HASL-224

407965

health and safety laboratory

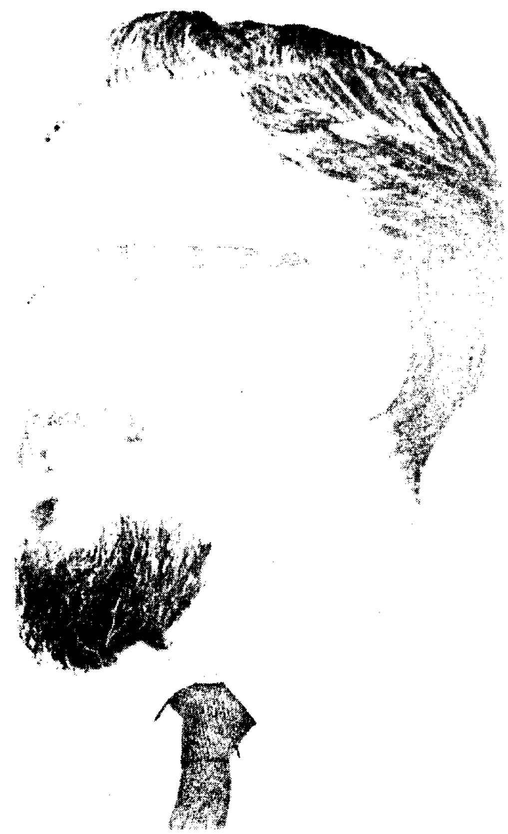
FALLOUT PROGRAM
QUARTERLY SUMMARY REPORT

April 1, 1970

UNITED STATES ATOMIC ENERGY COMMISSION
NEW YORK, N. Y. 10014

Printed in the United States of America
Available from
Clearinghouse for Federal Scientific and Technical Information
National Bureau of Standards, U. S. Department of Commerce
Springfield, Virginia 22151
Price: Printed Copy $3.00; Microfiche $0.65

GPO 963-577



Joseph Rivera suffered a heart attack and died on January 31, 1970. We are greatly saddened by the loss of our good friend and colleague. Soon after joining the Health and Safety Laboratory in 1960, Joe helped to implement the human diet and bone studies at HASL. He continued to pursue these and other investigations with the basic aim of estimating the exposure of man from radioactive fallout.

His strong interest in and involvement with the United Nations Scientific Committee on the Effects of Atomic Radiation, the National Committee on Radiation Protection and Measurements, and the Federal Radiation Council, exposed his scientific skills as well as his good humor to scientists from many areas of the world.

Joe was co-editor of the HASL "Quarterly". His advice and many contributions will be sorely missed. He was an independent thinker whose ideas and talents were sought in almost every endeavor at HASL.

HASL-224

UC-41, Health and Safety
TID-4500, 54th Ed.

HEALTH AND SAFETY LABORATORY

FALLOUT PROGRAM
QUARTERLY SUMMARY REPORT

(December 1, 1969 through March 1, 1970)

Prepared by

Edward P. Hardy, Jr.

Environmental Studies Division

Preceding reports in this series:

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April 1, 1970

UNITED STATES ATOMIC ENERGY COMMISSION
New York Operations Office

NYOO
Health and Safety

FALLOUT PROGRAM
QUARTERLY SUMMARY REPORT

April 1, 1970

A B S T R A C T

This report presents current data from the HASL Fallout Program, the National Radiation Laboratory in New Zealand, the Department of Scientific and Industrial Research in New Zealand, The EURATOM Joint Nuclear Research Centre and The Radiological Physics Division at Argonne National Laboratory. The initial section consists of interpretive reports and notes covering the following topics: radium-226 in diet, plutonium-239 anomaly in the troposphere, and the quality of radiochemical analyses in the HASL surface air sampling program. Subsequent sections include tabulations of radionuclide levels in stratospheric air, surface air, fallout, milk, other diet components, and tap water. A bibliography of recent publications related to radionuclide studies is also presented.

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Part II

HASL Fallout Program

INTRODUCTION

Every three months, the Health and Safety Laboratory issues a report summarizing current information obtained at HASL pertaining to fallout. This report, the latest in the series, contains information that became available during the period from December 1, 1969 to March 1, 1970. The next report is scheduled for publication July 1, 1970. Preceding reports in the series, starting with HASL-42, "Environmental Contamination from Weapons Tests", and continuing through HASL-224, (this report) may be purchased from the Clearinghouse for Federal Scientific and Technical Information, National Bureau of Standards, U. S. Department of Commerce, Springfield, Virginia 22151. A complete listing of these Fallout Program Quarterly Summary Reports is given on the title page of this report.

To give a more complete picture of the current fallout situation and to provide a medium for rapid publication of radionuclide data, these quarterly reports often contain information from other laboratories and programs, some of which are not part of the general AEC program. To assist in developing, as rapidly as possible, provisional interpretations of the data, special interpretive reports and notes prepared by scientists working in the field of fallout are also included from time to time. Many of these scientists are associated in some way with the general AEC program. Information developed outside of HASL is identified as such and is gratefully acknowledged by the Laboratory. In this report, data from the EURATOM Joint Nuclear Research Center at Ispra, the Division of Radiological Physics at Argonne National Laboratory, the National Radiation Laboratory in New Zealand and the Department of Scientific and Industrial Research in New Zealand, are given.

A portion of the radiochemical analyses either have been or are being carried out by commercial laboratories under contract to the HASL Environmental Studies Division. The results of these analyses are reported as part of HASL's regular fallout program. The contractor analytical laboratories which provided data are Nuclear Science and Engineering Corporation, Pittsburgh, Pennsylvania; Isotopes, Inc., Westwood, New Jersey; Radiochemistry Incorporated, Louisville, Kentucky; Tracerlab, Division of LFE, Richmond, California (now Trapelo Division/West); Controls for Radiation, Inc., Cambridge, Mass.; Hazleton-Nuclear Science Corporation, Palo Alto, Calif.; Food, Chemical and Research Laboratories, Inc., Seattle, Washington; Tracerlab, Division of LFE, Waltham, Mass; U. S. Testing Co., Inc., Richland, Washington, Custom Nuclear Co., Mountainview, California, and Ledoux and Co., Teaneck, New Jersey.

This report is divided into four main parts:

1. Interpretive Reports and Notes
2. HASL Fallout Program Data
3. Data from Sources Other than HASL
4. Recent Publications Related to Radionuclide Studies

PART I

INTERPRETIVE REPORTS

AND

N O T E S

RADIUM-226 IN THE DIET OF TWO U. S. CITIES

I. M. Fisenne and H. W. Keller

A revised estimate of the daily radium-226 dietary intake in three cities (New York City, Chicago and San Francisco) was reported in April 1969.[1] At that time, a comparison of the 1960 and 1966 diet estimates showed that the 1966 values were from 27% to 50% lower than the 1960 values. This difference was due to the change in the analytical procedure for radium-226. To obtain a more representative estimate of dietary intake, a second food sampling from the New York City and San Francisco was analyzed for radium-226. No Chicago diet samples were available for analyses, since food sampling from this city was terminated in 1968. Samples of New York City and San Francisco area tap water were also analyzed for radium-226.

The HASL food sampling program is described in HASL-200.[2] The tap water samples from New York City represent an integrated one month collection. The San Francisco area tap water sample was collected on a single day.

The radium-226 diet level estimates are shown in Tables 1 and 2. Duplicate sample analyses are also listed. The yearly consumption figures are taken from a U. S. Department of Agriculture report.[3] The average daily intake of radium-226 in the two cities may be computed from these data.

New York City	San Francisco
1.7 pCi/day	0.8 pCi/day

These values do not include the contribution of radium-226 from tap water. However, the radium-226 content of the water is low and would not materially increase the daily intake estimate.

New York City	San Francisco
0.011 pCi/liter	0.015 pCi/liter

Comparison of the two surveys in Tables 1 and 2 shows that although individual food types may vary by more than a factor of 2, the average daily intake for each city varies by less than 20% or within expected experimental error. It should also be noted that both the 1966 and 1968 food samplings were collected at mid-year so that possible seasonal variation was not studied. It seems unlikely that a significant seasonal variation in dietary radium-226 would exist for a given location.

The California State Department of Health has estimated the daily radium-226 intake of individuals receiving a hospital diet. The average daily radium-226 intake for Berkeley, California hospital diets from November 1967 to June 1968 was 0.4 pCi/day.(4) Similar diets collected from April to December 1968 in San Francisco averaged 1.3 pCi/day.(5,6,7)

The radium-226 content of human bone from New York City and San Francisco is 0.036 pCi/g Ca and 0.031 pCi/g Ca, respectively. Since the dietary radium-226 levels for these cities are different by about a factor of two, it would be expected that the bone levels would reflect this difference. We suggest that a particular dietary component or a combination of a few components may control the radium-226 level in man. Little is known about the availability of radium-226 from foodstuffs, but there is indication that it is quite variable. We are initiating a few studies to attempt to correlate radium-226 bone levels with particular dietary components.

TABLE 1

Radium-226 in New York City Diet

Diet Category	kg/yr	g Ca/yr	1966 pCi/kg	1966 pCi/yr	1968 pCi/kg	1968 pCi/yr	Average pCi/kg	Average pCi/yr
Dairy Products	200	216.0	0.25	50	0.30* 0.19*	60 38	0.25	50†
Fresh Vegetables	48	18.7	0.50	24	1.6 1.6	77 77	1.1	53
Canned Vegetables	22	4.4	0.65	14	0.68	15	0.67	15
Root Vegetables	10	3.8	1.4	14	1.2	12	1.3	13
Potatoes	38	3.8	2.8	106	1.7	65	2.3	87
Dry Beans	3	2.1	1.1	3.3	0.98	2.9	1.0	3
Fresh Fruit	59	9.4	0.43	25	0.20	12	0.32	19
Canned Fruit	11	0.6	0.17	1.9	0.15 0.16	1.7 1.8	0.16	1.8
Fruit Juice	28	2.5	0.42	12	0.90	25	0.66	18
Bakery Products	44	53.7	2.8	123	1.7	75	2.3	101
Flour	34	6.5	1.9	65	2.3	78	2.1	71
Whole Grain Products	11	10.3	2.2	24	2.7	30	2.5	28
Macaroni	3	0.6	2.1	6.3	1.4	4.2	1.8	5.4
Rice	3	1.1	0.76	2.3	3.3	9.9	2.0	60

TABLE 1

Radium-226 in New York City Diet

Diet Category	kg/yr	g Ca/yr	1966 pCi/kg	1966 pCi/yr	1968 pCi/kg	1968 pCi/yr	Average pCi/kg	Average pCi/yr
Meat	79	12.6	0.01	0.8	0.02	1.6	0.02	1.6
Poultry	20	6.0	0.76	15	0.10 0.11	2.0 2.2	0.44	8.8
Eggs	15	8.7	6.1	92	14 14	210 210	10	150
Fresh Fish	8	7.6	0.67	5.4	1.1	8.8	0.89	7.1
Shellfish	1	1.6	0.80	0.8	0.90	0.9	0.85	0.9
Yearly Intake		370		584.8		680.2		639.6
Daily Intake pCi/g Ca				1.6		1.8		1.7

*Two different samples
†Average of three samples

TABLE 2

Radium-226 in San Francisco Diet

Diet Category	kg/yr	g Ca/yr	1966 pCi/kg	1966 pCi/yr	1968 pCi/kg	1968 pCi/yr	Average pCi/kg	Average pCi/yr
Dairy Products	200	216.0	0.10	20	0.09	18	0.09	18
					0.08	16		
Fresh Vegetables	48	18.7	0.48	23	0.80	38	0.66	32
					0.88	42		
Canned Vegetables	22	4.4	0.35	7.7	0.36	7.9	0.36	7.9
Root Vegetables	10	3.8	1.2	12	1.5	15	1.4	14
Potatoes	38	3.8	0.14	5.3	0.33	13	0.24	9.1
Dry Beans	3	2.1	0.72	2.2	0.67	2.0	0.70	2.1
Fresh Fruit	59	9.4	0.25	15	0.27	16	0.26	15
Canned Fruit	11	0.6	0.70	7.7	0.16	1.8	0.44	4.8
					0.19	2.1		
Fruit Juice	28	2.5	0.33	9.2	0.79	22	0.56	16
Bakery Products	44	53.7	1.2	53	1.6	70	1.4	62
Flour	34	6.5	1.4	48	1.4	48	1.4	48
Whole Grain Products	11	10.3	2.1	23	2.2	24	2.2	24
Macaroni	3	0.6	2.6	7.8	1.7	5.1	2.2	6.6
Rice	3	1.1	0.24	0.7	0.33	1.0	0.29	0.9
Meat	79	12.6	0.01	0.8	0.02	1.6	0.02	1.6

TABLE 2

Radium-226 in San Francisco Diet

Diet Category	kg/yr	g Ca/yr	1966 pCi/kg	1966 pCi/yr	1968 pCi/kg	1968 pCi/yr	Average pCi/kg	Average pCi/yr
Poultry	20	6.0	0.43	8.6	0.38	7.6	0.41	8.2
Eggs	15	8.7	2.0	30	1.5	23	1.8	27
Fresh Fish	8	7.6	0.40	3.2	0.11	0.9	0.26	2.1
Shellfish	1	1.6	1.9	1.9	1.1	1.1	1.5	1.5
Yearly Intake		370		279.1			317.2	300.8
Daily Intake pCi/g Ca				0.75			0.86	0.81

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USAEC Report HASL-207, April (1969), p. 1-2

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(7) State of California Department of Public Health,
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Environmental Management
Radionuclides in Institutional Diet Samples, October - December 1968
USDHEW, PHS, Radiological Health Data and Reports,
Vol. 10, No. 7, July (1969), p. 308-311

All of the values reported by the contractor are corrected for a reagent blank, so that the blank values reported here reflect the contamination of the filter material both during manufacture and during handling at HASL and at the contractor laboratory.

Table 1 lists the results of the analyses of the blanks for each nuclide. In general these data indicate low levels of contamination for most of the nuclides, however it is significant to note that the average Pu-238 blank rose from 0.04 dpm in 1967 to 0.22 dpm in 1968. Because the amount of Pu-238 found in surface air samples is frequently in the range of 1 dpm this blank may represent a significant fraction of the total activity.

The results of analyses on standard samples are shown in Table 2. These data are indicative of the accuracy of the radiochemical analyses. The values shown are the average percent deviations between the added activities and the results reported by the contractor. Although most of the results are satisfactory, there appears to be a large positive bias in the Pu-238 values for much of 1968, which cannot be accounted for by the increase of the blank contamination. Samples submitted to the contractor during 1969 which were prepared with a new standard solution do not exhibit this bias, and it is therefore probable that the poor results reflect a degeneration of the Pu-238 standard solution used for the preparation of the 1968 quality control samples.

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Sr-90 in Surface Air; 1963-1967
USAEC Report HASL-204, January (1969), pp I-17 - I-27

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USAEC Report HASL-204, January (1969), pp I-28 - I-46

Table 1

Quality Control Results - Blanks - 1968

(Values in dpm/sample ± 1 std. Deviation)

	Fe-55	Sr-89	Sr-90	Zr-95	Cs-137	Ce-141	Ce-144	Pu-238	Pu-239	Stable Pb
January	42±67	7.5±4.6	0±.5	2.5±4.9	--	13±73	1.5±3.4	.34±.05	.04±.02	--
February	24±59	--	0.5±1.5	3.0±6.0	--	--	2.0±3.0	L	L	--
March	62±137	--	23.8±12.4	0±6.4	--	--	6.7±4.1	.18±.01	.09±.03	--
April	0±156	--	0±.03	1.4±13	--	--	5.4±2.5	0±.04	0±.03	--
May	0±86	--	0±1.1	0±8.8	--	--	0±3.3	.29±.05	.03±.02	--
June	96±72	--	1.6±4.3	3.1±6.1	--	--	0±1.9	.37±.05	0 ± .03	--
July	--	7.1±20.1	0.5±1.3	0.9±7.2	0.2±0.4	--	2.1±2.8	.36±11	.12±.10	--
August	--	0±2.3	0.5±0.4	9.3±4.4	0.7±4.0	--	2.0±1.6	.29±.07	.05±.05	--
September	--	0±1.5	0 ± 0.4	2.8±3.0	1.5±0.5	--	1.6±1.6	.41±.06	0 ±.03	--
October	--	--	0 ± 2.3	--	5.2±0.7	--	3.0±6.6	.11±.03	0 ±.02	.03
November	--	--	0.1±0.8	5.7±8.8	0.9±0.5	--	0.9±2.8	.06±.03	0 ±.03	--
December	--	--	0.9±3.2	13.5±16.1	0.1±0.5	--	229±270	.11±.09	0 ±.07	0.0

NOTE: L indicates sample lost

-- indicates no analysis

Table 2

Quality Control Results - Standards-1968
(Average values in % Deviation)

	Fe-55	Sr-89	Sr-90	Zr-95	Cs-137	Ce-144	Pu-238	Pu-239	Stable Pb
January	12.5	-12.5	-4.0	-13.0	--	-2.0	-8.5	-3.5	--
February	18.0	--	-16.0	-19.5	--	-1.5	17.0	3.0	--
March	21.5	--	-1.0	-21.0	--	-3.0	15.5	0.5	--
April	5.5	--	-5.5	-13.5	--	0.5	16.0	-0.5	--
May	-5.0	--	-22.0	-22.0	--	2.5	9.5	1.0	--
June	13.0	--	-9.0	-16.0	--	3.5	10.0	1.0	--
July	--	--	1.0	-6.0	11.0	10.0	10.0	1.0	--
August	--	66.5	-13.5	-6.0	-5.0	-2.0	29.0	-3.5	
September	--	-11.5	-6.5	-7.0	-8.0	2.0	9.0	0.5	--
October	--	--	-3.5	--	-6.0	1.0	26.5	2.0	11.3
November	--	--	-1.5	-11.5	-	8.0	39.0	6.1	27.0
December	--	--	-5.0	-14.8	1.0	4.5	35.0	3.9	2.7

NOTE: -- indicates no analysis.

Plutonium-239 Anomaly in the Troposphere

by H. L. Volchok, (HASL)
P. W. Krey, (HASL)

During the period mid-1968 through mid-1969, some unusual behavior of Pu-239 relative to Sr-90 has been observed in surface air. For many months and at many surface air sampling stations in the Northern Hemisphere, the ratio Pu-239/Sr-90 exceeded all values in the stratosphere at comparable times. Although a number of possibilities are discussed in this paper, this apparent enrichment of Pu-239 is not readily explainable.

Most of the Pu-239 existing in the world came about by the interaction of enormous neutron fluxes in atomic explosions with the U-238 present in such devices (1,2) or from unfissioned Pu-239 from the cores of the weapons. Much smaller amounts may have been released to the environment by a variety of accidents and incidents on the earth's surface such as airplane crashes at Thule, Greenland, and Palomares, Spain (3) or the recently publicized contamination in the neighborhood of Rocky Flats, Colorado (4). Sr-90 on the other hand has been released to the atmosphere mainly in nuclear explosions as a product of the fission reaction. Since the major production modes of these two radionuclides are very different, their distribution in the stratosphere and surface air have been studied for some time.

Stratospheric Data

The Pu-239/Sr-90 ratios at 19.2 km and just above the tropopause are illustrated in Figures 1 and 2 for the period August 1967 through April 1969. These figures were constructed from data obtained in Project Airstream (5,6,7,8) and represent the minimum and maximum altitudes routinely sampled in this program. Since the tropopause height varies with latitude, the altitudes in Figure 2 also vary as follows:

Latitude	Altitude
$75^\circ N-65^\circ N$	12.2 km
$65^\circ N-36^\circ N$	13.7 km
$36^\circ N-34^\circ S$	15.2 km
$34^\circ S-51^\circ S$	13.7 km

Figure 1 shows that at the higher altitude, the Pu-239/Sr-90 was uniformly less than 2% in both hemispheres, until the debris from the 6th Chinese test of June 1967 was intercepted in the last quarter of the year. At this point the ratio rose to greater than 2 but less than 3% and essentially remained within this range through all of 1968. The contours suggest that this debris at 19.2 km crossed the equator into the Southern Hemisphere in the spring of 1968 and influenced the ratio to as far south as the Airstream sampling network extends, $51^\circ S$.

Figure 1 further shows that the French thermonuclear tests in mid-1968 abruptly ended the influence of the 6th Chinese test debris in the Southern Hemisphere, plunging the ratio to below 1%. The Chinese 8th test in December of 1968 apparently generated a ratio of Pu-239/Sr-90 of about 2% since the pattern in the Northern Hemisphere was not markedly affected in early 1969.

The Pu-239/Sr-90 in the lower stratosphere, just above the tropopause, is illustrated in Figure 2, and exhibited a similar pattern with one striking difference. At this altitude the high ratios generated by small French tests in the Southern Hemisphere in mid-1967 are clearly seen. Most important to note, however, is that in the Northern Hemisphere the highest ratios observed in the entire period shown were greater than 2.5% but less than 3%, and in early 1969 virtually all of the data were below 2.5%. This observation holds true not only for the lowest stratosphere but also for altitudes as high as 19.2 km (Fig. 1).

Surface Air Data

The Pu-239/Sr-90 ratios in surface air for the period 1966 through mid-1969 are shown in Figure 3. This figure was derived from the data obtained in the Health and Safety Laboratory (HASL) Surface Air Sampling Program (9).

Since the onset of our surface air analyses for Pu-239, in late 1965 through the beginning of 1968, rarely did any sample from the Northern Hemisphere indicate a ratio in excess of 2.5%, and the few that did were always analytically suspect. This relative constancy of the ratio had been noted by other investigators in earlier studies of stratospheric samples (1). In the Southern Hemisphere, high ratios in surface air were seen closely following the small French Tests in 1966 and 1967. The peak ratios appear to be displaced poleward relative to the reported latitude of the Southern Hemisphere tests. Recognizing that some debris from these tests did enter the lower stratosphere and that these peaks prevailed throughout the spring of each year, we feel that the geographical and temporal extent of the highs are not unexpected.

As a result of the 6th Chinese test (June 1967) most of which was deposited in the stratosphere, the gradual rise in the Pu-239/Sr-90 in the Northern Hemisphere surface air from less than 2% in mid-1967 to almost 3% by mid 1968 was not surprising. Starting with June 1968, however, and persisting well into 1969, numerous samples were measured with ratios over 3% and a few even exceeded 4%. From Figures 1 and 2 it seems clear that ratios such as these could not be derived from the debris in the stratosphere without some fractionation of these two nuclides between the tropopause and the earth's surface.

Discussion

There are at least five possible explanations for the anomalously high Pu-239/Sr-90 ratios observed in surface air since mid-1968. These are as follows:

1. Systematic analytical bias. The possibility of a systematic error in the radiochemical analyses seems very remote because through the period of anomalous ratios, both the stratospheric and surface air samples were analyzed by a single contractor laboratory (Trapelo/West). The performance of the contractor during this period was monitoried by analysis of coded quality control samples and found to be excellent. Furthermore, the data are seen to be internally consistent, allowing for relatively smooth contouring.

2. Non-representative sampling. The representativeness of the samples in both the Airstream and Surface Air programs have always been considered adequate. The filter media, the particle size of the debris, the face velocities and the general conditions of sampling were all considered in design of the equipment in these programs. In this light, erratic bias in the samplers seems highly unlikely. In addition the continuing balance in the Sr-90 budget in

all compartments of the earth's atmosphere and on its surface (10) suggests that the overall representativeness of the data is good.

3. Transport of debris from regions of higher ratio in either the troposphere or stratosphere. Figures 1, 2, and 3 clearly eliminate this possibility in that from mid-1968 there are no other data in either the stratosphere or surface air of either hemisphere with ratios as high as the anomalies under consideration. In view of our conclusion regarding the representativeness of the data, it appears that there are no hidden compartments or pockets in the atmosphere containing unexpected debris.

4. Tropospheric injections of Pu-239. A few major injections of Pu-239 in 1968 could theoretically have produced the high Pu-239/Sr-90 observed from mid year onward. The actual amount of "excess" Pu-239 in the surface air during the period of the anomaly, that is the amount not accountable as coming out of the stratosphere, was estimated by using average ratios and Sr-90 concentrations. It was found that 22% of the surface air ratio (on the average) was excess, which is equivalent to about 2×10^{-5} dpm/m^3 of unaccountable Pu-239.

An upper and lower limit of the average monthly tropospheric inventory of the excess Pu-239 was then estimated from the above result, depending upon the assumed distribution with altitude. If the excess assumed an altitude profile similar to that of stratospheric debris, an upper limit of 70 curies of excess Pu-239 in the troposphere was indicated. If the excess concentration is essentially constant to an elevation of 1000 meters, with nothing above, a lower limit of about 1 curie was obtained.

There were no reported atmospheric nuclear tests in the Northern Hemisphere from December 1967 to December 1968 (11); hence the mid-to-late-1968 anomalies cannot be explained as due to fresh debris. Other possible surface releases of Pu-239, such as airplane crashes with loss of nuclear material, leaks from processing plants or other similar sources cannot be evaluated with information presently available. However, since virtually all of the Pu-238 in surface air, in the period of the anomaly came out of the stratosphere (either from nuclear tests or from the burn-up of SNAP-9A) a sharp decrease in the ratio Pu-238/Pu-239 would have occurred in the event of significant tropospheric releases of Pu-239. As Figure 4 indicates, this sharp decline cannot be seen. Some decrease did occur in 1968, much of it reflecting fallout from

China's 6th test in June 1967, but this did not closely match the Pu-239 increase either in magnitude or timing. Further, in the mid latitudes in 1968, and in all latitudes in 1969, increases in the Pu-238/Pu-239 occurred.

On balance, we do not feel that the data support major tropospheric injections of Pu-239 to account for the anomalous Pu-239/Sr-90 ratios in the Northern Hemisphere. There is, however, a good deal of evidence of global, or at least hemispheric distribution of material emanating from limited sources at the earth's surface. As examples: lead, identifiable as originating in urban environments has been found in both the Arctic and Antarctic (12); dust, derived from the arid regions of West Africa, has been traced westward across the Atlantic Ocean to Barbados (13); and pesticide residues found in organs of Antarctic fauna (14), also must have been transported in the troposphere many thousands of miles. Thus there is not sufficient evidence at this time to rule out this possibility.

5. Fractionation in the troposphere. This fifth possible explanation for the observed anomalies in the Pu-239/Sr-90 ratios offers much to the imagination, but there is little if any real positive evidence. Negatively, it can be demonstrated from Figure 3, that this had never happened to any observable extent in the preceeding two years. Also, it seems reasonable to assume that if the surface

air is enriched in Pu-239 in this particular period, somewhere in the atmosphere or on the ground we should observe data showing depletion in that isotope. Fallout data do not support this idea. Although sparse (only two deposition sites in the Northern Hemisphere had samples routinely analyzed for Pu-239), the fallout results indicate that Pu-239/Sr-90 ratios in precipitation are about the same as in the surface air (9, 15, 16, 17, 18, 19, 20, 21, 22, 23). On the other hand it certainly would not be unreasonable to expect fractionation between two such chemically different elements as Pu and Sr. Furthermore, since their origins differ markedly, they may very likely enter the troposphere on particles of different size. We do not propose to speculate further on the possible mechanisms of fractionation; however, it does seem clear that an acceptable case for fractionation of these radionuclides could be presented.

Conclusions

The anomalous ratios of Pu-239/Sr-90 in Northern Hemisphere surface air in 1968-1969 remain unexplained. Neither of the most plausible explanations advanced in this report, tropospheric releases of Pu-239 and tropospheric fractionation of the radionuclides, have been experimentally substantiated. In fact both explanations seem to be contraindicated by other observations and data. Sampling and analysis for Pu-239 and Sr-90 will be continued in both the stratospheric and surface air programs, and other studies which may bear on this subject will be considered to help finally understand this paradox.

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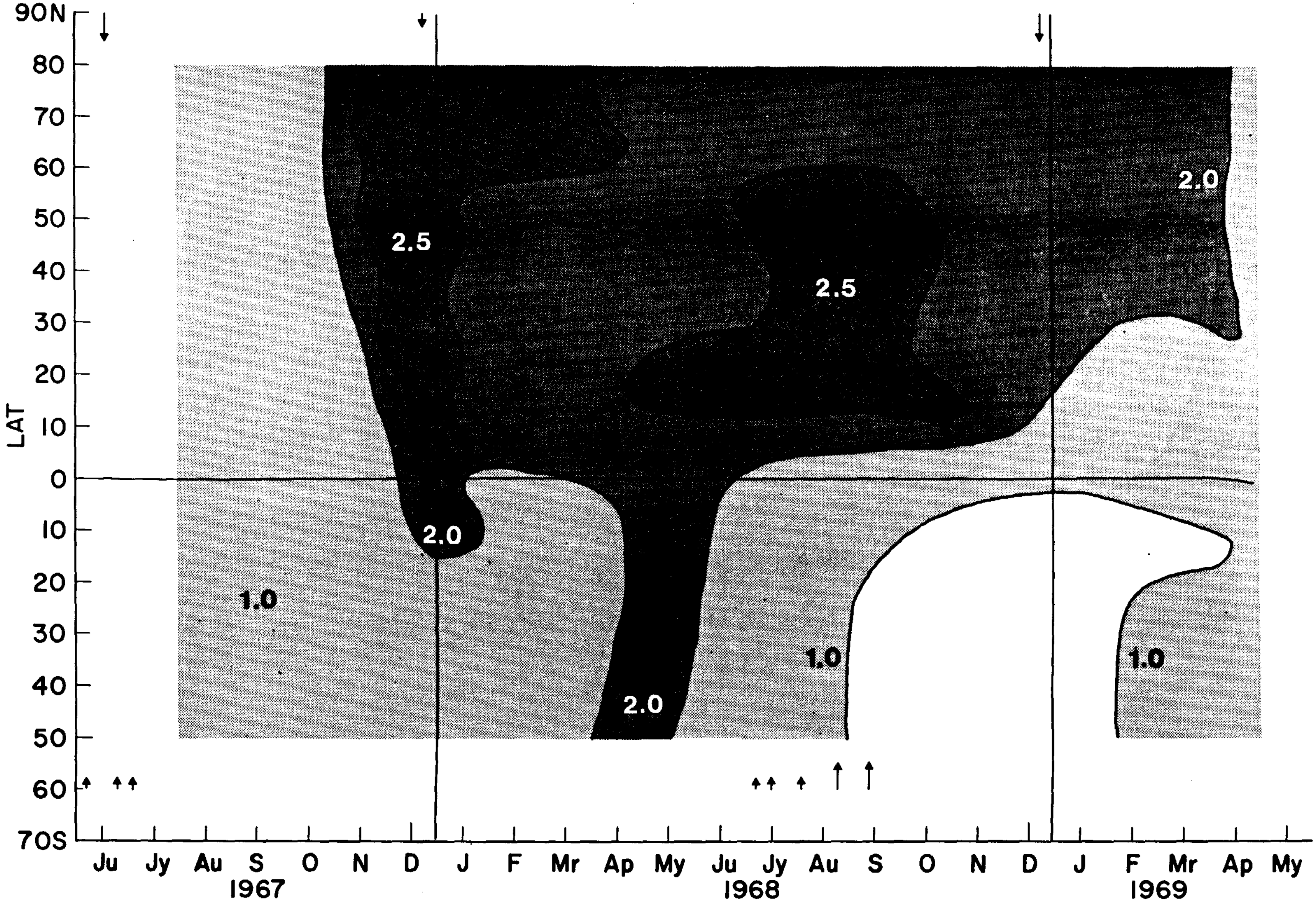
FIGURE I.

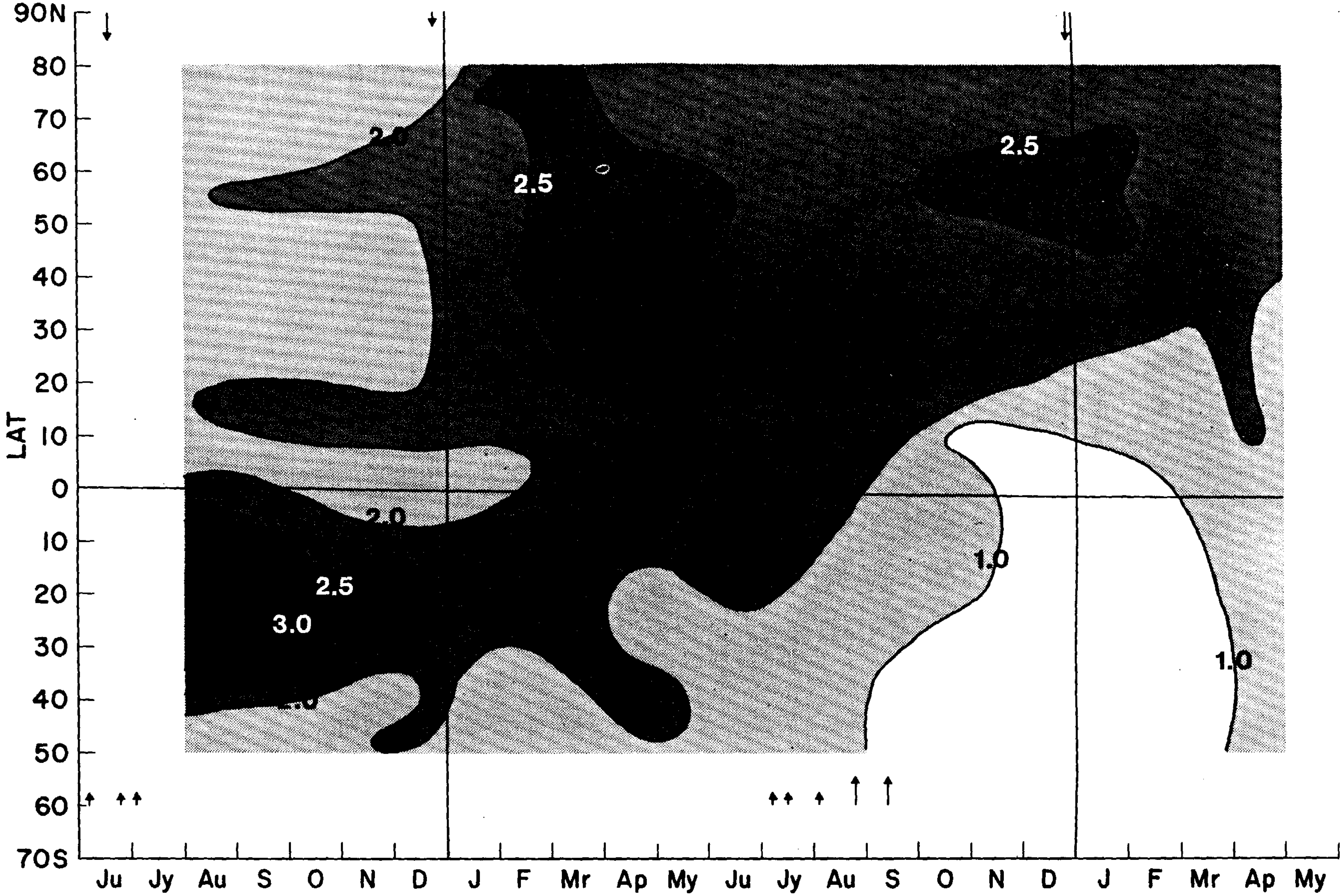
Pu-239/Sr-90 Ratio at 19.2 km



CONTOURS ARE IN PERCENT. ARROWS INDICATE THE DATE AND RANGE (SMALL ARROWS-KILOTONS; LARGE ARROWS-MEGATONS) OF ATMOSPHERIC NUCLEAR WEAPONS TESTS IN EACH HEMISPHERE.

FIGURE 2

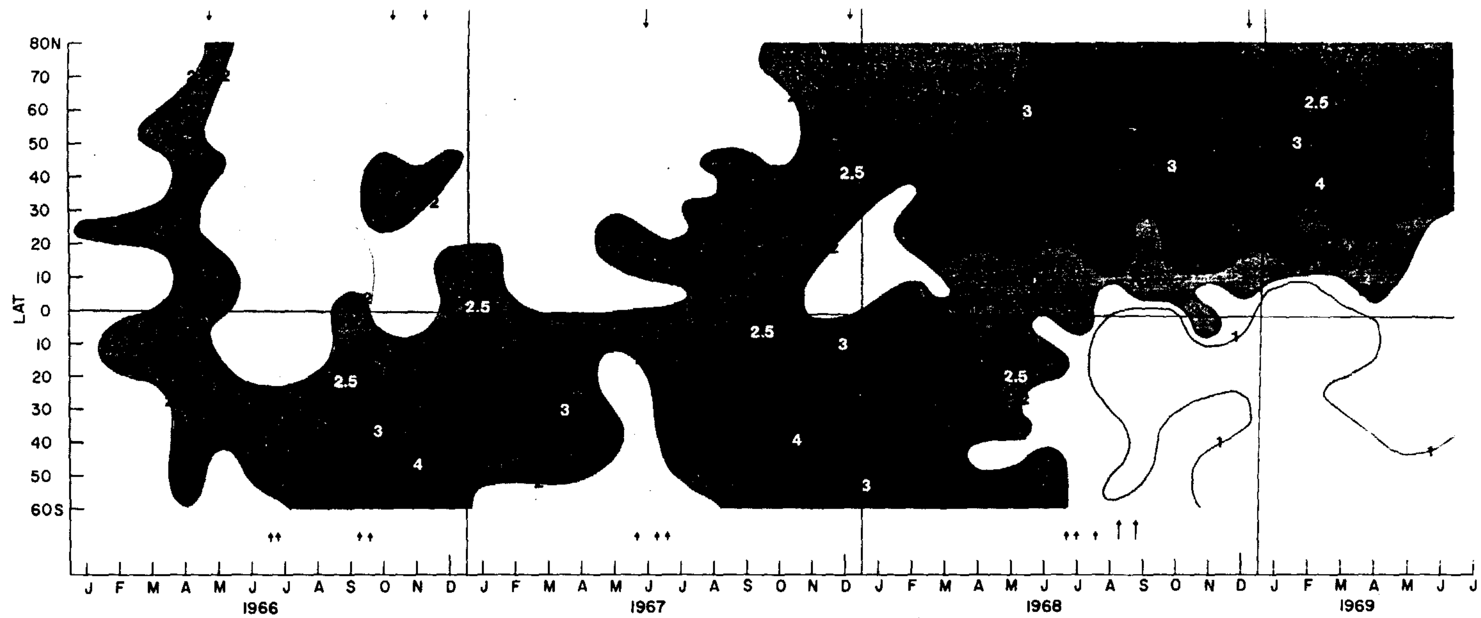
Pu-239/Sr-90 Ratio Just Above the Tropopause



CONTOURS ARE IN PERCENT. ARROWS INDICATE THE DATE AND RANGE (SMALL ARROWS - KILOTONS; LARGE ARROWS - MEGATONS) OF ATMOSPHERIC NUCLEAR WEAPONS TESTS IN EACH HEMISPHERE.

--LLAR WEAPONS TESTS IN EACH HEMISPHERE.

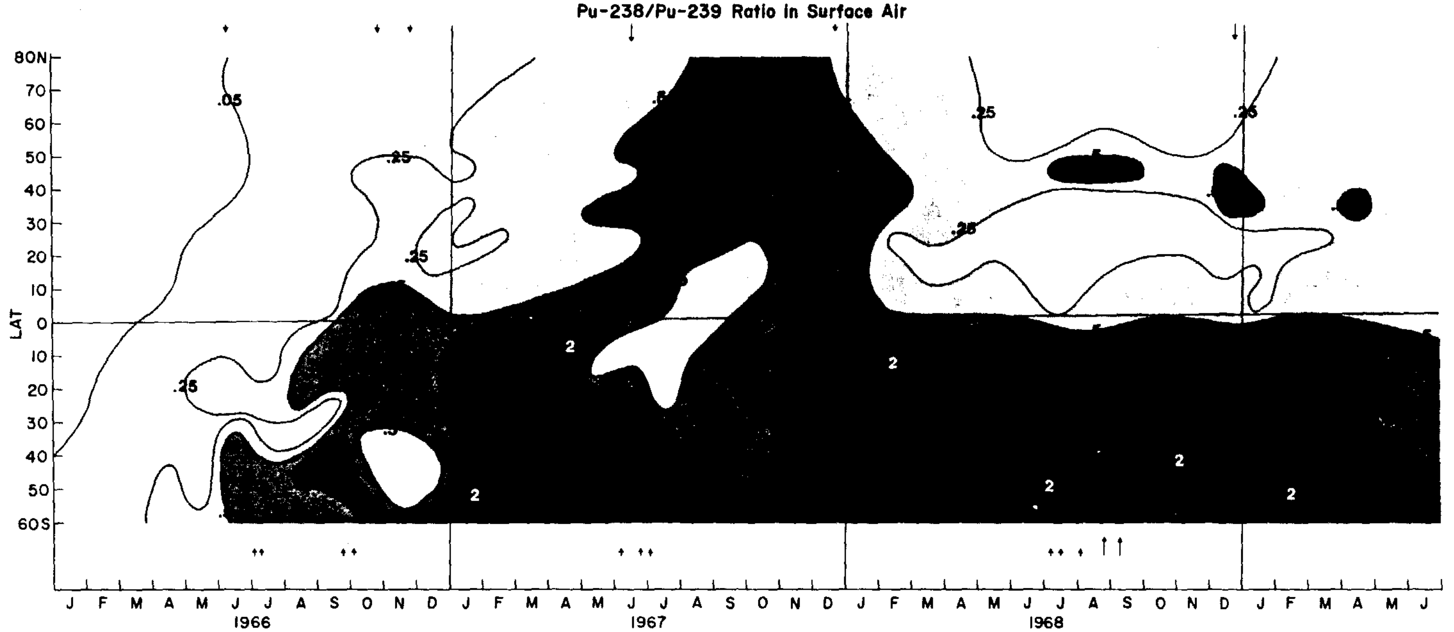
Pu-239/Sr-90 RATIO IN SURFACE AIR



CONTOURS ARE IN PERCENT. ARROWS INDICATE THE DATE AND RANGE (SMALL ARROWS-KILOTONS; LARGE ARROWS-MEGATONS) OF ATMOSPHERIC NUCLEAR WEAPONS TESTS IN EACH HEMISPHERE

FIGURE 4

Pu-238/Pu-239 Ratio in Surface Air



ARROWS INDICATE THE DATE AND RANGE (SMALL ARROWS-KILOTONS; LARGE ARROWS-MEGATONS) OF ATMOSPHERIC NUCLEAR WEAPONS TESTS IN EACH HEMISPHERE.

PART II

HASL FALLOUT PROGRAM DATA

1. Fallout Deposition

1.1 Monthly Precipitation

1.11 Sr^{90} and Sr^{89} in Monthly Deposition at World Land Sites

Precipitation and dry fallout are collected over monthly periods at stations in the United States and overseas. The samples are analyzed for Sr-90 and Sr-89 when it is expected to be present. A description of the sampling network and available data for each site are given in the Appendix, Section A.

1.12 Other Isotopes at Selected Sites

At a number of stations in the United States, monthly deposition collections were analyzed for radiostrontium and other nuclides of interest to the Atomic Energy Commission. Multinuclide analyses were discontinued as of July 1967 and the complete data reported in HASL-193, p. II-4 through II-25.

Plutonium analyses of monthly deposition are continuing at New York City, Melbourne, Seattle, Honolulu, Salisbury, Durban, and Rio de Janeiro. Available data are given in the Appendix, Section C.

1.2 Radiostrontium Deposition at Atlantic Ocean Weather Stations

Measurements of radiostrontium in precipitation and dry fallout collections at four U. S. Coast Guard Stations in the North Atlantic Ocean are carried out for comparison with land stations in the same latitude band. A description of the stations and available data are given in the Appendix, Section B.

2. Surface Air Sampling Program

The Health and Safety Laboratory has been collecting surface air particulate samples at stations in the Western Hemisphere since January 1963. The filters are analyzed for a number of fission and activation product radionuclides. A description of the program and available data are given in the Appendix, Section D.

3. <u>Project Airstream</u>

The Health and Safety Laboratory measures radioactivity in the lower stratosphere employing the RB-57F aircraft as a sampling platform. The aircraft are flown by the 58th Weather Reconnaissance Squadron under the direction of the 9th Weather Wing of the Air Weather Service. The missions are scheduled for early February, May, August and November and the coverage extends from 75°N to 51°S latitude in the Western Hemisphere. Air filter samples are collected from 12 to 19 km altitude and analyzed for ten radionuclides. A more complete description of the program and available data are given on pages II-9 to II-67.

4. <u>High Altitude Balloon Sampling Program</u>

Balloon borne filtering devices are used to collect nuclear debris at altitudes from 24-41 km. Balloon launchings are conducted quarterly at Fairbanks, Alaska, 65°N; San Angelo, Texas, 31°N; Panama C.Z., 9°N; and Mildüra, Australia, 34°S. Filters are analyzed for ten radionuclides. A more complete description of the program and available data were presented in HASL-217 on pages II-148 to II-206. Corrected sampling dates for three samples are given in this report beginning on page II-68.

5. <u>Radiostrontium in Milk and Tap Water</u>

Strontium^{90} levels in both powdered and fresh milk distributed in New York City and tap Water sampled at the Health and Safety Laboratory, have been measured on a monthly basis since 1954. These data are summarized in tabular and graphical form in the <u>Appendix</u>, <u>Section E</u>.

6. <u>Strontium^{90} in Diets</u>

Quarterly estimates of the annual dietary intake of Sr^{90} of New York City, Chicago, and San Francisco residents have been made based on analyses of foods purchased at these three cities every three months since 1960. Sampling in Chicago has been discontinued. The program is described and available data reported on p. II-4 to II-6 of this report.

7. <u>UNSCEAR - WHO Bone Program</u>

Available Sr^{90} data for human bone samples collected in 1969 from countries in Latin America and Africa are presented on pages II-7 and II-8 of this report.

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6. HASL Diet Studies: Fourth Quarter 1969

by J. Rivera, (HASL)

Results of the measurements of the Sr^{90} content of foods purchased in New York City and San Francisco in the fourth quarter of 1 are given in the following table. Estimates of the daily intake of based on these measurements and on the revised consumption statistic given in a recently available U. S. Department of Agriculture Report are also listed.

The estimates of daily Sr^{90} intake are a continuation of the HAS Tri-City diet studies which were started in March of 1960. Results c the earlier measurements along with those made during 1969 are shown graphically in the figure on page II-6. A complete description of th sampling methods and philosophy of the HASL diet studies was given in HASL-200[3].

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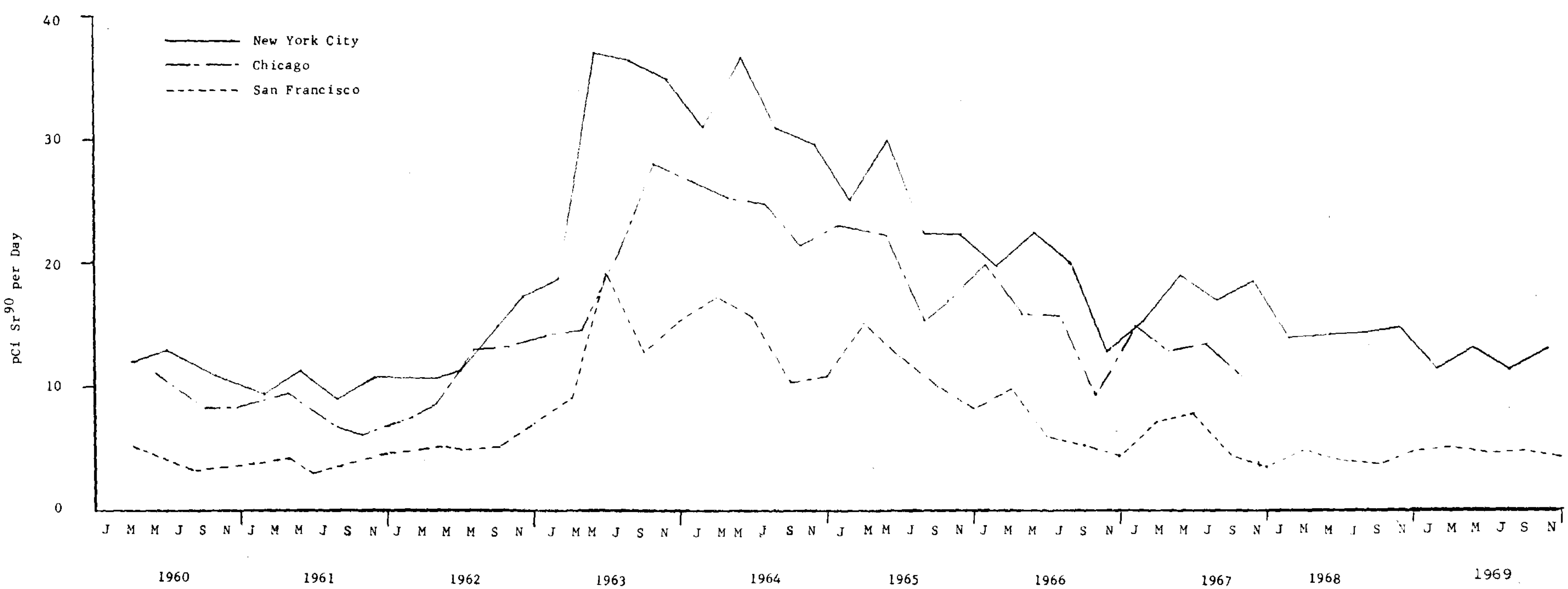
STRONTIUM^{90} IN NEW YORK CITY AND SAN FRANCISCO DIETS

- Fourth Quarter 1969 -

Diet Category	kg/yr.	gCa/yr	% of yearly intake of Ca	NEW YORK CITY pCi Sr^{90}/kg	NEW YORK CITY pCi Sr^{90}/yr	NEW YORK CITY % of yearly intake of Sr-90	SAN FRANCISCO pCi Sr^{90}/kg	SAN FRANCISCO pCi Sr^{90}/yr	SAN FRANCISCO % of yearly intake of Sr-90
DAIRY PRODUCTS	200	216.0		9.2	1840		2.1	420	
			58			38			27
FRESH VEGETABLES	48	18.7		18.1	869		4.0	192	
CANNED VEGETABLES	22	4.4		8.2	180		3.4	75	
ROOT VEGETABLES	10	3.8		7.8	78		4.5	45	
POTATOES	38	3.8		6.5	247		1.1	42	
DRY BEANS	3	2.1		36.8	110		11.1	33	
			9			31			24
FRESH FRUIT	59	9.4		10.5	620		3.1	183	
CANNED FRUIT	11	0.6		1.7	19		1.1	12	
FRUIT JUICES	28	2.5		3.7	104		1.8	50	
			3			15			16
BAKERY PRODUCTS	44	53.7		6.5	286		4.4	194	
FLOUR	34	6.5		5.5	187		3.8	129	
WHOLE GRAIN PRODUCTS	11	10.3		16.2	178		6.8	75	
MACARONI	3	0.6		4.0	12		3.1	9	
RICE	3	1.1		1.7	5		2.5	8	
			20			14			26
MEAT	79	12.6		0.5	40		0.4	32	
POULTRY	20	6.0		0.7	14		1.7	34	
EGGS	15	8.7		1.7	26		2.5	38	
FRESH FISH	8	7.6		0.3	2		0.3	2	
SHELL FISH	1	1.6		1.6	2		0.6	1	
			10			2			7
YEARLY INTAKE		370			4819			1574	
DAILY INTAKE = pCi/g Ca					13.0			4.2	

DAILY INTAKE OF STRONTIUM-90



UNSCEAR-WHO BONE PROGRAM

John H. Harley

In the work of the United Nations Scientific Committee on the Effects of Atomic Radiation, the major effort in evaluating fallout from weapons tests is directed towards estimating the dose commitment. A major contributor to bone dose is strontium-90 but there have not been adequate data for many regions in the world. The Committee decided that it would be useful to have even limited data for portions of the world not otherwise covered. It was agreed that some estimate could be made based on a small number of samples of adult bone and they requested the World Health Organization to assist in procuring samples.

Dr. E. I. Komorov of WHO has been coordinating this program. Samples for 1969 have been received from Senegal, Jamaica, Chile and Venezuela. Negotiations are under way to obtain additional material from other countries in Africa and from Asia. The samples are being analyzed by the Health and Safety Laboratory and the results are presented here as a tabulation of the available data.

Dr. Eduardo Penna-Franca of Brazil has also supplied samples, and they are included in the tabulation for comparison.

1969 HUMAN BONE FROM THE WHO

CHILE

Age (yr.)	Sex	pCi Sr^{90} per g Ca
91	M	2.0
58	M	1.7
74	M	2.3, 2.0*
46	M	1.5
33	M	1.1
19	M	2.7
50	F	2.3
51	M	1.3

BRAZIL

Age (yr.)	Sex	pCi Sr^{90} per g Ca
40	M	1.0
25	M	1.0
40	M	1.0
30	M	1.4, 1.4*
31	F	0.7, 0.7*

JAMAICA

Age (yr.)	Sex	pCi Sr^{90} per g Ca
62	F	1.2
42	F	1.4
34	M	1.0
60	F	0.6
36	M	1.5
67	M	1.0
50	M	1.3
61	F	1.2
57	M	0.9
51	M	0.8, 0.8*
46	M	1.1
57	F	0.6
65	F	1.0
19	M	1.6
54	F	0.7
72	M	1.8
23	M	1.3
28	F	2.2
22	M	1.1
22	F	1.8
21	M	1.6, 1.6*
19	M	0.8
23	F	1.0

VENEZUELA

Age (yr.)	Sex	pCi Sr^{90} per g Ca
56	M	0.5, 0.6*
41	F	0.4
32	M	0.7
63	M	0.6
60	F	0.8
unknown	M	0.6
42	F	0.6
26	F	0.8
67	M	0.7
65	M	0.7
50	F	0.7
83	F	0.7
56	M	0.5
70	F	0.7
0.2	F	2.5
23	M	0.5
30	M	0.7
26	F	0.7
30	F	1.1
unknown	M	0.7
24	F	0.8, 0.8*
25	M	0.7

SENEGAL

Age (yr.)	Sex	pCi Sr^{90} per g Ca
70	F	0.5
58	M	0.9
60	F	1.0
55	M	0.8, 0.8*
50	M	0.8
41	F	0.4
40	M	1.7
43	M	1.5
34	M	1.8
47	M	1.1
35	M	0.8
80	F	0.5

*duplicate analysis

3. PROJECT AIRSTREAM

by Philip W. Krey (HASL)
Michael Kleinman (HASL)

Project Airstream is HASL's study of radioactivity in the lower stratosphere employing the RB-57F aircraft as a sampling platform. The aircraft are flown by the 58th Weather Reconnaissance Squadron under the direction of the 9th Weather Wing of the Air Weather Service. This project is a continuation of the Defense Atomic Support Agency's Project Stardust except that Airstream's sampling missions are limited to only one per season.

The data in this report cover the missions flown in April, July and October 1969. Previous reports containing results from this program are given in references 1 through 8.

FLIGHT SCHEDULE

Airstream missions are scheduled for February, May, August and November with a ± one month slippage. However, each mission must be completed within a nine day interval. The first Airstream mission was flown in August 1967. The flight trajectory and altitude coverage of an Airstream mission are shown in Figures 3a and 3b, respectively. Prior to February 1969, a large gap in the altitude coverage between 15.2 and 18.3 km existed in the sensitive polar regions of each hemisphere.

Beginning with the February 1969 mission, this gap was partially clo. by sampling at 16.8 km instead of 18.3 km at all latitudes poleward : about 35° in both hemispheres.

The coverage in Figure 3b extends almost continuously at the indicated altitudes from 75°N to 51°S latitude except for a slight di continuity between 10°S to 16°S. Each mission is accomplished by con ducting return flights northward and southward from each of the four Air Force Bases of operation:

Eielson AFB	64°40'N	147°06'W
Kirtland AFB	35°03'N	106°36'W
Albrook AFB	08°57'N	79°34'W
Mendoza AFB	32°49'S	68°47'W

AIR FILTER SAMPLES

Air filter samples are collected along the flight tract at latitude increments of approximately 3 to 4° at each of the prescribed altitudes using the U-1 foil system. This system permits the sequential insertion of up to 12 IPC No. 1478 filter papers (diameter 16-3/8 into the sampling duct near the bomb bay on the right side of the aircraft. The volume of air sampled by each filter is calculated by the methods developed under Project Stardust and updated by Krajewski (9), and are reported as standard cubic meters (SCM) under the ICAO standard atmosphere (760 mm Hg and 15°C).

TOTAL GAMMA AND GAMMA SPECTRUM MEASUREMENTS

Upon arrival at HASL, the filters are coded, logged and quartered. The entire sample (or a representative fraction if the activity is too high) is folded and placed in a plastic box, 8 cm x 6.5 cm x 3.1 cm deep, for gamma spectrometric analysis on an 8" x 4" NaI (Tl) crystal. The total gamma activity is integrated between 100 Kev and 3.0 Mev, and the gamma concentration is reported as counts per minute (cpm) per 100 SCM on the counting date. The complex spectrum is then submitted for computer resolution by least squares fitting into its component members.

RADIOCHEMICAL ANALYSIS

Based upon the gamma measurements, fractions of the filters are combined into appropriate composites which are sent to contractor laboratories for detailed radiochemical analyses including the following nuclides:

Fe-55	Zr-95	Pb-210	Pu-238
Sr-89	Ce-141	Po-210	Pu-239,240
Sr-90	Ce-144		

At the present time, Trapelo Division/West formerly Tracerlab of Richmond, California is performing these analyses. Nuclide concentrations from radiochemical analyses are reported as picocuries per 100 standard cubic meters of air (pCi/100 SCM) at collection time. Following a previously established practice, Fe-55 is decay corrected to

October 15, 1961 which is the average production date of this nucl in the 1961 test series. This is not to convey that all the Fe-55 currently in the stratosphere originated in the 1961 tests. To cor vert pCi/100 SCM to disintegrations per minute per 10^3 standard cub feet multiply by 0.629.

One standard deviation of the counting error for all data in this report is less than ±20% and usually less than ±10% unless annc tated with the symbols:

A: One standard deviation of the counting error is between ±20 - 50%.

B: One standard deviation of the counting error is between ±51 - 100%.

*: Activity is not detectable. This designation is applied to data when one standard deviation of the counting error is greater than ±100%.

?: The nuclide concentration of a specific sample is considered suspect because it is inconsistent with the concentration of the same nuclide in adjacent samples in space and time or because it is inconsistent with other nuclides in the same sample.

The nuclide activity for each sample is corrected for the normal radiochemical parameters such as chemical yield and detection efficiency, but it is important to note that a blank adjustment is also made. The value of the adjustment is determined for each nuclide by analyzing a number of blank samples, that is, samples containing no activity. Any activity detected in blank samples represents the contamination introduced into the sample by the laboratory reagents and equipment. The average blank value for each nuclide with its measure of uncertainty is then subtracted from the sample activity.

The Po-210 activity has been decay corrected for ingrowth from its Pb-210 parent for the interval between its separation date and the day of collection. The reported error reflects the uncertainty of both the Pb-210 and Po-210 measurements.

R E S U L T S

An error in the volume computations of ten samples from the April 1969 mission was uncovered. The corrected radiochemical concentrations for these ten samples are given in Table 3a. The radiochemical analyses of the individual and composite samples from the July 1969 mission are reported in Table 3b.

The gross gamma and Zr-95 concentrations derived from NaI(Tl) gamma spectral analyses of the October 1969 mission are given in Table 3c. Such spectra reflect the combined photopeaks of Zr-95 and its daughter Nb-95 at counting time. To calculate the quantity of Zr^{95} in this mixture, the production date of the fresh fission product debris must be known. The Zr-95 data in Table 3c were calculated on the assumption that most of the Zr-95 in each of three latitude regions of the stratosphere were produced by three separate events as follows:

Latitude Region	Nuclear Test
90N - 40N	Chinese test of September 29, 1969
40N - 10N	Chinese test of December 28, 1968
10N - >51S	French thermonuclear tests in mid-1968

The samples in Tables 3b and 3c are grouped according to the altitude of collection beginning with 19.2 km. Within each altitude group, the samples are then listed with decreasing latitude. The fractions of each individual filter making up the composite are liste immediately below the composite sample number. The collection parameters of the composite sample and the contractor laboratory performing the analyses are given prior to the nuclide concentrations.

QUALITY CONTROL

To evaluate the contractor's performance in radiochemical analyses, HASL routinely submits blind duplicates, blanks and standards. The duplicates are identical composites submitted with different code numbers. The blanks are unexposed filters supplied by the Air Force. Standards are blank filters onto which calibrated solutions of various nuclides have been evaporated.

These calibrated solutions are available from a number of sources (i.e., Radiochemistry Center, IAEA, Nuclear Chicago) and are recalibrated at HASL. Generally, the agreement between HASL's measurement and the reported value is very good. HASL does not calibrate for Pb^{210} directly, and the supplier's value is accepted. HASL does calibrate for Po-210, and its evaluation of the Po-210 in a Pb-210 standard is now adopted rather than the equilibrium value from the Pb-210.

The results of the quality control program for the October 1969 mission are summarized in Table 3d. The standards indicate that the average accuracy of analysis is within ±10% or less. The blank analyses indicate that the contamination introduced by normal handling and laboratory procedure is either unmeasurable or insignificant for all the nuclides studied. The duplicate samples show that the precision error of analyses is generally less than ±10% except when the counting error of the measurement becomes the major uncertainty.

A serious exception to this general statement on analytical precision is the Pu-238 and Pu-239 results from sample 2476 which differ widely from the results of its duplicate 2458. While plutonium concentrations and ratios from sample 2458 appear reasonable for the region of the stratosphere from which it was collected, they do not for sample 2476. The results of the other quality control sampl in this and earlier reports attest to the overall reliability or the plutonium analyses. Therefore, it is likely that a sample s of the plutonium fraction of sample 2476 took place during analy although no positive evidence of such a switch was found. A thir duplicate of this sample will be submitted for Pu analyses to ver this conclusion.

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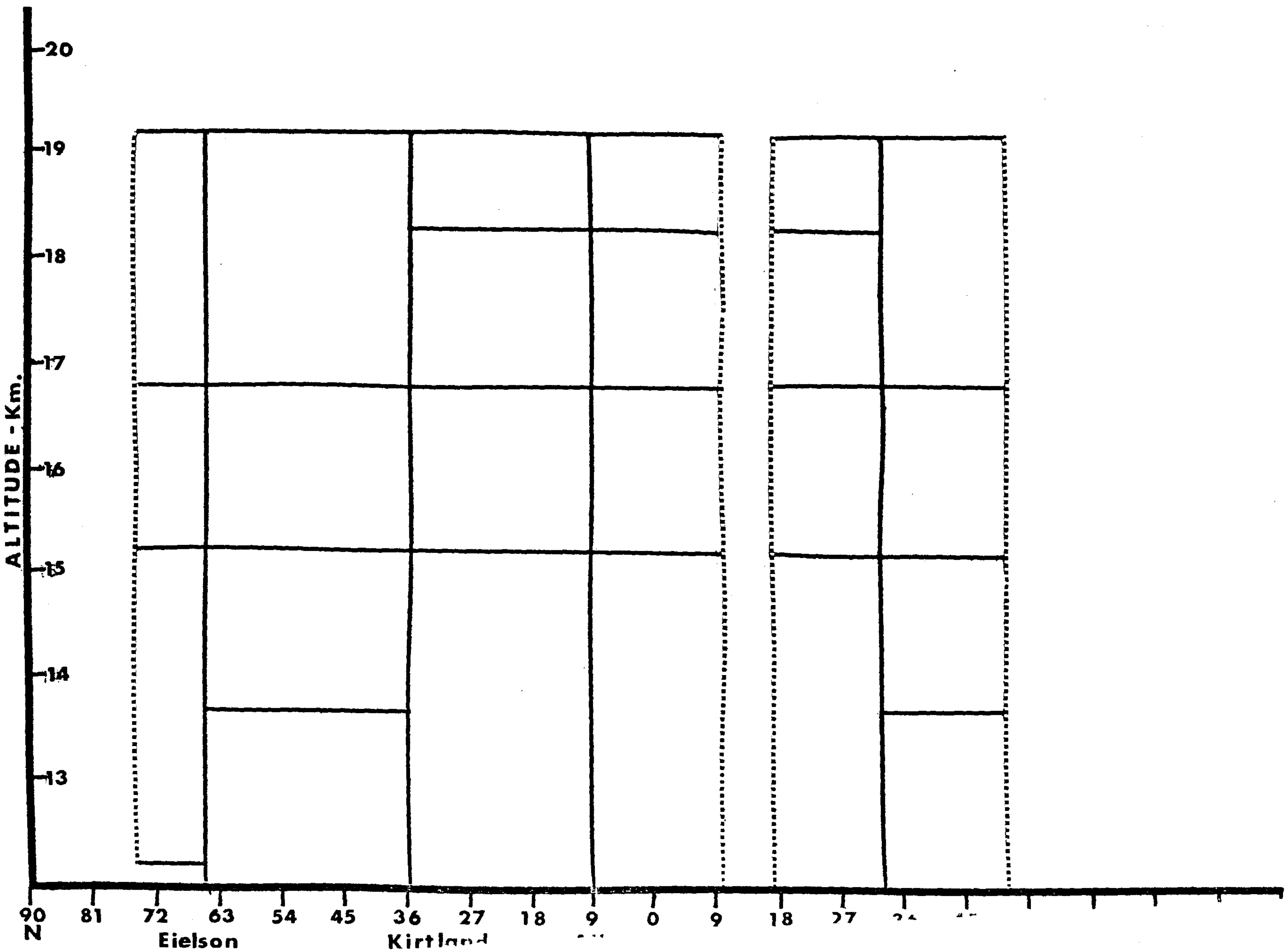
Figure 3a - Airstream Flight Trajectory

Figure 3b - Airstream Altitude Coverage



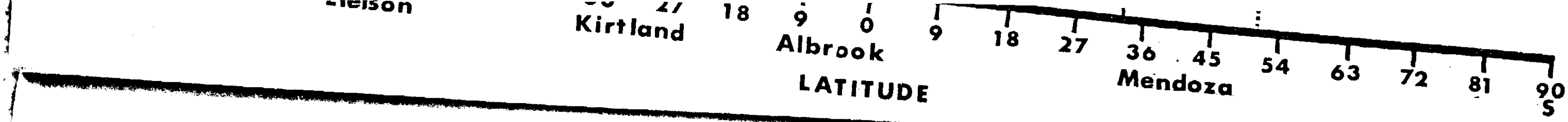


TABLE 3A

RADIOCHEMICAL ANALYSIS OF APRIL 1969 COMPOSITES

19.2 KM

SAMPLE NO.	2172	2224	2173	2176	2177
COMPOSED OF:	1/4:2052 2094 2095 2096	1/4:2052 2094 2095 2096	1/2:2053 2055	1/2:1943 2001	1/2:1944 1945 1946 1947
MIDPOINT OF: COLLECTION					
DATE	4/ 8/69	4/ 8/69	4/ 6/69	4/ 9/69	4/ 8/69
LAT.	31N-21N	31N-21N	21N-12N	7S-20S	20S-30S
LONG.	98W- 86W	98W- 86W	86W- 81W	80W- 73W	73W- 68W
VOL. OF AIR (100 SCM)	3.080	3.080	2.680	4.320	5.720
LAB:	TLW	TLW	TLW	TLW	TLW
FE-55	698.000	591.000	526.000		737.000
SR-89	3760.000	3660.000	3290.000	354.000	1150.000
SR-90	129.000	126.000	117.000	64.200	184.000
ZR-95	6410.000	6530.000	5640.000	814.000	3220.000
CE-144	3470.000	3360.000	2930.000	1160.000	4200.000
PB-210	0.561A	0.651A	0.551A	0.657A	0.496A
PO-210	0.495	0.487	0.447	0.536	0.420
PU-238	0.443	0.507	0.468	0.462	1.288
PU-239	2.494	2.574	2.214	0.641	2.409

A:COUNTING ERROR IS 20-50 PERCENT
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT
*:NOT DETECTABLE

TABLE 3A

RADIOCHEMICAL ANALYSIS OF APRIL 1969 COMPOSITES

16.8 KM

SAMPLE NO.	2190	2192
COMPOSED OF:	1/2:1973	1/2:2120
	1974	2121
	1975	2122
	2081	
	2082	
MIDPOINT OF: COLLECTION		
DATE	4/ 8/69	4/ 8/69
LAT.	59N-45N	35N-29N
LONG.	136W-117W	106W- 94W
VOL. OF AIR (100 SCM)	11.410	7.440
LAB:	TLW	TLW
FE-55	585.000	
SR-89	3500.000	2600.000
SR-90	106.000	81.900
ZR-95	6220.000	4460.000
CE-144	3320.000	2330.000
PB-210	0.516	0.622
PO-210	0.513	0.501
PU-238	0.482	0.229
PU-239	2.339	1.460

A:COUNTING ERROR IS 20-50 PERCENT
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT
*:NOT DETECTABLE

B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT
*:NOT DETECTABLE

TABLE 3A

RADIOCHEMICAL ANALYSIS OF APRIL 1969 COMPOSITES

13.7 KM

SAMPLE NO.	2216	2225	2217
COMPOSED OF:	1/4:1961 1962 1963	1/4:1961 1962 1963	1/2:1964 2107
MIDPOINT OF: COLLECTION			
DATE	4/ 8/69	4/ 8/69	4/ 9/69
LAT.	61N-53N	61N-53N	53N-47N
LONG.	138W-129W	138W-129W	129W-121W
VOL. OF AIR (100 SCM)	5.300	5.300	9.330

PC/100 SCM

LAB:	TLW	TLW	TLW
FE-55	779.000	928.000	457.000
SR-89	5980.000	5620.000	3260.000
SR-90	168.000	163.000	98.400
ZR-95	10100.000	9950.000	5510.000
CE-144	5050.000	4880.000	2800.000
PB-210	0.579A	0.431A	0.579
PO-210	0.398	0.397	0.469
PU-238	0.467	0.472	0.228
PU-239	3.289	3.230	1.848

A:COUNTING ERROR IS 20-50 PERCENT
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT
*:NOT DETECTABLE

TABLE 3A

RADIOCHEMICAL ANALYSIS OF APRIL 1969 COMPOSITES

12.2 KM

SAMPLE NO.	2223
COMPOSED OF:1/2:	1983
	1984
	1985
MIDPOINT OF:	
COLLECTION	
DATE	4/ 7/69
LAT.	75N-65N
LONG.	146W-143W
VOL. OF AIR (100 SCM)	12.740

PC/100 SCM

LAB:	TLW
SR-89	4020.000
SR-90	127.000
ZR-95	7200.000
CE-144	3590.000
PU-238	0.428
PU-239	2.579

A:COUNTING ERROR IS 20-50 PERCENT
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT

*:NOT DETECTABLE

TABLE 3B

RADIOCHEMICAL ANALYSIS OF JULY 1969 COMPOSITES

19.2 KM

SAMPLE NO.	2428	2429	2430	2431	2432	2433
COMPOSED OF:	1/2:2408	1/2:2308	1/2:2300	1/2:2296	1/2:2269	1/2:2271
	2409	2421	2309	2297	2270	2272
	2410	2422	2310	2298	2295	2273
	2424	2423	2311	2299		
	2425		2312			
MIDPOINT OF: COLLECTION						
DATE	7/23/69	7/24/69	7/23/69	7/23/69	7/26/69	7/27/69
LAT.	75N-59N	59N-47N	47N-35N	35N-26N	26N-18N	18N- 9N
LONG.	146W-136W	136W-121W	121W-106W	106W- 91W	91W- 84W	84W- 79W
VOL. OF AIR (100 SCM)	6.160	5.290	6.010	5.880	4.090	4.110

PC/100 SCM

LAB:	TLW	TLW	TLW	TLW	TLW	TLW
SR-90	67.200	93.200	97.400	93.200	74.200	78.000
ZR-95	688.000	1250.000	1180.000	1390.000	1100.000	1220.000
CE-144	1090.000	1700.000	1490.000	1830.000	1470.000	1530.000
PB-210	0.376A	0.484A	0.602A	0.604A	0.679A	0.804A
PO-210	0.166B	0.361A	0.300A	0.344A	0.472A	0.675
PU-238	0.582	0.608	0.542	0.400	0.299	0.356
PU-239	1.222	1.815	1.677	1.697	1.337	1.492

A:COUNTING ERROR IS 20-50 PERCENT
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT
*:NOT DETECTABLE

TABLE 3B

RADIOCHEMICAL ANALYSIS OF JULY 1969 COMPOSITES

19.2 KM

SAMPLE NO.	2434	2435	2436	2437	2438
COMPOSED OF:	1/2:2259 2260	1/2:2256 2257 2258	1/2:2346 2347 2348	1/2:2349 2350 2366 2367	1/2:2362 2363 2364 2365
MIDPOINT OF: COLLECTION					
DATE	7/25/69	7/25/69	7/24/69	7/24/69	7/23/69
LAT.	9N- 1N	1N-11S	15S-26S	26S-40S	40S-51S
LONG.	80W- 79W	81W- 78W	75W- 71W	71W- 68W	68W- 67W
VOL. OF AIR (100 SCM)	3.380	5.430	4.310	5.750	4.020
	PC/100 SCM				
LAB:	TLW	TLW	TLW	TLW	TLW
SR-90	69.000	55.600	113.000	128.000	140.000
ZR-95	615.000	511.000	577.000	637.000	711.000
CE-144	1090.000	922.000	1720.000	2020.000	2170.000
PB-210	0.676A	0.711	0.655A	0.762	0.404A
PO-210	0.539A	0.433A	0.576A	0.230B	0.287A
PU-238	0.335	0.351	0.728	0.829	1.002
PU-239	1.070	0.867	1.334	1.442	1.745

A:COUNTING ERROR IS 20-50 PERCENT
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT
*:NOT DETECTABLE

TABLE 3B

RADIOCHEMICAL ANALYSIS OF JULY 1969 COMPOSITES

18.3 KM

SAMPLE NO.	2439	2440	2441	2442	2443	2444
COMPOSED OF:	1/2:2291 2292 2293 2329	1/2:2267 2294	1/2:2265 2266 2276	1/2:2252 2277	1/2:2253 2254 2255	1/2:2343 2344 2345
MIDPOINT OF: COLLECTION						
DATE	7/24/69	7/25/69	7/27/69	7/26/69	7/25/69	7/24/69
LAT.	35N-26N	26N-18N	18N- 9N	9N- 1N	1N-11S	15S-26S
LONG.	106W- 91W	91W- 84W	84W- 79W	80W- 79W	81W- 78W	73W- 71W
VOL. OF AIR (100 SCM)	7.690	2.800	4.060	3.790	6.570	5.820

PC/100 SCM

LAB:	TLW	TLW	TLW	TLW	TLW	TLW
SR-90	86.400	65.500	61.200	44.900	42.200	70.500
ZR-95	1460.000	1080.000	951.000	521.000	466.000	463.000
CE-144	1800.000	1280.000	1220.000	777.000	699.000	1110.000
PB-210	0.698	1.200	1.021	0.948	0.865	1.161
PO-210	0.487	0.0 B	0.521A	0.306B	0.484A	*
PU-238	0.311	0.254	0.208	0.194	0.220	0.411
PU-239	1.559	1.203	1.058	0.722	0.649	0.910

A:COUNTING ERROR IS 20-50 PERCENT *:NOT DETECTABLE
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT

TABLE 3B

RADIOCHEMICAL ANALYSIS OF JULY 1969 COMPOSITES

18.3 KM

SAMPLE NO. 2445
COMPOSED OF:1/2:2342
2354

MIDPOINT OF:
COLLECTION

DATE	7/25/69
LAT.	26S-33S
LONG.	71W- 68W
VOL. OF AIR (100 SCM)	3.930

PC/100 SCM

LAB:	TLW
SR-90	106.000
ZR-95	600.000
CE-144	1850.000
PB-210	0.610A
PO-210	0.331A
PU-238	0.739
PU-239	1.348

A:COUNTING ERROR IS 20-50 PERCENT *:NOT DETECTABLE
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT

TABLE 3B

RADIOCHEMICAL ANALYSIS OF JULY 1969 COMPOSITES

16.8 KM

SAMPLE NO.	2446	2475	2447	2448	2449	2450
COMPOSED OF:	1/4:2404	1/4:2404	1/2:2417	1/2:2303	1/2:2320	1/2:2245
	2405	2405	2418	2304	2321	2246
	2406	2406	2419	2305	2322	2319
	2407	2407	2420	2306	2323	
				2307	2328	
MIDPOINT OF: COLLECTION						
DATE	7/22/69	7/22/69	7/24/69	7/23/69	7/24/69	7/26/69
LAT.	75N-61N	75N-61N	61N-50N	50N-39N	39N-26N	26N-18N
LONG.	150W-143W	150W-143W	138W-125W	125W-108W	108W- 91W	91W- 84W
VOL. OF AIR (100 SCM)	3.820	3.820	7.530	10.090	13.850	6.920
PC/100 SCM						
LAB:	TLW	TLW	TLW	TLW	TLW	TLW
SR-90	97.700	103.000	106.000	40.400	47.900	46.600
ZR-95	1390.000	1470.000	1540.000	721.000	803.000	714.000
CE-144	1790.000	2000.000	1980.000	912.000	1030.000	951.000
PB-210	0.569A	0.551A	0.790	1.188	0.975	1.309
PO-210	0.295A	0.388B	0.396A	0.293B	0.443	0.434A
PU-238	0.452	0.525	0.430	0.119	0.156	0.129
PU-239	1.726	1.864	1.816	0.772	0.871	0.798

A:COUNTING ERROR IS 20-50 PERCENT
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT
*:NOT DETECTABLE

TABLE 3B

RADIOCHEMICAL ANALYSIS OF JULY 1969 COMPOSITES

16.8 KM

SAMPLE NO.	2451	2452	2453	2454	2455	2340A
COMPOSED OF:	1/2:2247 2248 2249	1/2:2237 2238	1/2:2234 2235 2236	1/2:2336 2337	1/2:2338 2339	1/2:2340
MIDPOINT OF: COLLECTION						
DATE	7/27/69	7/23/69	7/23/69	7/24/69	7/24/69	7/24/69
LAT.	18N- 9N	9N- 1N	1N-11S	15S-23S	23S-29S	29S-33S
LONG.	84W- 79W	80W- 79W	81W- 78W	75W- 72W	72W- 69W	69W- 68W
VOL. OF AIR (100 SCM)	7.190	5.800	8.180	5.580	3.920	2.780

PC/100 SCM

LAB:	TLW	TLW	TLW	TLW	TLW	TLW
SR-90	22.400	9.265	12.400	16.000	37.300	30.100
ZR-95	358.000	126.000	141.000	135.000	240.000	159.000
CE-144	489.000	167.000	218.000	255.000	588.000	476.000
PB-210	1.050	1.065	1.280	1.448	0.947	
PO-210	0.329A	0.216B	*	*	0.413A	
PU-238	0.056	0.052	0.059	0.099	0.213	0.221
PU-239	0.392	0.172	0.182	0.207	0.429	0.399

A:COUNTING ERROR IS 20-50 PERCENT *:NOT DETECTABLE
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT

TABLE 3B

RADIOCHEMICAL ANALYSIS OF JULY 1969 COMPOSITES

16.8 KM

SAMPLE NO.	2353A	2456	2360A	2361A
COMPOSED OF:	1/2:2353	1/2:2357 2358 2359	1/2:2360	1/2:2361
MIDPOINT OF: COLLECTION				
DATE	7/25/69	7/23/69	7/23/69	7/23/69
LAT.	33S-37S	37S-46S	46S-49S	49S-51S
LONG.	69W- 68W	69W- 67W	67W- 67W	67W- 67W
VOL. OF AIR (100 SCM)	3.030	5.420	1.680	1.210
		PC/100 SCM		
LAB:	TLW	TLW	TLW	TLW
SR-90	126.000	66.100	141.000	99.100
ZR-95	548.000	361.000	670.000	514.000
CE-144	2060.000	1010.000	2270.000	1570.000
PB-210		0.797		
PO-210		0.481A		
PU-238	0.837	0.418	1.017	0.657
PU-239	1.470	0.743	1.638	1.214

A:COUNTING ERROR IS 20-50 PERCENT   *:NOT DETECTABLE
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT

TABLE 38

RADIOCHEMICAL ANALYSIS OF JULY 1969 COMPOSITES

15.2 KM

SAMPLE NO.	2457	2458	2476	2459	2460	2461
COMPOSED OF:	1/2:2388	1/4:2385	1/4:2385	1/2:2284	1/2:2281	1/2:2315
	2395	2386	2386	2285	2282	2316
	2396	2387	2387	2384	2283	2327
	2397					2330
MIDPOINT OF: COLLECTION						
DATE	7/24/69	7/25/69	7/25/69	7/24/69	7/24/69	7/25/69
LAT.	75N-61N	61N-53N	61N-53N	53N-45N	45N-39N	39N-29N
LONG.	147W-138W	138W-129W	138W-129W	129W-117W	117W-108W	106W- 94W
VOL. OF AIR (100 SCM)	12.740	3.810	3.810	9.110	8.110	15.270

PC/100 SCM

LAB:	TLW	TLW	TLW	TLW	TLW	TLW
SR-90	98.300	82.800	80.600	53.200	19.200	14.700
ZR-95	1600.000	1480.000	1350.000	945.000	328.000	251.000
CE-144	1880.000	1700.000	1650.000	1210.000	383.000	328.000
PB-210	0.897	0.920	0.813A	1.007	1.181	1.254
PO-210	0.498	0.333B	0.380A	0.405A	0.258A	0.317A
PU-238	0.378	0.223	0.692 ?	0.136	0.042	0.043
PU-239	1.926	1.477	0.718 ?	0.959	0.314	0.280

A:COUNTING ERROR IS 20-50 PERCENT   *:NOT DETECTABLE
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT

TABLE 3B

RADIOCHEMICAL ANALYSIS OF JULY 1969 COMPOSITES

15.2 KM

SAMPLE NO.	2462	2463	2464	2465	2335A	2466
COMPOSED OF:	1/2:2244	1/2:2241	1/2:2229	1/2:2231	1/2:2335	1/2:2332
	2317	2242	2230	2232		2333
	2318	2243	2275	2233		2334
			2278			
MIDPOINT OF: COLLECTION						
DATE	7/25/69	7/27/69	7/25/69	7/23/69	7/24/69	7/24/69
LAT.	29N-21N	21N-12N	12N- 1N	1N-11S	15S-20S	20S-29S
LONG.	94W- 86W	86W- 81W	81W- 79W	81W- 78W	75W- 73W	73W- 69W
VOL. OF AIR (100 SCM)	10.730	9.570	11.680	11.280	5.000	10.000
			PC/100 SCM			
LAB:	TLW	TLW	TLW	TLW	TLW	TLW
SR-90	9.891	4.293	2.362	1.206	2.429	9.514
ZR-95	159.000	76.400	34.700	14.500	18.500	61.600
CE-144	200.000	98.300	41.800	19.700	42.300	144.000
PB-210	1.162	1.585	0.924	0.720		1.058
PO-210	0.337A	0.283A	0.157A	*		0.436A
PU-238	0.032	0.014	0.008A	0.003B	0.015A	0.059
PU-239	0.192	0.078	0.025	0.018	0.038	0.117

A:COUNTING ERROR IS 20-50 PERCENT *:NOT DETECTABLE
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT

TABLE 3B

RADIOCHEMICAL ANALYSIS OF JULY 1969 COMPOSITES

15.2 KM

SAMPLE NO.	2352A	2467	2468	2469
COMPOSED OF:	1/2:2352	1/2:2378 2379	1/2:2376 2377	1/2:2374 2375
MIDPOINT OF: COLLECTION				
DATE	7/25/69	7/23/69	7/23/69	7/23/69
LAT.	29S-33S	33S-40S	40S-46S	46S-51S
LONG.	69W- 68W	69W- 68W	68W- 67W	67W- 67W
VOL. OF AIR (100 SCM)	3.390	7.920	6.060	4.420

PC/100 SCM

LAB:	TLW	TLW	TLW	TLW
SR-90	54.600	22.100	94.100	135.000
ZR-95	259.000	109.000	491.000	682.000
CE-144	876.000	322.000	1550.000	2000.000
PB-210		0.905	0.678	0.876
PO-210		0.424A	0.436A	0.289B
PU-238	0.356	0.136	0.625	0.921
PU-239	0.607	0.229	1.067	1.546

A:COUNTING ERROR IS 20-50 PERCENT *:NOT DETECTABLE
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT

TABLE 3B

RADIOCHEMICAL ANALYSIS OF JULY 1969 COMPOSITES

13.7 KM

SAMPLE NO.	2470	2286A	2471	2369A	2472	2473
COMPOSED OF:	1/2:2380 2381 2382 2383	1/2:2286	1/2:2287 2288 2289	1/2:2369	1/2:2370 2371	1/2:2372 2373
MIDPOINT OF: COLLECTION						
DATE	7/25/69	7/24/69	7/24/69	7/23/69	7/23/69	7/23/69
LAT.	61N-50N	50N-47N	47N-41N	37S-40S	40S-46S	46S-51S
LONG.	138W-125W	125W-121W	121W-111W	69W- 68W	68W- 67W	67W- 67W
VOL. OF AIR (100 SCM)	13.380	4.250	10.770	3.600	6.710	5.440

PC/100 SCM

LAB:	TLW	TLW	TLW	TLW	TLW	TLW
SR-90	62.300	9.612	3.319	9.979	18.700	52.800
ZR-95	1030.000	166.000	56.400	53.700	101.000	257.000
CE-144	1240.000	222.000	71.200	151.000	307.000	750.000
PB-210	0.985		1.081		0.900	0.876
PO-210	0.441		0.141B		0.378A	0.479A
PU-238	0.149	0.028A	0.012A	0.054	0.142	0.334
PU-239	1.036	0.193	0.061	0.113	0.244	0.584

A:COUNTING ERROR IS 20-50 PERCENT *:NOT DETECTABLE
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT

TABLE 38

RADIOCHEMICAL ANALYSIS OF JULY 1969 COMPOSITES

12.2 KM

SAMPLE NO. 2474
COMPOSED OF:1/2:2392
2393
2394

MIDPOINT OF: COLLECTION	
DATE	7/24/69
LAT.	75N-65N
LONG.	146W-143W
VOL. OF AIR (100 SCM)	13.690

PC/100 SCM

LAB:	TLW
SR-90	64.700
ZR-95	1190.000
CE-144	1410.000
PB-210	0.915
PO-210	0.493
PU-238	0.177
PU-239	1.304

A:COUNTING ERROR IS 20-50 PERCENT
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT
*:NOT DETECTABLE

TABLE 3C
TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 19.2 KM

SAMPLE NO.	2747	2748	2749	2764	2763	2762
FLIGHT NO.	288	288	288	296	296	296
DATE	10/13/69	10/13/69	10/13/69	10/14/69	10/14/69	10/14/69
TIME	0008-0044	0044-0117	0117-0145	0022-0110	0002-0022	2332-0002
LAT.	75N-71N	71N-68N	68N-65N	65N-61N	61N-59N	59N-56N
LONG.	143W-143W	144W-143W	146W-144W	147W-138W	138W-136W	136W-132W
VOL. OF AIR (100 SCM)	2.90	2.70	2.53	4.23	1.76	2.66
GROSS GAMMA/ M/100 SCM	466.	48500.	23600.	920000.	807000.	639000.
COUNT DATE	12/05/69	12/05/69	12/05/69	12/09/69	12/09/69	11/21/69
			PC/100 SCM			
ZR-95	163	18400	8160	337000	302000	257000

A:COUNTING ERROR IS 20-50 PERCENT *:NOT DETECTABLE
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT

TABLE 3C
TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 19.2 KM

SAMPLE NO.	2761	2760	2494	2495	2496	2497
FLIGHT NO.	296	296	292	292	292	292
DATE	10/14/69	10/14/69	10/17/69	10/17/69	10/17/69	10/17/69
TIME	2304-2332	2230-2304	1830-1906	1906-1932	1932-1957	1957-2022
LAT.	56N-53N	53N-50N	50N-47N	47N-45N	45N-43N	43N-41N
LONG.	132W-129W	129W-125W	125W-121W	121W-117W	117W-114W	114W-111W
VOL. OF AIR (100 SCM)	2.45	2.80	3.11	2.27	2.23	2.22
GROSS GAMMA/ M/100 SCM	165000.	211000.	140000.	367000.	260000.	131000.
COUNT DATE	12/05/69	12/05/69	12/05/69	12/05/69	12/05/69	12/05/69
			PC/100 SCM			
ZR-95	28100	73900	49000	135000	96000	48300

A:COUNTING ERROR IS 20-50 PERCENT
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT
*:NOT DETECTABLE

TABLE 3C

TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 19.2 KM

SAMPLE NO.	2498	2499	2525	2514	2513	2512
FLIGHT NO.	292	292	298	293	293	293
DATE	10/17/69	10/17/69	10/13/69	10/13/69	10/13/69	10/13/69
TIME	2022-2045	2045-2122	2145-2221	2055-2134	2022-2055	1952-2022
LAT.	41N-39N	39N-35N	39N-35N	35N-33N	33N-31N	31N-29N
LONG.	111W-108W	108W-106W	108W-106W	106W-102W	102W- 98W	98W- 94W
VOL. OF AIR (100 SCM)	2.05	3.30	3.35	3.55	3.00	2.73
GROSS GAMMA/ M/100 SCM	48800.	70900.	2670.	848.	493.	897.
COUNT DATE	12/05/69	12/05/69	11/13/69	12/01/69	12/01/69	12/01/69
			PC/100 SCM			
ZR-95	11400	16600	435	216	134	248

A:COUNTING ERROR IS 20-50 PERCENT

B:COUNTING ERROR IS 51-100 PERCENT

?:DATA SUSPECT

*:NOT DETECTABLE

TABLE 3C
TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 19.2 KM

SAMPLE NO.	2511	2510	2637	2638	2639	2640
FLIGHT NO.	293	293	291	291	291	291
DATE	10/13/69	10/13/69	10/16/69	10/16/69	10/16/69	10/16/69
TIME	1921-1952	1855-1921	1723-1759	1759-1832	1832-1901	1901-1929
LAT.	29N-26N	26N-24N	24N-21N	21N-18N	18N-15N	15N-12N
LONG.	94W- 91W	91W- 89W	89W- 86W	86W- 84W	84W- 82W	82W- 81W
VOL. OF AIR (100 SCM)	2.82	2.36	3.38	3.08	2.71	2.65
GROSS GAMMA/ M/100 SCM	979.	1120.	1060.	990.	1210.	1020.
COUNT DATE	12/01/69	11/12/69	11/19/69	11/19/69	11/19/69	11/19/69
			PC/100 SCM			
ZR-95	267	244	239	223	291	246

A:COUNTING ERROR IS 20-50 PERCENT
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT
*:NOT DETECTABLE

TABLE 3C
TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 19.2 KM

SAMPLE NO.	2641	2740	2739	2738	2737	2736
FLIGHT NO.	291	291	291	291	291	291
DATE	10/16/69	10/13/69	10/13/69	10/13/69	10/13/69	10/13/69
TIME	1929-2000	1850-1922	1815-1850	1740-1815	1703-1740	1626-1703
LAT.	12N- 9N	9N- 5N	5N- 1N	1N- 3S	3S- 7S	7S-11S
LONG.	81W- 79W	80W- 79W	80W- 80W	81W- 80W	81W- 80W	80W- 78W
VOL. OF AIR (100 SCM)	2.93	2.90	3.24	3.24	3.38	3.51
GROSS GAMMA/ M/100 SCM	809.	772.	639.	562.	648.	641.
COUNT DATE	11/19/69	12/04/69	11/23/69	11/22/69	11/22/69	11/22/69
			PC/100 SCM			
ZR-95	202	215	153	135	140	116

A:COUNTING ERROR IS 20-50 PERCENT
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT
*:NOT DETECTABLE

TABLE 3C
TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 19.2 KM

SAMPLE NO.	2615	2616	2617	2618	2619	2598
FLIGHT NO.	286	286	286	286	286	289
DATE	10/15/69	10/15/69	10/15/69	10/15/69	10/15/69	10/14/69
TIME	1552-1644	1644-1712	1712-1726	1726-1803	1803-1840	1852-1925
LAT.	15S-20S	20S-23S	23S-26S	26S-29S	29S-33S	33S-37S
LONG.	76W- 73W	73W- 72W	72W- 71W	71W- 69W	69W- 68W	69W- 68W
VOL. OF AIR (100 SCM)	4.86	2.70	1.32	3.55	3.44	3.02
GROSS GAMMA/ M/100 SCM	844.	685.	1230.	625.	721.	821.
COUNT DATE	11/18/69	11/18/69	11/18/69	11/18/69	11/18/69	11/17/69
			PC/100 SCM			
ZR-95	151	123	210	107	115	137

A:COUNTING ERROR IS 20-50 PERCENT *:NOT DETECTABLE
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT

TABLE 3C

TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 19.2 KM

SAMPLE NO.	2597	2596	2595	2594	2593
FLIGHT NO.	289	289	289	289	289
DATE	10/14/69	10/14/69	10/14/69	10/14/69	10/14/69
TIME	1825-1852	1800-1825	1735-1800	1711-1735	1655-1711
LAT.	37S-40S	40S-43S	43S-46S	46S-49S	49S-51S
LONG.	69W- 68W	68W- 67W	67W- 67W	67W- 67W	67W- 67W
VOL. OF AIR (100 SCM)	2.40	2.06	2.06	1.91	1.31
GROSS GAMMA/ M/100 SCM	729.	1040.	966.	1030.	1110.
COUNT DATE	11/17/69	11/17/69	11/17/69	11/17/69	11/17/69
			PC/100 SCM		
ZR-95	115	177	157	172	182

A:COUNTING ERROR IS 20-50 PERCENT

B:COUNTING ERROR IS 51-100 PERCENT

?:DATA SUSPECT

*:NOT DETECTABLE

TABLE 3C
TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 18.3 KM

SAMPLE NO.	2483	2505	2506	2507	2508	2509
FLIGHT NO.	293	293	293	293	293	293
DATE	10/16/69	10/13/69	10/13/69	10/13/69	10/13/69	10/13/69
TIME	1926-2001	1637-1642	1642-1718	1718-1747	1747-1826	1826-1848
LAT.	34N-33N	33N-33N	33N-31N	31N-29N	29N-26N	26N-24N
LONG.	106W-102W	102W-102W	102W- 98W	98W- 94W	94W- 91W	91W- 89W
VOL. OF AIR (100 SCM)	3.64	0.54	3.90	3.14	4.23	2.38
GROSS GAMMA/ M/100 SCM	4070.	2440.	1030.	1060.	1030.	1230.
COUNT DATE	12/05/69	11/12/69	11/12/69	11/12/69	11/12/69	11/12/69
			PC/100 SCM			
ZR-95	966	424	238	252	231	293

A:COUNTING ERROR IS 20-50 PERCENT
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT
*:NOT DETECTABLE

TABLE 3C

TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 18.3 KM

SAMPLE NO.	2636	2635	2634	2633	2729	2728
FLIGHT NO.	291	291	291	291	289	289
DATE	10/16/69	10/16/69	10/16/69	10/16/69	10/17/69	10/17/69
TIME	1645-1715	1613-1645	1545-1613	1515-1545	1631-1700	1555-1631
LAT.	24N-21N	21N-18N	18N-15N	15N-12N	12N- 9N	9N- 5N
LONG.	89W- 86W	86W- 84W	84W- 82W	82W- 81W	81W- 79W	79W- 79W
VOL. OF AIR (100 SCM)	3.53	3.77	3.21	3.45	3.36	4.14
GROSS GAMMA/ M/100 SCM	980.	833.	1160.	846.	714.	568.
COUNT DATE	11/19/69	11/19/69	11/19/69	11/19/69	11/22/69	11/22/69
			PC/100 SCM			
ZR-95	249	196	291	200	174	138

A:COUNTING ERROR IS 20-50 PERCENT

B:COUNTING ERROR IS 51-100 PERCENT

?:DATA SUSPECT

*:NOT DETECTABLE

TABLE 3C
TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 18.3 KM

SAMPLE NO.	2732	2733	2734	2603	2735	2604
FLIGHT NO.	291	291	291	289	291	289
DATE	10/13/69	10/13/69	10/13/69	10/12/69	10/13/69	10/12/69
TIME	1352-1426	1426-1503	1503-1542	1551-1631	1542-1619	1631-1708
LAT.	5N- 1N	1N- 3S	3S- 7S	7S-11S	7S-11S	11S-15S
LONG.	80W- 80W	81W- 80W	81W- 80W	80W- 78W	80W- 78W	78W- 76W
VOL. OF AIR (100 SCM)	4.02	4.26	4.49	4.78	4.31	4.42
GROSS GAMMA/ M/100 SCM	463.	404.	419.	404.	457.	493.
COUNT DATE	11/22/69	11/22/69	11/22/69	11/17/69	11/22/69	11/17/69
			PC/100 SCM			
ZR-95	113	89	91	77	85	84

A:COUNTING ERROR IS 20-50 PERCENT
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT
*:NOT DETECTABLE

TABLE 3C
TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 18.3 KM

SAMPLE NO.	2605	2614	2606	2613	2607	2612
FLIGHT NO.	289	286	289	286	289	286
DATE	10/12/69	10/15/69	10/12/69	10/15/69	10/12/69	10/15/69
TIME	1708-1756	1458-1541	1756-1827	1434-1458	1827-1853	1405-1434
LAT.	15S-20S	14S-20S	20S-23S	20S-23S	23S-26S	23S-26S
LONG.	76W- 74W	75W- 73W	74W- 72W	73W- 72W	72W- 71W	72W- 71W
VOL. OF AIR (100 SCM)	5.62	5.17	3.55	2.88	2.93	3.48
GROSS GAMMA/ M/100 SCM	826.	584.	738.	444.	717.	514.
COUNT DATE	11/17/69	11/18/69	11/17/69	11/18/69	11/18/69	11/18/69
			PC/100 SCM			
ZR-95	151	102	127	80	128	82

A:COUNTING ERROR IS 20-50 PERCENT
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT
*:NOT DETECTABLE

TABLE 3C
TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 18.3 KM

SAMPLE NO.	2608	2611	2609	2563
FLIGHT NO.	289	286	289	289
DATE	10/12/69	10/15/69	10/12/69	10/15/69
TIME	1853-1919	1338-1405	1919-1941	1633-1706
LAT.	26S-29S	26S-29S	29S-32S	29S-33S
LONG.	71W- 69W	71W- 69W	69W- 68W	69W- 58W
VOL. OF AIR (100 SCM)	2.93	2.99	2.48	3.81
GROSS GAMMA/ M/100 SCM	570.	632.	5.	362.
COUNT DATE	11/18/69	11/18/69	11/18/69	12/01/69
			PC/100 SCM	
ZR-95	112	107	*	63

A:COUNTING ERROR IS 20-50 PERCENT
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT
*:NOT DETECTABLE

TABLE 3C
TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 16.8 KM

SAMPLE NO.	2746	2745	2744	2743	2756	2757
FLIGHT NO.	288	288	288	288	296	296
DATE	10/13/69	10/13/69	10/13/69	10/13/69	10/14/69	10/14/69
TIME	2331-0004	2304-2331	2237-2304	2147-2237	2013-2033	2033-2105
LAT.	75N-71N	71N-68N	68N-65N	65N-61N	61N-59N	59N-56N
LONG.	143W-143W	144W-143W	146W-144W	146W-138W	138W-136W	136W-132W
VOL. OF AIR (100 SCM)	4.81	3.90	4.09	7.13	2.80	4.62
GROSS GAMMA/ M/100 SCM	1000.	3210.	4520.	127000.	525000.	46300.
COUNT DATE	11/22/69	12/03/69	12/05/69	12/05/69	12/05/69	12/05/69
			PC/100 SCM			
ZR-95	432	445	1600	46500	200000	18400

A:COUNTING ERROR IS 20-50 PERCENT *:NOT DETECTABLE
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT

TABLE 3C
TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 16.8 KM

SAMPLE NO.	2758	2759	2493	2492	2491	2490
FLIGHT NO.	296	296	292	292	292	292
DATE	10/14/69	10/14/69	10/17/69	10/17/69	10/17/69	10/17/69
TIME	2105-2135	2135-2210	1743-1820	1714-1743	1645-1714	1619-1645
LAT.	56N-53N	53N-50N	50N-47N	47N-45N	45N-43N	43N-41N
LONG.	132W-129W	129W-125W	125W-121W	121W-117W	117W-114W	114W-111W
VOL. OF AIR (100 SCM)	4.28	4.99	5.28	4.14	4.16	3.69
GROSS GAMMA/ M/100 SCM	170000.	86200.	6420.	1270.	1250.	1170.
COUNT DATE	12/05/69	12/05/69	11/12/69	11/12/69	11/12/69	11/12/69
			PC/100 SCM			
ZR-95	57700	33100	1320	471	462	451

A:COUNTING ERROR IS 20-50 PERCENT
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT
*:NOT DETECTABLE

TABLE 3C
TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 16.8 KM

SAMPLE NO.	2489	2488	2482	2549	2548	2547
FLIGHT NO.	292	292	293	298	298	298
DATE	10/17/69	10/17/69	10/16/69	10/14/69	10/14/69	10/14/69
TIME	1555-1619	1534-1555	1847-1919	2051-2130	2016-2051	1945-2016
LAT.	41N-39N	39N-36N	39N-35N	35N-33N	33N-31N	31N-29N
LONG.	111W-108W	108W-108W	108W-107W	106W-102W	102W- 98W	98W- 94W
VOL. OF AIR (100 SCM)	3.49	3.27	4.62	6.00	5.65	5.03
GROSS GAMMA/ M/100 SCM	1280.	642.	939.	930.	1320.	2370.
COUNT DATE	11/12/69	11/12/69	11/10/69	11/14/69	11/14/69	11/14/69
			PC/100 SCM			
ZR-95	263	144	183	170	205	323

A:COUNTING ERROR IS 20-50 PERCENT

B:COUNTING ERROR IS 51-100 PERCENT

?:DATA SUSPECT

*:NOT DETECTABLE

TABLE 3C
TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 16.8 KM

SAMPLE NO.	2546	2545	2721	2722	2723	2724
FLIGHT NO.	298	298	291	291	291	291
DATE	10/14/69	10/14/69	10/15/69	10/15/69	10/15/69	10/15/69
TIME	1909-1945	1845-1909	2017-2051	2051-2124	2124-2152	2152-2221
LAT.	29N-26N	26N-24N	24N-21N	21N-18N	18N-15N	15N-12N
LONG.	94W- 91W	91W- 89W	89W- 86W	86W- 84W	84W- 82W	82W- 81W
VOL. OF AIR (100 SCM)	5.86	3.90	5.47	5.38	4.66	4.85
GROSS GAMMA/ M/100 SCM	2580.	6130.	10700.	7810.	180.	245.
COUNT DATE	11/14/69	11/14/69	12/01/69	11/15/69	11/22/69	11/22/69
			PC/100 SCM			
ZR-95	373	730	2030	1010	34	49

A:COUNTING ERROR IS 20-50 PERCENT
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT
*:NOT DETECTABLE

TABLE 3C
TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 16.8 KM

SAMPLE NO.	2730	2652	2715	2651	2714	2650
FLIGHT NO.	289	286	291	286	291	286
DATE	10/17/69	10/16/69	10/13/69	10/16/69	10/13/69	10/16/69
TIME	1704-1733	1933-1955	1907-1942	1859-1933	1830-1907	1824-1859
LAT.	12N- 9N	8N- 5N	9N- 5N	5N- 1N	5N- 1N	1N- 3S
LONG.	81W- 79W	80W- 79W	80W- 79W	80W- 80W	80W- 80W	81W- 80W
VOL. OF AIR (100 SCM)	4.54	3.50	5.74	5.41	6.26	5.57
GROSS GAMMA/ M/100 SCM	405.	160.	103.	99.	79.	101.
COUNT DATE	11/21/69	11/21/69	11/22/69	11/21/69	11/21/69	11/21/69
			PC/100 SCM			
ZR-95	87	35	22	19	17	21

A:COUNTING ERROR IS 20-50 PERCENT
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT
*:NOT DETECTABLE

TABLE 3C
TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 16.8 KM

SAMPLE NO.	2713	2649	2712	2648	2711	2647
FLIGHT NO.	291	286	291	286	291	286
DATE	10/13/69	10/16/69	10/13/69	10/16/69	10/13/69	10/16/69
TIME	1752-1830	1746-1824	1714-1752	1657-1746	1626-1714	1628-1657
LAT.	1N- 3S	3S- 7S	3S- 7S	7S-12S	7S-11S	12S-15S
LONG.	81W- 80W	81W- 80W	81W- 80W	80W- 78W	80W- 78W	78W- 77W
VOL. OF AIR (100 SCM)	6.43	6.01	6.55	7.93	7.99	4.66
GROSS GAMMA/ M/100 SCM	92.	290.	86.	60.	125.	80.
COUNT DATE	11/22/69	11/21/69	11/22/69	11/21/69	11/22/69	11/21/69
			PC/100 SCM			
ZR-95	18	47	16	10	21	9

A:COUNTING ERROR IS 20-50 PERCENT *:NOT DETECTABLE
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT

TABLE 3C
TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 16.8 KM

SAMPLE NO.	2582	2646	2583	2645	2584	2644
FLIGHT NO.	289	286	289	286	289	286
DATE	10/13/69	10/16/69	10/13/69	10/16/69	10/13/69	10/16/69
TIME	1636-1727	1538-1628	1727-1753	1509-1538	1753-1820	1439-1509
LAT.	15S-20S	15S-20S	20S-23S	20S-23S	23S-26S	23S-26S
LONG.	76W- 73W	77W- 74W	73W- 72W	74W- 73W	72W- 71W	73W- 71W
VOL. OF AIR (100 SCM)	8.31	8.15	4.26	4.80	4.35	4.83
GROSS GAMMA/ M/100 SCM	91.	15.	55.	42.	80.	88.
COUNT DATE	11/15/69	11/21/69	11/15/69	11/21/69	11/15/69	11/21/69
			PC/100 SCM			
ZR-95	15	67	9	4	13	10

A:COUNTING ERROR IS 20-50 PERCENT *:NOT DETECTABLE
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT

TABLE 3C

TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 16.8 KM

SAMPLE NO.	2585	2643	2586	2562	2588	2589
FLIGHT NO.	289	286	289	289	289	289
DATE	10/13/69	10/16/69	10/13/69	10/15/69	10/14/69	10/14/69
TIME	1820-1848	1407-1439	1848-1923	1525-1601	1431-1500	1500-1525
LAT.	26S-29S	26S-29S	29S-33S	33S-37S	37S-40S	40S-43S
LONG.	71W- 70W	71W- 69W	70W- 69W	69W- 58W	69W- 68W	68W- 67W
VOL. OF AIR (100 SCM)	4.45	5.01	5.57	5.48	4.12	3.50
GROSS GAMMA/ M/100 SCM	153.	147.	294.	651.	944.	991.
COUNT DATE	11/17/69	11/21/69	11/17/69	12/01/69	11/17/69	11/17/69
			PC/100 SCM			
ZR-95	26	25	52	119	158	170

A:COUNTING ERROR IS 20-50 PERCENT

B:COUNTING ERROR IS 51-100 PERCENT

?:DATA SUSPECT

*:NOT DETECTABLE

TABLE 3C

TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 16.8 KM

SAMPLE NO.	2590	2591	2592
FLIGHT NO.	289	289	289
DATE	10/14/69	10/14/69	10/14/69
TIME	1525-1551	1551-1617	1618-1634
LAT.	43S-46S	46S-49S	49S-51S
LONG.	67W- 67W	67W- 67W	67W- 67W
VOL. OF AIR (100 SCM)	3.54	3.54	2.18
GROSS GAMMA/ M/100 SCM	1040.	1100.	1070.
COUNT DATE	11/17/69	11/17/69	11/17/69
			PC/100 SCM
ZR-95	178	186	184

A:COUNTING ERROR IS 20-50 PERCENT

B:COUNTING ERROR IS 51-100 PERCENT

?:DATA SUSPECT

*:NOT DETECTABLE

TABLE 3C
TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 15.2 KM

SAMPLE NO.	2772	2773	2774	2790	2789	2788
FLIGHT NO.	296	296	296	288	288	288
DATE	10/13/69	10/13/69	10/13/69	10/14/69	10/14/69	10/14/69
TIME	2224-2302	2302-2330	2330-2359	0047-0125	0028-0047	2359-0028
LAT.	75N-71N	71N-68N	68N-65N	65N-61N	61N-59N	59N-56N
LONG.	143W-143W	144W-143W	146W-144W	144W-139W	139W-136W	136W-132W
VOL. OF AIR (100 SCM)	7.31	5.44	5.50	7.52	3.84	5.84
GROSS GAMMA/ M/100 SCM	1420.	5990.	2220.	1640.	654.	1280.
COUNT DATE	11/15/69	11/15/69	11/15/69	11/15/69	11/21/69	11/15/69
			PC/100 SCM			
ZR-95	378	1400	621	424	216	334

A:COUNTING ERROR IS 20-50 PERCENT
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT
*:NOT DETECTABLE

TABLE 3C

TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 15.2 KM

SAMPLE NO.	2787	2786	2533	2532	2531	2530
FLIGHT NO.	288	288	293	293	293	293
DATE	10/14/69	10/14/69	10/14/69	10/14/69	10/14/69	10/14/69
TIME	2328-2359	2255-2328	1859-1941	1827-1859	1759-1827	1731-1759
LAT.	56N-53N	53N-50N	50N-47N	47N-45N	45N-43N	43N-41N
LONG.	132W-129W	129W-125W	125W-121W	121W-117W	117W-114W	114W-111W
VOL. OF AIR (100 SCM)	6.16	6.33	8.13	5.98	5.15	5.43
GROSS GAMMA/ M/100 SCM	2820.	1190.	5410.	3080.	1820.	343.
COUNT DATE	12/02/69	11/15/69	11/13/69	11/13/69	11/13/69	11/13/69
			PC/100 SCM			
ZR-95	991	472	1100	826	504	125

A:COUNTING ERROR IS 20-50 PERCENT

B:COUNTING ERROR IS 51-100 PERCENT

?:DATA SUSPECT

*:NOT DETECTABLE

TABLE 3C

TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 15.2 KM

SAMPLE NO.	2529	2481	2480	2486	2541	2542
FLIGHT NO.	293	293	293	292	298	298
DATE	10/14/69	10/16/69	10/16/69	10/15/69	10/14/69	10/14/69
TIME	1705-1731	1810-1843	1702-1749	1659-1742	1635-1710	1710-1740
LAT.	41N-39N	39N-36N	35N-33N	35N-33N	33N-31N	31N-29N
LONG.	111W-109W	108W-107W	106W-102W	106W-102W	102W- 98W	98W- 94W
VOL. OF AIR (100 SCM)	4.96	6.90	9.89	9.39	7.79	6.70
GROSS GAMMA/ M/100 SCM	381.	306.	138.	301.	146.	28.
COUNT DATE	11/13/69	11/10/69	11/10/69	11/12/69	11/14/69	11/14/69
			PC/100 SCM			
ZR-95	69	65	28	64	20	5

A:COUNTING ERROR IS 20-50 PERCENT

B:COUNTING ERROR IS 51-100 PERCENT

?:DATA SUSPECT

*:NOT DETECTABLE

TABLE 3C
TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 15.2 KM

SAMPLE NO.	2543	2544	2720	2719	2718	2717
FLIGHT NO.	298	298	291	291	291	291
DATE	10/14/69	10/14/69	10/15/69	10/15/69	10/15/69	10/15/69
TIME	1740-1818	1818-1841	1941-2012	1908-1941	1836-1908	1807-1836
LAT.	29N-26N	26N-24N	24N-21N	21N-18N	18N-15N	15N-12N
LONG.	94W- 91W	91W- 89W	89W- 86W	86W- 84W	84W- 82W	82W- 81W
VOL. OF AIR (100 SCM)	8.46	5.18	6.77	7.20	7.10	6.44
GROSS GAMMA/ M/100 SCM	29.	48.	226.	34.	155.	22.
COUNT DATE	11/14/69	11/14/69	11/21/69	11/21/69	11/22/69	11/22/69
			PC/100 SCM			
ZR-95	4	8	34	8	25	3

A:COUNTING ERROR IS 20-50 PERCENT
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT
*:NOT DETECTABLE

TABLE 3C
TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 15.2 KM

SAMPLE NO.	2716	2726	2727	2707	2708	2709
FLIGHT NO.	291	289	289	291	291	291
DATE	10/15/69	10/17/69	10/17/69	10/13/69	10/13/69	10/13/69
TIME	1750-1807	1440-1512	1512-1548	1350-1428	1428-1503	1503-1544
LAT.	12N-10N	12N- 9N	9N- 5N	5N- 1N	1N- 3S	3S- 7S
LONG.	81W- 80W	81W- 79W	79W- 79W	80W- 80W	81W- 80W	81W- 80W
VOL. OF AIR (100 SCM)	3.77	6.90	7.81	8.78	7.67	9.39
GROSS GAMMA/ M/100 SCM	13.	30.	11.	10.	16.	12.
COUNT DATE	11/22/69	12/05/69	11/23/69	11/26/69	11/26/69	11/26/69
			PC/100 SCM			
ZR-95	2	5	2	2	2	2

A:COUNTING ERROR IS 20-50 PERCENT *:NOT DETECTABLE
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT

TABLE 3C
TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 15.2 KM

SAMPLE NO.	2710	2581	2580	2579	2578	2561
FLIGHT NO.	291	289	289	289	289	289
DATE	10/13/69	10/13/69	10/13/69	10/13/69	10/13/69	10/15/69
TIME	1544-1626	1540-1630	1512-1540	1445-1512	1414-1445	1412-1447
LAT.	7S-11S	15S-20S	20S-23S	23S-26S	26S-29S	29S-33S
LONG.	80W- 78W	76W- 73W	73W- 72W	72W- 71W	71W- 70W	69W- 58W
VOL. OF AIR (100 SCM)	9.62	10.96	6.02	5.73	6.45	7.52
GROSS GAMMA/ M/100 SCM	18.	18.	33.	31.	42.	400.
COUNT DATE	11/26/69	11/15/69	11/15/69	11/15/69	11/15/69	11/14/69
			PC/100 SCM			
ZR-95	3	3	5	5	6	66

A:COUNTING ERROR IS 20-50 PERCENT

B:COUNTING ERROR IS 51-100 PERCENT

?:DATA SUSPECT

*:NOT DETECTABLE

TABLE 3C
TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 15.2 KM

SAMPLE NO.	2630	2629	2628	2627	2626	2625
FLIGHT NO.	286	286	286	286	286	286
DATE	10/14/69	10/14/69	10/14/69	10/14/69	10/14/69	10/14/69
TIME	1817-1852	1747-1816	1722-1746	1656-1721	1632-1655	1614-1631
LAT.	33S-37S	37S-40S	40S-43S	43S-46S	46S-49S	49S-51S
LONG.	69W- 68W	69W- 68W	68W- 67W	67W- 67W	67W- 67W	67W- 67W
VOL. OF AIR (100 SCM)	6.75	5.59	4.43	4.49	4.13	3.05
GROSS GAMMA/ M/100 SCM	344.	660.	770.	768.	683.	620.
COUNT DATE	11/19/69	11/19/69	11/19/69	11/18/69	11/18/69	11/18/69
			PC/100 SCM			
ZR-95	63	115	133	128	121	118

A:COUNTING ERROR IS 20-50 PERCENT
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT
*:NOT DETECTABLE

TABLE 3C
TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 13.7 KM

SAMPLE NO.	2782	2783	2784	2785	2534	2535
FLIGHT NO.	288	288	288	288	293	293
DATE	10/14/69	10/14/69	10/14/69	10/14/69	10/14/69	10/14/69
TIME	2032-2058	2058-2133	2133-2209	2209-2255	1949-2020	2020-2052
LAT.	61N-59N	59N-56N	56N-53N	53N-50N	50N-47N	47N-45N
LONG.	139W-136W	136W-132W	132W-129W	129W-125W	125W-121W	121W-117W
VOL. OF AIR (100 SCM)	6.25	8.41	4.79	11.23	7.45	7.19
GROSS GAMMA/ M/100 SCM	800.	722.	1660.	1530.	725.	645.
COUNT DATE	11/21/69	11/21/69	11/15/69	11/15/69	11/13/69	11/13/69
			PC/100 SCM			
ZR-95	224	292	660	422	279	249

A:COUNTING ERROR IS 20-50 PERCENT *:NOT DETECTABLE
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT

TABLE 3C

TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 13.7 KM

SAMPLE NO.	2536	2537	2538	2620	2621	2622
FLIGHT NO.	293	293	293	286	286	286
DATE	10/14/69	10/14/69	10/14/69	10/14/69	10/14/69	10/14/69
TIME	2052-2119	2119-2148	2148-2211	1348-1421	1422-1451	1452-1523
LAT.	45N-43N	43N-41N	41N-39N	37S-40S	40S-43S	43S-46S
LONG.	117W-114W	114W-111W	111W-109W	69W- 68W	68W- 67W	67W- 67W
VOL. OF AIR (100 SCM)	6.26	6.89	5.40	7.57	6.51	6.93
GROSS GAMMA/ M/100 SCM	677.	916.	741.	439.	521.	620.
COUNT DATE	11/13/69	11/14/69	11/14/69	11/18/69	11/18/69	11/18/69
			PC/100 SCM			
ZR-95	271	225	294	73	88	108

A:COUNTING ERROR IS 20-50 PERCENT

B:COUNTING ERROR IS 51-100 PERCENT

?:DATA SUSPECT

*:NOT DETECTABLE

TABLE 3C

TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 13.7 KM

SAMPLE NO.	2623	2624
FLIGHT NO.	286	286
DATE	10/14/69	10/14/69
TIME	1524-1551	1552-1610
LAT.	46S-49S	49S-51S
LONG.	67W- 67W	67W- 67W
VOL. OF AIR (100 SCM)	6.16	3.96
GROSS GAMMA/ M/100 SCM	515.	530.
COUNT DATE	11/18/69	11/18/69

PC/100 SCM

ZR-95	83	89

A:COUNTING ERROR IS 20-50 PERCENT

B:COUNTING ERROR IS 51-100 PERCENT

?:DATA SUSPECT

*:NOT DETECTABLE

TABLE 3C

TOTAL GAMMA AND ZR-95 CONCENTRATIONS IN OCTOBER 1969

ALTITUDE 12.2 KM

SAMPLE NO.	2771	2770	2769
FLIGHT NO.	296	296	296
DATE	10/13/69	10/13/69	10/13/69
TIME	2139-2218	2111-2139	2044-2111
LAT.	75N-71N	71N-68N	68N-65N
LONG.	143W-143W	144W-143W	146W-144W
VOL. OF AIR (100 SCM)	10.72	7.70	7.79
GROSS GAMMA/ M/100 SCM	534.	210.	263.
COUNT DATE	11/15/69	11/22/69	11/22/69

PC/100 SCM

ZR-95	108	44	51

A:COUNTING ERROR IS 20-50 PERCENT
B:COUNTING ERROR IS 51-100 PERCENT
?:DATA SUSPECT
*:NOT DETECTABLE

Table 3d

QUALITY CONTROL RESULTS

Report Date	Sample No. T	Reference Date		Sr-90	Zr-95	Ce-144	Pb-210	Po-210	Pu-238	Pu-239
				dpm ± % Standard Deviation						
Standards										
3/70	2477	7/25/69	added	3.26×10^3	1020	661	6.78	6.78	2.96	4.10
			found	$3.36 \times 10^3 \pm 1$	891±4	701±3	7.77±31	7.07±4	2.96±3	4.46±2
			% deviation	+3.1	-13	+6.0	+15	+4.3	0	+8.8
"	2478	7/27/69	added	3.91×10^3	891	560	9.76	9.76	2.96	3.49
			found	$3.42 \times 10^3 \pm 1$	835±4	607±2	10.4±19	11.1±5	2.56±5	3.63±4
			% deviation	+12	-6.3	+8.4	+6.6	+14	-4.8	+4.0
			Average % deviation	+7.5	-9.6	+7.2	+11	+9.2	-2.4	+6.4
				dpm ± % Standard Deviation						
Blanks										
2/70	2250A	7/27/69		*	*	2.99±69			*	*
"	2301A	7/23/69		*	2.74±60	3.08±19			*	*
				pCi/100 SCM						
Duplicates	2446			97.7±1	1390±1	1790±1	0.569±25	0.295±49	0.452±5	1.73±3
	2475			103±3	1470±1	2000±1	0.551±36	0.388±52	0.525±7	1.86±4
	% deviation about the average			±5.3	±5.6	+11	±3.2	±27	±15	±7.2
	2458			82.8±1	1480±2	1700±1	0.920±18	0.333±51	0.223±8	1.48±4
	2476			80.6±2	1350±1	1650±1	0.813±22	0.380±48	0.692±4?	0.718±4?
	% deviation about the average			±2.7	±9.2	±3.0	±12	±13		
			Average % deviation	±4.0	±7.4	±7.0	±7.6	±20		

? Data suspect

High Altitude Balloon Sampling Program

by P. W. Krey (HASL)

In HASL-217, the analyses of all high altitude balloon samples collected during 1968 were summarized. Unfortunately three samples collected in October 1968 at San Angelo, Texas were reported as having been flown in September. This error has been corrected in the accompanying tables which cover both the September and October flights made at San Angelo. None of the radiochemical data has been changed - only the collection dates.

Table 4

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING SEPTEMBER 1968
LATITUDE, 31N SAN ANGELO, TEXAS

ALTITUDE (KM)	21	24	27
FLIGHT DAY	16	01	08
HASL NUMBER	3011	2999	3001
COLLECTION UNIT	D7-1	D7-1	D7-1
ANALYTICAL LABORATORY	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	1298.0#	1756.7#	608.2
IRON-55	4200		
STRONTIUM-89	285A	*	*
STRONTIUM-90	543	282	97.2
ZIRCONIUM-95	635	109A	*
CERIUM-144	4720	943	118
POLONIUM-210	1.94A	1.76B	1.04B
PLUTONIUM-238	8.37	7.03	6.82
PLUTONIUM-239	13.0	5.80	2.37

A: One Standard Deviation of Counting Error is >20% to 50% of count.
B: One Standard Deviation of Counting Error is >50% to 100% of Count.
*: Standard Deviation Greater than Data Value.
#: Gross Gamma Count More than Two Weeks After Collection.

Table 4

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING SEPTEMBER 1968
LATITUDE, 31N SAN ANGELO, TEXAS

ALTITUDE (KM)	32	36	41
FLIGHT DAY	09	07	12
HASL NUMBER	3002	3000	3009
COLLECTION UNIT	AE-1	AE-1	HV3K
ANALYTICAL LABORATORY	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	706.2	776.0#	714.1
		PC/KSCM	
STRONTIUM-89	*	*	
STRONTIUM-90	32.7B	24.0B	61.1A
ZIRCONIUM-95	*	*	
CERIUM-144	65.0A	*	*
POLONIUM-210	*	*	11.5A
PLUTONIUM-238	3.88	2.33B	24.6
PLUTONIUM-239	1.06A	*	.792B

A: One Standard Deviation of Counting Error is 20% to 50% of Count.
B: One Standard Deviation of Counting Error is 50% to 100% of Count.
*: Standard Deviation Greater than Data Value.
#: Gross Gamma Count more than Two Weeks After Collection.

Table 4

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING OCTOBER 1968
LATITUDE, 31N SAN ANGELO, TEXAS

ALTITUDE (KM)	24	27	30
FLIGHT DAY	30	28	29
HASL NUMBER	3045	3035	3036
COLLECTION UNIT	D7-1	D7-1	D7-1
ANALYTICAL LABORATORY	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	1187.1#	296.9#	198.5#
		PC/KSCM	
IRON-55	6460		
STRONTIUM-89	206A	*	
STRONTIUM-90	426	104	28.5
ZIRCONIUM-95	275A	*	
CERIUM-144	2560	165	*
POLONIUM-210	1.22B	2.48A	*
PLUTONIUM-238	7.61	6.77	3.09
PLUTONIUM-239	10.0	1.98	.883A

A: ONE STANDARD DEVIATION OF COUNTING ERROR IS >20% TO 50% OF COUNT.
B: ONE STANDARD DEVIATION OF COUNTING ERROR IS >50% TO 100% OF COUNT.
*: STANDARD DEVIATION GREATER THAN DATA VALUE
#: GROSS GAMMA COUNT MORE THAN TWO WEEKS AFTER COLLECTION

Part III

DATA FROM SOURCES OTHER THAN HASL

Numerous Fallout studies are conducted by other organizations in the United States and abroad. Some of these are sent to the editors for dissemination in these HASL Quarterly reports. Submitted data are reproduced essentially as received and no interpretation by HASL is attempted.

REPORT No.
NRL-F 35

DEPARTMENT OF HEALTH

QUARTERLY REPORT

APRIL — JUNE
1969

ENVIRONMENTAL RADIOACTIVITY IN NEW ZEALAND

AND

MEASUREMENTS ON SAMPLES FROM FIJI AND RAROTONGA

NATIONAL RADIATION LABORATORY
P.O. BOX 1456, CHRISTCHURCH, NEW ZEALAND

SYMBOLS UNITS AND EQUIVALENTS

UNITS OF RADIOACTIVITY

Ci	Curie	3.7×10^{10} disintegrations per second
mCi	millicurie .. .. 10^{-3} Curies	
pCi	picocurie .. .. 10^{-12} Curies	2.22 disintegrations per minute

UNITS OF LENGTH, AREA, VOLUME AND MASS AND THEIR EQUIVALENTS IN THE IMPERIAL SYSTEM

cm	centimetre	0.394 inches
km^2	square kilometre	0.386 square miles
m^3	cubic metre..	35.31 cubic feet
litre	litre	0.880 quart
g	gram	0.0353 ounce

NOTES

1. Unless otherwise noted, all times given in this report are New Zealand Standard time i.e. G.M.T. + 12 hours.

2. Radioactive fallout in rain is expressed as:

   (a) Deposition - millicuries per square kilometre (mCi/km^2)

   (b) Concentration - picocuries per litre (pCi/litre)

   $$\text{Concentration (pCi/litre)} = \frac{\text{deposition } (mCi/km^2)}{\text{rainfall (cm)}} \times 100$$

   Multiply mCi/km^2 by 2.59 to obtain mCi/sq. mile.

3. The levels of strontium-90 contamination in food and bone are given in "Strontium Units" i.e. picocuries strontium-90 per gram of calcium ....pCi Sr^{90}/g Ca.

   Similarly caesium-137 results are given as picocuries of caesium-137 per gram of potassium..............................pCi Cs^{137}/g K.

   One litre of whole milk contains approximately:

   1.2 g of calcium

   1.4 g of potassium.

CONTENTS

POTENTIAL HEALTH HAZARD

The significance of the levels of radioactivity in environmental samples published in this Report may be understood more readily by comparing these levels with the following "permissible levels for the general population" which have been adopted for use in New Zealand.

These levels have been set as a guide to limit the controlled release of radioactive substances into the environment by licensed users in New Zealand.

They are levels which individually would not require remedial or preventive action and have been chosen to protect the most sensitive age group in the population. It is considered that any risk associated with these levels is exceedingly small and that levels many times as great would involve a hazard which is small compared to commonly accepted risks of life.

"Permissible levels" of Radioactivity

These levels were derived so as to ensure that the dose to any member of the public arising from the controlled use of radioactive materials does not exceed the Dose Limit recommended by the International Commission on Radiological Protection.

Strontium-90

In Milk: 270 Strontium Units - maintained indefinitely in the milk.

In Bone: 67 Strontium Units.

Caesium-137

In Milk: 7,000 pCi/g K - maintained indefinitely in the milk.

Iodine-131

In Milk: 200 pCi/litre - as an average intake over one year.

Total Beta Activity of Mixed Fission Products Between 10 and 80 Days Old

In Air: 300 pCi/m^3 - for continuous breathing.

In Rainwater: 6,000 pCi/litre - for continuous consumption.

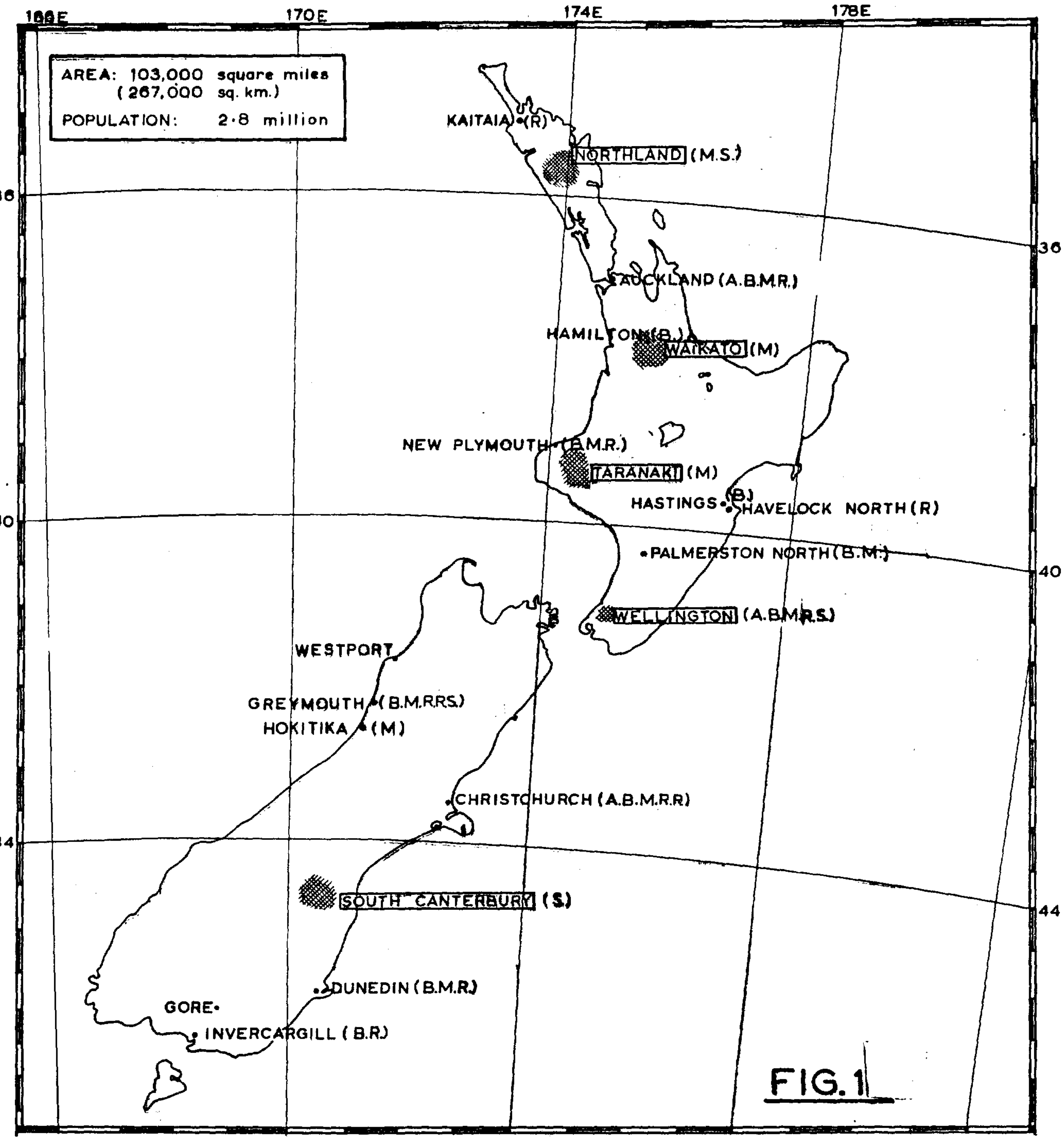


FIG.1

LOCATION OF COLLECTING STATIONS ESTABLISHED BY THE NATIONAL RADIATION LABORATORY FOR AIR (A), BONE (B), MILK (M), RAINWATER (R), AND SOIL (S), SAMPLES IN NEW ZEALAND. Where more than one type of collection is performed (e.g. weekly <u>and</u> monthly rainwater collection) the appropriate symbol is shown twice. Collection areas not confined to a single location but extending over part of a province or district are shown thus [NAME]

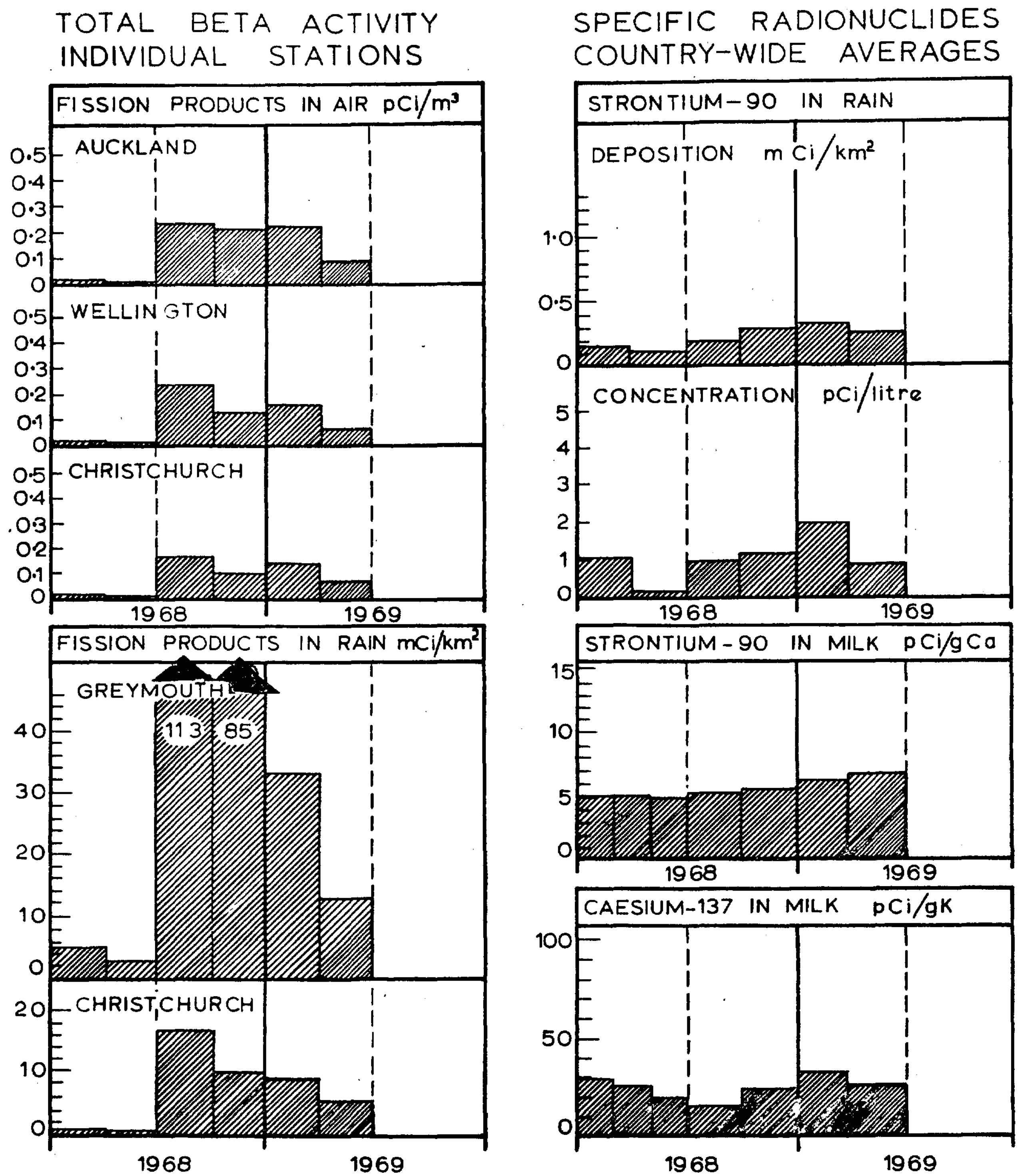


FIG. 2 SUMMARY OF ROUTINE MEASUREMENTS

SUMMARY

GENERAL

Results of routine monitoring of fallout in air, rain and milk samples during the second quarter 1969 are tabulated in this Report. These results are summarized on a quarterly basis and are presented graphically in Fig. 2, together with results from previous Quarterly Reports during 1968 and 1969.

Additional information on sample collection and evaluation, comparison of levels of environmental radioactivity and health hazard assessment is given in the Annual Summary Report for 1968 "ENVIRONMENTAL RADIOACTIVITY IN NEW ZEALAND, Report No. NRL-F33" which also includes the results of extended monitoring of fallout from the French nuclear tests in the Pacific.

TOTAL BETA ACTIVITY - INDIVIDUAL STATIONS

During the first quarter 1969, and also during the two previous quarters, levels of fission products in air and rainwater increased. These higher levels resulted from the 1968 series of nuclear tests conducted by France in the Pacific area between 8 July and 9 September. This series included for the first time the detonation of two hydrogen bombs.

The expected decrease in levels, which had been evident during the months following the previous test series of 1966 and 1967 occurred more slowly following the 1968 nuclear tests. The total beta activity of air samples during the first quarter 1969 had not decreased significantly from the levels of the previous two quarterly periods. There has been, however, a significant decrease during the second quarter 1969. The total beta activity of rain samples has steadily decreased since the third quarter 1968. The greater delay in the reduction of fission product levels following the 1968 nuclear tests undoubtedly results from the injection of fission debris into higher altitudes when hydrogen bombs are detonated. The subsequent deposition of the debris is thus extended over a longer period.

The average levels in air during the second quarter 1969 were 0.09 pCi/m^3 at Auckland and 0.06 pCi/m^3 at Wellington and Christchurch. During the corresponding periods in 1967 and 1968 the highest levels were 0.03 pCi/m^3 (at Auckland and Christchurch) and 0.01 pCi/m^3 (at Auckland) respectively.

The total deposition in rain during the second quarter 1969 was 12.3 mCi/km^2 at Greymouth, and 5.4 mCi/km^2 at Christchurch. The levels have steadily decreased since the third quarter 1968. During the second quarters of 1967 and 1968 the highest deposition was also at Greymouth: 4.7 and 2.3 mCi/km^2 respectively.

SPECIFIC RADIONUCLIDES - COUNTRY-WIDE AVERAGES

1. STRONTIUM-90 IN RAIN. The average deposition in rain decreased slightly from 0.34 mCi/km^2 during the first quarter 1969 to 0.27 mCi/km^2 during the second quarter 1969. This level is about one fifth of the highest level previously recorded i.e. during the first quarter 1965.

2. STRONTIUM-89 IN RAIN. The average deposition reached a maximum of 5.1 mCi/km^2 during October 1968, about one month after the conclusion of the 1968 nuclear tests. During the second quarter 1969 levels have been steadily falling: 0.5, 0.4 and 0.2 mCi/km^2 during April, May and June respectively. The previous highest level was 3.5 mCi/km^2 during November 1966.

3. STRONTIUM-90 IN MILK. The average level has increased slightly from 6.3 Strontium Units during the first quarter 1969 to 6.8 Strontium Units during the second quarter 1969. The highest level previously recorded was 15.9 Strontium Units during July-August 1964. The average level for the twelve months ending June 1969 (6.0 Strontium Units) is about 2% of the "permissible level" for the whole population[(1)].

4. CAESIUM-137 IN MILK. The average level has decreased slightly from 33 pCi/g K during the first quarter 1969 to 27 pCi/g K during the second quarter 1969. The highest level previously recorded was 81 pCi/g K during March-April 1965. The average level for the twelve months ending June 1969 (25 pCi/g K) is less than 0.4% of the "permissible level" for the whole population[(1)].

[(1)] SEE POTENTIAL HEALTH HAZARD - PAGE 3.

RESULTS OF ROUTINE MONITORING OF FALLOUT DURING SECOND QUARTER 1969

TABLE 1 TOTAL BETA ACTIVITY OF AIR SAMPLES

In Picocuries per Cubic Metre Four Days after Collection.
Filters changed 3 times each week.

AUCKLAND		WELLINGTON		CHRISTCHURCH	
Date Filter Removed	Total Beta Activity pCi/m^3	Date Filter Removed	Total Beta Activity pCi/m^3	Date Filter Removed	Total Beta Activity pCi/m^3
2.4.69	0.11	4.4.69	0.07	2.4.69	0.08
4.4.69	0.16	7.4.69	0.10	8.4.69	0.09
7.4.69	0.12	9.4.69	N.S.	14.4.69	0.07
9.4.69	0.12	11.4.69	0.06	16.4.69	0.09
11.4.69	0.13	14.4.69	0.15	21.4.69	0.05
14.4.69	0.25	16.4.69	0.07	23.4.69	0.03
16.4.69	0.15	18.4.69	0.12	24.4.69	0.05
18.4.69	0.16	21.4.69	0.02	28.4.69	0.04
21.4.69	0.08	23.4.69	0.08	30.4.69	0.08
23.4.69	0.07	25.4.69	0.06		
25.4.69	0.10	28.4.69	0.05		
28.4.69	0.08	30.4.69	0.11		
30.4.69	0.14				
Average	0.13	Average	0.08	Average	0.06
2.5.69	0.07	2.5.69	0.09	2.5.69	0.05
5.5.69	0.07	5.5.69	N.S.	5.5.69	0.05
7.5.69	0.03	7.5.69	0.07	7.5.69	0.07
9.5.69	0.11	9.5.69	0.04	9.5.69	0.05
12.5.69	0.08	12.5.69	0.06	12.5.69	0.03
14.5.69	0.13	14.5.69	0.11	14.5.69	0.07
16.5.69	0.09	16.5.69	0.13	16.5.69	0.06
19.5.69	0.09	19.5.69	0.06	19.5.69	0.05
21.5.69	0.05	21.5.69	0.10	21.5.69	0.10
23.5.69	<0.01	23.5.69	0.08	23.5.69	0.04
26.5.69	0.08	26.5.69	0.03	26.5.69	<0.01
28.5.69	0.09	28.5.69	0.04	28.5.69	0.02
30.5.69	0.04	30.5.69	0.05	30.5.69	0.03
Average	0.07	Average	0.07	Average	0.05
2.6.69	0.04	2.6.69	0.02	3.6.69	0.04
4.6.69	0.02	4.6.69	0.04	6.6.69	0.06
6.6.69	0.09	6.6.69	0.06	9.6.69	0.04
9.6.69	0.10	9.6.69	0.04	11.6.69	0.03
11.6.69	0.03	11.6.69	0.03	13.6.69	0.05
12.6.69	0.18	13.6.69	0.04	16.6.69	0.02
16.6.69	0.05	16.6.69	0.05	18.6.69	0.04
18.6.69	0.07	18.6.69	0.06	20.6.69	0.03
20.6.69	0.06	20.6.69	0.03	23.6.69	0.02
23.6.69	0.04	23.6.69	0.02	25.6.69	0.05
25.6.69	0.05	25.6.69	0.03	27.6.69	0.03
27.6.69	0.08	27.6.69	0.05	30.6.69	0.03
30.6.69	0.08	30.6.69	0.04		
Average	0.07	Average	0.04	Average	0.04
Quarterly Average	0.09	Quarterly Average	0.06	Quarterly Average	0.06

TABLE 2 TOTAL BETA ACTIVITY OF WEEKLY RAINWATER COLLECTIONS FOUR DAYS AFTER COLLECTION

AT	DATE OF COLLECTION FROM	TO	DEPOSITION mCi/km^2	RAINFALL cm	CONCENTRATION pCi/litre
GREYMOUTH	29.3.69	5.4.69	1.5	6.2	
	5.4.69	12.4.69	2.2	5.5	
	12.4.69	19.4.69	1.4	7.8	
	19.4.69	26.4.69	2.0	7.8	
	29.3.69	26.4.69	7.1	27.3	26
	26.4.69	3.5.69	0.2	1.0	
	3.5.69	10.5.69	1.3	2.8	
	10.5.69	17.5.69	0.4	1.0	
	17.5.69	24.5.69	1.6	8.9	
	24.5.69	31.5.69	0.2	0.9	
	26.4.69	31.5.69	3.7	14.6	25
	31.5.69	7.6.69	0.2	0.7	
	7.6.69	14.6.69	<0.1	0.3	
	14.6.69	21.6.69	0.9	7.0	
	21.6.69	28.6.69	0.3	1.5	
	31.5.69	28.6.69	1.5	9.5	16
	2nd QUARTER 1969		12.3	51.4	24
CHRISTCHURCH	28.3.69	3.4.69	0.2	0.2	
	3.4.69	11.4.69	1.5	0.8	
	11.4.69	18.4.69	0.3	<0.1	
	18.4.69	24.4.69	1.2	3.6	
	24.4.69	2.5.69	0.3	1.2	
	28.3.69	2.5.69	3.5	5.9	59
	2.5.69	9.5.69	0.5	1.7	
	9.5.69	16.5.69	<0.1	<0.1	
	16.5.69	23.5.69	0.1	0.7	
	23.5.69	30.5.69	0.3	2.6	
	2.5.69	30.5.69	1.0	5.1	20
	30.5.69	6.6.69	0.1	1.0	
	6.6.69	13.6.69	<0.1	TRACE	
	13.6.69	20.6.69	0.5	0.8	
	20.6.69	27.6.69	0.2	1.5	
	30.5.69	27.6.69	0.9	3.3	27
	2nd QUARTER 1969		5.4	14.3	38

TABLE 3a	STRONTIUM-90 IN RAIN SECOND QUARTER 1969								
COLLECTING STATIONS	DEPOSITION mCi/km^2			RAINFALL cm			CONCENTRATION pCi/litre		
<u>New Zealand</u>	Apr.	May	Jun.	Apr.	May	Jun.	Apr.	May	Jun.
Kaitaia	0.09	0.14	0.18	12.1	22.0	25.2	0.8	0.6	0.7
Auckland	0.12	0.07	0.12	12.3	11.7	8.7	1.0	0.6	1.4
New Plymouth	0.09	0.05	0.08	11.1	13.4	14.6	0.8	0.4	0.5
Havelock North	0.06	0.03	0.03	7.0	5.1	5.2	0.8	0.6	0.6
Wellington	0.12	0.12	0.05	7.2	16.9	7.5	1.7	0.7	0.7
Greymouth	0.23	0.16	0.13	24.3	13.6	14.1	0.9	1.2	0.9
Christchurch	0.08	0.06	0.02	5.8	5.1	2.5	1.3	1.2	1.0
Dunedin	0.07	0.06	0.02	5.3	7.5	2.9	1.2	0.9	0.8
Invercargill	0.10	0.07	0.08	11.2	7.9	11.6	0.9	0.9	0.7
<u>Country-Wide Averages</u>									
Monthly	0.11	0.08	0.08	10.7	11.5	10.3	1.0	0.8	0.8
Quarterly		0.27*						0.9	
<u>Pacific Islands</u>									
Suva, Fiji	0.10	N.S.	0.04	25.0	7.3	2.4	0.4	N.S.	1.7
Rarotonga	0.07	0.04	0.03	35.8	9.1	7.3	0.2	0.5	0.4

* This value is the sum of the monthly depositions during the quarter.

N.S. No Sample.

TABLE 3b	STRONTIUM-89 IN RAIN SECOND QUARTER 1969					
COLLECTING STATIONS	DEPOSITION mCi/km^2 (at mid-month)			RATIO Strontium-89/Strontium-90		
New Zealand	Apr.	May	Jun.	Apr.	May	Jun.
Kaitaia	0.4	0.7	0.4	4	5	2
Auckland	0.5	0.2	0.5	4	3	4
New Plymouth	0.4	0.3	0.2	4	6	3
Havelock North	0.2	0.3	<0.1	4	8	3
Wellington	0.4	0.4	0.1	3	3	2
Greymouth	1.1	0.7	0.3	5	5	2
Christchurch	0.4	0.2	0.1	6	3	4
Dunedin	0.4	0.2	<0.1	6	3	3
Invercargill	0.5	0.2	0.3	5	3	4
Country-Wide Averages						
Monthly	0.5	0.4	0.2	5	4	3
Quarterly		1.1*			4	
Pacific Islands						
Suva, Fiji	0.4	N.S.	<0.1	4	N.S.	2
Rarotonga	0.4	0.2	<0.1	5	4	3

* This value is the sum of the monthly depositions during the quarter.

N.S. No Sample.

TABLE 4 STRONTIUM-90 AND CAESIUM-137 IN MILK 1969

COLLECTING STATIONS	STRONTIUM-90 pCi/g Ca	CAESIUM-137 pCi/g K		
	April - June	April	May	June
Northland	5.1	17	20	29
Auckland	4.9	24	23	(30)***
Waikato	5.9**	50	52	(40)***
Taranaki	9.4	102	93	79
Palmerston North	10.1	5	7	1
Wellington	4.7	11	9	6
Westland *	16.4	46	38	29
Christchurch	2.0	2	3	1
Dunedin	2.9	7	5	1
Country-Wide Averages				
Monthly		29	28	24
Quarterly	6.8		27	

* The Westland Collecting Station was referred to as Greymouth or Hokitika in previous reports.

** April - May only

*** No Sample. Results in brackets are estimates used for calculating the country-wide average.

REPORT No.
NRL-F 36

DEPARTMENT OF HEALTH

QUARTERLY REPORT
JULY-SEPTEMBER
1969

ENVIRONMENTAL RADIOACTIVITY IN NEW ZEALAND

AND

MEASUREMENTS ON SAMPLES FROM FIJI AND RAROTONGA

NATIONAL RADIATION LABORATORY
P.O. BOX 1456, CHRISTCHURCH, NEW ZEALAND

SYMBOLS UNITS AND EQUIVALENTS

UNITS OF RADIOACTIVITY

Ci	Curie		3.7×10^{10} disintegrations per second
mCi	millicurie	10^{-3} Curies	
pCi	picocurie	10^{-12} Curies	2.22 disintegrations per minute

UNITS OF LENGTH, AREA, VOLUME AND MASS AND THEIR EQUIVALENTS IN THE IMPERIAL SYSTEM

cm	centimetre	0.394 inches
km^2	square kilometre	0.386 square miles
m^3	cubic metre	35.31 cubic feet
litre	litre	0.880 quart
g	gram	0.0353 ounce

NOTES

1. Unless otherwise noted, all times given in this report are New Zealand Standard time i.e. G.M.T. + 12 hours.

2. Radioactive fallout in rain is expressed as:

   (a) Deposition - millicuries per square kilometre (mCi/km^2)

   (b) Concentration - picocuries per litre (pCi/litre)

   $$\text{Concentration (pCi/litre)} = \frac{\text{deposition } (mCi/km^2)}{\text{rainfall (cm)}} \times 100$$

   Multiply mCi/km^2 by 2.59 to obtain mCi/sq. mile.

3. The levels of strontium-90 contamination in food and bone are given in "Strontium Units" i.e. picocuries strontium-90 per gram of calcium .... pCi Sr^{90}/g Ca.

   Similarly caesium-137 results are given as picocuries of caesium-137 per gram of potassium.............................. pCi Cs^{137}/g K.

   One litre of whole milk contains approximately:

   1.2 g of calcium

   1.4 g of potassium.

CONTENTS

POTENTIAL HEALTH HAZARD

The significance of the levels of radioactivity in environmental samples published in this Report may be understood more readily by comparing these levels with the following "permissible levels for the general population" which have been adopted for use in New Zealand.

These levels have been set as a guide to limit the controlled release of radioactive substances into the environment by licensed users in New Zealand.

They are levels which individually would not require remedial or preventive action and have been chosen to protect the most sensitive age group in the population. It is considered that any risk associated with these levels is exceedingly small and that levels many times as great would involve a hazard which is small compared to commonly accepted risks of life.

"Permissible levels" of Radioactivity

These levels were derived so as to ensure that the dose to any member of the public arising from the controlled use of radioactive materials does not exceed the Dose Limit recommended by the International Commission on Radiological Protection.

Strontium-90

In Milk: 270 Strontium Units - maintained indefinitely in the milk.

In Bone: 67 Strontium Units.

Caesium-137

In Milk: 7,000 pCi/g K - maintained indefinitely in the milk.

Iodine-131

In Milk: 200 pCi/litre - as an average intake over one year.

Total Beta Activity of Mixed Fission Products Between 10 and 80 Days Old

In Air: 300 pCi/m^3 - for continuous breathing.

In Rainwater: 6,000 pCi/litre - for continuous consumption.

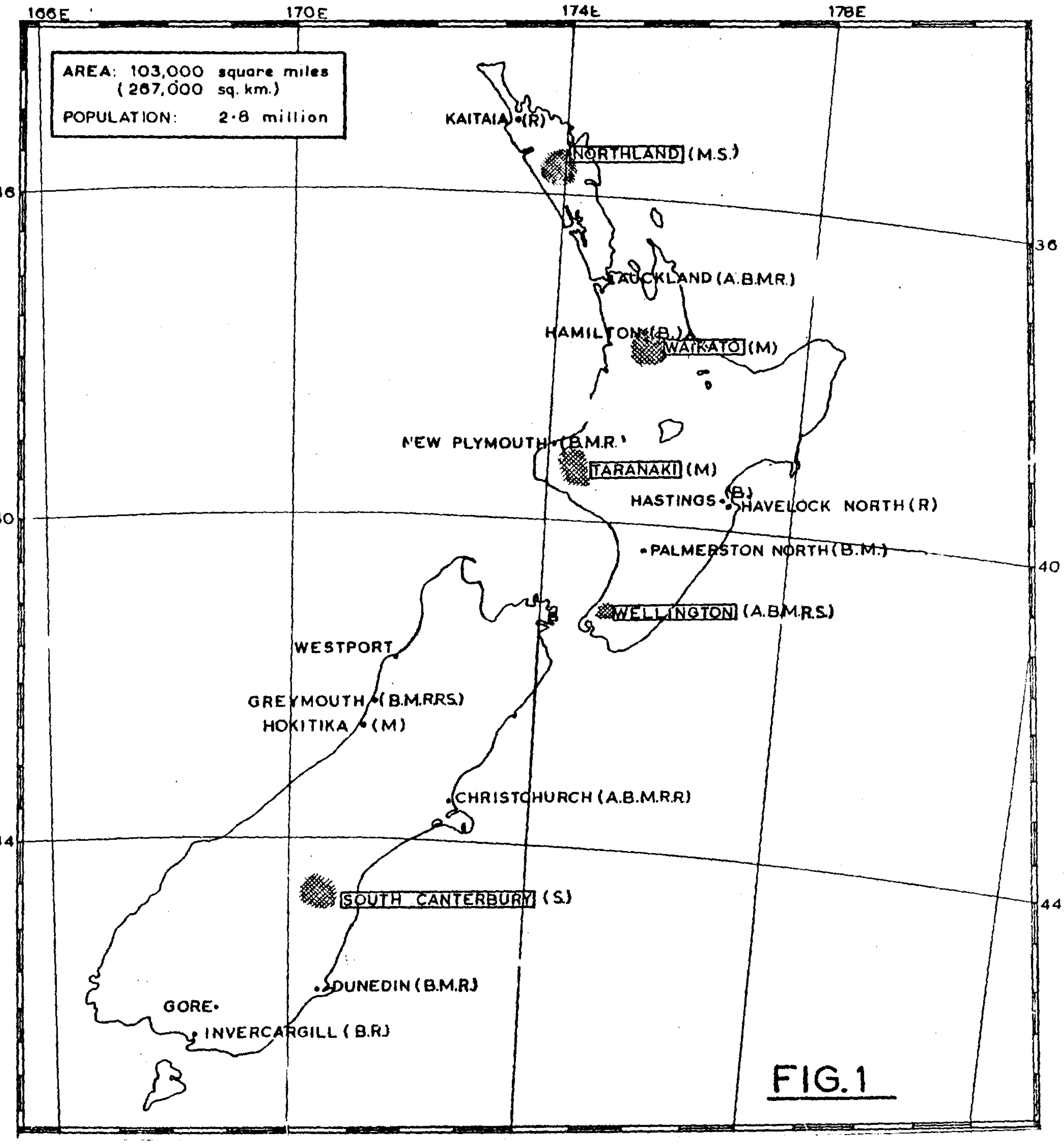


FIG.1

LOCATION OF COLLECTING STATIONS ESTABLISHED BY THE NATIONAL RADIATION LABORATORY FOR AIR (A), BONE (B), MILK (M), RAINWATER (R), AND SOIL (S), SAMPLES IN NEW ZEALAND. Where more than one type of collection is performed (e.g. weekly and monthly rainwater collection) the appropriate symbol is shown twice. Collection areas not confined to a single location but extending over part of a province or district are shown thus ▩ [NAME]

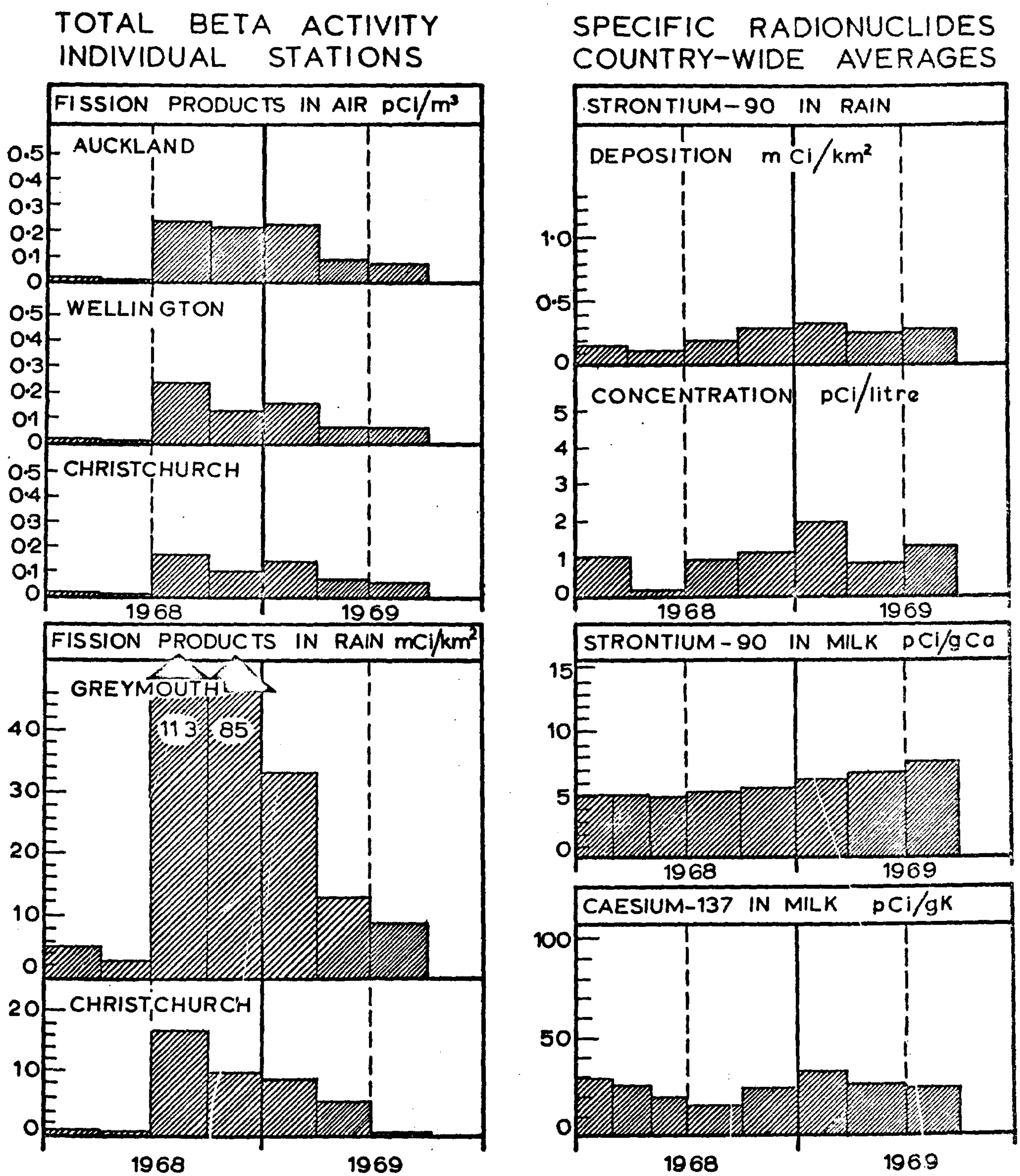


FIG. 2 SUMMARY OF ROUTINE MEASUREMENTS

SUMMARY

GENERAL

Results of routine monitoring of fallout in air, rain and milk samples during the third quarter 1969 are tabulated in this Report. These results are summarized on a quarterly basis and are presented graphically in Fig. 2, together with results from previous Quarterly Reports during 1968 and 1969.

Additional information on sample collection and evaluation, comparison of levels of environmental radioactivity and health hazard assessment is given in the Annual Summary Report for 1968 "ENVIRONMENTAL RADIOACTIVITY IN NEW ZEALAND, Report No.NRL-F33" which also includes the results of extended monitoring of fallout from the French nuclear tests in the Pacific.

TOTAL BETA ACTIVITY - INDIVIDUAL STATIONS

As already noted in the reports NRL-F31 to NRL-F35, increased levels of fission products in air and rainwater were measured during the third quarter 1968. These levels resulted from the 1968 series of nuclear tests conducted by France in the Pacific Area between 8 July and 9 September. This series included for the first time the detonation of two hydrogen bombs.

The expected decrease in levels, which had been evident during the months following the previous test series of 1966 and 1967, occurred more slowly following the 1968 nuclear tests. The greater delay in the reduction of fission product levels following the 1968 nuclear tests undoubtedly resulted from the injection of fission debris into higher altitudes when the hydrogen bombs were tested. The subsequent deposition of the debris was thus extended over a longer period.

During the second and third quarters 1969, however, there were significant decreases in the levels of total beta activity of air and rainwater.

The average levels in air during the third quarter 1969 were 0.08 pCi/m^3 at Auckland, 0.06 pCi/m^3 at Wellington and 0.05 pCi/m^3 at Christchurch. During the corresponding period in 1968 the levels were 0.23 pCi/m^3 at Auckland and Wellington, and 0.16 pCi/m^3 at Christchurch.

The total deposition in rain during the third quarter 1969 was 9.1 mCi/km^2 at Greymouth, and 0.4 mCi/km^2 at Christchurch. During the corresponding period in 1968 the deposition was 112.8 mCi/km^2 at Greymouth, and 16.4 mCi/km^2 at Christchurch.

SPECIFIC RADIONUCLIDES - COUNTRY-WIDE AVERAGES

1. STRONTIUM-90 IN RAIN The average deposition in rain increased slightly from 0.27 mCi/km^2 during the second quarter 1969 to 0.30 mCi/km^2 during the third quarter 1969. This level is less than one quarter of the highest level previously recorded, i.e., during the first quarter 1965.

2. STRONTIUM-89 IN RAIN The average deposition reached a maximum of 5.1 mCi/km^2 during October 1968, about one month after the conclusion of the 1968 nuclear tests. During the third quarter 1969 levels were about 0.1 mCi/km^2 per month.

3. STONTIUM-90 IN MILK The average level has increased from 6.8 Strontium Units during the second quarter 1969 to 7.9 Strontium Units during the third quarter 1969. The highest level previously recorded was 15.9 Strontium Units during July-August 1964. The average level for the twelve months ending September 1969 (6.6 Strontium Units) is about 2.5% of the "permissible level" for the whole population[(1)].

4. CAESIUM-137 IN MILK The average level has decreased slightly from 27 pCi/g K during the second quarter 1969 to 24 pCi/g K during the third quarter 1969. The highest level for the twelve months ending September 1969 (27 pCi/g K) is less than 0.4% of the "permissible level" for the whole population[(1)].

(1) See "POTENTIAL HEALTH HAZARD" - Page 3.

RESULTS OF ROUTINE MONITORING OF FALLOUT DURING THIRD QUARTER 1969

TABLE 1 — TOTAL BETA ACTIVITY OF AIR SAMPLES

In Picocuries per Cubic Metre Four Days after Collection.
Filters changed 3 times each week.

AUCKLAND		WELLINGTON		CHRISTCHURCH	
Date Filter Removed	Total Beta Activity pCi/m^3	Date Filter Removed	Total Beta Activity pCi/m^3	Date Filter Removed	Total Beta Activity pCi/m^3
2.7.69	0.10	2.7.69	0.05	2.7.69	0.04
4.7.69	0.08	4.7.69	0.04	4.7.69	0.06
7.7.69	0.09	8.7.69	0.09	7.7.69	0.05
9.7.69	0.07	9.7.69	0.08	9.7.69	0.05
11.7.69	0.03	11.7.69	0.03	11.7.69	0.04
14.7.69	0.04	14.7.69	0.04	15.7.69	0.04
16.7.69	0.06	16.7.69	0.04	18.7.69	0.04
18.7.69	0.04	18.7.69	0.04	21.7.69	0.05
21.7.69	0.04	21.7.69	0.03	23.7.69	0.07
23.7.69	0.08	23.7.69	0.07	25.7.69	0.08
25.7.69	0.07	25.7.69	0.09	28.7.69	0.03
28.7.69	0.04	28.7.69	0.02	30.7.69	0.04
30.7.69	0.05	30.7.69	0.03	1.8.69	0.03
1.8.69	0.09	1.8.69	0.03		
Average	0.06	Average	0.05	Average	0.05
4.8.69	0.09	4.8.69	0.05	4.8.69	0.03
6.8.69	0.13	6.8.69	0.05	6.8.69	0.05
8.8.69	0.04	8.8.69	0.17	8.8.69	0.04
11.8.69	0.07	11.8.69	0.05	11.8.69	0.05
13.8.69	0.05	13.8.69	0.06	14.8.69	0.05
15.8.69	0.08	15.8.69	0.08	15.8.69	0.03
18.8.69	0.13	18.8.69	0.02	18.8.69	0.04
20.8.69	0.10	20.8.69	0.07	20.8.69	0.05
22.8.69	0.07	22.8.69	0.07	25.8.69	0.09
25.8.69	0.03	25.8.69	0.05	27.8.69	0.12
27.8.69	0.08	27.8.69	0.09	29.8.69	0.04
29.8.69	0.10	29.8.69	0.06	1.9.69	0.06
1.9.69	0.08	1.9.69	0.05		
Average	0.08	Average	0.07	Average	0.05
3.9.69	0.09	3.9.69	0.03	3.9.69	0.05
5.9.69	0.09	5.9.69	0.12	5.9.69	0.08
8.9.69	0.11	8.9.69	0.09	8.9.69	0.04
10.9.69	0.03	10.9.69	0.05	10.9.69	0.02
12.9.69	0.09	12.9.69	0.07	12.9.69	0.07
15.9.69	0.10	15.9.69	0.08	15.9.69	0.05
17.9.69	0.12	17.9.69	0.09	17.9.69	0.05
19.9.69	0.08	19.9.69	0.06	19.9.69	0.04
22.9.69	0.07	22.9.69	0.05	22.9.69	0.04
24.9.69	0.07	24.9.69	0.04	24.9.69	0.06
26.9.69	0.12	26.9.69	0.06	29.9.69	0.08
29.9.69	0.08	29.9.69	0.07	1.10.69	0.08
1.10.69	0.10	1.10.69	0.08		
Average	0.09	Average	0.07	Average	0.05
Quarterly Average	0.08	Quarterly Average	0.06	Quarterly Average	0.05

TABLE 3b STRONTIUM-89 IN RAIN THIRD QUARTER 1969

COLLECTING STATIONS	DEPOSITION mCi/km^2 (at mid-month)			RATIO Strontium-89/Strontium-90		
	July	Aug.	Sept.	July	Aug.	Sept.
New Zealand						
Kaitaia	0.2	<0.1	0.2	3	1	1
Auckland	0.2	0.3	(0.2)**	2	2	(1)**
New Plymouth	0.1	0.3	(0.2)**	2	2	(1)**
Havelock North	<0.1	0.1	<0.1	3	2	<1
Wellington	0.1	0.1	0.1	2	1	2
Greymouth	0.2	0.2	0.5	2	2	1
Christchurch	<0.1	0.2	<0.1	2	1	<1
Dunedin	<0.1	<0.1	<0.1	1	2	<1
Invercargill	<0.1	<0.1	0.2	2	1	1
Country-Wide Averages						
Monthly	0.1	0.1	0.2	2	2	1
Quarterly		0.4*			2	
Pacific Islands						
Suva, Fiji	0.6	<0.1	***	4	<1	***
Rarotonga	0.1	<0.1	***	3	<1	***

* This value is the sum of the monthly depositions during the quarter.

** Results in brackets are estimates used for calculating the country-wide average.

*** Sample transport delay. Results to be published in the fourth quarterly report.

TABLE 4 STRONTIUM-90 AND CAESIUM-137 IN MILK THIRD QUARTER 1969

COLLECTING STATIONS	STRONTIUM-90 pCi/g Ca	CAESIUM-137 pCi/g K		
	July - Sept.	July	Aug.	Sept.
Northland	9.3	15	25	50
Auckland	7.2	39	25	27
Waikato	6.9	27	29	35
Taranaki	11.7	45	92	113
Palmerston North	5.6	5	2	3
Wellington	5.5	8	2	7
Westland *	20.7	16	18	44
Christchurch	1.8	2	<1	<1
Dunedin	2.7	3	(1)**	<1
Country-Wide Averages				
Monthly		18	22	31
Quarterly	7.9		24	

* The Westland Collecting Station was referred to as Greymouth or Hokitika in previous reports.

** No sample. Result in brackets is an estimate used for calculating the country-wide average.

2. Department of Scientific and Industrial Research
The Institute of Nuclear Sciences
Lower Hutt, New Zealand

RADIOISOTOPES IN RAINWATER:

Results for

January-April 1968	report No. 72
May - August 1968	report No. 73
September-December 1968	report No. 74

RADIOISOTOPES IN RAINWATER

Report No 72
Period: January - April 1968
Station: Gracefield, Lower Hutt, New Zealand, S 41° 14' E 174° 55'   Stainless steel collector 1 ft diameter

Sampling Period start	finish	Activity: microcuries/sq.mile Sr^{90}	Ba^{140}	Cs^{137}	$\frac{Ba^{140}}{Sr^{90}}$	$\frac{Cs^{137}}{Sr^{90}}$	Rain Inches	Remarks
1 - 2	2 - 1	248 ± 20 (96)*		200 ± 12 (77)*		0.81	4.69	monthly pot sample
Accumulated total or average for 1968		248 ± 20 (96)*		200 ± 12 (77)*		0.81	4.69	
2 - 1	3 - 1							recovery so low, no results recorded
Accumulated total or average for 1968		248 ± 20 (96)*		200 ± 12 (77)*		0.81	7.33	
3 - 1	4 - 1	41.5 ± 3 (16)*		22.3 ± 1.6 (8.6)*		0.54	0.66	monthly pot sample
accumulated total or average for 1968		289 ± 20 (112)*		223 ± 12 (85.6)*		0.77	7.99	
4 - 1	5 - 1	234 ± 16 (90)*		163 ± 27 (63)*		0.70	14.36	monthly pot sample
accumulated total or average for 1968		523 ± 25 (202)*		386 ± 30 (148.6)*		0.74	22.35	

* Microcuries per square kilometer

<u>Note</u>: Errors quoted are purely counting errors and do not include experimental errors or calibration uncertainties.

INSTITUTE OF NUCLEAR SCIENCES Report 113/- WJM

RADIOISOTOPES IN RAINWATER

Report No 73, Period: May 1968
Station - Gracefield, Lower Hutt, New Zealand S 41°14' E 174°55' Stainless steel collector 1 ft diameter.

Sampling period start	Sampling period finish	Activity: Microcuries/sq. mile Sr^{90}	Ba^{140}	Cs^{137}	Ba^{140}/Sr^{90}	Cs^{137}/Sr^{90}	Rain, inches	Remarks
5 - 1	6 - 1	149 ± 11.0 (58.0)*		175 ± 8 (68)*		1.17	8.89	Monthly pot sample
Accumulated total or average for 968		672 ± 27 (259)*		561 ± 31 (217)*		0.83	31.24	
6 - 1	7 - 1	123 ± 8 (48)*		151 ± 2 (58)*		1.23	7.72	Monthly pot sample
Accumulated total or average for 968		795 ± 28 (307)*		712 ± 31 (275)*		0.90	38.96	
7 - 1	8 - 1	112 ± 7.3 (43)*	45,400 ±380 (17,900)*	155 ± 24 (55)*	404.0	1.39	6.90	Monthly pot sample
Accumulated total or average for 968		907 ± 29 (350)*	45,400 ±380 (17,900)	987 ± 31 (330)*	404.0	1.09	45.86	
8 - 1	9 - 2	93.5 ± 3.2 (36)*	8,360 ± 124 (3240)*	116 ± 1.35 (45)*	89.0	1.23	2.59	Monthly pot sample
Accumulated total or average for 968		1000.5 ± 30 (386)*	53,760 ± 392 (21,140)*	1103 ± 31.5 (375)*	246	1.10	48.45	

* microcuries per square kilometer

Note: Errors quoted are purely counting errors and do not include experimental errors or calibration uncertainities.

INS-50/113/-

RADIOISOTOPES IN RAINWATER

Report No. 74 - September 1968 to December 1968

Station - Gracefield, Lower Hutt   S41°14' E174°55'

Stainless Steel Collector 1ft. diameter

Sampling Period Start	Finish	Activity microcurie/Sq. mile Sr^{90}	Ba^{140}	Cs^{137}	Ba^{140}/Sr^{90}	Cs^{137}/Sr^{90}	Rain Inches	Remarks
9 - 2	10 - 1	153 ± 6.5 59*	4530 ± 67.1 1750*	186 ± 1.9 71.5*	29.6	1.22	4.43	Monthly Pot Sample
Accumulated Total or average for 1968		1153.5 ± 31 445*	58290 ± 400 22890*	1289 ± 32.0 446.5*	50.5	1.11	52.88	
10 - 1	11 - 1	262 ± 6.4 105*	6360 ± 81 2430*	555 ± 3.8 214*	24	2.12	8.40	Monthly Pot Sample Sr^{90} probably low
Accumulated total or average for 1968		1415.5 ± 31.5 550*	64,590 ± 408 25,320*	1744 ± 32.0 660.5*	46	1.21	61.28	
11 - 1	12 - 1	190 ± 6.4 73*	543 ± 32.5 214*	214 ± 6.7 82.5*	2.93	1.12	2.07	Monthly Pot Sample
Accumulated total or average for 1968		1605.5 ± 32.0 623*	65,133 ± 420 25,534*	1958 ± 32.7 743*	40.7	1.20	63.35	
12 - 1	2 - 1 - 69	178 ± 4.0 69*	-	296 ± 3.2 114*	-	1.69	4.60	Monthly Pot Sample Sr^{90} probably low
Accumulated total or average for 1968		1783.5 ± 32.0 692*	65,133 ± 420 25,534*	2254 ± 33 857*	36.6	1.24	67.95	

* Microcuries per square kilometer

Note errors quoted are purely counting errors and do not include experimental errors or calibrations uncertainties.

Cesium-137 in Various Chicago Foods*
(Collection Month January, 1970)

S. S. Brar and D. M. Nelson

Radiological Physics Division
Argonne National Laboratory
Argonne, Illinois 60439

Since April, 1961, the ^{137}Cs and potassium content of the Chicago portion of Tri-City Diet Sampling Program has been determined[1-4] in bulk food samples by gamma ray spectrometry using a 4" x 4" NaI (Tl) crystal. The individual food components were counted for a minimum of 100 minutes, and from these measurements composite daily and yearly food intakes were obtained. Cesium-137 activity in food, now, is an order of magnitude lower than it was a few years ago; consequently, a new procedure for these measurements has been adopted in order to improve accuracy. The same variety of foods (all fresh vegetables; all fresh fruits, etc.) are composited before measurement, and the samples are counted a minimum of 400 minutes. The results of the January, 1970, quarter are tabulated in Tables I and II.

*Work performed under the auspices of the U. S. Atomic Energy Commission.

Table I

Cesium-137 in Chicago Diets
(Adults)

January, 1970

	kg/yr	Potassium g/kg	^{137}Cs pCi/kg	Potassium g/yr	^{137}Cs pCi/yr
White Bread	37	1.0	18	37	666
Whole Wheat Bread	11	2.6	39	29	429
Eggs	16	1.3	0	21	0
Fresh Vegetables	43	3.5	0	151	0
Root Vegetables	17	2.9	0	49	0
Milk	221	1.5	12	332	2652
Poultry	17	2.4	11	41	187
Fresh Fish*	8	3.7	32	30	256
Flour	43	1.1	21	47	903
Macaroni	3	2.2	28	7	84
Meat	73	3.3	28	241	2044
Dried Beans	3	12.5	9	38	27
Fresh Fruit	68	2.3	0	156	0
Potatoes	45	4.2	8	189	360
Canned Fruits	26	1.0	14	26	364
Canned Fruit Juices	19	1.7	18	32	342
Canned Vegetables	20	.8	0	16	0
Total/yr				1442	8314
Total/day				4.0	23

*It is assumed in arriving at the average that nine times more ocean fish is consumed than fresh water fish.

Table II

Cesium-137 in Chicago Diets

(Infants)

January, 1970

	kg/yr	Potassium g/kg	^{137}Cs pCi/kg	Potassium g/yr	^{137}Cs pCi/yr
Evaporated Milk	137	3.2	34	438	4658
Formula Milk	37	1.7	30	63	1110
Cereals	8	6.9	26	55	208
Fruits	23	1.3	8	30	184
Meats	17	2.2	28	37	476
Vegetables	23	2.2	0	51	0
Total/yr				674	6636
Total/day				1.8	18

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EURATOM JOINT NUCLEAR RESEARCH CENTRE

ISPRA ESTABLISHMENT

Protection Service

Site Survey and Meteorology Section

QUARTERLY REPORT

III - 32

The Euratom Ispra Establishment is located in Northern Italy 58 Km NW away from Milan and 14 Km W from Varese.

The activity levels shown in this report represent weapons-test fallout, and do not reflect any contamination from the site.

SAMPLE COLLECTION

a. Air

Air is drawn by pumps through paper filters at the rate of, at least, 500 m^3 / day, measured by gás meter.

The single daily filters are measured for gross beta radioactivity and then pooled to give monthly samples, for gamma spectrometry and radiochemical analyses.

b. Wet and dry deposition

These samples are collected monthly by means of four 1 m^2 stainless steel funnels, having the bottom always covered with deionized water. The collected water is evaporated and the dry residue analysed.

c. Milk

Milk is collected twice a week in four small local dairies to give 8 liters / month. About six liters dry matter are submitted to gamma spectrometry and two liters ashed for radiochemical determination of strontium-90.

CHEMICAL PROCEDURES AND COUNTING TECHNIQUES

a. Strontium-90 is separated by the fuming nitric acid precipitation and then purified through hydroxides and chromates precipitations. The activity of the final strontium carbonate and yttrium oxalate precipitates is measured in low level anticoincidence beta counters.

b. Cesium-137 is measured by direct gamma spectrometry on the unprocessed or dried samples and, whenever it is necessary, by gamma spectrometry after chemical separation. This is performed by filtration of the solution, obtained dissolving the sample, through a thin AMP (ammonium molybdophosphate) layer, by which cesium is retained. Details of this procedure may be found in the paper by E. Van der Stricht issued on "Radiochemical Acta" 3, 193-199 (1964).

c. Gamma emitting nuclides are measured by direct gamma spectrometry, using, also the spectrum stripping technique.

d. Plutonium-239+240 is separated by anion exchange and electrodeposition; details of the procedure may be found in the paper by M.C. de Bortoli: "Radiochemical determination of plutonium in soil and other environmental samples", Anal. Chem. 39, 375 (March 1967).

The activity is measured in a Frish grid ionisation chamber connected to a multichannel analyser.

EXTRAPOLATION OF THE DATA

Except when otherwise stated, the data presented in this report are extrapolated to the last day of the collecting period.

FALLOUT DEPOSITION

1969

SITE : I S P R A LAT. 45° 49' N LONG. 8° 37' E ALT. 250 m

Month	Gross beta (1)		^{90}Sr	^{89}Sr	^{137}Cs	^{239}Pu	^{238}Pu	Precipitation
	mCi/Km^2	Date (2)	mCi/Km^2	mCi/Km^2	mCi/Km^2	$\mu Ci/Km^2$	$\mu Ci/Km^2$	mm
October	0.78	11-11	*	*	*	*	*	5.0
November	3.80	11-12	0.073	0.20	0.098	*	*	123.4
December	0.95	13-1-70	0.012	0.008	0.013	0.22	0.06	22.4

(1) Potassium-40 equivalent (40 mg/cm^2).

(2) Day and month of the gross beta measurement.

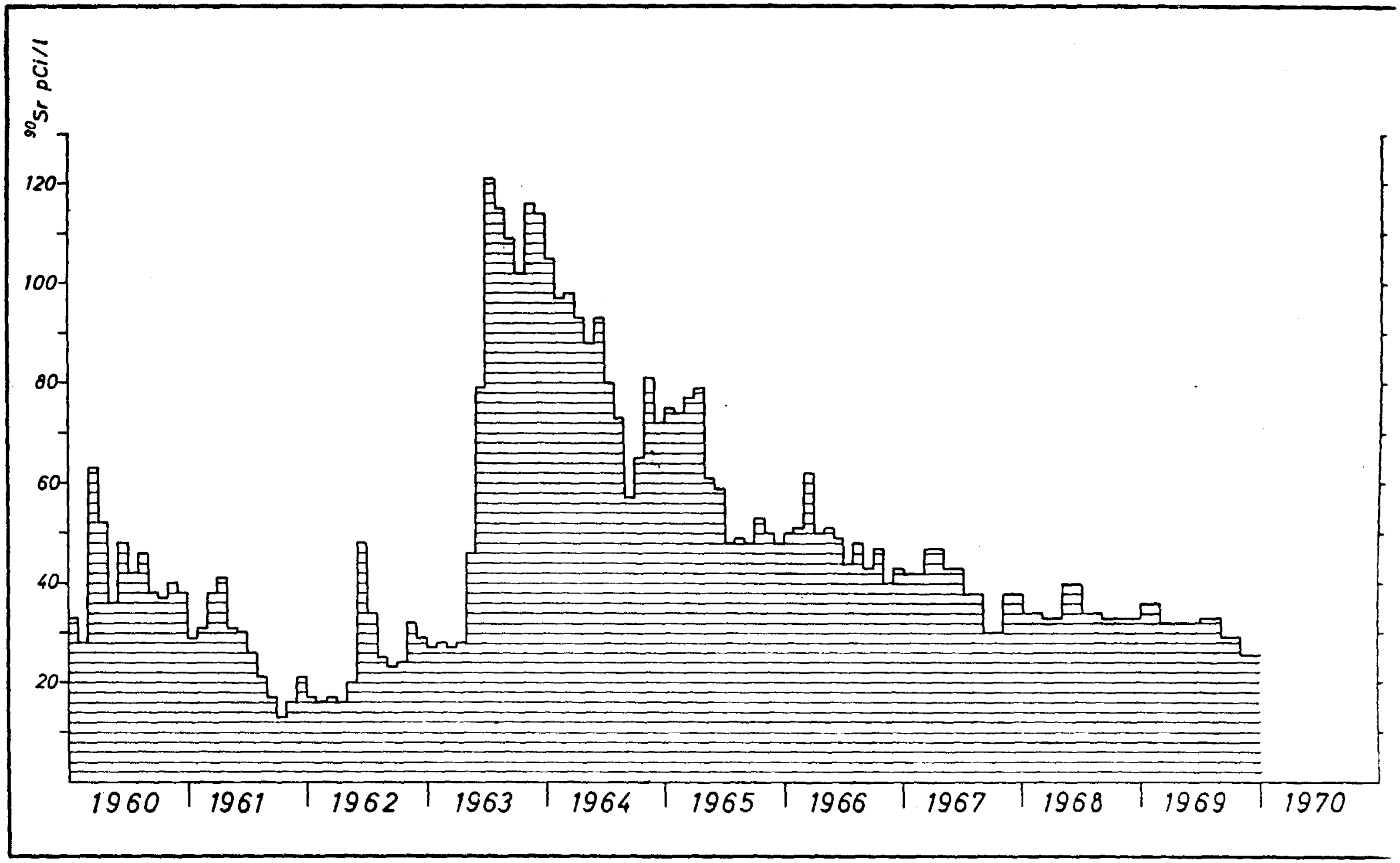
* Data not yet available.

AIR RADIOACTIVITY

1969

SITE : I S P R A LAT. 45° 49' N LONG. 8° 37' E ALT. 250 m

Month	Gross beta pCi/m^3	^{90}Sr 10^{-3}pCi/m^3	^{89}Sr 10^{-3}pCi/m^3	^{137}Cs 10^{-3}pCi/m^3	^{239}Pu 10^{-5}pCi/m^3	^{238}Pu 10^{-5}pCi/m^3
October	0.22	1.6	3.6	1.8	3.7	0.40
November	0.12	0.95	2.2	1.7	2.3	0.44
December	0.14	1.5	1.9	2.1	1.5	0.41



Strontium-90 in the milk of the Ispra zone

G.B. 24.11.69

PART IV

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