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health and safety laboratory

FALLOUT PROGRAM
QUARTERLY SUMMARY REPORT

July 1, 1967

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

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HEALTH AND SAFETY LABORATORY

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FALLOUT PROGRAM
QUARTERLY SUMMARY REPORT

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(March 1, 1967 through June 1, 1967)

Prepared by

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Joseph Rivera

Environmental Studies Division

Preceding reports in this series:

HASL-42, -51, -65, -77, -84, -88
-95, -105, -111, -113, -115,
-117, -122, -127, -131, -132,
-135, -138, -140, -142, -144,
-146, -149, -155, -158, -161,
-164, -165, -171, -172, -173,
-174, and -181.

July 1, 1967

UNITED STATES ATOMIC ENERGY COMMISSION
New York Operations Office

NYOO
Health and Safety

FALLOUT PROGRAM
QUARTERLY SUMMARY REPORT

July 1, 1967

ABSTRACT

This report presents current data from the HASL Fallout Program, Isotopes, Inc., Euratom Joint Nuclear Research Center, Argonne National Laboratory, and the National Radiation Laboratory in New Zealand. Radionuclide levels in stratospheric air, surface air, fallout, milk, other diet components, and tap water, are given in tabular form. The initial section consists of interpretive reports and notes covering the following topics: fallout of SNAP-9A debris; the ratio of Cs-137 to Sr-90 in monthly fallout; and strontium-90 in human vertebrae. A bibliography of recent publications related to radionuclide studies is also presented.

This 34th Quarterly Summary Report of the Fallout Program
is dedicated with affection to

Dr. CHARLES DUNHAM

on the occasion of his departure as Director of the Division
of Biology and Medicine of the Atomic Energy Commission.

Dr. Dunham's encouragement of the rapid publication
and dissemination of the results of fallout studies in these
reports has proved sufficiently inspiring to see us through
34 deadlines. We take this opportunity to offer him our
thanks.

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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 March 1, 1967 to June 1, 1967. The next report is scheduled for publication on October 1, 1967. Preceding reports in the series, starting with HASL-42, "Environmental Contamination from Weapons Tests", and continuing through HASL-51, -65, -77, -84, -88, -95, -105, -111, -113, -115, -117, -122, -127, -131, -132, -135, -138, -140, -142, -144, -146, -149, -155, -158, -161, -164, -165, -171, -172, -173, -174, -181 and -182 (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.

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 National Radiation Laboratory in New Zealand, the Division of Biological and Medical Research at Argonne National Laboratory, and Isotopes, Inc., are given.

A portion of the radiochemical analyses are carried out by commercial laboratories under contract to the HASL Environmental Studies and Radiochemistry Divisions. 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; Controls for Radiation, Inc., Cambridge, Massachusetts; Hazleton-Nuclear Science Corporation, Palo Alto, California; Food, Chemical and Research Laboratories, Inc., Seattle, Washington; and Tracerlab, Division of LFE, Waltham, Massachusetts.

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
NOTES

FALLOUT OF Pu-238 FROM THE SNAP-9A BURNUP II

by Herbert L. Volchok - HASL

The initial data on the deposition of plutonium from the disintegration of the SNAP-9A power source upon re-entry into the atmosphere, was reported in the last Health and Safety Laboratory (HASL) Quarterly Report (1). Included in this report were brief descriptions of the samplers and of the analytical procedure. Only data from samples collected in New York City were ready at that time, although we had also collected samples from Melbourne, Australia. Since the last report six of the Melbourne samples have been completed covering the period May through November 1966. Unfortunately the July sample was lost at the collection site.

Table 1 summarizes the Australian plutonium data including an estimated value for the month of July. The July value of Pu-239,240 (hereafter for convenience referred to as Pu-239) was obtained by utilizing the Melbourne, Australia Sr-90 fallout for that month (2), and the ratio of Pu-239/Sr-90 = 0.017 which has remained quite constant in stratospheric debris during the past few years (3). A value for the ratio Pu-238/Pu-239 for July was obtained by interpolation on the smoothly increasing value of this ratio plotted as a function of time, for the months represented. From the two foregoing estimates the total Pu-238 in July 1966 was then computed.

The increasing value of the ratio Pu-238/Pu-239 in these samples of fallout from Melbourne Australia are generally similar to those in surface level air at stations of about the same latitude in the Southern Hemisphere (4), and much higher than those of the Northern Hemisphere as exemplified by the New York City data (1).

As indicated in Table 1, the non-SNAP-9A plutonium-238 is computed from the total by use of the value 0.03 as the ratio of Pu-238/Pu-239 for typical debris of nuclear weapons tests (1). With this, by difference, the SNAP-9A originated Pu-238 shown in the last column of Table 1 is determined.

Estimates of worldwide deposition of the SNAP-9A debris have been made. For this calculation, it has been assumed that the Pu-238 fallout in New York City and Melbourne are each directly proportional to the total fallout in their respective hemispheres, and that these relationships are the same as had pertained for the Sr-90 deposition in prior years. The ratio of Sr-90 deposition in New York City to that of the entire Northern Hemisphere has been utilized previously for predicting fallout (1,5). A recently updated value for this ratio is 123 ± 10 kCi of deposit in the Northern Hemisphere for each mCi/Km^2 in New York City. The analogous ratio for the Southern Hemisphere and Melbourne Australia is 180 ± 15 .

The cumulative deposition of Pu-238 which can be attributed to the SNAP-9A re-entry is 1.57×10^{-3} mCi/km² in New York City through October of 1966. This, by use of the conversion factor described above, implies a deposit of 0.19 kilocuries in the entire Northern Hemisphere. For the Southern Hemisphere, we unfortunately did not start sampling quite soon enough. The first sample from Australia (see Table 1) was in May of 1966 and the Pu-238/Pu-239 ratio was already 0.34. For the sampling period in 1966, May through November, the deposition at Melbourne was 5.82×10^{-3} mCi/km² or an implied deposit of 1.05 kCi in the Southern Hemisphere.

To help clarify the total cumulative fallout of the SNAP-9A debris in the Southern Hemisphere, a number of soil samples from Australia, collected in late 1966 are now being analyzed for the plutonium isotopes.

It seems reasonable to conclude on the basis of the data presented, that in 1966 some 1.3 to 1.6 kilocuries of the SNAP-9A plutonium-238 were deposited on the earth's surface, or something like 8 to 10% of the total released. This is more than twice the amount predicted in an earlier report (6).

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Table 1

PLUTONIUM FALLOUT IN MELBOURNE, AUSTRALIA - 1966
 (Values are in dpm for the entire sample area of 1.05 m²)

	$\frac{\text{Pu-238}}{\text{Pu-239}}$	$\frac{\text{total}}{\text{Pu-239} \quad \text{Pu-238}}$		$\frac{\text{non-SNAP}}{\text{Pu-238*}}$	$\frac{\text{SNAP}}{\text{Pu-238}}$
May	0.34	0.32	0.11	0.01	0.10
June	0.55	1.33	0.73	0.04	0.69
July	0.7**	2.8***	2.0	0.08	1.92
August	0.84	1.13	0.95	0.03	0.92
September	0.97	1.18	1.15	0.04	1.11
October	1.00	6.50	6.47	0.20	6.27
November	1.20	1.97	2.37	0.06	2.31

*Based upon the pre-SNAP ratio of 238/239 $\approx$ 0.03
 (see ref. 1)

**Interpolated

***Based upon the ratio Pu-239/Sr-90 $\approx$ 0.017
 (see ref. 2)

The Ratio of Cs¹³⁷ to Sr⁹⁰ in Global Fallout

by Edward Hardy and
Norton Chu - HASL

Although Cs-137 is not considered as hazardous a fission product as Sr-90 it is often useful to estimate the deposition of this isotope from atmospheric nuclear tests for external dose and dose commitment calculations. The monthly rain water samples collected at globally dispersed stations for the Health and Safety Laboratory, are analyzed routinely for Sr-90 only, and the results reported in these quarterly reports. It is generally assumed that the ratio of Cs-137 to Sr-90 in fallout can range from ~1.4 to 2.0 depending upon the fissionable material used (1)(2). Based on measured fission product yields of individual nuclides obtained by analysis of debris from megaton weapons, Harley et al (3) calculated activity ratios at formation using current data on half-lives and decay schemes. The Cs-137 to Sr-90 ratio under these conditions was 1.45. Analyses of Cs-137 and Sr-90 in monthly fallout at New York City, Pittsburgh, Pennsylvania; Westwood, New Jersey; and Richmond, California from 1958 to 1962 showed considerable spread in the ratio of these two isotopes at individual sites (4). The spread was assumed to reflect errors in sampling and analysis techniques although the annual averages did not exceed the theoretical range. The ratios observed at these sites did not show seasonal trends or differences during heavy and light fallout periods.

Beginning with fallout collections in November 1965 and extending through October 1966, the monthly pot samples from 14 stations were analyzed at HASL for Cs-137 in addition to Sr-90. A consecutive set of samples were not available at all sites due to collection problems and unmeasurable levels of activity. A sufficient amount of data, however, was obtained to determine whether temporal and latitudinal effects could be observed in the ratio of Cs-137 to Sr-90. Both isotopes were measured by radiochemical procedures described in the HASL procedures manual (5). The results which are shown in Table 1 represent 8 sites in the Northern Hemisphere from 41° to 4° and 6 sites in the Southern Hemisphere from 1° to 34° latitude.

Assuming that latitudinal effects are insignificant, the averaged values for each month are plotted in Figure 1. Similarly, assuming that temporal effects are negligible, the averaged values are plotted by latitude in Figure 2. The error assigned to each point is simply the Gaussian standard deviation of the mean. The numbers in parentheses represent the number of results included in the average.

It appears that the temporal and latitudinal variations in the Cs-137 to Sr-90 ratio are random. The average ratio for the 90 values reported in Table 1 is 1.6 ± 0.2 . Depending upon the activity levels, errors of individual ratio measurements ranged from 0.02 to 0.6. The United Nations Scientific Committee on the Effects of Atomic Radiation reported in 1964 (6), measurements of Sr-90 and Cs-137 in precipitation which indicated that there was some variation in the ratio

with geographical location. Data from 20 United Kingdom precipitation collection stations during the period January 1961 - May 1963 showed that the Cs-137/Sr-90 ratio diminished significantly after September 1961, from about 1.8 to 1.4. This was the beginning of large scale weapons testing by the USSR followed by the U. S. A. In the 1966 UNSCEAR report (7), eleven countries reported Cs-137 to Sr-90 ratios in fallout ranging from 1.3 to 1.9. Most values, however, were greater than 1.5.

The HASL data reported here cover a relatively short time period. The variability from the mean ratio of 1.6 probably reflect inconsistencies in the analyses rather than fractionation or atypical fission yields.

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- (7) Report of the United Nations Scientific Committee on the Effects of Atomic Radiation, 21st Session of General Assembly
Supplement No. 14, (A/6314), 1966, (New York), Annex B. Par. 36

Table 1

The Ratio of Cs-137 to Sr-90 in Monthly Deposition

Site	Lat. ^o	Cs-137/Sr-90											
		1965						1966					
		Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.
Salt Lake City, Utah	40° 46' N	2.2	1.9	1.6	1.7	1.8	1.6	1.6	1.6	1.4	1.4	1.3	1.6
New York City, N. Y.	40° 40' N		1.7	1.6	1.7								
Tehran, Iran	35° 44' N	1.7	1.6	1.4	1.5								
Hiroshima, Japan	34° 23' N	1.8		1.5	1.6								
Nagasaki, Japan	32° 45' N	2.1	1.4		1.3	1.7	1.4	1.6	1.6	1.5	1.5	1.5	1.6
Coral Gables, Florida	25° 44' N	1.6	1.2	1.4		1.5	1.6	1.6	1.6	1.5	1.4		
Honolulu, Hawaii	21° 19' N		1.9	1.6	1.3								
Bogota, Colombia	04° 38' N	1.7			1.6								
Kikuyu, Kenya	01° 13' S	2.0	1.8		1.6								
Salisbury, Rhodesia	17° 48' S	1.5	1.2	1.5	1.4	1.5		1.7					
Pretoria, Rep. of S. Africa	25° 45' S	1.6	1.3	1.6	1.4	1.6	1.6	1.6	1.5	1.8	1.7	1.8	1.9
Durban, Rep. of S. Africa	29° 52' S	1.8	2.0	1.2	1.3	1.6	1.6	1.7	1.3	1.7	1.6	1.5	1.5
Santiago, Chile	33° 29' S	1.6	1.3				1.4		1.3				

Fig. 1

Fig. 2

STRONTIUM-90 IN HUMAN VERTEBRAE

- 1966 Results -

by Joseph Rivera (HASL)

One problem that concerns the Health and Safety Laboratory is the estimation of the radiation dose to man from fallout from nuclear weapons tests. To aid in the solution of this problem, several related studies have been undertaken by the laboratory. One of these is the systematic long-term measurement of the Sr-90 content of the diet, and another is the systematic long-term determination of the Sr-90 content of human bone. Results of the Sr-90 analyses of foods have been published regularly in these Quarterly Reports and a summary of the data available through 1963 was given in HASL-147 (1). A summary of the bone sampling program through 1964 together with an interpretation of the relations between diet and bone levels was given in HASL-163 (2). Summaries of the results of diet studies for 1964 and 1965 were presented in HASL-173 (3) and the results of the bone sampling program during 1965 were given in HASL-172 (4).

Results of the analyses of specimens obtained during 1966 are listed in Table 1 and are shown graphically in Figure 1. As in previous years, vertebrae from New York City have about twice the Sr-90 concentrations found in vertebrae from San Francisco. In general, the distribution of Sr-90 concentrations with age is also similar to that observed in previous years, that is, the concentrations in bones from the younger children are greater than those in specimens from older individuals. More specifically, during 1965 and 1966 peak Sr-90 concentrations were observed in children of ages 1 - 2 and 2 - 3 at death while in previous years (1961-64) peak concentrations were found in children 0 - 1 years of age at death. This shift in peak concentration to older children is to be expected when diet Sr⁹⁰ concentrations are declining as has been the case during 1965 and 1966. Fallout from the Chinese thermonuclear weapon detonated in June 1967 may be sufficient to just check the downward trend in diet Sr-90/Ca ratios and therefore this shift in peak Sr-90 bone levels to older ages may not be evident in samples obtained during late 1967 and early 1968.

Quality Control

The accuracy of the radiochemical analyses performed on samples obtained during 1966 may be judged from the quality control data set out in Table 2. The precision of the analyses estimated from the results for 12 blind duplicates is $\pm 10\%$. The routine analysis of 7 blank samples showed that there was no low-level contamination. All unknown samples analyzed had activities well above the routine minimum detectable activity of from 0.1 to 0.2 disintegrations per minute per gram of ash, which corresponds to a Sr-90/Ca ratio of about 0.2 pCi/gCa. The accuracy of the analyses as judged by the analyses of 7 secondary standards was acceptable. Taking all factors into consideration the over-all accuracy of single analyses of human bone specimens performed during 1966 is estimated to be about $\pm 10\%$.

Calculated and Observed Values

Although the accuracy of the analyses are estimated to be within $\pm 10\%$ the sampling errors are probably much greater. The average values listed in Table 1 for each age group are, however, probably valid for those groups where many specimens have been represented, that is, for the 0 - 1 year group and for adults.

A formula for predicting the Sr-90/Ca ratios of infant bones was derived in HASL-163. This formula was:

$$X = 0.2Z$$

where X is the average Sr-90/Ca ratio of infant bones during a year in which the diet had a Sr-90/Ca ratio of Z. In deriving this formula it was assumed that the Z was not changing rapidly with time. An improvement in the formula is achieved by considering the Sr-90/Ca ratio of an infant at birth in January to be 1/10 the Sr-90/Ca ratio of the diet for October, November, and December (assuming the mother's diet during the last tri-mester of pregnancy was not different from that of the general population). The Sr-90/Ca ratio of an infant at the end of the first year of life is assumed to be given, as in HASL-163, by the equation:

$$X_1 = \frac{30X_0 - 30X_0 f + 30 f KZ + 70 KZ}{100}$$

where, X_0 = the Sr⁹⁰/Ca ratio at birth, f is the fractional replacement of calcium during the year, K is the bone-diet observed ratio, Z is the Sr-90/Ca ratio of the child's diet during the year (assumed here to be the same as the general diet) and the calcium content of the skeleton is assumed to increase from 30 g at birth to 100 g at one year of age.

Taking $X_0 = 0.10 Z_m$, where Z_m is the average Sr⁹⁰/Ca ratio of the diet for October, November and December of the preceding year, $f = 0.50$, $K = 0.35$, the average Sr⁹⁰/Ca ratio of infant bones during the first year of life should be given by:

$$\bar{X}_{0-1} = X_0 + X_1 = \frac{.10Z_m}{2} + \frac{.03Z_m + .30Z}{2}$$

$$\bar{X}_{0-1} = .065Z_m + .15Z$$

A comparison of calculated and observed values obtained using this relation and data obtained since 1962 on diet and bone Sr-90 concentrations is shown below:

	New York City				San Francisco			
	Z	Z _m	Cal ^{X_{o-1}}	Obs	Z	Z _m	Cal ^{X_{o-1}}	Obs
1962	13	10	2.6	4.1	5	4	1.1	1.2
1963	31	18	5.8	7.6	10	7	2.0	2.5
1964	32	35	7.1	7.9	14	14	3.0	2.9
1965	24	29	5.5	5.0	12	10	2.5	3.3
1966	19	22	4.3	4.3	6	9	1.5	2.4

In HASL-163 it was shown that the Sr-90/Ca ratio of adult vertebrae could be estimated using the relation:

$$X_n = 0.9 X_{n-1} + .02 Z_{n-1}$$

where X_n is the Sr-90/Ca ratio of the vertebrae at the beginning of the year 'n', X_{n-1} is the ratio at the beginning of year 'n-1', and Z_{n-1} is the Sr-90/Ca ratio of the diet during the year. In deriving this expression it was assumed that the rate of replacement of calcium in vertebrae is 8% per year and that the bone-diet observed ratio was 0.25.

Since for good statistics the observed adult Sr-90/Ca ratios used in calculations are average values rather than values at the beginning of calendar years, the appropriate value of Z that should be used in the above equation is the average value for the interval from mid year to mid year. A comparison of calculated with observed Sr-90/Ca ratios in adult bone using this formula and the appropriate diet values taken from a graph of the results of the tri-city diet studies is shown below:

	New York City			San Francisco		
	<u>Z_{n-1}</u>	<u>X_n(Calcu)</u>	<u>X_n(Obs)</u>	<u>Z_{n-1}</u>	<u>X_n(Calcu)</u>	<u>X_n(Obs)</u>
1961			0.89			0.52
1962	10.5	1.01	1.03	4.1	0.55	0.74
1963	21.3	1.36	1.55	8.2	0.83	0.98
1964	34.4	2.06	2.02	14.8	1.18	1.23
1965	16.3	2.14	2.13	12.3	1.36	1.16
1966	22.0	2.35	2.07	9.1	1.22	1.25

Conclusions

Results of the bone sampling program during 1966 were consistent with expectations. It appears that reasonably accurate predictions can be made of bone Sr-90 concentrations from diet Sr-90 concentrations. The agreement between predictions and observations supports the view that the diet and bone sampling programs in the two cities are representative. Moreover the proportionality in bone levels to diet concentrations suggests that bone concentrations may be inferred wherever reasonable estimates of diet Sr-90 intake can be made.

Constructing models to predict Sr-90 concentrations in bones of children from 1 to 19 years of age, from survey diet and bone data is very difficult because of the few samples obtainable in any given year. It is hoped that the meager data available each year may somehow be combined and that a model may then be developed that is as good as that for infants and adults now in existence.

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Table 1a

Strontium-90 to Calcium Ratios in Human Vertebrae
Children - New York City - 1965

<u>Age</u>	<u>pCi Sr⁹⁰/g Ca</u>	<u>Average</u>	<u>No. of Specimens</u>
< 1 mo	-	-	-
1 mo - 1 yr	4.29 (6) 4.42 (2)	4.32	8
1 - 2	7.04 (2)	7.04	2
2 - 3	5.98 6.36 (2)	6.23	3
3 - 4	-	-	-
4 - 5	5.00	5.00	1
5 - 6	4.70 (2)	4.70	2
6 - 7	3.17 3.06 3.40	3.21	3
7 - 8	3.29 2.70 3.42 3.26	3.17	4
8 - 9	3.62 2.80	3.21	2
9 - 10	3.07	3.07	1
10 - 11	3.75	3.75	1
11 - 12	-	-	-
12 - 13	-	-	-
13 - 14	-	-	-
14 - 15	-	-	-
15 - 16	3.80	3.80	1
16 - 17	1.43 3.86 3.40	2.90	3
17 - 18	3.54	3.54	1
18 - 19	2.10	2.10	1
19 - 20	-	-	-
20 - 40	2.62 2.03 1.33 1.96 2.81 1.89 2.70	2.19	7
40 - 60	1.89 1.90 2.79 1.59 1.60	1.95	5
> 60	2.23 1.68 2.09 2.15 3.15 2.81 1.46 1.62 1.30 1.20	2.05	10

Table 1B

Strontium-90 to Calcium Ratios in Human Vertebrae
San Francisco - 1966

<u>Age</u>	<u>pCi. Sr⁹⁰/g Ca</u>				<u>Average</u>	<u>No. of Specimens</u>
< 1 mo	1.14 (4)	1.27 (6)	1.22 (5)	0.98 (3)	1.18	18
1 mo - 1 yr	2.59 (5)	2.13(5)	3.29 (2)	1.34 (2)	2.35	14
1 - 2	2.27 (2)	3.87 (2)			3.07	4
2 - 3	3.81 (2)				3.81	2
3 - 4	1.95	2.81	3.78	3.16	2.93	4
4 - 5	2.93	3.42	1.83		2.73	3
5 - 6	2.20				2.20	1
6 - 7	1.46	1.31			1.38	2
7 - 8	1.71	0.90			1.31	2
8 - 9	1.46				1.46	1
9 - 10	1.58				1.58	1
10 - 11	1.46				1.46	1
11 - 12	0.95	1.46			1.21	2
12 - 13	0.98				0.98	1
13 - 14	1.77	2.81			2.29	2
14 - 15	-				-	-
15 - 16	-				-	-
16 - 17	1.79				1.79	1
17 - 18	1.70				1.70	1
18 - 19	2.35				2.35	1
19 - 20	-				-	-
<hr/>						
20 - 40	1.46	1.34	1.50		1.43	3
40 - 60	0.73	1.80			1.27	2
>60	0.92	1.30	1.10	1.10	1.11	4

Table 2
Quality Control Samples - 1966 - Bone Program
 (dpm Sr-90/g ash)

<u>Splits *</u>		<u>Blanks**</u>		<u>Standards***</u>		
HB1042	2.0 ± .03	HB1080	≤0.05	HB1085	5407	1.0 ± .01
HB1071	1.5 ± .01					
		HB1065	0.04 ± .01	HB1060	5407	1.1 ± .01
HB1037	1.0 ± .01					
HB1069	1.1 ± .01	HB1045	≤0.07	HB1055	B0126	12.5 ± .04
HB1036	0.9 ± .01	HB1020	0.08 ± .04	HB1025	B0126	16.7 ± .04
HB1038	1.0 ± .01					
		HB1010	0.02 ± .01	HB1015	5407	1.1 ± .01
HB1072	3.64 ± .03					
HB1075	3.39 ± .03	HB995	≤0.06	HB1000	5407	0.73 ± .03
HB1038	1.1 ± .01	HB980	≤0.11	HB985	5407	0.98 ± .06
HB1070	0.9 ± .01					
HB1049	3.07 ± .02					
HB1050	3.17 ± .02					
HB1040	2.28 ± .02					
HB1041	1.96 ± .02					
HB1034	0.7 ± .01					
HB1035	0.8 ± .01					
HB1029	1.5 ± .01					
HB1030	1.4 ± .01					
HB1005	1.35 ± .04					
HB1006	1.39 ± .04					
HB989	3.16 ± 0.10					
HB990	2.88 ± 0.10					
HB975	2.74 ± .07					
HB991	3.06 ± .09					

*from these results the estimated standard deviation of a single measurement is ±10%

**negative net count rates are reported as ≤ the counting error (1 S.D.)

***previous results obtained on these two samples were:

B0126 - 16.1±1.4 (46 analyses)

5407 - 1.05±0.12 (41 analyses)

Figure 1

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 strontium-90, and strontium-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 Fission Product and Activation Product Radionuclides in Monthly Deposition at Selected Sites

At a number of stations in the United States, monthly precipitation and dry fallout collections have been analyzed for radiostrontium and other nuclides of interest to the Atomic Energy Commission. These sites and associated data are given in the Appendix, section B.

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 C.

2. Radiostrontium in Milk and Tap Water

Strontium-90 levels in 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 forms in the Appendix, section D.

3. Tri-City Diet Studies - Twenty-Sixth and Twenty-Seventh Samplings

by J. Rivera - HASL

Quarterly estimates of the annual dietary intake of Sr-90 of New York City, Chicago, and San Francisco residents, have been made based on the analyses of foods purchased at these cities every three months since March 1960. The foods purchased were grouped in nineteen categories prior to ashing for analysis. Starting in 1965, to reduce the number of analyses required for this program, only 14 of the diet categories were analyzed on a quarterly basis. The ash obtained from eggs, poultry, fresh fish, shellfish, and meat purchased quarterly were combined and yearly composites of each category were analyzed for Sr-90. The reason why these particular diet categories were chosen for yearly rather than quarterly analyses is that they generally have a much lower Sr-90 concentration than the other categories. From data obtained over a four-year period, the contribution of these five diet categories to the total annual intake of Sr-90 was about 5%, therefore this amount was added to the computed intake of Sr-90 from the 14 categories analyzed to obtain quarterly estimates of annual Sr-90 intake at the three cities.

The results of the analyses of foods and estimates of the intake of Sr-90 at each of the cities made this way are shown in Table 3. The estimated average daily intakes of Sr-90 at each of the cities since the tri-city diet studies began are shown in Figure 3.

Details of the sampling methods and a description of the results of these studies obtained through 1963 may be found in HASL-147 (HASL Contributions to the Study of Fallout in Food Chains, Joseph Rivera and John Harley, July 1, 1964).

Results of analyses of foods from five sampling periods rather than the usual three have been included in this report so that estimates of the yearly intake of Sr-90 could be made at the three cities for 1966. These estimates are important in the interpretation of the results obtained for the 1966 bone sampling program which are described elsewhere in this Quarterly Summary Report. The analyses of foods for Sr-90 are usually performed at HASL. The results reported for October, November, and December, however, were based on analyses performed at contractor laboratories. Because of some apparent difficulties in these analyses revealed by the quality control samples, the results for these sampling months must be considered tentative. After some of the samples are re-analyzed at HASL, a detailed summary and interpretation of the diet data for 1966 will be presented. At present, however, it appears that the average annual Sr-90/Ca ratios at New York City, Chicago, and San Francisco during 1966 were 18, 15, and 6.2 pCi/g Ca respectively.

Table 3

STRONTIUM-90, TRI-CITY DIET STUDIES
(Twenty-Sixth and Twenty-Seventh Samplings)

<u>Food Category</u>	<u>kg/yr</u>	<u>g Ca/yr</u>	NEW YORK CITY 8/66		SAN FRANCISCO 9/66		CHICAGO 10/66		NEW YORK CITY 11/66		SAN FRANCISCO 12/66	
			<u>pCi/kg</u>	<u>pCi/yr</u>	<u>pCi/kg</u>	<u>pCi/yr</u>	<u>pCi/kg</u>	<u>pCi/yr</u>	<u>pCi/kg</u>	<u>pCi/yr</u>	<u>pCi/kg</u>	<u>pCi/yr</u>
Bakery Products	37	37.0	14.6	540	6.5	241	6.8	252	6.6	244	3.9	144
Whole Grain Products	11	10.0	40.3	443	14.1	155	33.5	369	16.1	177	10.6	117
Fresh Vegetables	43	15.0	17.6	757	2.0	86	8.1	348	9.9	426	6.4	275
Root Vegetables	17	6.1	10.2	173	6.9	117	6.5	111	10.4	177	6.0	102
Milk	221	234.4	14.7	3249	3.0	663	6.2	1370	10.6	2343	1.8	398
Flour	43	8.6	14.3	615	5.1	219	4.7	202	9.3	400	4.2	181
Macaroni	3	0.7	12.0	36	6.6	20	5.0	15	6.0	18	2.3	7
Rice	3	1.1	3.3	10	1.7	5	1.7	5	2.3	7	2.0	6
Dried Beans	3	2.9	5.0	15	21.4	65	24.4	74	7.0	21	13.5	41
Fresh Fruit	68	12.6	3.0	204	2.7	184	3.8	261	3.2	218	1.5	102
Potatoes	45	5.8	9.1	410	1.0	45	4.3	194	3.9	176	1.5	68
Canned Fruit	26	1.3	1.8	47	1.4	36	1.2	31	2.9	75	1.2	31
Fruit Juices	19	1.7	8.3	158	2.3	44	1.6	30	4.1	78	1.7	32
Canned Vegetables	20	4.2	11.4	228	2.9	58	5.8	116	8.9	178	3.9	78
Meat, Fish, Poultry Eggs, etc.	99	42.0	-	362*	-	102*	-	178*	-	239*	-	183*
ANNUAL INTAKE		383		7247		2040		3556		4777		1665
pCi/Day				19.9		5.6		9.7		13.1		4.6
pCi/gCa				18.9		5.3		9.3		12.5		4.3

*Estimated to be 5% of Annual Intake.

4. HIGH ALTITUDE BALLOON SAMPLING PROGRAM

by Philip W. Krey (HASL)

The U. S. Atomic Energy Commission's program for measuring upper stratospheric nuclear debris collected by balloon-borne filtering devices has been in continuous operation since 1956. The collection period for the balloon samples covered in this report is from March 1966 through February 1967. During this time interval, monthly collections were made at three or more altitudes up to a maximum of 41 Km at the locations given in Table 4a.

Aircraft samples collected at 15 to 20 Km during the period December 1965 to August 1966 were obtained from the Stardust Program through the cooperation of the Defense Atomic Support Agency. The analyses of these aircraft samples will provide the area of intercomparison and correlation between the Stardust and High Altitude Balloon Sampling Programs.

Filters are shipped to HASL where total gamma measurements and gamma spectra of each sample are obtained under uniform geometry. Selected filters are then analyzed at contractor laboratories and at HASL for fission products, plutonium isotopes and other radionuclides of current interest.

RESULTS

Results of gross gamma activity and radionuclide concentrations for balloon and aircraft samples collected during the period covered by this report are given in Tables 4b and 4c, respectively. Previously reported data are repeated until all the nuclide analyses requested for the earliest sample in the report have been completed. The balloon samples are listed in order of their latitude of collection beginning with the most northern site at 65°N. The aircraft samples are listed chronologically and then with latitude within each collection month. The results of the coded quality control program administered by the Health and Safety laboratory during the course of these analyses without the knowledge of the contractor laboratories are given in Tables 4d, 4e and 4f.

Previous reports containing data from this program are given in references 1 through 11.

BALLOON SAMPLE COLLECTION DATA

Information pertaining to the collection of the balloon samples is provided by the Atmospheric Radioactivity Research Branch of the Environmental Science Services Administration where flight data prepared by the balloon operations organizations are summarized and evaluated.

HASL NUMBER

A number is assigned by the Health and Safety Laboratory to each individual air filter received. Filters split for radiochemical assay, after gross gamma measurements were obtained, are designated by a letter suffix to the HASL number. The gross gamma activity of each fraction of a split filter is also measured. On the assumption that the gross gamma activity of a stratospheric air filter sample is directly proportional to the volume of standard air sampled, the fraction of the total air volume sampled by each split is calculated on the basis of its total gamma activity.

ALTITUDE

Altitude data are obtained from barometric readings on the balloon gondola and refer to pressure altitude in the ICAO Standard Atmosphere. The predominant sampling altitude is given in units of 1000 meters (KM). The entire sample was collected within ± 0.6 KM of the predominant altitude unless annotated with the symbol, ?. This symbol indicates that:

1. The altitude varies greater than the allowed ± 0.6 Km, or
2. The altitude is estimated or uncertain because of flight operational difficulties, or
3. The volume assigned to the filter is uncertain or estimated also because of flight operational difficulties.

SAMPLING UNIT AND FLIGHT DATA

Most collections are made with the "Direct Flow Sampler" which is referred to as unit D7 in Table 4b. This system utilized one square foot of I.P.C. No. 1478 filter paper together with a Westinghouse motor and Torrington 704 blower. A discussion of this sampling unit has been presented by Wood (12).

Many samples at the higher altitudes (32 KM and above) are collected by an Air Ejector pump unit which is referred to as unit AE in Table 4b. This system employs two square feet of I.P.C. No. 1478 filter paper. The air is drawn through the filter by the aspirator action of escaping nitrogen gas released downstream of the filter. This sampler was developed by the Applied Science Division, Litton Systems, Inc. under Contract No. AT(11-1)-401 to the U. S. Atomic Energy Commission (13).

A larger model Air Ejector system has been developed by the Applied Science Division (14) to sample greater volumes of air particularly at the upper altitudes. This system, identified as HV3K in Table 4b, uses 8 square feet of IPC filter paper and filters about 50% more volume at sampling altitude as the Air Ejector.

For each successful flight, two equivalent air filtering units of a single type are carried aloft by the same balloon giving rise to two equivalent air filters per flight. This duplication has been limited to the lower altitude samplings in recent time. In Table 4b, the day of the flight is given for each filter, and the number of the appropriate sampling unit is also identified, i.e., D7-1 or D7-2.

In an effort to increase the volume of air sampled, one of the two filters (HASL No. A-2422) of the 32 KM mission at 65°N on August 8, 1966 was flown with a light weight paper. This filter consisted of two pieces of one quarter weight IPC No. 1478 paper. Based upon the Sr-90, Ce-144 and Pu-238 analyses of the filter and the normal 1478 duplicate filter, it appears that the collection efficiency of the light weight paper is about 20% less than the normal paper. This assumes that there is no uncertainty in the volume assigned to each filter. If the light weight paper is to be used in future flights, additional intercomparisons of the filter efficiencies with the normal filters should be conducted.

GAMMA ACTIVITY MEASUREMENTS

The gross gamma activity concentrations (Gr Gamma) expressed as counts per minute per 10³ standard cubic meters of air (cpm/KSCM) are reported in Tables 4b and 4c as of the counting date, one to two weeks after collection. Filters gamma counted beyond this two week lapse period after collection are indicated with the symbol ≠.

COUNTING PROCEDURE

The filter samples are received in the plastic bags from the collection sites and counted without prior treatment. The samples collected prior to January 1, 1966 were folded into a plastic box 80 mm x 65 mm x 31 mm deep which is placed in the center of a heavily shielded 8" diameter x 4" NaI (Tl) crystal. Of the two samples received from each flight after January 1, 1966, one (usually the sample from unit #1) is compressed into a nylon planchet 2 inches in diameter, 1 inch high. The planchets offer a more uniform and reproducible geometry than the plastic box. The second filter from each flight is still assayed in the plastic box as before. This filter is not compressed because it may be selected at a later date for SNAP-9A particle studies or other research which could be unduly complicated by the pelletizing. There is no significant variation in the detection efficiencies of the two methods of counting.

The large filters from the HV-3K sampler are quartered, and each quarter compressed into a nylon planchet for counting. The activity reported is the integral of the four individual measurements. For all types of samples, the pulses from three phototubes, matched for pulse height response, are summed, amplified, and fed to a multichannel analyzer to obtain a gamma spectrum. The total gamma activity is obtained between 0.1 and 3.0 MeV.

STANDARDIZATION AND PRECISION

Because of the complexity involved in estimating the disintegration rate from the observed gamma counts per minute in a mixture of nuclides such as those present in composited weapons debris, such a conversion has not been attempted. The CPM results reported therefore, are of significance on a relative basis only. The efficiency of the counting system has been compared, however, to a standard Cs-137 source counted under the same geometry. This source yields about 0.3 counts per emitted photon which is equivalent to about 0.25 counts per disintegration of Cs-137.

The percent standard deviation of the gross gamma measurements excluding the counting statistics is about 1.3%. This estimate includes all sources of error such as fluctuations in counter response and factors relating to sampling handling, but does not include the counting statistic of an individual filter. Precision of gamma activity measurements are discussed in more detail in an earlier report (15).

RADIOCHEMICAL MEASUREMENTS

At least one filter collected from each successful flight during the period covered by this report has been analyzed radiochemically. Since the last major nuclear weapon test series occurred at the end of 1962, only the longer lived artificially produced radionuclides were present in most of the filters analyzed. Consequently, emphasis was given to the determinations of Fe-55, Sr-90, Cd-109, Ce-144, Pu-238 and Pu-239. Periodically, Mn-54, Cd-113m, Sb-125, Cs-137 and Pm-147 were also measured.

The Chinese and French tests in 1966 injected fresh debris into the lower atmosphere. Although little of this debris was expected to rise to the balloon sampling altitudes, a search for traces of fresh fission products such as Sr-89, Zr-95, and Ce-141 was made. The half lives and dominant radiations of all these radionuclides are given on the last page of the Appendix to this HASL Quarterly.

The long-lived fission product and Pu-239 behavior should describe the general distribution of all previous nuclear weapon debris still present in the stratosphere. The other tracer nuclides can be associated with debris from a single detonation or a series of detonations. Mn-54 and Fe-55 were produced in large quantities in the 1961 and 1962 test series. Cd-109 was generated by the U. S. high altitude test over Johnston Island July 9, 1962. About 17,000 curies of Pu-238 were disseminated on April 21, 1964 during the reentry burnup of a SNAP-9A power source.

ANALYTICAL LABORATORY

Practically all radiochemical analyses conducted under this program have been performed by independent contractor laboratories. These laboratories are identified as follows:

Isotopes, Inc. : II

Tracerlab, West: TLW

RADIONUCLIDE CONCENTRATIONS

The radionuclide concentrations reported in Tables 4b and 4c are expressed in picocuries per 10^3 standard cubic meters of air (pCi/KSCM). The volume of air was computed at 1013 millibars and 15°C , such that 1 SCM = 1.225 kilograms of air. Most filters sampled between 14 and 42 m^3 depending upon the altitude of collection. The concentrations are reported on the collection date for the fission products and the plutonium isotopes, but on the following dates for the other nuclides:

Mn-54 and Fe-55: October 15, 1961
Cd-109 : July 9, 1962

Results of split samples or duplicate collections are listed together in the tables. One standard deviation of the counting error for all data in the tables is less than 20% and usually less than 10%, unless otherwise annotated with the symbols described below.

QUALITY CONTROL PROGRAM

To evaluate the analytical performance of the contractor laboratories, HASL routinely submits coded blank, duplicate and standard samples for analysis. A blank is an appropriate sized piece of unexposed IPC filter paper taken from the roll of paper currently used by the flight organizations. A duplicate sample is the fraction of a single filter which was split or the equivalent sample taken from the same balloon flight. As indicated earlier, the gamma activity of each split was determined so that the geometric division of the sample and the volume of air associated with each fraction could be accurately determined. A standard is prepared by evaporating weighed aliquots of various tracer solutions calibrated at HASL onto a regulation size blank of IPC paper.

The analyses of the blank samples in Table 4d illustrate that the laboratory contamination for most of the nuclides investigated was either unmeasurable or relatively unimportant compared to the activities present in the aircraft and balloon filters at the lower altitudes. However, the concentrations of Cd-109 at all altitudes have essentially reached blank levels by the early part of 1966. It also appears from Table 4d that the laboratory contamination at Isotopes, Inc. is somewhat higher for most nuclides than the contamination at Tracerlab-West.

At the higher altitudes, similar conditions prevail with the exception that for the very small concentrations of Sr-90 and Sb-125 observed, the blank levels for these nuclides sometimes represent as much as 50% of the activity collected by the filter. The impact of the possibly high blank level in any one sample from the upper altitudes on the reliability of the data from that sample is appreciably lessened by the evaluation of the reasonableness of each datum in this program. Each nuclide analysis is compared with analyses of other nuclides in the same sample and with the analyses of other samples adjacent in time and space

before it is accepted. If these comparisons uncover unreasonable concentrations or composition of radioactive debris, the suspect nuclides are annotated. Since it is unlikely that laboratory contamination can satisfy these criteria, acceptable data in this program, even at the very low levels, probably do not suffer seriously from laboratory contamination.

According to Volk (16), an estimate of the standard deviation of a measurement can be obtained by the equation:

$$\sigma \approx 0.8862d$$

where σ = percent standard deviation
d = deviation between duplicate measurements
expressed as percent of the mean.

A summary of the duplicate analyses reported in Tables 4b and 4c is given in Table 4e where the average percent standard deviation is listed for each nuclide with the number of duplicate analyses involved for each analytical laboratory. Only duplicates in which the counting error was less than 20% were included. For Tracerlab, the average percent standard deviation was less than $\pm 10\%$ for all nuclides measured during this reporting period. Fewer duplicates were performed by Isotopes, Inc.; while the precision for Sr-90 and Ce-144 was satisfactory, the large deviations for Cs-137, Pm-147, Pu-239 and Pb-210 reflect serious analytical difficulties at Isotopes, Inc. during this time.

The reproducibility between Isotopes, Inc. and Tracerlab in Table 4e is not unreasonable based upon the precision illustrated by each individual laboratory. The problems in plutonium analyses which Isotopes, Inc. has recently encountered are highlighted in the large disagreement in the Pu-238 and Pu-239 data between the two labs.

Table 4f presents the analyses of coded standard samples by both contractor laboratories completed since December 1965, the earliest collection date covered by this report. The accuracy of analyses by Tracerlab as evidenced by the average percent deviation listed in Table 4f is within $\pm 7\%$ for all nuclides except Zr-95, Po-210 and Pb-210 which are -14, +400 and -12 percent, respectively. A serious problem seems to exist in Tracerlab's Po-210 analysis, although the Po-210 results from the stratospheric filter samples reported by TLW generally do not appear unreasonable. Previous large negative biases in Sb-125 analyses exhibited by both Tracerlab and Isotopes, Inc. were due to an improper assessment of the HASL standard. When the correction in the standard was made, the bias was significantly reduced.

The average percent deviations for most of the nuclides analyzed by Isotopes, Inc. in Table 4f are also less than $\pm 10\%$. However, Cd-109 results, as indicated in previous reports (11), continue to show a positive bias of about $+20\%$. Pu-239 results from March 1966 on reflect positive errors by factors of 2 to 4. In addition, the individual Cs-137, Pm-147 and Pb-210 deviations vary over too wide a range, although the average deviation appears respectable. The results of these standards analyses by Isotopes, Inc. verify the problems in Cs-137, Pm-147, Pb-210 and Pu-239 radiochemistry which were emphasized by the duplicate sample analyses (Table 4e) and by the large number of suspect analyses of stratospheric filters reported by Isotopes, Inc. during this period.

NOTATION SYSTEM

The notation system described here applies to all the tables covered by this report. One standard deviation of the counting error for all data is less than $\pm 20\%$ and usually less than $\pm 10\%$ unless annotated with these symbols:

- #: Gross gamma measurement was made beyond two week lapse period after collection
- A: One standard deviation of the counting error is between $\pm 20 - 50\%$.
- B: One standard deviation of the counting error is between $\pm 51 - 100\%$.
- *: Activity is not detectable. This designation is applied to data when an equal to or less than value ($\leq$) is reported or when one standard deviation of the counting error is greater than 100% .
- ?: When annotating an altitude of collection, this symbol signifies that the latitude or volume of air sampled is estimated or uncertain. When the symbol is applied to a concentration value, the datum is considered suspect because:
 1. The magnitude of the concentration is inconsistent with adjacent samples in space and time; or
 2. The relative activity of the nuclide is inconsistent with other nuclides in the same sample.
 3. The sample activity approaches the average value of blank samples for the analytical laboratory.

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- (5) Ibid, HASL-140, p. 166, October 1, 1963
- (6) "High Altitude Sampling Program (Project Ash Can)"
HASL-127, p. 151, July 1, 1962
- (7) Ibid, HASL-115, p. 70, October 1, 1961
- (8) Ibid, HASL-171, p. 223, April 1, 1966
- (9) Ibid, HASL-172, p. II-21, July 1, 1966
- (10) Ibid, HASL-173, p. II-21, October 1, 1966
- (11) Ibid, HASL-174, p. II-3, January 1, 1967
- (12) Wood, R.C.
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Atmosphere Monitoring Program
HASL-115, p. 155, October 1, 1961
- (13) Wood, R.C.
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- (14) Wood, R.C. and Olson, R.
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Sampling Flights at San Angelo, Texas
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Table 4a

HIGH ALTITUDE BALLOON LAUNCHING SITES

<u>LOCATION</u>	<u>LATITUDE</u>	<u>FREQUENCY</u>	<u>FLIGHT ORGANIZATION</u>
Eilson Air Force Base, Alaska	65°N	May-Aug., Nov	Detachment 31, 6th Weather Wing (MAC)
San Angelo, Texas	31°N	Monthly	Detachment 31, 6th Weather Wing (MAC)
Albrook Air Force Base, Panama Canal Zone	9°N	Jan-Apr Sept and Oct	Detachment 31, 6th Weather Wing (MAC)
Natal, Brazil	6°S	Oct. 1966	Detachment 31, 6th Weather Wing (MAC)
Mildura, Australia	34°S	Monthly	Department of Supply Commonwealth of Australia

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING JULY 1966
 LATITUDE, 65N EILSON AIR FORCE BASE, ALASKA

ALTITUDE (KM)	24	27	32
FLIGHT DAY	12	13	14
HASL NUMBER	2385	2387	2390
COLLECTION UNIT	07-1	07-1	07-1
ANALYTICAL LABORATORY	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	3867.4	218.3	1513.2#

PC/KSCM

MANGANESE-54	*		
IRON-55	3960	*	*
STRONTIUM-89	*	*	29.5B
STRONTIUM-90	415	117	69.6
ZIRCONIUM-95			28.4B
CADMIUM-109	*	*	*
ANTIMONY-125	363		
CESIUM-137	520		
CERIUM-141	*	*	*
CERIUM-144	528	135	97.0
PROMETHIUM-147	895	291	151
LEAD-210	5.04B	4.88A	14.5
POLONIUM-210	3.03A	5.81B	12.3
PLUTONIUM-238	23.2	20.0	25.4
PLUTONIUM-239	6.39	2.32A	1.58A

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 4b (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING AUGUST 1966
LATITUDE, 65N EILSON AIR FORCE BASE, ALASKA

ALTITUDE (KM)	23	27a	32	32	36
FLIGHT DAY	03	06	08	08	10
HASL NUMBER	2400	2420	2422	2423	2427
COLLECTION UNIT	D7-1	D7-1	D7-1	D7-2	AE-1
ANALYTICAL LABORATORY	TLW	TLW	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	2031.2	1952.5#	1940.7#	2242.0#	2173.0#
			PC/KSCM		
BERYLLIUM-7	14300				
IRON-55	2550	596B	1400B	1030B	*
STRONTIUM-89	24.1B	11.8B	*	25.2B	34.5B
STRONTIUM-90	261	123	78.4	93.0	71.3?
ZIRCONIUM-95	*	*	13.4B	58.2A	52.3B
CADMIUM-109	32.6B	45.1B	20.7B	53.2B	*
CERIUM-141	*	*	119B	*	*
CERIUM-144	360	144	65.2	79.5A	80.1A
PLUTONIUM-238	19.6	22.2	21.0	28.6	27.2
PLUTONIUM-239	4.18	2.27	.538B	2.23A	2.72?

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
 ?: DATA SUSPECT
 a: VOLUME ESTIMATED
 #: GROSS GAMMA COUNT MORE THAN TWO WEEKS AFTER COLLECTION

TABLE 4b (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING MAY 1966
LATITUDE, 31N SAN ANGELO, TEXAS

ALTITUDE (KM)	25	27	27	32
FLIGHT DAY	18	22	22	4
HASL NUMBER	2333	2340	2341	2316
COLLECTION UNIT	07-1	07-1	07-2	07-1
ANALYTICAL LABORATORY	II	II	II	II
GROSS GAMMA (CPM/KSCM)	3357.4#	1513.3#	1828.9#	1041.9#

PC/KSCM

BERYLLIUM-7	17600	8640A	13000A	
MANGANESE-54	*	26300?	31700?	*
IRON-55	212?			1250A
STRONTIUM-90	24.0?	415	441	212
CADMIUM-109	*	39.0A	58.9A	
ANTIMONY-125	834	295	339	248
CESIUM-137	3280	1110?	1680?	331
CERIUM-144	30.9?	1050	825	384
PROMETHIUM-147	349?	2540?	3850?	1030?
LEAD-210	37.2A		21.8	94.9
PLUTONIUM-238	64.3	45.1	54.1	35.3
PLUTONIUM-239	89.1	17.7?	1290?	11.6?

A: ONE STANDARD DEVIATION OF COUNTING ERROR IS >20% TO 50% OF COUNT.

*: STANDARD DEVIATION GREATER THAN DATA VALUE

?: DATA SUSPECT

#: GROSS GAMMA COUNT MORE THAN TWO WEEKS AFTER COLLECTION

TABLE 4b (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS
BALLOON SAMPLES COLLECTED DURING JUNE 1966
LATITUDE, 31N SAN ANGELO, TEXAS

ALTITUDE (KM)	25	27	32
FLIGHT DAY	11	14	15
HASL NUMBER	2359	2361	2367
COLLECTION UNIT	D7-1	D7-1	AE-1
ANALYTICAL LABORATORY	II	II	TLW
GROSS GAMMA (CPM/KSCM)	5613.5#	1707.6	1912.7#
		PC/KSCM	
BERYLLIUM-7	6880	8420A	
MANGANESE-54		*	
IRON-55	13600	4230	352?
STRONTIUM-90	1520	452	135
CADMIUM-109	*	28.4A	*
CERIUM-144	1580	632	175
LEAD-210	180	46.5	
PLUTONIUM-238	54.0	75.0	23.1
PLUTONIUM-239	89.0?	23.3?	3.43A

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
?: DATA SUSPECT
#: GROSS GAMMA COUNT MORE THAN TWO WEEKS AFTER COLLECTION

TABLE 4b (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING JULY 1966
LATITUDE, 31N SAN ANGELO, TEXAS

ALTITUDE (KM)	24	27	32
FLIGHT DAY	6	13	20
HASL NUMBER	2377	2382	2393
COLLECTION UNIT	D7-1	D7-1	D7-1
ANALYTICAL LABORATORY	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	3111.3#	2662.3	386.9A#

PC/KSCM

MANGANESE-54	*		
IRON-55	8580	5660	*
STRONTIUM-89	*	65.5A	*
STRONTIUM-90	1120	578	122
ZIRCONIUM-95			*
CADMIUM-109	*	*	*
ANTIMONY-125	662		
CESIUM-137	1600		
CERIUM-141	*	*	*
CERIUM-144	1420	823	159
PROMETHIUM-147	2660	1440	
LEAD-210	8.89A	8.13A	18.8A
POLONIUM-210	6.42A	3.91A	25.6
PLUTONIUM-238	15.6	14.0	26.1
PLUTONIUM-239	17.0	8.41	2.42A

A: ONE STANDARD DEVIATION OF COUNTING ERROR IS >20% TO 50% OF COUNT.

*: STANDARD DEVIATION GREATER THAN DATA VALUE

#: GROSS GAMMA COUNT MORE THAN TWO WEEKS AFTER COLLECTION

TABLE 4b (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING AUGUST 1966
LATITUDE, 31N SAN ANGELO, TEXAS

ALTITUDE (KM)	24	28	32
FLIGHT DAY	09	04	17
HASL NUMBER	2418	2402	2426
COLLECTION UNIT	D7-1	D7-1	D7-1
ANALYTICAL LABORATORY	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	3065.9	1646.1	982.3

PC/KSCM

BERYLLIUM-7		*	
IRON-55	11500	8670	1290
STRONTIUM-89	*	*	18.3B
STRONTIUM-90	1320	611	119
ZIRCONIUM-95	10.3B	*	13.0B
CADMIUM-109	53.5A	*	*
CERIUM-141	*	*	*
CERIUM-144	1560	822	129
PLUTONIUM-238	20.3	12.2	18.6
PLUTONIUM-239	20.3	10.5	1.85A

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

TABLE 4b (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING SEPTEMBER 1966
LATITUDE, 31N SAN ANGELO, TEXAS

ALTITUDE (KM)	25	27	33	37	41
FLIGHT DAY	23	22	21	19	26
HASL NUMBER	2450	2448	2454	2447	2462E
COLLECTION UNIT	D7-1	D7-1	D7-1	AE-1	HV3K
ANALYTICAL LABORATORY	TLW	TLW	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	3169.9#	1261.1	729.6#	957.0#	111.5#
			PC/KSCM		
IRON-55	13900	6600	1410A	721B	*
STRONTIUM-89	*	31.7B	*	12.1B	
STRONTIUM-90	1310	489	131	83.2	81.4A
ZIRCONIUM-95	*	*	*	25.1B	
CADMIUM-109	*	*	*	*	*
CERIUM-141	*	*	*	*	
CERIUM-144	1530	587	137	85.8A	27.5?
LEAD-210	5.42A	1.68B	3.50B	7.92A	*
POLONIUM-210	5.42	3.77	6.13	6.60	7.43
PLUTONIUM-238	12.3	12.3	19.8	16.2	3.34A
PLUTONIUM-239	18.6	9.66	1.45A	1.65B	*

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

?: DATA SUSPECT

#: GROSS GAMMA COUNT MORE THAN TWO WEEKS AFTER COLLECTION

TABLE 4b (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING OCTOBER 1966
LATITUDE, 31N SAN ANGELO, TEXAS

ALTITUDE (KM)	24	27	32
FLIGHT DAY	20	16	13
HASL NUMBER	2483	2476	2478
COLLECTION UNIT	D7-1	D7-1	AE-1
ANALYTICAL LABORATORY	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	1720.2#	1232.3#	649.1#
		PC/KSCM	
BERYLLIUM-7	4440	9410	*
IRON-55	5860	1060A	1120A
STRONTIUM-89	*	*	*
STRONTIUM-90	617	202	76.9
ZIRCONIUM-95	*	*	*
CADMIUM-109	*	*	*
CERIUM-141	*	*	*
CERIUM-144	775	228	106A
PROMETHIUM-147	1480	560	166A
PLUTONIUM-238	14.7	16.0	13.5
PLUTONIUM-239	11.0	3.55	1.56

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

TABLE 4b (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING NOVEMBER 1966
LATITUDE, 31N SAN ANGELO, TEXAS

ALTITUDE (KM)	24	27	32
FLIGHT DAY	15	14	03
HASL NUMBER	2513	2507	2501
COLLECTION UNIT	D7-1	D7-1	AE-1
ANALYTICAL LABORATORY	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	1383.7	2063.3	1226.9#
	PC/KSCM		
IRON-55	1570A	2230	2360?
STRONTIUM-89	*	52.8B	*
STRONTIUM-90	172	217	101A
ZIRCONIUM-95	*	*	*
CADMIUM-109	*	*	*
CERIUM-141	*	*	*
CERIUM-144	187	247	140
LEAD-210	*	*	*
POLONIUM-210	3.82	2.97	43.4?
PLUTONIUM-238	19.1	15.1	16.2
PLUTONIUM-239	3.34	4.25	2.99?

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
?: DATA SUSPECT
#: GROSS GAMMA COUNT MORE THAN TWO WEEKS AFTER COLLECTION

TABLE 4b

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING DECEMBER 1966
LATITUDE, 31N SAN ANGELO, TEXAS

ALTITUDE (KM)	24	27	36
FLIGHT DAY	09	08	14
HASL NUMBER	2556	2547	2559
COLLECTION UNIT	D7-1	D7-1	D7-1
ANALYTICAL LABORATORY	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	2658.9#	1103.4#	196.2#
		PC/KSCM	
IRON-55		814B	
STRONTIUM-89	*	*	*
STRONTIUM-90	897	128A	80.7
ZIRCONIUM-95	*	*	*
CADMIUM-109		*	
CERIUM-141	*	*	*
CERIUM-144	965	143	179?
LEAD-210	*		
POLONIUM-210	5.32A		
PLUTONIUM-238	13.9	17.4	9.81
PLUTONIUM-239	14.5	3.31	1.31A

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
?: DATA SUSPECT
#: GROSS GAMMA COUNT MORE THAN TWO WEEKS AFTER COLLECTION

TABLE 4b (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING JANUARY 1967
LATITUDE, 31N SAN ANGELO, TEXAS

ALTITUDE (KM)	24	27
FLIGHT DAY	12	05
HASL NUMBER	2565	2563
COLLECTION UNIT	D7-1	D7-1
ANALYTICAL LABORATORY	TLW	TLW
GROSS GAMMA (CPM/KSCM)	3472.8	3509.2
	PC/KSCM	
STRONTIUM-89	51.0A	88.9A
STRONTIUM-90	149	163
ZIRCONIUM-95	91.7A	100B
CERIUM-141	*	*
CERIUM-144	174	206
LEAD-210	*	10.2B
POLONIUM-210	4.66	18.7
PLUTONIUM-238	17.4	13.3
PLUTONIUM-239	2.91A	3.49

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

TABLE 4b (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS
BALLOON SAMPLES COLLECTED DURING FEBRUARY 1967
LATITUDE, 31N SAN ANGELO, TEXAS

ALTITUDE (KM)	24	27
FLIGHT DAY	07	02
HASL NUMBER	2583	2580
COLLECTION UNIT	D7-1	D7-1
ANALYTICAL LABORATORY	TLW	TLW
GROSS GAMMA (CPM/KSCM)	1649.2	816.4
	PC/KSCM	
MANGANESE-54	*	*
STRONTIUM-89	33.6B	*
STRONTIUM-90	358	111
ZIRCONIUM-95	*	*
ANTIMONY-125	165	48.0A
CERIUM-141	*	*
CERIUM-144	324	102
LEAD-210	*	*
POLONIUM-210	5.92	4.08A
PLUTONIUM-238	15.0	8.78
PLUTONIUM-239	6.98	2.04A

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

TABLE 4b (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING MARCH 1966
LATITUDE, 09N ALBROOK AIR FORCE BASE, CANAL ZONE

ALTITUDE (KM)	36
FLIGHT DAY	28
HASL NUMBER	2261
COLLECTION UNIT	AE-2
ANALYTICAL LABORATORY	TLW
GROSS GAMMA (CPM/KSCM)	1199.2

PC/KSCM

IRON-55	*
STRONTIUM-90	219
CADMIUM-109	*
CERIUM-144	348
LEAD-210	16.7A
PLUTONIUM-238	18.0
PLUTONIUM-239	6.00A

A: ONE STANDARD DEVIATION OF COUNTING ERROR IS >20% TO 50% OF COUNT.
*: STANDARD DEVIATION GREATER THAN DATA VALUE

TABLE 4b (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING APRIL 1966
LATITUDE, 09N ALBROOK AIR FORCE BASE, CANAL ZONE

ALTITUDE (KM)	31
FLIGHT DAY	2
HASL NUMBER	2264
COLLECTION UNIT	D7-1
ANALYTICAL LABORATORY	TLW
GROSS GAMMA (CPM/KSCM)	1743.1

PC/KSCM

IRON-55	3130
STRONTIUM-90	385
CADMIUM-109	*
CERIUM-144	603
LEAD-210	9.96A
PLUTONIUM-238	13.4
PLUTONIUM-239	8.46

A: ONE STANDARD DEVIATION OF COUNTING ERROR IS >20% TO 50% OF COUNT.
*: STANDARD DEVIATION GREATER THAN DATA VALUE

TABLE 4b (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING SEPTEMBER 1966
LATITUDE, 09N ALBROOK AIR FORCE BASE, CANAL ZONE

ALTITUDE (KM)	25	28	32	36
FLIGHT DAY	23	22	24	21
HASL NUMBER	2460	2458	2452	2457
COLLECTION UNIT	D7-1	D7-1	D7-1	D7-1
ANALYTICAL LABORATORY	TLW	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	3484.3#	1571.8#	777.9A#	197.7A#

PC/KSCM

IRON-55	15000	6880	1320B	993B
STRONTIUM-89	*	*	*	*
STRONTIUM-90	1500	670	281	89.3
ZIRCONIUM-95	*	10.6B	*	36.4A
CADMIUM-109	*	*	*	*
CERIUM-141	*	*	*	*
CERIUM-144	1800	824	338	93.8A
LEAD-210	*	3.88B	9.57A	3.67B
POLONIUM-210	4.44	3.88	6.57A	2.81A
PLUTONIUM-238	11.0	10.9	17.4	7.33
PLUTONIUM-239	27.1	10.9	4.19A	1.13B

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 4b (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING JANUARY 1967
LATITUDE, 09N ALBROOK AIR FORCE BASE, CANAL ZONE

ALTITUDE (KM)	24	27	32
FLIGHT DAY	23	20	21
HASL NUMBER	2577	2573	2576
COLLECTION UNIT	D7-1	D7-1	AE-1
ANALYTICAL LABORATORY	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	2158.9	1469.1	519.2
	PC/KSCM		
STRONTIUM-89	*	*	*
STRONTIUM-90	973	586	268
ZIRCONIUM-95	*	*	*
CERIUM-141	*	*	*
CERIUM-144	907	578	254
LEAD-210	*	*	*
POLONIUM-210	4.64	4.12	3.46A
PLUTONIUM-238	7.47	13.7	13.1
PLUTONIUM-239	19.6	10.3	5.54

A: ONE STANDARD DEVIATION OF COUNTING ERROR IS >20% TO 50% OF COUNT.
*: STANDARD DEVIATION GREATER THAN DATA VALUE

TABLE 4b (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING OCTOBER 1966
LATITUDE, 06S NATAL, BRAZIL

ALTITUDE (KM)	24	25	27	28	32	32
FLIGHT DAY	25	20	24	29	28	22
HASL NUMBER	2493	2487	2491	2512	2502	2485
COLLECTION UNIT	07-1	07-1	07-1	07-2	07-1	07-1
ANALYTICAL LABORATORY	TLW	TLW	TLW	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	2627.3	2287.3#	1259.5#	1116.4#	1159.5#	1017.3#
	PC/KSCM					
BERYLLIUM-7	*		*			
MANGANESE-54	*	*	*	*	*	*
IRON-55	12300		5600			4710A
STRONTIUM-89	139B	187B	*	*	*	*
STRONTIUM-90	1130	1050	484	391	264	378
ZIRCONIUM-95	55.3A	*	65.0A	*	*	88.6B
CADMIUM-109	*		*			*
ANTIMONY-125	489	489	201	211A	106B	132B
CESIUM-137	2140		623			595
CERIUM-141		*		*	*	
CERIUM-144		1120		475	297	
PROMETHIUM-147	2510		1190			722
LEAD-210		*		*	*	
POLONIUM-210		12.9A		33.2	18.3B	
PLUTONIUM-238	14.8	14.7	18.7	20.8	13.1	14.4
PLUTONIUM-239	18.1	18.7	7.20A	9.61	4.74A	6.57A

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 4b (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING OCTOBER 1966
LATITUDE, 06S NATAL, BRAZIL

ALTITUDE (KM)	37	37	41
FLIGHT DAY	23	27	30
HASL NUMBER	2490	2510	2522
COLLECTION UNIT	AE-1	AE-1	HV3K
ANALYTICAL LABORATORY	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	670.9#	388.4#	255.3A#

PC/KSCM

MANGANESE-54	*	*	*
IRON-55	2060?		*
STRONTIUM-89	*	*	171B
STRONTIUM-90	88.2	55.0B	151
ZIRCONIUM-95	*	*	351A
CADMIUM-109	*		*
ANTIMONY-125	*	*	*
CESIUM-137	103		162
CERIUM-141		*	1200B
CERIUM-144		97.1A	221
PROMETHIUM-147	102B		362
LEAD-210		*	
POLONIUM-210		*	
PLUTONIUM-238	16.9	13.8	21.7
PLUTONIUM-239	1.41B	2.47?	2.12A

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

?: DATA SUSPECT

#: GROSS GAMMA COUNT MORE THAN TWO WEEKS AFTER COLLECTION

TABLE 4b (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING MARCH 1966
LATITUDE, 34S MILDURA, AUSTRALIA

ALTITUDE (KM)	24	27	32	32
FLIGHT DAY	17	10	24	24
HASL NUMBER	2241	2234	2253	2254
COLLECTION UNIT	07-1	07-1	07-1	07-2
ANALYTICAL LABORATORY	II	II	II	
GROSS GAMMA (CPM/KSCM)	2494.8#	1849.5	1736.5	1324.1
	PC/KSCM			
IRON-55	6980	5980	7060	
STRONTIUM-90	763	761	795	670
CADMIUM-109	*	81.3A	*	
CERIUM-144	1100	1190	1360	1280
LEAD-210	59.1	34.1	102	*
PLUTONIUM-238	111	68.1	27.8?	22.6?
PLUTONIUM-239	15.8	7.69	16.8	13.1

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

TABLE 4b (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING APRIL 1966
LATITUDE, 34S MILDURA, AUSTRALIA

ALTITUDE (KM)	24	27	32	36	36
FLIGHT DAY	14	5	19	27	27
HASL NUMBER	2285	2272	2304	2311	2312
COLLECTION UNIT	07-1	07-1	07-1	AE-1	AE-2
ANALYTICAL LABORATORY	II	II	II	TLW	
GROSS GAMMA (CPM/KSCM)	2250.5	1932.8	985.4#	3026.6#	1986.2#
			PC/KSCM		
IRON-55	4690	4920	1160A	6890	
STRONTIUM-90	561	505	160	693	646
CADMIUM-109	*	*		*	
CERIUM-144	962	866	400	1050	957
LEAD-210	27.3	65.3	34.9	20.2A	*
PLUTONIUM-238	76.3	62.4	944?	61.4	60.2
PLUTONIUM-239	12.7	9.66	16.8	12.6	8.83

A: ONE STANDARD DEVIATION OF COUNTING ERROR IS >20% TO 50% OF COUNT.

*: STANDARD DEVIATION GREATER THAN DATA VALUE

?: DATA SUSPECT

#: GROSS GAMMA COUNT MORE THAN TWO WEEKS AFTER COLLECTION

TABLE 4b (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING MAY 1966
LATITUDE, 34S MILDURA, AUSTRALIA

ALTITUDE (KM)	24	27
FLIGHT DAY	12	6
HASL NUMBER	2321	2314
COLLECTION UNIT	D7-1	D7-1
ANALYTICAL LABORATORY	TLW	TLW
GROSS GAMMA (CPM/KSCM)	1873.9	1823.4

PC/KSCM

MANGANESE-54	*	*
IRON-55	6580	7550
STRONTIUM-90	635	540
ANTIMONY-125	341	288
CESIUM-137	925	819
CERIUM-144	916	900
PROMETHIUM-147	1480	5980?
LEAD-210	3.95A	3.76A
PLUTONIUM-238	61.0	46.5
PLUTONIUM-239	9.46	10.7

A: ONE STANDARD DEVIATION OF COUNTING ERROR IS >20% TO 50% OF COUNT.
*: STANDARD DEVIATION GREATER THAN DATA VALUE
?: DATA SUSPECT

TABLE 4b (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING JUNE 1966
LATITUDE, 34S MILDURA, AUSTRALIA

ALTITUDE (KM)	24	27	31
FLIGHT DAY	17	7	9
HASL NUMBER	2368	2351	2353
COLLECTION UNIT	07-1	07-1	07-1
ANALYTICAL LABORATORY	II	II	II
GROSS GAMMA (CPM/KSCM)	2144.5	1607.2	1177.0#
		PC/KSCM	
BERYLLIUM-7	11400	8020	6550A
IRON-55		3080	1410
STRONTIUM-90	548	330	174
CADMIUM-109	31.5A	*	*
CERIUM-144	698	498	300
LEAD-210	47.3	44.3	95.8
PLUTONIUM-238	141?	103?	65.5?
PLUTONIUM-239	32.7?	30.2?	8.41?

A: ONE STANDARD DEVIATION OF COUNTING ERROR IS >20% TO 50% OF COUNT.

*: STANDARD DEVIATION GREATER THAN DATA VALUE

?: DATA SUSPECT

#: GROSS GAMMA COUNT MORE THAN TWO WEEKS AFTER COLLECTION

TABLE 4b (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING JULY 1966
LATITUDE, 34S MILDURA, AUSTRALIA

ALTITUDE (KM)	23	27
FLIGHT DAY	12	28
HASE NUMBER	2380	2396
COLLECTION UNIT	07-1	07-1
ANALYTICAL LABORATORY	TLW	TLW
GROSS GAMMA (CPM/KSCM)	2118.5	739.0#

PC/KSCM

MANGANESE-54	*	
IRON-55	6410	19100?
STRONTIUM-89	*	*
STRONTIUM-90	678	189
ZIRCONIUM-95		53.1A
CADMIUM-109	19.48	34.8A
ANTIMONY-125	409	
CESIUM-137	939	
CERIUM-141	1248	*
CERIUM-144	827	293
PROMETHIUM-147	1610	641
LEAD-210	4.23A	3.00B
POLONIUM-210	4.23A	10.4?
PLUTONIUM-238	36.5	16.7
PLUTONIUM-239	12.5	3.83

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
 ? : DATA SUSPECT
 #: GROSS GAMMA COUNT MORE THAN TWO WEEKS AFTER COLLECTION

TABLE 4b (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATION

BALLOON SAMPLES COLLECTED DURING AUGUST 1966

LATITUDE, 34S MILDURA, AUSTRALIA

ALTITUDE (KM)	24	27
FLIGHT DAY	4	28
HASL NUMBER	2406	2431
COLLECTION UNIT	D7-1	D7-1
ANALYTICAL LABORATORY	TLW	TLW
GROSS GAMMA (CPM/KSCM)	1876.4	749.0#
	PC/KSCM	
BERYLLIUM-7	6710	
IRON-55	6700	1660A
STRONTIUM-89	*	*
STRONTIUM-90	595	136
ZIRCONIUM-95	*	9.35B
CADMIUM-109	50.6A	*
CERIUM-141	*	*
CERIUM-144	764	163
PLUTONIUM-238	39.0	13.8
PLUTONIUM-239	9.08	2.94A

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 4b (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING SEPTEMBER 1966
LATITUDE, 34S MILDURA, AUSTRALIA

ALTITUDE (KM)	24	32	37
FLIGHT DAY	7	22	26
HASL NUMBER	2437	2443	2455
COLLECTION UNIT	07-1	07-1	AE-1
ANALYTICAL LABORATORY	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	1346.8#	681.4A#	478.7A#
	PC/KSCM		
IRON-55	7250	1750B	*
STRONTIUM-89	*	*	*
STRONTIUM-90	614	106	57.4
ZIRCONIUM-95	17.5A	81.2A	*
CADMIUM-109	*	*	*
CERIUM-141	*	*	*
CERIUM-144	734	96.0B	*
LEAD-210	2.17B	8.04B	13.1A
POLONIUM-210	3.46	13.0	8.37A
PLUTONIUM-238	31.9	10.5A	13.1
PLUTONIUM-239	8.36A	3.10B	2.99?

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
 ?: DATA SUSPECT
 #: GROSS GAMMA COUNT MORE THAN TWO WEEKS AFTER COLLECTION

TABLE 4b (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING OCTOBER 1966
LATITUDE, 34S MILDURA, AUSTRALIA

ALTITUDE (KM)	25	25	27	28	32
FLIGHT DAY	4	28	1	27	20
HASL NUMBER	2471	2499	2464	2497	2479
COLLECTION UNIT	07-1	07-1	07-1	07-1	07-1
ANALYTICAL LABORATORY	TLW	TLW	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	1400.2#	1258.2#	1517.5	721.7#	833.2#
			PC/KSCM		
IRON-55	5120	3630	1980A	2660A	1040B
STRONTIUM-89	*	*	*	*	
STRONTIUM-90	551	313	120	159	
ZIRCONIUM-95	69.0A	47.3B	*	*	*
CADMIUM-109	*	*	*	*	*
CERIUM-141	*	*	*	*	*
CERIUM-144	652	367	149	214	128A
PROMETHIUM-147	1230		272		140A
LEAD-210		*		*	
POLONIUM-210		4.46		2.58A	
PLUTONIUM-238	25.3	20.5	20.7	15.5	13.8
PLUTONIUM-239	8.92	7.09	2.92?	4.89?	1.98

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
 ?: DATA SUSPECT
 #: GROSS GAMMA COUNT MORE THAN TWO WEEKS AFTER COLLECTION

TABLE 4b (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING DECEMBER 1966
 LATITUDE, 34S MILDURA, AUSTRALIA

ALTITUDE (KM)	36
FLIGHT DAY	21
HASL NUMBER	2552
COLLECTION UNIT	AE-1
ANALYTICAL LABORATORY	TLW
GROSS GAMMA (CPM/KSCM)	1513.3#

PC/KSCM

STRONTIUM-89	*
STRONTIUM-90	63.7A
ZIRCONIUM-95	*
CERIUM-141	*
CERIUM-144	*
LEAD-210	*
POLONIUM-210	8.20A
PLUTONIUM-238	10.6A
PLUTONIUM-239	.631B

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 4b (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING JANUARY 1967
LATITUDE, 34S MILDURA, AUSTRALIA

ALTITUDE (KM)	24	27
FLIGHT DAY	20	18
HASL NUMBER	2571	2568
COLLECTION UNIT	D7-1	D7-1
ANALYTICAL LABORATORY	TLW	TLW
GROSS GAMMA (CPM/KSCM)	1638.0	1048.3
	PC/KSCM	
STRONTIUM-89	*	*
STRONTIUM-90	296	156
ZIRCONIUM-95	*	*
CERIUM-141	*	*
CERIUM-144	269	156
LEAD-210	*	
POLONIUM-210	2.37A	3.85
PLUTONIUM-238	26.2	16.0
PLUTONIUM-239	5.10	3.85?

A: ONE STANDARD DEVIATION OF COUNTING ERROR IS >20% TO 50% OF COUNT.
*: STANDARD DEVIATION GREATER THAN DATA VALUE
?: DATA SUSPECT

TABLE 4C

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

AIRCRAFT SAMPLES COLLECTED DURING DECEMBER 1965

LATITUDE	35N	35N	34N	34N	36S
ALTITUDE (KM)	18	18	19	19	18
FLIGHT DAY	06	06	07	07	07
HASL NUMBER	2182A	2182B	2181A	2181B	2184A
COLLECTION UNIT	AC-1	AC-1	AC-1	AC-1	AC-1
ANALYTICAL LABORATORY	II	TLW	II	II	II
GROSS GAMMA (CPM/KSCM)	436.0#	436.0#	721.2#	721.2#	230.8#
			PC/KSCM		
MANGANESE-54	*	8300B	*	*	*
IRON-55	14900	13000	24300		10000
STRONTIUM-90	1620	1390	2960	3050	1050
CADMIUM-109	127A	12.4?	118	87.8A	75.8A
CADMIUM-113M	*	16.2A	23.4A	21.3A	21.0A
ANTIMONY-125	1060	1130	1910	2230	604
CESIUM-137	2400	1840	4280	7950?	1670
CERIUM-144	3820	3160	6930	7300	2210
PROMETHIUM-147	208?		227?	18900	151?
LEAD-210	329?	18.0	32.8	107	38.2
PLUTONIUM-238	6.07	2.88	1.48A	9.37?	*
PLUTONIUM-239	13.3?	21.5	41.2	382?	*

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

?: DATA SUSPECT

#: GROSS GAMMA COUNT MORE THAN TWO WEEKS AFTER COLLECTION

TABLE 4c (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS
AIRCRAFT SAMPLES COLLECTED DURING JANUARY 1966

LATITUDE	31N
ALTITUDE (KM)	18
FLIGHT DAY	31
HASL NUMBER	2290A
COLLECTION UNIT	AC-1
ANALYTICAL LABORATORY	II
GROSS GAMMA (CPM/KSCM)	3978.7#

	PC/KSCM
IRON-55	18700
STRONTIUM-90	2150
CADMIUM-109	*
CERIUM-144	4500
PLUTONIUM-238	4.97
PLUTONIUM-239	*

*: STANDARD DEVIATION GREATER THAN DATA VALUE
#: GROSS GAMMA COUNT MORE THAN TWO WEEKS AFTER COLLECTION

TABLE 4c (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS
AIRCRAFT SAMPLES COLLECTED DURING FEBRUARY 1966

LATITUDE	64N	34N	10N	10N
ALTITUDE (KM)	18	20	20	20
FLIGHT DAY	27	28	28	28
HASL NUMBER	2292A	2293A	2295A	2295B
COLLECTION UNIT	AC-1	AC-1	AC-1	AC-1
ANALYTICAL LABORATORY	TLW	II	TLW	II
GROSS GAMMA (CPM/KSCM)	3129.3#	4217.7#	2783.3#	2783.3#
	PC/KSCM			
MANGANESE-54	3880?	*	10600	*
IRON-55	16700	17000	15700	
STRONTIUM-90	1230	2160	1350	1450
CADMIUM-109	54.7	*	*	88.2A
CADMIUM-113M	22.8A	*	155?	20.9A
ANTIMONY-125	928	1270	739	1170
CESIUM-137	1710	3050	2030	4320?
CERIUM-144	2120	4060	2320	3220
PROMETHIUM-147		4020	15100?	8480
LEAD-210	3.85B	31.0	7.69	
PLUTONIUM-238	15.8	43.4	.831A	3.32?
PLUTONIUM-239	17.9	65.6?	22.0	88.2?

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
 ?: DATA SUSPECT
 #: GROSS GAMMA COUNT MORE THAN TWO WEEKS AFTER COLLECTION

TABLE 4c (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

AIRCRAFT SAMPLES COLLECTED DURING MARCH 1966

LATITUDE	65N	65N	34N	34N	11N
ALTITUDE (KM)	18	18	19	19	20
FLIGHT DAY	29	29	29	29	28
HASL NUMBER	2299A	2299B	2300A	2300B	2302A
COLLECTION UNIT	AC-1	AC-1	AC-1	AC-1	AC-1
ANALYTICAL LABORATORY	TLW	TLW	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	3760.7#	3732.0#	4676.9#	4699.5#	3531.1#
			PC/KSCM		
IRON-55	16700	17500	21100	24500	15500
STRONTIUM-89		*			
STRONTIUM-90	1490	1650	1950	2160	1300
ZIRCONIUM-95		84.4B			
CADMIUM-109	*	*	41.4A	52.8A	25.1B
CERIUM-141		*			
CERIUM-144	2610	3090	3380	3610	2320
LEAD-210	7.17A	9.18A	*	*	11.3
POLONIUM-210		2.30A			
PLUTONIUM-238	14.8	13.8	14.3	15.5	2.92A
PLUTONIUM-239	24.7	27.6	34.0	33.5	21.9

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 4c (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

AIRCRAFT SAMPLES COLLECTED DURING APRIL 1966

LATITUDE	60N	60N	34N	34N	07N	07N
ALTITUDE (KM)	20	20	20	20	20	20
FLIGHT DAY	28	28	25	25	27	27
HASL NUMBER	2411A	2411B	2409A	2409B	2413A	2413B
COLLECTION UNIT	AC-1	AC-1	AC-1	AC-1	AC-1	AC-1
ANALYTICAL LABORATORY	TLW	TLW	TLW	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	3395.3#	3389.8#	4026.7#	4035.5#	2097.7#	2094.7#
			PC/KSCM			
IRON-55	16800	14300	15900	17300	14300	
STRONTIUM-90	1620	1530	1850	2100	1360	1310
CADMIUM-109	*	*	*	*	*	
CERIUM-144	2690	2400	2820	3340	1970	1860
PLUTONIUM-238	14.5	15.0	8.04	10.8	2.80A	2.38A
PLUTONIUM-239	24.4	22.6	27.3	31.2	23.1	15.3

A: ONE STANDARD DEVIATION OF COUNTING ERROR IS >20% TO 50% OF COUNT.

#: STANDARD DEVIATION GREATER THAN DATA VALUE

#: GROSS GAMMA COUNT MORE THAN TWO WEEKS AFTER COLLECTION

TABLE 4c (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS
AIRCRAFT SAMPLES COLLECTED DURING MAY 1966

LATITUDE	60N	38N	38N	10N	30S
ALTITUDE (KM)	18	18	18	18	18
FLIGHT DAY	30	30	30	28	27
HASL NUMBER	2415A	2414A	2414B	2417A	2416A
COLLECTION UNIT	AC-1	AC-1	AC-2	AC-1	AC-1
ANALYTICAL LABORATORY	TLW	TLW	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	3423.9#	2615.5#	2615.5#	1060.8#	1895.9#
			PC/KSCM		
IRON-55	17700	10400	12300	5050	9190
STRONTIUM-89	*	*	*	118A	*
STRONTIUM-90	1660	1310	1230	471	901
ZIRCONIUM-95	*	*	29.5B	*	51.4A
CADMIUM-109	53.1A	68.0	27.5A	18.3B	65.6A
CERIUM-141	*	*	*	*	*
CERIUM-144	2250	1730	1570	634	1140
PROMETHIUM-147	4000	2910	2770	1150	1980
PLUTONIUM-238	9.84	7.18	5.67A	1.67	37.0
PLUTONIUM-239	27.4	19.7	21.8	7.11	9.24

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 4c (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

AIRCRAFT SAMPLES COLLECTED DURING JUNE 1966

LATITUDE	34N	30N	06N
ALTITUDE (KM)	20	18	18
FLIGHT DAY	22	14	17
HASL NUMBER	2524A	2528A	2527A
COLLECTION UNIT	AC-1	AC-1	AC-1
ANALYTICAL LABORATORY	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	3276.3#	1569.3#	871.6#
	PC/KSCM		
STRONTIUM-90	1760	827	472
CERIUM-144	2480	1130	606
PLUTONIUM-238	17.5	58.3?	1.03A
PLUTONIUM-239	27.3	10.8	6.65

A: ONE STANDARD DEVIATION OF COUNTING ERROR IS >20% TO 50% OF COUNT.

?: DATA SUSPECT

#: GROSS GAMMA COUNT MORE THAN TWO WEEKS AFTER COLLECTION

TABLE 4c (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

AIRCRAFT SAMPLES COLLECTED DURING JULY 1966

LATITUDE	62N	34N	10N	32S
ALTITUDE (KM)	20	20	20	20
FLIGHT DAY	17	20	18	19
HASL NUMBER	2529A	2531A	2533A	2535A
COLLECTION UNIT	AC-1	AC-1	AC-1	AC-1
ANALYTICAL LABORATORY	TLW	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	2604.8#	1943.6#	1607.8#	3607.7#
	PC/KSCM			
STRONTIUM-89	*	1210B	*	*
STRONTIUM-90	1230	960	944	1860
ZIRCONIUM-95	*	*	*	*
CERIUM-141	*	*	*	*
CERIUM-144	1600	1290	1280	2620
LEAD-210	*	*	*	*
POLONIUM-210	3.47A	3.89A	6.61	6.91A
PLUTONIUM-238	16.8	8.75	2.84A	93.6
PLUTONIUM-239	18.4	16.8	15.0	30.7

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 4c (cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

AIRCRAFT SAMPLES COLLECTED DURING AUGUST 1966

LATITUDE	63N	34N	07N	32S
ALTITUDE (KM)	20	20	20	20
FLIGHT DAY	14	15	19	17
HASL NUMBER	2537A	2539A	2541A	2543A
COLLECTION UNIT	AC-1	AC-1	AC-1	AC-1
ANALYTICAL LABORATORY	TLW	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	3244.8#	4647.7#	2326.6#	2301.1#
	PC/KSCM			
STRONTIUM-89	*	*	*	*
STRONTIUM-90	1250	2620	1520	1080
ZIRCONIUM-95	*	*	*	*
CERIUM-141	*	*	*	*
CERIUM-144	1530	3340	1890	1390
PLUTONIUM-238	23.9	18.4	3.83	53.5
PLUTONIUM-239	18.1	37.7	22.3	17.9

*: STANDARD DEVIATION GREATER THAN DATA VALUE

#: GROSS GAMMA COUNT MORE THAN TWO WEEKS AFTER COLLECTION

Table 4d

ANALYSES OF CODED BLANK SAMPLES

Anal. Lab.	Sample #	Report Date	dpm/Sample																
			Be-7	Mn-54	Fe-55	Sr-89	Sr-90	Zr-95	Cd-109	Cd-113m	Sb-125	Cs-137	Ce-141	Ce-144	Pm-147	Pb-210	Po-210	Pu-238	Pu-239
<u>ISOTOPES, INC.</u>																			
	2070	12/1/65	1100B	*	28A		0.90A		*	*	4.0A	3.12		*	6.73			*	*
	2082	12/1/65			49A		1.7A		*					2.4A				*	0.05A
	2132	1/2/66			*		1.7A		*					1.4A				*	*
	2215	2/2/66		*	*		2.36		*		2.93	2.2A		40.0	20.2			*	2.26A
	2243	3/1/66				*	2.28		*					3.2A		1.68		*	*
	2283	4/1/66			*	*	0.94		*	*	4.57	3.29		3.46	13.2	1.99		0.29A	*
	2342	5/22/66		*	*		4.70		*		4.04	3.57		14.1	17.2	3.4		*	*
<u>TRACERLAB - WEST</u>																			
	2100	1/3/66			*		0.60B		*					*				0.13A	*
	2206	2/1/66		*	*		0.78		*		*	*		*	*			0.05B	*
	2207	3/2/66			*		2.97		*					*		0.46A		0.17A	*
	2281	4/15/66		*	*		0.21B		*	3.07	1.0A	1.24		0.43B		0.16B		*	0.04A
	2323	5/1/66	*	*	89	*	*		*		*	0.59A		*	1.8B	*		0.18A	0.08A
	2376	7/1/66			*	*	0.30B		*				*	*	*	*	*	0.08B	0.03B
	2384	7/1/66			*	*	1.62			2.3B			*	*				0.13A	0.04A
	2466	9/1/66			*		0.87A	*	*				*	*		0.29B	*	*	*
	2463	10/3/66			*	*	*	*	*				*	*	*			*	*
	2495	11/1/66			*	*	0.92B	*	*				*	2.4B		*	0.16A	0.09B	0.05B
	2549	12/15/66			*	*	0.96B	*					*	*				*	0.03B

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

B: " " " " " " " " " 51 - 100%

*: Not Detectable

Table 4e

PERCENT STANDARD DEVIATION OF CODED DUPLICATE SAMPLES

<u>Laboratory</u>	<u>Fe-55</u>	<u>Sr-90</u>	<u>Sb-125</u>	<u>Cs-137</u>	<u>Ce-144</u>	<u>Pm-147</u>	<u>Pu-238</u>	<u>Pu-239</u>	<u>Pb-210</u>
Intra Isotopes, Inc.		2.8	14	53	4.5	170		140	94
# of Duplicates		1	1	1	1	1		1	1
Intra TLW	11	7.2			9.8	4.5	10.	12	
# of Duplicates	5	6			6	1	4	6	
Between II and TLW	12	9.5	23	23	24		63	74	
# of Duplicates	1	2	2	1	2		1	2	

Table 4f

ANALYSES OF CODED STANDARD SAMPLES

dpm

TRACERLAB - WEST

Sample #	Report Date		Mn-54	Fe-55	Sr-89	Sr-90	Zr-95	Cd-109	Sb-125	Cs-137	Ce-141	Ce-144	Pm-147	Pb-210	Po-210	Pu-238	Pu-239
2138	1/15/66	Added	42000	30600		139		355	3140	205		481	1940			0	12.5
		Found	53600	29300		132		355	2770	210		492	2060			0.14A	12.8
		% Deviation	+28	-4.2		-5		±0	-12	+2.4		+2.3	+6.2				+2.4
2202	1/15/66	Added		35500		271		534				455				0	13.3
		Found		33600		270		569				459				0.18A	13.5
		% Deviation		-5.4		-0.4		+6.6				+0.9					+1.5
2248	2/15/66	Added	36400	9660		172		371	868	241		157	1710			0	5.95
		Found	33100	9570		169		361	685	247		154	2040			0.13A	6.16
		% Deviation	-9.1	-0.9		-1.7		-2.7	-21	+2.5		-1.9	+19				+3.5
2279	3/2/66	Added		5800		106		405				160				0	6.06
		Found		5750		101		427				154				0.16A	5.69
		% Deviation		-0.9		-4.7		+5.4				-3.8					-6.1
2332	4/1/66	Added	24800	8090		213		678	0	413		406	0	47.1		0	23.6
		Found	26000	8180		202		707	8.73	439		424	7.6A	42.6		0.12A	23.0
		% Deviation	+4.8	+1.1		-5.2		+4.3		+6.3		+4.4		-9.6			-2.5
2373	5/2/66	Added	37900	7000		202		375	1030	393		436	662	38.2		0	7.71
		Found	41500	6190		191		321	895	405		442	638	34.7		0.12B	8.26
		% Deviation	+9.5	-12		-5.4		-14	-13	+3.1		+1.4	-3.6	-9.2			+7.1
2395	6/1/66	Added	164000	5290	553	48.9		759	860	70.8	640	552	777	20.6		0	2.63
		Found	175000	5240	503	51.4		677	742	72.4	702A	546	876	19.9		0.08B	2.64
		% Deviation	+6.7	-0.9	-7.8	+5.1		-11	-14	+2.2	+9.7	-1.1	+13	-3.3			+0.38
2429	8/1/66	Added		8840	270	46.4	638	221			155	361			6.89	0	2.95
		Found		9040	280	51.6	610	142			335B	489			5.51	0.09A	2.79
		% Deviation		+2.3	+3.7	+11	-4.4	-36			?	+35			-20		-5.4
2474	9/1/66	Added		4280	240	55.1	890	682			173	453		22.8	5.88	7.25	3.45
		Found		3830	231	51.2	741	614			*	482		21.3	27.5	6.52	3.0
		% Deviation		-11	-3.8	-7.1	-17	-10				+6.4		-6.6	+370	-10	-13
2519	11/1/66	Added	117000	9870	71.9	44.7	374	523	684	29.6	23.4	323	1370			4.70	3.19
		Found	105000	10100	73.9	43.3	337	480	631	30.9	30B	29B	1280			4.59	2.61
		% Deviation	-10	+2.3	+2.8	-3.1	-9.9	-8.3	-7.7	+4.4	+29		-6.8			-2.3	-18
2550	11/1/66	Added		8670	204	75.5	253	701			106	46.7		33.2	3.20	5.17	2.92
		Found		8380	194	70.9	199	629			120A	51.0		22.9	30.2	4.70	2.92
		% Deviation		-3.3	-4.9	-6.1	-21	-11			+11	+9.2		-31	+840	-9.1	±0
2587	12/1/66	Added			89.2	62.0	210				61.9	53.8				6.76	2.26
		Found			76.9	59.4	170				170B	53.4				6.47	2.01
		% Deviation			-14	-4.2	-19					-0.74				-4.3	-11
Average % Deviation			+5.0	-3.0	-4.0	-2.2	-14	-7.0	-14	+3.5		+4.7	+5.6	-12	+400	-6.4	-3.4

*: Not Detectable

A: Counting Error is 20 - 50%

B: Counting Error is 51 - 100%

Table 4f (Cont'd)

ANALYSES OF CODED STANDARD SAMPLESISOTOPES, INC.

ISOTOPES, INC.			dpm										
Sample #	Report Date		Mn-54	Fe-55	Sr-90	Cd-109	Sb-125	Cs-137	Ce-144	Pm-147	Pb-210	Pu-238	Pu-239
2137	1/15/66	Added	44800	29400	143	269	2880	564	388	1510		0	13.4
		Found	38400	27100	153	335	2480	634	412	1170		0.09A	13.7
		% Deviation	-14	-7.8	+7.0	+25	-14	+12	+6.2	-23			+2.2
2201	1/15/66	Added		35900	468	597			621			0	13.9
		Found		35200	490	736			643			0.17A	13.0
		% Deviation		-1.9	+4.7	+23			+3.5			-6.5	
2247	2/15/66	Added	23400	9920	167	287	1070	195	165			0	6.94
		Found	22400	10100	225	343	1010	238	190			*	6.79
		% Deviation	-4.3	+1.8	+35	+20	-5.6	+22	+15			-2.0	
2278	3/1/66	Added		6440	94.4	34			162			0	8.88
		Found		6030	99.0	373			188			0.22	13.2
		% Deviation		-6	+5	+19			+16			+49	
2331	4/1/66	Added	23600	8140	230	424	0	398	434	0	23.9	0	8.55
		Found	21100	6130	251	517	9.43	481	504	13.6	13.9	*	35.9
		% Deviation	-11	-25	+9.1	+22		+21	+16		-42		+320
2372	5/2/66	Added	41300		142	494	830	711	354	682	28.7	0	8.11
		Found	41800		139	577	946	241	347	886	44.9	0.29A	25.1
		% Deviation	+1.2		-2.1	+17	+14	-66	-2.0	+30	+56		+210
Average % Deviation			-7.0	-7.8	+9.8	+21	-1.9	-2.7	+9.1	+3.5	+7.0		+96

*: Not Detectable

A: Counting Error is 20 - 50%

B: Counting Error is 51 - 100%

(a): Data not included in average % Deviation.

5. SURFACE AIR SAMPLING PROGRAM

by Philip W. Krey - HASL

The Health and Safety Laboratory began its Surface Air Sampling Program in January, 1963 as a continuation of the 80th Meridian Program conducted by the U. S. Naval Research Laboratory. The objectives of this work are to determine the concentrations of radioactivity in surface air in both hemispheres as a function of latitude and season, and to interpret these data in terms of the dominant meteorological and physical processes which are operative.

SAMPLE COLLECTION

The sampling sites and their coordinates in the HASL Program are given in Table 5a. The basic network consists of a line of sites approximately along the 80th Meridian extending from about 76°N to 53°S Latitudes. Duplicate collections are made at the New York site which provide a measure of the reproducibility of sampling and analysis in this program. Additional sites in Hawaii and in the continental United States were implemented to supply data relating to possible longitudinal, coastal, or altitude effects on surface air concentrations. Four North Atlantic Ocean weather stations operated by the United States Coast Guard have been sampling since November 1965 to furnish data on the concentrations of radioactivity in surface air in a maritime environment. The Environmental Science Services Administration maintained a collection site at the Amundson Scott Station in Antarctica until 1966. The air filter samples from this site are also included in the HASL Program.

Approximately 1400 cubic meters of ambient air per day are drawn through a 20 centimeter diameter Microsorban filter for the land stations. For the ocean stations, about 2200 cubic meters of air per day are filtered by a 20 x 25 cm Microsorban filter. Each filter is changed on the 1st, 8th, 15th and 22nd of the month or more frequently if the filter becomes clogged with debris suspended in the air. Under normal conditions, the filters from each station are compressed into a monthly composite and the gamma spectrum of the composite is obtained by an 8" x 4" NaI (Tl) crystal approximately two weeks after the last collection in the month. If a nuclear event occurs such that measurable quantities of radioactivity are injected into the atmosphere, each filter collected in the same hemisphere in which the event takes place is assayed individually in an attempt to better delineate the disposition and dispersion of the nuclear debris during the ensuing weeks. At some stations, even daily samples are collected after a nuclear test.

The integrated response between 100 Kev and 3.0 Mev is corrected by the average detection efficiency (35%) of the gamma photons present in fallout, and the total gamma activity is reported in units of photons/min/10³m³. Average monthly gamma concentrations are calculated by weighting the concentrations in each sampling interval by the relative period of time in the interval. After the gamma measurements have been completed, monthly composites from each site are submitted to contractor laboratories for radiochemical analyses.

RADIOCHEMICAL ANALYSES

Since the last major nuclear weapon test series occurred at the end of 1962, only the longer lived artificially produced radionuclides were present in the filters analyzed prior to May 1966. Consequently, emphasis was given to the determination of Mn-54, Fe-55, Sr-90, Cd-109, Cs-137, Ce-144, Pu-238 and Pu-239. Sr-89, Zr-95 and Ce-141 were analyzed in samples collected after May 1966 following the Chinese and French nuclear weapons tests.

The longer lived fission products and Pu-239 concentrations should describe the general distribution in surface air of all previous nuclear weapon debris which was transferred from the lower stratosphere to the troposphere during the collection period of this report. Other tracer nuclides can be associated with debris from a single detonation or a series of detonations. Mn-54 and Fe-55 were produced in large quantities in the 1961 and 1962 test series. Cd-109 was generated by the U. S. high altitude test over Johnston Island on July 9, 1962. While Pu-238 is present in low concentrations in nuclear weapons debris, about 17,000 curies of Pu-238 was disseminated at high altitude in the stratosphere on April 21, 1964 during the reentry burn-up of a SNAP-9A power source.

ANALYTICAL LABORATORIES

Food, Chemical and Research Laboratories, Inc. (FCRL) of Seattle, Washington, performed the analyses of most of the samples in this report. Isotopes, Inc., of Westwood, New Jersey analyzed most of the samples collected at Westwood, N. J., and a few samples from Chacaltaya, Bolivia, Antofagasta, and Santiago, Chile. Previous reports containing data on the HASL Surface Air Sampling Program are given in references (1), (2), (3), (4), (5) and (6).

RESULTS

The activity concentrations in surface air during 1966 of all the radionuclides investigated in this program are presented in Table 5b. The sites are listed according to latitude beginning with the most northern site at Thule, Greenland. The coded duplicate samples from the New York site were analyzed, and these results are also given in Table 5b. Such duplicate samples were part of a quality control program maintained with Food, Chemical and Research Laboratories in which coded duplicates, standards and blanks were submitted with each shipment of samples. The results of the standards and blank analyses conducted during the period covered by this report are given in Table 5c.

The concentrations are reported at the midpoint of the collection month for the plutonium isotopes and the fission products and on the following dates for the induced nuclides:

Mn-54 and Fe-55: October 15, 1961
Cd-109: July 9, 1962

One standard deviation of the counting error for these data is always less than $\pm 20\%$ and usually less than $\pm 10\%$ unless otherwise indicated by the following 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%
- *: No detectable activity
- ?: Suspect data

Datum is suspect when the concentration of a nuclide is inconsistent with:

1. its concentrations in samples adjacent in time and place, or with
2. concentrations of other nuclides in the same sample.

DATA RELIABILITY

According to Volk (7) an estimate of the standard deviation of an analysis can be obtained from duplicate measurements by the equation:

$$\sigma = 0.8862d$$

where σ = percent standard deviation
 d = deviation between duplicate measurements
expressed as percent of the mean

Invoking this equation, the standard deviation for each duplicate measurement at New York is reported in Table 5b along with the average standard deviation for each nuclide during the time interval covered by this report. Individual deviations are included in the calculation of the average deviation only when the counting error of each duplicate is less than 20 percent. The average percent standard deviation of analysis for most of the long-lived nuclides at New York is $\pm 10\%$ or less. The deviation of the shorter lived fission products, Sr-89 and Ce-141, increases to about $\pm 17\%$, while the deviation of Zr-95 jumps to $\pm 28\%$. The precision of the Pu-239 analysis is also rather poor at $\pm 27\%$ in spite of the improvement which had been anticipated in plutonium radiochemistry (6).

The sensitivity of the Cd-109 analysis in the samples from New York is not sufficient to satisfy the requirement that the counting error of the duplicates must be less than $\pm 20\%$. A similar analytical insensitivity exists for the Pu-238 concentrations in surface air at New York except for the suspect analyses of the June 1966 samples. Consequently, no average percent standard deviations are presented for these nuclides in Table 5b.

A blank is prepared by sprinkling a small amount of pre-1945 soil (<100mg) onto an unexposed Microsorban filter. Then carbon soot from burning naphthalene is filtered onto the Microsorban paper for a few moments under laboratory conditions. This procedure produces blanks which are very similar in appearance, and in some respects, composition to the routine filters collected by this program. When the blanks are coded, as are all the filters submitted to radiochemistry, they are not readily distinguishable from routine samples.

A standard is prepared by evaporating weighed aliquots of standard solutions of various nuclides calibrated at HASL onto a blank sample. A few drops of a wetting agent is applied to the blank prior to the addition of the standard to permit permeation of the solution between the polyethylene fibres of the Microsorban filter. Each prepared quality control filter may be either a blank or a standard for a particular nuclide depending on whether standard solution for that nuclide has or has not been added. The results of the coded blank and standard sample analyses are given in Table 5c.

A review of the blank data in Table 5c indicates that the laboratory contamination for most of the nuclides is either not measurable or at a level which is usually negligible with regard to the activities in the samples. Many of Cd-109 blanks are reported as not detectable, but in a few cases, the blanks reflect more Cd-109 than exist in the surface air filters. While half of the Pu-238 blank analyses reported in Table 5c also reflect non-measurable activities, the other half averages about 0.23 dpm which converts to an average concentration of about 6×10^{-3} dpm/10³m³. Consequently, some of the Pu-238 concentrations in Table 5b which are close to this value must be considered with reservation.

The accuracy of the analyses for each nuclide performed by FCRL during the period covered by this report is summarized by the average percent deviation of standard samples analyses given at the bottom Table 5c. Only those nuclide analyses were included in the computation of these averages in which the counting error was less than $\pm 20\%$. For this reason, no average value is reported for Ce-141.

The reliability of analysis appears to be divided into two groups. One group includes Mn-54, Fe-55, Sr-90, Ce-144, Pu-238, and Pu-239 analyses which have an average percent deviation of about $\pm 10\%$ or less. It should be noted that during July and August 1966, the Ce-144 deviation fluctuated between a +20 and a -20% even though the average deviation was only -1.8%. The second group includes Sr-89, Zr-95, Cd-109 and Cs-137 which has an average percent deviation of about $\pm 20\%$. Allowance must be made for these inaccuracies when comparing these data with data from other programs.

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TABLE 5a

HASL SURFACE AIR SAMPLING STATIONS

<u>STATIONS</u>	<u>LATITUDE</u>	<u>LONGITUDE</u>	<u>ELEVATION(m)</u>
Thule, Greenland	76°36'N	68°35'W	259
Charlie Ocean Station	57°00'N	35°30'W	0
Bravo Ocean Station	56°30'N	51°00'W	0
Moosonee, Ontario, Canada	51°16'N	80°39'W	10
Delta Ocean Station	49°00'N	41°00'W	0
Seattle, Washington	47°36'N	122°20'W	3
Appleton, Wisconsin	44°15'N	88°25'W	229
Westwood, New Jersey	41°00'N	74°01'W	38
New York, New York	40°48'N	73°58'W	38
Sterling, Virginia	38°58'N	77°25'W	76
Palo Alto, California	37°30'N	122°23'W	19
Midwest City, Oklahoma	35°25'N	97°30'W	364
Changed to Norman, Oklahoma on 9/20/65	35°14'N	97°27'W	
Chattanooga, Tennessee	35°03'N	85°20'W	206
Echo Ocean Station	35°00'N	48°00'W	0
Miami, Florida	25°49'N	80°17'W	4
Bimini, Bahamas	25°46'N	79°22'W	
Mauna Loa, Hawaii	19°28'N	155°36'W	3401
San Juan, Puerto Rico	18°26'N	66°00'W	10
Miraflores, Panama Canal Zone	9°00'N	79°35'W	10
Relocated to Balboa, Panama Canal Zone in June 1965	8°58'N	79°34'W	23
Guayaquil, Ecuador	2°10'S	79°52'W	7
Lima, Peru	12°06'S	77°01'W	134
Chacaltaya, Bolivia	16°21'S	68°07'W	5220

TABLE 5a (Cont'd)

HASL SURFACE AIR SAMPLING STATIONS

<u>STATIONS</u>	<u>LATITUDE</u>	<u>LONGITUDE</u>	<u>ELEVATION(m)</u>
Antofagasta, Chile	23°37'S	70°16'W	519
Portillo, Chile	32°50'S	70°08'W	2850
Santiago, Chile	33°27'S	70°42'W	520
Puerto Montt, Chile	41°27'S	72°57'W	5
Punta Arenas, Chile	53°08'S	70°53'W	3

Table 5b

ACTIVITY CONCENTRATIONS IN SURFACE AIR DURING 1966

SITE: THULE, GREENLAND

MONTH	Total Gamma (Photons/m/10 ³ m ³)	dpm/10 ³ m ³ at mid month										
		Mn-54	Fe-55	Sr-89	Sr-90	Zr-95	Cd-109	Cs-137	Ce-141	Ce-144	Pu-238	Pu-239
Feb	87	225	193		24.0		*	34.6		50.9	.0086B	.340
Mar	94	262	292		24.1		0.72A	38.5		42.6	.0088	.377
Apr	81	202	139?		23.6		0.68A	32.2		39.8	.019A	.444
June	58		89.8	*	10.8	28.8	*		16.2	16.1	.011	.166
July	46		80.5	6.54	6.42	8.44	*		30A	8.90	.0041A	.0737
Aug	28		71.2	4.17	5.33	2.78	*		*	7.92	.086A	.051A

A: Counting Error is 20-50%

B: Counting Error is 51-100%

?: Data Suspect

*: Not detectable

Table 5b (cont'd)

ACTIVITY CONCENTRATIONS IN SURFACE AIR DURING 1966

SITE: CHARLIE OCEAN STATION

Month	Total Gamma	dpm/10 ³ m ³ at mid month										
	Photons/m/10 ³ /m ³	<u>Mn-54</u>	<u>Fe-55</u>	<u>Sr-89</u>	<u>Sr-90</u>	<u>Zr-95</u>	<u>Cd-109</u>	<u>Cs-137</u>	<u>Ce-141</u>	<u>Ce-144</u>	<u>Pu-238</u>	<u>Pu-239</u>
Feb	13	50.3	61.3		5.25		13?	7.13		9.53	*	.078
Mar	39	391	396		41.5		.62A	55.5		70.6	.0256	.0026A?
Apr	32	127	82.4		15.3		.61A	17.6		27.3	.0434	.308
May	37		87.7	*	8.42	5.34	.12A		*	13.8	.00958	.169
June	26		62.6	*	5.45	6.60	.38		34A	8.29	.010A	.0684
July	27		124?	9.9	3.3	10.8	*		*	5.35	.0049A	.0397
Aug	23		40.3	6.27	4.33	4.08	.27B		*	6.15	.014B	.068A

A: Counting Error is 20-50%

B: Counting Error is 51-100%

?: Data Suspect

*: Not Detectable

Table 5b (cont'd)

ACTIVITY CONCENTRATIONS IN SURFACE AIR DURING 1966

SITE: BRAVO OCEAN STATION

MONTH	Total Gamma (Photons/m/10 ³ /m ³)	dpm/10 ³ m ³ at mid month										
		Mn-54	Fe-55	Sr-89	Sr-90	Zr-95	Cd-109	Cs-137	Ce-141	Ce-144	Pu-238	Pu-239
Feb	25	80.3	69.5		8.8		*	11.2		17.4	*	.092
Mar	41	128	170		12.6		.51A	16.5		21.6	*	.194
Apr	49	215	177		20.9		.27B	25.3		25.2	.026A	.454
May	29		67.9	2.17	5.99	2.7B	.16B		261?	8.07	.0087	.151?
June	17		70.3	4.83	7.04	7.20	.40A		18.0	10.9	.0080A	.108
July	33		47.6	2.2B	3.8	13.5	*		32.1	5.02	.0156	.0409
Aug	24		58.5	9.20	4.08	86.3?	*		81.9	6.70	*	.032A

A: Counting Error is 20-50%

B: Counting Error is 51-100%

?: Data Suspect

*: Not Detectable

Table 5b: (cont'd)

ACTIVITY CONCENTRATIONS IN SURFACE AIR DURING 1966

SITE: MOOSONEE, CANADA

Month	Total Gamma (Photons/m/10 ³ m ³)	dpm/10 ³ m ³ at mid month										
		Mn-54	Fe-55	Sr-89	Sr-90	Zr-95	Cd-109	Cs-137	Ce-141	Ce-144	Pu-238	Pu-239
Jan	39	92.3	81.0		9.39		.18B	14.8		18.1		.084A
Feb	38	111	99.5		11.6		*	16.2		22.1	.019A	.14
Mar	65	144	182		11.8		.65A	23.0		24.7	.0052A	.275
Apr	46	88.2	104		11.8		.54B	15.9		17.4	*	.297?
May	66		107	*	15.5	8.55	.35A		*	21.9	.0087A	.227
June	130		118	21.4	12.6	23.7	*		54.6	19.0	.0069B	.186
July	96		143	*	12.8	11.9	.46A		*	21.7	.015A	.152
Aug	55		58.6	5.54	5.12	2.09	*		*	7.92	.026B	.048A

A: Counting Error is 20-50%

B: Counting Error is 51-100%

?: Data Suspect

* Not Detectable

Table 5b. (cont'd)

ACTIVITY CONCENTRATIONS IN SURFACE AIR DURING 1966

SITE: DELTA OCEAN STATION

Month	Total Gamma (Photons/m/10 ³ m ³)	dpm/10 ³ m ³ at mid month										
		<u>Mn-54</u>	<u>Fe-55</u>	<u>Sr-89</u>	<u>Sr-90</u>	<u>Zr-95</u>	<u>Cd-109</u>	<u>Cs-137</u>	<u>Ce-141</u>	<u>Ce-144</u>	<u>Pu-238</u>	<u>Pu-239</u>
Feb	25	98.0	105		9.17		*	15.9		21.1	.012A	.12B
Mar	43	152	221		16.4		.57A	21.6		27.5	.0082A	.333
Apr	40	125	101		13.5		*	15.5		20.7	.014A	.251
May	60		149	*	14.8	8.64	.58A		*	23.5	.010A	.259
June	62		91.9	14.2	11.5	26.8	*		39.1	18.8	.0355?	.141
July	67		81.5	20.6	7.15	35.0	.12A		28A	14.0	.0053A	.0678
Aug			45.6	6.45	3.20	1.8	*		28A	4.62	.0075B	.0278

A: Counting Error is 20-50%

B: Counting Error is 51-100%

?: Data Suspect

*: Not Detectable

Table 5b (cont'd)
ACTIVITY CONCENTRATIONS IN SURFACE AIR DURING 1966

SITE: SEATTLE, WASHINGTON

Month	Total Gamma (Photons/m/10 ³ m ³)	dpm/10 ³ m ³ at mid month							
		<u>Fe-55</u>	<u>Sr-89</u>	<u>Sr-90</u>	<u>Zr-95</u>	<u>Cd-109</u>	<u>Ce-141</u>	<u>Ce-144</u>	<u>Pu-238</u> <u>Pu-239</u>
Jan	20	71.8		7.04		.36A		13.0	.011B .075
Feb	34	88.7		8.37		*		15.7	* .112
Apr	83	127		13.3		*		22.4	.028A .348?
May	210	129	*	9.16	49.1	.38A	19A	22.9	.011A .234?
June	100	86.4	4.24	8.44	14.9	.90A?	23.3?	13.2	* .118
July	49	66.0	8.22	5.07	10.5	*	24A	10.6	.0460 .114

A: Counting Error is 20-50%
 B: Counting Error is 51-100%
 ?:: Data Suspect
 *: Not Detectable

Table 5b (cont'd)

ACTIVITY CONCENTRATIONS IN SURFACE AIR DURING 1966

SITE: WESTWOOD, NEW JERSEY

Month	Total Gamma (Photons/m/10 ³ m ³)	dpm/10 ³ m ³ at mid month					
		<u>Fe-55</u>	<u>Sr-90</u>	<u>Cd-109</u>	<u>Ce-144</u>	<u>Pu-238</u>	<u>Pu-239</u>
Jan	36	69.3	10.6	*	20.9	.0075A	.276?
Feb	39	73.6	11.9	*	21.3	.0046A	.163
Mar	72	128	19.3	*	29.5	.00766	.293
Apr	51	108	15.9	*	31.7	.0073A	.295?
May	150	151	21.3	.681	45.2	.016A	.446
June	280	178	27.8	.505	45.9	.0186	.626
July	180	141	17.4	.88A	25.5		
Aug	84	53.9	7.92	.52	9.56		
Sept	47	35.3	4.94	.21A	5.36		
Oct	19	22.2	3.15	.426	4.15		

A: Counting Error is 20-50%

B: Counting Error is 51-100%

?: Data Suspect

*: Not Detectable

Table 5b (cont'd)

ACTIVITY CONCENTRATIONS IN SURFACE AIR DURING 1966

SITE: NEW YORK, NEW YORK

Month	Sample No	Total Gamma (Photons/m/10 ³ /m ³)	dpm/10 ³ m ³ at mid month										
			Mn-54	Fe-55	Sr-89	Sr-90	Zr-95	Cd-109	Cs-137	Ce-141	Ce-144	Pu-238	Pu-239
Jan	E3954		90.0	117		10.1		0.162B	20.2		22.2	0.0088B	0.164
	E3966		99.2	113		11.1		0.674A	21.8		22.6	0.020A	0.184
Mean	±% Std. Deviation	46	94.6±8.6	115±3.5		10.6±9.4		?	21±7.6		22.4±1.8	0.015±70	0.174±5.1
Feb	E4038	30	74.3±9.7	77.5±6.3		7.0±4		*	12.5±1		14±1.9	0.0163±45	0.053±14
Mar	E4074		170	201		16.0		0.94	32.6		30.2	0.0075A	0.310
	E4086		160	233		16.9		0.44A	32.0		30.0	0.0046A	0.324
Mean	±% Std. Deviation	75	165±5.4	217±13		16.5±4.8		0.69±64	32.3±1.6		30.1±0.59	0.0061±42	0.317±3.9
Apr	E4129		139	144		16.2		*	22.7		23.7	0.0700	0.530
	E4141		135	129		16.4		0.51B	23.4		24.1	*	0.370
Mean	±% Std. Deviation	63	137±2.6	137±9.7		16.3±1.1			23.1±2.7		23.9±1.5		0.45±32
May	E4250			242	25.1	23.0	38.4	0.67B		34A	41.9	0.035A	0.468
	E4262			274	24.6	21.4	50.3	1.26		64A	40.4	0.010A	0.389
Mean	±% Std. Deviation	440		258±11	24.9±1.8	22.2±7.7	44.4±24	0.96±54		49±54	41.2±3.2	0.022±96	0.428±16
June	E4509			325	52.5	25.6	60.7	1.3A		123	46.3	0.038?	0.263
	E4521			266	38.2	26.1	42.8	0.96B		149	47.4	0.116?	0.405
Mean	±% Std. Deviation	510		296±18	45.4±28	25.9±1.7	51.8±31	1.1±27		136±17	46.9±2.1	0.077±90 [@]	0.334±38
July	E4879			272	35.8	18.5	33A	0.57A		48A	34.5	0.042A	0.416
	E4891			263	23.7	18.2A	29.9	0.54A		31A	40.6	0.029A	0.165
Mean	±% Std. Deviation	250		268±3	29.8±3	18.4±1.4	31.6±11	0.56±4.8		40±38	37.6±1.4	0.035±33	0.291±76
Aug	E5220			13.3? [@]	11.6	10.4	3.89	0.94B [@]		45A	15.1	0.021A	0.138
	E5232			156? [@]	12.3	6.72	5.3A	* [@]		44A	14.1	0.018B	0.174
Mean	±% Std. Deviation	100			12±5.2	8.56±38	4.6±27			44±2	14.6±6.1	0.020±15	0.156±20
Average % Standard Deviation			±6.6	±9.2	±18	±9.5	±28	-	±3.2	±17	±3.9	-	±27

[@]: Not included in calculation of average % standard deviation

A: Counting Error is 20 - 50%

B: Counting Error is 51 - 100%

*: Not detectable

?: Suspect data

Table 5b (cont'd)

ACTIVITY CONCENTRATIONS IN SURFACE AIR DURING 1966

SITE: STERLING, VIRGINIA

Month	Total Gamma (Photons/m/10 ³ m ³)	dpm/10 ³ m ³ at mid month										
		<u>Mn-54</u>	<u>Fe-55</u>	<u>Sr-89</u>	<u>Sr-90</u>	<u>Zr-95</u>	<u>Cd-109</u>	<u>Cs-137</u>	<u>Ce-141</u>	<u>Ce-144</u>	<u>Pu-238</u>	<u>Pu-239</u>
Jan	31	71.5	82.5		9.11		*	14.0		18.1	*	.135
Feb	36	87.9	105		10.2		1.29	14.7		20.5	.0045B	.10
Mar	72	142	221		15.4		.94	26.6		27.4	.0058A	.291
Apr	43	80.2	110		11.7		.71A	14.6		16.6	*	.264
May	150		183	19.2	20A	27.4	.47A		30A	33.1	.0393	.383
June	330		221	54.9	22.4	71.2	*		88.5	41.2	.017A	.342
July	190		195	45.7	14.9	225?	1.61		90.0	25.3	.024	.217
Aug	96		106	6.69	7.47	5.67	.26B		28A	10.7	.037B	.101

A: Counting Error is 20-50%

B: Counting Error is 51-100%

?: Data Suspect

*: Not Detectable

Table 5b (cont'd)

ACTIVITY CONCENTRATIONS IN SURFACE AIR DURING 1966

SITE: ECHO OCEAN STATION

Month	Total Gamma (Photons/m/10 ³ m ³)	dpm/10 ³ m ³ at mid month										
		<u>Mn-54</u>	<u>Fe-55</u>	<u>Sr-89</u>	<u>Sr-90</u>	<u>Zr-95</u>	<u>Cd-109</u>	<u>Cs-137</u>	<u>Ce-141</u>	<u>Ce-144</u>	<u>Pu-238</u>	<u>Pu-239</u>
Feb	40	212	162		17.0		*	24.3		34.0	*	.139
Mar	56	182	254		17.6		.910	29.8		34.6	.0087A	.320
Apr	40	143	163		19.5		.027B?	22.7		30.2	.033A	.412
May	157		199	.66B?	22.2	38.0	.44A		27A	35.7	.0221	.398
June	49		67.8	15.9	5.3	20.8	.099A		38A	12.9	.0073	.052
Aug			51.9	5.89	5.04	3.29	*		72.4	7.16	.049A	.151

A: Counting Error is 20-50%

B: Counting Error is 51-100%

?: Data Suspect

*: Not Detectable

Table 5b (cont'd)

ACTIVITY CONCENTRATIONS IN SURFACE AIR DURING 1966

SITE: MIAMI, FLORIDA

Month	Total Gamma (Photons/m/10 ³ /m ³)	dpm/10 ³ m ³ at mid month										
		<u>Mn-54</u>	<u>Fe-55</u>	<u>Sr-89</u>	<u>Sr-90</u>	<u>Zr-95</u>	<u>Cd-109</u>	<u>Cs-137</u>	<u>Ce-141</u>	<u>Ce-144</u>	<u>Pu-238</u>	<u>Pu-239</u>
Jan	37	114	136		11.5		.53A	20.6		28.8	.011A	.258
Feb	55	128	117		10.9		*	18.7		27.3	*	*
Mar	94	222	291		18.6		.53A	37.7		44.0	.0138	.467?
Apr	98	227	239		26.6		.90A	36.2		41.5	.018A	.553
May	510		120	93.6	12.0	54.5?	.46A	222		45.6	.022A	.155
June	510.		87.0	86.3	10.4	109	.70A	138		34.9	.014A	.158
July	89		67.9	20.4	5.05	14.5?	*	52.5		11.4	.012A	.074A
Aug	81		1.3B?	9.90	0.89?	30.6	*	54A		6.55	*	.0168A

A: Counting Error is 20-50%

B: Counting Error is 51-100%

?: Data Suspect

*: Not Detectable

Table 5b (cont'd)

ACTIVITY CONCENTRATIONS IN SURFACE AIR DURING 1966

SITE: BIMINI, BAHAMAS

<u>Month</u>	Total Gamma (Photons/m/10 ³ m ³)	dpm/10 ³ m ³ at mid month								
		<u>Fe-55</u>	<u>Sr-89</u>	<u>Sr-90</u>	<u>Zr-95</u>	<u>Cd-109</u>	<u>Ce-141</u>	<u>Ce-144</u>	<u>Pu-238</u>	<u>Pu-239</u>
July	125	37.6?	21A	11.7	86.9	2.2A	74.5	19.4	.016A	.108
Aug	74	74.0	5.03	6.94	9.85	2.36	56A	10.5	.041A	.099

A: Counting Error is 20-50%

?: Data Suspect

Table 5b (cont'd)

ACTIVITY CONCENTRATIONS IN SURFACE AIR DURING 1966

SITE: MAUNA LOA, HAWAII

Month	Total Gamma (Photons/m/10 ³ m ³)	dpm/10 ³ m ³ at mid month										
		<u>Mn-54</u>	<u>Fe-55</u>	<u>Sr-89</u>	<u>Sr-90</u>	<u>Zr-95</u>	<u>Cd-109</u>	<u>Cs-137</u>	<u>Ce-141</u>	<u>Ce-144</u>	<u>Pu-238</u>	<u>Pu-239</u>
Jan	49	104	117		9.92		.29B	21.4?		25.0	.0042B	.174
Feb	46	90.0	136		10.4		.28B	13.7		21.6	.012A	.149
Mar	89	190	183		20.5		.860	32.2		35.1	.0104	.360
Apr	73	121	156		18.0		1.6A	24.1		25.3	.0326	.326
May	1300		129	66.9	17.4	49.7?	.94A		162	70.5	.015A	.273
June	1200		123	206	12.3	255	.17B		363	70.5	.013A	.238
July	190		96.6	24.7	8.44	30.9	*		78.6	16.6	.012A	.104
Aug	74		36.1	4.0	3.16	3.33	.60A		28.9	4.56	.034B	.068A

A: Counting Error is 20-50%
 B: Counting Error is 51-100%
 ?: Data Suspect
 *: Not Detectable

Table 5b (cont'd)

ACTIVITY CONCENTRATIONS IN SURFACE AIR DURING 1966

SITE: SAN JUAN, PUERTO RICO

Month	Total Gamma (Photons/m/10 ³ m ³)	dpm/10 ³ m ³ at mid month										
		<u>Mn-54</u>	<u>Fe-55</u>	<u>Sr-89</u>	<u>Sr-90</u>	<u>Zr-95</u>	<u>Cd-109</u>	<u>Cs-137</u>	<u>Ce-141</u>	<u>Ce-144</u>	<u>Pu-238</u>	<u>Pu-239</u>
Jan	19	43.8	51.3		5.09		.20B	8.86		10.5	.022B?	.088
Feb	51	106	119		11.5		*	18.2		23.5	.0073B	.220
Mar	49	161	214?		12.5		2.6A?	20.8		19.6	.0035B	.235
Apr	42	82.6	98.3		10.2		*	13.9		15.9	*	.208
May	190		98.6	36.3	10.2	81.2	.49A	105		21.9	.018A	.231
June	360		91.3	63.3	12.1	119	.19B	122		32.0	.0074A	.129
July	120		59.6	27.4	5.18	51.6	*	70.2		14.4	.0064A	.0702
Aug	68		61.7	*	4.87	6.25	.42B	*		8.05	.027A	.072

A: Counting Error is 20-50%
 B: Counting Error is 51-100%
 ?: Data Suspect
 *: Not Detectable

Table 5b (cont'd)

ACTIVITY CONCENTRATIONS IN SURFACE AIR DURING 1966

SITE: BALBOA, PANAMA CANAL ZONE

Month	Total Gamma (Photons/m/10 ³ m ³)	dpm/10 ³ m ³ at mid month										
		<u>Mn-54</u>	<u>Fe-55</u>	<u>Sr-89</u>	<u>Sr-90</u>	<u>Zr-95</u>	<u>Cd-109</u>	<u>Cs-137</u>	<u>Ce-141</u>	<u>Ce-144</u>	<u>Pu-238</u>	<u>Pu-239</u>
Jan	23	44.2	49.9		5.31		.15B	8.14		10.0	.0077A	.082
Feb	36	79.2	70.3		8.32		.65A	11.9		18.4	*	.083
Mar	47	113	126		9.67		.48A	14.9		15.7	.0033A	.159
Apr	40	61.0	75.8		7.57		*	11.5		14.2	*	.011A?
May	56		30.9	16.3?	2.55	13.6	.23B		27A	5.89	*	.0625
June	41		82.2?	8.2	0.60?	13.8	*		13.5	2.04	*	.0077A
July	28		20.4?	7.24	0.88	8.75	4.61?		15A	2.96	*	.024A
Aug	37		5.37	3.81	0.95	4.48	*		33	2.17	*	.033A?

A: Counting Error is 20-50%

B: Counting Error is 51-100%

?: Data Suspect

*: Not Detectable

Table 5b (cont'd)

ACTIVITY CONCENTRATIONS IN SURFACE AIR DURING 1966

SITE: GUAYAQUIL, ECUADOR

Month	Total Gamma (Photons/m/10 ³ m ³)	dpm/10 ³ m ³ at mid month										
		<u>Mn-54</u>	<u>Fe-55</u>	<u>Sr-89</u>	<u>Sr-90</u>	<u>Zr-95</u>	<u>Cd-109</u>	<u>Cs-137</u>	<u>Ce-141</u>	<u>Ce-144</u>	<u>Pu-238</u>	<u>Pu-239</u>
Jan	7.0	16A	11A		1.69		*	3.10		3.08	*	.021A
Feb	15	20A	21.4		2.02		*	3.14		3.71	*	.044
Mar	11	32A ?	15B?		1.11		1.3A ?	2.34		1.86	.0028A	.0270?
Apr	12	14B	28A?		1.04		*	1.77		1.66	*	.0275
May	11		*	*	.965	*	*		*	1.40	.0029B	.0150
June	16		13A	2.46	1.28	8.8A	*		12A?	3.32	.015A	.015A
July	1600		24A	190	2.11	34.9?	0.54A		488	36.1	*	.273
Aug	130		38.1	4.92	3.05	4.61	0.31B		15A	5.75	.018A	.043

A: Counting Error is 20-50%

B: Counting Error is 51-100%

?: Data Suspect

*: Not Detectable

Table 5b (cont'd)

ACTIVITY CONCENTRATIONS IN SURFACE AIR DURING 1966

SITE. LIMA, PERU

Month	Total Gamma (Photons/m/10 ³ m ³)	dpm/10 ³ m ³ at mid month										
		Mn-54	Fe-55	Sr-89	Sr-90	Zr-95	Cd-109	Cs-137	Ce-141	Ce-144	Pu-238	Pu-239
Jan	29	42.7	50A		6.94		.80A	11.3		11.7	.0007B	.063
Feb	40	62.5	48.4		6.34		*	10.1		11.3	*	.142
Mar	27	39.8	55.2		4.24		1.81	6.15		6.95	.085	.011A
Apr	26	12B?	31A		3.29		*	4.44		4.52	.0045A	.175?
May	23		29.2	.52A	2.31	5.1A	.37A		2.7A	3.13	.015A	.049
June	3.0		27.3	4.89	2.22	5.4	*		14.1	5.25	.012A	.0297
July	18000		61.7	450	6.0	654	*		1058	94.4	.046A	.404
Aug	420		51A	37.8	4.26	131	*		131	20.1	.048A	.052

A: Counting Error is 20-50%

B: Counting Error is 51-100%

?: Data Suspect

*: Not Detectable

Table 5b (cont'd)

ACTIVITY CONCENTRATIONS IN SURFACE AIR DURING 1966

SITE: CHACALTAYA, BOLIVIA

Month	Total Gamma (Photons/m/10 ³ m ³)	dpm/10 ³ m ³ at mid month										
		Mn-54	Fe-55	Sr-89	Sr-90	Zr-95	Cd-109	Cs-137	Ce-141	Ce-144	Pu-238	Pu-239
Jan	12	13A	14.6		1.64		.21B	4.12?		2.85	.0027B	.029
Feb	8	*	12.1		0.94		*	1.54		2.37	*	.038A
Mar	18	24A	15.5		1.54		.34B	2.26		2.23	.0022B	.0303
Apr	19	22B	11A		1.13		1.2A ?	2.04		2.09	.030A	.0595?
May	16		11.8	*	1.42	1.8A	*	*	6.18	1.95	.014A	.0167
June	63		26.1	17.0	2.71	23.5	*	*	39.6	8.34	.0450	.0428
July	14000		31?	847	6.62	2070	.39A		3300	295	.069	.313
Aug	2100		36.2	117	2.89	283	.30B		320A	53.0	.050A	.134A

A: Counting Error is 20-50%

B: Counting Error is 51-100%

?: Data Suspect

*: Not Detectable

Table 7 (cont'd.)
ACTIVITY CONCENTRATION IN LARVAE OF *POGONIA*

STATION: 14-04-52A, CHL

Month	Total Gamma Photons, $m^2/10^3, hr^2$	dpm/ $10^3 m^2$ at mid month										
		Mn-54	Fe-57	Co-58	Sr-90	Pr-147	Cd-109	Cs-137	Se-75	Ce-144	La-140	
Jan	23	41.8	30.5		6.10		.67A	7.2		10.4	.0024B	.099
Feb	26	44.6	44.5		5.05		.32B	8.0		8.66	.0089B	.085
Mar	22	28.5	35.0		2.98		1.1A	16.3		4.52	.0038	.0477
Apr	16	33.1	40.9		2.73		1.0A	4.77		4.12	.0142	.069?
May	20		24.0	*	2.26	1.1B	*		*	3.14	.013A	.0459
June	22		24A		2.49		*			5.71	.021A	.050
July	10,000		52.0	230	5.08	514	.42A		750	84.0	.182	.420
Aug	590		86?	37.9	3.73	90.6	*		180A?	14.1	.050A	.089

A: Counting Error is 20-50%
 B: Counting Error is 51-100%
 ?: Data Suspect
 *: Not Detectable

Table 5b (cont'd)

ACTIVITY CONCENTRATIONS IN SURFACE AIR DURING 1966

SITE: PORTILLO, CHILE

Month	Total Gamma (Photons/m/10 ³ m ³)	dpm/10 ³ m ³ at mid month								
		Fe-55	Sr-89	Sr-90	Zr-95	Cd-109	Ce-141	Ce-144	Pu-238	Pu-239
May	88	95.5?	5.12	4.95	28.0	.98B	18A	10.3	.063A	.0815
June	48	127?	*	3.07	17.6	*	11.1	7.38	.0495	.0620
July	18000	185?	4050	77A	8620	.85A	9320	1250	.387	3.03
Aug	540	133	79.5	15.1	224	1.5A	67B?	59.3	.23A?	.031A

A: Counting Error is 20-50%

B: Counting Error is 51-100%

?: Data Suspect

*: Not Detectable

Table 5b (cont'd)

ACTIVITY CONCENTRATIONS IN SURFACE AIR DURING 1966

SITE: SANTIAGO, CHILE

Month	Total Gamma (Photons/m/10 ³ m ³)	dpm/10 ³ m ³ at mid month										
		Mn-54	Fe-55	Sr-89	Sr-90	Zr-95	Cd-109	Cs-137	Ce-141	Ce-144	Pu-238	Pu-239
Jan	31	49.1	66.1		7.05		*	15.5?		10.8	.013A?	.059
Feb	40	54.8	118		8.53		*	14.4		12.0	.0040B	.0846
Mar	31	33A	105?		4.39		2.1A	7.57		6.93	.0095A	.0680
Apr	26	*	83A?		3.72		*	4.98		4.68	.0082B	.0780
May	38		*	*	2.57	*	.17B		*	3.5		
June	19		16A	*	2.02		1.3A?		3.05	3.07	.0360	.0439
July	2700		54A	195	5.18	349	.32B		505	580?	.0214	.120
Aug.	460		30B	34.7	4.17	133	.31B		172	25.5	.0131	.093

A: Counting Error is 20-50%

B: Counting Error is 51-100%

?: Data Suspect

*: Not Detectable

Table 5b (cont'd)

ACTIVITY CONCENTRATIONS IN SURFACE AIR DURING 1966

SITE: PUERTO MONTT, CHILE

Month	Total Gamma (Photons/m/10 ³ m ³)	dpm/10 ³ m ³ at mid-month										
		Mn-54	Fe-55	Sr-89	Sr-90	Zr-95	Cd-109	Cs-137	Ce-141	Ce-144	Pu-238	Pu-239
Jan	18	29.6	37.6		4.22		.55A	8.51		7.58	.0041A	.0665
Feb	23	39.3	46.0		4.85		.37A	7.0		8.22	.009B	.112
Mar	15	32A	47.5?		2.89		.32A	4.62		4.94	*	.050
Apr	20	44.0	41A		2.67		.33B	3.89		7.12	.022A	.0615?
May	9.8		16.5	*	1.6	*	.19B		*	2.39	.0064A	.0267
June	8.6		10.6	*	1.4A	*	*		*	3.3	.0243	.0359
July	33		19.7	1.8	1.31	40?	*		10.6	2.67	.016B	.046A
Aug	95		36.2	20.1	2.93	49.7	.41B		134	10.6	.11A?	.087

A: Counting Error is 20 - 50%

B: Counting Error is 51 - 100%

?: Data Suspect

*: Not Detectable

Table 5b (cont'd)
ACTIVITY CONCENTRATIONS IN SURFACE AIR DURING 1966

SITE: PUNTA ARENAS, CHILE

Month	Total Gamma (Photons/m/10 ³ m ³)	dpm/10 ³ m ³ at mid month										
		Mn-54	Fe-55	Sr-89	Sr-90	Zr-95	Cd-109	Cs-137	Ce-141	Ce-144	Pu-238	Pu-239
Jan	13	25.8	*		2.41		*	4.92		4.33	*	.044A
Feb	13	15A	46.7?		2.33		*	3.50		3.89	*	.0410
Mar	14	32A	44?		2.79		.71A	4.58		4.0	.0005A	.0461
Apr	19	20A	23B		1.65		.27B	2.77		2.55	.016A	.0411?
May	6.6		7.7A	.69	1.17	*	.39B		*	1.66	.0046B	.0205
June	6.5		11.1	*	1.17	*	*		3.4A	1.42	.016A	.0203
July	19		15.5	.97	1.39	5.8	1.46?		9.50	2.1	*	.0296
Aug	25		16.6	3.45	1.58	9.05	*		24.5	2.87	.028B	.075A?

A: Counting Error is 20 - 50%
B: Counting Error is 51 - 100%
?: Data Suspect
*: Not Detectable

Table 5c

ANALYSES OF CODED BLANK AND STANDARD SAMPLES

Report Date	Sample No.		dpm with percent deviation of found from added values								
			Mn-54	Fe-55	Sr-90	Cd-109	Cs-137	Ce-144	Pu-238	Pu-239	
1/15/66	E3958	Added	58600	0	0	0	854	668	0	0	
		Found	58500	*	1.61A	*	1000	619	*	0.04B	
		% Deviation	-0.2				+17	-7.3			
	E3962	Added	0	10800	235	454	0	0	0	17.8	
		Found	*	8580	230	32.9?	*	*	0.21B	15.2	
		% Deviation		-21	-2.1					-15	
	E3970	Added	37500	0	0	0	653	481	0	0	
		Found	36200	93B	0.41	31.9A	537	586	*	0.09B	
		% Deviation	-3.5				-18	+22			
	E3974	Added	0	9230	245	343	0	0	0	16.4	
		Found	575A	7990	239	250	2.27A	*	0.25A	16.2	
		% Deviation		-13	-2.4	-27				-1.2	
2/15/66	E4042	Added	24400	0	0	0	488	483	0	0	
		Found	26400	94A	2.0B	*	463	467	*	0.38A	
		% Deviation	+8.2				-5.1	-3.3			
	E4046	Added	0	6970	277	567	0	0	0	19.0	
		Found	300B	550	249	161	0.63B	1.2A	0.36A	17A	
		% Deviation		-21	-10	-72				-13	
	E4054	Added	25700	0	0	0	687	506	0	0	
		Found	28700	*	*	41.4	722	713	*	0.23A	
		% Deviation	+12				+5.1	+41			
	E4058	Added	0	5930	164	583	0	0	0	8.84	
		Found	*	5040	147	*?	3.32	1.39	0.088B	1.85	
		% Deviation		-15	-10					-79	
3/15/66	E4078	Added	27100	9490	354	471	399	403	0	13.2	
		Found	8610	8980	372	465	281	326	*	12.6	
		% Deviation	-68	-5.4	+5.1	-1.2	-29	-19		-4.6	
	E4082	Added	0	9100	157	537	0	0	0	9.8	
		Found	475	10700	145	563	4.45	*	*	8.32	
		% Deviation		+18	-7.8	+4.8				-15	
	E4090	Added	28000	0	0	0	406	439	0	0	
		Found	32900	120B	0.208	*	251	406	*	0.33A	
		% Deviation	+18				-38	-7.5			
	4/15/66	E4133	Added	38700	6340	197	592	49.4	429	0	14.6
			Found	38400	6760	170	446	33.6	374	*	17.5
			% Deviation	-0.8	+6.6	-14	-25	-32	-13		+ 20
E4137		Added	0	6950	266	560	0	0	0	17.4	
		Found	*	6860	141	281	3.3	3.0	*	19.3	
		% Deviation		-1.3	-47	-50				+11	
E4145		Added	23100	0	0	0	46.7	585	0	0	
		Found	22000	207	0.59A	*	23.7	503	0.33A	*	
		% Deviation	-4.8				-49	-14			

*: Not detectable

A: Counting Error is 20 - 50%

B: Counting error is 51 - 100%

Table 5c (cont'd)
ANALYSES OF CODED BLANK AND STANDARD SAMPLES

Report Date	Sample No.	dpm with percent deviation of found from added values										
		Mn-54	Fe-55	Sr-89	Sr-90	Zr-95	Cd-109	Cs-137	Ce-141	Ce-144	Pu-238	Pu-239
5/15/66	E4254 Added		8840	0	169	0	440		0	0	0	22.1
	Found		7040	*	163	11.8B	424		*	*	0.30A	25.8
	% Deviation		-20		-3.6		-3.6					+17
	E4258 Added		5350	0	182	0	540		0	341	0	8.26
	Found		4880	23.5A	173	20.7B	536		*	344	0.50A	8.57
	% Deviation		-8.9		-4.9		-0.6			+0.9		+3.8
	E4266 Added		0	0	0	0	0		0	335	0	0
	Found		*	*	*	*	*		*	329	0.02A	0.05B
	% Deviation									-1.8		
	6/15/66 E4513 Added		4630	450	50.3	1590	677		760	564	0	2.74
	Found		1070A?	346	56.2	2030	469A		718	533	0.17B	2.91
	% Deviation			-23	+12	+28	-31		-5.5	-5.5		+6.2
	E4517 Added		0	0	0	1810	0		487	560	0	0
	Found		104A	*	*	2000	*		510A	480	*	*
	% Deviation					+10			+4.3	-14		
	E4525 Added		9980	476	47.6	0	682		0	0	0	2.89
	Found		6220	412	47.9	*	664		56A	4.0A	*	3.01
	% Deviation		-38	-13	+0.6		-2.6					+4.2

*: Not detectable

A: Counting Error is 20 - 50%

B: Counting Error is 51 - 100%

Table 5c (Cont'd)

ANALYSES OF CODED BLANK AND STANDARD SAMPLES

Report Date	Sample No.		Mn-54	Fe-55	Sr-89	Sr-90	Zr-95	Cd-109	Cs-137	Ce-141	Ce-144	Pu-238	Pu-239
7/15/66	E4883	Added		10700	368	48.3	1170	693		301	455	0	2.62
		Found		15800	355	39.4	1540	530		*?	542	*	0.72A
		% Deviation		+48	-3.5	-18	+32	-24			+19		-72
	E4887	Added		0	0	0	0	795		0	0	0	2.31
		Found		140A	*	*	310	569		100A	3.74	0.27B	2.66
		% Deviation						-28					+15
	E4895	Added		10100	324	51.0	1230	0		272	409	0	0
		Found		9580	181	52.9	1390	*		350B	491	0.13B	0.97A
		% Deviation		-5.1	-44	+3.7	+13			+28	+20		
8/15/66	E5224	Added		5510	178	48.3	628	751		131	316	4.02	4.34
		Found		5370	82A	53.3	800	615		*	237	2.6A	7.38
		% Deviation		-2.5	-54	+10	+27	-18			-25	-36	+70
	E5228	Added		0	0	0	833	0		135	455	0	0
		Found		*	*	*	1090	14B		1180A?	356	*	*
		% Deviation					+31				-22		
	E5236	Added		6780	176	52.4	0	975		0	0	6.42	3.21
		Found		7180	160	52.1	102	777		*	*	5.8	1.9A
		% Deviation		+5.9	-10	-0.57		-20				-11	-41
Average % Deviation			-4.9	-4.8	-19	-5.6	+24	-22	-19		-1.8	-11	+2.5

@: Not included in calculation of average % deviation

A: Counting Error is 20 - 50%

B: Counting Error is 51 - 100%

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 data are sent to the editors for dissemination in these HASL quarterly reports. Some of these data are sent to the editors as received and no interpretation by HASL is attempted.

	<u>Page</u>
1. Isotopes, Inc., Westwood, N. J. The Eighteenth Progress Report on Project Stardust: "Flight Data and Results of Radiochemical Analyses of Filter Samples Collected During October-December 1966" work performed under contract to the Defense Atomic Support Agency.	III-2
2. Global Atmospheric Radioactivity, November 1963, May 1964, November 1964, May 1965 August 1965 and November 1965	III-30
3. EURATOM Joint Nuclear Research Centre - Ispra Establishment: Protection Service Site Survey and Meteorology Section Quarterly Report	III-48
4. Division of Biological and Medical Research Argonne National Laboratory "Cs-137 in Various Chicago Foods (Collection Month April, 1967)" by S. S. Brar and D. M. Nelson	III-56
5. National Radiation Laboratory, Department of Health, Christchurch, New Zealand Environmental Radioactivity in New Zealand a. Quarterly report for October-December 1966 and Annual Summary: NRL F23	III-61

1.

The Eighteenth Progress Report on
Project Stardust

FLIGHT DATA AND RESULTS OF
RADIOCHEMICAL ANALYSES OF FILTER
SAMPLES COLLECTED DURING OCTOBER-DECEMBER 1966

By

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A report on work performed under Contract DA-49-146-XZ-079
prepared for the Defense Atomic Support Agency
Washington, D. C. 20301

April 30, 1967

ISOTOPES, INC.
123 Woodland Ave.
Westwood, New Jersey

The following data and explanatory material, have been cleared
by the Department of Defense for open publication.

This is the eighth of a series of reports of flight data and of results of radiochemical analyses of stratospheric and tropospheric air filter samples collected during Project Stardust. The previous reports have been published by the U. S. Atomic Energy Commission Health and Safety Laboratory. The periods during which the samples were collected and the reports containing the data are as follows:

June 1961 - December 1962	HASL 153
January - December 1963	HASL 168
January - December 1964	HASL 169
January - December 1965	HASL 176
January - March 1966	HASL 173, pp III-2 to III-25
April - June 1966	HASL 174, pp III-2 to III-27
July - September 1966	HASL 181, pp III-2 to III-23

The present report contains data for all air filter samples collected during October to December 1966 for Project Stardust.

The Stardust Sampling and Analytical Program

Since early 1965 the General Dynamics RB-57F aircraft has been the primary sampling vehicle used during Project Stardust. To obtain maximum performance from this aircraft, it has been employed primarily at altitudes of about fifteen kilometers and higher. Other aircraft, including the RB-57C, the C-135, and the WC-130, have been employed for sampling the troposphere and the lower regions of the polar stratosphere. The 58th Reconnaissance Squadron of the 9th Weather Reconnaissance Wing (MAC) of the U. S. Air Force has had prime responsibility for the collection of samples.

Stratospheric sampling was begun in Project Stardust in June 1961. By January 1966 the regular sampling corridor extended from 75°N, 143°W to 55°S, 68°W. Between 75°N or 65°N and 31°N sampling missions have been flown at 39, 43, 50, 55, 60, and about 65 thousand feet (at about 12, 13, 15, 17, 18 and 20 kilometers). Between 31°N and 55°S they have been flown only at 50, 55, 60, and about 65 thousand feet. A number of samples were collected at 24 to 31 thousand feet (at about 7.3 to 9.4 kilometers) during November and December 1966 by aircraft deploying personnel from Kirtland AFB to Mendoza, Argentina.

The program of radiochemical analysis of filter samples has evolved into a system which now consists of three basic groups. Samples included in the first of these, designated the "SI" group, are analyzed for fission products, such as strontium-90, strontium-89 and barium-140. The long-lived, potentially hazardous nuclide, plutonium-239, and the tracer nuclide, plutonium-238, injected into the atmosphere in April 1964 by burn-up of a SNAP-9A power source, are measured in the second group, the "SQ" samples. Cadmium-109, which was produced by a high altitude event in the 1962 series of nuclear weapon tests performed at Johnston Island and Christmas Island, is measured in the third group, the "SX" samples, together with plutonium-238 and plutonium-239. Strontium-90 and sometimes strontium-89 are also measured in the "SQ" and "SX" samples.

Flight Data for Air Filter Samples

Flight data for all usable air filter samples collected for Project Stardust during the interval October to December 1966 are listed in Table 1. The data reported include an identification of the sampling vehicle, the date, time, latitude, longitude and altitude of sample collection, the volume of air sampled, the total beta activity of the filter sample and the identification of

the samples for radiochemical analysis in which the filter was included.

The data in Table 1 have been arranged chronologically according to sampling date. The sampling date, the aircraft type, and when known, the serial number of the aircraft are listed above the data for samples collected by that aircraft. Aircraft used during 1966 have included the RB-57F, the RB-57C, the C-135, and the WC-130B. The first column of the table contains the filter sample numbers which were assigned to the filters upon their receipt at Isotopes, Inc. A letter designating the filter type has been added to each filter sample number.

The following filter types are distinguished:

<u>Filter Designation</u>	<u>Aircraft Type</u>	<u>Sampler Type</u>	<u>Exposed ² Area (cm²)</u>
U	RB-57F, C-135, WC 130	U-1	1288
F	RB-57C	F-57	1626

The times at which the collection of each filter sample was begun and completed are given in the second column of Table 1. Greenwich mean time is used, and the day, hour and minute are included in each time listing.

The latitudes, longitudes and altitudes at which sampling was begun and completed are given for each filter in the third, fourth, and fifth columns. Degrees and minutes are listed for each latitude and longitude. Only one longitude is given for filters collected along a north-south oriented flight track. Only a single altitude is given, since the sampling vehicle is generally kept at one altitude during the collection of each filter. On normal Stardust missions it is only when the vehicle is attempting to attain its maximum altitude that a change in altitude during filter collection is deliberately planned. The mean altitude is given for such samples. Generally, the reported altitudes should be accurate to within about 0.3 kilometer.

The volume of air sampled by each filter, in hundreds of cubic meters at standard temperature and pressure, is given in the sixth column of Table 1, and the total beta activity of each, in picocuries per standard cubic meter, is given in the seventh column. The quantity of air sampled per unit time by a filter depends mainly on the sampler design, the altitude of collection, and the aircraft speed, but also to a lesser extent upon the ambient temperature. The total beta activities are measured using a disk of approximately one inch diameter cut from each filter.

In the eighth column of Table 1 the samples which have been prepared for radiochemical analysis are listed. The aliquot of the filter included within each sample is given in parentheses following the sample number.

Results of Radiochemical Analyses

The results of radiochemical analyses of Stardust filter samples collected during October to December 1966 are summarized in Tables 2 and 3. The nuclides listed in Table 2 are the fission product strontium-90, the activation product, cadmium-109, the nuclear weapon component, plutonium-239, and the tracer for April 1964 SNAP-9A power source burn-up, plutonium-238.

The nuclides listed in Table 3 are the fission products strontium-90, strontium-89, zirconium-95, cesium-137, barium-140, cerium-141 and cerium-144. All samples are listed in Table 3.

In Tables 2 and 3 the samples are arranged chronologically according to sample collection date. The latitude and longitude ranges over which the samples were collected and the mean altitudes of collection are listed. The volume of air (in units of one hundred cubic meters, STP) represented by the sample and the total beta activity (in picocuries per cubic meter, STP) are

given. These two parameters have been calculated from the volumes and total beta activities of the filters which constitute the sample.

The activities of the various radionuclides are given in units of picocuries per 100 cubic meters, STP. Each nuclide activity reported has a letter following it to indicate the potential error in the measurement, based on counting statistics. The errors indicated by the various letters are:

A: $\leq 5\%$	D: 20-50%
B: 5-10%	E: 50-100%
C: 10-20%	F: $> 100\%$

When activities were below the limit of detection, the activity corresponding to that lower limit is given, preceded by an "I". Results which are considered to be of questionable validity are included in the table but are preceded by a "Q".

The nuclide activities, with the exception of cadmium-109 activities, are corrected for decay to 12:00Z on collection date. The cadmium-109 activities are corrected for decay to 9 July 1962. The plutonium-239 activities which are given in Table 2 actually represent the sum of the activities of plutonium-239 and plutonium-240, which are not distinguished by the alpha spectrometer used to count the samples.

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TABLE 1 FLIGHT DATA FOR STARDUST FILTERS COLLECTED DURING 1966

FILTER NUMBER	TIME (Z)	LATITUDE	LONGITUDE	ALTITUDE (M)	VOLUME (100 CM)	BETA (PC/CM)	SAMPLES AND ALIQUOTS
09 OCT 1966	AIRCRAFT = RB-57F	A/C 292					
22661U	091419/091459	34-40 /39-00S	69-25 / 69-15W	15.2	8.4	18.5	SQ-8126(1/4)
22662U	091459/091535	39-00 /43-00S	69-15 / 69-00W	15.2	7.0	22.4	SQ-8126(1/4)
22663U	091535/091610	43-00 /47-00S	69-00 / 67-55W	15.2	6.9	16.4	SQ-8126(1/4)
22664U	091610/091642	47-00 /50-30S	67-55 / 67-50W	15.2	6.2	24.3	SQ-8126(1/4)
22665U	091642/091713	50-30 /53-45S	67-50 / 67-45W	15.2	6.1	11.4	SQ-8126(1/4)
22666U	091720/091752	53-45 /50-00S	67-45 / 67-50W	16.8	4.6	23.1	SQ-8127(1/4)
22667U	091752/091823	50-00 /46-00S	67-50 / 69-00W	16.8	4.5	18.3	SQ-8127(1/4)
22668U	091823/091857	46-00 /42-00S	69-00 / 68-10W	16.8	4.9	18.3	SQ-8127(1/4)
22669U	091857/091933	42-00 /38-00S	68-10 / 69-15W	16.8	5.2	18.7	SQ-8127(1/4)
22670U	091933/092016	38-00 /33-00S	69-15 / 69-50W	16.8	6.1	21.4	SQ-8127(1/4)
09 OCT 1966	AIRCRAFT = RB-57F	A/C 297					
22673U	091539/091621	36-00 /41-00S	69-20 / 69-10W	18.3	4.4	22.2	SQ-8128(2/4)
22674U	091621/091655	41-00 /45-00S	69-10 / 69-00W	18.3	3.6	24.6	SQ-8128(2/4)
22675U	091655/091725	45-00 /49-00S	69-00 / 67-50W	18.3	3.2	2.8	SQ-8128(2/4)
22676U	091725/091740	49-00 /50-50S	67-50 / 67-45W	18.3	1.6	14.4	SQ-8128(2/4)
22677U	091740/091756	50-50 /49-00S	67-45 / 67-50W	19.1	1.4	22.2	SQ-8129(2/4)
22678U	091756/091820	49-00 /46-00S	67-50 / 68-00W	19.2	2.1	23.8	SQ-8129(2/4)
22679U	091820/091852	46-00 /42-00S	69-00 / 69-10W	19.3	2.8	27.9	SQ-8129(2/4)
22680U	091852/091924	42-00 /38-00S	69-10 / 69-15W	19.3	2.7	20.9	SQ-8129(2/4)
22681U	091924/091943	38-00 /33-00S	69-15 / 69-50W	19.4	1.6	19.4	SQ-8129(2/4)
10 OCT 1966	AIRCRAFT = RB-57F	A/C 291					
22577U	101733/101800	35-00 /32-30N	103-30 /101-00W	18.3	3.1	21.1	SQ-8102(2/4)
22578U	101800/101825	32-30 /30-00N	101-00 / 99-00W	18.3	2.9	19.0	SQ-8102(2/4)
22579U	101825/101900	30-00 /26-30N	99-00 / 97-30W	18.3	4.1	20.0	SQ-8102(2/4)
22580U	101900/101930	26-30 /23-00N	97-30 / 99-00W	18.3	3.5	22.7	SQ-8102(2/4)
22581U	102000/102040	23-00 /26-30N	98-00 / 97-30W	19.5	3.5	26.0	SQ-8103(2/4)
22582U	102040/102115	26-30 /30-00N	97-30 / 99-00W	19.7	3.0	21.8	SQ-8103(2/4)
22583U	102115/102145	30-00 /32-30N	99-00 /101-00W	19.9	2.4	23.0	SQ-8103(2/4)
22584U	102145/102220	32-30 /35-00N	101-00 /105-00W	20.1	2.6	34.5	SQ-8103(2/4)
10 OCT 1966	AIRCRAFT = RB-57F	A/C 294					
22553U	101434/101505	07-20 /04-00N	79-50 / 80-30W	15.2	7.2	500.	SF-8097(2/4), SF-8092(1/4)
22554U	101505/101541	04-00 /00-00N	80-30 / 81-10W	15.2	8.4	2.44	SF-8097(2/4)
22555U	101541/101618	00-00 /04-00S	81-10 / 81-50W	15.2	8.7	2.51	SF-8097(2/4)
22556U	101618/101658	04-00 /08-00S	81-50 / 80-00W	15.2	9.2	29.1	SF-8093(2/4)
22557U	101658/101720	08-00 /10-00S	80-00 / 79-30W	15.2	5.1	282.	SF-8093(2/4)
22558U	101720/101750	10-00 /07-00S	79-30 / 80-40W	19.5	2.5	16.4	SQ-8098(2/4)
22559U	101750/101831	07-00 /03-00S	80-40 / 81-40W	20.0	3.1	17.4	SQ-8098(2/4)
22560U	101831/101905	03-00S/01-00N	81-40 / 81-00W	20.1	2.4	21.4	SQ-8098(2/4)
22561U	101905/101933	01-00 /05-00N	81-00 / 80-20W	20.3	2.0	19.2	SQ-8098(2/4)
22562U	101933/102010	05-00 /09-00N	80-20 / 79-30W	20.4	2.5	37.4	SQ-8098(2/4)

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TABLE 1 FLIGHT DATA FOR STARDUST FILTERS COLLECTED DURING 1966

FILTER NUMBER	TIME (Z)	LATITUDE	LONGITUDE	ALTITUDE (KM)	VOLUME (100 SCM)	BETA (PC/SCM)	SAMPLES AND ALIQUOTS
10 OCT 1966	AIRCRAFT =	RB-57F	A/C 297				
22684U	101416/101500	31-40 /27-10S	68-30 / 70-57W	15.2	8.6	190.	SF-8121(2/4), SF-8125(1/4)
22685U	101500/101543	27-10 /23-00S	70-57 / 73-00W	15.2	8.7	600.	SF-8121(2/4), SF-8124(1/4)
22686U	101543/101629	23-00 /18-21S	73-00 / 75-10W	15.2	9.2	780.	SF-8121(2/4), SF-8123(1/4)
22687U	101629/101710	18-21 /14-00S	75-10 / 77-00W	15.2	8.1	690.	SF-8121(2/4), SF-8122(1/4)
22688U	101710/101725	14-00S	77-00W	17.2	2.0	34.6	
22689U	101725/101802	14-00 /18-21S	77-00 / 75-10W	19.3	3.2	18.0	SQ-8131(2/4)
22690U	101802/101849	18-21 /23-00S	75-10 / 73-00W	19.5	3.9	22.4	SQ-8131(2/4)
22691U	101849/101925	23-00 /27-10S	73-00 / 70-57W	19.5	3.0	21.4	SQ-8131(2/4)
22692U	101925/102013	27-10 /31-40S	70-57 / 68-30W	19.5	4.1	20.3	SQ-8131(2/4)
11 OCT 1966	AIRCRAFT =	RB-57F	A/C 299				
22589U	111730/111807	36-45 /41-00N	108-05 /108-00W	18.3	4.2	21.4	SQ-8104(2/4)
22590U	111807/111832	41-00 /44-00N	108-00 /107-55W	18.3	2.8	28.4	SQ-8104(2/4)
22591U	111832/111857	44-00 /47-00N	107-55 /107-50W	18.3	2.8	24.7	SQ-8104(2/4)
22592U	111857/111923	47-00 /50-00N	107-50 /107-40W	18.3	2.9	22.9	SQ-8104(2/4)
22593U	111940/112006	50-00 /47-00N	107-40 /107-50W	19.1	2.5	22.0	SQ-8105(2/4)
22594U	112006/112032	47-00 /44-00N	107-50 /107-55W	19.6	2.2	21.0	SQ-8105(2/4)
22595U	112032/112059	44-00 /41-00N	107-55 /108-00W	19.8	2.2	23.9	SQ-8105(2/4)
22596U	112059/112135	41-00 /36-45N	108-00 /108-05W	19.9	2.8	27.5	SQ-8105(2/4)
11 OCT 1966	AIRCRAFT =	RB-57F	A/C 297				
22565U	111520/111601	31-00 /27-00S	68-50 / 71-00W	18.3	4.6	93.1	SF-8094(2/4)
22566U	111601/111640	27-00 /23-00S	71-00 / 73-20W	18.3	4.7	12.3	SQ-8099(2/4)
22567U	111640/111720	23-00 /19-00S	73-20 / 75-20W	18.3	4.7	18.3	SQ-8099(2/4)
22568U	111720/111800	19-00 /15-00S	75-20 / 77-20W	18.3	4.8	18.2	SQ-8099(2/4)
22569U	111800/111838	15-00 /11-00S	77-20 / 79-15W	18.3	4.6	13.4	SQ-8099(2/4)
22570U	111838/111918	11-00 /07-00S	79-15 / 81-10W	18.3	4.8	17.1	SQ-8101(2/4)
22571U	111918/111955	07-00 /03-00S	81-10 / 81-40W	18.3	4.2	16.5	SQ-8101(2/4)
22572U	111955/112032	03-00S/01-00N	81-40 / 80-55W	18.3	4.3	18.8	SQ-8101(2/4)
22573U	112032/112116	01-00 /06-00N	80-55 / 80-05W	18.3	5.2	16.5	SQ-8101(2/4)
22574U	112116/112142	06-00 /08-50N	80-05 / 79-35W	18.3	3.0	11.5	SQ-8101(2/4)
12 OCT 1966	AIRCRAFT =	RB-57F	A/C 299				
22699U	121735/121812	36-45 /41-00N	108-05 /108-00W	15.2	7.3	11.1	SQ-8106(2/4)
22600U	121812/121837	41-00 /44-00N	108-00 /107-55W	15.2	4.9	6.87	SQ-8106(2/4)
22601U	121837/121900	44-00 /47-00N	107-55 /107-50W	15.2	4.3	11.6	SQ-8106(2/4)
22602U	121900/121928	47-00 /50-00N	107-50 /107-45W	15.2	5.3	17.7	SQ-8106(2/4)
22603U	121947/122015	50-00 /47-00N	107-45 /107-50W	16.8	4.0	20.2	SQ-8107(2/4)
22604U	122015/122040	47-00 /44-00N	107-50 /107-55W	16.8	3.5	18.0	SQ-8107(2/4)
22605U	122040/122112	44-00 /41-00N	107-55 /108-00W	16.8	4.9	16.5	SQ-8107(2/4)
22606U	122112/122152	41-00 /36-45N	108-00 /108-05W	16.8	6.3	15.9	SQ-8107(2/4)

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FILTER NUMBER	TIME (Z)	LATITUDE	LONGITUDE	ALTITUDE (KM)	VOLUME (100 SCM)	BETA (PC/SCM)	SAMPLES AND ALIQUOTS
13 OCT 1966	AIRCRAFT = RB-57F A/C 294						
22609U	131535/131603	08-45 /12-12N	79-35 / 81-37W	15.2	6.2	5.79	SQ-8109(2/4)
22610U	131603/131646	12-12 /16-00N	81-30 / 83-15W	15.2	9.3	1.24	SQ-8109(2/4)
22611U	131646/131724	16-00 /19-20N	83-15 / 85-25W	15.2	8.1	1.09	SQ-8109(2/4)
22612U	131724/131808	19-20 /23-00N	85-25 / 88-10W	15.2	9.4	0.42	SQ-8109(2/4)
22613U	131808/131853	23-00 /26-20N	88-10 / 91-45W	15.2	9.5	0.41	SQ-8109(2/4)
22614U	131853/131940	26-20 /29-45N	91-45 / 95-35W	15.2	9.8	0.24	SQ-8109(2/4)
13 OCT 1966	AIRCRAFT = RB-57F A/C 297						
22617U	131310/131349	09-25 /13-00N	79-50 / 81-50W	16.8	6.4	5.91	SQ-8111(2/4)
22618U	131349/131428	13-00 /17-00N	81-50 / 83-45W	16.8	8.3	3.71	SQ-8111(2/4)
22619U	131428/131513	17-00 /21-00N	83-45 / 86-30W	16.8	7.7	3.33	SQ-8111(2/4)
22620U	131513/131601	21-00 /25-00N	86-30 / 90-35W	16.8	8.2	1.56	SQ-8111(2/4)
22621U	131601/131640	25-00 /28-00N	90-05 / 93-50W	16.8	6.5	2.17	SQ-8109(2/4)
22622U	131640/131718	28-00 /31-00N	93-50 / 97-10W	16.8	6.5	5.52	SQ-8109(2/4)
22623U	131718/131751	31-00 /34-00N	97-10 /101-15W	16.8	5.3	1.21	SQ-8109(2/4)
22624U	131751/131833	34-00 /36-30N	101-15 /104-57W	16.8	6.6	7.00	SQ-8109(2/4)
13 OCT 1966	AIRCRAFT = RB-57F A/C 290						
22627U	131846/131915	09-20 /12-12N	79-50 / 81-30W	18.3	3.3	21.4	SQ-8113(2/4)
22628U	131915/131950	12-12 /16-00N	81-30 / 83-15W	18.3	4.0	14.1	SQ-8113(2/4)
22629U	131950/132025	16-00 /19-20N	83-15 / 85-25W	18.3	4.0	22.8	SQ-8113(2/4)
22630U	132025/132103	19-20 /23-00N	85-25 / 88-10W	18.3	4.3	11.6	SQ-8113(2/4)
22631U	132103/132145	23-00 /26-20N	88-10 / 91-45W	18.3	4.8	16.6	SQ-8112(2/4)
22632U	132145/132223	26-20 /29-45N	91-45 / 95-35W	18.3	4.4	24.5	SQ-8112(2/4)
22633U	132223/132253	29-45 /33-05N	95-35 / 99-15W	18.3	3.4	27.2	SQ-8112(2/4)
22634U	132253/132340	33-05 /36-23N	99-15 /103-15W	18.3	5.3	16.0	SQ-8112(2/4)
13 OCT 1966	AIRCRAFT = RB-57F A/C 298						
22637U	131433/131503	09-00 /12-30N	79-30 / 81-30W	19.1	2.8	0.14	SQ-8114(2/4)
22638U	131503/131551	12-30 /17-30N	81-30 / 84-00W	19.3	4.4	7.00	SQ-8114(2/4)
22639U	131551/131633	17-30 /22-00N	84-00 / 87-00W	19.6	3.5	30.0	SQ-8114(2/4)
22640U	131633/131720	22-00 /26-00N	87-00 / 91-00W	19.7	3.8	29.7	SQ-8114(2/4)
22641U	131720/131805	26-00 /30-00N	91-00 / 95-00W	19.8	3.5	26.7	SQ-8114(2/4)
22642U	131805/131835	30-00 /33-00N	95-00 / 99-00W	19.9	2.3	38.5	SQ-8114(2/4)
22643U	131835/131915	33-00 /36-30N	99-00 /103-00W	20.0	3.0	29.1	SQ-8114(2/4)
25 OCT 1966	AIRCRAFT = RB-57C A/C 842						
22694F	260023/260057	41-13 /43-34N	112-06 /116-15W	13.1	17.4	0.52	SF-8162(3/4)
22695F	260057/260136	43-34 /47-15N	116-15 /122-30W	13.1	19.9	0.53	SF-8162(3/4)
26 OCT 1966	AIRCRAFT = RB-57C A/C 842						
22696F	261957/262054	55-00 /60-00N	133-30 /140-40W	13.1	28.0	8.78	SQ-8144(2/4)
22697F	262054/262142	60-00 /64-00N	140-40 /145-40W	13.1	23.7	5.13	SQ-8144(2/4)
26 OCT 1966	AIRCRAFT = RB-57C A/C 851						
22698F	261815/261851	41-13 /43-34N	112-06 /116-15W	11.9	22.1	0.41	SF-8163(3/4)
22699F	261851/261930	43-34 /47-10N	116-15 /117-30W	11.9	24.0	1.14	SF-8163(3/4)

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FILTER NUMBER	TIME (Z)	LATITUDE	LONGITUDE	ALTITUDE (KM)	VOLUME (100 SCM)	BETA (PC/SCM)	SAMPLES AND ALIQUOTS
27 OCT 1966	AIRCRAFT = RB-57C	A/C 842					
22700F	272227/272319	55-00 /50-32N	133-30 /127-00W	11.9	32.5	3.72	SF-8164(2/4)
22701F	272319/280005	50-32 /48-00N	127-00 /119-20W	11.9	29.3	0.97	SF-8164(2/4)
27 OCT 1966	AIRCRAFT = RB-57F	A/C 292					
22649U	271430/271511	31-00 /27-00S	69-50 / 71-00W	16.8	5.8	28.5	SQ-8116(1/4), SF-8119(2/4)
22650U	271511/271550	27-00 /23-00S	71-00 / 73-20W	16.8	5.9	32.8	SQ-8116(1/4), SF-8119(2/4)
22651U	271550/271628	23-00 /19-00S	73-20 / 75-20W	16.8	6.2	107.	SQ-8116(1/4), SF-8119(2/4)
22652U	271628/271706	19-00 /15-00S	75-20 / 77-20W	16.8	6.2	79.6	SQ-8116(1/4), SF-8119(2/4)
22653U	271706/271742	15-00 /11-00S	77-20 / 79-15W	16.8	6.2	300.	SF-8117(2/4)
22654U	271742/271818	11-00 /07-00S	79-15 / 81-10W	16.8	6.2	265.	SF-8117(2/4)
22655U	271818/271855	07-00 /03-00S	81-10 / 81-40W	16.8	6.4	97.8	SQ-8115(1/4), SF-8119(2/4)
22656U	271855/271930	03-00S/01-00N	81-40 / 80-55W	16.8	6.1	170.	SQ-8115(1/4), SF-8119(2/4)
22657U	271930/272011	01-00 /06-00N	80-55 / 80-05W	16.8	6.3	103.	SQ-8115(1/4), SF-8119(2/4)
22658U	272011/272030	06-00 /08-50N	80-05 / 79-35W	16.8	3.0	99.6	SQ-8115(1/4), SF-8119(2/4)
28 OCT 1966	AIRCRAFT = RB-57C	A/C 842					
22702F	290100/290151	55-00 /60-00N	133-30 /140-40W	11.9	31.3	2.53	SQ-8145(2/4)
22703F	290151/290235	60-00 /64-00N	140-40 /145-40W	11.9	27.0	2.39	SQ-8145(2/4)
28 OCT 1966	AIRCRAFT = RB-57C	A/C 851					
22704F	290111/290139	41-13 /39-03N	112-06 /108-47W	11.9	17.6	0.28	SF-8165(3/4)
22705F	290139/290215	39-03 /35-02N	108-47 /106-48W	11.9	22.4	0.19	SF-8165(3/4)
29 OCT 1966	AIRCRAFT = RB-57C	A/C 842					
22706F	292150/292240	55-00 /50-32N	133-30 /127-00W	13.1	25.0	6.91	SF-8166(1/4)
22707F	292240/292330	50-32 /47-23N	127-00 /119-20W	13.1	25.0	4.20	SF-8166(1/4)
22708F	300330/300358	41-13 /39-03N	112-06 /108-47W	13.1	14.0	3.81	SF-8167(2/4)
22709F	300358/300434	39-03 /35-02N	108-47 /106-48W	13.1	19.0	2.42	SF-8167(2/4)
06 NOV 1966	AIRCRAFT = C -135	A/C 667					
22837U	061402/061432	36-23 /33-05N	103-15 / 99-15W	9.1	27.4	0.37	SF-8168(2/4)
22838U	061432/061504	33-05 /29-45N	99-15 / 95-35W	9.1	29.5	0.16	SF-8168(2/4)
22839U	061504/061536	29-45 /26-20N	95-35 / 91-45W	9.1	29.9	0.12	SF-8168(2/4)
22840U	061536/061609	26-20 /23-00N	91-45 / 88-10W	9.1	30.3	0.92	SF-8168(2/4)
22841U	061609/061641	23-00 /19-20N	88-10 / 85-25W	9.1	30.6	0.03	SF-8168(2/4)
22842U	061641/061708	19-20 /16-00N	85-25 / 83-15W	9.1	25.9	0.33	SF-8168(2/4)
22843U	061708/061739	16-00 /12-12N	83-15 / 81-30W	9.1	28.5	0.42	SF-8168(2/4)
22844U	061739/061803	12-12 /09-30N	81-30 / 79-50W	9.1	21.7	0.83	SF-8168(2/4)
06 NOV 1966	AIRCRAFT = RB-57F	A/C 291					
22711U	061840/061915	35-15 /32-00N	101-50 / 98-00W	15.2	7.4	1.70	SF-8169(2/4)
22712U	061915/061950	32-00 /29-00N	98-00 / 95-30W	15.2	7.7	1.33	SF-8169(2/4)
22713U	061950/062031	29-00 /25-30N	95-30 / 92-05W	15.2	9.4	1.17	SF-8169(2/4)
22714U	062031/062113	25-30 /22-00N	90-05 / 87-00W	15.2	9.3	0.63	SF-8169(2/4)
22715U	062113/062154	22-00 /18-00N	87-00 / 84-20W	15.2	9.4	4.23	SF-8169(2/4)
22716U	062154/062237	18-00 /14-00N	84-20 / 82-20W	15.2	9.9	0.75	SF-8169(2/4)
22717U	062237/062312	14-00 /10-00N	82-20 / 80-00W	15.2	9.1	0.41	SF-8169(2/4)

ISOTOPES, INCORPORATED

TABLE 1 FLIGHT DATA FOR STARDUST FILTERS COLLECTED DURING 1966

FILTER NUMBER	TIME (Z)	LATITUDE	LONGITUDE	ALTITUDE (KM)	VOLUME (100 SCM)	BETA (PC/SCM)	SAMPLES AND ALIQUOTS
06 NOV 1966	AIRCRAFT = RB-57F A/C 290						
22720U	061515/061620	33-55 /30-00N	104-15 / 95-15W	16.8	10.1	8.89	SF-8171(1/4)
22721U	061620/061710	30-00 /26-00N	96-15 / 91-20W	16.8	8.1	6.81	SF-8171(1/4)
22722U	061710/061755	26-00 /22-00N	91-20 / 87-00W	16.8	7.4	4.85	SF-8171(1/4)
22723U	061755/061842	22-00 /18-00N	87-00 / 84-30W	16.8	7.3	10.8	SF-8171(1/4)
22724U	061842/061922	18-00 /14-00N	84-30 / 82-20W	16.8	6.6	6.61	SF-8171(1/4)
22725U	061922/062004	14-00 /10-00N	82-20 / 80-10W	16.8	7.0	5.50	SF-8171(1/4)
06 NOV 1966	AIRCRAFT = RB-57F A/C 299						
22728U	061621/061703	33-30 /30-00N	99-40 / 95-40W	18.3	4.9	24.3	SF-8172(1/4)
22729U	061703/061750	30-00 /26-00N	95-40 / 91-18W	18.3	5.7	24.1	SF-8172(1/4)
22730U	061750/061838	26-00 /22-00N	91-18 / 87-00W	18.3	5.6	13.3	SF-8172(1/4)
22731U	061843/061919	21-30 /18-00N	86-45 / 84-25W	19.7	3.2	13.9	SF-8173(1/4)
22732U	061919/061957	18-00 /14-00N	84-25 / 82-20W	20.0	3.1	21.1	SF-8173(1/4)
22733U	061957/062037	14-00 /10-00N	82-20 / 80-10W	20.1	3.2	8.02	SF-8173(1/4)
07 NOV 1966	AIRCRAFT = RB-57F A/C 292						
22902U	071653/071730	36-45 /40-00N	103-10 /110-10W	15.2	7.6	13.5	SF-8174(1/4)
22903U	071730/071820	40-00 /44-00N	110-10 /116-45W	15.2	10.2	4.90	SF-8174(1/4)
22904U	071820/071915	44-00 /48-00N	116-45 /123-00W	15.2	11.0	3.26	SF-8174(1/4)
22905U	071915/072006	48-00 /52-00N	123-00 /127-40W	15.2	10.0	6.54	SF-8174(1/4)
22906U	072006/072100	52-00 /56-00N	127-40 /132-40W	15.2	10.4	5.42	SF-8174(1/4)
22907U	072100/072146	56-00 /60-00N	132-40 /137-35W	15.2	9.6	6.56	SF-8174(1/4)
22908U	072146/072220	60-00 /64-00N	137-35 /145-50W	15.2	6.3	14.9	SF-8174(1/4)
07 NOV 1966	AIRCRAFT = RB-57F A/C 294						
22911U	071717/071751	36-45 /40-00N	108-10 /110-30W	18.3	3.7	17.7	SF-8175(1/4)
22912U	071751/071850	40-00 /44-00N	110-30 /116-50W	18.3	6.3	20.2	SF-8175(1/4)
22913U	071850/071945	44-00 /48-00N	116-50 /123-00W	18.3	6.1	15.8	SF-8175(1/4)
22914U	071945/072040	48-00 /52-00N	123-00 /129-10W	18.3	5.9	17.2	SF-8175(1/4)
22915U	072040/072123	52-00 /56-00N	128-10 /132-30W	18.3	4.6	19.0	SF-8175(1/4)
22916U	072123/072208	56-00 /60-00N	132-30 /137-30W	18.3	4.6	22.6	SF-8175(1/4)
22917U	072208/072300	60-00 /64-00N	137-30 /145-40W	18.3	5.3	18.6	SF-8175(1/4)
10 NOV 1966	AIRCRAFT = RB-57F A/C 294						
22920U	100315/100350	61-10 /66-00N	145-30 /145-20W	18.3	3.4	17.0	SQ-8146(2/4)
22921U	100350/100417	66-00 /69-00N	145-20 /144-00W	18.3	2.6	21.2	SQ-8146(2/4)
22922U	100417/100444	69-00 /72-00N	144-00 /143-30W	18.3	2.6	20.7	SQ-8146(2/4)
22923U	100444/100509	72-00 /75-00N	143-30 /143-00W	18.3	2.4	21.4	SQ-8146(2/4)
22924U	100512/100538	75-00 /72-00N	143-00 /143-30W	19.2	2.2	16.9	SQ-8147(2/4)
22925U	100538/100608	72-00 /68-00N	143-30 /144-30W	19.3	2.4	22.4	SQ-8147(2/4)
22926U	100608/100642	68-00 /64-00N	144-30 /145-30W	19.5	2.5	15.4	SQ-8147(2/4)

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TABLE 1 FLIGHT DATA FOR STARDUST FILTERS COLLECTED DURING 1966

FILTER NUMBER	TIME (Z)	LATITUDE	LONGITUDE	ALTITUDE (KM)	VOLUME (LIT SCM)	BETA (PC/SCM)	SAMPLES AND ALIQUOTS
10 NOV 1966	AIRCRAFT = RB-57F A/C 298						
22736U	101724/101902	36-30 /41-00N	107-50 /107-57W	16.8	5.6	20.4	SF-8176(1/4)
22737U	101802/101842	41-00 /45-30N	107-57 /107-53W	16.8	5.8	12.8	SF-8176(1/4)
22738U	101842/101921	45-30 /50-00N	107-50 /107-45W	16.8	5.6	17.2	SF-8176(1/4)
22739U	101927/102005	50-00 /45-30N	107-45 /108-00W	18.9	3.5	16.1	SF-8177(1/4)
22740U	102035/102046	45-30 /41-00N	108-00 /107-55W	19.6	3.2	20.8	SF-8177(1/4)
22741U	102046/102129	41-00 /36-00N	107-55 /107-30W	19.9	3.3	18.3	SF-8177(1/4)
10 NOV 1966	AIRCRAFT = RB-57F A/C 291						
22744U	101451/101515	06-40 /04-00N	79-37W	15.2	5.4	3.09	SF-8178(3/4)
22745U	101515/101554	04-00 /00-00N	79-37 / 79-23W	15.2	8.9	2.88	SF-8178(3/4)
22746U	101554/101627	00-00 /03-00S	79-23 / 79-35W	15.2	7.5	2.39	SF-8178(3/4)
22747U	101627/101710	03-00 /07-00S	79-35 / 77-30W	15.2	9.2	3.23	SF-8178(3/4)
22748U	101710/101744	07-00 /11-00S	77-30 / 75-30W	15.2	7.7	38.5	SF-8132(3/4)
22749U	101744/101820	11-00 /14-30S	75-30 / 75-30W	15.2	8.2	172.	SF-8132(3/4)
10 NOV 1966	AIRCRAFT = RB-57F A/C 290						
22752U	101321/101354	07-00 /03-00N	79-40 / 79-45W	16.8	5.6	5.64	SF-8179(3/4)
22753U	101354/101429	03-00N/01-00S	79-45 / 79-22W	16.8	5.8	9.95	SF-8179(3/4)
22754U	101429/101506	01-00 /05-00S	79-22 / 79-05W	16.8	6.1	39.5	SF-8133(3/4)
22755U	101506/101542	05-00 /09-00S	79-05 / 77-00W	16.8	5.9	62.2	SF-8133(3/4)
22756U	101542/101613	09-00 /12-00S	77-00 / 75-00W	16.8	5.1	68.1	SF-8133(3/4)
22757U	101621/101700	13-00 /17-00S	75-45 / 74-35W	19.2	4.2	17.4	SQ-8148(2/4)
22758U	101700/101737	17-00 /21-00S	74-35 / 73-10W	19.2	3.5	14.6	SQ-8148(2/4)
22759U	101737/101814	21-00 /25-00S	73-10 / 71-40W	19.4	3.3	16.7	SQ-8148(2/4)
22760U	101814/101846	25-00 /28-30S	71-40 / 70-00W	19.6	2.8	10.1	SQ-8148(2/4)
22761U	101846/101916	28-30 /32-00S	70-00 / 68-30W	19.6	2.6	13.8	SQ-8148(2/4)
11 NOV 1966	AIRCRAFT = RB-57F A/C 284						
22929U	112015/112052	44-00 /62-00N	145-40 /144-30W	15.2	6.2	19.4	SQ-8149(2/4)
22930U	112052/112128	62-00 /72-00N	144-30 /143-30W	15.2	4.1	27.9	SQ-8149(2/4)
22931U	112128/112155	72-00 /75-00N	143-30 /143-00W	15.2	5.1	18.1	SQ-8149(2/4)
22932U	112200/112225	75-00 /72-00N	143-00 /143-30W	16.8	3.4	21.2	SQ-8151(2/4)
22933U	112225/112255	72-00 /68-00N	143-30 /144-30W	16.8	4.2	27.9	SQ-8151(2/4)
22934U	112255/112330	68-00 /64-00N	144-30 /145-40W	16.8	4.7	21.3	SQ-8151(2/4)
11 NOV 1966	AIRCRAFT = C -135 A/C 667						
22847U	111350/111920	08-45N/29-50S	79-30 / 63-43W	8.8	25.5	12.8	SF-8134(3/4)
22849U	111400/111435	07-00 /03-00N	79-35 / 79-40W	9.1	29.2	9.79	SF-8131(2/4)
22850U	111435/111452	03-00 /01-00N	79-40W	9.1	14.5	4.69	SF-8131(2/4)
22851U	111452/111538	01-00N/05-00S	79-40 / 78-35W	9.1	39.4	0.94	SF-8131(2/4)
22852U	111538/111610	05-00 /09-00S	78-35 / 77-00W	9.1	27.2	0.71	SF-8131(2/4)
22853U	111610/111642	09-00 /13-00S	77-00 / 75-50W	9.1	27.4	1.31	SF-8131(2/4)
22854U	111642/111714	13-00 /17-00S	75-50 / 74-35W	9.1	26.7	2.02	SF-8131(2/4)
22855U	111714/111747	17-00 /21-00S	74-35 / 72-55W	9.1	29.1	5.11	SF-8131(2/4)
22856U	111747/111815	21-00 /25-00S	72-55 / 71-10W	9.1	23.7	17.8	SF-8135(3/4)
22857U	111815/111840	25-00 /28-30S	71-10 / 69-45W	9.1	21.4	43.3	SF-8135(3/4)
22858U	111840/111903	28-30 /31-30S	69-45 / 68-35W	9.1	19.6	55.7	SF-8135(3/4)

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TABLE 1 FLIGHT DATA FOR STARDUST FILTERS COLLECTED DURING 1966

FILTER NUMBER	TIME (Z)	LATITUDE	LONGITUDE	ALTITUDE (KM)	VOLUME (100 SCM)	BETA (PC/SCM)	SAMPLES AND ALLOTS
11 NOV 1966	AIRCRAFT = RB-57F	A/C 290					
22764U	111320/111356	34-40 /39-00S	63-25 / 63-15W	15.2	7.1	22.8	SQ-8152(1/4), SF-8132(2/4)
22765U	111356/111431	39-00 /43-00S	63-15 / 63-00W	15.2	6.9	12.6	SQ-8152(1/4), SF-8132(1/4)
22766U	111431/111504	43-00 /47-00S	63-00 / 67-55W	15.2	6.3	10.0	SQ-8152(1/4), SF-8133(1/4)
22767U	111504/111537	47-00 /50-30S	67-55 / 67-50W	15.2	6.1	15.3	SQ-8152(1/4), SF-8133(1/4)
22768U	111537/111603	50-30 /53-45S	67-50 / 67-45W	15.2	4.9	16.6	SQ-8152(1/4), SF-8133(1/4)
22769U	111608/111635	53-45 /57-00S	67-45 / 67-50W	16.8	3.8	45.2	SF-8134(2/4), SQ-8153(1/4)
22770U	111635/111709	50-00 /46-00S	67-50 / 68-00W	16.8	4.9	22.5	SF-8134(2/4), SQ-8153(1/4)
22771U	111709/111745	46-00 /42-00S	68-00 / 68-10W	16.8	5.3	95.6	SF-8135(2/4), SQ-8153(1/4)
22772U	111745/111820	42-00 /38-00S	68-10 / 68-15W	16.8	4.9	106.	SF-8135(2/4), SQ-8153(1/4)
22773U	111820/111903	38-00 /33-00S	68-15 / 68-50W	16.8	6.0	37.4	SF-8136(2/4), SQ-8153(1/4)
12 NOV 1966	AIRCRAFT = RB-57F	A/C 294					
22776U	121915/121952	64-00 /61-00N	145-45 /138-00W	16.8	5.0	8.46	SF-8135(1/4)
22777U	121952/122023	61-00 /58-00N	138-00 /133-10W	16.8	4.3	17.0	SF-8135(1/4)
22778U	122023/122052	58-00 /55-00N	133-10 /129-35W	16.8	3.9	25.6	SF-8135(1/4)
22779U	122052/122123	55-00 /52-00N	129-35 /126-45W	16.8	4.3	20.6	SF-8135(1/4)
22780U	122123/122153	52-00 /49-00N	126-45 /124-05W	16.8	4.2	20.4	SF-8135(1/4)
22781U	122153/122227	49-00 /46-00N	124-05 /119-30W	16.8	4.9	20.1	SF-8135(1/4)
22782U	122227/122308	46-00 /43-00N	119-30 /114-20W	16.8	6.1	15.3	SF-8135(1/4)
22783U	122308/122346	43-00 /40-00N	114-20 /110-00W	16.8	5.6	11.4	SF-8135(1/4)
22784U	122346/130015	40-00 /36-45N	110-00 /108-05W	16.8	4.3	10.7	SF-8135(1/4)
12 NOV 1966	AIRCRAFT = RB-57F	A/C 290					
22787U	121520/121601	31-00 /27-00S	69-53 / 71-00W	15.2	8.4	249.	SF-8138(2/4)
22788U	121601/121642	27-00 /23-00S	71-00 / 72-30W	15.2	8.6	49.8	SF-8138(2/4)
22789U	121642/121724	23-00 /19-00S	72-30 / 74-10W	15.2	9.3	1.65	SF-8136(3/4)
22790U	121724/121757	19-00 /15-00S	74-10 / 75-15W	15.2	7.2	142.	SF-8137(2/4)
22791U	121757/121835	15-00 /11-00S	75-15 / 76-25W	15.2	6.8	92.4	SF-8137(2/4)
22792U	121842/121912	10-30 /07-00S	76-35 / 77-35W	13.3	3.4	17.4	SF-8137(2/4)
22793U	121912/121946	07-00 /03-00S	77-35 / 78-40W	13.3	3.8	10.5	SF-8137(2/4)
22794U	121946/122022	03-00S/01-00N	78-40 / 79-40W	13.3	4.1	5.32	SF-8137(2/4)
22795U	122022/122054	01-00 /04-30N	79-40W	13.3	3.8	0.34	SF-8137(2/4)
22796U	122054/122125	04-30 /08-00N	79-40W	13.3	3.8	0.63	SF-8137(2/4)
12 NOV 1966	AIRCRAFT = C -135	A/C 667					
22861U	121400/121955	29-50 /53-45S	63-48 / 67-50W	8.2	24.5	5.73	SF-8139(3/4)
22863U	121405/121425	33-50 /36-00S	63-55 / 63-20W	7.6	18.8	3.82	SQ-8156(2/4)
22864U	121425/121505	36-00 /40-00S	63-20 / 63-10W	7.6	37.7	5.82	SQ-8156(2/4)
22865U	121505/121540	40-00 /45-00S	63-10 / 63-00W	7.6	33.5	2.53	SQ-8156(2/4)
22866U	121540/121610	45-00 /49-00S	63-00 / 67-50W	7.6	27.9	9.74	SQ-8156(2/4)
22867U	121610/121650	49-00 /53-45S	67-50 / 67-45W	7.6	37.5	3.11	SQ-8156(2/4)
22868U	121650/121725	53-45 /50-00S	67-45 / 67-50W	9.1	26.8	4.55	
22869U	121725/121755	50-00 /46-00S	67-50 / 68-00W	9.1	23.7	7.36	SQ-8157(2/4)
22870U	121755/121830	46-00 /42-00S	68-00 / 68-10W	9.1	27.4	10.7	SQ-8157(2/4)
22871U	121830/121900	42-00 /38-00S	68-10 / 68-15W	9.1	23.7	3.14	SQ-8157(2/4)
22872U	121900/121940	38-00 /33-00S	63-15 / 68-50W	9.1	31.1	10.7	SQ-8157(2/4)

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FILTER NUMBER	TIME (Z)	LATITUDE	LONGITUDE	ALTITUDE (KM)	VOLUME (100 SCM)	BETA (PC/SCM)	SAMPLES AND ALLOYS
12 NOV 1966	AIRCRAFT = RB-57F	A/C 291					
22798U	121333/121417	36-00 /41-00S	68-20 / 68-10W	18.3	4.8	13.4	SQ-8154(2/4)
22799U	121417/121450	41-00 /45-00S	68-10 / 68-00W	18.3	3.6	10.7	SQ-8154(2/4)
22800U	121450/121525	45-00 /49-00S	68-00 / 67-50W	18.3	3.8	7.76	SQ-8154(2/4)
22801U	121525/121557	49-00 /53-45S	67-50 / 67-45W	18.3	3.5	8.79	SQ-8154(2/4)
22802U	121557/121620	53-45 /50-00S	67-45 / 67-50W	19.5	2.0	0.06	SQ-8155(2/4)
22803U	121620/121651	50-00 /46-00S	67-50 / 68-00W	19.7	2.5	14.9	SQ-8155(2/4)
22804U	121651/121723	46-00 /42-00S	68-00 / 68-10W	19.8	2.6	13.8	SQ-8155(2/4)
22805U	121723/121759	42-00 /39-00S	68-10 / 68-15W	20.0	2.7	9.50	SQ-8155(2/4)
22806U	121759/121829	38-00 /33-00S	68-15 / 68-50W	20.1	2.2	11.1	SQ-8155(2/4)
13 NOV 1966	AIRCRAFT = RB-57F	A/C 299					
22809U	131435/131516	10-00 /14-00N	80-12 / 82-22W	18.3	5.1	7.80	SF-8139(2/4)
22810U	131516/131552	14-00 /18-00N	82-22 / 84-24W	18.3	4.5	12.5	SF-8139(2/4)
22811U	131552/131634	18-00 /22-00N	84-24 / 87-00W	19.3	4.8	13.4	SF-8139(2/4)
22812U	131634/131722	22-00 /26-00N	87-00 / 91-19W	19.3	4.3	19.4	SQ-8158(2/4)
22813U	131722/131811	26-00 /30-00N	91-19 / 95-40W	19.7	4.3	16.1	SQ-8158(2/4)
22814U	131811/131917	30-00 /35-00N	95-40 /101-18W	19.8	5.5	21.1	SQ-8158(2/4)
13 NOV 1966	AIRCRAFT = C-135	A/C 667					
22875U	131525/132120	29-50S/08-45N	68-48 / 70-30W	8.5	02.8	3.79	SF-8142(3/4)
22877U	131550/131610	30-30 /28-00S	69-00 / 70-00W	9.1	15.8	3.90	SF-8139(2/4)
22878U	131610/131640	28-00 /25-00S	70-00 / 71-10W	9.1	23.4	10.0	SF-8139(2/4)
22879U	131640/131710	25-00 /21-00S	71-10 / 72-55W	9.1	24.2	10.4	SF-8139(2/4)
22880U	131710/131745	21-00 /17-00S	72-55 / 74-35W	9.1	28.3	5.71	SF-8139(2/4)
22881U	131745/131820	17-00 /12-20S	74-35 / 76-05W	9.1	28.7	0.98	SF-8191(2/4)
22882U	131820/131855	12-20 /09-00S	76-05 / 77-00W	9.1	29.2	1.18	SF-8191(2/4)
22883U	131855/131925	09-00 /05-00S	77-00 / 79-05W	9.1	25.5	1.51	SF-8191(2/4)
22884U	131925/131955	05-00 /01-00S	78-05 / 79-10W	9.1	25.4	0.15	SF-8191(2/4)
22885U	131955/132030	01-00S/03-00N	79-10 / 79-40W	9.1	29.2	1.75	SF-8191(2/4)
22886U	132030/132050	03-00 /08-00N	79-40 / 79-35W	9.1	16.4	0.70	SF-8191(2/4)
13 NOV 1966	AIRCRAFT = RB-57F	A/C 291					
22825U	131226/131305	31-00 /27-00S	68-50 / 71-00W	16.8	6.4	36.3	SF-8141(2/4)
22826U	131305/131343	27-00 /23-00S	71-00 / 72-30W	16.8	6.2	49.2	SF-8141(2/4)
22827U	131343/131420	23-00 /19-00S	72-30 / 73-55W	16.8	6.2	143.	SF-8141(2/4)
22828U	131420/131456	19-00 /15-00S	73-55 / 75-15W	16.8	6.0	80.2	SF-8141(2/4)
22829U	131456/131534	15-00 /11-00S	75-15 / 76-25W	16.8	6.4	1.00	SF-8132(3/4)
22830U	131540/131606	10-30 /07-00S	76-35 / 77-30W	13.9	2.8	14.6	SQ-8159(2/4)
22831U	131606/131642	07-00 /03-00S	77-30 / 78-40W	19.2	3.5	4.76	SQ-8159(2/4)
22832U	131642/131717	03-00S/01-00N	78-40 / 79-40W	19.3	3.2	12.8	SQ-8159(2/4)
22833U	131717/131745	01-00 /04-30N	79-40 / 79-30W	19.3	2.5	14.4	SQ-8159(2/4)
22834U	131745/131815	04-30 /09-00N	79-30 / 79-40W	19.3	2.7	10.9	SQ-8159(2/4)

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TABLE 1 FLIGHT DATA FOR STARDUST FILTERS COLLECTED DURING 1966

FILTER NUMBER	TIME (Z)	LATITUDE	LONGITUDE	ALTITUDE (KM)	VOLUME (100 SCM)	BETA (PC/SCM)	SAMPLES AND ALLOYS
15 NOV 1966	AIRCRAFT = C -135	A/C 667					
22889U	151455/152020	08-45 /35-03N	79-30 /106-36W	8.8	35.4	0.14	
22891U	151510/151530	10-21 /12-12N	80-21 / 81-30W	9.4	16.4	1.02	SQ-8161(2/4)
22892U	151530/151605	12-12 /16-00N	81-30 / 83-15W	9.4	29.1	0.22	SQ-8161(2/4)
22893U	151605/151635	16-00 /19-20N	83-15 / 85-25W	9.4	24.7	0.32	SQ-8161(2/4)
22894U	151635/151715	19-20 /23-00N	85-25 / 88-10W	9.4	31.7	0.11	SQ-8161(2/4)
22895U	151715/151800	23-00 /26-20N	88-10 / 91-45W	9.4	36.3	0.39	SQ-8161(2/4)
22896U	151800/151835	26-20 /29-45N	91-45 / 95-35W	9.4	28.7	0.73	SQ-8161(2/4)
22897U	151835/151915	29-45 /33-05N	95-35 / 99-15W	9.4	32.9	0.23	SQ-8161(2/4)
22898U	151915/151950	33-05 /36-23N	99-15 /103-15W	9.4	29.1	0.13	SQ-8161(2/4)
20 NOV 1966	AIRCRAFT = RB-57C	A/C 851					
22936F	202137/202220	41-13 /44-17N	112-06 /117-09W	11.9	27.9	0.98	SF-8233(2/4)
22937F	202220/202259	44-17 /47-26N	117-09 /122-19W	11.9	25.7	3.52	SF-8233(2/4)
20 NOV 1966	AIRCRAFT = RB-57C	A/C 842					
22938F	202117/202201	41-13 /44-17N	112-06 /117-09W	13.1	21.6	3.89	SF-8234(2/4)
22939F	202201/202243	44-17 /47-26N	117-09 /122-19W	13.1	21.0	4.00	SF-8234(2/4)
22 NOV 1966	AIRCRAFT = RB-57C	A/C 851					
22942F	221722/221815	55-00 /60-00N	133-30 /140-40W	11.9	35.5	3.64	SQ-8229(2/4)
22943F	221815/221859	60-00 /64-00N	140-40 /145-40W	11.9	30.7	3.34	SQ-8229(2/4)
22 NOV 1966	AIRCRAFT = RB-57C	A/C 839					
22944F	221706/221803	55-00 /59-52N	133-30 /140-25W	13.1	29.1	7.10	SQ-8231(2/4)
22945F	221803/221850	59-52 /64-00N	140-25 /145-43W	13.1	24.5	5.67	SQ-8231(2/4)
22949F	222343/230031	55-00 /50-32N	133-30 /127-00W	11.9	30.6	2.48	SF-8235(2/4)
22950F	230031/230104	50-32 /47-26N	127-00 /122-18W	11.9	21.2	2.59	SF-8235(2/4)
22 NOV 1966	AIRCRAFT = RB-57C	A/C 851					
22954F	230025/230110	55-00 /50-32N	133-30 /127-00W	13.1	24.2	2.87	SF-8236(2/4)
22955F	230110/230200	50-32 /47-48N	127-00 /119-20W	13.1	26.9	3.30	SF-8236(2/4)
23 NOV 1966	AIRCRAFT = RB-57C	A/C 839					
22956F	231905/231934	41-13 /39-03N	112-06 /108-47W	11.9	18.5	4.54	SF-8237(2/4)
22957F	231934/232012	39-03 /35-02N	108-47 /106-48W	11.9	24.2	1.87	SF-8237(2/4)
23 NOV 1966	AIRCRAFT = RB-57C	A/C 851					
22961F	232016/232045	41-13 /39-04N	112-06 /108-48W	13.1	14.5	4.90	SF-8238(2/4)
22962F	232045/232125	39-04 /35-03N	108-48 /106-49W	13.1	21.2	4.11	SF-8238(2/4)

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TABLE 1 FLIGHT DATA FOR STARDUST FILTERS COLLECTED DURING 1966

FILTER NUMBER	TIME (Z)	LATITUDE	LONGITUDE	ALTITUDE (KM)	VOLUME (100 SCM)	BETA (PC/SCM)	SAMPLES AND ALIQUOTS
04 DEC 1966	AIRCRAFT = WC-130 A/C 496						
23057U	040735/040825	34-46 /34-00N	104-36 / 98-42W	7.0	29.0	0.18	SX-8202(3/4)
23058U	040825/040930	34-00 /29-53N	98-42 / 95-27W	7.6	35.7	0.40	SX-8202(3/4)
23059U	040930/041032	29-53 /26-12N	95-27 / 90-35W	7.6	33.7	0.11	SX-8202(3/4)
23060U	041032/041131	26-12 /22-40N	90-35 / 87-42W	7.6	31.5	0.12	SX-8202(3/4)
23061U	041131/041232	22-40 /18-30N	87-42 / 84-48W	7.6	33.6	0.11	SX-8202(3/4)
23064U	041232/041333	18-30 /14-07N	84-48 / 82-23W	7.6	33.5	0.08	SX-8202(3/4)
23065U	041333/041430	14-07 /10-00N	82-23 / 80-13W	7.6	31.3	0.04	SX-8202(3/4)
23062U	040710/041232	35-03 /19-30N	106-36 / 84-48W	7.2	78.3	0.20	
23063U	041232/041445	18-30 /08-55N	84-48 / 79-35W	7.2	78.0	0.03	
04 DEC 1966	AIRCRAFT = RB-57F A/C 290						
23095U	041529/041606	35-00 /32-00N	101-50 / 97-40W	16.8	5.6	6.64	SX-8203(2/4)
23096U	041606/041643	32-00 /29-00N	97-40 / 94-40W	16.8	5.8	8.84	SX-8203(2/4)
23097U	041643/041723	29-00 /25-30N	94-40 / 90-50W	16.8	6.2	7.65	SX-8203(2/4)
23098U	041723/041808	25-30 /22-00N	90-50 / 87-30W	16.8	7.4	6.24	SX-8203(2/4)
23099U	041808/041852	22-00 /18-00N	87-00 / 83-55W	16.8	7.4	4.33	SX-8203(2/4)
23100U	041852/041935	18-00 /14-00N	83-55 / 82-20W	16.8	7.3	3.86	SX-8203(2/4)
23101U	041935/042010	14-00 /10-00N	82-20 / 80-10W	16.8	5.7	3.92	SX-8203(2/4)
23102U	042010/042023	10-00 /08-45N	80-10 / 79-35W	16.8	2.2	2.33	SX-8203(2/4)
04 DEC 1966	AIRCRAFT = RB-57F A/C 298						
23105U	041524/041603	33-30 /30-00N	99-27 / 95-38W	18.3	4.6	15.9	SX-8221(2/4)
23106U	041603/041648	30-00 /26-00N	95-38 / 91-17W	18.3	5.5	17.2	SX-8221(2/4)
23107U	041648/041736	26-00 /22-00N	91-17 / 87-00W	18.3	5.9	17.4	SX-8221(2/4)
23108U	041736/041816	22-00 /18-00N	87-00 / 84-23W	19.7	3.5	26.0	SX-8222(2/4)
23109U	041816/041853	18-00 /14-00N	84-23 / 82-20W	19.9	3.1	19.4	SX-8222(2/4)
23110U	041853/041930	14-00 /10-00N	82-20 / 80-12W	20.0	3.0	19.2	SX-8222(2/4)
05 DEC 1966	AIRCRAFT = RB-57F A/C 291						
22984U	051835/051905	36-45 /40-00N	108-10 /110-00W	16.8	4.3	13.1	SX-8204(2/4)
22985U	051905/051956	40-00 /43-30N	110-00 /115-35W	16.8	7.3	14.9	SX-8204(2/4)
22986U	051956/052045	43-30 /47-00N	115-05 /121-20W	16.8	6.6	16.1	SX-8204(2/4)
22987U	052045/052121	47-00 /50-00N	121-20 /125-15W	16.8	4.9	17.5	SX-8204(2/4)
22988U	052121/052202	50-00 /54-00N	125-15 /129-00W	16.8	5.6	19.7	SX-8204(2/4)
22989U	052202/052045	54-00 /58-00N	129-00 /133-50W	16.8	5.9	10.2	SX-8204(2/4)
22990U	052245/052317	58-00 /61-00N	133-50 /138-20W	16.8	4.5	16.5	SX-8204(2/4)
22991U	052317/052357	61-00 /64-00N	138-20 /145-45W	16.8	5.5	14.7	SX-8204(2/4)
05 DEC 1966	AIRCRAFT = RB-57F A/C 299						
22994U	051751/051823	36-45 /40-00N	108-10 /110-00W	18.0	3.6	27.1	SX-8223(2/4)
22995U	051823/051911	40-00 /43-30N	110-00 /115-35W	18.0	5.5	14.0	SX-8223(2/4)
22996U	051911/052000	43-30 /47-00N	115-05 /121-20W	18.0	5.3	27.3	SX-8223(2/4)
22997U	052000/052036	47-00 /50-00N	121-20 /125-15W	18.0	3.9	13.8	SX-8223(2/4)
22998U	052036/052113	50-00 /54-00N	125-15 /129-00W	18.3	3.8	32.7	SX-8223(2/4)
22999U	052113/052154	54-00 /58-00N	129-00 /133-50W	18.3	4.2	14.6	SX-8223(2/4)
23000U	052154/052227	58-00 /61-00N	133-50 /138-20W	18.4	3.2	11.6	SX-8223(2/4)
23001U	052227/052307	61-00 /64-00N	138-20 /145-45W	18.4	4.0	15.7	SX-8223(2/4)

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05 DEC 1966	AIRCRAFT = RB-57F	A/C 292					
23113U	051626/051703	35-00 /32-00N	101-15 / 97-40W	15.2	7.7	9.49	SX-8205(2/4)
23114U	051703/051737	32-00 /29-00N	97-40 / 94-35W	15.2	7.1	8.67	SX-8205(2/4)
23115U	051737/051820	29-00 /25-30N	94-35 / 90-40W	15.2	9.2	4.74	SX-8205(2/4)
23116U	051820/051902	25-30 /22-00N	90-40 / 87-00W	15.2	9.0	1.23	SX-8205(2/4)
23117U	051902/051946	22-00 /18-00N	87-00 / 84-25W	15.2	9.7	3.17	SX-8205(2/4)
23118U	051946/052033	18-00 /14-00N	84-25 / 82-20W	15.2	10.6	1.57	SX-8205(2/4)
23119U	052033/052117	14-00 /10-00N	82-20 / 80-10W	15.2	9.9	1.42	SX-8205(2/4)
23120U	052117/052130	10-00 /08-50N	80-10 / 79-30W	15.2	5.2	0.49	SX-8205(2/4)
05 DEC 1966	AIRCRAFT = WC-130	A/C 496					
23071U	050632/050742	07-11 /02-07N	80-00 / 81-24W	7.0	40.5	0.52	
23072U	050742/050849	02-07N/02-48S	81-24 / 82-00W	7.6	36.4	1.44	
23073U	050849/050955	02-48 /07-18S	82-00 / 80-26W	7.6	36.2	1.03	
23074U	050955/051055	07-18 /11-12S	80-26 / 77-41W	7.6	32.6	1.22	
23076U	050602/051115	08-55N/12-02S	79-36 / 77-07W	6.9	79.5	0.78	SF-8197(3/4)
23180U	051318/051423	13-45 /18-25S	74-14 / 74-28W	7.6	33.9	3.10	
23181U	051423/051519	18-25 /23-18S	74-28 / 73-20W	7.6	30.2	1.49	
23182U	051519/051617	23-18 /27-11S	73-20 / 72-07W	7.6	31.5	2.60	
23183U	051617/051720	27-11 /32-14S	72-07 / 68-38W	7.6	34.2	0.52	
23185U	051243/051730	12-02 /32-50S	77-07 / 68-47W	7.0	57.4	2.18	SF-8197(3/4)
06 DEC 1966	AIRCRAFT = RB-57F	A/C 292					
23024U	061422/061458	07-00 /03-00N	79-35W	16.8	5.9	16.5	SF-8193(2/4), SX-8205(1/4)
23025U	061458/061533	03-00N/01-00S	79-35 / 79-10W	16.8	5.3	18.1	SF-8193(2/4), SX-8205(1/4)
23026U	061533/061610	01-00 /05-00S	79-10 / 78-05W	16.8	5.9	19.2	SF-8193(2/4), SX-8205(1/4)
23027U	061610/061643	05-00 /09-00S	78-05 / 77-00W	16.8	5.3	19.1	SF-8193(2/4), SX-8205(1/4)
23028U	061643/061714	09-00 /12-00S	77-00 / 76-10W	16.8	5.1	22.4	SF-8193(2/4), SX-8205(1/4)
23029U	061730/061759	13-50 /17-00S	75-35 / 74-40W	19.2	2.9	11.9	SX-8207(2/4)
23030U	061759/061834	17-00 /21-00S	74-40 / 73-15W	19.3	3.4	11.3	SX-8207(2/4)
23031U	061834/061910	21-00 /25-00S	73-15 / 71-45W	19.4	3.3	14.8	SX-8207(2/4)
23032U	061910/061943	25-00 /28-30S	71-45 / 70-15W	19.5	2.9	14.2	SX-8207(2/4)
23033U	061943/062015	28-30 /32-00S	70-15 / 68-35W	19.5	2.3	11.0	SX-8207(2/4)
07 DEC 1966	AIRCRAFT = RB-57F	A/C 291					
23004U	072145/072216	64-00 /68-00N	145-44 /144-35W	15.2	6.0	16.7	SX-8208(2/4)
23005U	072216/072253	68-00 /72-00N	144-35 /143-22W	15.2	7.4	13.0	SX-8208(2/4)
23006U	072253/072317	72-00 /75-00N	143-22 /143-00W	15.2	4.3	19.0	SX-8208(2/4)
23007U	072323/072336	75-00 /72-00N	143-00 /143-22W	16.8	1.8	19.2	SX-8224(2/4)
23008U	072336/080009	72-00 /68-00N	143-22 /144-35W	16.8	4.6	15.3	SX-8224(2/4)
23009U	080009/080045	68-00 /64-00N	144-35 /145-44W	16.8	5.1	13.8	SX-8224(2/4)

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07 DEC 1966	AIRCRAFT = RB-57F	A/C 299					
23012U	072105/072134	62-10 /66-00N	145-25 /145-20W	18.3	2.7	25.2	SX-8225(2/4)
23013U	072134/072202	66-00 /69-00N	145-20 /144-05W	18.3	2.9	24.3	SX-8225(2/4)
23014U	072202/072230	69-00 /72-00N	144-05 /143-20W	18.3	2.9	10.2	SX-8225(2/4)
23015U	072230/072257	72-00 /75-00N	143-20 /143-00W	18.3	2.9	17.7	SX-8225(2/4)
23016U	072257/072327	75-00 /72-00N	143-00 /143-20W	19.1	2.7	10.0	SX-8225(2/4)
23017U	072327/072358	72-00 /69-00N	143-20 /144-35W	19.2	2.7	14.7	SX-8226(2/4)
23018U	072358/080030	68-00 /64-35N	144-35 /147-00W	19.2	2.7	20.9	SX-8226(2/4)
07 DEC 1966	AIRCRAFT = WC-130	A/C 496					
23081U	071400/071459	34-33 /39-33S	68-25 / 68-10W	7.6	30.8	1.37	SX-8209(2/4)
23082U	071459/071559	39-33 /44-34S	68-10 / 67-39W	7.6	32.0	2.40	SX-8209(2/4)
23083U	071559/071700	44-34 /49-35S	67-39 / 67-45W	7.6	33.6	3.97	SX-8209(2/4)
23084U	071700/071751	49-35 /53-47S	67-45 / 67-46W	7.6	27.9	2.02	SX-8209(2/4)
23085U	071751/071855	53-47 /48-47S	67-46 / 67-43W	7.6	34.6	2.08	SX-8209(2/4)
23086U	071855/072004	48-47 /43-45S	67-43W	7.6	38.2	6.28	SX-8209(2/4)
23087U	072004/072116	43-45 /38-46S	67-43 / 68-12W	7.6	39.1	2.20	SX-8209(2/4)
23088U	072116/072227	38-46 /33-53S	68-12 / 68-51W	7.6	37.7	0.61	SX-8209(2/4)
23090U	071330/072240	53-47 /32-50S	67-46 / 68-47W	7.3	02.7	2.37	SF-8194(3/4)
07 DEC 1966	AIRCRAFT = RB-57F	A/C 292					
23036U	071334/071408	35-00 /39-00S	68-23 / 68-10W	15.2	6.8	53.0	SF-8195(2/4), SX-8211(1/4)
23037U	071408/071442	39-00 /43-00S	68-10 / 68-00W	15.2	6.5	41.0	SF-8195(2/4), SX-8211(1/4)
23038U	071442/071517	43-00 /47-00S	68-00 / 67-50W	15.2	6.2	42.6	SF-8195(2/4), SX-8211(1/4)
23039U	071517/071552	47-00 /51-00S	67-50 / 67-45W	15.2	6.2	14.7	SF-8239(2/4), SX-8211(1/4)
23040U	071556/071631	51-00 /47-00S	67-45 / 67-50W	16.8	4.6	3.90	SX-8212(2/4), SF-8241(1/4)
23041U	071631/071706	47-00 /43-00S	67-50 / 68-00W	16.8	4.6	8.36	SX-8212(2/4), SF-8241(1/4)
23042U	071706/071741	43-00 /39-00S	68-00 / 68-10W	16.8	4.8	16.6	SX-8212(2/4), SF-8242(1/4)
23043U	071741/071819	39-00 /34-00S	68-10 / 68-23W	16.8	5.3	40.9	SX-8212(2/4), SF-8242(1/4)
08 DEC 1966	AIRCRAFT = RB-57F	A/C 299					
23190U	081840/081920	63-30 /60-00N	143-45 /136-40W	15.2	8.0	16.8	SF-8198(1/4), SX-8213(2/4)
23191U	081920/081958	60-00 /56-00N	136-40 /131-00W	15.2	7.7	11.8	SF-8198(1/4), SX-8213(2/4)
23192U	081958/082038	56-00 /52-00N	131-00 /127-00W	15.2	8.4	15.9	SF-8198(1/4), SX-8213(2/4)
23193U	082038/082115	52-00 /48-00N	127-00 /123-00W	15.2	7.9	10.4	SF-8198(1/4), SX-8213(2/4)
23194U	082115/082203	48-00 /44-00N	123-00 /116-00W	15.2	9.9	13.3	SF-8198(1/4), SX-8213(2/4)
23195U	082203/082249	44-00 /40-00N	116-00 /110-00W	15.2	9.5	12.7	SF-8198(1/4), SX-8213(2/4)
23196U	082249/082330	40-00 /36-00N	110-00 /107-30W	15.2	8.4	10.1	SF-8198(1/4), SX-8213(2/4)
08 DEC 1966	AIRCRAFT = RB-57F	A/C 290					
23046U	081322/081405	36-00 /41-00S	68-17 / 68-05W	18.3	4.9	17.5	SX-8214(2/4)
23047U	081405/081440	41-00 /45-00S	68-05 / 67-55W	18.3	4.0	13.1	SX-8214(2/4)
23048U	081440/081512	45-00 /49-00S	67-55 / 67-50W	18.3	3.4	12.1	SX-8214(2/4)
23049U	081512/081528	49-00 /50-50S	67-50 / 67-52W	18.3	1.7	10.6	SX-8214(2/4)
23050U	081531/081546	50-50 /49-00S	67-52 / 67-50W	19.0	1.4	16.5	SX-8215(2/4)
23051U	081546/081611	49-00 /46-00S	67-50 / 67-53W	19.3	2.2	11.6	SX-8215(2/4)
23052U	081611/081644	46-00 /42-00S	67-53 / 68-05W	19.4	2.8	12.4	SX-8215(2/4)
23053U	081644/081717	42-00 /38-00S	68-05 / 68-15W	19.6	2.6	10.4	SX-8215(2/4)
23054U	081717/081750	38-00 /34-00S	68-15 / 68-50W	19.9	2.5	6.67	SX-8215(2/4)

ISOTOPES, INCORPORATED

TABLE 1 FLIGHT DATA FOR STARDUST FILTERS COLLECTED DURING 1966

FILTER NUMBER	TIME (Z)	LATITUDE	LONGITUDE	ALTITUDE (KM)	VOLUME (100 SCM)	BETA (PC/SCM)	SAMPLES AND ALIQUOTS
09 DEC 1966	AIRCRAFT = R8-57F	A/C 298					
23199U	091605/091617	08-50 /10-00N	79-35 / 80-10W	18.3	1.3	11.8	SX-8227(2/4)
23200U	091617/091658	10-00 /14-00N	80-10 / 82-20W	18.3	4.4	9.91	SX-8227(2/4)
23201U	091658/091737	14-00 /18-00N	82-20 / 84-20W	18.3	4.7	13.1	SX-8227(2/4)
23202U	091737/091816	18-00 /22-00N	84-20 / 87-00W	18.3	4.8	9.35	SX-8227(2/4)
23203U	091816/091858	22-00 /25-30N	87-00 / 90-35W	19.0	4.1	16.0	SX-8228(2/4)
23204U	091858/091939	25-30 /29-00N	90-35 / 94-35W	19.6	3.4	17.7	SX-8228(2/4)
23205U	091939/092023	29-00 /32-00N	94-35 / 99-45W	19.6	3.6	15.3	SX-8228(2/4)
23206U	092023/092116	32-00 /35-00N	99-45 /105-45W	19.4	4.6	16.4	SX-8228(2/4)
09 DEC 1966	AIRCRAFT = R8-57F	A/C 290					
23123U	091320/091408	31-00 /27-00S	69-00 / 71-00W	15.2	10.4	11.5	SX-8216(2/4)
23124U	091408/091446	27-00 /23-00S	71-00 / 72-30W	15.2	8.6	7.46	SX-8216(2/4)
23125U	091446/091530	23-00 /19-00S	72-30 / 74-00W	15.2	9.9	1.81	SX-8216(2/4)
23126U	091530/091607	19-00 /15-00S	74-00 / 75-15W	15.2	8.3	13.3	SX-8216(2/4)
23127U	091607/091645	15-00 /11-00S	75-15 / 76-25W	15.2	8.6	3.28	SX-8216(2/4)
23128U	091650/091719	10-30 /07-00S	76-35 / 77-35W	18.3	3.3	17.1	SX-8218(2/4)
23129U	091719/091802	07-00 /03-00S	77-35 / 78-40W	18.3	5.2	16.9	SX-8218(2/4)
23130U	091802/091839	03-00S/01-00N	78-40 / 79-45W	18.3	4.5	16.5	SX-8218(2/4)
23131U	091839/091911	01-00 /04-30N	79-45 / 79-35W	18.3	4.1	12.5	SX-8218(2/4)
23132U	091911/091943	04-30 /07-50N	79-35W	18.3	4.0	10.3	SX-8218(2/4)
09 DEC 1966	AIRCRAFT = R8-57F	A/C 292					
23135U	091227/091304	30-20 /27-00S	69-15 / 70-55W	16.9	6.0	32.7	S8-8196(2/4), SX-8217(1/4)
23136U	091304/091341	27-00 /23-00S	70-55 / 72-30W	16.8	5.9	46.5	S8-8196(2/4), SX-8217(1/4)
23137U	091341/091420	23-00 /19-00S	72-30 / 73-55W	16.8	6.3	28.1	S8-8196(2/4), SX-8217(1/4)
23138U	091420/091500	19-00 /15-00S	73-55 / 75-15W	16.8	6.5	26.0	S8-8196(2/4), SX-8217(1/4)
23139U	091500/091539	15-00 /11-00S	75-15 / 76-20W	16.8	6.4	24.0	S8-8196(2/4), SX-8217(1/4)
23140U	091559/091616	08-50 /07-00S	77-00 / 77-30W	19.0	1.7	11.3	SX-8219(2/4)
23141U	091616/091654	07-00 /03-00S	77-30 / 78-35W	19.2	3.6	11.4	SX-8219(2/4)
23142U	091654/091738	03-00S/01-00N	78-35 / 79-35W	19.4	3.8	16.9	SX-8219(2/4)
23143U	091738/091800	01-00 /04-30N	79-35W	19.6	1.8	16.4	SX-8219(2/4)
23144U	091800/091830	04-30 /08-00N	79-35W	19.7	2.4	10.7	SX-8219(2/4)
10 DEC 1966	AIRCRAFT = WC-130	A/C 496					
23147U	102102/102206	10-05 /05-58S	78-28 / 81-20W	7.6	31.1	0.16	SF-8243(3/4)
23148U	102206/102308	05-58 /01-10S	81-20 / 82-00W	7.3	34.5	0.04	SF-8243(3/4)
23149U	102308/110007	01-10S/03-40N	82-00 / 81-00W	7.3	33.7	0.11	SF-8243(3/4)
23150U	110007/110053	03-40 /07-25N	81-00 / 79-55W	7.3	26.7	0.05	SF-8243(3/4)
23152U	102023/110105	12-02S/09-55N	77-07 / 79-36W	6.7	58.8	0.12	
23157U	101259/101413	31-17 /27-34S	69-19 / 72-18W	7.3	35.0	1.76	SF-8244(2/4)
23158U	101413/101517	27-34 /22-44S	72-18 / 73-30W	7.3	36.2	0.99	SF-8244(2/4)
23159U	101517/101620	22-44 /17-51S	73-30 / 74-36W	7.3	35.7	1.83	SF-8244(2/4)
23160U	101620/101720	17-51 /13-00S	74-36 / 76-35W	7.3	34.5	0.56	SF-8244(2/4)
23162U	101223/101740	32-50 /12-02S	68-47 / 77-07W	6.7	81.6	0.71	

ISOTOPES, INCORPORATED

TABLE 1 FLIGHT DATA FOR STARDUST FILTERS COLLECTED DURING 1966

FILTER NUMBER	TIME (Z)	LATITUDE	LONGITUDE	ALTITUDE (KM)	VOLUME (100 SCM)	BETA (PC/SCM)	SAMPLES AND ALIQUOTS
11 DEC 1966	AIRCRAFT = WC-130 A/C 496						
23167U	111914/112020	11-05 /15-39N	80-51 / 83-05W	7.3	34.3	0.07	SF-8245(2/4)
23168U	112020/112124	15-39 /19-52N	83-05 / 85-54W	7.3	36.0	0.04	SF-8245(2/4)
23169U	112124/112230	19-52 /23-53N	85-54 / 89-02W	7.3	37.9	0.07	SF-8245(2/4)
23170U	112230/112333	23-53 /27-26N	89-02 / 93-00W	7.3	36.3	0.00	SF-8245(2/4)
23171U	112333/120034	27-26 /30-25N	93-00 / 97-20W	7.3	35.6	0.07	SF-8245(2/4)
23172U	120034/120140	30-25 /33-04N	97-20 /102-22W	7.3	37.8	0.03	SF-8245(2/4)
23173U	120140/120225	33-04 /34-43N	102-22 /105-57W	7.3	26.0	0.00	SF-8245(2/4)
23175U	111833/120240	08-55 /35-03N	79-36 /106-36W	6.9	77.9	0.07	
18 DEC 1966	AIRCRAFT = RB-57C A/C 832						
23324F	182204/182253	41-13 /44-17N	112-06 /117-09W	11.9	07.3	0.08	SF-8295(2/4)
23325F	182253/182345	44-17 /47-08N	117-09 /122-28W	11.9	50.9	0.06	SF-8295(2/4)
18 DEC 1966	AIRCRAFT = RB-57C A/C 851						
23328F	182134/182223	41-13 /44-17N	112-06 /117-09W	13.1	86.7	0.45	SF-8268(2/4)
23329F	182223/182312	44-17 /47-26N	117-09 /122-19W	13.1	86.7	0.48	SF-8268(2/4)
19 DEC 1966	AIRCRAFT = RB-57C A/C 832						
23332F	192215/192306	55-00 /60-00N	133-30 /140-40W	11.9	15.0	2.39	SX-8253(2/4)
23333F	192306/192348	60-00 /64-00N	140-40 /145-40W	11.9	97.9	2.54	SX-8253(2/4)
19 DEC 1966	AIRCRAFT = RB-57C A/C 851						
23337F	192219/192315	55-00 /59-52N	133-30 /140-25W	13.1	99.1	3.08	SX-8254(2/4)
23338F	192315/200000	59-52 /64-00N	140-25 /145-43W	13.1	79.6	3.35	SX-8254(2/4)
20 DEC 1966	AIRCRAFT = RB-57C A/C 851						
23341F	202319/210013	55-00 /50-32N	133-30 /127-00W	11.9	17.2	2.23	SF-8269(2/4)
23342F	210013/210048	50-32 /47-26N	127-00 /122-13W	11.9	76.0	1.62	SF-8271(2/4)
21 DEC 1966	AIRCRAFT = RB-57C A/C 832						
23343F	212358/220051	55-00 /50-32N	133-00 /127-00W	13.1	91.2	1.90	SF-8272(2/4)
23344F	220051/220115	50-32 /48-44N	127-00 /123-27W	13.1	42.0	0.96	SF-8273(3/4)
21 DEC 1966	AIRCRAFT = RB-57C A/C 851						
23348F	211920/211947	41-13 /38-57N	117-06 /109-07W	11.9	58.6	0.94	SF-8274(2/4)
23349F	211947/212024	38-57 /35-02N	109-07 /106-48W	11.9	80.3	0.20	SF-8274(2/4)
22 DEC 1966	AIRCRAFT = RB-57C A/C 842						
23350F	222055/222122	41-13 /39-04N	112-06 /108-48W	13.1	47.8	1.01	SF-8275(2/4)
23351F	222122/222156	39-04 /35-03N	108-48 /106-49W	13.1	51.9	0.76	SF-8275(2/4)

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TABLE 2 TRACER NUCLIDES IN STARDUST SAMPLES

SAMPLE NUMBER	LATITUDE (DEG.)	LONGITUDE (DEG.)	ALTITUDE (KM)	VOLUME (100 SCM)	TOTAL BETA (PC/SCM)	ACTIVITIES (PC/100 SCM)			
						SR 90	PU 238	PU 239	CD 109
09 OCT 1966									
SQ-8126	35 /54S	68W	15.2	8.6	18.8	59. B	2.32A	0.97A	-
SQ-8127	33 /54S	69/ 68W	16.8	6.3	20.2	77. B	3.39A	1.37B	-
SQ-8128	36 /51S	68W	18.3	6.4	17.0	73. B	3.42A	1.27B	-
SQ-8129	33 /51S	69/ 68W	19.3	5.3	23.1	96. B	4.53B	2.11B	-
10 OCT 1966									
SQ-8102	35 /23N	104/ 98W	18.3	6.8	20.8	111. A	0.63B	1.82A	-
SQ-8103	35 /23N	105/ 98W	19.8	5.8	26.2	142. A	1.17A	2.05B	-
SQ-8098	09N/10S	80/ 78W	20.1	6.2	22.3	127. A	0.94A	2.11A	-
SQ-8131	14 /32S	77/ 68W	19.5	7.1	20.5	88. B	4.32B	1.59B	-
11 OCT 1966									
SQ-8104	50 /37N	108W	18.3	6.3	24.0	149. A	1.19A	2.22A	-
SQ-8105	50 /37N	108W	19.6	4.8	23.8	146. A	1.77A	2.18A	-
SQ-8101	09N/11S	80/ 79W	18.3	10.8	16.4	67. A	0.66A	0.94A	-
SQ-8099	11 /27S	79/ 71W	18.3	9.4	15.6	65. B	1.98B	0.96B	-
12 OCT 1966									
SQ-8106	50 /37N	108W	15.2	10.9	11.8	45. B	0.16B	0.64A	-
SQ-8107	50 /37N	108W	16.8	9.4	17.4	85. A	0.41B	1.33B	-
13 OCT 1966									
SQ-8108	30 /09N	90/ 80W	15.2	26.2	1.50	1.1C	0.02C	0.04B	-
SQ-8109	36 /25N	105/ 90W	16.8	9.6	5.35	20. B	0.10B	0.34A	-
SQ-8111	25 /09N	90/ 80W	16.8	15.3	3.48	10. B	0.05C	0.17B	-
SQ-8112	36 /23N	103/ 89W	18.3	9.0	20.4	94. A	0.52B	1.56B	-
SQ-8113	23 /09N	88/ 80W	18.3	7.8	17.2	95. A	0.63C	1.69B	-
SQ-8114	36 /09N	103/ 80W	19.6	11.6	22.2	174. A	0.76B	1.68A	-
26 OCT 1966									
SQ-8144	64 /55N	146/134W	13.1	25.8	7.12	26. B	0.22B	0.76B	-
27 OCT 1966									
SQ-8115	09N/07S	80/ 81W	16.8	5.6	118.	11. C	0.14B	0.21B	-
SQ-8116	15 /31S	77/ 69W	16.8	6.0	63.	50. B	1.76B	0.80B	-
28 OCT 1966									
SQ-8145	64 /55N	146/134W	11.9	29.2	2.47	18. B	0.08A	0.35A	-
10 NOV 1966									
SQ-8146	75 /61N	143/146W	18.3	5.5	19.8	96. B	1.75B	2.07B	-
SQ-8147	75 /64N	143/146W	19.3	3.6	18.2	90. B	2.12B	2.02B	-
SQ-8148	13 /32S	76/ 68W	19.3	8.2	14.9	63. A	2.10A	1.43B	-

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TABLE 2 TRACER NUCLIDES IN STARDUST SAMPLES

SAMPLE NUMBER	LATITUDE (DEG.)	LONGITUDE (DEG.)	ALTITUDE (KM)	VOLUME (100 SCM)	TOTAL BETA (PC/SCM)	ACTIVITIES (PC/100 SCM)			
						SR 90	PU 238	PU 239	CD 109
11 NOV 1966									
SQ-8149	75 /64N	143/146W	15.2	9.0	21.9	100. 8	0.82A	2.07A	-
SQ-8151	75 /64N	143/146W	16.8	6.0	23.6	127. 8	1.58B	2.51A	-
SQ-8152	35 /54S	68W	15.2	7.8	15.5	54. 8	2.12A	0.90B	-
SQ-8153	33 /54S	69/ 68W	16.8	6.2	62.1	37. 8	1.49B	0.763	-
12 NOV 1966									
SQ-8156	34 /54S	69/ 68W	7.6	77.7	4.92	0.68	0.038	0.038	-
SQ-8157	33 /50S	69/ 68W	9.1	53.0	8.26	1.2B	0.04C	0.04C	-
SQ-8154	36 /54S	68W	18.3	7.8	10.4	65. 8	3.22A	1.12A	-
SQ-8155	33 /54S	69/ 68W	19.8	6.0	10.3	58. 8	2.82B	0.92B	-
13 NOV 1966									
SQ-8158	35 /22N	101/ 87W	19.6	7.1	19.0	125. 8	1.27B	2.25B	-
SQ-8159	08N/10S	80/ 77W	19.2	7.4	11.2	69. 8	0.62B	1.36A	-
15 NOV 1966									
SQ-8161	36 /10N	103/ 80W	9.4	14.2	0.29	0.1C	0.000	0.01B	-
22 NOV 1966									
SQ-8229	64 /55N	146/134W	11.9	32.8	3.50	12.1B	0.05B	0.21A	-
SQ-8231	64 /55N	146/134W	13.1	26.8	6.45	34. 8	0.18B	0.66B	-
04 DEC 1966									
SX-8202	35 /10N	105/ 80W	7.5	71.2	0.15	0.2D	L 0.01	L 0.01	L 0.1
SX-8203	35 /09N	102/ 80W	16.8	23.8	5.66	11.4B	0.08B	0.26B	0.4C
SX-8221	34 /22N	99/ 87W	18.3	8.0	16.9	82. 8	0.56A	1.38A	4.1B
SX-8222	22 /10N	87/ 80W	19.9	4.8	21.9	112. 8	1.06B	2.02B	5.4C
05 DEC 1966									
SX-8204	64 /37N	146/108W	16.8	22.3	15.3	63. A	0.93B	1.64B	4.0B
SX-8223	64 /37N	146/108W	18.2	16.8	19.7	97. 8	1.24B	1.86B	5.5A
SX-8205	35 /09N	101/ 80W	15.2	34.2	3.71	6.5B	0.05C	0.16C	0.4D
06 DEC 1966									
SX-8206	07N/12S	80/ 76W	16.8	7.0	18.8	9.2C	0.25D	0.17D	1.0D
SX-8207	14 /32S	76/ 69W	19.4	7.6	12.6	55. 8	2.67C	1.17B	5.4C
07 DEC 1966									
SX-8208	75 /64N	143/146W	15.2	9.1	15.8	112. 8	1.41B	2.38B	4.5C
SX-8224	75 /64N	143/146W	16.8	5.8	15.3	86. A	1.27C	1.22B	5.0B
SX-8225	75 /62N	143/145W	18.3	5.7	19.2	100. 8	1.69B	1.68B	5.2B
SX-8226	75 /65N	143/147W	19.2	4.0	15.2	69. 8	1.59B	1.24B	3.7C
SX-8209	34 /54S	68W	7.6	37.0	2.65	1.0B	0.03B	0.03B	0.1C
SX-8211	35 /51S	68W	15.2	6.4	38.2	33. 8	1.45B	0.87B	2.2D
SX-8212	34 /51S	68W	16.8	9.6	18.3	40. 8	1.82B	0.73B	4.6B

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TABLE 2 TRACER NUCLIDES IN STARDUST SAMPLES

SAMPLE NUMBER	LATITUDE (DEG.)	LONGITUDE (DEG.)	ALTITUDE (KM)	VOLUME (100 SCM)	TOTAL BETA (PC/SCM)	ACTIVITIES (PC/100 SCM)			
						SR 90	PU 238	PU 239	CO 109
08 DEC 1966									
SX-8213	64 /36N	144/109W	15.2	29.9	13.0	76. A	0.72A	1.36B	5.0B
SX-8214	36 /51S	68W	18.3	7.7	14.1	69. B	3.46A	1.19A	5.9B
SX-8215	34 /51S	69/ 69W	19.4	5.8	11.0	58. B	4.10B	1.15B	6.1C
09 DEC 1966									
SX-8228	35 /22N	106/ 87W	19.4	7.8	16.3	175. A	1.21A	2.00A	4.9B
SX-8227	22 /09N	87/ 80W	18.3	7.6	10.9	54. B	0.32B	0.93B	2.4C
SX-8218	08N/10S	80/ 77W	18.3	10.6	14.7	35. B	0.51B	0.86B	2.2B
SX-8219	08N/09S	80/ 77W	19.4	6.6	13.5	70. A	0.73A	1.50A	4.7C
SX-8216	11 /31S	76/ 69W	15.2	22.9	7.42	2.9C	0.09C	0.09C	0.20
SX-8217	11 /30S	76/ 69W	16.8	7.8	31.2	12.1B	0.36C	0.31C	1.4C
19 DEC 1966									
SX-8253	64 /55N	146/134W	11.9	06.4	2.46	12.8B	0.11C	0.32C	0.5B
SX-8254	64 /55N	146/134W	13.1	89.4	3.20	14.1B	0.14C	0.36B	0 3.6A

ISOTOPES, INCORPORATED

TABLE 3 FISSION PRODUCTS IN STARDUST SAMPLES

SAMPLE NUMBER	LATITUDE (DEG.)	LONGITUDE (DEG.)	ALTITUDE (KM)	VOLUME (100 SCM)	TOTAL BETA (PC/SCM)	ACTIVITIES (PC/100 SCM)						
						SR 90	SR 89	ZR 95	CS 137	BA 140	CE 141	CE 144
09 OCT 1966												
SQ-8126	35 /54S	68W	15.2	8.6	19.8	59. B	73.18	-	-	-	-	-
SQ-8127	33 /54S	69/ 68W	16.8	6.3	20.2	77. B L	8.1	-	-	-	-	-
SQ-8128	36 /51S	68W	18.3	6.4	17.0	73. B L	14.	-	-	-	-	-
SQ-8129	33 /51S	69/ 68W	19.3	5.3	23.1	96. B L	5.3	-	-	-	-	-
10 OCT 1966												
SQ-8102	35 /23N	104/ 98W	18.3	6.8	20.8	111. A	45. C	-	-	-	-	-
SQ-8103	35 /23N	105/ 98W	19.8	5.8	26.2	142. A L	17.	-	-	-	-	-
SF-8087	07 /04N	80W	15.2	3.6	500.	18. B	1550. A	3470. A	65.6C	12500. A	4200. B	533. A
SF-8092	07 /04N	80W	15.2	1.8	500.	24. B	1830. A	3200. A	-	12300. B	10400. B	993. A
SF-8097	04N/04S	80/ 82W	15.2	8.6	2.47	0.9C	8.88	-	-	-	-	-
SF-8093	04 /10S	82/ 78W	15.2	7.2	119.	4.28	235. A	476. A	-	1570. B	775. A	76. A
SQ-8098	09N/10S	80/ 78W	20.1	6.2	22.3	127. A	21. C	-	-	-	-	-
SF-8121	14 /32S	77/ 68W	15.2	17.3	120.	21. B	2700. A	8670. A	35.9A	32800. A	10500. B	1160. A
SF-8122	14 /18S	77/ 75W	15.2	2.0	690.	17. C	2210. B	7230. A	-	22700. B	14000. A	1010. A
SF-8123	18 /23S	75/ 73W	15.2	2.3	780.	34. B	4650. A	2400. A	-	35400. A	28600. A	1830. A
SF-8124	23 /27S	73/ 71W	15.2	2.2	600.	24. B	3220. B	5320. A	-	25000. B	12100. B	738. A
SF-8125	27 /32S	71/ 68W	15.2	2.2	190.	17. C	1260. B	2110. A	-	8650. B	5570. B	445. A
SQ-8131	14 /32S	77/ 68W	19.5	7.1	20.6	88. B L	0.2	-	-	-	-	-
11 OCT 1966												
SQ-8104	50 /37N	108W	18.3	6.3	24.0	149. A	31.3C	-	-	-	-	-
SQ-8105	50 /37N	108W	19.6	4.8	23.8	146. A L	15.7	-	-	-	-	-
SQ-8101	09N/11S	80/ 79W	18.3	10.8	16.4	67. A	18.7C	-	-	-	-	-
SQ-8099	11 /27S	79/ 71W	18.3	9.4	15.6	65. B	57.98	-	-	-	-	-
SF-8094	27 /31S	71/ 69W	18.3	2.3	93.1	56. B	243. B	354. A	-	622. C	704. B	127. B
12 OCT 1966												
SQ-8106	50 /37N	108W	15.2	10.9	11.8	45. B	37. C	-	-	-	-	-
SQ-8107	50 /37N	108W	16.8	9.4	17.4	85. A	38. C	-	-	-	-	-
13 OCT 1966												
SQ-8108	30 /09N	96/ 80W	15.2	26.2	1.50	1.1C	20. B	-	-	-	-	-
SQ-8109	36 /25N	105/ 90W	16.8	9.6	5.35	20. B	40. C	-	-	-	-	-
SQ-8111	25 /09N	90/ 80W	16.8	15.3	3.48	10. B	15. B	-	-	-	-	-
SQ-8112	36 /23N	103/ 88W	18.3	9.0	20.4	94. A	48. C	-	-	-	-	-
SQ-8113	23 /09N	88/ 80W	18.3	7.8	17.2	95. A	45. C	-	-	-	-	-
SQ-8114	36 /09N	103/ 80W	19.6	11.6	22.2	104. A	22. C	-	-	-	-	-
25 OCT 1966												
SF-8162	47 /41N	122/112W	13.1	33.5	0.44	1.3C L	1.4	-	-	-	-	-
26 OCT 1966												
SQ-8144	64 /55N	146/134W	13.1	25.8	7.12	26. B	7.5C	-	-	-	-	-
SF-8163	47 /41N	118/112W	11.9	34.6	0.79	1.98 L	0.7	-	-	-	-	-

ISOTOPES, INCORPORATED

TABLE 3 FISSION PRODUCTS IN STARDUST SAMPLES

SAMPLE NUMBER	LATITUDE (DEG.)	LONGITUDE (DEG.)	ALTITUDE (KM)	VOLUME (100 SCM)	TOTAL BETA (PC/SCM)	ACTIVITIES (PC/100 SCM)							
						SR 90	SR 89	ZR 95	CS 137	BA 140	CE 141	CE 144	
27 OCT 1966													
SF-8164	55 /48N	134/119W	11.9	30.4	2.44	13. B	L 5.4	-	-	-	-	-	-
SQ-8115	09N/07S	80/ 81W	16.8	5.6	118.	11. C	321. B	-	-	-	-	-	-
SF-8118	09N/07S	80/ 81W	16.8	11.2	119.	9.5B	342. B	401. B	-	914. A	887.8	90. A	-
SF-8117	07 /15S	81/ 77W	16.8	6.2	283.	13. B	797. B	900. A	34.4B	2480. A	2340.3	192. A	-
SQ-8116	15 /31S	77/ 69W	16.8	6.0	63.	50. B	234. B	-	-	-	-	-	-
SF-8119	15 /31S	77/ 69W	16.8	12.0	63.	43. B	173. B	210. B	-	364. B	448.3	86. A	-
28 OCT 1966													
SQ-8145	64 /55N	146/134W	11.9	29.2	2.47	18. B	5.2C	-	-	-	-	-	-
SF-8165	41 /35N	112/107W	11.9	30.0	0.23	1.0C	L 0.8	-	-	-	-	-	-
29 OCT 1966													
SF-8166	55 /47N	134/119W	13.1	12.5	5.56	40. B	L 8.4	-	-	-	-	-	-
SF-8167	41 /35N	112/107W	13.1	16.0	3.03	13.2B	3.8C	-	-	-	-	-	-
06 NOV 1966													
SF-8168	36 /10N	103/ 80W	9.1	12.2	0.27	0.4C	L 0.4	-	-	-	-	-	-
SF-8169	35 /10N	102/ 80W	15.2	30.3	1.47	1.7C	3.3C	-	-	-	-	-	-
SF-8171	34 /10N	104/ 80W	16.8	10.9	8.00	19. B	4.9D	-	-	-	-	-	-
SF-8172	34 /22N	100/ 87W	18.3	4.0	20.4	114. B	L 4.4	-	-	-	-	-	-
SF-8173	22 /10N	87/ 80W	19.9	2.4	15.9	148. A	L 2.6	-	-	-	-	-	-
07 NOV 1966													
SF-8174	64 /37N	146/108W	15.2	16.0	7.18	49. B	L 7.7	-	-	-	-	-	-
SF-8175	64 /37N	146/108W	19.3	9.1	18.6	129. B	L 13.	-	-	-	-	-	-
10 NOV 1966													
SQ-8146	75 /61N	143/146W	18.3	5.5	19.3	96. B	L 1.6	-	-	-	-	-	-
SQ-8147	75 /64N	143/146W	19.3	3.6	18.2	90. B	L 2.9	-	-	-	-	-	-
SF-8176	50 /36N	108W	16.8	4.2	16.8	103. B	L 5.4	-	-	-	-	-	-
SF-8177	50 /36N	108W	19.5	2.5	18.3	117. B	L 1.8	-	-	-	-	-	-
SF-8178	07N/07S	80/ 78W	15.2	23.7	3.12	0.7C	11.2C	-	-	-	-	-	-
SF-8179	07N/01S	80/ 79W	16.8	8.6	8.32	4.2C	38. B	-	-	-	-	-	-
SF-8133	01 /12S	79/ 76W	16.8	9.0	57.7	11.73	274. B	696. B	-	458. B	990.8	101. A	-
SF-8132	07 /14S	78/ 76W	15.2	11.9	108.	5.2B	362. A	471. B	-	698. A	1160.3	132. A	-
SQ-8148	13 /32S	76/ 68W	19.3	8.2	14.9	63. A	L 1.4	-	-	-	-	-	-

TABLE 3 FISSION PRODUCTS IN STARDUST SAMPLES

SAMPLE NUMBER	LATITUDE (DEG.)	LONGITUDE (DEG.)	ALTITUDE (KM)	VOLUME (100 SCM)	TOTAL BETA (PC/SCM)	ACTIVITIES (PC/100 SCM)						
						SR 90	SR 89	ZR 95	CS 137	BA 140	CE 141	CE 144
11 NOV 1966												
SQ-8149	75 /64N	143/146W	15.2	9.0	21.9	100. B	11.8D	-	-	-	-	-
SQ-8151	75 /64N	143/146W	16.8	6.0	23.6	127. B	L 0.9	-	-	-	-	-
SF-8134	09N/30S	80/ 69W	8.8	14.1	12.8	1.0B	42. A	70. A	-	60. A	143.8	16.4
SF-8181	07N/21S	80/ 73W	9.1	96.2	3.34	0.2C	12.4B	-	-	-	-	-
SF-8135	21 /32S	73/ 69W	9.1	48.5	37.7	4.0B	146. A	175. B	-	239. A	472.8	62.4
SQ-8152	35 /54S	68W	15.2	7.8	15.5	54. B	L 7.1	-	-	-	-	-
SF-8182	35 /39S	68W	15.2	3.6	22.8	36. B	69. B	-	-	-	-	-
SF-8183	39 /54S	68W	15.2	6.0	13.4	59. B	L 9.9	-	-	-	-	-
SQ-8153	33 /54S	69/ 68W	16.8	6.2	62.1	37. B	190. B	-	-	-	-	-
SF-8136	33 /46S	69/ 68W	16.8	8.1	77.2	53. B	417. B	510. A	-	611. B	1110.8	158.4
SF-8184	46 /54S	68W	16.8	4.4	32.4	43. B	118. B	-	-	-	-	-
12 NOV 1966												
SF-8185	64 /37N	146/108W	16.8	10.6	16.3	87. B	14. C	-	-	-	-	-
SF-8187	08N/10S	80/ 77W	18.3	9.4	6.58	33. B	L 5.7	-	-	-	-	-
SF-8137	11 /19S	76/ 74W	15.2	7.0	118.	11.2B	637. B	1020. A	-	1230. B	2180.8	241.4
SF-8186	19 /23S	74/ 72W	15.2	7.0	1.65	2.6C	10.2C	-	-	-	-	-
SF-8138	23 /31S	72/ 69W	15.2	8.5	148.	16.5B	656. A	720. B	-	1190. A	1690.8	193.4
SF-8139	30 /54S	69/ 68W	8.2	43.4	5.73	0.9B	30. A	48.5A	-	43. A	82.8	12.4
SQ-8156	34 /54S	69/ 68W	7.6	77.7	4.92	0.6B	17.0B	-	-	-	-	-
SQ-8157	33 /50S	69/ 68W	9.1	53.0	8.26	1.2B	29. B	-	-	-	-	-
SQ-8154	36 /54S	68W	18.3	7.8	10.4	65. B	L 0.6	-	-	-	-	-
SQ-8155	33 /54S	69/ 68W	19.8	6.0	10.3	58. B	L 0.8	-	-	-	-	-
13 NOV 1966												
SQ-8158	35 /22N	101/ 87W	19.6	7.1	19.0	125. B	L 0.8	-	-	-	-	-
SF-8188	22 /10N	87/ 80W	18.3	7.2	11.1	78. B	L 6.2	-	-	-	-	-
SF-8142	09N/30S	80/ 69W	8.5	27.1	3.79	0.4A	15.9A	27.9A	-	28.1B	51.8	7.4
SF-8191	08N/17S	80/ 75W	9.1	77.2	1.09	0.10	1.8B	-	-	-	-	-
SQ-8159	08N/10S	80/ 77W	19.2	7.4	11.2	69. B	L 11.	-	-	-	-	-
SF-8192	11 /15S	76/ 75W	16.8	4.8	1.00	0.70	L 3.8	-	-	-	-	-
SF-8189	17 /30S	75/ 69W	9.1	45.8	7.72	0.7C	30. B	-	-	-	-	-
SF-8141	15 /31S	75/ 69W	16.8	12.4	76.7	33. B	300. A	606. B	-	508. B	839.8	115.4
15 NOV 1966												
SQ-8161	36 /10N	103/ 80W	9.4	14.2	0.29	0.1C	L 0.5	-	-	-	-	-
20 NOV 1966												
SF-8233	47 /41N	122/112W	11.9	26.8	2.20	10.4B	L 3.4	-	-	-	-	-
SF-8234	47 /41N	122/112W	13.1	21.3	3.94	11.3B	9.2B	-	-	-	-	-
22 NOV 1966												
SQ-8229	64 /55N	146/134W	11.9	32.8	3.50	12.1B	5.8C	-	-	-	-	-
SQ-8231	64 /55N	146/134W	13.1	26.8	6.45	34. B	11.4B	-	-	-	-	-
SF-8235	55 /47N	134/122W	11.9	25.9	2.53	14.8B	L 1.3	-	-	-	-	-
SF-8236	55 /48N	134/119W	13.1	25.6	3.10	12.3B	L 3.5	-	-	-	-	-

ISOTOPES, INCORPORATED

TABLE 3 FISSION PRODUCTS IN STARDUST SAMPLES

SAMPLE NUMBER	LATITUDE (DEG.)	LONGITUDE (DEG.)	ALTITUDE (KM)	VOLUME (100 SCM)	TOTAL BETA (PC/SCM)	ACTIVITIES (PC/100 SCM)							
						SR 90	SR 89	ZR 95	CS 137	BA 140	CE 141	CE 144	
23 NOV 1966													
SF-8237	41 /35N	112/107W	11.9	21.4	3.03	10.08	L 5.0	-	-	-	-	-	-
SF-8238	41 /35N	112/107W	13.1	17.8	4.43	13.58	L 5.0	-	-	-	-	-	-
04 DEC 1966													
SX-8202	35 /10N	105/ 80W	7.5	71.2	0.15	0.20	0.40	-	-	-	-	-	-
SX-8203	35 /09N	102/ 80W	16.8	23.8	5.66	11.43	16.03	-	-	-	-	-	-
SX-8221	34 /22N	99/ 87W	18.3	8.0	16.9	82.3	-	-	-	-	-	-	-
SX-8222	22 /10N	87/ 80W	19.9	4.8	21.8	112.8	-	-	-	-	-	-	-
05 DEC 1966													
SX-8204	64 /37N	146/108W	16.8	22.3	15.3	63. A	L 3.7	-	-	-	-	-	-
SX-8223	64 /37N	146/108W	18.2	16.8	19.7	97. B	-	-	-	-	-	-	-
SX-8205	35 /09N	101/ 80W	15.2	34.2	3.71	6.58	8.68	-	-	-	-	-	-
SF-8197	09N/33S	80/ 69W	7.0	52.7	1.44	0.48	6.28	10.14	-	5.70	20.3	4.3	-
06 DEC 1966													
SF-8193	07N/12S	80/ 76W	16.8	14.0	18.8	8.98	77. B	122.3	-	61.40	228.3	52.8	-
SX-8206	07N/12S	80/ 76W	16.8	7.0	18.8	9.20	74. B	-	-	-	-	-	-
SX-8207	14 /32S	76/ 69W	19.4	7.6	12.6	55. B	L 11.0	-	-	-	-	-	-
07 DEC 1966													
SX-8208	75 /64N	143/146W	15.2	9.1	15.8	112. B	L 6.5	-	-	-	-	-	-
SX-8224	75 /64N	143/146W	16.8	5.8	15.3	86. A	-	-	-	-	-	-	-
SX-8225	75 /62N	143/145W	18.3	5.7	19.2	100. B	-	-	-	-	-	-	-
SX-8226	75 /65N	143/147W	19.2	4.0	15.2	69. B	-	-	-	-	-	-	-
SF-8194	33 /54S	69/ 68W	7.3	27.0	2.37	0.88	7.48	10.04	-	6.40	25.9	6.9	-
SX-8209	34 /54S	68W	7.6	37.0	2.66	1.08	7.04	-	-	-	-	-	-
SF-8195	35 /47S	68W	15.2	9.9	45.7	26. B	192. B	266. B	-	125. B	563. B	114.8	-
SF-8239	47 /51S	68W	15.2	3.1	14.7	31. B	L 20.0	-	-	-	-	-	-
SX-8211	35 /51S	68W	15.2	6.4	38.2	33. B	165. A	-	-	-	-	-	-
SX-8212	34 /51S	68W	16.8	9.6	18.3	40. B	60. B	-	-	-	-	-	-
SF-8242	34 /43S	68W	16.8	2.5	29.4	44. B	112. B	-	-	-	-	-	-
SF-8241	43 /51S	68W	16.8	2.3	6.13	33. B	L 9.0	-	-	-	-	-	-
08 DEC 1966													
SF-8198	64 /36N	144/108W	15.2	15.0	13.0	74. A	7.10	6.10	-	L 1.7	L 43.0	78.8	-
SX-8213	64 /36N	144/108W	15.2	29.9	13.0	76. A	L 0.8	-	-	-	-	-	-
SX-8214	36 /51S	68W	18.3	7.0	14.1	68. B	L 7.9	-	-	-	-	-	-
SX-8215	34 /51S	69/ 68W	19.4	5.8	11.0	58. B	L 2.0	-	-	-	-	-	-
09 DEC 1966													
SX-8228	35 /22N	106/ 87W	19.4	7.8	16.3	105. A	-	-	-	-	-	-	-
SX-8227	22 /09N	87/ 80W	18.3	7.6	10.9	54. B	-	-	-	-	-	-	-
SX-8218	08N/10S	80/ 77W	18.3	10.6	14.7	35. B	28. B	-	-	-	-	-	-
SX-8219	08N/09S	80/ 77W	19.4	6.6	13.5	70. A	L 17.0	-	-	-	-	-	-
SX-8216	11 /31S	76/ 69W	15.2	22.9	7.42	2.90	37. A	-	-	-	-	-	-
SF-8196	11 /30S	76/ 69W	16.8	15.6	31.2	12.08	141. B	222. B	-	90. B	408.0	87.3	-
SX-8217	11 /30S	76/ 69W	16.8	7.8	31.2	12.18	148. B	-	-	-	-	-	-

ISOTOPES, INCORPORATED

TABLE 3 FISSION PRODUCTS IN STARDUST SAMPLES

SAMPLE NUMBER	LATITUDE (DEG.)	LONGITUDE (DEG.)	ALTITUDE (KM)	VOLUME (100 SCM)	TOTAL BETA (PC/SCM)	ACTIVITIES (PC/100 SCM)							
						SR 90	SR 89	ZR 95	CS 137	BA 140	CE 141	CE 144	
10 DEC 1966													
SF-8243	07N/10S	80/ 78W	7.4	94.5	0.09 L	0.1	L	0.7	-	-	-	-	-
SF-8244	13 /31S	77/ 69W	7.3	70.7	1.29	0.2C	3.7C	-	-	-	-	-	-
11 DEC 1966													
SF-8245	35 /11N	106/ 81W	7.3	22.0	0.04	0.2C	L	0.4	-	-	-	-	-
18 DEC 1966													
SF-8295	47 /41N	122/112W	11.9	29.0	0.07	0.78	-	-	-	-	-	-	-
SF-8268	47 /41N	122/112W	13.1	86.7	0.46	0.6A	2.58	-	-	-	-	-	-
19 DEC 1966													
SX-8253	64 /55N	146/134W	11.9	6.4	2.46	12.88	6.5C	-	-	-	-	-	-
SX-8254	64 /55N	146/134W	13.1	89.4	3.20	14.18	4.5C	-	-	-	-	-	-
20 DEC 1966													
SF-8269	55 /51N	134/127W	11.9	58.6	2.23	8.38	L	1.5	-	-	-	-	-
SF-8271	51 /47N	127/122W	11.9	38.0	1.62	9.58	L	1.8	-	-	-	-	-
21 DEC 1966													
SF-8272	55 /51N	133/127W	13.1	45.6	1.90	10.38	5.48	-	-	-	-	-	-
SF-8273	51 /49N	127/123W	13.1	31.5	0.96	2.78	L	2.9	-	-	-	-	-
SF-8274	41 /35N	112/107W	11.9	69.4	0.51	2.48	L	1.9	-	-	-	-	-
22 DEC 1966													
SF-8275	41 /35N	112/107W	13.1	54.8	0.87	1.98	L	1.6	-	-	-	-	-

GLOBAL ATMOSPHERIC RADIOACTIVITY,

NOVEMBER 1963, MAY 1964

NOVEMBER 1964, MAY 1965

AUGUST 1965 and NOVEMBER 1965

Introduction:

In November 1963, May 1964, November 1964, May 1965, August 1965 and November 1965, USAF aircraft were deployed to make a series of vertical profiles of particulate radioactivity in the atmosphere. Aircraft sampling was normally conducted in the vicinity of four latitudes: 70°N, 35°N, 10°N and 40°S. Altitudes samples varied from approximately 15,000 feet to about 65,000 feet. Radiochemical analysis was by government laboratories.

These data were collected as part of a cooperative effort by the U.S. Department of Defense, Atomic Energy Commission and Environmental Science Services Administration, and are a continuation of similar sampling programs conducted in the past (1, 2, 3, 4, 5).

Data:

A summary of the data is given in the tables.

Date	Date (GCT) on which the filter was extracted from the aircraft, immediately after landing.
Altitude	Pressure altitude (in thousands of feet) at which sampling was performed.
Tropopause	Height of tropopause (in thousands of feet) as reported by a nearby radiosonde station.
Isotopic data	All data are reported in units of disintegrations per minute per 1000 standard cubic feet of air. In many instances a filter paper was split and duplicate radiochemical analyses were performed. For those cases more than one number is reported. All radioactivity data with the exception of Cd-109 are corrected for

decay to day of extraction of the filter. Cd-109 is corrected to July 9, 1962. The following constants were used:

<u>Isotope</u>	<u>Half-life</u> <u>Days</u>	<u>Decay Constant</u> <u>Days⁻¹</u>
Be-7	53.0	0.0131
Na-22	949	0.00073
Mn-54	309	0.00224
Fe-55	1073	0.000646
Sr-89	53.0	0.0131
Sr-90	10104	0.0000686
Zr-95	63.6	0.0109
Cd-109	470	0.00147
Cs-137	9708	0.0000714
Ce-144	282	0.00246
Pb-210	8030	0.0000863
Pu-238	31500	2.2×10^{-5}
Pu-239	8800000	7.8×10^{-8}

Unless otherwise indicated, the precision of the radiochemical analysis is within 3%. Standard errors in the analysis greater than 3% are indicated by a lower case letter following the value in accordance with the following code:

- a 3-10%
- b 11-20%
- c 21-40%
- d 41-100%
- e > 100%

LIA indicates the isotope was lost in the radiochemical analyses.

N.R. indicates the isotope was not detected in resolvable amounts.

ACKNOWLEDGMENTS

This program would not have been possible without the cooperation of the Government of Australia.

REFERENCES

1. Fallout Program, Quarterly Summary Report, Health and Safety Laboratory, New York Operations Office, U.S.A.E.C., HASL-115, October 1, 1961, pp. 177-183.
2. Fallout Program, Quarterly Summary Report, Health and Safety Laboratory, New York Operations Office, U.S.A.E.C., HASL-117, December 30, 1961, pp. 225-229.
3. Fallout Program, Quarterly Summary Report, Health and Safety Laboratory, New York Operations Office, U.S.A.E.C., HASL-142, January 1, 1964, pp. 272-276.
4. Fallout Program, Quarterly Summary Report, Health and Safety Laboratory, New York Operations Office, U.S.A.E.C., HASL-165, January 1, 1966, pp. 301-311.
5. Fallout Program, Quarterly Summary Report, Health and Safety Laboratory, New York Operations Office, U.S.A.E.C., HASL-172, July 1, 1966, pp. 164-171.

TABLE I

Atmospheric Radioactivity Data, November, 1963

Latitude	70-71°N	70°N	70°N	70-72°N	71-73°N	70-72°N	30-35°N
Date	6	20	20	5	5	5	6
Altitude (K ft.)	15	15	40	50	60	66	16
Tropopause (Ht., K ft.)	28-20	28-30	28-30	30-32	30-32	30-32	34-35
Isotope							
Be-7	-	17.4d	590	820	850a	1180a	-
	-	-	490	620	930a	1130	-
	-	-	440a	-	-	1190	-
Mn-54	-	4.8	540	930	1270	1300	-
	-	-	470	940	2120	1890	-
Fe-55	-	23.0	3290	5720	8330	8100	-
	-	-	2140	4370	7110	6260	-
Sr-89	1.8	5.7b	210	560a	1080a	1040a	1.5a
	-	-	260	600a	1440a	1140	-
Sr-90	3.1	5.2	410	720	1310	1200	2.1
	-	-	380	650	1220	1160	-
Zr-95	7.8	8.5	960	2140	3890	3960	6.0
	-	-	920	1950	3880	3800	-
Cs-137	5.1	5.0	670	1120	1400	1580	3.1
	-	-	540	910	1800	1470	-
Ce-144	48.4	53.4	5780	10450	16850	17760	31.5
	-	51.9	5610	11880	21620	18370	-
	-	-	5430	9860	19080	16540	-
Pu-238	0.002	0.01	0.10a	0.17a	0.34a	0.35a	-
	-	-	0.08a	0.16b	0.31a	0.35b	-
	-	-	0.11a	0.18a	0.27a	0.34a	-
	-	-	-	0.16	-	-	-
Pu-239	0.03a	0.04b	3.7	6.4a	12.6	12.6	0.02b
	-	0.03a	4.5a	6.4a	13.7	13.4	-
	-	-	3.2	7.1	11.3	12.7	-
	-	-	-	6.9	-	-	-

Table I (continued)

November 1963

Latitude	30-31°N	32-33°N	10°N	8°N	40-41°S	41-43°S
Date	6	19	4	5	19	19
Altitude (K ft.)	40	67	15	69	15	65
Tropopause (Ht., K ft.)	34-35	36-44	52	54	34	34
Isotope						
Be-7	100b	890b	-	240b	-	830a
	<170	780	-	300b	-	360b
	-	810a	-	270c	-	NR
Mn-54	34.7	1560	-	1440	-	2100
	-	1260	-	1610	-	2020
Fe-55	170	8740	-	8460	-	1220
	-	5930	-	6390	-	870
Sr-89	14.1a	810a	NR	590a	NR	38.1c
	25.2a	1320a	-	700b	-	56.4a
Sr-90	25.7	1280	0.06	1100	0.9a	280
	20.2	1080	-	930	-	230
Zr-95	70.7	3640	NR	2670	0.7	200
	64.5	3000	-	2100	-	180
Cs-137	37.2	1890	-	1700	1.3	390
	31.3	1500	-	1270	-	290
Ce-144	440	17640	14.4	14510	NR	2390
	430	18030	-	15530	-	2350
	340	15580	-	13400	-	2080
Pu-238	0.007b	0.29a	-	0.35a	-	0.10b
	0.006c	0.36a	-	0.32a	-	0.11b
	0.005c	0.33a	-	0.33a	-	0.12a
	-	0.23a	-	0.31a	-	0.11a
Pu-239	0.2	12.7	0.001b	9.3a	0.009	1.7a
	0.3a	15.0a	-	10.5a	-	1.5b
	0.2	11.9	-	9.7	-	1.5
	-	10.7a	-	-	-	-

TABLE II

Atmospheric Radioactive Data, May, 1964

Latitude	70°N	71°N	70-72°N	70-73°N	70-71°N	70-73°N	72-73°N
Date	18	18	19	18	19	5	18
Altitude (K ft.)	15	40	50	60	60	64	64
Tropopause (Ht., K ft.)	26-35	26-35	27-32	26-35	27-32	24-26	26-35
Isotope							
Be-7	26.7b - -	620a 590a 720	540 610a -	820a 1030a -	850a - -	820a - -	730a - -
Na-22	-	1.70a	1.92a	1.29a	-	0.91a	-
Mn-54	11.6a -	340 370	310 380	420 500	- -	280 280	- -
Fe-55	96.3 -	2280 -	2250 2340	2850a 2870	- -	1650 1470a	- -
Sr-90	22.3 17.3	400 420	380 -	530 -	670 -	370 -	400 -
Zr-95	5.7 6.6	150 160	130 -	170 -	220 -	110 -	120 -
Cs-137	34.8 25.0 -	580 640 640	550 650 -	760 860 -	980 - -	540 450 -	580 - -
Ce-144	220 180 180a	3770 4030 4320	4580 4160 -	6000 5500 -	5740 - -	3050 3160 -	3220 - -
Pu-238	NR 0.004a 0.002a 0.005c	0.10a 0.12a 0.11a 0.12a	0.17a 0.16a 0.16a -	0.30a 0.28a 0.26b -	0.29a - - -	0.20a 0.08a 0.21a -	0.20a - - -
Pu-239	0.3a 0.2a 0.2 0.2	4.1 4.4a 4.5 4.5	5.3 4.8 4.7a -	6.2 5.4 6.1 -	6.2a - - -	2.9 2.4 2.9 -	2.8 - - -

Table II (continued)

May 1964

Latitude	30-35°N	35°N	32°N	32°N	33-35°N	10°N	7-9°N
Date	20	21	20	19	19	June 1	May 19
Altitude (K ft.)	15	40	50	60	67	15	67
Tropopause (Ht., K ft.)	43-44	36-39	43-44	45-46	45-46	-	55
Isotope							
Be-7	-	40.6c	240a	570b	610a	-	250c
	-	34.4b	170c	400c	360c	-	<200
	-	-	230a	570a	540c	-	180a
Na-22	-	NR	0.43a	1.82a	1.81a	-	2.02a
Mn-54	7.2	2.7d	110	510	450	-	450
	-	2.0b	110	380a	410	-	470
Fe-55	36.7	11.8a	NR	3530a	3110	-	3300a
	-	-	620	2500	2580	-	2730
Sr-90	0.8	2.4	140	400a	510	0.2	450
	-	-	100	-	-	-	-
Zr-95	2.9	0.9a	44.1	230	190	NR	170
	-	-	39.7	150	190	-	160
Cs-137	-	3.7	210	890	840	0.3	-
	-	3.6	150	600	750	-	-
	-	-	140	700	770	-	-
Ce-144	72.6	23.1	1190	5540	4760	1.9	4540
	71.2	24.0	900	3610	4300	-	3890
	-	-	1170	4660	4730	-	4740
Pu-238	0.001d	NR	0.03b	0.18a	0.26a	NR	0.13a
	0.002c	0.003	0.04a	0.49a	0.20a	-	0.16a
	0.002a	-	0.03a	0.28a	0.24a	-	0.23a
	-	-	-	0.17b	0.22b	-	0.15a
Pu-239	0.08	-	1.3a	6.1	5.4a	0.001	4.7
	0.07	-	1.2a	6.2	5.2a	-	4.8
	-	-	1.2	6.4	6.1	-	6.9
	-	-	1.0a	4.2	5.5a	-	4.4a

Latitude	40-44°S	40-42°S
Date	6	5
Altitude (K ft.)	15	64
Tropopause (Ht., K ft.)	-	39
Isotope		
Be-7	-	190c
	-	470a
Na-22	-	0.2c
Mn-54	-	48.5
	-	110
Fe-55	-	320c
	-	660
Sr-90	0.4a	-
Zr-95	NR	13.0a
Cs-137	0.6a	100
	-	220
Ce-144	4.2	470
	-	1210
Pu-238	NR	0.03a
	-	0.07a
	-	0.04a
	-	0.02c
	0.001	0.8
	-	1.2
	-	0.6
	-	-

TABLE III

Atmospheric Radioactive Data, November 1964

Latitude	70-75°N	70-75°N	70°N	70°N	70°N	70-71°N	70-75°N
Date	2	3	17	3	17	2	30
Altitude (K ft.)	15	40	40	50	50	60	60
Tropopause (Ht., K ft.)	27-37	25-26	33-37	25-26	33-37	28-31	29-37
Isotope							
Be-7	20.3b -	790 680	580 -	820 850a	880a -	1240 1220	1160a -
Na-22	NR	NR	-	NR	-	0.80b	-
Mn-54	0.7c -	140a 130	- -	190a 220	- -	78.8 86.5	- -
Fe-55	0.01c -	1250a 930	- -	1810b 1700	- -	590b 610	- -
Sr-90	1.5	290	160	440	320	220	360
Zr-95	2.8	14.9	7.4a	18.3	17.1a	7.9a	13.6a
Cd-109	0.2c	2.3c	-	9.0a	-	2.5c	-
Cs-137	2.2 -	390 300	770 -	450 560	300 -	240 260	490 -
Ce-144	8.2 -	1350 1390	860 -	2020 2500	2070 -	1040 1060	1850 -
Pu-238	0.002d - -	0.08b 0.07a 0.07a	0.05c - -	0.13a 0.15a 0.15a	0.13a - -	0.11b 0.14a 0.14a	0.13d - -
Pu-239	0.01 - -	2.3 2.1 2.0	1.3 - -	3.3 3.7 3.5a	3.3 - -	1.5 1.5 1.4	3.3 - -

Table III (continued)

November 1964

Latitude	70°N	70-75°N	30-35°N	32-34°N	31-34°N	35°N	7-9°N
Date	2	30	19	5	4	30	3
Altitude (K ft.)	63	63	16	39	60	60	68
Tropopause (Ht., K ft.)	28-31	29-37	-	48-52	55	42-44	48
Isotope							
Be-7	1260c 1120	1050 -	19.3 -	19.7d -	360b -	740a 690a	350b -
Na-22	1.40b	-	0.03b	NR	-	1.25a	-
Mn-54	93.8 94.4	- -	1.0b -	0.5b -	- -	170a 170	- -
Fe-55	860c 660	- -	NR -	NR 2.3d	- -	1600 1070	- -
Sr-90	250	280	2.2	1.0b	310	430	440
Zr-95	7.8a	10.1a	0.3a	0.5a	19.6a	14.2	25.5a
Cd-109	13.5b	-	NR	NR	-	6.1b	-
Cs-137	290 250	400 -	2.7 -	1.2a 1.0	970 -	480 450	1330 -
Ce-144	1080 1090	1530 -	10.6 -	4.6 4.3	1900 -	1850 1830	2570 -
Pu-238	0.12b 0.12a 0.12a	0.13d - -	- - -	<0.003 0.001 -	- - -	0.18a 0.14a 0.14a	0.20b - -
Pu-239	1.7 1.6 1.4	2.3 - -	0.02 - -	0.007b 0.006a 0.006b	3.4 - -	3.3 3.0 2.7	4.2 - -

Table III (continued)

November 1964

Latitude	7-9°N	42-45°S	40-43°S
Date	17	3	17
Altitude (K ft.)	68	65	67
Tropopause (Ht., K ft.)	56	30-36	39-40
Isotope			
Be-7	160d	390b	960a
	140a	560a	-
Na-22	2.22b	0.46b	-
Mn-54	260	56.0	-
	220	59.4	-
Fe-55	2650	640b	-
	1770a	450	-
Sr-90	540	160	120
Zr-95	21.1a	3.9	2.2
Cd-109	-	22.6	-
Cs-137	660	180	220
Ce-144	2460	570	600
	2350	570	-
Pu-238	0.07d	0.04b	0.03d
	0.12a	0.04a	-
	0.14b	0.06a	-
Pu-239	4.2	0.9a	0.7a
	3.5	0.8a	-
	4.4a	0.8	-

TABLE IV

Atmospheric Radioactive Data, May, 1965

Latitude	62-70°N	70-75°N	70-75°N	70-75°N	70°N	70-75°N	30-35°N
Date	18	19	4	3	3	3	3
Altitude (K ft.)	15	40	50	60	62	62	15
Tropopause (Ht., K ft.)	29-36	31-36	27-28	28-31	28-31	28-31	47-50
Isotope							
Be-7	-	890a	950a	1210b	690c	850d	-
	-	740b	-	1520	-	1150a	-
	-	760	-	-	-	-	-
Mn-54	1.2a	78.0a	5.9	110a	63.4a	73.6a	1.1b
	-	62.6	6.1	110a	-	-	-
Fe-55	12.7b	950a	62.1	1300b	550c	710	7.5
	-	620	-	1140	-	-	-
Sr-90	2.3	200	260	290	180	200	2.4
	-	190	-	-	-	-	-
Cd-109	-	0.5d	-	12.8	7.8d	-	-
Cs-137	5.0	300	390	LIA	LIA	310	-
	-	270	-	450	-	290	-
	-	250	-	-	-	-	-
Ce-144	-	750	900	1060	630	560	-
	-	560	-	1190	-	780	-
	-	630	-	-	-	-	-
Pu-238	0.01	0.08b	0.14b	0.18b	0.05d	0.16d	0.007c
	-	0.08c	-	0.15b	-	0.13a	-
	-	0.08a	-	-	-	-	-
Pu-239	0.02a	2.0	2.6	2.6	1.5	1.6	0.17b
	0.36	1.7	-	2.9	1.9	1.8	0.06b
	0.02a	1.7	-	2.7	-	-	-
	-	1.5	-	-	-	-	-

Table IV (continued)

May, 1965

Latitude	31-35°N	30-35°N	30-35°N	30-35°N	30-35°N	30-35°N
Date	3	18	3	18	3	18
Altitude (K ft.)	39	50	60	60	64	63
Tropopause (Ht., K ft.)	47-50	40-41	43-44	40-41	43-44	40-41
Isotope						
Be-7	NR	490a	-	390c	460a	400b
	20.1	-	-	610a	-	-
	-	-	-	-	-	-
Mn-54	NR	-	-	53.8	78.6	71.3
	0.6c	-	-	52.9	-	-
Fe-55	NR	-	-	760	680	910
	7.9	-	-	540	-	-
Sr-90	1.5	130	180	150	200	200
Cd-109	NR	-	-	NR	-	6.9c
Cs-137	4.2b	200	110	220	110	290
	2.3	-	-	220	290	-
Ce-144	4.9a	450	650	560	730	710
	5.4	-	-	600	760	-
Pu-238	< 0.004	0.06	-	0.07	NR	0.13b
	-	-	-	0.08	0.07c	-
	-	-	-	-	-	-
Pu-239	0.02b	1.2	1.5	1.4	1.8	1.9
	0.01b	-	-	1.4	1.7	1.5
	0.01a	-	-	1.8	-	-

Table IV (continued)

May, 1965

Latitude	5-10°N	7-10°N	5-10°N	40-44°S	40-45°S	40°S
Date	18	22	22	19	18	4
Altitude (K ft.)	52	60	66	40	62	66
Tropopause (Ht., K ft.)	52	57	57	29-34	33-35	38-41
Isotope						
Be-7	NR 83.1 -	110 190a -	180c - -	710c 780a 1010	NR 1140a -	520b - -
Mn-54	NR < 3.8	52.5 42.2	110a -	15.8a 23.9	26.4 -	26.9 -
Fe-55	NR < 16	630b 470	1300b -	230b 230	270a -	290c -
Sr-90	5.7a -	140 -	290 -	55.0 61.1a	120 -	86.1 -
Cd-109	NR	6.0d	5.2d	4.7c	-	8.4c
Cs-137	13.1 4.7 -	LIA 170 -	LIA - -	72.5 35.9 100	170 130 -	120 - -
Ce-144	18.8 85.3 -	500 440 -	1080 - -	160 180 240a	390 300 -	290 - -
Pu-238	< 0.006 - -	0.12c 0.06b -	0.08d - -	0.03c 0.03c 0.04a	0.16d 0.14b -	0.04c - -
Pu-239	0.06 0.02 0.03 -	1.3a 1.1 1.0 -	3.0a - - -	0.4a 0.5 0.5 0.4	1.0 0.7a - -	0.7a 0.6 - -

TABLE V

Atmospheric Radioactivity Data, August 1965

Latitude	70-75°N	70-75°N	70-75°N	30-35°N	30-35°N	31-35°N	5-10°N
Date	27	27	27	22	9	22	25
Altitude (K ft.)	40	50	64	40	50	65	60
Tropopause (Ht., K ft.)	30-33	30-33	30-33	47	52-54	45-52	52
Isotope							
Be-7	770a 570	1030a 850	980a 580	31.4d 52.8a	320a 320a	540b 860	310c 450
Mn-54	26.7a 22.2	61.5a 43.4	38.3a 34.2	NR ≤ 1.5	8.0b 17.9a	51.8a 52.9	38.7a 43.5
Fe-55	360b 250	720a 510	440c 380	48.8b 0.9d	94.1d 76.2a	670b 590	450c 500
Sr-90	84.2	160	110	0.6	21.3	160	120
Cs-137	130 100	230 190	150 160	2.2 0.9	35.5 32.3	230 260	180 210
Ce-144	250 210	430 430	320 320	1.8a 1.9	61.1 66.2	440 530	650 410
Pb-210	0.48c	0.30b	≤ 0.11	0.21c	0.44b	≤ 0.09	0.89b
Pu-238	0.009e 0.04a	0.07b 0.06a	0.13c 0.07b	≤ 0.005	0.008d	0.02e 0.10a	0.06e 0.07b
Pu-239	0.71a 0.65a 0.64	1.6 1.4 1.3	0.96a 0.99a 1.1a	0.02c 0.004c 0.004b	0.19a 0.19a 0.21	1.4a 1.7a 1.5	1.0a 1.3a 1.2

Table V (continued)

August 1965

Latitude	5-10°N	40-43S	40-43°S
Date	10	24	24
Altitude (K ft.)	67	60	63
Tropopause (Ht., K ft.)	49	36-38	36-38
Isotope			
Be-7	350b 330a	210c 790	100d 770
Mn-54	76.4a 70.4	20.9b 24.0a	31.4a 26.6
Fe-55	950 760	340d 290	450c 320a
Sr-90	240	88.2	130
Cs-137	360 350	120 120	170 120
Ce-144	950 590	220 270	310 230
Pb-210	0.75c	< 0.23	< 0.36
Pu-238	0.10c 0.11a	1.6a	1.9a 3.9
Pu-239	2.1a 2.2a 2.0	0.7b 0.8a 1.0a	1.0a 0.8a 0.6a

TABLE VI

Atmospheric Radioactivity Data, November 1965

Latitude	70°N	70-75°N	70-75°N	30-35°N	30-35°N	30-35°N	7-10°N
Date	16	15	16	15	16	29	15
Altitude (K ft.)	40	50	64	50	60	65	64
Tropopause (Ht., K ft.)	30-35	33-36	27-34	44-46	43-46	38-41	56
Isotope							
Be-7	340a 360	1100a 930	770a 810	220d 230	760c 790	790b 640	250c 270a
Mn-54	5.4c 8.9a	85.0a 38.4	27.0a 24.3	47.4c 4.5b	52.4d 34.7a	28.5b 33.1a	30.6a 34.9a
Fe-55	130 120	780 490	460 330a	780 700a	460 330a	390 460a	390 460
Sr-90	29.6	200	120	22.6	190	120	120
Cs-137	43.3 51.6	280 240	170 150	34.6 29.1	270 300	150 160	170 210
Ce-144	89.0 84.2	420 380	260 260	54.1 47.1	440 460	250 240	260 330
Pb-210	0.63a 0.56a	0.57b 0.21c	<0.13 —	0.95c 0.36b	1.68c 0.74b	0.46c <0.15	1.34c 0.85b
Pu-238	0.03a 0.03a	0.05c 0.10a 0.05a	0.11c 0.19a 0.17a	0.01c 0.01c 0.01a	0.08c 0.08b 0.08a	0.11c 0.18a 0.13a	0.07b 0.09a 0.07a
Pu-239	0.28a 0.33 0.29	1.6a 1.5 1.8	0.91a 0.93 0.79	0.21a 0.19a 0.24	1.8a 1.9 1.6	0.86a 1.0a 1.0	0.93a 1.2 1.1

Table VI (continued)

November 1965

Latitude	40-45°S	40-43°S	40-44°S
Date	17	18	18
Altitude (K ft.)	40	60	65
Tropopause (Ht., K ft.)	36	36	36
Isotope			
Be-7	370a 380	490b 600	650b 700
Mn-54	6.5b 5.3	14.4b 20.3	21.9b 13.0a
Fe-55	95.0 34.9c	340 300a	320 200b
Sr-90	26.1	89.7	81.8
Cs-137	34.6 33.0	120 150	110 97.6
Ce-144	54.3 49.4	170a 230	170 160
Pb-210	0.61c 0.44b	0.32c <0.14	0.21c <0.14
Pu-238	0.03b 0.02a	0.80a 1.1a 0.97a	2.8a 2.7 2.9a
Pu-239	0.18a 0.26a 0.22a	0.62a 0.81a 0.74	0.63a 0.59a 0.61a

EURATOM JOINT NUCLEAR RESEARCH CENTRE

ISPRA ESTABLISHMENT

Protection Service

Site Survey and Meteorology Section

QUARTERLY REPORT

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, 250 m^3 / day, measured by gas 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 1 m^2 stainless steel funnels (one in Milan and four at Ispra), 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 and daily at the milk supply station of Milan to give 8 to 15 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 "Radiochimica 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., in press. 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.

SITE : I S P R A

LAT. 45° 49' N

LONG. 8° 37' E

ALT. 250 m

AIR RADIOACTIVITY1966

Month	Gross beta pCi/m ³	⁹⁰ Sr 10 ⁻² pCi/m ³	⁸⁹ Sr 10 ⁻² pCi/m ³	¹³⁷ Cs 10 ⁻² pCi/m ³	²³⁹ Pu 10 ⁻⁴ pCi/m ³	²³⁸ Pu 10 ⁻⁶ pCi/m ³
July	0.14	0.36	0.78	0.49	0.66	5.0
August	0.11	0.29	0.34	0.42	0.50	5.0
September	0.075	0.13	0.13	0.20	0.28	3.8
October	0.039	0.062	0.067	0.12	0.16	2.5
November	0.22	0.095	1.4	0.12	0.28	2.0
December	0.10	0.20	0.27	0.32	0.33	3.1

SITE : I S P R A

LAT. 45° 49' N

LONG. 8° 37' E

ALT. 250 m

AIR RADIOACTIVITY1967

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
January	0.12	1.4	7.1	2.1	2.2	0.23
February	0.26	2.7	30	4.7	3.8	0.61
March	0.20	3.0	31	4.8	7.7	2.3

MONTHLY FALLOUT DEPOSITION

1966

SITE : I S P R A

LAT. 45° 49' N

LONG. 8° 37' E

ALT. 250 m

Month	Gross beta (1)		Strontium-90		⁸⁹ Sr	Cesium-137		Precipitation
	mCi/Km ²	pCi/l	mCi/Km ²	pCi/l	mCi/Km ²	mCi/Km ²	pCi/l	mm
October	2.4	6.9	0.23	0.66	0.14	0.33	0.95	347.8
November	2.2	9.5	0.083	0.36	0.40	0.12	0.52	233.0
December	0.43	13	0.042	1.3	0.051	0.062	1.9	32.6

SITE: M I L A N O

LAT. 45° 28' N

LONG. 9° 12' E

ALT. 131 m

Month	Gross beta (1)		Strontium-90		⁸⁹ Sr	Cesium-137		Precipitation
	mCi/Km ²	pCi/l	mCi/Km ²	pCi/l	mCi/Km ²	mCi/Km ²	pCi/l	mm
October	1.9	6.5	0.15	0.51	0.12	0.28	0.96	293
November	3.4	26	0.097	0.73	0.48	0.15	1.1	133
December	0.56	12	0.048	1.1	0.064	0.070	1.6	45

(1) Potassium-40 equivalent (40 mg / cm²).

MONTHLY FALLOUT DEPOSITION

1967

SITE: I S P R A

LAT. 45° 49' N

LONG. 8° 37' E

ALT. 250 m

Month	Gross beta (1)		Strontium-90		⁸⁹ Sr	Cesium-137		Precipitation
	mCi/Km ²	pCi/l	mCi/Km ²	pCi/l	mCi/Km ²	mCi/Km ²	pCi/l	mm
January	1.5	190	0.030	3.8	0.18	0.074	9.2	8.0
February	5.7	94	0.18	3.0	1.9	0.24	4.0	60.6 (2)
March	6.5	40	0.23	1.4	2.6	0.39	2.4	163.8

SITE: M I L A N O

LAT. 45° 28' N

LONG. 9° 12' E

ALT. 131 m

Month	Gross beta (1)		Strontium-90		⁸⁹ Sr	Cesium-137		Precipitation
	mCi/Km ²	pCi/l	mCi/Km ²	pCi/l	mCi/Km ²	mCi/Km ²	pCi/l	mm
January	1.6	76	0.056	2.7	0.25	0.066	3.1	21
February	3.4	47	0.12	1.6	1.2	0.19	2.7	73
March	5.0	185	0.24	8.9	2.6	0.37	14	27

(1) Potassium-40 equivalent (40 mg / cm²).

(2) Snow 46.0 cm.

Cs-137 in Various Chicago Foods

(Collection Month April, 1967)

S. S. Brar and D. M. Nelson

Division of Biological and Medical Research

Argonne National Laboratory

Argonne, Illinois

Since April, 1961, the Cs-137 and potassium content of the Chicago portion of the Tri-City Diet Sampling program has been determined^{1, 2, 3, 4} in bulk food samples by gamma-ray spectrometry.

The results of April, 1967 quarter are tabulated below in Tables I, II, and III.

Table I

Item	Potassium g/kg	Cesium-137 pc/kg
White Bread (Dry)	2.0	32
Whole Wheat Bread (Dry)	4.3	53
Eggs	1.4	8
Fresh Vegetables:		
Cabbage	2.6	T
Lettuce	1.9	T
Spinach	6.0	7
Peas	1.5	T
Stringbeans	3.0	9
Tomatoes	2.6	19
Root Vegetables (Fresh):		
Carrots	3.7	T
Onions	1.5	T
Milk (Fresh)	1.5	13
Poultry Muscle	2.2	8

Item	Potassium g/kg	Cesium-137 pc/kg
Fresh Fish (Frozen):		
Lake Fillet	3.1	1784
Ocean Fillet	3.1	20
Halibut	4.4	79
Flour (White)	1.1	18
Macaroni	2.2	67
Rice	.9	12
Meat Muscle:		
Beef	3.5	19
Pork	3.1	26
Shellfish:		
Oysters	1.2	*
Shrimps	1.5	8
Dried Beans	13.3	6
Fresh Fruits:		
Melons	3.4	T
Apples	1.1	8
Bananas	3.6	7
Berries	1.2	8
Oranges	2.0	10
Potatoes	5.0	T
Canned Fruits:		
Apple Sauce	.7	9
Peaches	1.2	T
Pears	.6	7
Pineapple	1.1	24
Canned Juices:		
Grapefruit	1.8	14
Orange	2.1	16
Pineapple	1.5	30
Tomato	2.6	7
Canned Vegetables:		
Peas	1.1	9
Stringbeans	.7	10
Tomatoes	1.8	T
Baby Foods:		
Canned Milk	3.1	26
Formula Milk	2.1	25
Cereals	9.6	104
Fruits	.9	7
Meats	1.8	20
Vegetables	1.6	6

T < .5 pc/kg

* Presence of Zr^{95} - Nb^{95} prevented the determination of Cs-137 value.

Table II
Cs-137 in Chicago Diets
(Adults)

April, 1967

	Potassium		Cs-137	Potassium		Cs-137
	kg/yr	g/kg	pc/kg	g/yr	pc/yr	
White Bread	37	1.6	26	59	962	
Whole Wheat Bread	11	3.4	42	37	462	
Eggs	16	1.4	8	22	128	
Fresh Vegetables	43	2.9	5	125	215	
Root Vegetables	17	2.6	T	44	---	
Milk	221	1.5	13	332	2873	
Poultry	17	2.2	8	37	136	
Fresh Fish	8	3.2	202	26	1616	
Flour	43	1.1	18	47	774	
Macaroni	3	2.2	67	7	201	
Rice	3	.9	12	3	36	
Meat	73	3.3	23	241	1679	
Shellfish	1	1.5	8	1	8	
Dried Beans	3	13.3	6	40	81	
Fresh Fruit	68	2.3	7	156	476	
Potatoes	45	5.0	T	225	----	
Canned Fruit	26	.9	10	23	260	
Fruit Juices	19	2.0	16	38	304	
Canned Vegetables	20	1.2	6	24	120	
				<hr/>	<hr/>	
Total/yr				1487	10331	
Total/day				4.1	28	

Table III
Cs-137 in Chicago Diets
(Infants)

April, 1967

	kg/yr	Potassium g/kg	Cs-137 pc/kg	Potassium g/yr	Cs-137 pc/yr
Evaporated Milk	137	3.1	26	425	3562
Formula Milk	37	2.1	25	78	925
Cereals	8	9.6	104	77	832
Fruits	23	.9	7	21	161
Meats	17	1.8	20	31	340
Vegetables	23	1.6	6	37	138
				<hr/>	<hr/>
Total/yr				669	5958
Total/day				1.8	16

References:

- (1) S. S. Brar et al, USAEC Report No. Hasl-146, Cs-137 in Various Chicago Diets, pp. 225-232, July 1, 1964.
- (2) J. Rivera and J. J. Kelly, USAEC Report No. HASL-144, Cs-137 in Tri-City Diets, p. 223, April 1, 1964.
- (3) J. Rivera and J. H. Harley, USAEC Report No. HASL-147 Contributions to the Study of Fallout in Food Chains, pp 31, 32, 33, 34, and 35 July, 1964.
- (4) S. S. Brar, D. M. Nelson, and G. L. Manual, USAEC Report No. 181, Cs-137 in Various Chicago Foods, pp. III-134 to III-138, April 1, 1964.

DEPARTMENT OF HEALTH

QUARTERLY REPORT
OCTOBER—DECEMBER 1966

AND

ANNUAL SUMMARY

ON

ENVIRONMENTAL RADIOACTIVITY IN NEW ZEALAND

AND

RESULTS OF EXTENDED MONITORING OF FALLOUT
FROM FRENCH NUCLEAR TESTS IN THE PACIFIC

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

ABBREVIATIONS, DEFINITIONS AND CONVERSION FACTORS

All times given in this report are New Zealand Standard Time,
i.e. G.M.T. + 12 hours

Centimetre	cm	Gram	g
Square kilometre	km ²	Millicurie	mCi
Cubic metre	m ³	Picocurie	pCi

1 curie = 3.7×10^{10} nuclear transformations per second

1 mCi = 10^{-3} curies

1 pCi = 10^{-12} curies = 2.22 nuclear transformations per minute

Multiply cm by 0.394 to obtain inches

Multiply inches by 2.54 to obtain cm

Multiply mCi/km² by 2.59 to obtain mCi/sq.mile

Multiply mCi/sq.mile by 0.386 to obtain mCi/km²

The concentration of radioactivity in rainwater (previously called Specific Activity) is calculated from the formula:

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

The level of strontium-90 contamination in food and bone is expressed as a ratio of strontium-90 to calcium. Results are given as "Strontium Units" i.e. picocuries of strontium-90 per gram of calcium pCi Sr⁹⁰/g Ca

Similarly caesium-137 results are given as picocuries of caesium-137 per gram of potassium ... pCi Cs¹³⁷/g K

1 litre of whole milk contains approximately 1.2 g of calcium

1 litre of whole milk contains approximately 1.4 g of potassium

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LOCATION OF COLLECTING STATIONS ESTABLISHED BY THE NATIONAL RADIATION LABORATORY FOR AIR (A), BONE (B), MILK (M), RAINWATER (R), SOIL (S), AND THYROIDS (T) 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]

SUMMARY

Country-wide averages since measurements commenced at this laboratory, are shown in the following graphs.

SUMMARY

(a) NEW ZEALAND ROUTINE MEASUREMENTS DURING 1966

In this Summary a distinction is made between the levels of radioactivity due to long-lived radionuclides (which are of major significance in assessing health hazards) and short-lived radionuclides from the recent French nuclear tests in the Pacific which, although showing increased levels of radioactivity during limited periods, are of less significance in assessing health hazards.

The levels of the long-lived fallout products strontium-90 and caesium-137 in rainwater and milk have decreased during 1966.

Strontium-89 from the French tests has been measured in rainwater and milk during the third and fourth quarter, and the low value for the ratio of strontium-89 to strontium-90 indicates that most of the strontium-90 has come from the stratospheric reservoir of strontium-90 from previous nuclear testing and that relatively little has been contributed by the current tests.

The level of strontium-90 in rain during 1966 was less than one half of the level for 1965 and was approximately one third the highest level previously recorded during 1964. The level of strontium-90 in milk has decreased from a country-wide average of 11.6 strontium-units in 1965, which was the highest annual average recorded for New Zealand, to 7.9 strontium-units for 1966. Similarly the country-wide average of caesium-137 in milk during 1966 has decreased to two-thirds of the average level for 1965.

The fallout levels in air and in rainwater due to the short-lived bomb debris from the French tests, however, have increased during the third and particularly the fourth quarter 1966. The total beta activity of air at three New Zealand stations increased three to four fold during the third quarter compared to the first half of 1966. During the fourth quarter the average level was about ten times greater than in the first half of 1966. A similar ten fold increase in the total beta activity of weekly rain samples at Greymouth and Christchurch occurred during the fourth quarter.

SUMMARY Cont.

The following table lists the average values obtained during 1966.

RAINWATER

COUNTRY-WIDE AVERAGE FROM 9 STATIONS

		First Quarter	Second Quarter	Third Quarter	Fourth Quarter
Strontium-90	mCi/km ²	0.47	0.28	0.23	0.3 ¹ / ₄
Strontium-90	pCi/litre	1.7	0.9	1.0	1.1
Strontium-89*	mCi/km ²	-	-	0.7	6.5
Ratio Strontium-89/Strontium-90*		-	-	3	19

MILK

COUNTRY-WIDE AVERAGES FROM 9 STATIONS

		Jan. Feb.	Mar. Apr.	May June	July Aug.	Sept. Oct.	Nov. Dec.
Strontium-90	pCi/g Ca	8.4	7.6	7.7	8.2	8.0	7.6
Strontium-89*	pCi/g Ca	-	-	-	7	18	43
Caesium-137	pCi/g K	55	48	38	30	30	38

AIR FILTERS

MEASUREMENTS AT SELECTED STATIONS

Total Beta Activity pCi/m ³ At	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
Auckland)	0.04	0.02	0.09	0.42
Wellington*)	-	-	0.10	0.24
Christchurch)	0.03	0.02	0.09	0.27

RAINWATER

MEASUREMENTS AT SELECTED STATIONS

Total Beta Activity mCi/km ² At	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
Greymouth*)	-	-	9.3	97.0
Christchurch)	2.3	1.1	3.5	24.7

* The measurements of total beta radioactivity in air filters from Wellington and in rainwater from Greymouth, and also the measurements of strontium-89 in rainwater and milk from the country-wide collecting network, are part of the extended monitoring operations during the period of the French tests. These measurements which were started in July 1966 are included here for comparison purposes.

(b) ANNUAL COMPARISONS

The following table compares the annual levels of the long lived radio-nuclides, strontium-90 and caesium-137 in New Zealand rainwater and milk.

<u>STRONTIUM-90 IN RAINWATER</u>	<u>COUNTRY-WIDE AVERAGE</u>						
	1960	1961	1962	1963	1964	1965	1966
Annual Deposition mCi/km ²	0.9	1.2	1.6	1.8	3.6	3.1	1.3
Average Concentration pCi/litre	0.7	0.9	1.2	1.7	3.0	2.3	1.1

<u>STRONTIUM-90 IN MILK</u>	<u>COUNTRY-WIDE AVERAGE</u>						
	1961	1962	1963	1964	1965	1966	
"Strontium Units" pCi/g Ca	4.9	6.1	7.1	10.8	11.6	7.9	

<u>CAESIUM-137 IN MILK</u>	<u>COUNTRY-WIDE AVERAGE</u>						
					1964	1965	1966
pCi/g K					56	60	40

On page 8, New Zealand's total accumulation of strontium-90 from rain is compared with that of New York City and Milford Haven in the United Kingdom. The dotted portion of the curve for New Zealand is based on soil measurements undertaken by the U.S. Department of Agriculture on samples from three collecting sites. The part of the curve from July 1959 to July 1962 is derived from our measurements on rain samples from six collecting stations. From July 1962 the average result from our network of nine rainwater collecting stations has been used. The New York city values have been taken from the Health and Safety Laboratory, United States Atomic Energy Commission, Fallout Program, Quarterly Summary Reports, and the Milford Haven values have been taken from the reports of the United Kingdom Atomic Energy Authority "The World-Wide Deposition of Long Lived Fission Products from Nuclear Test-Explosions", and also from the reports of the United Kingdom Agricultural Research Council Radiobiological Laboratory. The values for the cumulative deposits have been corrected for radioactive decay.

The accumulation of strontium-90 at three sites in New Zealand has been measured for soils sampled at the end of 1966. The results are as follows:

STRONTIUM-90 ACCUMULATION IN SOIL

SELECTED STATIONS

Station	Cumulative Deposition mCi/km ²
North Auckland	12.9
Greymouth	23.0
South Canterbury	9.1

SUMMARY Cont.

FIG. 3 TOTAL ACCUMULATION OF STRONTIUM-90 FROM RAIN

SUMMARY Cont.

FIG. 4

STRONTIUM -90 LEVELS IN MILK

SUMMARY Cont.

On page 9, a graphical comparison of the levels of strontium-90 in Canadian, New York City and New Zealand milk is given. The values shown for Canada and New Zealand are the averages of the results for all collecting stations. The Canadian values are taken from the monthly reports "Data from Radiation Protection Programs" of the Radiation Protection Division, Department of National Health and Welfare, Canada. The New York City values are the averages of results for samples collected daily from the local milk supply and are taken from the Fallout Program, Quarterly Summary Reports of the Health and Safety Laboratory, United States Atomic Energy Commission. For purposes of comparison the average level for each two monthly period is plotted for each locality.

(c) RESULTS OF EXTENDED MONITORING OF PACIFIC TESTS

1. Gamma Ray Radiation Monitoring

No gamma ray radiation readings exceeding 0.3 mR/hr (the lowest reporting level set for this monitoring service) were reported from any of the seven Pacific Island stations where these measurements were made. The following graph shows the average daily readings of background gamma radiation made at Apia, Samoa, using the portable gamma ray survey meter. Each reading is the mean of ten readings taken several times daily. The increased background radiation on and following 16 September coincides with the relatively high fission product activity in rainwater collected at Apia during the week 13-20 September.

SUMMARY Cont.

2. Total Beta Activity of Daily Air Filter Samples

The results of measurements on daily air filter samples during the monitoring period have been averaged over each calendar month for each collecting station. These monthly averages are given in the following table:

AIR FILTERS	- AVERAGE MONTHLY AIR ACTIVITY - pCi/m^3					
	July	August	September	October	November	December
Nandi (Fiji)	0.24	0.70	4.40	1.89	0.87	0.23
Rarotonga	0.05	0.39	0.24	1.89	0.64	0.25
Auckland	0.07	0.12	0.08	0.66	0.40	0.20
Wellington	0.07	0.14	0.08	0.38	0.26	0.14
Christchurch	0.10	0.09	0.08	0.44	0.23	0.14

These monthly averages are also shown graphically on this page together with all past monthly averages from the Auckland and Christchurch collecting stations. Values less than $0.1 \text{ pCi}/\text{m}^3$ are not shown. Increases in the total beta activity of the air are readily noticeable during periods of nuclear testing particularly in the Southern Hemisphere. The levels, however, should be compared with the adopted permissible level of $300 \text{ pCi}/\text{m}^3$ for continuous breathing by the general population. (See Hazard Assessment p. 21)

FIG 6 MONTHLY AVERAGES OF FISSION PRODUCT ACTIVITY IN THE BREATHING ZONE.

SUMMARY Cont.

The detailed results of total beta activity in daily air filters, at the time of measurement, have been given in Section C of the previous two quarterly reports NRL P-1 and NRL P-2 and are concluded for 1966 in Section C of this report. The graphical presentation of these results, however, is given on pages 14 and 15, together with the symbolic representation of the five nuclear explosions which are indicated on the graphs by the letters A, B, C, D and E, in chronological order, on the days on which they occurred.

Age determinations of the fission products present in selected air filters, particularly those showing relatively high total beta activity, have been possible in many cases. This has indicated the particular explosion which produced the fission products and has allowed an adjustment of the measured activity of the sample to the activity present at the time of collection. Wherever the origin of the fission products could be determined, this is indicated by marking the column with the appropriate letter indicating the particular explosion which produced most of the activity in this sample and in these cases only the height of the column represents activity at the time of collection. Where age determinations show that the origin of fission debris may have been either of two nuclear detonations or more probably a mixture of fission debris from each detonation the column is labelled thus D/E. (using the appropriate letters).

In all other cases the heights of the columns represent activities at the time of measurement as given in the tables.

The highest daily levels recorded were:

- (1) At Nandi, Fiji on 17 September, measured as 73.5 pCi/m^3 four days later. The origin of the fission products was the third nuclear explosion on 12 September, and the activity adjusted to the day of collection was 150 pCi/m^3 of 5 day old fission products.
- (2) At Hamilton on 9 October, measured as 18.2 pCi/m^3 seventeen days later. The fission products originated from the fifth nuclear explosion on 5 October and the activity adjusted to the day of collection was 141 pCi/m^3 of 4 day old fission products.

The Nandi air filter of 17 September was analysed by gamma ray spectrometry and the results are graphed on page 13. Six gamma analyses of this sample during the period 22 September to 5 November are compared on the graph and the differing half-lives of the various radionuclides present are clearly demonstrated.

FIG. 7

GAMMA ANALYSIS OF AIR FILTER FROM NANDI FIJI 17/9/66.

SUMMARY Cont.

SUMMARY Cont.

FIG.8a TOTAL BETA ACTIVITIES OF DAILY AIR FILTER SAMPLES
(in pCi per m³)

SUMMARY Cont.

FIG 8b TOTAL BETA ACTIVITIES OF DAILY AIR FILTER SAMPLES
(in pCi per m³)

SUMMARY Cont.

3. Total Beta Activity of Weekly Rainwater Samples

The detailed results of total beta activity of weekly rainwater samples, at the time of measurement, from twelve Pacific Islands and from Greymouth and Christchurch have been given in the tables in Section C of the previous two Quarterly Reports NRL F21 and NRL F22, and are concluded for 1966 in Section C of this report. The graphical presentation of these results is given on page 17. As in the case of air filter samples, selected rainwater samples have been measured for fission product age in order to determine the origin of the activity and for these samples the result has been adjusted to the activity present at mid collection time. Where this has been done the appropriate column in the graphical presentation has been labelled with the letter designating the particular nuclear explosion which contributed the majority of the measured activity. The remaining columns represent the activities at the time of measurement as given in the tables.

Increases in total beta activity of rainwater samples have been detected at all stations. The highest levels recorded were at Apia (Samoa) and Niue, during the week 13-20 September. The origin of the activity at both places was the third Nuclear detonation on 12 September. The level at Samoa was 1800 mCi/km² at the time of measurement 7 days after the end of collection, and at Niue was 284 mCi/km² at the time of measurement 21 days after the end of collection. These values adjust to 7,700 and 3,400 mCi/km² of approximately 4 day old fission products at Samoa and Niue respectively at mid collection time and are shown on the graphs as average daily depositions of 1,100 and 486 mCi/km² respectively. The concentration of fission products in Samoa rainwater is discussed under Hazard Assessment p. 21.

4. Iodine-131 in Milk

(a) New Zealand - Thrice Weekly Collection

Tables and graphs of individual results have been given in Section C of the previous two quarterly reports, NRL F21 and NRL F22 and are concluded for 1966 in Section C of this report. The level of iodine-131 in milk increased generally over the whole of New Zealand during October and November with no marked variation between different areas. The highest level recorded for an individual sample was 36 pCi/litre during October. By mid December levels had fallen to below the minimum detectable level 5 pCi/litre. The country-wide average level during the monitoring period was 7 pCi/litre. The following table lists the monthly average levels for six collecting stations:

IODINE-131 IN MILK - pCi/LITRE - FROM 8 JULY-16 DECEMBER

	July	August	September	October	November	December	Average
Auckland	5	5	<5	12	8	<5	7
New Plymouth	10	7	<5	13	11	<5	8
Wellington	<5	5	<5	15	11	<5	7
Greymouth	<5	5	<5	15	10	<5	7
Christchurch	<5	<5	<5	13	5	<5	6
Dunedin	<5	<5	<5	17	7	<5	7
Country-Wide average	5	5	<5	14	9	<5	7

SUMMARY Cont.

FIG 9 AVERAGE DAILY DEPOSITION OF FISSION PRODUCTS DURING THE COLLECTION PERIODS SHOWN (in mCi per km²)

SUMMARY Cont.

(b) Pacific Islands - Weekly Collection

Weekly samples of milk were also collected from Suva (Fiji) and Apia (Samoa) from early October to mid-November following increased activity found in Fiji air filters and Samoan rainwater during the latter half of the period. Iodine-131 was found in all samples. The results are as follows:

IODINE-131 IN MILK - pCi/LITRE - PACIFIC ISLAND STATION

Date	Suva, Fiji	Date	Apia, Samoa
October, 8	245	October, 6	190
" 17	168	" 13	100
" 24	124	" 20	88
		" 27	41
November, 7	52	November, 2	46
" 14	39	" 12	29
		" 17	14
Average	126	Average	73

The levels of Iodine-131 in New Zealand, and Pacific Island milk are discussed further under "Hazard Assessment" pages 21, 22.

5. Iodine-131 in Cattle Thyroid

Because of the enhanced sensitivity of detection of iodine-131 in animal thyroids, these samples have been used as an indicator of the arrival of iodine-131 during the present monitoring operations. Iodine-131 has been detected in thyroids from all of the eight collecting stations within New Zealand. Tables and graphs of individual results have been given in Section C of the previous two quarterly reports NRL F21 and NRL F22 and are concluded for 1966 in Section C of this report. The highest levels occurred in cattle slaughtered during the last week of October and reached a maximum of 726 pCi/g of thyroid at Gore on 31 October.

The maximum, minimum and average levels of iodine-131 in milk and in cattle thyroid during the monitoring period are compared graphically on page 19. While there is some obvious correlation between the two (i.e. the average concentration in milk expressed as pCi/litre is approximately equal to one tenth the average concentration in the thyroid expressed as pCi/g) the peak activities do not coincide in time, the rise and fall of the thyroid activity lagging behind that of milk.

SUMMARY Cont.

Fig 10

- (a) I^{131} IN MILK Activity in pCi/litre at time of sample collection from milk treatment stations Results for eight stations.
- (b) I^{131} IN CATTLE THYROIDS. Activity in pCi/gram (wet weight) at time of slaughter Results for eight stations.

SUMMARY Cont.

(d) HAZARD ASSESSMENT

Strontium-90

The derivation of potential health hazard from fallout results is a complex problem. However, the significance of observed levels of strontium-90 can be readily understood by comparing these levels with the recommendations made by the British Medical Research Council on the "permissible levels" for the concentration of strontium-90 in human bone. A "cautionary level" was set at one half of the "permissible level" and the Council stated that this "cautionary level" would not be exceeded if the following levels were maintained indefinitely in the diet:

400 Strontium Units for individuals in the general population,
or 130 Strontium Units as average for the population as a whole.

Because the strontium-90 level in the total diet (expressed in Strontium Units) differs relatively little from that in milk, some guidance on the general situation in New Zealand may be provided by comparing the levels in New Zealand milk with the "cautionary level" set by the Council. In doing this, however, it must be emphasized that the "cautionary level" refers to continuous lifetime exposure. Average levels over an extended period, such as one year, are therefore more meaningful than individual results. The all station average for New Zealand milk for the 12 months ending December 1966 (7.9 Strontium Units) is thus:

6% of the "cautionary level" for the whole population, or about
3% of the "permissible level" for the whole population.

Caesium-137

The British Research Council has not provided a permissible level for caesium-137 in milk. For the general population it is possible to derive such a "permissible level" by applying a number of conversion factors to the permissible level in drinking water accepted for radiation workers. It has been assumed that one third of the daily intake of caesium-137 comes from milk, that the average consumption is 0.5 litres per day and that the permissible level for the general population is 1/30 of that for a radiation worker. The figure so derived is 7,000 pCi/g K.

The all station average for New Zealand milk for the 12 months ending December 1966 (40 pCi/g K) is thus less than 0.6% of the above "permissible level" for the whole population.

SUMMARY Cont.

Total Beta Activity

The permissible levels of total beta activities in air and water, due to mixed fission products, have not been set by international agreement but are based on published evaluations of the health hazards of mixed fission products of various ages. (1, 2) For the purpose of assessing the hazards of environmental contamination resulting from the current Pacific testing we have adopted the most cautious values listed for bomb debris between 10 and 80 days old.

These adopted values are:

For air	300 pCi/m ³	)	for continuous use by the
For water	6,000 pCi/litre)		general public

The highest monthly average radioactivity in air was 4.4 pCi/m³ at Nandi (Fiji) for September. This level is 1.5% of the "permissible" level for continuous breathing by the entire population.

The highest weekly total beta activity in rainwater occurred in Apia, Samoa between 13 and 20 September with a specific activity of 23,000 pCi/litre. As noted in the previous Quarterly Reports NRL F21 and NRL F22 this was between four and five times the permissible level for continuous consumption. Measurements on subsequent weekly rainwater samples from Apia now make possible the calculation of the average concentration of fission products in rainwater over longer periods.

The average concentration over the four weekly period 30 August - 27 September was 11,800 pCi/litre. This corresponds to about twice the maximum permissible concentration for continuous consumption.

The average concentration over the entire monitoring period i.e. 1 July - 2 January 1967 was 1,530 pCi/litre. This corresponds to about one quarter of the maximum permissible concentration for continuous consumption.

Iodine-131

In October 1961 the British Medical Research Council specified that an acceptable dose would not be exceeded in any age group of the population unless an average concentration of iodine-131 of 130 pCi/litre in milk was exceeded over a period of one year, or higher concentrations were maintained for corresponding shorter times.

The British Medical Research Council now states, however, that further information has become available which indicates that the original figure of 130 pCi/litre was unduly cautious, and that a more appropriate "acceptable level" of iodine-131 now appears to be 200 pCi/litre as an average intake over a period of one year.

SUMMARY Cont.

The country-wide average level of iodine-131 in New Zealand milk during the monitoring period (8 July - 16 December 1966) was 7 pCi/litre. For the entire year 1966 the average level would be about one half of this. This is less than 2% of the "acceptable level" for any age group.

It was not originally intended to include milk from the Pacific Islands in this monitoring programme because of the very small production and consumption of fresh milk in the Islands, and the consequent small significance of milk as an article of diet representing a health hazard to the general population. After the increased radioactivity found in air and rain at Fiji and Samoa, during the latter half of September, it was decided that it would be of interest to measure iodine-131 in weekly milk samples from these two stations. The five samples from Suva, Fiji (the station with the higher iodine-131 levels) were obtained over the period 8 October to mid-November. The average level for these samples was 126 pCi/litre. An attempt has been made to assess the average level over the period of interest i.e. from about 16 September to the end of December. It is unlikely that the average level exceeded 150 pCi/litre over this period, and it is unlikely that the average level in milk from Suva over the entire year 1966 exceed 50 pCi/litre or about 25% of the "Acceptable Level".

1. A.H. Booth, "Guide Levels in Radiation Protection Programs", Data from Radiation Protection Programs, Vol. 4, No. 2, February 1966. Department of National Health and Welfare, Ottawa, Canada.
2. D.L. Summers and M.C. Gaske, "Maximum Permissible Activity (MPA) for Fission Products in Air and Water", Health Physics, Vol. 4, pp. 289-292 (1961).

SECTION A

GENERAL INFORMATION

In September 1957 the New Zealand Department of Health was charged, under a Cabinet directive, with the responsibility for the monitoring of environmental radioactive contamination in New Zealand and the Pacific areas with which it is associated. Subsequently the network of collecting stations shown in Fig. 1a and b has been established to provide the necessary samples of air, rain water, soil, animal thyroids, milk, and human bones. The collections and measurements are being made on a routine basis and the results are published in a series of Quarterly Reports ("Fallout in New Zealand", DXRL-F1 to F9 and NRL-F10 to F18; and "Environmental Radioactivity in New Zealand", NRL-F19 onwards).

SAMPLE COLLECTION AND EVALUATION

The selection of rainwater collecting stations was based on the requirement that an adequate geographical coverage of the country must be made, taking account of natural features, such as mountain ranges which, particularly in the South Island, account for the extremes in rainfall. Furthermore, proximity of rainwater collecting sites to milk producing areas is desirable, so that comparisons between levels of contamination in rain and milk can be made.

The selection of milk producing areas was based not only on geographical coverage and routine availability of samples but also on population distribution, so that the average result of all stations would be representative of the contamination in the average New Zealand diet.

During the period of nuclear testing which started in the Christmas Island area in April 1962, the routine monitoring operations conducted by this Laboratory were extended within New Zealand and a new network of monitoring and collection stations was established throughout the Pacific area. The extent of these monitoring operations and the results of the measurements have been published in previous issues of the Laboratory's Quarterly Reports. (See particularly DXRL-F5, DXRL-F7, and DXRL-F8).

After the conclusion of the 1962 Pacific test series, the monitoring activities of the Laboratory reverted to the established routine pattern. However, in preparation for the French series of nuclear tests in the Pacific, the monitoring operations of the Laboratory were again extended. The following information lists the type and extent of sample collection and measurement undertaken by the Laboratory during its routine operations as well as during the present series of nuclear tests.

1. PORTABLE GAMMA RAY SURVEY METERS (for monitoring of the gamma radiation dose rate at 7 Pacific Island stations)

Duplicate sets of gamma radiation monitors have been provided on the following 7 Pacific Islands stations:

Penrhyn	Aitutaki	Rarotonga	Mangaia	Apia (Samoa)	Niue	Tonga
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The most sensitive range on these instruments is 0 - 0.5 mR/hr, enabling significant readings to be made even on natural background radiation. Any increase in the gamma radiation dose rate on any of the islands monitored can thus be detected long before it reaches levels indicating a possible health hazard. Gamma radiation dose rate measurements are made several times each day by observers of the New Zealand Meteorological Service concurrently with their meteorological observations. Readings are made at a fixed position, 3 feet (91cm) above the ground. Only readings exceeding 0.3mR/hr will be reported.

2. AIR SAMPLING (for measurement of Total Beta Activity)

Routinely air filter samples were collected continually at Auckland and Christchurch. Sampling involves the collection of particulates in ground level air by drawing the air through 11 cm diameter filters using positive displacement pumps. The filters were changed three times weekly. Since July, however, daily air filter samples are being collected at the following 5 stations:

Auckland	Wellington	Christchurch	Rarotonga	Nandi (Fiji)
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The air filter samples are collected by pumping about 100 m³ of air in 24 hours through a glass fibre filter of 11 cm diameter (Whatman GF/A). The air filters are returned to Christchurch for measurement of total beta activity on a Beckman Wide Beta II Planchet Counting System, using the 5 inch diameter detector with a 500 microgram per cm² window and Phillips Pure Grade methane counting gas during a 50 minute counting period. Background with this installation using glass fibre filters on 4.5 inch stainless steel trays is 14 counts per minute and the efficiency of counting is 57%, for a Potassium Chloride standard. This corresponds to 127 net counts per minute for a 100 m³ air sample with an activity of 1 pCi/m³. Results are reported at the 95% confidence level of better than $\pm 10\%$ (typically about $\pm 7\%$).

3. RAIN WATER

(a) MONTHLY COLLECTION (for measurement of Strontium-90 and Strontium-89)

Rainwater is routinely collected by exposing a stainless steel pot of 30 cm diameter and 30 cm height, at ground level, for 1 month at each of the following 11 collecting sites:

Site	Rainfall (during year 1966 in cm)	Site	Rainfall (during year 1966 in cm)
Kaitia	151	Christchurch	55
Auckland	129	Dunedin	51
New Plymouth	174	Invercargill	88
Havelock North	93		
Wellington	164	Suva, Fiji*	210
Greymouth	209	Rarotonga**	169

*Normally a 3-monthly collection, changed to monthly collections from June 1966
**Monthly collections started June 1966.

Strontium carrier is added to the collecting pot before despatch to the collecting site. A supply of distilled water is maintained at the site and is added to the pot when necessary to prevent the contents from evaporating to dryness during dry periods. On arrival at the laboratory the sample is passed slowly through a column of cation exchange resin. Strontium is then selectively eluted from the resin column, precipitated as the carbonate and weighed. (When strontium-89 is to be measured the strontium carbonate is counted without delay through an absorber which completely absorbs the beta activity due to strontium-90). The precipitate is redissolved. Yttrium carrier is added and the solution is held for 2 weeks to allow yttrium-90 to approach equilibrium. The strontium-90 activity is then determined by separating daughter yttrium-90 and measuring its activity in a low background beta counter. Three measurements of beta activity are made over a period of eight days to check the rate of decay and isotopic purity. The net count rate of the yttrium-90 source is extrapolated to the parent-daughter separation time, corrected for carrier recoveries, yttrium-90 ingrowth and counter efficiency. The beta counters are calibrated with yttrium-90 sources which have been separated from strontium-90 standards. Counter performance is evaluated by frequent background measurements and daily control runs using a $\text{Sr}^{90}/\text{Y}^{90}$ source. A full description of the method is given in the paper "Ion Exchange Methods for the Estimation of Sr^{90} in Rain, Milk and Bone" by L.P. Gregory, published in Health Physics, Vol. 10, No. 7, pp 483-493, July 1964.

(b) WEEKLY COLLECTION (for measurement of Total Beta Activity)

Samples of rainwater, collected each week by means of a polythene funnel and bottle collector from the 14 stations listed below, are returned to Christchurch for processing and measurement of total beta activity. Weekly collections were started at Rarotonga in December 1965 in order to obtain background levels prior to the commencement of nuclear testing.

LOCATION OF 14 RAINWATER STATIONS MAKING WEEKLY COLLECTIONS				
Tarawa	Suva (Fiji)	Tonga	Aitutaki	Greymouth
Funafuti	Samoa	Raoul	Rarotonga	Christchurch
Nandi (Fiji)	Niue	Penrhyn	Mangaia	

The collecting bottles contain carrier solution for fission products and the funnels have a diameter of 9.9 cm for Pacific Island Stations and 17.0 cm for New Zealand Stations. The collected rainwater is concentrated by evaporation in glass beakers, transferred to 4.5 inch stainless steel planchettes and evaporated to dryness. Acid washes are used to ensure the complete transfer of fission products from the collecting bottle and beaker to the planchette. The evaporated samples are counted in the planchette counting system described above under Section 2 "Air Sampling". The background, with an empty planchette, is 6 counts per minute, and the efficiency of counting is 55%, giving 8.6 net counts per minute per mCi/km² for Pacific Island samples and 27.7 net counts per minute per mCi/km² for New Zealand samples. Results are reported at the 95% confidence level to about $\pm 10\%$.

4. MILK

(a) MONTHLY COLLECTION (for measurement of Strontium-90, Strontium-89 and Caesium-137).

Representative milk samples are obtained in New Zealand each month from the following 9 urban centres or provinces:

Northland	Taranaki	Greymouth
Auckland	Palmerston North	Christchurch
Waikato	Wellington	Dunedin

Aliquots of monthly milk samples are aggregated on a two monthly basis for each station for processing and measurement of strontium-90 content. Dried milk samples are ashed at 600°C in a muffle furnace. Liquid milk samples are initially evaporated to dryness in a tray lined with polyethylene film before ashing. The milk ash is dissolved in dilute hydrochloric acid. Strontium carrier is added and the solution is passed through a large column of cation exchange resin. Magnesium and calcium are eluted from the column and discarded. Strontium is then eluted, evaporated to dryness and purified by a second ion exchange separation using a small column. The strontium is finally recovered as the carbonate and weighed. The remaining procedure, including the measurement of radioactivity is identical with that used for rainwater samples. Reference to the published procedure has been given under Rainwater (a) Monthly Collection in this section of the Report.

Monthly composite samples of milk from each of the sampling areas are measured for caesium-137 and potassium-40 by gamma spectrometry. Liquid milk samples are dried and powdered before measurement.

For gamma ray evaluation samples are evenly packed to occupy a fixed volume (65 millilitres) in a screw-capped polyethylene bottle. After weighing, the samples are counted in a 4" x 4" NaI (Tl) well crystal coupled to a 5" photomultiplier, the output pulses being fed to a Nuclear Data 512 channel pulse height analyser. An analysis of the activities present is made using the results

obtained from a range of standard powder samples counted in the same geometry.

Corrections for the varying densities of powder supplied are also employed. Counting times are arranged as far as possible so that the total statistical counting errors amount to the following relative standard errors in the results.

Value pCi/g K	5	10	20	50	100
Percentage error $\pm$	25	15	10	5	3

(b) THRICE WEEKLY COLLECTION (for measurement of Iodine-131)

Representative samples of fresh milk are obtained on Mondays, Wednesdays and Fridays of each week from the following 6 town milk supplies:

Auckland	New Plymouth	Wellington	Greymouth	Christchurch	Dunedin
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During the course of this measurement programme for Iodine -131 in milk, additional collections were made as follows:

1. Thrice weekly collections from Invercargill commenced 19 October.
2. Weekly collection from Suva, Fiji and Apia, Samoa commenced early October continuing through to mid-November.

Samples of one litre of milk are poured slowly through 40 ml of "DE ACIDITE FF ANION EXCHANGE RESIN". The resin, after washing with distilled water, is transferred to a 65 ml polythene bottle which is measured in a shielded 4" x 4" NaI(Tl) well crystal, optically coupled to a 5" photo-multiplier tube. The output is analysed in a Nuclear Data Model 130 AT 512 channel Pulse Height Analyser. The sensitivity of the system in the I^{131} photopeak, at 364 keV, has been determined by calibration against an Amersham Standard as 0.85 counts per minute per pCi for the energy band selected (330 - 400 keV). Normal background for this energy band in the system used is 47.5 ± 0.25 counts per minute. Samples are normally counted for 80 minute periods and values of less than 5 pCi are reported as such. Above this level results are reported with an overall accuracy estimated at better than ± 2 pCi.

5. ANIMAL THYROIDS (for measurement of Iodine-131)

Sampling of cattle thyroids is carried out once each week at the following 8 stations:

Northland (Moerewa)	Palmerston North (Longburn)
Hamilton (Horotiu)	Westport
Hastings (Tomoana)	Christchurch (Islington)
New Plymouth (Waitara)	Gore

Samples as received are chopped into small pieces, any fatty tissue being discarded. The small pieces of the sample are hand mixed and a random sample taken to fill a 65 ml polythene bottle. Counting is carried out by standing the polythene bottle centrally on a 2" x 2" NaI(Tl) crystal/photo-multiplier combination, with the output coupled to a Nuclear Data Model 130 AT 512 channel Pulse Height Analyser. The efficiency of counting for I^{131} in the 364 keV photopeak with this equipment has been determined as 4.8 counts per minute per 100 pCi with a background count rate in this energy band of 10.8 counts per minute. This sensitivity is adequate since the I^{131} concentration in the thyroids is about one thousand times greater than that in the milk. The overall accuracy of this measurement is of the order of $\pm 10\%$.

6. HUMAN BONE (for measurement of Strontium-90, Radium-226 and Lead-210)

Post mortem samples of human bone are obtained whenever possible. Samples have been collected at Auckland, Hamilton, Hastings, Napier, New Plymouth, Palmerston North, Wellington, Nelson, Greymouth, Christchurch, Dunedin, Invercargill, and from some provincial areas. Results of the measurements are routinely published in the Laboratory's "Quarterly Reports".

7. SOIL (for measurement of Strontium-90)

Soil is sampled annually from the following 4 districts: Northland, Wellington, Greymouth and South Canterbury. Samples were taken at Campbell Island (52.5°S 169.0°E) up to February 1965.

SECTION B

QUARTERLY REPORT OCTOBER-DECEMBER 1966 AND ANNUAL SUMMARY

1. TOTAL BETA ACTIVITY OF AIR FILTER SAMPLES COLLECTED NEAR GROUND LEVEL

The total beta activity of daily air filter samples from Nandi, Rarotonga, Auckland, Wellington and Christchurch for October and up to 22 November were given in Section C, Table 1 of the previous Quarterly Report N.R.L. F22. The results of these measurements are continued to the end of December in Section C, Table 1 of this report. All these results since the beginning of July are graphed in Fig. 8a, b, in the Summary.

2. TOTAL BETA ACTIVITY OF FALLOUT DEPOSITED ON THE GROUND

The total beta activity of weekly rainwater samples collected at Greymouth and Christchurch during October and November together with results from twelve Pacific Island Stations were given in Section C, Table 2 of the previous Quarterly Report N.R.L. F22. The results of these measurements are continued to the end of December in Section C, Table 2 of this report. All results since the beginning of July are graphed in Fig. 9 in the Summary.

3. STRONTIUM-90 AND STRONTIUM-89 IN RAIN

Values for strontium-90 deposition, rainfall, the concentration of strontium-90 in rain, strontium-89 deposition and the ratio strontium-89/strontium-90 for monthly collections during 1966 from nine New Zealand stations, Suva (Fiji) and Rarotonga are given in Tables 1 - 4 on the following pages. Past and present results for strontium-90 deposition and rainfall are given in graphical form in Fig. 11a, b, c, d, e and f. Country-wide averages of strontium-90 deposition and concentration in rain since measurements commenced at this Laboratory are shown graphically in the Summary (Fig. 2a, b.).

4. STRONTIUM-90 AND STRONTIUM-89 IN MILK

Results of strontium-90 measurements on two-monthly milk collections from nine New Zealand stations during 1966 are given in Table 5. Strontium-89 values for samples collected since July are also included in Table 5. Past and present results for Strontium-90 are shown graphically for individual stations in Fig 12a, b, and for country-wide averages in the Summary (Fig. 2c).

5. CAESIUM-137 IN MILK

Table 6 gives the values for caesium-137 in monthly milk samples during 1966, together with two-monthly country-wide averages so that comparisons may be made with two-monthly strontium-90 values in Table 5. Past and present results are shown graphically for individual stations in Fig 13 and two-monthly country-wide averages are graphed in the Summary (Fig. 2d).

TABLE 1.														DEPOSITION OF STRONTIUM-90 DURING 1966 - MILLICURIES PER SQUARE KILOMETRE													
<u>New Zealand Stations</u>		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total													
Kaitaia		0.29	0.09	0.17	0.09	0.14	0.07	0.10	0.07	0.16	0.06	0.19	0.13	1.56													
Auckland		0.20	0.15	0.13	0.07*	0.08	0.11*	0.09	0.08	0.10	0.05	0.13	0.09	1.28													
New Plymouth		0.33	0.09	0.11	0.16	0.13	0.15	0.16	0.11	0.14	0.11	0.26	0.18	1.91													
Havelock North		0.14	0.05	0.07	0.03	0.08	0.02	0.07	0.07	0.03	0.04	0.09	0.16	0.84													
Wellington		0.31	0.08	0.05	0.18	0.14	0.08	0.10	0.14	0.10	0.08	0.17	0.19	1.60													
Greymouth		0.50	0.31	0.20	0.24	0.04	0.11	0.10	0.07	0.14	0.08	0.25	0.16	2.19													
Christchurch		0.16	0.07	0.07	0.06	0.04	0.04	0.04	0.04	0.03	0.06	0.05	0.05	0.71													
Dunedin		0.19	0.06	0.09*	0.05	0.02	0.03	0.03	0.04	0.02	0.06	0.10	0.05	0.74													
Invercargill		0.19	0.07	0.13	0.19	0.06	0.08	0.06	0.03	0.03	0.06	0.11	0.09	1.10													
<u>Country-wide Averages</u>														1.32													
Monthly		0.25	0.11	0.11	0.12	0.08	0.08	0.08	0.07	0.08	0.07	0.15	0.12														
Quarterly		0.47			0.28			0.23			0.34																
<u>Pacific Islands</u>														1.19													
Suva, Fiji		0.18**			0.25**			0.14	0.14	0.05	0.18	0.15	0.10														
Rarotonga ^{xxx}		-	-	-	-	-	0.04	0.05	0.05	0.04	0.09	0.17	0.02			-											

* Sample lost - the listed value which is required for averaging purposes is estimated using the rainfall at the collecting site and the country-wide average concentration of strontium-90 in rain for the month.

** Three monthly deposition.

xxx Collections and measurements commenced June 1966.

TABLE 2.	RAINFALL DURING 1966												CENTIMETRES
<u>New Zealand Stations</u>	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Kaitaia	14.6	8.7	13.1	7.6	17.9	12.5	15.5	6.7	23.4	3.1	11.8	16.3	151
Auckland	11.4	20.4	7.4	7.0	13.5	13.0	10.4	9.3	9.2	5.0	13.3	9.0	129
New Plymouth	16.6	8.0	8.0	16.1	13.5	24.0	20.9	6.7	18.6	6.5	18.2	17.1	174
Havelock North	6.7	6.8	4.6	5.6	9.2	1.3	14.2	14.2	2.9	4.4	7.7	15.8	93
Wellington	12.0	8.6	4.0	24.9	17.7	11.0	20.2	15.4	9.2	5.4	10.5	24.8	164
Greymouth	19.0	26.1	13.4	34.3	5.9	19.1	10.5	12.5	17.3	13.1	22.8	15.1	209
Christchurch	5.0	4.8	6.6	5.5	4.6	2.6	2.1	5.3	1.9	3.9	9.0	3.9	55
Dunedin	13.5	1.9	6.5	2.6	2.8	4.0	2.2	3.6	1.2	5.2	4.5	3.4	51
Invercargill	8.1	3.2	8.8	13.4	7.1	13.4	6.2	3.0	2.6	4.2	9.9	7.6	68
<u>Pacific Islands</u>													
Suva, Fiji	67.1*			74.0*			10.0	9.9	1.7	13.2	14.3	19.2	210
Rarotonga	-	-	-	-	-	6.1	5.5	10.4	7.0	7.9	34.6	11.9	-

* Three monthly rainfall.

TABLE 3. CONCENTRATION OF STRONTIUM-90 IN RAIN DURING 1966 - PICOCURIES PER LITRE

<u>New Zealand Stations</u>	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Average
Kaitaia	2.0	1.0	1.3	1.1	0.8	0.5	0.6	1.0	0.7	2.0	1.7	0.8	1.0
Auckland	1.8	0.7	1.8	1.0*	0.6	0.9*	0.9	0.8	1.0	1.0	1.0	1.0	1.0
New Plymouth	2.0	1.1	1.3	1.0	0.9	0.6	0.8	1.6	0.7	1.7	1.4	1.0	1.1
Havelock North	2.0	0.8	1.4	0.5	0.8	1.6	0.5	0.5	1.2	1.0	1.2	1.0	0.9
Wellington	2.5	0.9	1.3	0.7	0.8	0.7	0.5	0.9	1.0	1.5	1.6	0.7	1.0
Greymouth	2.6	1.2	1.5	0.7	0.7	0.6	1.0	0.6	0.8	0.6	1.1	1.1	1.1
Christchurch	3.1	1.5	1.1	1.1	0.9	1.5	1.9	0.7	1.8	1.4	0.6	1.4	1.3
Dunedin	1.4	3.2	1.4*	1.7	0.8	0.8	1.1	1.3	1.9	1.3	2.1	1.4	1.5
Invercargill	2.3	2.3	1.5	1.4	0.9	0.6	0.9	1.1	1.0	1.4	1.1	1.5	1.3
<u>Country-wide Averages</u>													1.1
Monthly	2.2	1.4	1.4	1.0	0.8	0.9	0.9	1.0	1.1	1.3	1.3	1.1	
Quarterly	1.7			0.9			1.0			1.2			
<u>Pacific Islands</u>													0.6
Suva, Fiji	0.3**			0.3**			1.4	1.4	3.1	1.3	1.0	0.5	
Rarotonga	-	-	-	-	-	0.6	0.8	0.5	0.6	1.1	0.5	0.2	

NOTE: Individual values listed are calculated from values of deposition and rainfall given in Tables 1 and 2 using the formula given inside the front cover. Monthly and quarterly country-wide averages are the averages of individual values listed above for the month or quarter. Annual averages for each station, listed in the last column, are derived from the total deposition and rainfall for each station given in Tables 1 and 2 and are used for calculating the country-wide average for the year.

* Sample lost - country-wide average for month used.

** Quarterly Averages

TABLE 4. STRONTIUM-89 (AT MID-MONTH) - JULY-DECEMBER 1966													
	Deposition Millicuries Per Square Kilometre						Ratio Strontium-89/Strontium-90						
	July	Aug.	Sep.	Oct.	Nov.	Dec.	July	Aug.	Sep.	Oct.	Nov.	Dec.	
<u>New Zealand Stations</u>													
Kaitaia	0.3	0.4	0.5	1.5	4.5	1.7	3	6	3	25	24	13	
Auckland	0.4	0.4	0.4	0.8	3.3	1.3	4	5	4	16	25	14	
New Plymouth	0.5	0.4	0.5	3.2	6.6	2.2	3	4	3	29	25	12	
Havelock North -	0.1	0.3	<0.1	0.9	1.7	1.6	2	4	2	22	19	10	
Wellington	0.1	0.4	0.2	2.0	3.1	2.1	1	3	2	25	18	11	
Greymouth	0.2	0.5	0.3	3.3	5.5	2.3	2	7	2	41	22	14	
Christchurch	<0.1	0.2	<0.1	0.7	1.0	0.5	<1	4	<1	12	20	10	
Dunedin	<0.1	0.2	<0.1	0.7	2.5	0.5	<1	5	<1	11	25	10	
Invercargill	<0.1	0.1	<0.1	1.4	3.1	0.9	<1	4	<1	23	28	10	
<u>Country-wide Averages</u>													
Monthly	0.2	0.3	0.2	1.6	3.5	1.4	2	5	2	23	23	11	
<u>Pacific Islands</u>													
Suva, Fiji	1.3	2.2	0.6	8.4	4.3	2.1	10	16	12	46	29	21	
Rarotonga	0.1	0.6	1.1	4.3	7.3	0.5	2	13	26	48	43	21	

FIG 11a

STRONTIUM 90 IN RAIN

Millicuries Sr^{90} per square kilometre per month. Lefthand scale.
Centimetres of rain per month. Righthand scale.

FIG 11b

STRONTIUM 90 IN RAIN Millicuries Sr^{90} per square kilometre per month. Lefthand scale.

Centimetres of rain per month. Righthand scale.

FIG 11c

STRONTIUM 90 IN RAIN

Millicuries Sr^{90} per square kilometre per month. Lefthand scale.
Centimetres of rain per month. Righthand scale.

STRONTIUM 90 IN RAIN

▨ Millicuries Sr^{90} per square kilometre per month. Lefthand scale.
□ Centimetres of rain per month. Righthand scale.

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FIG 11e

STRONTIUM 90 IN RAIN

Millicuries Sr^{90} per square kilometre per month. Lefthand scale.
Centimetres of rain per month. Righthand scale.

FIG 11f

STRONTIUM 90 IN RAIN

Millicuries Sr^{90} per square kilometre per month. Lefthand scale.
Centimetres of rain per month. Righthand scale.

TABLE 5 STRONTIUM-90 AND STRONTIUM-89 IN MILK 1966										
<u>New Zealand Stations</u>	Strontium-90 (pCi/g Ca)							Strontium-89 (pCi/g Ca) At Mid-Collection Date		
	Jan. Feb.	Mar. Apr.	May June	July Aug.	Sep. Oct.	Nov. Dec.	Annual Average	July. Aug.	Sep. Oct.	Nov. Dec.
Northland	7.7	6.7	6.1*	7.4	5.5	5.6	6.5	5	12	38
Auckland	5.5	6.7	5.8	5.9	6.7	5.8	6.1	8	14	35
Waikato	5.3	6.3	5.8	8.2	6.9	5.5	6.3	10	13	32
Taranaki	13.0	10.1	11.8	13.3	15.3	11.4	12.5	9	38	72
Palmerston North	5.3	4.6	4.9	6.7	3.5	3.6	4.8	14	7	26
Wellington	6.3	5.4	7.3	7.0	5.2	5.4	6.1	8	12	43
Greymouth	26.0	21.4	20.6	19.1	23.0	25.8	22.7	7	45	107
Christchurch	2.5	2.8	2.6	2.4	2.2	1.7	2.4	3	4	8
Dunedin	4.4	4.4	4.4	3.6	3.5	3.6	4.0	<1	20	23
Country-wide Average	8.4	7.6	7.7	8.2	8.0	7.6	7.9	7	18	43

* May Sample only.

TABLE 6. CAESIUM-137 IN MILK 1966 - pCi/g K													
<u>New Zealand Stations</u>	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Average
Northland	41	47	52	39	43	30	45	36	26	29	25	28	37
Auckland	53	48	47	33	33	21	33	27	26	24	28*	32	33
Waikato	71	86	86	68	67	60	42	42	45	41	51	58	60
Taranaki	198	195	182	156	155	108	76	106	112	126	129	153	141
Palmerston North	21	10	18	13	13	8	6	11	6	7	9	12	11
Wellington	26	23	19	19	21	12	15	14	14	13	19	20	18
Greymouth	67	60	48	52	44	32	34	30	21	31	45	48	43
Christchurch	11	5	6	5	6	4	3	4	3	2	1	3	4
Dunedin	15	13	14	12	11	7	5	9	6	6	6	8	9
<u>Country-wide Averages</u>													40
Monthly	56	54	52	44	44	31	29	31	29	31	35	40	
Two monthly	55		48			38		30		30		38	

* Sample lost - estimated value used for averaging purposes.

FIG. 12a STRONTIUM 90 IN MILK (Strontium Units= $\text{pCi Sr}^{90}/\text{g calcium}$)

FIG.12 b STRONTIUM 90 IN MILK (Strontium Units = pCi Sr⁹⁰/g calcium)

FIG. 13

CAESIUM 137 IN MILK.

NOTE 1 - In order to avoid confusion the individual values for Palmerston North and Dunedin have not been plotted. In practically all cases these lie between the values for Wellington and those for Christchurch.

NOTE 2 - Dashed lines indicate no samples available.

SECTION C

RESULTS OF EXTENDED MONITORING OF PACIFIC TESTS

CONTINUED FROM THOSE PUBLISHED IN QUARTERLY REPORT NO. N.R.L.F22

TABLE 1 (continued): TOTAL BETA ACTIVITY OF DAILY AIR FILTER SAMPLES
STATED IN PICOCURIES PER CURIC METRE ON DAY OF MEASUREMENT

COLLECTION: From 9.00 on the date shown to 9.00 am on the following day. Stated in New Zealand Standard Time, i.e. G.M.T. + 12 hours.

MEASUREMENT: Routinely 4 days after the end of collection. Where this is not possible due to delays in transit, the number of days elapsed between the end of collection and measurement is given in brackets after the measurement.

November 1966	Nandi	Rarotonga	Auckland	Wellington	Christchurch
23	0.91	1.29 (21)	0.28	< 0.01	0.35
24	1.20	0.42 (20)	0.66	0.30	0.61
25	0.73	0.33 (19)	0.93	0.49	0.34
26	0.58	0.46 (18)	0.43	0.19	0.20
27	0.11	0.37 (17)	0.36	0.16	0.20
28	0.14	0.14 (16)	0.76	0.29	0.38
29	0.29	0.38 (22)	0.51	0.15	0.17
30	0.54	0.10 (21)	0.14	0.15	0.42
Average for Month	0.87	0.64	0.40	0.20	0.23

TABLE 1 (continued)

December 1966	Nandi	Rarotonga	Auckland	Wellington	Christchurch
1	0.75	0.05 (20)	0.32	0.26	0.19
2	0.68	0.51 (19)	0.11	0.05	0.08
3	0.66	0.45 (18)	0.11	0.09	0.11
4	0.12	0.86 (17)	0.13	0.10	0.11
5	0.20	0.65 (16)	0.27	0.16	0.13
6	0.12	0.43 (15)	0.28	0.10	0.07
7	0.24	0.35 (14)	0.18	0.08	0.06
8	0.27	0.57 (13)	0.10	0.12	0.12
9	0.24	0.45 (12)	0.32	0.14	0.16
10	0.25	0.46 (11)	0.10	0.05	0.06
11	0.45	0.28 (11)	0.10	0.06	0.06
12	0.47	0.18 (10)	0.23	0.14	0.11
13	0.31	0.17 (11)	0.29	0.14	0.20
14	0.33	0.20 (11)	0.29	0.21	0.43
15	0.12	0.16 (11)	0.32	0.31	0.63
16	0.26	0.10 (11)	0.33	0.31	0.20
17	0.19	0.08 (11)	0.27	0.30	0.20
18	0.16	0.14 (11)	0.27	0.26	0.20
19	0.17 (14)	0.06 (12)	0.28	0.22	0.06
20	0.13 (13)	0.07 (11)	0.35 (13)	0.20 (13)	0.06 (13)
21	0.11 (12)	0.01 (11)	0.17 (12)	0.25 (12)	0.15 (11)
22	0.19 (11)	0.09 (11)	0.23 (11)	0.14 (11)	0.15 (11)
23	0.24 (10)	0.10 (11)	0.15 (13)	0.05 (11)	0.05 (9)
24	0.20 (9)	0.21 (11)	0.15 (13)	0.05 (11)	0.05 (9)
25	0.07 (8)	0.07 (11)	0.15 (13)	0.05 (11)	0.05 (9)
26	0.07 (7)	0.16 (11)	0.09 (6)	0.06 (9)	0.09 (6)
27	0.07 (6)	0.09 (11)	0.09 (6)	0.06 (9)	0.09 (6)
28	0.05	0.10 (11)	0.18	0.07	0.12
29	0.04	0.11 (11)	0.18	0.07	0.12
30	0.02		0.14	0.07	0.10
31	0.03		0.14	0.07	0.10
Average	0.23	0.25	0.20	0.14	0.14

NOTE 1) Auckland, Wellington and Christchurch air filter collections reverted to the normal thrice-weekly filter changes from 23 December. The average daily values have been listed and graphed for these longer collection periods.

2) Air filter monitoring finished at Nandi on 31 December and at Rarotonga on 29 December.

TABLE 2 (Continued): TOTAL BETA ACTIVITY OF WEEKLY RAINWATER SAMPLESAT TIME OF MEASUREMENTIn Millicuries per Square Kilometre
1966

NOTE: The normal collection period for each rainwater sample is 7 days. For some collections, however, the period may be longer or shorter than 7 days due to heavy rainfall or sample transport requirements. An additional column has been introduced in Table 2, therefore, giving the average daily deposition over the collection period. The graphical presentation of these results now shows the average daily deposition over the collection period for all past and present results.

AT	Date of Collection From To	Date of Measurement	Rainfall cm	Total Beta Activity mCi/km ²	Average Daily Deposition mCi/km ²	Specific Activity pCi/litre
LAKAWA	12 Nov - 19 Nov	4 Jan	2.64	0.8	0.12	
	19 " - 26 "	4 "	3.30	2.1	0.30	
	29 Oct - 26 Nov		15.70	27.3		174
	26 Nov - 10 Dec	5 Jan	0.28	0.4	0.03	
	10 Dec - 18 "	5 "	3.78	0.6	0.08	
	18 " - 24 "	4 "	3.25	0.2	0.03	
	24 " - 31 "	12 "	4.78	0.4	0.06	
	26 Nov - 31 Dec		12.09	1.6		13
	24 Nov - 3 Dec	9 Dec	4.39	2.3	0.25	
	1 Nov - 3 Dec		30.96	45.3		146
FUNAFUTI	3 Dec - 10 Dec	20 Dec	14.38	2.0	0.28	
	10 " - 16 "	23 "	19.61	2.2	0.36	
	16 " - 20 "	5 Jan	15.23	2.2	0.54	
	20 " - 29 "	5 "	2.70	0.8	0.09	
	29 " - 1 Jan	9 "	1.24	0.4	0.14	
	3 Dec - 1 Jan		53.16	7.6		14
NANDI (FIJI)	28 Nov - 5 Dec	13 Dec	3.07	1.9	0.27	
	5 Dec - 12 Dec	20 "	18.10	6.6	0.94	
	12 " - 19 "	23 "	2.04	1.8	0.25	
	19 " - 26 "	3 Jan	1.98	1.0	0.15	
	26 " - 2 Jan	11 "	5.18	0.7	0.10	
	28 Nov - 2 Jan		30.37	12.0		40

TABLE 2 (Continued)

AT	Date of Collection From To	Date of Measurement	Rainfall cm	Total Beta Activity mCi/km ²	Average Daily Deposition mCi/km ²	Specific Activity pCi/litre
SUVA (FIJI)	29 Nov - 7 Dec	13 Dec	5.75	13.3	1.66	
	7 Dec - 16 "			No Sample		
	16 " - 23 "	5 Jan	1.73	0.8	0.11	
	23 " - 30 "	12 "	5.08	1.0	0.14	
SAMOA	29 Nov - 6 Dec	14 Dec	13.33	4.4	0.63	
	6 Dec - 13 "	20 "	5.62	1.6	0.22	
	13 " - 21 "	4 Jan	7.30	2.9	0.36	
	21 " - 27 "	5 "	7.96	1.8	0.30	
	27 " - 2 Jan	9 "	5.81	1.4	0.28	
	29 Nov - 2 Jan		40.02	12.1		30
NIUE	19 Oct - 27 Oct	13 Dec	1.68	3.6	0.45	
	27 " - 3 Nov	8 Dec	2.92	6.2	0.89	
	28 Sept - 3 Nov		23.65	76.4		323
	3 Nov - 10 Nov	13 Dec	0.31	5.1	0.73	
	10 " - 17 "	13 "	0.69	3.9	0.56	
	17 " - 24 "	18 Jan	0.33	1.0	0.15	
	24 " - 1 Dec	18 "	2.83	1.7	0.25	
	3 Nov - 1 Dec		4.16	11.7		281
	1 Dec - 6 Dec	18 "	0.25	0.8	0.17	
	6 " - 13 "	18 "	0.31	2.4	0.34	
	13 " - 20 "	18 "	0.41	1.0	0.14	
	1 Dec - 20 Dec		0.97	4.2		432

TABLE 2 (Continued)

AT	Date of Collection From To	Date of Measurement	Rainfall cm	Total Beta Activity mCi/km ²	Average Daily Deposition mCi/km ²	Specific Activity pCi/litre
TONGA	25 Nov - 2 Dec	19 Dec	0.15	0.2	0.03	
	28 Oct - 2 Dec		3.27	8.6		263
	2 Dec - 9 Dec	4 Jan	4.17	2.2	0.31	
	9 " - 19 "	4 "	1.22	1.9	0.19	
	19 " - 26 "	10 "	4.85	1.6	0.23	
	26 " - 1 Jan	10 "	7.45	1.1	0.22	
	2 Dec - 1 Jan		17.69	6.8		38
RAOUL	Collection Finished 1 Nov. See N.R.L.-F22					
PENRHYN	30 Aug - 6 Sept	16 Dec	3.50	0.3	0.04	
	6 Sept - 13 "	16 "	7.25	0.4	0.05	
	13 " - 19 "	15 "	6.08	3.7	0.61	
	19 " - 27 "	15 "	4.85	2.1	0.26	
	30 Aug - 27 Sept		21.68	6.5		30
	27 Sept - 4 Oct	15 Dec	3.48	7.2	1.03	
	4 Oct - 12 "	15 "	0.58	4.8	0.60	
	12 " - 18 "	15 "	0.38	6.8	1.14	
	18 " - 25 "	16 "	2.64	2.3	0.33	
	25 " - 1 Nov	16 "	2.14	1.3	0.19	
	27 Sept - 1 Nov		9.22	22.4		243
	1 Nov - 8 Nov	16 Dec	1.83	3.5	0.50	
	8 " - 15 "	16 "	3.58	4.2	0.60	
	15 " - 22 "	16 Mar	2.46	0.6	0.08	
	22 " - 30 "	16 "	2.10	0.2	0.02	
	1 Nov - 30 Nov		9.97	8.5		85
	30 Nov - 6 Dec	17 Mar	0.02	0.2	0.03	
	6 Dec - 14 "	16 "	0.46	0.3	0.04	
	14 " - 21 "	17 "	3.92	0.6	0.08	
	21 " - 27 "	16 "	4.47	0.8	0.13	
	27 " - 2 Jan	17 "	0.94	0.3	0.06	
	30 Nov - 2 Jan		9.81	2.2		22

TABLE 2 (Continued)

AT	Date of Collection From To	Date of Measurement	Rainfall cm	Total Beta Activity mCi/km ²	Average Daily Deposition mCi/km ²	Specific Activity pCi/litre
AITUTAKI	13 Oct - 20 Oct	8 Dec	1.58	1.6	0.23	
	20 " - 27 "	8 "	5.41	9.1	1.30	
	27 " - 3 Nov	8 "	0.10	0.9	0.13	
	29 Sept - 3 Nov		8.27	26.0		314
	3 Nov - 10 Nov	16 Dec	0.03	0.1	0.01	
	10 " - 17 "	14 "	25.77	16.0	2.29	
	17 " - 24 "	19 "	1.30	1.1	0.15	
	24 " - 1 Dec	22 "	15.15	6.0	0.86	
	3 Nov - 1 Dec		42.25	23.2		55
	1 Dec - 8 Dec	3 Jan	6.76	1.6	0.22	
	8 " - 14 "	3 "	0.08	0.6	0.10	
RAROTONGA	2 Nov - 9 Nov	12 Dec	8.61	12.0	1.72	
	9 " - 16 "	9 "	15.27	17.5	2.50	
	16 " - 23 "	13 "	0.03	0.8	0.11	
	23 " - 30 "	14 "	4.90	5.6	0.80	
	2 Nov - 30 Nov		28.81	35.9		125
MANGAIA	3 Nov - 10 Nov	13 Dec	6.38	8.0	1.14	
	10 " - 17 "	2 "	3.02	9.9	1.42	
	17 " - 24 "	14 "	Nil	0.4	0.05	
	24 " - 1 Dec	4 Jan	22.43	6.8	0.85	
	3 Nov - 1 Dec		31.83	25.1		79
	1 Dec - 7 Dec			No Sample		
	7 " - 15 "	23 Jan	1.65	1.5	0.19	

TABLE 2 (Continued)

T	Date of Collection		Date of Measurement	Rainfall cm	Total Beta Activity mCi/km ²	Average Daily Deposition mCi/km ²	Specific Activity pCi/litre
	From	To					
GREENBUSH	3 Dec	- 10 Dec	15 Dec	6.35	2.5	0.36	
	10 "	- 17 "	20 "	1.50	0.9	0.13	
	17 "	- 24 "	5 Jan	5.66	5.6	0.80	
	24 "	- 31 "	5 "	0.64	1.0	0.15	
	3 Dec	- 31 Dec		14.15	10.0		71
CHRISTCHURCH	2 Dec	- 9 Dec	13 Dec	0.41	0.8	0.12	
	9 "	- 16 "	20 "	1.60	0.6	0.08	
	16 "	- 23 "	3 Jan	0.05	0.5	0.07	
	23 "	- 30 "		1.80	1.7*	0.24*	
	2 Dec	- 30 Dec		3.86	3.6		93

* Sample lost. Estimated result based on average specific activity of samples collected from 2 Dec. - 23 Dec., used for averaging purposes.

TABLE 3: IODINE-131 IN MILK, STATED IN PICOCURIES
PER LITRE AT NOON ON DAY OF COLLECTION

NEW ZEALAND COLLECTING STATIONS

DATE	<u>AUCKLAND</u>	<u>NEW PLYMOUTH</u>	<u>WELLINGTON</u>	<u>GREYMOUTH</u>	<u>CHRISTCHURCH</u>	<u>DUNEDIN</u>	<u>INVERCARGILI</u>
DECEMBER							
2	5	<5	<5	6	<5	6	7
5	6	<5	<5	<5	<5	<5	<5
7	<5	<5	<5	<5	<5	6	<5
9	<5	<5	<5	<5	6	<5	8
12	5	6	<5	7	5	<5	6
14	<5	5	<5	<5	<5	<5	7
16	<5	5	<5	<5	<5	<5	<5

TABLE 4: IODINE-131 IN CATTLE THYROIDS, STATED IN PICOCURIES
PER GRAM WET WEIGHT, AT TIME OF SLAUGHTER

DATE	<u>NORTHLAND</u> <u>(MOEREWAI)</u>	<u>HAMILTON</u> <u>(HOROTIU)</u>	<u>NEW PLYMOUTH</u> <u>(WAITARA)</u>	<u>HASTINGS</u> <u>(TOMOANA)</u>	<u>PALMERSTON</u> <u>NORTH</u> <u>(LONGBURN)</u>	<u>WESTPORT</u>	<u>CHRISTCHURCH</u> <u>(ISLINGTON)</u>	<u>GORE</u>
DECEMBER								
5	37	53			65	39		
6				13				
7			42					
12		31	44		48			60
13	24			31			20	
19	10	16	26		26		11	36
20				18

^{131}I IN MILK: Activity stated in pCi/litre at noon on day of collection as given in Table 3. The dotted horizontal line indicates the minimum reporting level of 5 pCi/litre. Samples with an activity below 5 pCi/litre are indicated by a short thin vertical line on the day of collection.

Symbol indicates nuclear detonation on this day.

^{131}I IN MILK: Activity stated in pCi/litre at noon on day of collection as given in Table 3. The dotted horizontal line indicates the minimum reporting level of 5 pCi/litre. Samples with an activity below 5 pCi/litre are indicated by a short thin vertical line on the day of collection.

Symbol indicates nuclear detonation on this day.

^{131}I IN MILK: Activity stated in pCi/litre at noon on day of collection as given in Table 3. The dotted horizontal line indicates the minimum reporting level of 5 pCi/litre. Samples with an activity below 5 pCi/litre are indicated by a short thin vertical line on the day of collection.

Symbol indicates nuclear detonation on this day

021
100
611

¹³¹I IN CATTLE THYROIDS: Activity stated in pCi/gram wet weight, at time of slaughter as given in Table 4.

Symbol indicates nuclear detonation on this day.

^{131}I IN CATTLE THYROIDS: Activity stated in pCi/gram wet weight, at time of slaughter as given in Table 4.

☢ Symbol indicates nuclear detonation on this day.

¹³¹I IN CATTLE THYROIDS: Activity stated in pCi/gram wet weight, at time of slaughter as given in Table 4.

☛ Symbol indicates nuclear detonation on this day.

^{131}I IN CATTLE THYROIDS: Activity stated in pCi/gram wet weight, at time of slaughter as given in Table 4.

☢ Symbol indicates nuclear detonation on this day.

SECTION D

SPECIAL SURVEYS AND MISCELLANEOUS MEASUREMENTS

1. CAESIUM-137 INDIVIDUAL MILK STATIONS, TARANAKI

Separate analyses were made throughout the year on the monthly milk samples from the five factories which constitute the Taranaki station in our milk network, as indicated in Fig. 16 with their respective collection areas. The values are given below in Table 1. Previous values were given in the annual summary for 1965, Report N.R.L. F19 Table 6.

It will be seen that for each area the values were high in late summer and low in late winter as in the previous years. The average activity over the year shows a decrease of 23%, compared with 1965, this being fairly evenly distributed between the individual stations.

TABLE 1 CAESIUM-137 IN MILK TARANAKI PROVINCE, 1966

STATION	Cs137 pCi/g K												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avge
Clifton	111	110	100	107	92	(84)	76	67	70	67	89	82	88
Inglewood	297	273	222	(219)	215	(186)	157	160	152	197	(227)	257	214
Midhurst	293	323	284	253	227	82	56	173	195	104	214	238	204
Stratford	156	142	148	141	116	121	43	101	100	171	111	117	122
Cape Egmont	115	126	112	110	101	(86)	70	75	50	66	88	97	91
Average	194	195	173	166	150	112	80	115	113	121	146	158	144

NOTES

1. In three months of the year one or other of the five factories produced no milk powder. For the purpose of this table interpolated values (enclosed in brackets) have been assumed.

2. The figures in the bottom row do not agree exactly with the values for Taranaki given in the tables in the quarterly reports. The reason for this is that the above values represent means of quotients while the Taranaki value in the quarterly reports is derived from measurement on a composite sample made from equal weights taken from the milk powders sent from the factories.

1. CLIFTON
2. INGLEWOOD
3. MIDHURST
4. STRATFORD
5. CAPE EGMONT

FIG.16 MILK STATIONS, TARANAKI

2. CAESIUM-137/STRONTIUM-90 RATIOS IN MILK

The evaluation of the caesium-137 unit/strontium-90 unit ratios for the New Zealand milk network has been continued through 1966, the pattern of results being similar to that shown in previous years.

The average values of the ratios for Taranaki, Waikato, Auckland, and Northland were 11.7, 9.9, 5.6, and 5.7, respectively with values for the other stations lying between 1.9 and 3.0. The all station average for the year was 5.0 (compared with 5.1 for the previous year) but this reduces to 3.3 with Taranaki and Waikato values removed (3.6 in 1965).

The normal range of the ratio caesium-137 units/strontium-90 units is from 1.0 to 5.0, although it has been established that in certain areas, (notably Florida, Jamaica, and at certain special sites in England), the ratio has a value very similar to that found in Taranaki and Waikato, and undergoes a similar seasonal variation to that shown in Figure 17.

3. LEAD-210 IN RAIN

The deposition and concentration of naturally-occurring lead-210 in rain at Kaitaia, New Plymouth, Christchurch and Invercargill during 1965 were given in the previous Annual Report NRL F19 on page 31. This survey has been continued throughout 1966. Monthly values were obtained for all stations throughout the year except for the October collection at Kaitaia. The value for this sample was estimated using the average concentration at Kaitaia during the rest of the year, and the known rainfall during October. The following total values for 1966 were obtained:

TABLE 2

LEAD-210 IN RAIN 1966

Collecting Station	Annual Deposition mCi/km ²	Annual Rainfall cm	Average Concentration pCi/litre
Kaitaia	1.86	151	1.23
New Plymouth	2.04	174	1.17
Christchurch	0.74	55	1.34
Invercargill	0.97	87	1.11

4. RADIUM-226 IN FERTILISERS

Samples of phosphate rock from the major producing islands in the Pacific have been tested for natural radioactivity. All samples tested showed an activity between 23 and 28 pCi/g of rock. During conversion to the superphosphate for commercial application a dilution to about half the initial activity appears to take place, probably due to the use of large quantities of sulphuric acid in the manufacture of the finished product.

Assuming an annual average application of 200 lbs superphosphate per acre, with an activity of ~14 pCi/g, to normal soil with a natural background activity of ~1 pCi/g and cultivated to a depth of 6 inches, it would take at least 450 years for the natural background activity to be doubled by this application, not allowing for any leaching or exchange between topsoil and lower layers which would tend to increase this period.

5. CAESIUM-137 IN FLOUR

Mention was made in the last Annual Report (NRL F19 p. 32) that flour samples were being measured for caesium-137, but no values were given. Owing to the long processing and counting times involved, only a few more samples were measured during the early part of 1966, after which no further time was available due to extra routine work created by the French Tests in the Pacific.

The average activity of the 26 samples so far measured was 53 pCi Cs-137 per Kg. If we assume a mean daily intake per person of 200 grams flour from all sources and 0.5 litres of milk, then the total Cs-137 intake from these two sources (which normally supply about two thirds of the total Cs-137 content of diet) would be:-

From flour - 10 pCi Cs-137/day

From milk - 43 pCi Cs-137/day

These figures apply to 1965, since the wheat was grown in the 1964-65 season and can be assumed to be consumed during that year, and the milk value is the mean of the countrywide averages for 1965.

6. STRONTIUM-90 IN HUMAN BONE

Previous results have been given in DXRL-F7, DXRL-F8, NRL-F11, NRL-F13 and NRL-F14. Further values are as follows:

TABLE 3

STRONTIUM-90 IN HUMAN BONE

Area	Year of death	Age at Death		Type of Bone	pCi/g Ca
		Years	Months		
Low rainfall	1961	78		Humerus	0.2
Medium rainfall	1966	24		Femur	0.5
Medium rainfall	1966	3	6	Femur	2.4
High rainfall	1966	17		Femur	1.0

7. RADIUM-226 AND LEAD-210 IN HUMAN BONE

Ashed samples of human bone collected for strontium-90 measurements have also been measured for the long-lived naturally occurring radionuclides radium-226 and lead-210. The following values were obtained:

TABLE 4

RADIUM-226 AND LEAD-210 IN HUMAN BONE

Age at Death		Type of Bone	pCi/g ash	
Years	Months		Radium-226	Lead-210
0	5	Femur, Spine, rib.	0.016	0.044
0	9	Femur	0.036	0.075
1	3	Femur	0.026	0.091
2	6	Femur	0.020	0.056
4		Femur	0.009	0.088
5		Femur	0.010	0.071
7		Femur	0.026	0.139
7		Femur	0.020	0.086
9		Femur, Spine	0.011	0.048
16		Femur	0.017	0.136
16		Femur	0.013	0.053
19		Rib, Vertebra	0.013	0.174
19		Femur	0.023	0.068
23		Femur, Spine	0.214	0.340
53		Femur	0.026	0.093
60		Femur	0.011	0.089
68		Femur	0.012	0.073
72		Vertebra	0.021	0.159
80		Femur	0.040	0.098
85		Femur	0.010	0.099

8. RADON-222 IN ARTESIAN WATER

Radon-222 has been measured in several samples of Christchurch artesian water by rapid separation and measurement of the beta emitting daughter bismuth-214. Typical values for Christchurch water are of the order of 1000 pCi/litre.

9. INTERNATIONAL INTERCOMPARISON SAMPLES

The Laboratory again participated in the international intercomparison of measurements of low levels of naturally-occurring and artificial radio-nuclides in environmental samples. Samples were supplied by the International Atomic Energy Agency and during 1966 and early 1967 the following measurements were made:

1. The levels of strontium-90, stable strontium, caesium-137, potassium and radium-226 in mixed diet samples.
2. The levels of polonium-210 in vegetation, meat and bone samples.

ACKNOWLEDGEMENT

The assistance of the Director of the New Zealand Meteorological Service (Dr J. F. Gabites) and of his staff of observers has made it possible to:

1. Obtain gamma radiation dose rate measurements several times each day at 7 Pacific Islands from the monitoring instruments installed by this Laboratory;
2. obtain daily air filter samples at 2 Pacific Islands and at Wellington from the air samplers installed by this Laboratory;
3. obtain weekly rainwater samples at 13 collecting stations;
4. obtain monthly rainwater samples at 2 Pacific Islands and at 6 collecting stations in New Zealand.

Weekly samples of cattle thyroids are obtained through the assistance of the Department of Agriculture's meat inspection service at 8 collecting stations.

Officers of the Department of Health assist in obtaining thrice weekly milk samples from 6 towns, and the Auckland daily air filter samples.

Other types of samples are obtained through the assistance of the Soil Bureau, Geological Survey, and Fruit Research Orchard of the Department of Scientific and Industrial Research, from pathologists, and from a number of privately operated milk processing plants.

Mr L. P. Gregory, as Officer in Charge of the Environmental Radioactivity section of the Laboratory, is responsible for the sample preparation and measurement of Total Beta Activity, for the sample preparation and radiochemical separation of specific radionuclides and for the measurement of strontium-89 and strontium-90. He is assisted in this work by one professional officer (Mr P. Baltakmens). Technical assistance was given in this work by Miss G. E. Neal and part-time assistance is given by Mr L. J. Tucker and Mr N. G. Wilson.

Gamma ray spectroscopy is under the control of Mr H. J. Yeabsley, Deputy Director. The measurements of caesium-137 and iodine-131 are made by Mr J. E. Doubs, Technical Officer, with part-time assistance by Mr N. G. Wilson.

Mr J. F. McCahon, Senior Principal Radiation Officer, was responsible for establishing the relationship between gamma radiation dose rate and potential health hazard, on which the operation of the gamma radiation monitors in the Pacific Islands is based.

Maps and graphs for this report have been drawn by Mr A. D. Parton, Mr T. Baltakmens and Miss S. Loader.

G.E. Roth
DIRECTOR

PART IV

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