AEC RESEARCH AND
DEVELOPMENT REPORT

HW-83723

EVALUATION OF RADIOLOGICAL CONDITIONS IN THE VICINITY OF HANFORD JANUARY - JUNE, 1964

THE ENVIRONMENTAL STUDIES AND EVALUATION STAFF

AUGUST 17, 1964

HANFORD LABORATORIES

HANFORD ATOMIC PRODUCTS OPERATION
RICHLAND, WASHINGTON

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EVALUATION OF RADIOLOGICAL CONDITIONS IN THE VICINITY OF HANFORD JANUARY-JUNE, 1964

By

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HANFORD ATOMIC PRODUCTS OPERATION
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EVALUATION OF RADIOLOGICAL CONDITIONS IN THE VICINITY OF HANFORD JANUARY-JUNE, 1964

INTRODUCTION

The Hanford Environmental Surveillance Program for the first half of 1964 is summarized in this report. In most cases, the data for this reporting period have been added to charts that record the results of similar measurements for several previous years so that trends will be apparent. Evaluations of environmental exposure are compared with the guides for exposure and permissible rates of intake for specific radionuclides recommended by the Federal Radiation Council (FRC),[1,2,3] the National Committee on Radiation Protection and Measurements (NCRP),[4] and the International Committee on Radiation Protection (ICRP).[5] The comparisons show that exposures were well within the limits at all times and that releases of radioactive materials from the Hanford plants were adequately controlled.

Figures 1 and 2 show the relationship of the Hanford project to the Pacific Northwest and the surrounding communities.

ENVIRONMENTAL CONDITIONS

The radiation exposures estimated for people living in the neighboring communities during 1963[6] are presented in Figures 3, 4, 5, and 6 for total body, bone, GI tract, and thyroid respectively. These figures represent the dose in mrems or in percent of maximum permissible rate of intake for a "maximum" individual and for the "average" population in the Tri-Cities. The hypothetical maximum individual has been assigned dietary and other habits that would result in what would seem to be the largest possible rational exposure. The "average" Tri-City resident is assumed to have "average" dietary habits, no unusual living habits, and purchases all of his foodstuffs from commercial outlets. The radionuclides of particular interest in the Hanford environs continued to be Sr^{90}, I^{131}, P^{32}, Zn^{65}, Cr^{51}, As^{76}, and Np^{239}.

RADIONUCLIDES IN THE COLUMBIA RIVER

Concentrations of the more important radionuclides have been measured in the Columbia River at Pasco for the past several years (shown in Figure 7). Starting in the latter part of 1963, the emphasis on measurement of radioactive materials in the river was shifted to Richland as the new water plant for this city was put into operation. The seasonal variations in concentrations of the radionuclides are due primarily, but not exclusively, to the quantity of water available (Figure 8) for dilution of reactor effluent. The rates of transport of certain radionuclides shown in Figure 9 are obtained by multiplying the concentration of the radionuclides in the river water by river flow rate.

RADIONUCLIDES IN DRINKING WATER

The City of Richland started a new water treatment plant in the latter part of 1963 that uses Columbia River water. Prior to that time, Pasco and Kennewick were the communities closest to the reactors that used the river for sanitary water. Table I summarizes the concentration of several radionuclides in the sanitary water of Richland, Pasco, and Kennewick.

TABLE I

CONCENTRATION OF SEVERAL RADIONUCLIDES MEASURED IN SANITARY WATER JANUARY-JUNE, 1964

Radionuclide	Richland	Pasco	Kennewick
Total Beta	15,000	5200	800
RE + Y	100	10	10
Na^{24}	2,800	600	130
P^{32}	80	80	10
Cr^{51}	11,000	7000	3000
Cu^{64}	2,400	400	90
Zn^{65}	100	80	<20
As^{76}	600	250	<60
Sr^{90}	1.7	1.4	<0.6
I^{131}	12	7	<3
Np^{239}	2,000	1000	30

The concentrations of short-lived radionuclides in the sanitary water at the time it is consumed are less than those shown in Table I because of the flow time through the distribution system between the treatment plant and the consumer. The flow time may vary from a few hours to days depending upon water use and location of the customer on the distribution system.

The calculated dose to the GI tract, total body, thyroid, and percentage of maximum permissible rate of intake (MPRI) for bone from drinking water for the 12 month period ending June 30, 1964, is presented in Table II. The municipal water systems of the three cities using Columbia River water serve approximately 19,000 dwellings.

TABLE II

CALCULATED DOSE FOR SELECTED ORGANS
FROM ROUTINE INGESTION* OF SANITARY WATER
JULY 1963-JUNE 1964

	GI Tract, mrem	Total Body, mrem	Bone, % MPRI	Thyroid, † mrem
Richland**	50	3	1	75
Pasco	25	2	1	40
Kennewick	5	<1	<0.1	<20

* The "standard man" beverage intake of 1.2 liters per day was used in this calculation.

** The radiation dose shown for Richland residents was accrued only from September 1963 subsequent to the change from well water to Columbia River water.

† The radiation dose is estimated for a 2 gram thyroid of a small child and a beverage intake of 1 liter per day.

Figure 10 shows the estimated GI tract dose at Pasco for the past several years and at Richland beginning in January 1964.

RADIONUCLIDES IN FISH AND WATERFOWL

The Columbia River is popular for sports fishing both above and below the Hanford reservation and fish that feed downstream from the reactors acquire some radionuclides from the reactor effluent. P^{32} and Zn^{65} are the principal nuclides found in fish but levels vary according to species and the season. Whitefish are the game fish that usually contain

the greatest concentration of P^{32} (Figure 11). During most of the first half of 1964 the concentrations of P^{32} measured in whitefish were somewhat higher than observed during the same period in 1963; in June, however, the level was typical of that observed in previous years.

No new data were developed for waterfowl since hunting was prohibited during the time of year covered by this report.

RADIONUCLIDES IN MARINE ORGANISMS

Zn^{65} and P^{32} are the only radionuclides of reactor effluent found in sufficient abundance beyond the mouth of the Columbia River to be of radiological interest. Oysters usually contain more Zn^{65} than other common sea food organisms. Analyses of oysters grown in the Willapa Bay area, shown in Figure 12, indicated some reduction of Zn^{65} concentrations during the first half of 1964, but the concentrations of P^{32} followed the previously observed seasonal trend.

RADIONUCLIDES IN THE ATMOSPHERE

Hanford gaseous waste is released to the atmosphere through 200-foot high stacks after removal of over 99% of the radioactive materials. I^{131} is the radionuclide of primary interest in the separations facilities process off-gases. The average monthly I^{131} release rates during the first half of 1964 are shown in Figure 13. The average emission rate during this period was 0.16 curie per day. Routine measurements of I^{131} in air at Richland, North Richland, Benton City, and Pasco indicated that the average concentration during the 12 months ending June 30, 1964, was less than 0.02 pc/m^3. A sustained concentration of I^{131} at this level in inspired air would result in an annual dose to the thyroid of the "standard man" of much less than 1 mrem.

The average emission rate of gross filterable beta from the separations facilities stacks during the first half of 1964 was less than 0.02 curie per day. The average emission rate of Sr^{90} from fission product recovery facilities during the same period was less than 0.002 curie per day.

RADIONUCLIDES IN MILK AND AGRICULTURAL PRODUCE

Locally produced milk and farm products may contain radionuclides derived from airborne materials or from irrigation water drawn from the river below the reactors. Radionuclides originating in reactor effluent can be traced through irrigation water to farm produce, pasture grass, and milk.

The milk surveillance program includes samples from local dairy farms and commercial supplies sold in local stores. Concentrations of radioiodine measured in locally available milk are shown in Figure 14. Generally, the average concentration of I^{131} in both local and commercial milk was at or below the reporting limit* of picocuries/liter except for a brief increase during May and June to about 10 picocuries/liter. Sr^{90} in local milk was primarily from world-wide fallout. Figure 15 shows that the concentrations of Sr^{90} ranged from about 4 picocuries/liter to a maximum of 18 picocuries/liter during the first half of 1964. These values are among the lowest concentrations measured in the United States.(7)

P^{32} and Zn^{65} are found in milk obtained from dairy farms that use water drawn from the Columbia River below the reactors for irrigation of pasture land. Figures 16 and 17 show the average concentrations of these radionuclides measured in milk produced in the Riverview-Ringold area during the first half of 1964. Seasonal fluctuations caused by grazing and irrigating practices followed the pattern expected for this period.

Samples of vegetables and fruits had concentrations of I^{131} approximately equivalent to the detection level of 0.05 picocuries/gram.

CONCENTRATIONS OF I^{131} IN CATTLE THYROIDS

The average concentration of I^{131} in the thyroids of 109 cattle slaughtered at Moses Lake, Pasco, Walla Walla, Wenatchee, and Yakima were at or below the reporting limit of 5 picocuries I^{131} per gram (Figure 18). The maximum concentration measured in an individual sample was only 11 picocuries/gram, considerably less than observed in early 1963.

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* "Reporting limit" used here and elsewhere in this report indicates the lowest concentration that the analytical procedure employed is able to detect with reasonable confidence.

RADIOACTIVE PARTICULATES IN THE ATMOSPHERE

During the early part of 1964 some of the remote air monitoring stations (Boise and Lewiston, Idaho; Klamath Falls and Meacham, Oregon; Great Falls, Montana; and Seattle, Washington) were discontinued and replaced by stations forming a ring about the perimeter of the Hanford reservation. These sampling stations now include Pendleton and McNary Dam, Oregon; Spokane, Walla Walla, Yakima, Moses Lake, Ellensburg, Wenatchee, Sunnyside, and Washtucna, Washington. The activity observed on air filters (Figure 19) was less than 1 picocurie β/m^3 of air during the early part of 1964 but steadily increased to a maximum of about 3 picocuries β/m^3 in May following the spring influx of world-wide fallout. Activity in air decreased sharply during June to levels of 1 to 2 picocuries β/m^3.

EXTERNAL RADIATION

Ionization chambers stationed on the Hanford reservation and submerged in the Columbia River are used to estimate the gamma radiation dose from external sources. Measurements in air indicated the exposure for the period January-June, 1964, averaged about 0.43 mR/day (Figure 20). Essentially all of this exposure originates with natural background and world-wide fallout.

Radiation measurements made in the river in the vicinity of Richland during the first half of 1964 indicated an average dose rate of about 2.5 mR/day from gamma emitters (especially Na^{24}) introduced with reactor effluent water.

CONCLUSIONS

Comprehensive surveillance of the Hanford environs during the first half of 1964 showed that the amounts of radioactive materials present were well within the nationally accepted limits at all times and that releases of radioactive materials from the Hanford plants were adequately controlled. P^{32} continued to be the radioisotope of Hanford origin that contributed the most exposure to individuals who ate locally caught fish in quantity.

Radiological conditions in the Hanford environs were similar to those observed last year and the exposures received by people who live in nearby communities were not substantially different from those estimated in Reference 6. The one exception was an expected increase in the dose to the GI tract of Richland residents from use of the Columbia River for a water supply.

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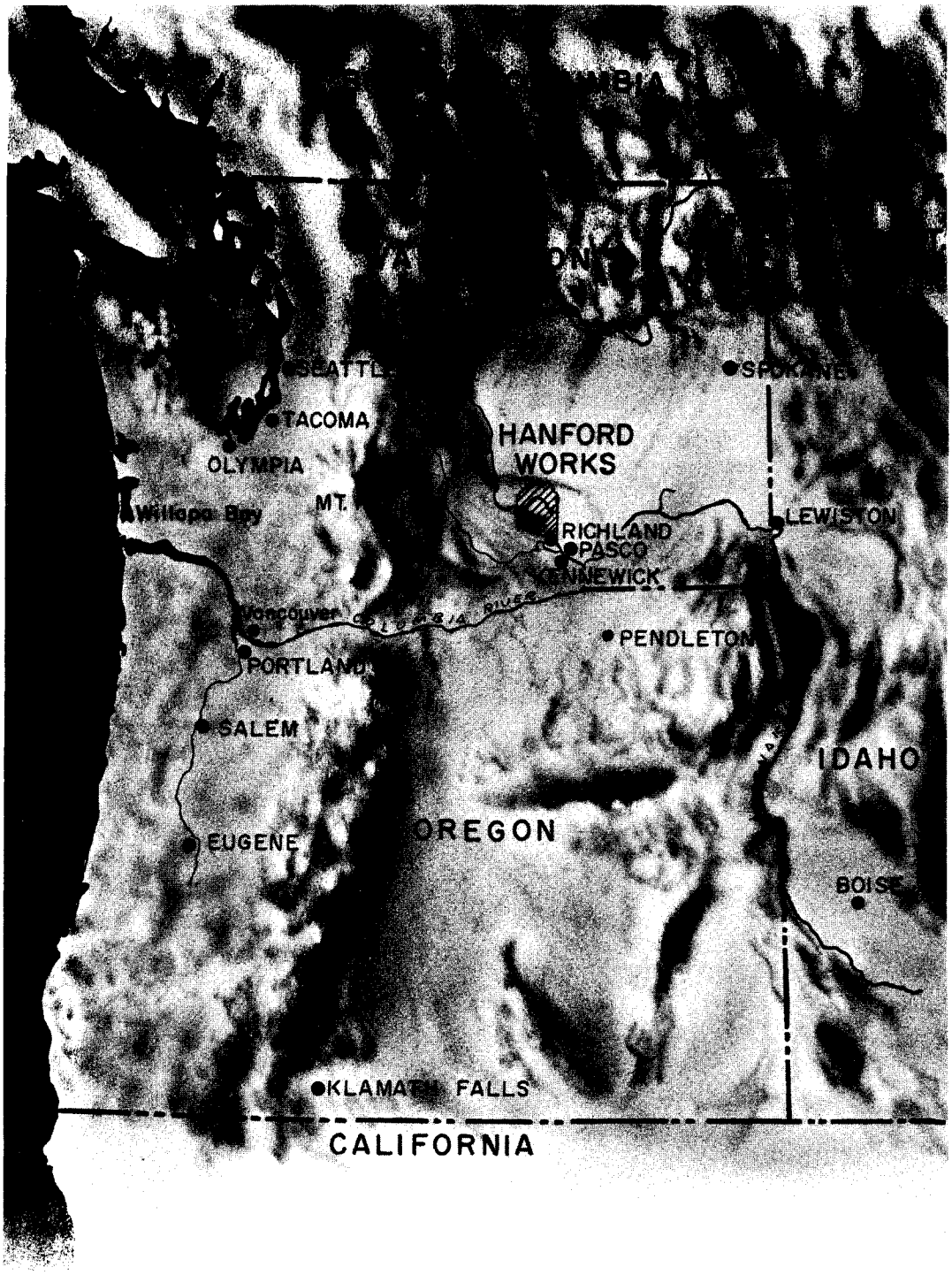

FIGURE 1

Geographical Relationship
of Hanford Works to Pacific Northwest

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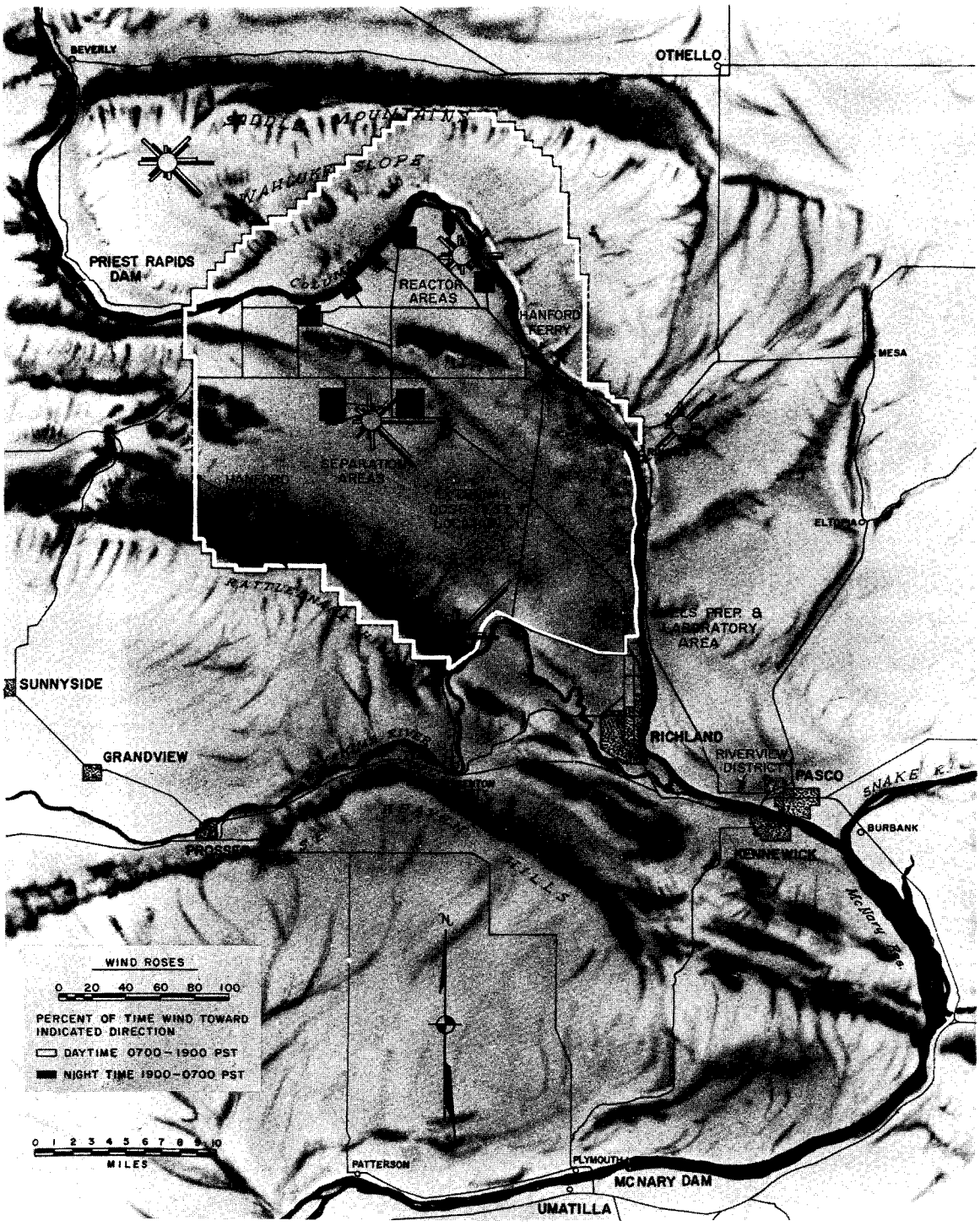

FIGURE 2

Features of Hanford Project and Vicinity

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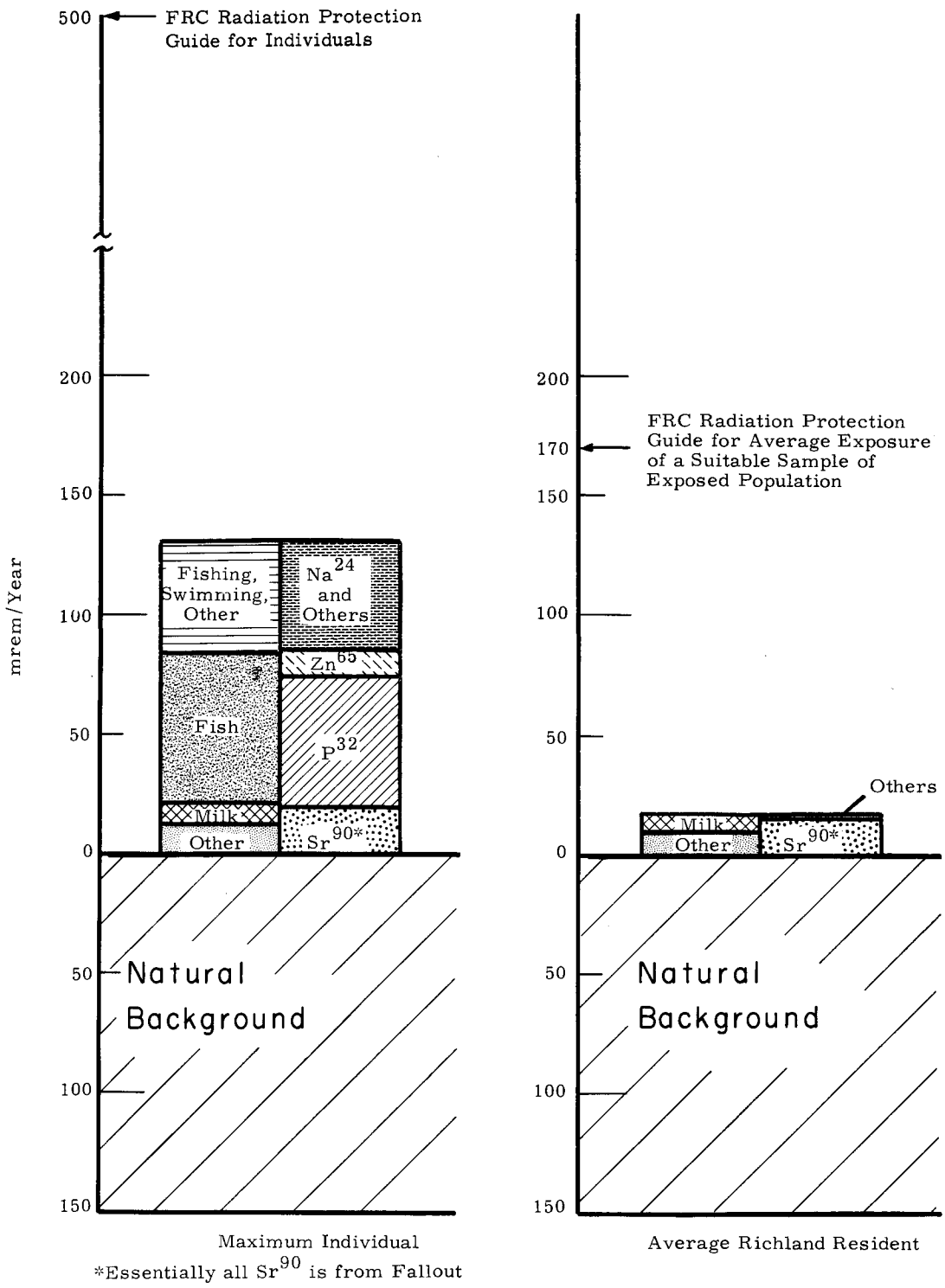

*Essentially all Sr^{90} is from Fallout

FIGURE 3

Calculated Dose to Total Body, 1963

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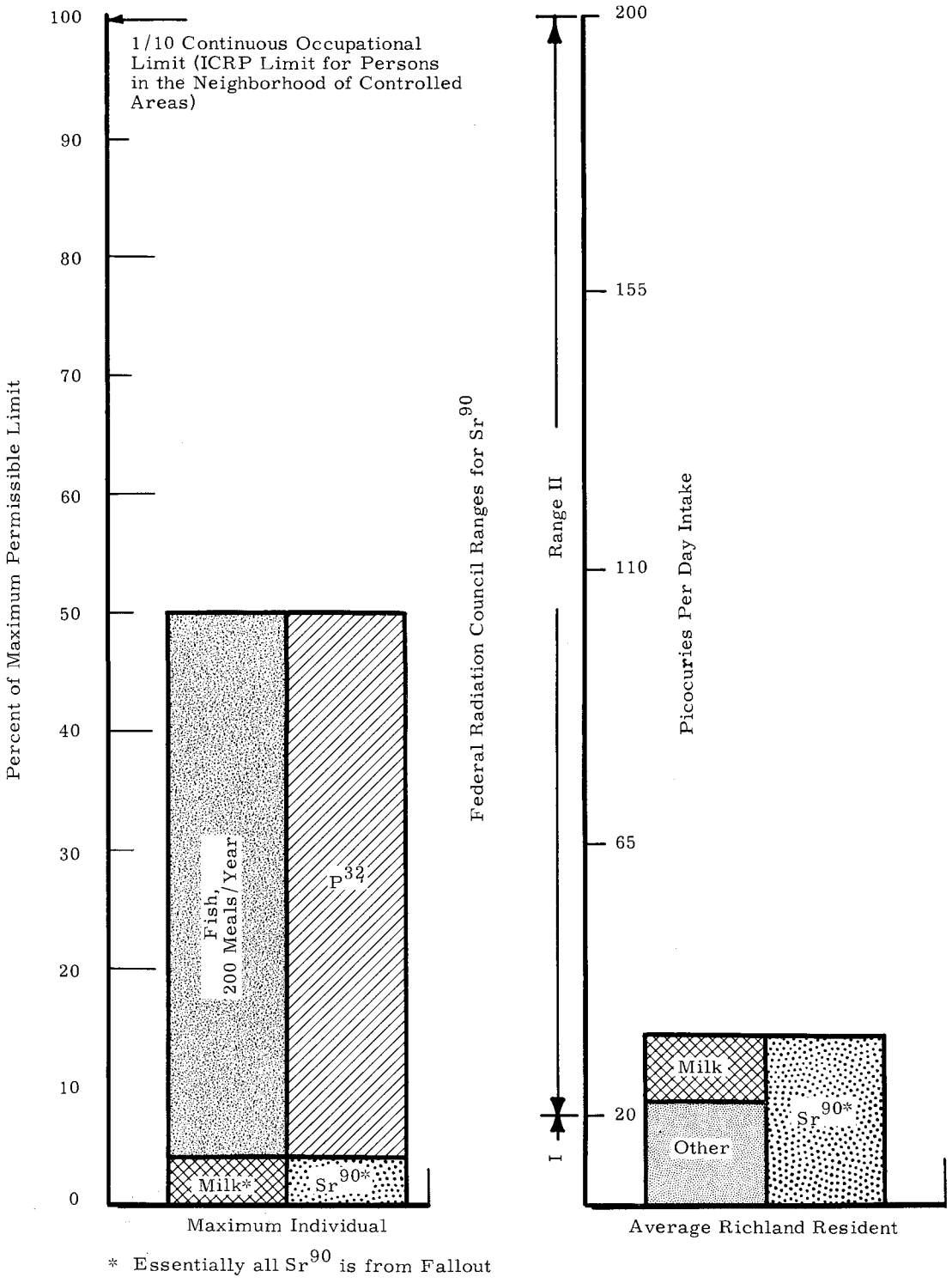

FIGURE 4

Calculated Dose to Bone, 1963

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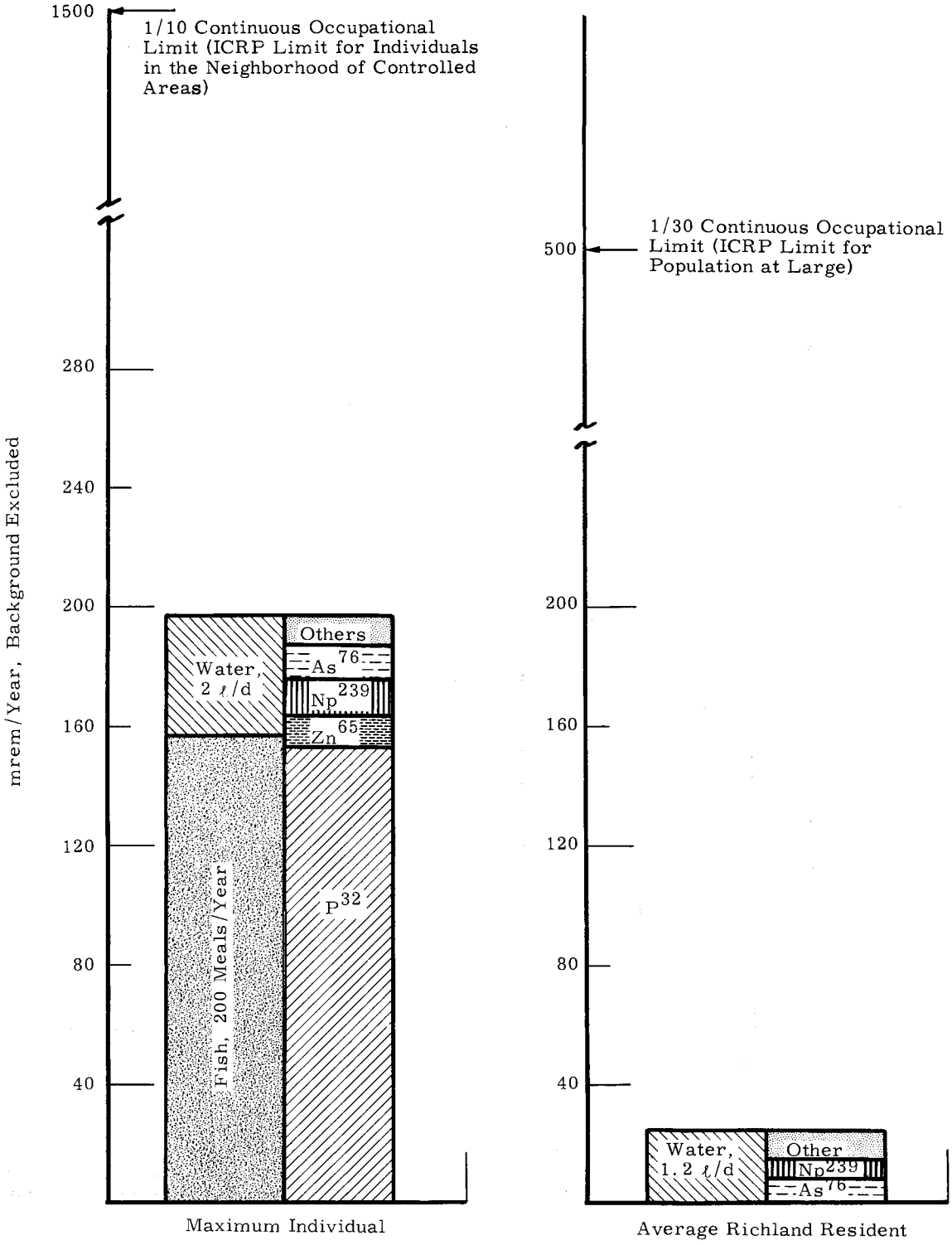

FIGURE 5

Calculated Dose to the GI Tract, 1963

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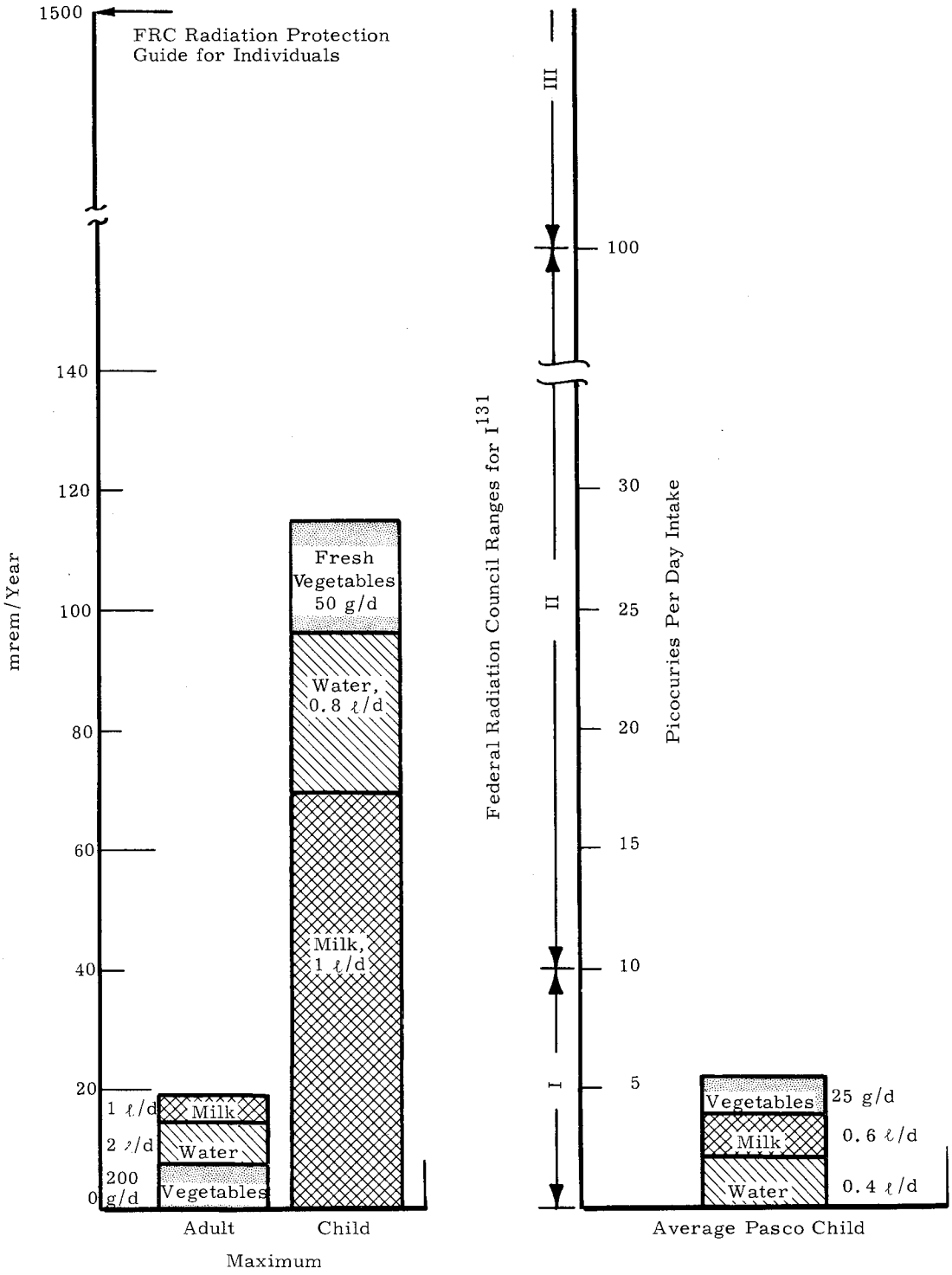

FIGURE 6

Calculated Dose to Thyroid, 1963

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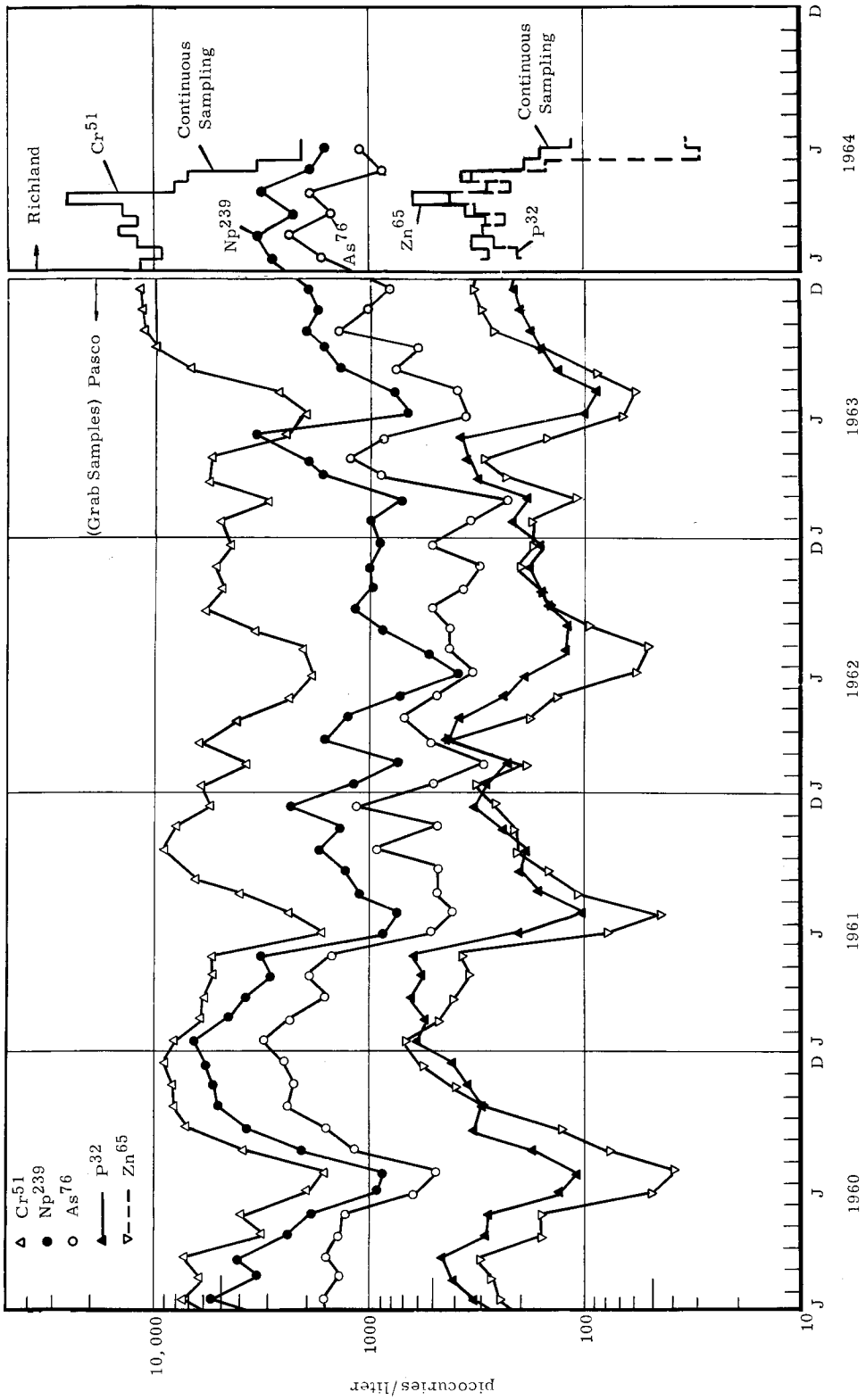

FIGURE 7

Concentration of Radionuclides in Columbia River Water at Pasco and Richland, Washington

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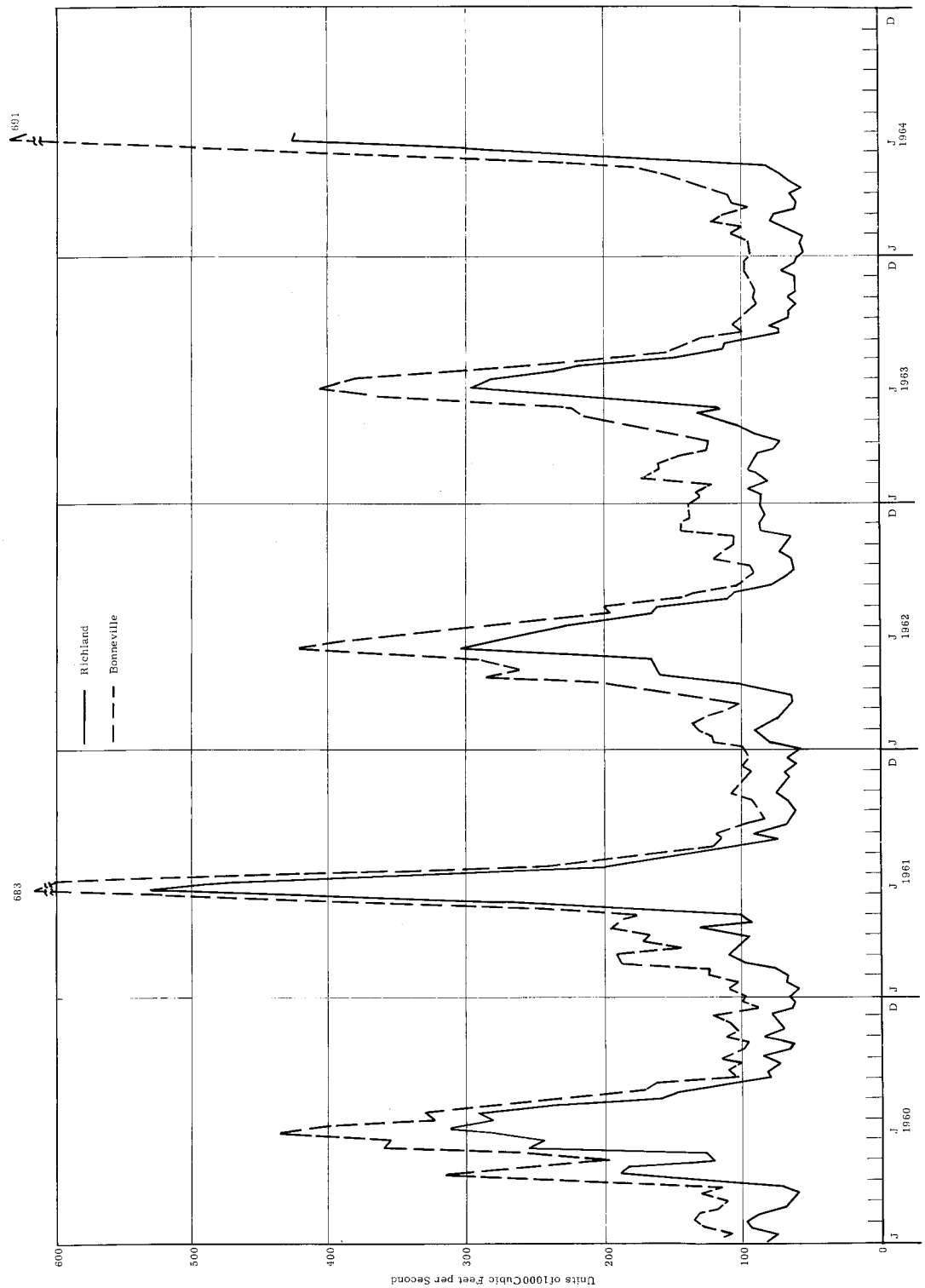

FIGURE 8
Columbia River Flow at Richland and Bonneville Dam

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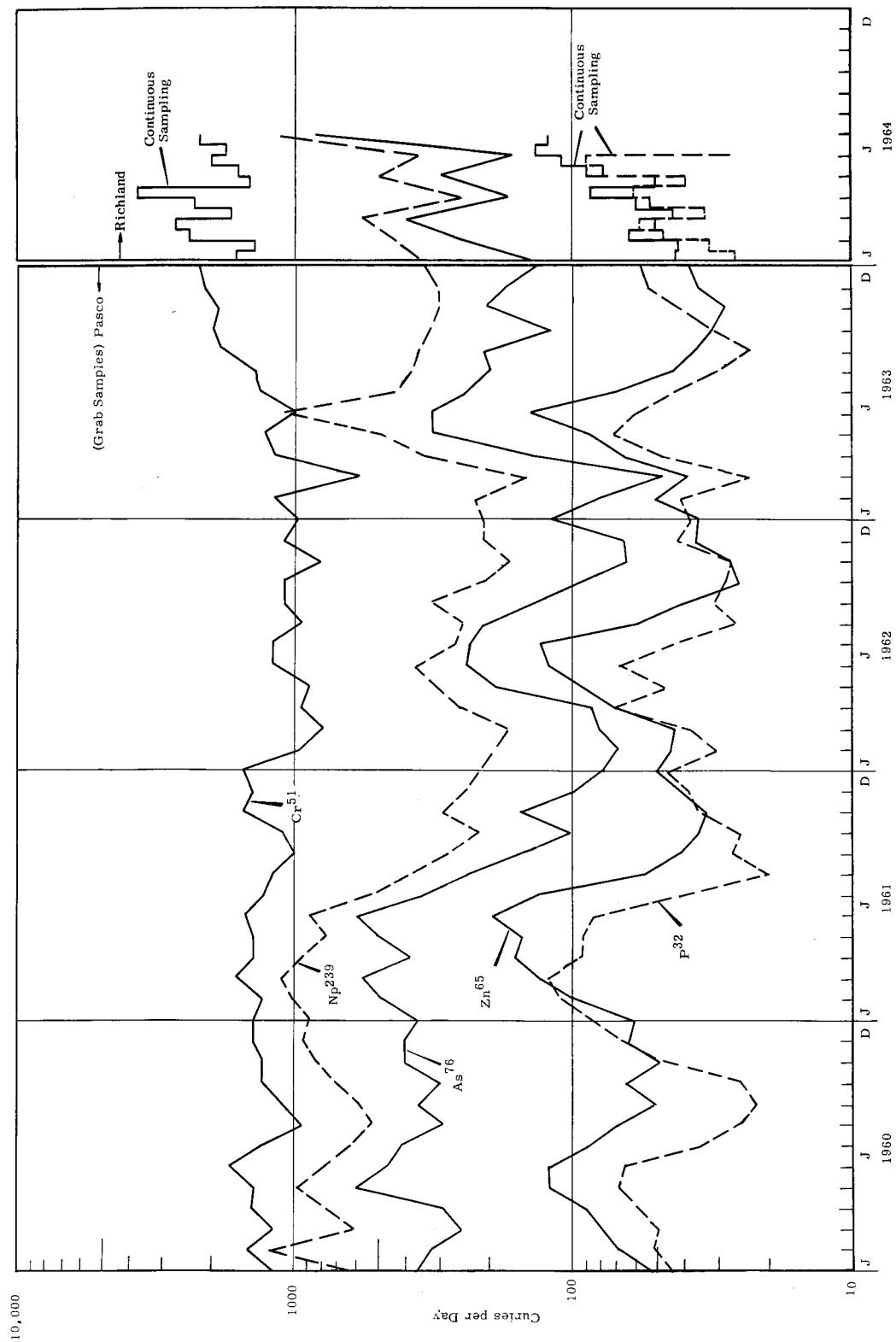

FIGURE 9

Rate of Transport of Radionuclides at Pasco and Richland, Washington

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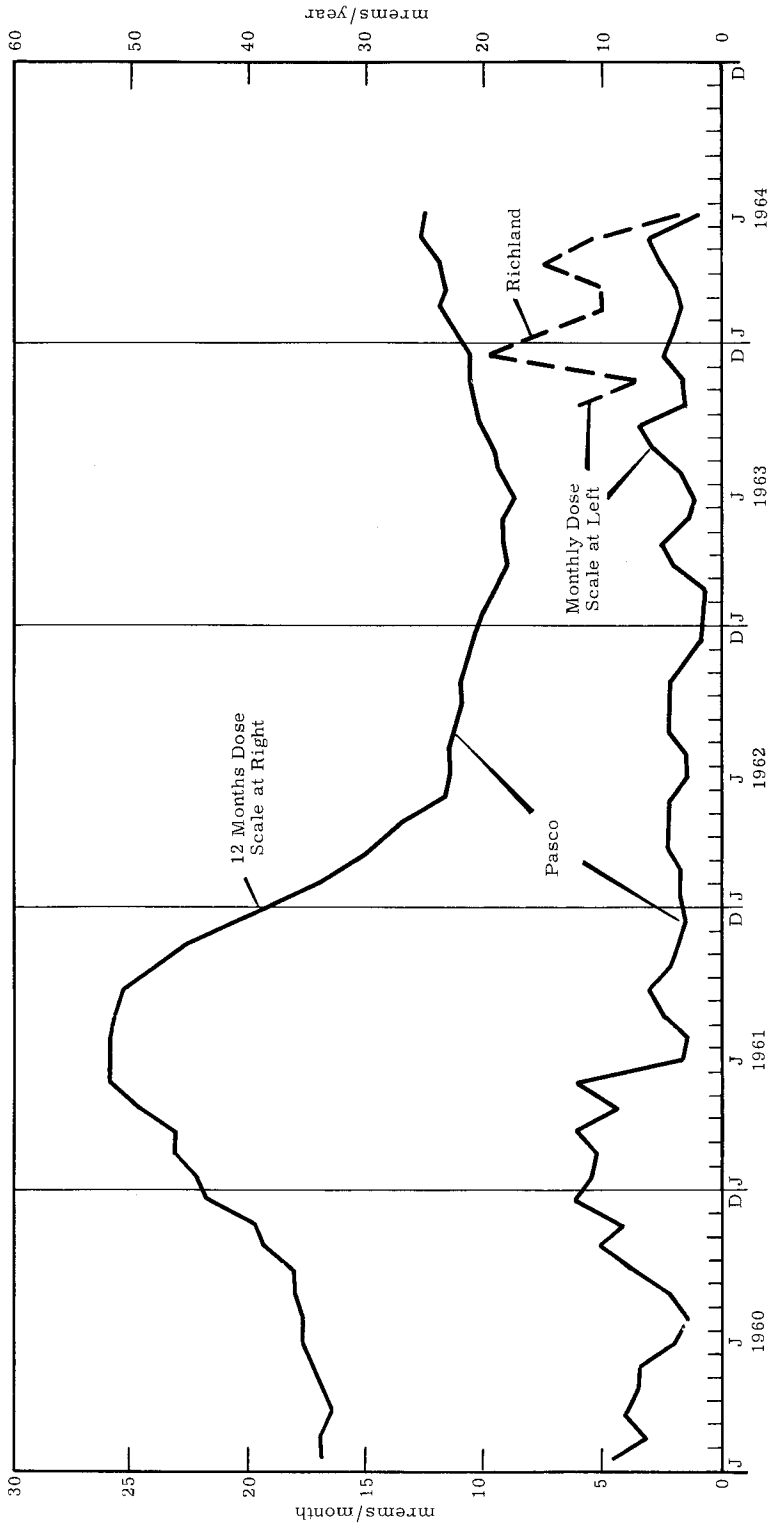

FIGURE 10

Calculated Dose to GI Tract from Pasco and Richland Sanitary Water

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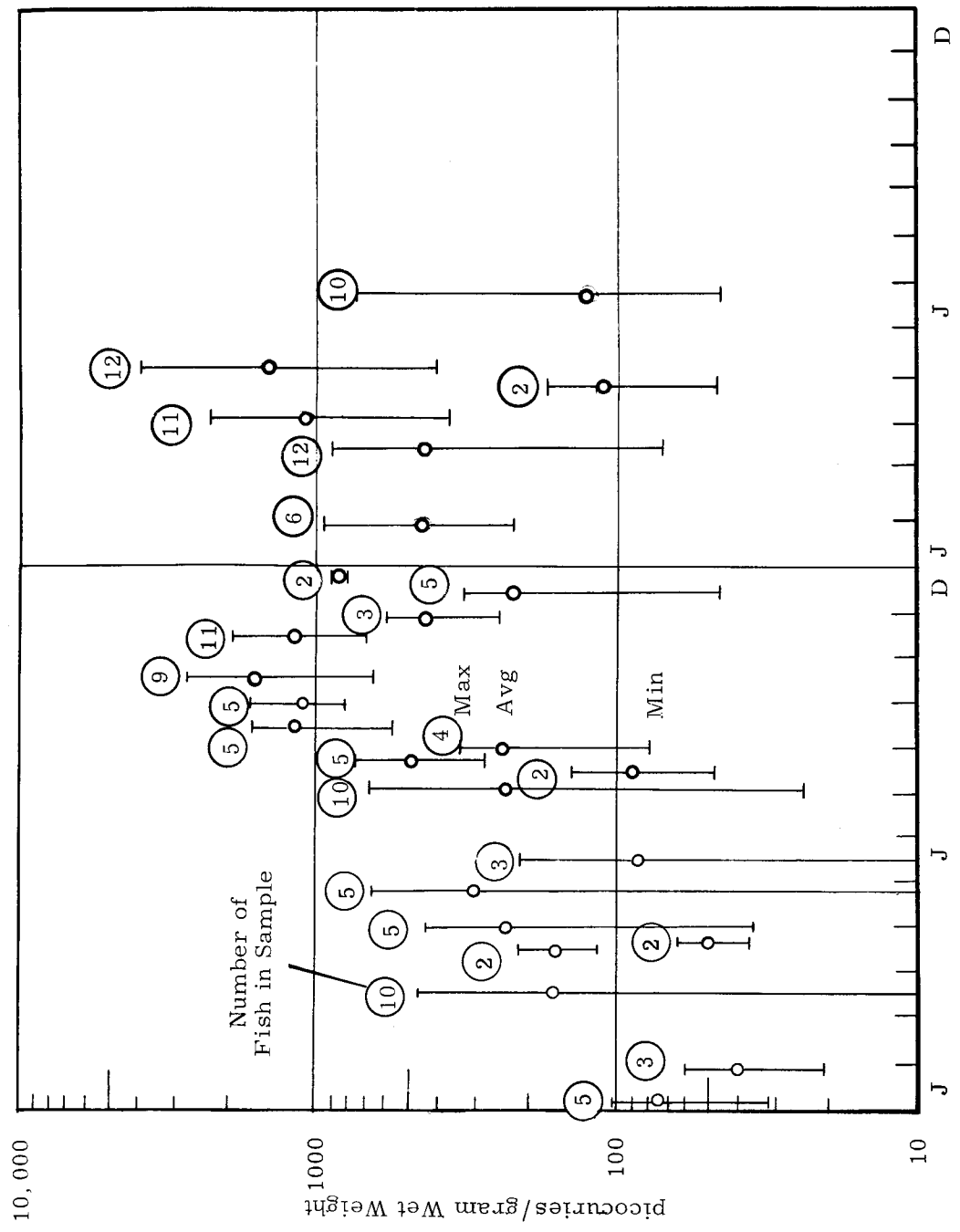

FIGURE 11

P^{32} in Whitefish Caught in Columbia River Between Ringold and Richland

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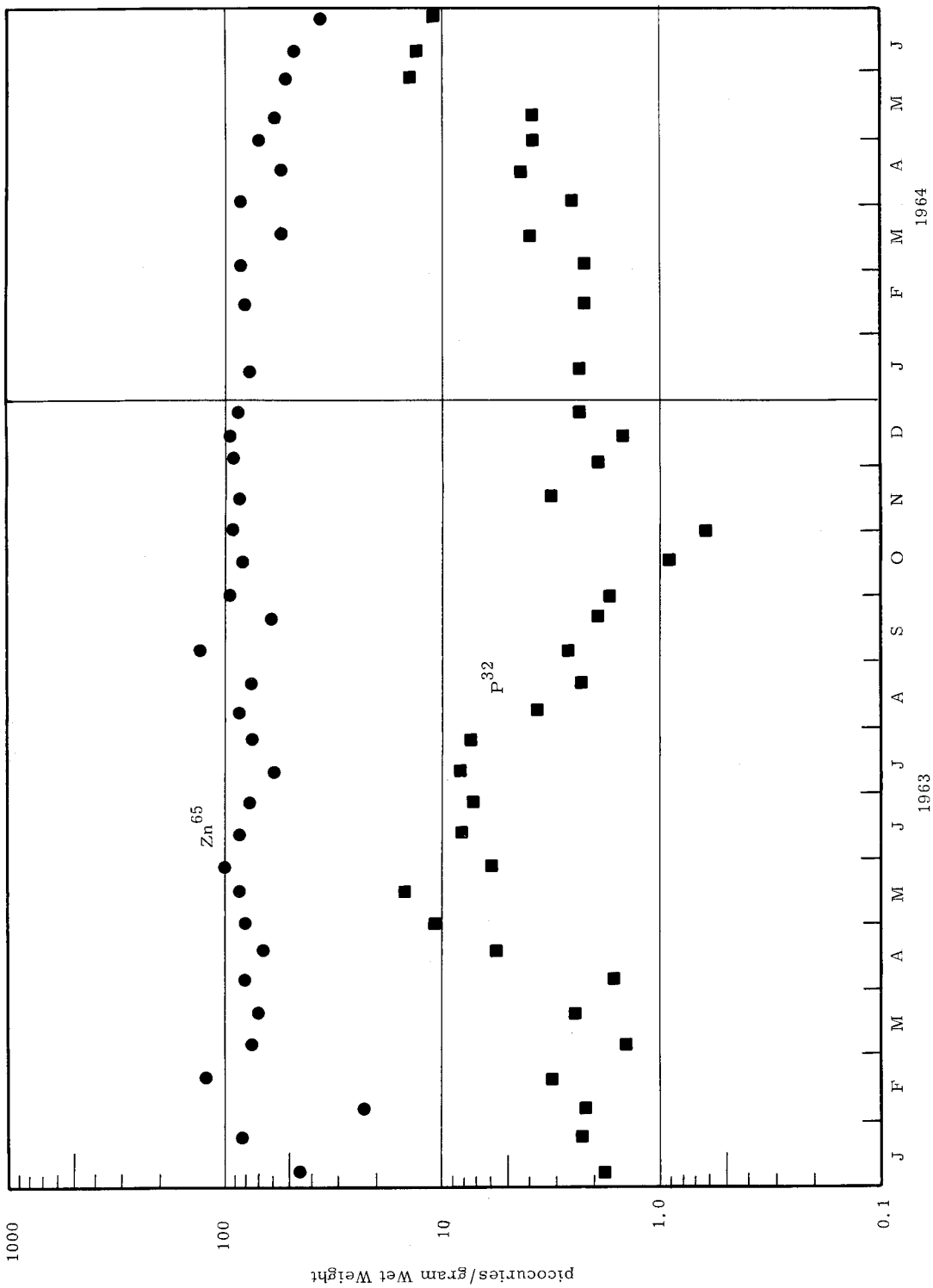

FIGURE 12
Zn^{65} and P^{32} in Willapa Bay Oysters

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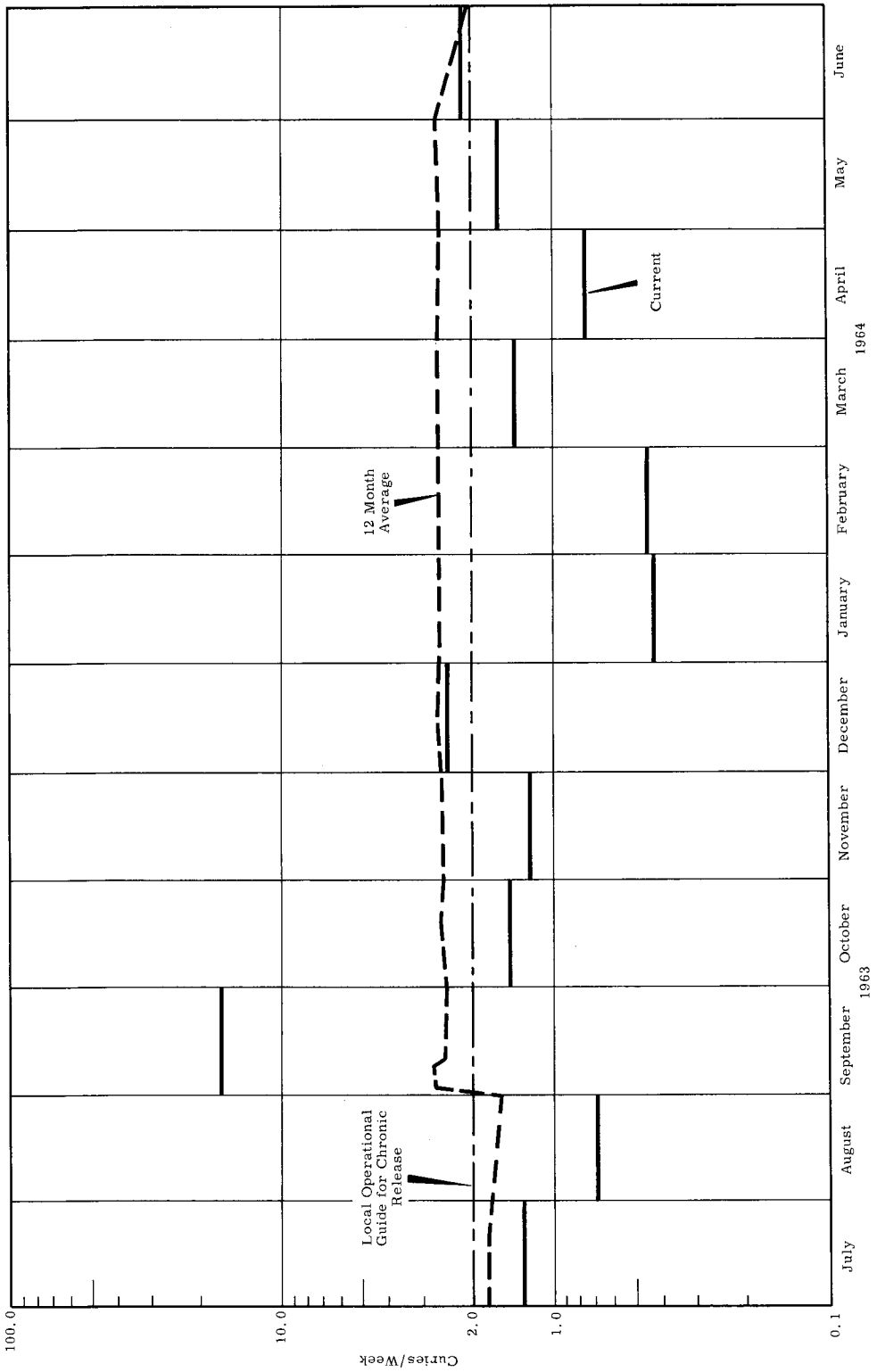

FIGURE 13
Release of I^{131} to the Atmosphere

AEC-GE RICHLAND, WASH.

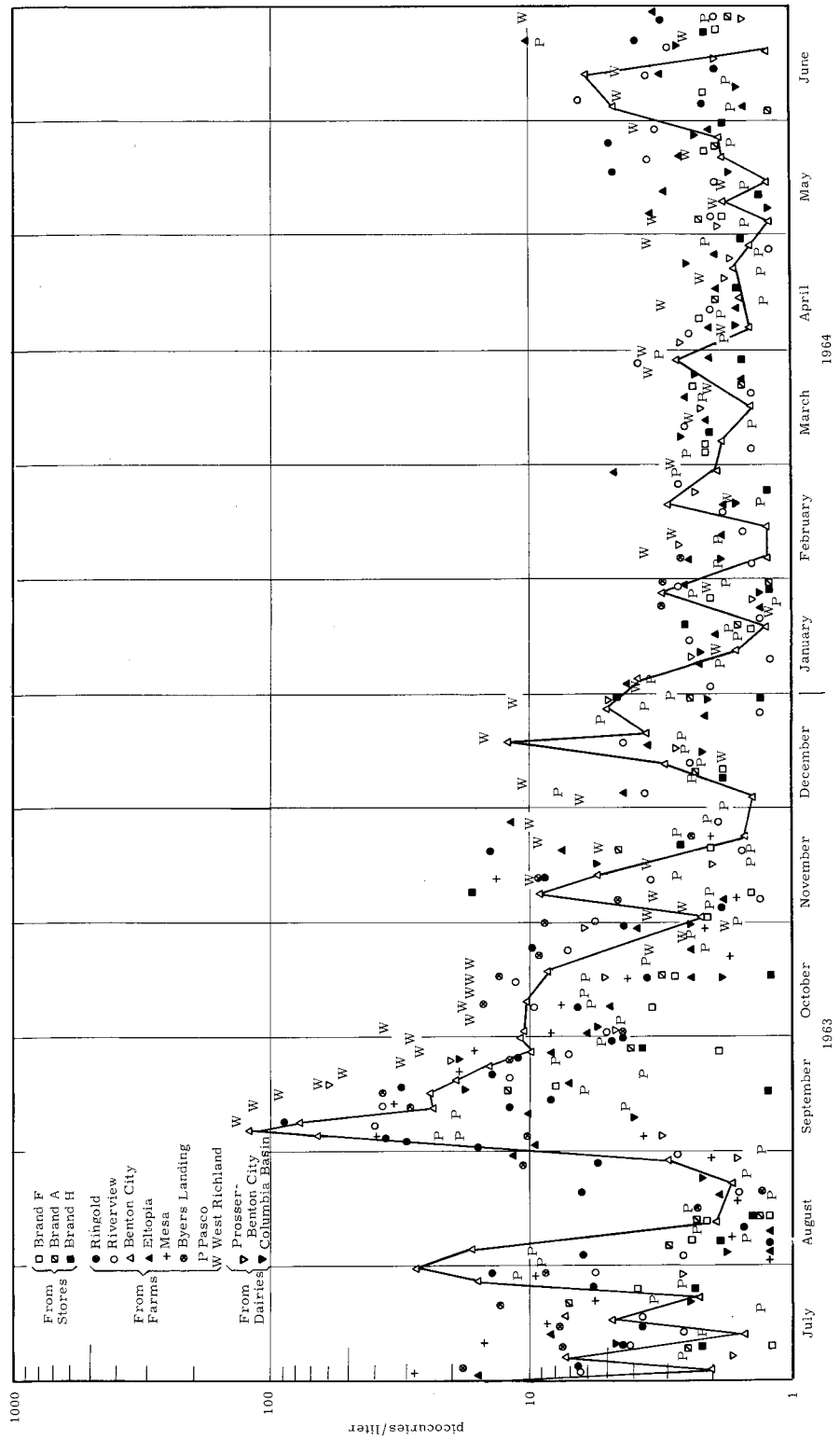

FIGURE 14
I^{131} in Locally Produced Milk

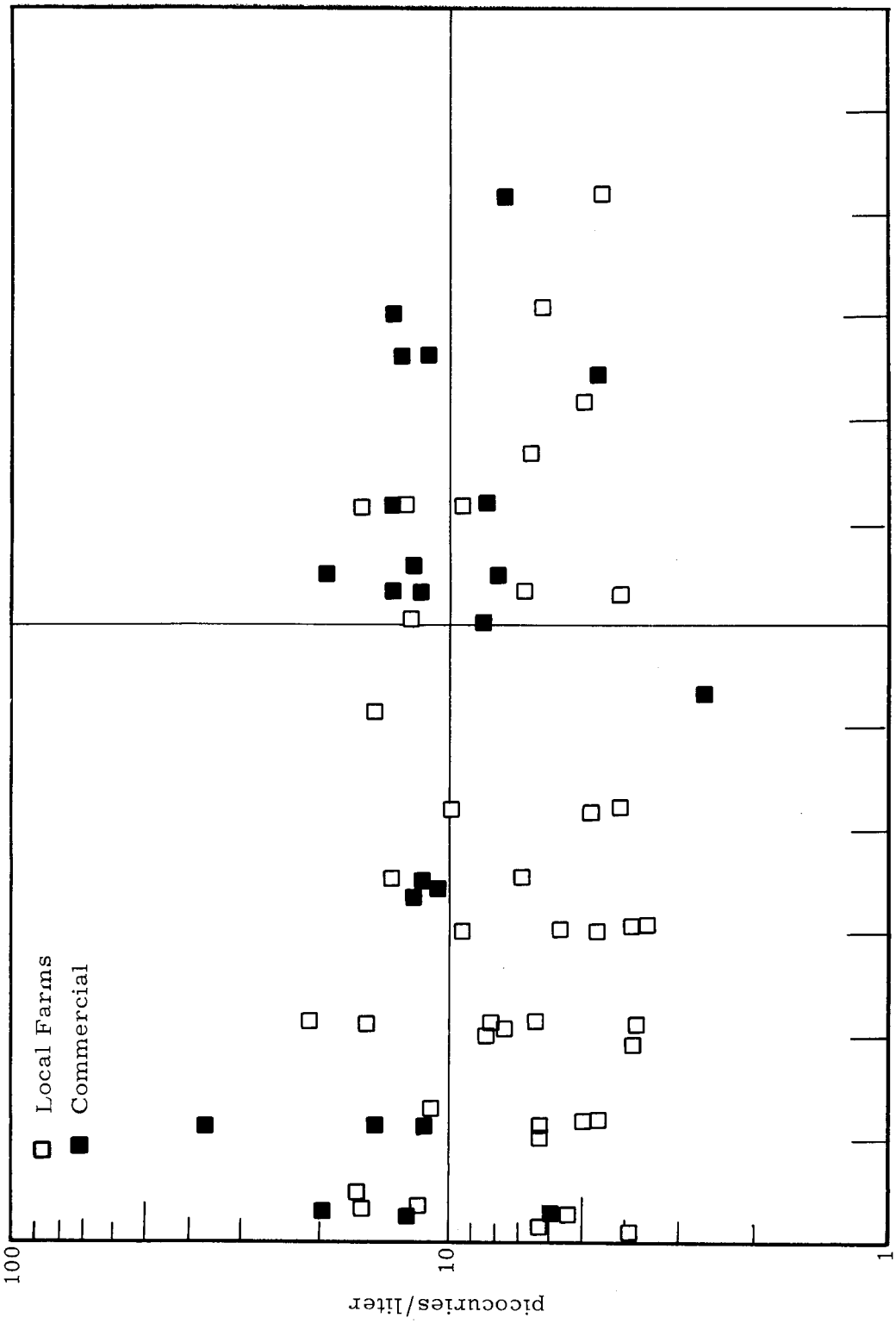

FIGURE 15
Sr^{90} in Locally Produced Milk

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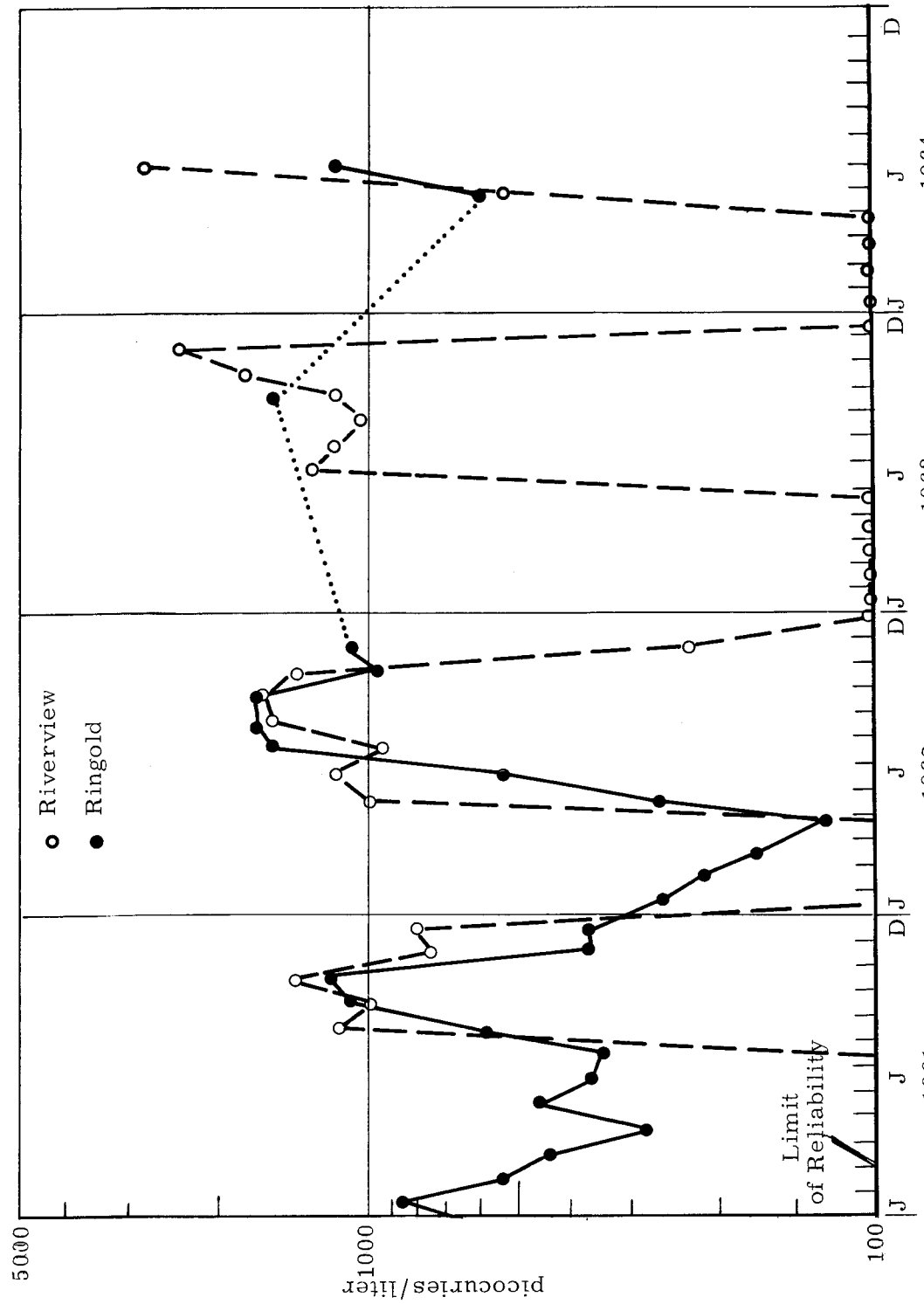

FIGURE 16
P^{32} in Locally Produced Milk

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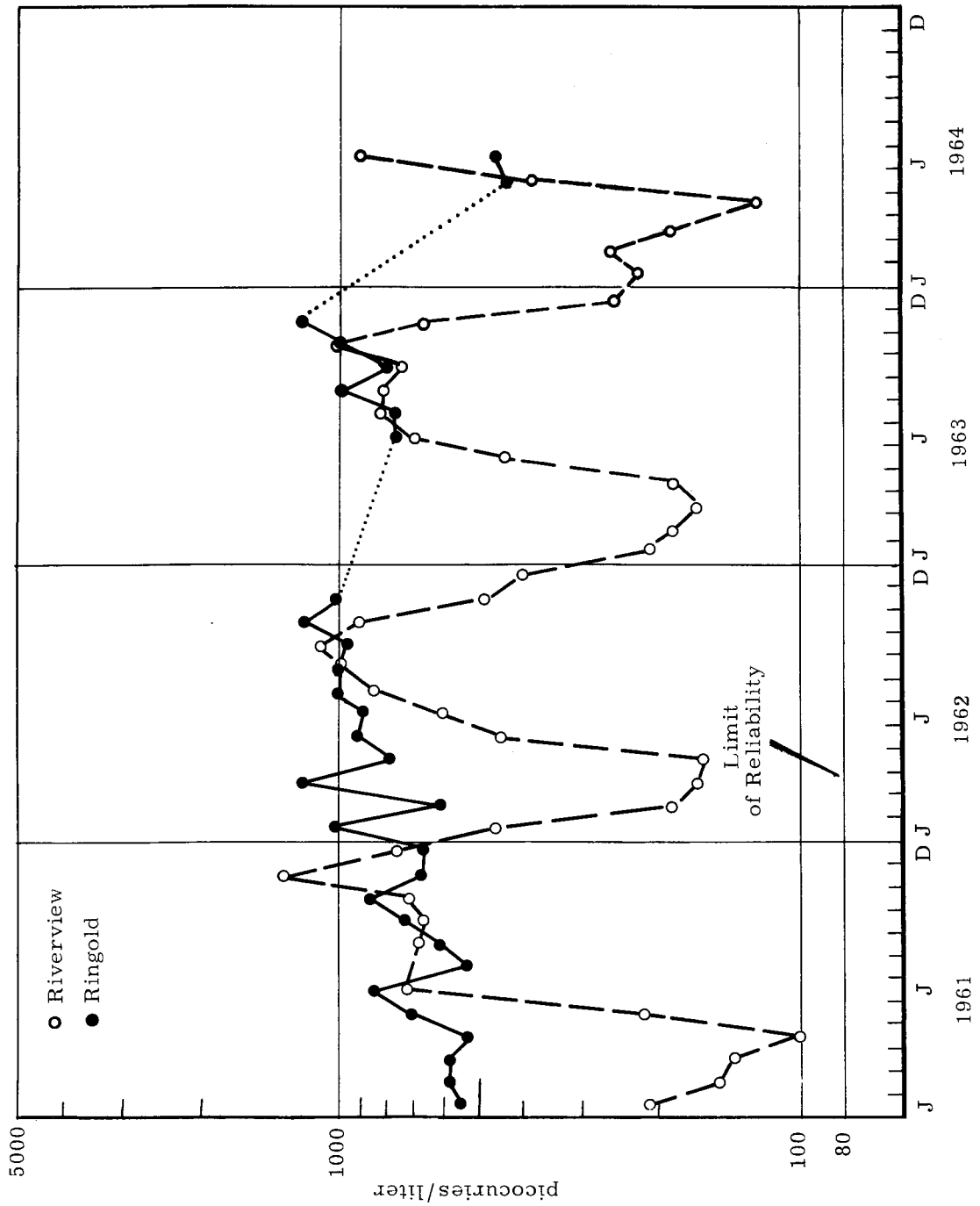

FIGURE 17
Zn^{65} in Locally Produced Milk

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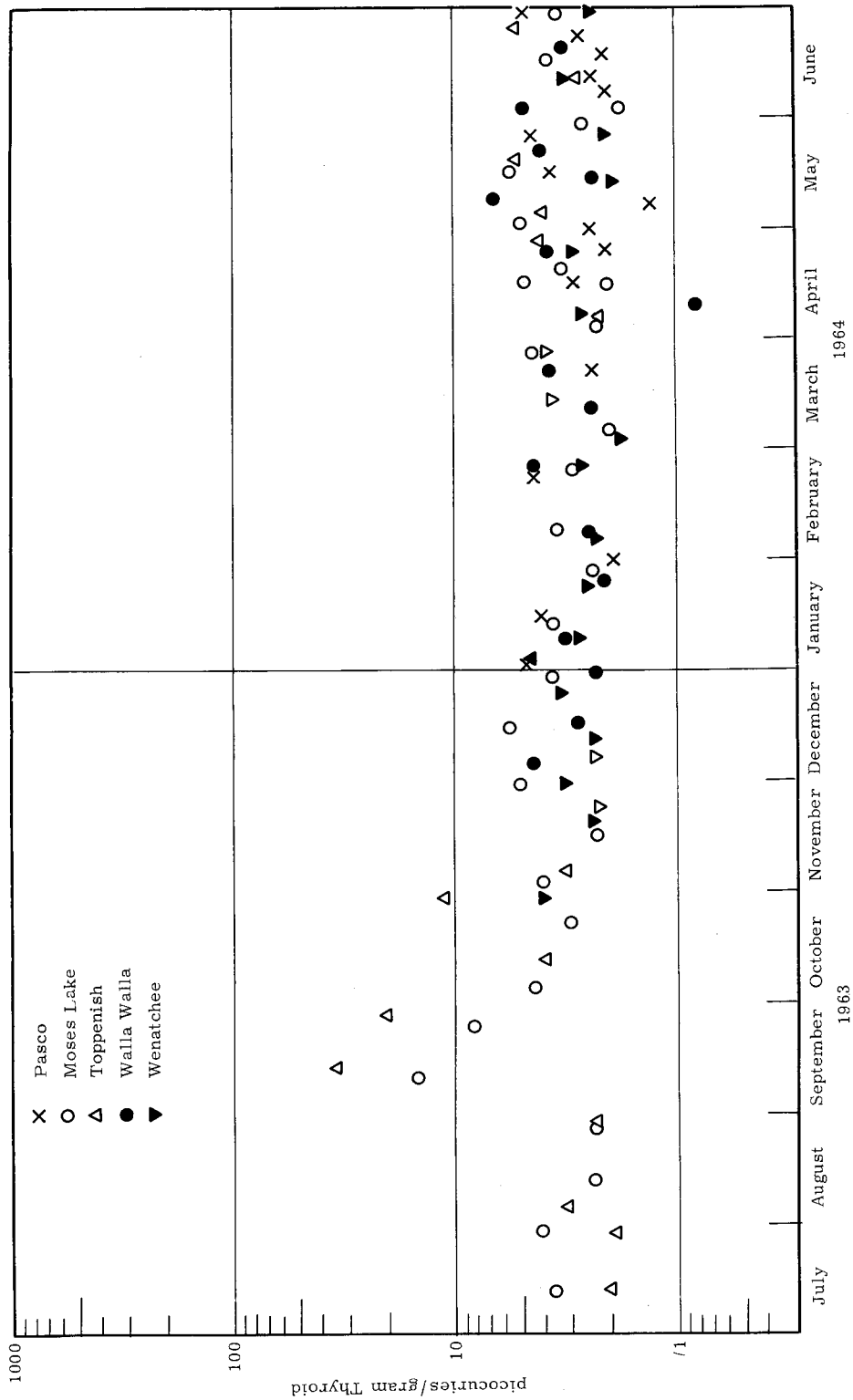

FIGURE 18
Average Concentrations of I^{131} in Beef Cattle Thyroids

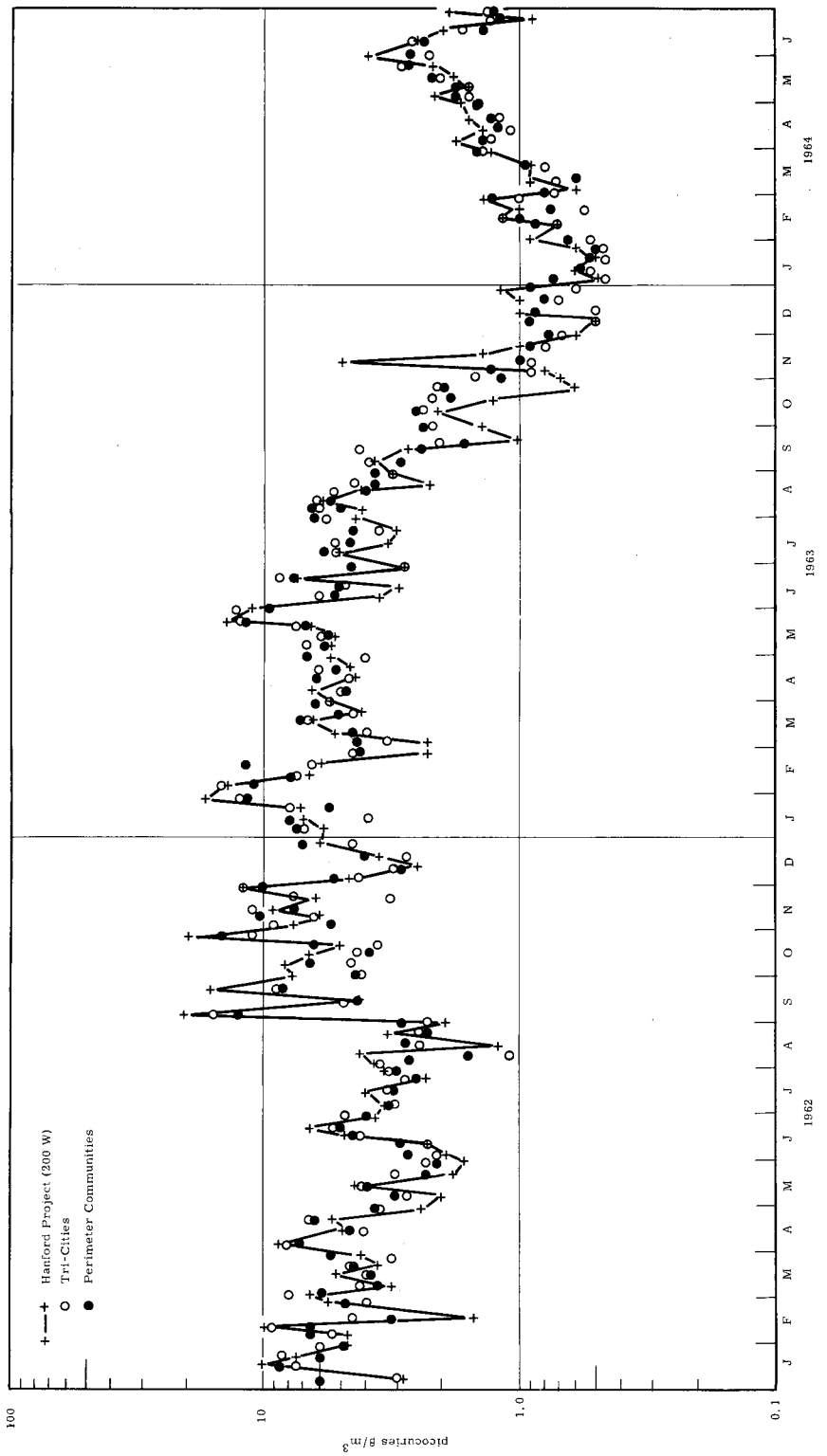

FIGURE 19

Activity on Filters from Several Hanford Perimeter Sampling Stations

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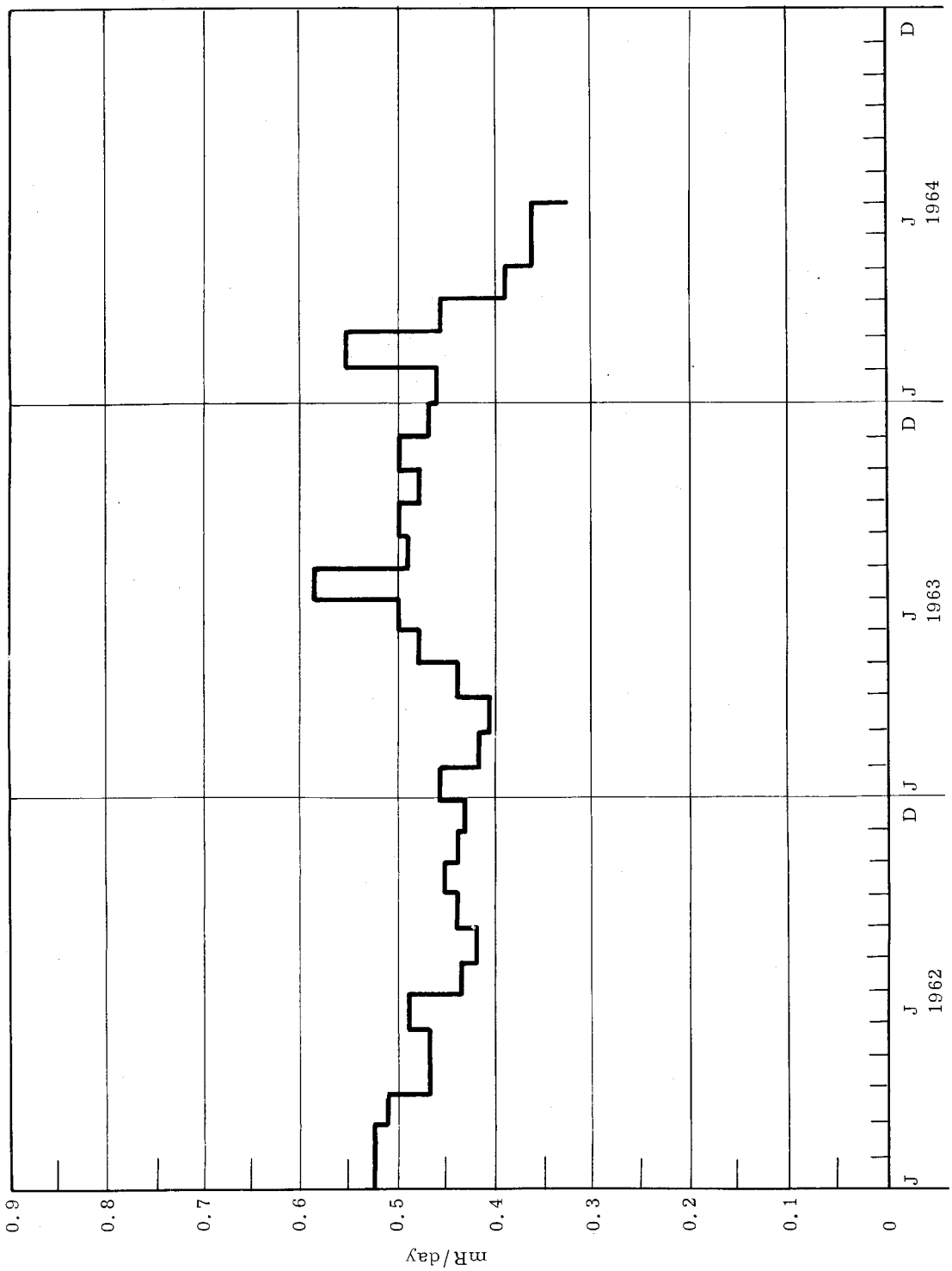

FIGURE 20

External Dose Rate as Measured at Hanford External Dose Test Location

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