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**ARGONNE NATIONAL LABORATORY
and
ARGONNE CANCER RESEARCH HOSPITAL**

**THE ARGONNE RADIUM STUDIES
Summary of Fundamental Data**

**Charles E. Miller, Robert J. Hasterlik,
and Asher J. Finkel**

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THE ARGONNE RADIUM STUDIES

Summary of Fundamental Data

For the past twenty years a continuing investigation of the long-term effects of radium deposition has been conducted at Argonne National Laboratory and Argonne Cancer Research Hospital. These studies were expanded greatly in 1957 after the discovery of a photograph of 98 dial painters taken in August 1924. The identification and tracing of these and many other persons occupationally exposed to radium, along with those iatrogenically exposed, made possible the collection of a substantial body of data regarding exposure, radium body content, retention patterns, and the medical consequences of such exposure. Essential portions of this information have been placed and stored on computer magnetic tape in a standard format in order to facilitate rapid retrieval of selected data.

The corpus of information condensed and summarized in this report represents an information retrieval dated January 1, 1969. The material summarized here has been developed primarily by the present investigators. Some information gathered on these same patients by other investigators (W. B. Looney, R. D. Evans, A. M. Brues, W. P. Norris, L. D. Marinelli, P. F. Gustafson, and A. F. Stehney) has been included, along with some more recent data from autoradiographic and microradiographic analyses of bone specimens (R. E. Rowland) and radiochemical analyses of bone and teeth (H. F. Lucas and R. B. Holtzman). The contributions of these investigators are clearly denoted. The work of each investigator is also cited by reference to the published literature.

The determinations of radium body content were made principally by Charles E. Miller, utilizing the human gamma-ray spectrometer of the Argonne National Laboratory Health Division and the measurement techniques that he developed. Each patient's radium content was measured by means of the tilting-chair technique and many were also measured with the 7-crystal-position technique. In some cases field measurements (so designated) had to be made in homes, hospitals, and mortuaries because the patient could not be transported to a total-body counter. Measurements on some patients were made in the whole-body counter either at Argonne Cancer Research Hospital or, through the kindness of Dr. W. Blahd, at the Veterans Administration Center, Los Angeles.

All radiographs reported herein were read and interpreted by Robert J. Hasterlik and Asher J. Finkel, who devised a method of evaluation and quantitative scoring of the skeletal radiographs. After some modifications mutually arrived at in consultations between our group and Dr. J. Gary, Boston, radiologist for the Massachusetts Institute of Technology Radioactivity Center, a uniform scoring system was adopted by both groups.

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An interchange of selected sets of x-rays between the MIT and the Argonne groups demonstrated that agreement exists in the application of the scoring system and that it has, in fact, been uniformly applied to all radiographic studies by both groups of investigators. All radiographs were read without knowledge of the patient's radium content.

In presenting this summary of the raw data the authors trust that the information will be of value to other scientists, contemporary and future, who will be interested in the long-term consequences of internal radium deposition in a unique population whose exposure occurred 35 to 50 years ago. Publication in this format is timely even though the study may not be completed until perhaps another 20 or 25 years have elapsed. The present compilation will be followed shortly by an interpretive monograph dealing with the findings and their significance.

It should be noted that the present compilation includes only those persons about whom we have developed some scientific data. There is a list of names to whom numbers have been assigned that have not been studied because of refusal to cooperate or because they were occupationally exposed after 1930 and consequently acquired body contents in the domain of 10^{-9} curies of radium. These two groups account for the gaps in the serial numbering of the patients included in this report.

Finally, it should be recognized that the present report is the result of the patient and perspicacious work of Mrs. Irene D. Sweet who helped trace and interview the patients, who converted the raw data into a form adaptable for magnetic tape storage, and who was responsible for the organization and collation of the data.

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Acknowledgments

The authors wish to thank the many persons who helped with this study. Foremost among these are the patients themselves, who graciously cooperated with the investigators, as well as their personal physicians and dentists, too numerous to mention. Special thanks are given to Dr. W. Tuteur of Elgin State Hospital and Dr. R. J. Graff of Manteno State Hospital, Illinois for their interest and cooperation, and to Mr. C. H. Wallhausen, U.S. Radium Corporation, New York City, for making old records available to us. Technical help was provided by O. J. Steingraber, J. B. Corcoran, and C. A. Priess who worked with the Argonne whole-body counter. Members of the Argonne National Laboratory Health Division staff, particularly Miss Wren Watkins, R.N., and Miss Alma Ruckdashel, R.N., along with the other nurses, medical technologists, and secretaries, were of enormous help. We acknowledge the interest and encouragement of Dr. A. M. Brues, Dr. J. E. Rose, and Mr. L. D. Marinelli in these studies. To these many persons we publicly acknowledge our debt and gratitude.

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A STATEMENT ON FORMAT

The pertinent data for each case have been organized according to the format which follows. Each line of the printout has a code number in the last ten columns on the right to permit any particular piece of data on any patient to be retrieved quickly by computer technique.

The first two digits of the code number (i.e., 03) refer to patients that comprise the Argonne National Laboratory-Argonne Cancer Research Hospital series. The numerals 09 refer to a group of patients occupationally exposed to radium in Pittsburgh, Pennsylvania and studied either at the Massachusetts Institute of Technology Radioactivity Center or at Argonne.

The next three digits (i.e., 401, 402) are a specific identification number assigned to each individual patient. Patients administered radium iatrogenically as a therapeutic procedure at the Elgin State Hospital in 1931 are assigned numbers in the 100 series. Other patients administered radium orally or parenterally by their physicians, principally in the Chicago area, as a form of medical therapy during the period about 1920 to 1930 comprise the 200 series. The 300 series has been left unassigned for further iatrogenic patients as they are identified. All persons occupationally exposed, such as dial painters, radium chemists, janitors, and office workers, are assigned numbers in the 400 through 900 series. In the case of the Pittsburgh series the numbers were assigned sequentially beginning with 001 and include only occupationally exposed persons.

The last two digits of the code number and the letter following (i.e., 01, 02, 02A) refer to the particular categories of information outlined on the format sheet. Categories 01 through 05 are self-explanatory, and, of course, are listed only if the patient died (with identifying numbers omitted in this printout). Category 09 lists causes of death and may contain two entries. The first is always the causes of death as officially stated on the death certificate by the attending physician. In some instances this listing is at variance with the true causes of death, in which case another listing follows that gives causes of death proposed by us on the basis of additional information and interpretation, and is identified by the word, "actual."

Category 10 is concerned with the source of the case, i.e., the manner by which the patient came to our attention. In the case of the occupationally exposed, this will have been for the most part by our search; however, in some instances more than one source may appear. Category 11 lists the principal literature references to that patient. Category 12 gives the type of exposure. Category 13 outlines the details of radium acquisition by the patient. In the case of those administered radium therapeutically it will contain information concerning the physician involved, date of administration, type of medication, and, where known, amount of radium

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administered. For those occupationally exposed, this category will contain information concerning the actual factory involved, alleged dates of employment, job activity, and work habits (tipping of brush with lips).

Category 14 lists pertinent items concerning the details of medical administration of radium to the Elgin State Hospital patients and a summary of their medical histories. Categories 15 through 20 should be self-explanatory. Categories 21 through 24 are reserved for elaboration of the medical history.

The date of a specific gamma-ray measurement and the amount of radium B and radium C present in the patient, as determined by total-body count, are given in category 25. The date of the radon breath determination and the amount of radium in the body from which radon escapes into the breath are given in category 26. The total amount of ^{226}Ra present in the body, as calculated from the gamma-ray measurement, is given in category 27, and as calculated from the breath measurement, in category 28. The assumed ratio of radium B and radium C in the body to total-body radium, which is used to calculate the total-body radium, is given in the last column of category 27, while the assumed ratio of radon in the breath to total-body radium, which is used to calculate the total-body radium from the breath measurement, is given in the last column of category 28. The date on which the calculated maximum body burden occurred in each patient and the magnitude of this body burden is assigned to category 29, but has been omitted from this printout.

Categories 30A-D yield a summary of the analysis of the skeletal radiographs and special mastoid or paranasal sinus laminagraphy. The radiographic interpretation has been written in detail and is on file at the Argonne National Laboratory. Categories 31 through 39 are reserved for repeat radiographic examinations. Categories 40 through 49 report hematologic studies.

Categories 50-50A contain an inventory of tissue samples on hand, which are available for future use and study. Categories 51 through 59 summarize other studies done on various specimens, for the most part osseous tissues, collected in the course of our studies.

Category 60 is of especial importance since it lists tumor diagnoses as established by competent authority. Categories 61 through 64 are at present unassigned. Category 65 lists blood dyscrasias as established by competent authority from examination of blood smears or tissue, or from the best interpretation of available clinical history and data. Categories 66 and 67 list all surgical procedures sustained by the patient or diseases previously or now present. The listing is according to that of the American Medical Association Standard Nomenclature of Diseases (1961), and the numerals to the left of the diagnosis refer to the Standard Nomenclature's

numerical coding of the condition. All diagnoses in which the condition is believed, on the basis of present knowledge, to be related to the patient's body content of radium are placed in category 66, and all diagnoses believed not to be related to radium deposition are in category 67.

Where an autopsy report is on file at Argonne National Laboratory or the Argonne Cancer Research Hospital, this is so stated in category 70, and where primary tumor diagnostic slides or the slides from the autopsy are filed at these institutions, this is so stated under categories 71 and 72. Categories 73 through 88 are reserved for studies of radium content of teeth.

Category 89 lists the notation "not studied." This publication, however, contains data on only those patients who have been studied. In addition, there exists a number of individuals who were former dial painters who have been assigned code numbers but are not listed in this study because of the fragmentary nature of the data available.

Categories 91 through 98 are reserved for additional data derived during the course of these studies, and category 99 completes the tabulation with the last date on which data were added or revised. A listing of all abbreviations used in this compilation follows.

LIST OF ABBREVIATIONS

A, B, C, D, etc. in category 27 refer to literature citations in category 11.

ACRH	Argonne Cancer Research Hospital
AJF	Asher J. Finkel
AMBH	Albert Merritt Billings Hospital (The University of Chicago)
AMP	Amputated
ANL	Argonne National Laboratory
B	Basophils
BIM	Division of Biological and Medical Research, ANL
BR RADON	Breath radon
CALC	Calculated
CEM	Charles E. Miller
CVA	Cerebrovascular accident
DEC	Deceased
DIFF	Differential white cell count
E	Eosinophils
HD	Health Division, ANL
HFL	Henry F. Lucas, Jr.
HG	Hemoglobin
HGS	Human gamma-ray spectrometer
HTC	Hematocrit = packed cell volume
INVEST	Investigator
L	Lymphocytes
LASL	Los Alamos Scientific Laboratory
LW	Living and well
LOC	Location
M	Monocytes
MISC	Miscarriage
MIT	Massachusetts Institute of Technology Radioactivity Center
MONG	Mongolism
MVD	Marvin Van Dilla

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NCI	Nanocurie = 10^{-9} curie
P	Polymorphonuclear leucocytes
PCI	Picocurie = 10^{-12} curie
PFG	Philip F. Gustafson
PPF	Pertinent positive findings
RA RET	Radon retention factor
RBC	Red blood cell count
RBH	Richard B. Holtzman
RER	Robert E. Rowland
RJH	Robert J. Hasterlik
RPY	Radiological Physics Division, ANL
7-CRYST- POS	Seven-crystal-position technique for whole-body gamma-ray spectrometry
ST	Stab cells = white blood cells in band stage
TL	Thorium C"
TS	Thomas Speckman
U OF C	The University of Chicago Clinics
U OF ILL RES. HOSP.	Research & Educational Hospital, University of Illinois
U OF MO	University of Missouri
UCI	μ Ci = microcurie
UUCI/G	$\mu\mu$ Ci/g = micromicrocurie/gram
UUG/G	$\mu\mu$ g/g = micromicrogram/gram
VA LA	Veterans Administration, Los Angeles, Radioisotope Service whole-body counter
WBC	White blood cell count
WPN	William P. Norris

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FORMAT

03-000	NAME	BIRTHDATE	03-000-01		
	ADDRESS, OR DECEASED	TELEPHONE	02		
	IF DECEASED, FORMER ADDRESS		02A		
	MAIDEN NAME		03		
	OTHER NAMES		04		
	SEX	SOC.SEC.NO.	05		
	OTHER PERTINENT NOS.		05A		
DECEASED DATE	AT HOSPITAL OR HOME, CITY, STATE		06		
DEATH CERT.NO.	AUTOPSY		07		
INTERMENT			08		
CAUSES OF DEATH			09		
SOURCE OF CASE	SEARCH BY		10		
	SYMPTOMS				
	REFERRED BY				
	KNOWN FROM LITERATURE ONLY				
	OTHER (SPECIFY)				
LITERATURE CITATION			11		
EXPOSURE	DIAL PAINTER	01	12		
	RA CHEMIST OR LAB WORKER	02			
	OTHER OCCUP., SPECIFY	03			
	THERAPEUTIC--ORAL	04			
	THERAPEUTIC--INJECTION	05			
	THERAPEUTIC--OTHER	06			
	UNKNOWN	07			
SOURCE			13		
SOURCE AND MEDICAL RECORD	(ELGIN GROUP)		14		
FAMILY HISTORY			15		
MARRIED	PARA	GRAVIDA	15A		
HUSBAND	BIRTH	HEALTH	15B		
CHILDREN	SEX	BIRTH	HEALTH	16	
MEDICAL HISTORY			20		
GAMMA-RAY MEASUREMENTS			25		
DATE	NUCLIDE	AMOUNT	TECHNIQUE	INVEST.	25A
BREATH MEASUREMENTS					26
DATE	NUCLIDE	AMOUNT	TECHNIQUE	INVEST.	26A
COMPUTED TOTAL-BODY RADIUM					27
DATE	GAMMA-RAY	BR. RADON	TOTAL	RA.RET.	27A
TOTAL-BCDY RADIUM COMPUTED FROM BREATH RADON					28
DATE	BR. RADON	TOTAL	RA.RET.		28A
ESTIMATED DATE AND AMOUNT OF MAXIMUM BODY BURDEN					29

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X-RAY EXAMINATION										30
TYPE										30A
DATE		WHERE	X-RAY NO.					LOC.		30B
GENERAL IMPRESSION										30C
PERTINENT POSITIVE FINDINGS										30D
CLINICAL LABORATORY FINDINGS										40
DATE		HG	HTC	RBC						40A
WBC		DIFF. P	ST	L	M	E	B			40B
OTHER PROCEDURES OR REMARKS										40C
SPECIMENS AVAILABLE										50
TISSUE		AMOUNT						LOC.	CUSTODIAN	50A
RADIOCHEMICAL ANALYSIS										51
DATE	G ASH	TISSUE	UUG/G ASH RA-226					UUCI/G ASH TH-228	INVEST.	51A
MICRORADIOGRAPHIC ANALYSIS										52
DATE		TISSUE		RESULTS					INVEST.	52A
AUTORADIOGRAPHIC ANALYSIS										53
DATE		TISSUE							INVEST.	53A
MAXIMUM HOT SPOT								PCI RA-226/MG BONE		53B
CYTOGENETIC ANALYSIS										54
DATE		TISSUE		RESULTS					INVEST.	54A
OTHER ANALYSES										55
MALIGNANT TUMCR										60
BLOOD DYSCRASIAS										65
000 -0000 DISEASE									(RADIUM)	66
000 -0000 DISEASE									(NON-RADIUM)	67
AUTOPSY REPORT AT ANL										70
PRIMARY TUMOR SLIDE AT ANL										71
AUTOPSY SLIDE AT ANL										72
TCOTH MEASUREMENT										73
SAMPLE			TCOTH							73A
TOTAL WT.			CALC.GMS.CA.							73B
ADDITIONAL INFORMATION										91
DATA REVISED (DATE)										99

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PATIENT C3-101	BCRN 11-04-08	03-101-01
FEMALE		03-101-02
		03-101-05
OTHER PERTINENT NCS.	CASE A	03-101-05A
SOURCE OF CASE	ELGIN 05	03-101-10
LITERATURE CITATION		03-101-11
SCHLUNDT, ET AL, AM.J.ROENT. 30,515 (OCT. 1933). CASE A.		03-101-11A
MCRRIS, ET AL, AM.J.ROENT. 73,785 (MAY 1955). CASE A.		03-101-11B
LCONEY, ET AL, AM.J.ROENT. 73,1006 (JUNE 1955). CASE A.		03-101-11C
MILLER, (IN) SYMPOSIUM ON WHOLE BODY COUNTING, P. 81, IAEA, VIENNA (1962). CASE C3-101.		03-101-11D
MILLER AND MARINELLI, (IN) SYMPOSIUM ON WHOLE BODY COUNTING, P. 279, IAEA, VIENNA (1962). CASE A.		03-101-11E
MILLER, ANL-6839 (1964) PP. 18-39. CASE 03-101.		03-101-11F
MILLER AND FINKEL, ANL-7217 (1965) PP. 7-90. CASE 03-101.		03-101-11G
MILLER AND FINKEL, AM.J.ROENT. 103,871 (AUG. 1968), CASE 03-101.		03-101-11H
		03-101-11I
		03-101-11J
EXPOSURE	THERAPEUTIC--INJECTION 05	03-101-12
SOURCE AND HOSPITAL RECORD		03-101-14
ADMITTED ELGIN STATE HOSPITAL 05-16-30. RECEIVED RADIUM CHLORIDE INTRAVENOUSLY, TOTAL 150 UCI, BETWEEN MARCH AND JULY, 1931.		03-101-14A
AGE 23 AT INJECTION. HOSPITAL RECORD--		03-101-14B
01-12-31 IN ANNEX 4.		03-101-14C
06-24-31 IN WING COTTAGE.		03-101-14D
09-08-31 WING COTTAGE 2. RECEIVING RADIUM CHLORIDE WEEKLY.		03-101-14E
09-28-31 IS RECEIVING RADIUM CHLORIDE INTRAVENOUSLY.		03-101-14F
11-17-31 WING COTTAGE, RECEIVING RADIUM CHLORIDE.		03-101-14G
(NOTE THAT ABOVE DATES CONTRADICT PUBLISHED MARCH TO JULY INJECTION DATES.)		03-101-14H
		03-101-14I
		03-101-14J
FAMILY HISTORY		03-101-15
NEVER MARRIED		03-101-15A
MEDICAL RECORD		03-101-20
DIAGNOSED DEMENTIA PRAECOX AT ELGIN STATE HOSPITAL. PATIENT		03-101-20A
REMAINED WELL UNTIL 1940, AT WHICH TIME BECAUSE OF ORTHOPEDIC		03-101-20B
DIFFICULTIES RADIOGRAPHS WERE MADE AT ELGIN STATE HOSP. OF BOTH		03-101-20C
FEMORA AND WERE REPORTED AS SHOWING OLD OSTEOCHONDRITIS. OVER THE		03-101-20D
YEARS PATIENT HAS DEVELOPED A WADDLING GAIT.		03-101-20E
GAMMA-RAY MEASUREMENTS		03-101-25
07-30-59 RAB,RAC C.495 UCI HGS 1 TILTING CHAIR CEM		03-101-25E
03-10-60 RAB,RAC C.521 UCI HGS 1 TILTING CHAIR CEM		03-101-25F
12-17-63 RAB,RAC C.384 UCI HGS 1 TILTING CHAIR CEM		03-101-25G
12-17-63 RAB,RAC C.490 UCI HGS 1 7-CRYST-PCS CEM		03-101-25H
BREATH MEASUREMENTS		03-101-26
03-10-60 EM-222 1.0 UCI BREATH RADON HELMET FFL		03-101-26F

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CCMPUTEC TOTAL-BODY RADIUM									03-101-27
12-31	1.00	UCI	7.20	UCI	8.20	UCI TOTAL	SCHLUNDT A		03-101-27A
06-32	0.90	UCI	2.50	UCI	3.40	UCI TOTAL	SCHLUNDT A		03-101-27B
05-51	0.57	UCI	1.04	UCI	1.61	UCI TOTAL	NORRIS B		03-101-27C
07-53	0.60	UCI	1.15	UCI	1.75	UCI TOTAL	AGRRIS B		03-101-27D
07-30-59	0.495	UCI			1.596	UCI TOTAL	0.31		03-101-27E
03-10-60	0.521	UCI			1.680	UCI TOTAL	0.31		03-101-27F
12-17-63	0.384	UCI			1.242	UCI TOTAL	0.31		03-101-27G
12-17-63	0.490	UCI			1.580	UCI TOTAL	0.31		03-101-27H

TOTAL-BODY RADIUM COMPUTED FROM BREATH RADON									03-101-28
03-10-60	1.0	UCI	1.449	UCI TOTAL	0.69				03-101-28F

X-RAY EXAMINATION									03-101-30
PARTIAL SKELETAL SURVEY									03-101-30A
05-11-51	ELGIN STATE HOSP.		LOC.	ACRH					03-101-30B
ADVANCED CHANGES TYPICAL OF RADIUM DEPOSITICN.					SCORE 10				03-101-30C
PPF PATCHY BONE SCLEROSIS IN NECK OF RIGHT HUMERUS, NECK OF LEFT HUMERUS, AT SITE OF OLD PROXIMAL EPIPHYSEAL LINES. ASEPTIC NECROSIS OF HEADS OF BOTH FEMORA WITH MARKED SECCNDARY HYPERTROPHIC OSTEOARTHRITIC CHANGES ABOUT BOTH HIP JOINTS.									03-101-30E
									03-101-30F
									03-101-30G

PARTIAL SKELETAL SURVEY									03-101-31A
07-23-53	ELGIN STATE HOSP.		LOC.	ACRH					03-101-31B
ADVANCED CHANGES TYPICAL OF RADIUM DEPOSITICN.					SCORE 12				03-101-31C
PPF MULTIPLE UP TO 5 MM SIZE LINEAR AREAS OF BCNE RESCRPTION PRESENT IN THE CORTICES OF BOTH TIBIAE AND FIBULAE. MARKED PROGRESSION IN FRAGMENTATION, COMPRESSION, AND RESCRPTION OF HEADS OF BOTH FEMORA.									03-101-31E
									03-101-31F
									03-101-31G

PARTIAL SKELETAL SURVEY									03-101-32A
12-05-55	ELGIN STATE HOSP.		LOC.	ACRH					03-101-32B
ADVANCED CHANGES TYPICAL OF RADIUM DEPOSITION.					SCORE 12				03-101-32C
PPF COARSENING OF TRABECULAR PATTERN OF PELVIS, TIBIAE AND FIBULAE UNCHANGED, FURTHER PROGRESSION IN RESORPTION OF HEADS OF THE FEMORA. SOME INCREASES IN PATCHY SCLEROSIS IN REGION OF NECK AND GREATER TROCHANTER OF RIGHT FEMUR AND A FEW UP TO 8 MM SIZE AREAS OF BONE RESORPTION IN THE PROXIMAL THIRD OF SHAFT OF LEFT FEMUR. PATCHY SCLEROSIS IN HEAD OF LEFT HUMERUS.									03-101-32E
									03-101-32F
									03-101-32G
									03-101-32H
									03-101-32I

COMPLETE SKELETAL SURVEY									03-101-33A
08-22-58	ELGIN STATE HOSP.		LOC.	ACRH					03-101-33B
ADVANCED CHANGES TYPICAL OF RADIUM DEPOSITICN.					SCORE 14				03-101-33C
PPF PROGRESSION OF SCLEROTIC CHANGES IN HEAD OF RIGHT HUMERUS WITH ROUGHENING AND FLATTENING OF SUPERIOR ARTICULAR SURFACE OF THIS HUMERUS. SIMILAR CHANGES IN HEAD OF LEFT HUMERUS. FURTHER RESCRPTION OF HEAD OF RIGHT AND LEFT FEMORA WHICH ARE NOW ALMOST COMPLETELY RESORBED. INCREASE IN PATCHY SCLEROSIS IN NECK AND GREATER TROCHANTER REGIONS OF BOTH FEMORA. NO FURTHER CHANGES IN TIBIAE AND FIBULAE.									03-101-33E
									03-101-33F
									03-101-33G
									03-101-33H
									03-101-33I
									03-101-33J

COMPLETE SKELETAL SURVEY

12-18-63	ANL	X-RAY NO. R-229	LOC. ANL	03-101-34A
ADVANCED CHANGES TYPICAL OF RADIUM DEPOSITION. SCORE 18				03-101-34B
PPF PROGRESSIVE DESTRUCTIVE CHANGES IN HEAD OF RIGHT HUMERUS				03-101-34C
WITH LESSER CHANGES IN HEAD OF LEFT HUMERUS. COARSENING OF				03-101-34D
TRABECULAR PATTERN OF RIGHT AND LEFT RADIUS AND ULNA. SEVERAL				03-101-34E
AREAS OF BONE RESORPTION PRESENT IN THE CARPAL CAPITATE BONE.				03-101-34F
PROGRESSION IN RESORPTION OF HEADS OF BOTH FEMORA WITH MULTIPLE				03-101-34G
AREAS OF BONE RESORPTION PRESENT IN NECK OF BOTH FEMORA. MARKED				03-101-34H
COARSENING IN NUMBER OF AND SIZE OF LINEAR AREAS OF BONE RESORP-				03-101-34I
TION PRESENT IN THE MID PORTION OF SHAFTS OF BOTH TIBIAE AND				03-101-34J
FIBULAE.				03-101-34K
				03-101-34L

CLINICAL LABORATORY FINDINGS

09-22-32	HG 98	HTC	RBC 4.9	03-101-40
WBC 9,500	DIFF. P 62	ST 2	L 35 M E B	03-101-40A
				03-101-40B
09-06-49	HG 14.5	HTC	RBC 3.94	03-101-41A
WBC 11,600	DIFF. P 43	ST 4	L M E B	03-101-41B
1951	HG 12.5	HTC	RBC 4.50	03-101-42A
12-18-63	HG 13.3	HTC 43	RBC 4.48	03-101-43A
WBC 12,400	DIFF. P 76	ST	L 21 M 3 E B	03-101-43B

2301 -4722.1	ASEPTIC NECROSIS OF THE HEAD OF THE HUMERUS (LEFT,RIGHT)	03-101-66
23113-4722.1	ASEPTIC NECROSIS OF THE HEAD OF THE RADIUS	03-101-66A
23513-4722.1	ASEPTIC NECROSIS OF THE HEAD OF THE FEMUR (LEFT,RIGHT)	03-101-66B

000 -X20 SCHIZOPHRENIC REACTION, NOT OTHERWISE SPECIFIED 03-101-67

DATA REVISED 11-01-68 03-101-99