been reviewed and added to the Registry files. Tissue samples from various organs were analyzed by them for plutonium. Generally the samples included lung, tracheobronchial lymph nodes, bone (including long bone), liver, spleen, kidney, connective tissue and mediastinum. The highest concentrations occurred in the lymph nodes in eight cases, the lung in five and the liver in one. The lowest concentrations were distributed among the other organs although the kidney was identified most often. The systemic depositions extrapolated from autopsy samples ranged from 0.2 to 17 nCi while the earlier health physics estimates ranged from 2 to 20 nCi and were often several times higher than those found at autopsy. No information has been received as to any in vivo chest measurements but all autopsy samples were positive for plutonium in the chest area.

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