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RINGOLD - A HANFORD ENVIRONMENTAL STUDY

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HANFORD LABORATORIES
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RICHLAND, WASHINGTON

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The Hanford Atomic Products Operation at Richland, Washington, is a complex of nuclear reactors, fuel fabrication plants, chemical separation facilities and research and development laboratories. During the course of operating these facilities various radioactive wastes are generated. The high level wastes are concentrated and retained in storage within the project area. Low level wastes are released to the atmosphere, the Columbia River, and to ground in a controlled manner. These low level wastes are potential sources of radiation exposure to persons living in the vicinity of the project. Controlling low level waste releases so that radiation exposures are within applicable limits is one of the attendant responsibilities to the operation of the plant.

In assessing off site exposures the environmental surveillance program has regularly sampled and radioanalyzed air, water, and farm produce and made measurements of external radiation. From the results of these radioanalyses, estimates of internal depositions and radiation exposure to hypothetical individuals of assumed dietary habits are developed. In mid-1962 the AEC authorized the use of Hanford's Whole Body Counter facilities in conjunction with the environmental surveillance program. The use of these facilities permits direct determination of many radionuclides in the body and avoids many of the assumptions necessary in the usual exposure estimate. The first population group for whom this technique was applied was the people from the small and well defined Ringold farm area. This paper describes the Ringold area, the people who live there and the results of their examinations.

The relationship of the Hanford facilities to local geographical features in general is shown in Figure 1. The project boundary encloses a controlled area of about 600 square miles. The project is situated along the Columbia River in a semi-arid portion of South-eastern Washington. The natural vegetation of the area is sparce and consists mainly of sagebrush and grasses and is primarily suited to grazing. Irrigation projects associated with upper Columbia River dams are reclaiming sizeable areas for agricultural purposes. The population of the surrounding communities totals about 80,000 people.

The Ringold area is one of the few farming areas using Columbia River water drawn downstream from the reactors for irrigation purposes. Ringold amounts to about 500 acres of land situated on a flat between the Columbia River on the west and high bluffs on the east. The area is bounded on the north by the Hanford project boundary and ends on the south where the river meets the bluffs. The area is shown in the aerial photograph of Figure 2. Ringold is about thirteen miles downstream from the nearest production reactor. It is also about thirteen miles east of the chemical separations facilities. . . the shortest air distance to a farming area from the separations plants. The community is about nine miles upstream from the laboratories and fuel fabrications areas.

The Ringold area and the people who live there are of particular interest in relation to radiation exposure from environmental sources because it is the area nearest the production facilities and therefore would be expected to have the greatest potential for radiation exposure as a result

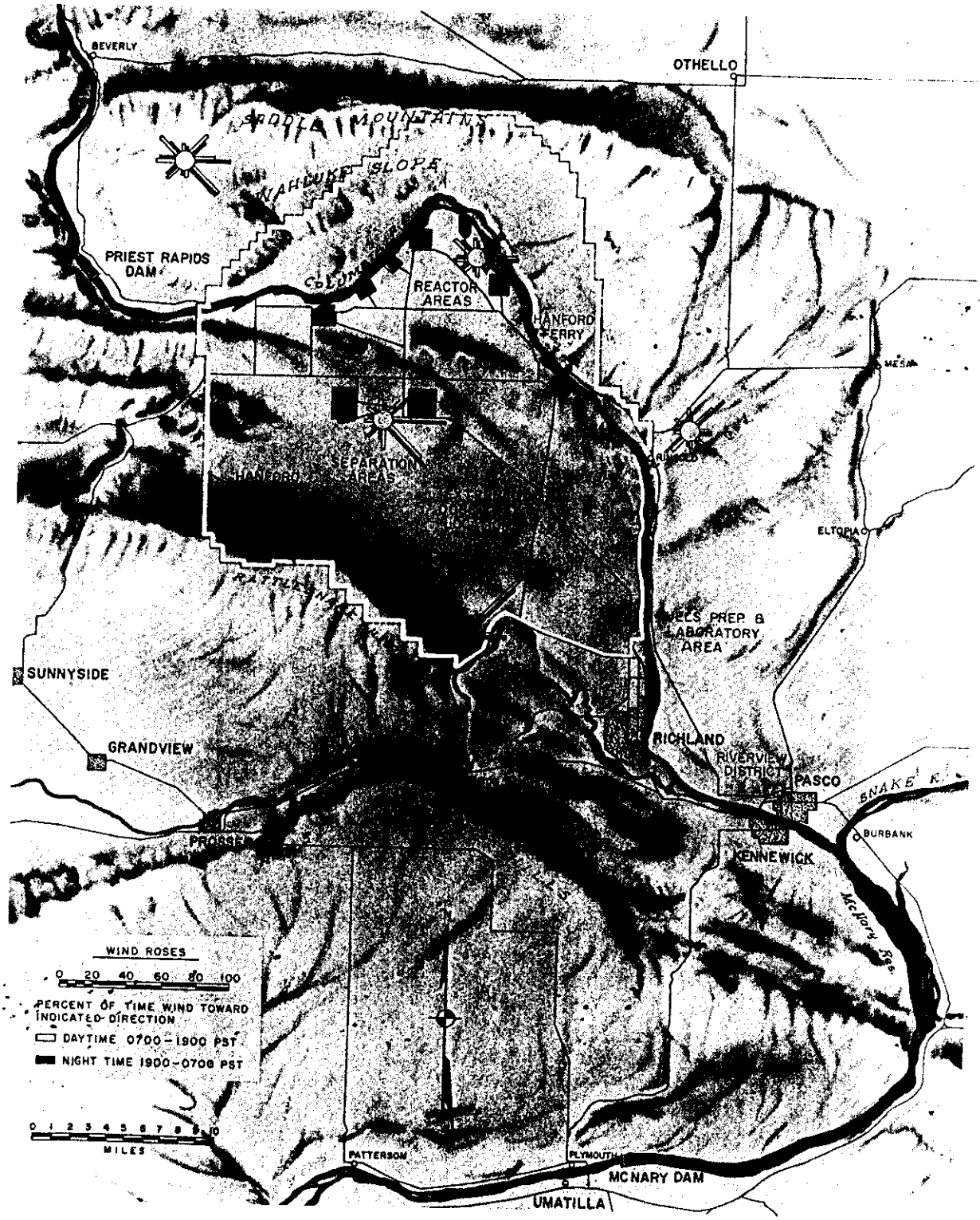

FIGURE 1
FEATURES OF HANFORD PROJECT AND VICINITY

AEC-GE RICHLAND, WASH.

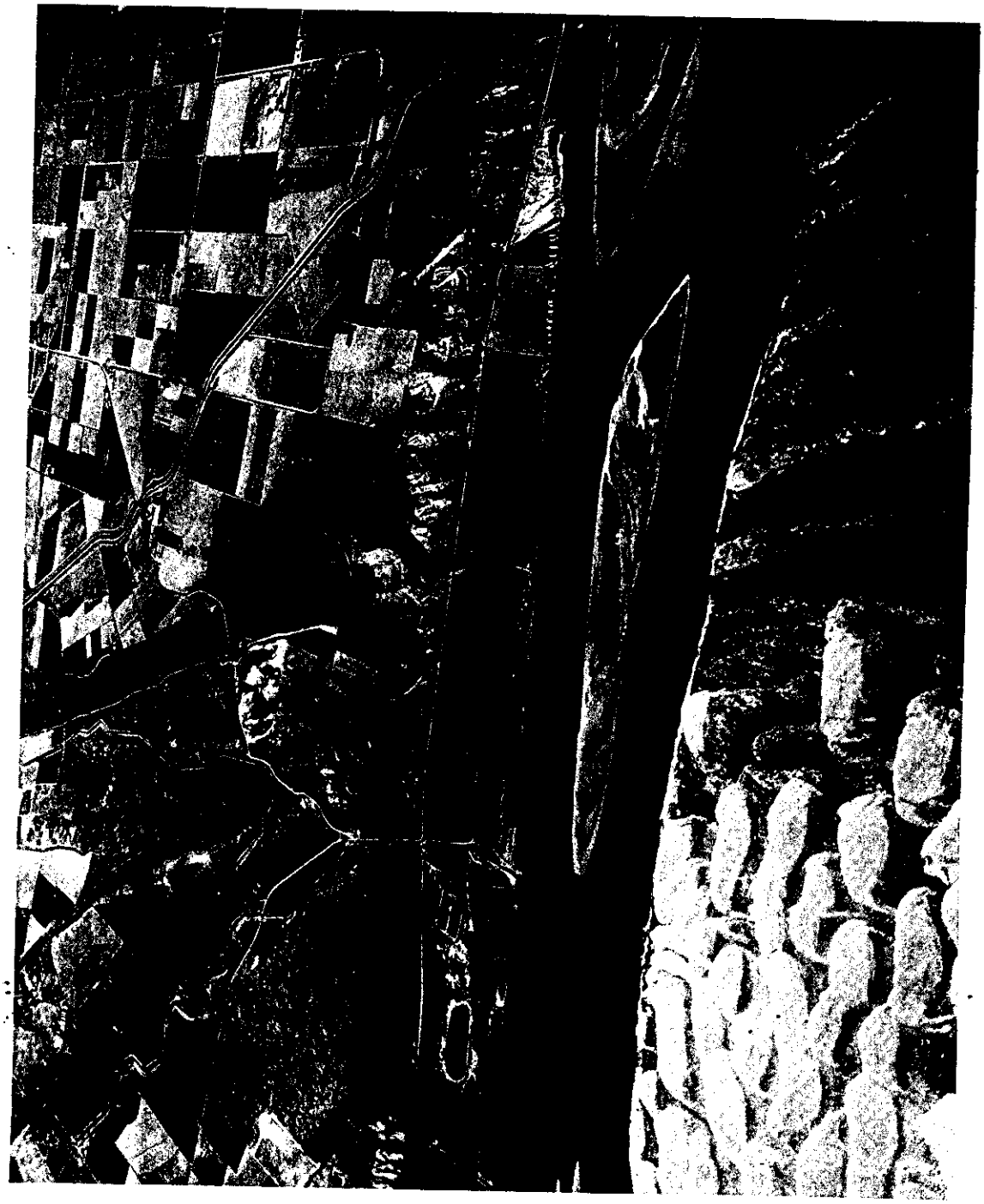

FIGURE 2
THE RINGOLD AREA

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of plant operations. Also significant is the fact that the number of people involved is small which makes direct acquaintance with each family practical. There were 20 people living in the Ringold area at the time of this study.

A description of the farms and farm families follows in geographical order.

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Next to the north boundary (left margin of photograph) is a farm of about 30 acres

The principal crop produced by the farm is apricots. Though a garden was kept, most of this families' meat, milk etc. was purchased in town. Their water supply is from a well fed by water from Ringold springs. These springs occur on the hillside above their property. These people make little use of Columbia River fish. Recently, the farm was sold to provide for expansion of fish ponds of the State Fisheries Department.

The next area involves about 140 acres which contain newly built fish rearing ponds under the direction of the State Fisheries and Game Departments. The family are the PERSONAL DATA DELETED caretakers for the Game Department. They have been at Ringold

They obtain their meat exclusively from game obtained at Ringold. (Both shot deer a short distance from their house.) Their milk is purchased from a local farm beyond the bluffs. They have a garden for vegetables and their water is obtained from a well fed by Ringold Springs. As time permits they expect to make use of Columbia River fish in their food supply.

In the photograph the southern boundary of the Game Department land is the water waste way that terminates in the river just downstream of the ponds. Beyond this the 15 acres of land which is in orchards.

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This family has made almost no use of Ringold produce. Their meat, vegetables, milk etc. was all purchased in stores. Until recently when their cow came fresh, their milk was prepared exclusively from powdered milk mixed with water from Ringold Springs. They made no use of Columbia River fish. Their orchard was irrigated with water from the waste way and their water supply was from the springs.

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The next farm is about 160 acres of permanent pasture. Until recently kept a dairy herd. Presently cattle are kept for meat or for replacements in dairy herds. Irrigation water is taken from the river. Their drinking water is from a well and most of their food is purchased in town. This family has lived on their Ringold farm

Where Ringold flat is bounded by bluffs an essentially frost free area exists which is ideal for production of fruit. The farm is such an area. The principal crop is peaches but pears, apples, apricots etc. are also grown. A good year would yield over 100 ton of produce from the 45 acre farm.

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Their water is from a well and their irrigation water is pumped from the river. They keep a cow or two for their milk needs, keep a garden for their vegetables and raise their own beef. They make little use of Columbia River fish.

The last farm consists of 76 acres belonging to and which is primarily devoted to raising sheep.

Most of this families' food supply is purchased in stores. Their water supply comes from a well. an ardent fisherman for Columbia River Steelhead and claims an annual catch of about 15 such fish.

During the past several years the environmental surveillance program has regularly obtained produce from these farms. This produce was radioassayed and the results were used to develop estimates of radiation exposure to a hypothetical Ringold resident of assumed dietary habits. The radionuclides which have been detected in a sufficient number of these samples to be of interest were Zinc^{65}, Phosphorus^{32}, Iodine^{131}, and Strontium^{90}. Zinc^{65} and P^{32} are identified with reactor effluent water. These radionuclides enter man through ingestion of Columbia River water downstream from the reactors, from ingestion of milk, meat or produce raised on land irrigated with such water or from consumption of fish and water fowl which inhabit the river. Small amounts of I^{131} and Sr^{90}

are released by Hanford facilities, however, at the time of this study these radionuclides were identified primarily with fallout from nuclear weapons testing. The foodstuffs of primary interest have been milk and Columbia River fish. Results of the environmental surveillance program have been documented in considerable detail in quarterly and annual reports of the Hanford Laboratories Environmental Studies and Evaluation Operation which are avialable from the Office of Technical Services, U. S. Department of Commerce.(1.)

In November of 1962 the families of the Ringold area were invited to be examined in Hanford's Whole Body Counter. The Hanford Whole Body Counter facility consists of a low background iron room which is about 10 feet square and whose walls, ceiling, and floor are made of steel ten inches thick. The room weighs about 120 tons. Various scintillation detectors are used in conjunction with a transistorized multichannel pulse height analyzer to satisfy a number of internal dosimetry needs.

For the examination of the Ringold families the pulse height analyzer was electronically divided into two 200 channel units which could receive signals from two detectors simultaneously. In this way a 9 3/8" x 4" NaI detector was used for whole body counting and a 3" x 3" NaI detector was used to measure I^{131} in the thyroid. The measurement apparatus with a subject in place is shown in Figure 3. The sensitivity of the thyroid counter for I^{131} is taken nominally to be 30pc for a 20 minute examination.

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FIGURE 3
RINGOLD EXAMINEE AND EQUIPMENT

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In addition to naturally occurring Potassuim^{40}, Zinc^{65}, and Cesium^{137}, were detected in all subjects. I^{131} was detected in those drinking local milk. Fallout from weapons testing was relatively high in this area at the time of examination which accounts for the occurrence of I^{131} in the thyroid glands. Fallout was the predominant source of the Cs^{137}.

The results of the whole body and thyroid counts of the Ringold families are presented in Table I.

In the twelve individuals counted the amount of Zinc^{65} present ranged from 3.6-82nc, Cs^{137} from 1.1-10nc and I^{131} ranged from below detection to 300pc.

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the only member of her family examined. However, since their food supply was not typical of a farm family and the amounts detected in were small the inability to examine the rest of the family wasn't considered a serious problem to the completness of the data. A second measurement was arranged three weeks after the first measurement. More frequent measurements would have been of considerable interest. However, the 70 mile round trip between Ringold and the Whole Body Counter was somewhat of a deterent.

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A comparison of group exposures to applicable limits is shown in Figure 4. The curve of maximums is the highest value observed regardless of the individual. It is evident that of those radionuclides

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TABLE I

RINGOLD WHOLE BODY COUNTER RESULTS

Subj.	Sex	Age	Exam Date	Zn^{65}		Cs^{137}		I^{131} in Thyroid	
				nc	%NCRPL*	nc	%NCRPL*	pc	%FRCL**
			12/1/62	82	1.4	4.5	0.15	110	1.6
			12/1/62	43	0.7	1.1	0.04	48	0.6
			12/1/62	33	0.55	1.4	0.05	120	3.0
			12/22/62	30	0.55	1.4	0.05	55	3.0
			12/1/62	57	0.9	2.2	0.08	300	4.3
			12/22/62	54	0.9	2.5	0.08	170	4.3
			12/2/62	20	0.33	2.6	0.09	-	-
			12/2/62	8.6	0.14	4.3	0.14	-	-
			12/15	3.6	0.06	4.7	0.14	35	0.4
			12/15	3.6	0.06	4.5	0.15	-	-
			12/15	12	0.20	10	0.33	-	-
			12/15	4.0	0.07	5.3	0.18	150	2.0
			1/5/63	10	0.17	6.7	0.22	-	-
			1/5	5.5	0.09	8.0	0.25	-	-

*The values in the column headed %NCRPL are the whole body counter results expressed as percentages of the maximum permissible body burden for the critical organ under the "neighborhood" concept as described by the National Committee on Radiation Protection and Measurements (2).

**The values in the column headed %FRCL are the measured thyroid burdens assumed to exist for one year and expressed as percentages of the recommended annual dose to the thyroid as described by the Federal Radiation Council(3).

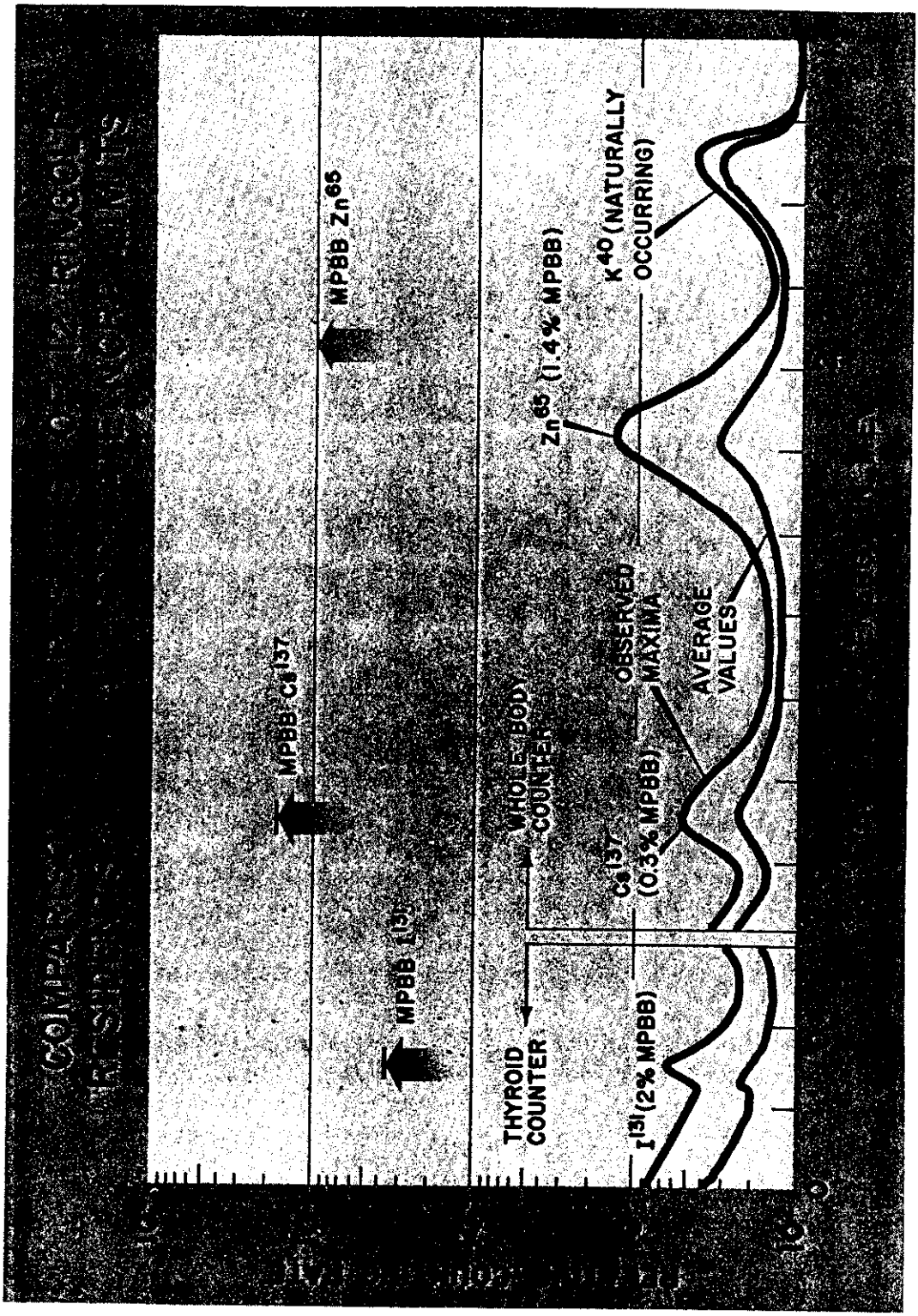

FIGURE 4
COMPARISON OF WHOLE BODY COUNTER
RESULTS WITH APPLICABLE NCRP LIMITS

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detected all were well below limits. (some artistic license was used in the continuation of the curve between quantitatively established values for particular radionuclides.)

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Of the families at Ringold most nearly fits the image of a farm family which makes optimum use of farm produce for their sustenance. Because of this and their cooperative spirit in this study they were requested to provide a 48 hour total urine collection. Hopefully radioanalysis of the urine would indicate the presence of any of radionuclides not observed in the Whole Body Counter. Radiochemical analyses were performed for Tritium, Plutonium^{239}, Uranium, Phosphorus^{32}, and Strontium^{90}. In addition a gamma scan was performed on the urine. Trace amounts of Chromium^{51}, Cesium^{137}, Zirconium-Niobium^{95}, and Iodine^{131} were identified in some samples. No attempt has been made to interpret trace findings in terms of body burdens. Neither H^3 nor Pu^{239} were detected in the urine. Small amounts of U on the order of 1-2 ug/l were found in each sample. The presence of uranium was attributed to its occurrence in well water.

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Phosphorus^{32} was detected and ranged from 1.0 to 1.8 x 10^{-4} nc P^{32}/l. Though there is no well established relationship between the amount of P^{32} excreted on a daily basis and the residual body burden, an interesting comparison may be made between these results and the excretion rate of a man whose body burden had been established in the course of development of an in vivo measurement technique. This person excreted about 3.5 x 10^{-3}uc P^{32} per 24 hour

voiding while at a level of 0.4uc in the body.

These values in terms of NCRP limits range from 1-5%. By another comparison the equilibrium amount of P^{32} in the body may be determined using standard man parameters and an average concentration of 8×10^{-4} pc/l of milk for 1962. Assuming each consumed such milk at a rate of one liter per day, the implied body burden would be 0.01uc which is in fair agreement with the estimate from the analysis of urine.

The results from examining the Ringold residents have confirmed the place of Whole Body Counting in environmental surveillance programs. Of primary importance, the Whole Body Count provides a direct measurement on the subject of interest and avoids dietary assumptions, uptake parameters etc. It is unlikely that a significant quantity of any gamma emitting nuclide would go unnoticed. That only a few radionuclides were detected in the Ringold residents and that those present were in sufficiently small amounts to be comfortably within applicable limits was a gratifying conclusion of this study.

ACKNOWLEDGEMENTS

The spirited cooperation of the Ringold residents who participated in this study is gratefully acknowledged. I am particularly indebted to for her enthusiastic support of the study, and the information on the Ringold area supplied by her. Thanks also to for use of his photograph in this paper.

I also would like to express my appreciation to the following: Mr. R. W. Meisinger of Environmental Studies and Evaluation Operation for introducing me to the Ringold residents. Lance Micheal for the aerial photograpy. F. Swanberg, Jr. and associates of Internal Dosimetry Operation for radiochemical analyses and in particular Mrs. Joyce Bernard for her assistance in performing the Whole Body Counter measurements and data reduction.

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