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FALLOUT PROGRAM
QUARTERLY SUMMARY REPORT

January 1, 1968

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HEALTH AND SAFETY LABORATORY

FALLOUT PROGRAM
QUARTERLY SUMMARY REPORT

(September 1, 1967 through December 1, 1967)

Prepared by

Edward P. Hardy, Jr.
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, -181, -182, and -183.

January 1, 1968

UNITED STATES ATOMIC ENERGY COMMISSION
New York Operations Office

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FALLOUT PROGRAM
QUARTERLY SUMMARY REPORT

January 1, 1968

ABSTRACT

This report presents current data from the HASL Fallout Program, Isotopes Inc., National Radiation Laboratory in New Zealand, the Division of Biological and Medical Research at Argonne National Laboratory, Euratom Joint Nuclear Research Centre, the Division of Biology and Medicine, USAEC, and the Air Resources Laboratories, ESSA. 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: Pu-238 fallout from SNAP-9A, significance of Cs-137 levels in man, seasonal stratospheric distribution of Cd-109, Pu-238, and Sr-90, stratospheric radioactivity in November 1967, and the HASL quality control program. A bibliography of recent publications related to radionuclide studies is also presented.

Table of Contents

10

List of Tables

Part II

HASL FALLOUT PROGRAM

List of Tables (Cont'd)

Part II

HASL FALLOUT PROGRAM

Page

High Altitude Balloon Sampling Program

List of Figures

Part II

HASL FALLOUT PROGRAM

Introduction

Every three months, the Health and Safety Laboratory issues a report summarizing current information obtained at HASL pertaining to fallout. This report, the latest in the series, contains information that became available during the period from September 1, 1967 to December 1, 1967. The next report is scheduled for publication on April 1, 1968. 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, -182, -183 and -184 (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, Isotopes, Inc., The Division of Biology and Medicine, USAEC, and the Air Resources Laboratories ESSA 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; Tracerlab, Division of LFE, Waltham, Massachusetts, and U. S. Testing Co., Inc., Richland, Washington.

This report is divided into four main parts:

1. Interpretive Reports and Notes
2. HASL Fallout Program Data
3. Data from Ssurces 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-III

by Herbert L. Volchok, (HASL)

Plutonium-238 was released by the disintegration of a SNAP-9A power source upon re-entry into the atmosphere in April of 1964. It was estimated (1) that the re-entry took place at an altitude of about 46 kilometers, over the Indian Ocean. Krey (2) by integrating the concentrations of SNAP debris from samples obtained by balloon and aircraft sampling, was able to account for 15 kilocuries (kCi) in the stratosphere in the early part of 1966. Eighty percent of this total was found to be in the Southern Hemisphere, at that time.

In order to document the deposition of material from the SNAP-9A burn-up, the Health and Safety Laboratory (HASL) initiated a sampling and analysis program in 1966. Large area collections (about one square meter) of fallout are made each month at Melbourne, Australia and New York City. Brief descriptions of the samplers, analytical procedures and preliminary data were reported earlier, (3, 4).

Data from both sites through July of 1967 are now completed. At Melbourne, sampling was not started until May of 1966, in New York all of 1966 was sampled. Tables 1 and 2 summarize the results of the plutonium analyses and also lists the Pu-238 to Pu-239,240 ratios for each month. The plutonium isotope ratio is useful for indicating the presence or absence of SNAP-9A debris. Measurements of air samples obtained prior to the re-entry of the SNAP showed a fairly constant Pu-238/Pu-239 ratio averaging about 0.03 (5). Thus any sample with a ratio in excess of that may be presumed to contain Pu-238 from the SNAP-9A and the amount may be determined by subtracting out the indicated "background" amount. Tables 1 and 2 also list the amount of Pu-238 calculated by that method. Note that in Table 1, values for the fallout at Melbourne, Australia were estimated for the first four months of 1966, by first computing the

Pu-239 assuming that this is 1½ percent of the Sr-90 in all cases. Sr-90 has been measured at Melbourne as part of another program (6). Then by extrapolating the smoothly increasing ratio Pu-238/Pu-239 to 0.03, (the pre-SNAP value) the numbers listed in the Table were obtained.

Figure 1 shows the time variation of the Pu-238/Pu-239 for both sites. The Melbourne ratio was assumed to have initially exceeded the 0.03 background level at the beginning of 1966, since little or no Pu-238 from the SNAP-9A could be definitely identified in the surface air of the Southern Hemisphere before early 1966 (7). Thus the ratio at Melbourne must have risen rapidly after the first appearance of the debris, in contrast to the situation in New York where the increase was rather gradual until the spring of 1966. It was somewhat surprising to see the Southern Hemisphere ratio decrease from March through July of 1967. Presumably this is an indication of either large scale movements of air, or a seasonal pattern of diffusion in the lower stratosphere. As the Southern Hemisphere spring advances, this trend may reverse with the ratios at Melbourne increasing again.

Figure 2 shows the actual monthly deposition of the SNAP-9A Pu-238 at the two sites. It is interesting to note that even in the first year of deposition the seasonal effect was quite marked in the Southern Hemisphere in 1966 and recognizable in New York in 1967. Perhaps even more unexpected, the New York fallout of Pu-238 attributable to the SNAP-9A was greater than that at Melbourne for three out of the four months; April through July. In the subsequent months of 1967, advancing into the Southern Hemisphere spring, it is anticipated that the Melbourne concentrations will sharply increase to even higher levels than in 1966.

As in the prior reports (3, 4) a computation of the global deposit of the SNAP-9A debris has been made. For this calculation it is assumed that the total SNAP-9A fallout in each hemisphere is directly proportional to that at the single sampling site in that hemisphere, and further that these relationships are identical to those observed for Sr-90 fallout. For the Northern Hemisphere, nine years of Sr-90 data gives a value of 123 ± 10 kilocuries (kCi) deposited in the Northern Hemisphere for each millicurie per square kilometer (mCi/km^2) deposited in New York City. Eight years of measurements at Melbourne, Australia results in a value of 180 ± 15 for the Southern Hemisphere.

Table 3 summarizes the hemispheric and worldwide deposits of the Pu-238 from SNAP-9A by months, through July of 1967. From these data it can be seen that in 1966 a little more than 1.3 kCi was deposited on the earth's surface while almost as much came down in the first seven months of 1967. The total through July of 1967, 2.55 kCi, represents some 17% of the 15 kCi accountable in the stratosphere by Krey in early 1966 (2).

The deposition rate is seen to have increased substantially in 1967 and based upon the last five months a stratospheric half residence time of a little over three years was calculated. Presumably this value will decrease as the distribution of the SNAP-9A material in the stratosphere approaches that which currently exists for the nuclear weapons debris.

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1964

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USAEC Report HASL-173, October (1966)

Table 1

Plutonium in Melbourne, Australia Fallout[1]
(values in 10^{-3} mCi/km^2)

	Pu-239	Pu-239	Pu-238 Pu-239	SNAP-9A Pu-238
Jan. 1966	1.35B	.06B	0.04B	0.01
Feb. "	1.05B	.08B	0.08B	0.04
Mar. "	1.80B	.22B	0.12B	0.16
Apr. "	1.20B	.24B	0.20B	0.16
May "	0.14	.05	0.36	0.04
Jun "	0.5B	.32	0.55	0.30
July "	1.35B	.96B	0.71B	0.91
Aug. "	0.49	.41B	0.84	0.39
Sept. "	0.51	.50	0.98	0.48
Oct. "	2.83	2.81	0.99	2.70
Nov. "	0.86	1.03	1.20	1.00
Dec. ")) Jan. 1967)	1.92	2.91	1.52	2.85
Feb. "	0.19A	.29	1.52	0.28
Mar. "	0.11A	.31	2.82	0.31
Apr. "	0.18A	.47	2.61	0.46
May "	0.21A	.48	2.29	0.47
June "	0.22A	.42	1.91	0.41
July "	0.50	.73	1.46	0.71

1 - Errors are less than ± 20% (1 sigma) except for "A" which indicate 20-50%.

B - Values were derived by extrapolation and from Sr^{90} levels.

Table 2

Plutonium in New York City Fallout[1]
(values in 10^{-3} mCi/km^2)

	Pu-239	Pu-238	Pu-238 / Pu-239	SNAP-9A Pu-238
Dec. 1965	3.23	0.09	0.03	0
Jan. 1966	3.47	0.12	0.04	0.02
Feb. "	3.18	0.30	0.09	0.20
Mar. "	2.02	0.12	0.06	0.06
Apr. "	4.59	0.18	0.04	0.04
May "	4.45	0.57	0.13	0.44
June "	2.23	0.17	0.08	0.10
July "	2.49	0.30	0.12	0.22
Aug. "	2.21	0.27	0.12	0.20
Sept. "	1.46	0.21	0.14	0.17
Oct. "	1.75	0.17	0.10	0.12
Nov. "	0.82	0.15	0.18	0.12
Dec. "	1.47	0.27	0.18	0.23
Jan. 1967	1.66	0.14	0.08	0.09
Feb. "	1.91	0.20	0.11	0.14
Mar. "	1.98	0.34	0.17	0.28
Apr. "	5.18	1.53	0.30	1.37
May "	3.06	0.91	0.30	0.82
June "	1.29	0.57	0.44	0.53
July "	2.57	2.44	0.95	2.36

1 - Errors are less than ±20% (1 sigma) for all data.

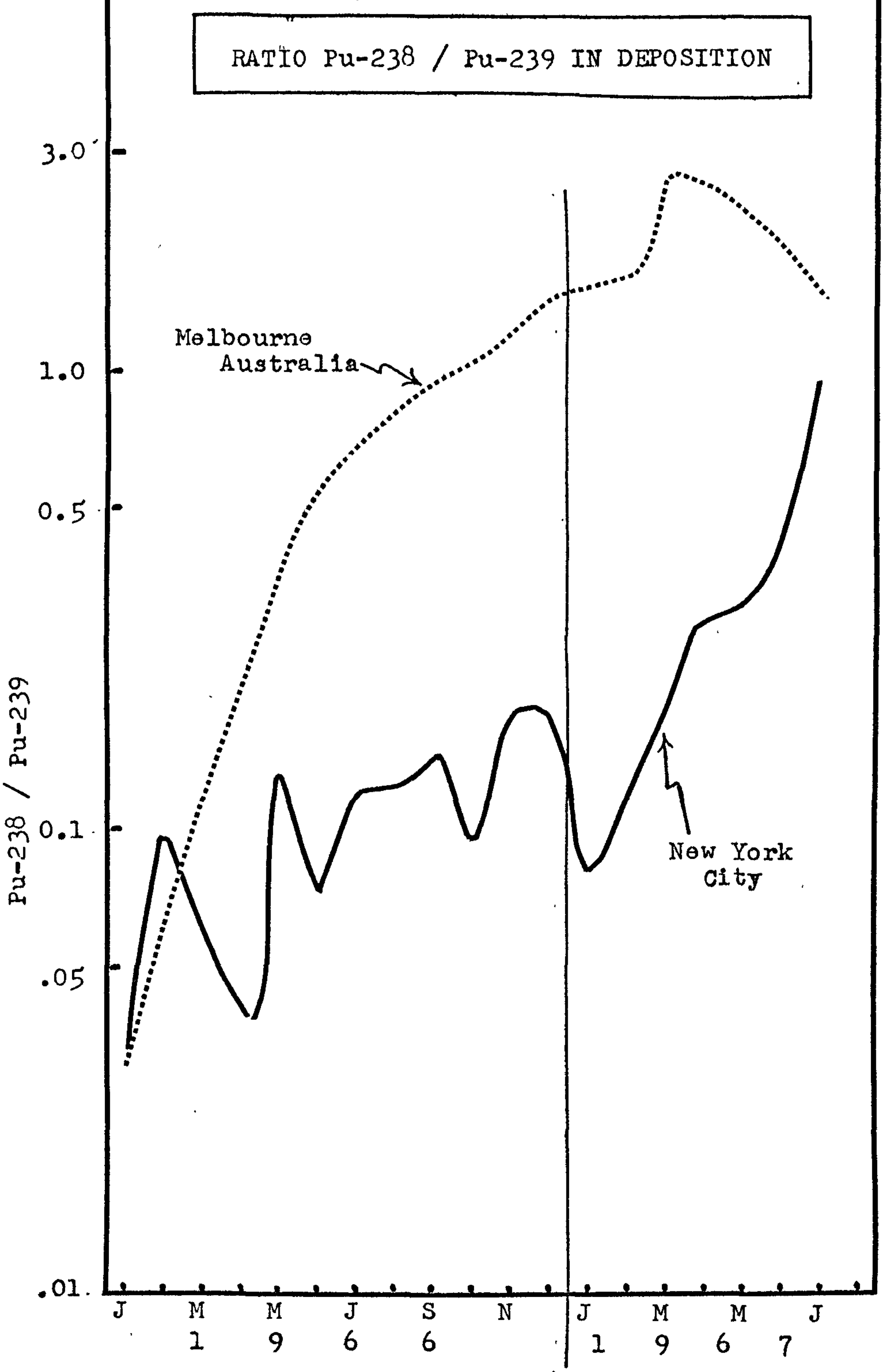
Table 3

Hemispheric and Worldwide SNAP-9A Pu-238 Deposition
(values in kilocuries)

	Northern Hemisphere	Southern Hemisphere	Worldwide
Jan. 1966	.002	.002	.004
Feb. "	.023	.008	.031
Mar. "	.007	.028	.035
Apr. "	.005	.028	.033
May "	.050	.008	.050
June "	.011	.053	.064
July "	.026	.165	.181
Aug. "	.022	.071	.093
Sept. "	.019	.086	.105
Oct. "	.014	.486	.100
Nov. "	.015	.179	.194
Dec. "	.026	.395*	.421
Total 1966	.220	1.509	1.319
Jan. 1967	.010	.118*	.120
Feb. "	.016	.050	.066
Mar. "	.032	.056	.088
Apr. "	.157	.083	.240
May "	.093	.085	.178
June "	.060	.074	.134
July "	.270	.128	.398
Sub Total	.638	.594	1.232
Total through July 1967	.858	2.103	2.551

*Derived from the December 1966 - January 1967 combined sample by the Sr-90 proportion.

Figure 1


RATIO Pu-238 / Pu-239 IN DEPOSITION
3.0
1.0
0.5
0.1
.05
.01
Pu-238 / Pu-239
Melbourne
Australia
New York
City
J
M
M
J
S
N
J
M
M
J
1 9 6 6
1 9 6 7

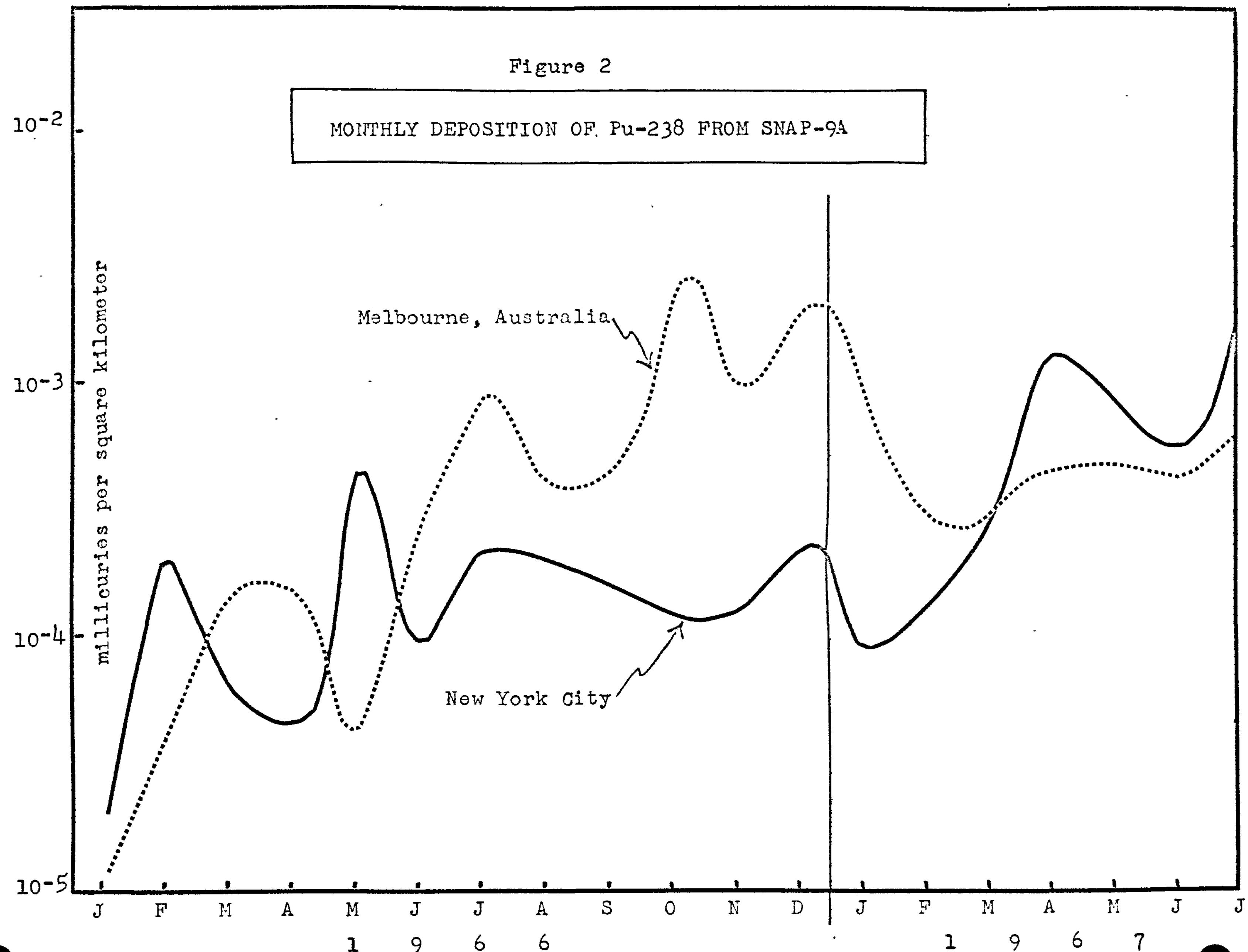


Figure 2
MONTHLY DEPOSITION OF Pu-238 FROM SNAP-9A
10-2
10-3
10-4
10-5
millicuries per square kilometer
Melbourne, Australia
New York City
J F M A M J J A S O N D J F M A M J J
1 9 6 6
1 9 6 7

~~THE~~ SIGNIFICANCE OF ^{137}Cs IN MAN AND HIS DIET

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ABSTRACT

Cesium-137 from the worldwide fallout of nuclear test debris is ubiquitous in the biosphere, throughout the human diet, and is present in measurable quantity in the peoples of the world. Many measurements of ^{137}Cs have been made in various media, including an AEC sponsored ^{137}Cs wholebody counting program and diet studies which have been conducted by both AEC and PHS. Diet and wholebody measurements of ^{137}Cs for the period 1961 through 1966 will be presented in this paper. The human subjects examined may not represent the average population since they have been drawn from a specific group, namely laboratory and university personnel.

The differences in ^{137}Cs wholebody burden across the country are less than anticipated on the basis of variations in regional ^{137}Cs fallout levels. In fact, the variations from one regional group to another are no greater than those observed within a group from a specific location. This is attributed to a common source of such staple items as grain products and meats. The biological half life of ^{137}Cs in adults ranges from 50 to 150 days, and is sufficiently short so that equilibrium or near equilibrium between diet and body burden is established even during times when the dietary level of ^{137}Cs was changing fairly rapidly.

The mean body burden of ^{137}Cs in the U. S. population is presented, and the radiation exposure due to this burden is calculated. Implications of the concentration effect observed in going from diet to man will be discussed as will the radiological importance of a possible long-term ^{137}Cs resevoir in bone. The prediction of future levels of ^{137}Cs in diet and man will be given for various circumstances.

INTRODUCTION

Cesium-137 is produced in the fission process with a yield of ~6 atoms per 100 fissions, and the yield is fairly independent of the type of fission involved, i.e. fission induced by either fast or slow neutrons (1). It has a physical half life of 30.5 years and resembles potassium metabolically. Stable cesium is relatively rare geologically, and in the biosphere, and whereas potassium is an essential element, there is no evidence that cesium is a necessary trace element in a biological sense. Radioactive ^{137}Cs was first detected in man by Miller and Marinelli in 1955 (2), who noted its presence in background subjects measured as part of the Argonne Radium Toxicity Program. Some 10 subjects have been examined by Miller et al from 1955 up to the present, representing a useful set of data for observing the changes in ^{137}Cs body burden as a function of time. The liquid scintillator wholebody system designed and built at Los Alamos Scientific Laboratory (LASL) by Anderson and Langham (3) was used to examine a large number of human subjects, first from within the laboratory and later from all over the world. A number of diet components were also examined at LASL, and their relative importance as sources of ^{137}Cs intake was identified by

Anderson et al (3, 4). These initial investigations showed the great importance of milk as a source of ^{137}Cs. They also showed a close quantitative and temporal correlation between the concentration of ^{137}Cs in milk and that found *in vivo* in man. Subsequent attempts were made at LASL and elsewhere to relate fallout deposition (i.e. ^{137}Cs) with levels in food (primarily milk) and those occurring in man (5). These early foodchain models were more successful in predicting body burdens of ^{137}Cs than were similar attempts at modelling the behavior of ^{90}Sr.

The rapidity with which wholebody ^{137}Cs follows changes in the dietary level is a direct consequence of its relatively short biological half time in man. Cesium and potassium are both remarkably well absorbed from the diet ($\sim$100%) (6) and are deposited in the soft tissues (muscle) of the body from which they are readily turned over. Empirical estimates of the biological half life of ^{137}Cs in human adults were undertaken by several investigators, using themselves as experimental subjects, taking known amounts of ^{137}Cs orally (7). The biological half times so observed ranged from 70 to 120 days, and more recent data indicate the spread to be somewhat greater (7). These half times are for a single exposure, i.e. intake event, in all cases. More recent work by Pendleton et al has shown a shorter biological half time for ^{137}Cs in children than in adults, and experimental animals have also indicated this trend (8).

The rapidity with which body burdens of ^{137}Cs responded to changes in ^{137}Cs intake and the speed of change in intake levels as a function of fallout rate led to monitoring of milk by PHS as a means of quick evaluation of radiological hazard. Milk sampling in a number of major milk-sheds was initiated in 1959. Other foods were added to the PHS sampling program; total diet sampling and specific foods were examined with regularity. The Chicago diet samples collected as part of the AEC Tri City ^{90}Sr Diet Study were subjected to ^{137}Cs analyses commencing in 1961.

Also in 1961, the AEC undertook an intercalibration study of whole-body ^{137}Cs measurements. These involved a number of laboratories having wholebody counters--either NaI(Tl) crystals or liquid scintillator type--which had been in the business for some time or intended to do considerable wholebody counting of ^{137}Cs in the future. The accuracy and precision attainable under the best, practical situation was determined, as well as the reproducibility of repeated measurements. The end point of this study was the recommendation of standard techniques and an evaluation of errors involved (9). It also provided a basis for the meaningful comparison of data from one laboratory to another, an important aspect as regards this report.

The geographic spread of these laboratories spans the heavily populated areas of the country. Most laboratories have continued to make wholebody measurements after the formal comparisons were ended, and thereby have provided valuable data on ^{137}Cs burdens for the U. S. These wholebody and the food monitoring programs provide the basic input for this report.

MATERIALS AND METHODS

The materials used for analysis were those provided by nature, in the form of willing human subjects for wholebody counting, and representative samples of their diets. Wholebody counting by means of NaI(Tl) spectrometry and low background shielding was done at Argonne National Laboratory (ANL), Brookhaven National Laboratory (BNL), Hanford, Idaho Operations Office (IDOO), Massachusetts Institute of Technology (MIT), and the University of California at Los Angeles (UCLA). The liquid scintillator systems were used at LASL. For the specifics of individual counting systems and for a more detailed and sophisticated treatment of wholebody counting, the reader is referred to the literature (9, 10, 11).

The basic approach for in vivo wholebody counting of ^{137}Cs (or for any other gamma-emitter for that matter) is to accumulate as high a net count from the subject as possible, compare with a standard reference source of the same radionuclide, and thus determine the body content of the subject being examined. There are a number of corrections which may be considered. Those for geometry (detector to subject), body size (height and weight being the common parameters), analyzer calibration, background variations, and such other peculiarities as may seem important in obtaining the best final value. The two common geometries used are: 1) A contour chair in which the subject is in a reclining position and the detector (crystal) is placed over the abdominal region at a fixed distance; 2) A troughlike bed in which the subject lies and which slides into an annular detector filled with liquid scintillator. The NaI crystal possesses high resolution, and one may more easily discern, and hence cope with, extraneous radionuclides. The geometry is poorer because of the small solid angle, although the efficiency is good with a large detector (8" dia. by 4" thick NaI(Tl) crystal for example). Counting times usually run from 20 to 40 minutes. The liquid scintillator system on the other hand has nearly 4 pi geometry, also high efficiency, but poor resolution. Compensation of body movements while in the detector are automatically taken into account. Counts usually run 5 to 10 minutes, and the background is correspondingly higher.

It should be stressed that in addition to measuring ^{137}Cs, whole-body counting also provides a measure of potassium content via measurement of ^{40}K. The same is true of gamma-ray measurements of diet components, or total diet samples. This is a fortunate happenstance because here we have two chemically similar elements, both metabolized by biological systems and both measurable at the same time. Comparisons of the two, by the $^{137}Cs/K$ ratio or other means, may often provide useful information.

Among the foods examined, milk has been studied the most extensively from several aspects; number of samples, locations of sampling, and the time period over which sampling has extended. The major categories of foods have been measured for ^{137}Cs by the AEC Tri City Program and by both PHS and Food and Drug Administration (FDA) studies. The Tri City Program has an adult diet which consists of 16 groups of items which may be reduced to some 5 or 6 major categories, and an infant diet of milk, grain products, and meat (12). PHS and FDA have also conducted composite diet sampling using both an institutional and a teenage diet as well as a wide range of less common foods, or products consumed in small daily amounts (13, 14). These various studies tend to indicate that the important sources of dietary ^{137}Cs are included within the more routine sampling programs. There is, of course, always the chance that an item eaten in small abundance or by a small segment of the population will contain a high concentration of ^{137}Cs and thereby assume unexpected importance.

Two principal analytical procedures have been followed in handling diet samples. The one more commonly used is gamma-ray spectrometry of bulk samples analyzed non-destructively. A variation of this involves drying or in some cases ashing samples to reduce the volume or mass of a given sample. The methods currently employed for sample analysis vary from place to place but basically use a NaI(Tl) detector, bulk samples mounted in a fixed relation to the detector, a low background shield, and a multichannel analyzer. Data reduction (spectrum stripping, least squares analysis, etc.) are normally done by computer (15, 16). A second approach is used in some instances, namely, radiochemical separations from suitably treated diet samples (17). This is more time consuming and at times less accurate due to losses of cesium in the ashing step and hence is less generally used at present.

RESULTS AND DISCUSSION

Concurrent measurements of ^{137}Cs in diet and in man provide an opportunity for studying their interactions and interdependencies, and for predicting the human body burden to be expected from various intake situations. The resultant radiation exposure from such intakes may also be determined. Perhaps of even greater interest is the chance to follow a widely dispersed environmental contaminant over a considerable period during which time it varies in absolute concentration and in the rate of contamination (deposition).

The rather strong dependence of the ^{137}Cs concentration in the human diet and in man on the rate of fallout deposition is illustrated in Figure 1. These data collected at Argonne are representative of the Chicago area. The deposition of ^{137}Cs is expressed in millicuries/km^2/year (mCi/km^2/year), and the concentrations of ^{137}Cs in total diet and man are given in picocuries/g potassium (pCi/g K).

The development of ideas and the illustration of apparent trends and their interpretation will be based upon the data obtained from the Chicago area. This is not entirely arbitrary, since wholebody measurements and fairly detailed ^{137}Cs data for infant and adult diets including milk are available for this locality. The PHS has data on ^{137}Cs in milk for the Chicago area as part of their milk sampling network. These data may be compared and some notion of the fit between the two sampling efforts may be derived. Similarly, PHS and FDA have examined institutional diets from the Chicago area for ^{137}Cs, and again a comparison between two programs is possible.

Several points are apparent in Figure 1: 1) The maximum ^{137}Cs level in the diet occurs some 6-12 months after maximum deposition of this radionuclide on the ground. 2) The highest ^{137}Cs level in man occurs 4-5 months after the maximum level was reached in the diet. 3) All three curves decrease fairly rapidly after attaining their maximum values. The annual deposition drops with a half time of approximately 12 months, whereas the diet and wholebody levels both decrease with an effective half life of 18 months. 4) There is an increase in the $^{137}Cs/K$ ratio by approximately a factor of 3 in going from diet to man. This latter phenomenon is a manifestation of the trophic level effect first identified by Pendleton and Hanson (18) in aquatic biota and later investigated in terrestrial ecosystems by Pendleton et al (19). The trophic level effect is one in which there is an increase in ^{137}Cs relative to potassium through each step in the trophic scale. This amounts to an actual increase in the concentration of ^{137}Cs per unit mass in the case of man and his diet because the concentration of potassium is essentially the same in both levels--approximately 2 grams potassium/kg wet weight. The constancy of potassium at these trophic levels is due to homeostatic control by the biological systems involved. The fact that ^{137}Cs is enhanced relative to potassium is understandable on the basis of the longer biological half time for ^{137}Cs (and stable cesium) in man relative to that for potassium. The biological half time for potassium in adults is 25 to 50 days compared to 50 to 150 days for ^{137}Cs; in fact, the enhancement in the $^{137}Cs/K$ ratio appears to be in direct proportion to the ratio of cesium to potassium biological half times. It should be further emphasized that ^{137}Cs is present in trace amount, and hence the higher the concentration of this radionuclide in the diet, the greater will be the concentration in man because the ^{137}Cs levels are well below those at which homeostatic or other biological control mechanisms will begin to become effective.

The $^{137}Cs/K$ ratio observed in the infant, teenage, and the two adult diets sampled in the Chicago area at various times are shown in Figure 2. At any given time, comparable values of the ratio appear in all four diets. The total daily intake of ^{137}Cs will increase directly with the amount of food consumed; however, the intake of potassium occurs at such a rate that the $^{137}Cs/K$ ratio remains essentially constant. Differences in the increase in the $^{137}Cs/K$ ratio between consumer and his diet as a function of age will alter the equilibrium body burden as will be discussed when we consider internal radiation dose.

One might presume that the similarity in $^{137}Cs/K$ ratio seen in the various diets arises because of similarities in composition as regards dietary contributors of ^{137}Cs. This is not true of the infant and adult diets, as far as milk is concerned, as is shown in Figure 3. The portion of the daily intake of ^{137}Cs which derives from cow's milk in the infant case ranges from 75 to 90 percent, whereas in the adult diet between 20 and 50 percent of the ^{137}Cs intake comes from milk.

It should also be noted that, on the average, the percentage of total dietary ^{137}Cs contributed by milk decreased between 1962 and 1967. This is more apparent in the adult diet than in the infant diet in which milk is the prime source of total nutrient as well as of ^{137}Cs. The lessening importance of milk as a source of ^{137}Cs reflects the decreasing rates of fallout, illustrated in Figure 1, following the cessation of large scale nuclear testing in the atmosphere at the end of 1962.

The relative importance of milk, grain products, meat, fruits, and vegetables as regards ^{137}Cs in the adult diet (Chicago) is shown in Figure 4. All together these 5 food categories provide more than 95 percent of the total ^{137}Cs intake of the average population. The primary mode of entry of ^{137}Cs into the food supply is by means of adsorption on plant surfaces (leaves, stem, and other above ground portions of plants) and by means of foliar absorption in which the radionuclide is solubilized and passes through the leaf membrane and into the circulatory system of the plant (20). Cesium-137 has been shown to be strongly bound by clay particles in soils, and hence is not available in most soil types for uptake by plant roots (21). Thus the ^{137}Cs in plant material depends upon the amount of deposition which occurs during the growing period of the plant in question rather than upon the total accumulation of this radionuclide in the soil.

Entry of ^{137}Cs into cow's milk is by the very direct route of deposition on grass and other pasture plant surfaces, ingestion of forage by the cow, followed by transfer to milk of a portion of the ingested ^{137}Cs. Changes in fallout rate quickly result in corresponding changes in the ^{137}Cs level in milk due to the short biològical link outline above. The close correlation between deposition and milk levels is further enhanced by the rapid loss, by physical means, of fallout from pasture vegetation. Because of its perishable nature, there is normally little delay between the production of milk and its consumption by man. From the foregoing, there is a sound basis for monitoring radioactivity in milk during periods of nuclear testing as an indicator of dietary contamination.

The data for ^{137}Cs in milk (Figures 3 and 4) and other diet categories (Figure 4) show considerable variability over relatively short time intervals. In part these variations are due to the randomness of sampling. To a fair degree, however, they reflect actual changes in fallout rate due to the sequence of nuclear test or to seasonal influences on fallout deposition.

The large increase in total diet ^{137}Cs in October 1961, shown in Figure 1, is in response to the resumption of atmospheric nuclear testing in September of that year. The higher ^{137}Cs levels seen in milk, as well as other food categories, during the spring and summer months reflect definite seasonal variations.

Fallout of ^{137}Cs, as well as other radionuclides produced in the fission process, show increased levels in surface air during the spring months, the so-called "spring maximum" which is of meteorological origin (22,23). This increase in radioactivity in surface air results from enhanced stratosphere-troposphere transport of debris during the late winter and early spring months. The spring months (here taken to be April through July) are also a time of relatively higher precipitation in the middle latitudes; for example the Great Lakes region receives 50 to 55 percent of the annual rainfall during April through July. This period coincides with much of the active growing season as well as the pasture feeding season for cows and cattle. The result is higher deposition levels occurring in conjunction with the growing and outdoor grazing season over much of the United States.

The typical pattern of ^{137}Cs in milk from mid-latitudes is one in which there are higher levels in spring and early summer, with decreases by autumn as the fallout rate diminishes (Figure 4). When cattle are taken indoors for the winter, levels may increase again as cows are put on feed grown during spring and summer which contains correspondingly higher ^{137}Cs levels than the autumn pasture. Accordingly as fallout levels are successively increasing each spring (1962-63) or decreasing (1964-67) this pattern, due to changes from outdoor to indoor feeding and vice versa, may reverse or become less pronounced. To a degree, fresh fruits and vegetables also show seasonal trends. Thus a portion of the dietary intake of ^{137}Cs does vary strictly as a function of the time of year.

There are two important diet categories which tend to smooth out seasonal variations as well as changes from one year to another. These categories are grain products and meat, which themselves are strongly related because of the practice of grain-feeding livestock prior to marketing. Grain from a given harvest may be used as feed, or made into flour, which may be consumed over a year's time, thus nullifying any seasonal variation. In addition grain harvested in a given year may be consumed over a period of several years, and may not even reach the market for a year or more after harvest. This delay in marketing tends to minimize annual fluctuations in ^{137}Cs levels, and may actual produce a lag in the appearance of maximal ^{137}Cs levels in this diet component. Such a time lag between production and consumption is the probable cause for the increase in the relative importance of grain products and meat as sources of ^{137}Cs in the human diet from 1962 to 1967 as shown in Figure 4.

Thus although milk is an important (and rapid) contributor of ^{137}Cs to man, the total intake of ^{137}Cs does not vary as abruptly as this foodstuff might indicate, and as a consequence the food intake as a whole varies more slowly, and the body burden comes more nearly into equilibrium with intake.

It should be pointed out that there are significant differences in dairy feeding practices throughout the United States, both as regards the time spent on pasture, and the type of feeds which are involved. Thus the pattern of seasonal variations of ^{137}Cs in milk shown in Figures 3 and 4 is representative only of the northern portion of the U.S., with the exception of the Pacific northwest where mild winters make possible pasture feeding throughout the year. Similarly outdoor feeding is done over much of the southern U. S., and field irrigation or drylot feeding is conducted in the southwest. Rainfall patterns are also different over the country as is the magnitude of of spring maximum. The net result is more uniform deposition, and resultant levels of ^{137}Cs in milk, throughout the entire year in some sections of the U. S. Typical concentrations of ^{137}Cs in milk as a function of time for various geographic regions and feeding regimens are illustrated in Figure 5. The cold winter, indoor feeding region is represented by Pittsburgh, the mild winter northwest by Seattle; the mild winter, nearly full-time outdoor grazing region by Montgomery, Alabama; and the arid regions of the southwest by Albuquerque. The weighted average for the entire United States milk supply is also shown in Figure 5. These data are all from the PHS milk network.

As previously stated, the differences in the concentration of ^{137}Cs in milk fron one region to another are closely related to differences in the rate of fallout deposition on the vegetation used for feed, as well as to the feeding routine itself. Total deposition, which is the time integral of the deposition rate, is a more thoroughly documented quantity. The cumulative deposition of ^{137}Cs over the U. S. for 1959 through 1965 derived from the HASL Fallout Network ^{90}Sr deposition data (24) using a value of 1.6 for the $^{137}Cs/^{90}Sr$ ratio (25) is shown in Figure 6. There is clearly a factor of 2 to 3 between ^{137}Cs deposition in various regions of the United States. Differences of this order are also apparent in the ^{137}Cs data in milk shown in Figure 5.

Milk is, in general, produced and consumed locally, and as a consequence should have the strongest regional influence on the total diet levels of ^{137}Cs. In certain seasons, the same will be true for locally grown fruits and vegetables; whereas during the winter nation-wide distribution of these foodstuffs from the southern growing regions will apply. The principal grain-growing region in the U.S. is in the Great Plains, an area of fairly uniform ^{137}Cs deposition (Figure 6), with subsequent distribution over the nation. Similarly major meat production is relatively restricted geographically, and the practice of grain feeding (again that grown primarily in the Great Plains region) before marketing may tend to yield a more uniform concentration of ^{137}Cs in meat, even though produced locally. Realizing that there are regional differences in growing seasons, amount and rate of ^{137}Cs deposition, as well as in food eating preferences throughout the country, one would expect to find differences in whole-body ^{137}Cs levels.

The average ^{137}Cs body burden expressed in pCi/g K at each of 7 sites extending from Massachusetts to California and from Washington state to New Mexico are shown in Figure 7. In addition to the mean value of all measurements, the average variation about the mean is also indicated for the Argonne data. For the six other sites only the mean values are plotted. Between 10 and 20 individuals were wholebody counted by each laboratory at the beginning of the intercomparison study in 1961-62. The number of individuals examined has decreased with time and there have been substitutions of people from time to time.

Two features of the data in Figure 7 are worth emphasizing; 1) The striking similarity in the temporal behavior of wholebody ^{137}Cs at all 7 sites, and 2) The ^{137}Cs body burdens in adults from a low fallout region (Los Angeles and New Mexico) are well within a factor of 2 of those observed from a higher fallout region (Massachusetts and New York). In fact the envelope formed by the deviation from the mean of the Argonne measurements encompasses the bulk of the data points from the other laboratories.

The wholebody measurements of ^{137}Cs are consistent with the dietary intake postulated above in which grain products and meats are fairly uniformily labelled with ^{137}Cs on a nationwide scale, and milk reflects local variations in ^{137}Cs deposition. Examination of ^{137}Cs institutional diets from the various regions considered in the wholebody counting program confirm the fact that the ^{137}Cs intake is fairly constant, at any given time, throughout the country, and such differences as do occur may be attributed to differences in the concentration of this radionuclide in milk. We may then proceed on the basis that we understand, or can at least explain, the variations in diet level and the body burden of ^{137}Cs in the U.S.

Before considering the radiation aspects of the ^{137}Cs body burden, mention should be made of a group, albeit a relatively small one, of the population which contain appreciably higher levels of ^{137}Cs than those discussed above. These are the Alaskan Eskimos. Because of the peculiarities of the lichen-caribou-man food chain,influenced by the nutrient deficient arctic environment,caribou-eating Eskimos attain ^{137}Cs levels 50 to 100 times greater than those shown in Figure 7 (26). People depending to a substantial degree on freshwater fish for food are also likely to have ^{137}Cs body burdens several times greater than those observed among people eating a more diversified diet. (27). It is not the intent of this paper to discuss these special groups in detail; however, the reader should be aware of their existence in order to place the dosimetric aspects of ^{137}Cs in a realistic perspective.

The relatively uniform distribution of ^{137}Cs throughout the body results in a correspondingly uniform radiation exposure to the entire body including the gonads. Hence potential genetic damage is of primary concern from internal ^{137}Cs, and the 30-year integral dose is the more crucial in this regard. This contrasts with the case of ^{90}Sr in which the irradiation of bone marrow (70-year integral dose) and the potential induction of leukemias is of prime consideration.

The average ^{137}Cs body burden for the U. S. closely approximates that observed in Chicago in both concentration and its variations with time. Thus the Argonne wholebody data have been used to calculate the average dose to adults on the basis that for the standard 70 kg man, 1pCi Cs^{137}/g K present in the body for one year delivers a dose of 0.02 mrad (28). The exposure prior to 1955 was calculated based upon ^{137}Cs deposition data obtained at Argonne. The annual dose commitments from 1953 through 1967 for the average total U. S. adult population are shown in Table I. Extrapolation to future times was done using the diet and body burden trend shown in Figure 1, which indicates an effective half time of about 18 months for ^{137}Cs in the diet and in man through mid-1967. The 30- and 70-year integral dose calculated on the assumption that this fairly short environmental half time for ^{137}Cs is maintained, and no further input of ^{137}Cs occurs, are tabulated in Table II.

This procedure leads to a lower limit of the integral dose which is in accord with the observed diminishing fallout rate as the stratospheric reservoir becomes depleted. It makes no provision, however, for the following: 1) Differences in metabolism (biological half time) of ^{137}Cs as a function of age, or of potassium intake level, 2) The effect of a possible long-term ^{137}Cs compartment in bone, 3) Inputs due to further atmospheric nuclear tests, and 4) Recycling or other means whereby a portion of the ^{137}Cs already deposited may become available for plant uptake. These factors will now be considered in some detail.

1) Effects of age and potassium intake.

In regard to ^{137}Cs biological half time as a function of age, Pendleton et al (29) and Rundo et al (30) have observed half times of 15 to 20 days in infants. McCraw (31) in his review paper on half life as a function of age, points out that a smooth relationship exists from infancy to approximately 20 to 25 years of age, with the half time varying from 15 days to 100 days. There is a suggestion that half time may decrease with old age; however, other factors such as decreased diet, weight loss, etc., make this only a supposition at present (31). Pendleton et al (29) have also noted that the $^{137}Cs/K$ ratio in young children is essentially the same as in their diet. Thus the shorter biological half time tends to minimize the ^{137}Cs burden in children, and hence the radiation dose, by allowing more rapid equilibration between body burden and diet.

From a total dose standpoint, the adult population (for which we fortunately have more data) is the more heavily exposed with the dose to teenagers somewhere in between the adult and infant exposures.

However, we should also bear in mind that the younger age group, although exposed to a lesser degree, is the more radiation sensitive, and hence may be subject to greater risk.

The integral dose for the years 1962 through 1965 has been calculated for infants and teenagers using the $^{137}Cs/K$ diet ratios shown in Figure 2. The increase in the $^{137}Cs/K$ ratio between diet and wholebody was taken as unity for infants and 2.0 for teenagers. The integral dose to adults for this same time interval was obtained from Table I. The results for infants, teenagers, and adults respectively are: 3.8; 6.0; and 7.5 mrads. This indicates adults to be the critical population in the sense of receiving the highest dose.

The work by Pendleton <u>et al</u> (29) has shown that the value of the quantity

$$\frac{(^{137}Cs/K)\ \text{Man}}{(^{137}Cs/K)\ \text{Diet}}$$

increases as the daily intake of potassium increases. The teenage diet postulates a potassium intake of 5.2g/day, leading to an increase on the $^{137}Cs/K$ ratio by a factor of 4 between teenager and his diet. On this basis, instead of the 6.0 mrads stated previously as the dose to teenagers for 1962 through 1965, the dose would be 12.0 mrads. Teenagers would then become the critical population in regard to exposure. However, there are not sufficient wholebody data on teenagers and adults from the same locale to test out this hypothesis.

2) Cesium 137 in bone.

The work of Yamagata and Yamagata (32) in 1960 identified concentrations of ^{137}Cs in bone which were comparable to contemporary levels in muscle, and in rib bone the concentration was higher than in muscle. Similar observations were made by Anderson and Gustafson (33) in rib bone collected in 1961 before the resumption of atmospheric testing. Investigations by Nay et al (34) in 1962-63 showed levels in bone which are lower than in muscle, and in 1965 the West German Federal Ministry of Scientific Research (35) reported data on concentrations of ^{137}Cs in bone and muscle which indicated that approximately 5 percent of the body burden was present in bone. The question of greatest importance then is whether or not this cesium is tightly bound in bone or is present in a superficial state. The fact that levels in bone during the high body burden period of 1963-1964 were fairly low (yet higher than in 1960-61) may indicate a long biological half time, and hence a slow equilibration between diet levels and those present in bone. Periodic assay of bone ^{137}Cs appears to be one way of answering this question. Another possibility is that as the total body burden decreases the amount present in bone will become of relatively greater importance and one would then expect to see the body burden decrease more slowly with time. Figure 8 indicates the possible trend assuming that 5 percent of the burden was in bone at the beginning of 1965. According to Figure 8, by the end of 1970 half of the total body burden will be in bone and the curve will show a distinct departure from the present trend. Continued atmospheric testing could mask such a trend, and indeed the recent injection into the stratosphere of nuclear debris from the Chinese Communist event of a few MT on June 17, 1967, (36), probably will produce a measurable increase in body burden within the next year or so. The ^{137}Cs body burden anticipated from an arbitrary injection of 5MT of fission products into the atmosphere is also indicated in Figure 8. The dose in 30- and 70-year intervals from a bone compartment is presented in Table II, under the assumption that no significant new inputs of ^{137}Cs occur.

3) Inputs from further atmosphere testing.

A further factor to consider is the continuous injection of modest amount of ^{137}Cs into the biosphere by atmospheric testing. Such injections must indeed be highly speculative, and for the sake of argument a level of 5MT of fission per year was chosen, which results in an average deposition of a total of 3 mCi/km^2 in mid-latitudes (30° - 50°N) and provides an intake level of 2 pCi/g K and a body burden of approximately 6 pCi/g K. One is certainly free to scale the magnitude of injection up or down. The dose from this level of testing would be 0.12 mrad/year, and the 30- and 70-year integral doses from this source are indicated on Table II.

4) Recycling or continuing availability of deposited ^{137}Cs.

The continued availability of ^{137}Cs for plant and animal uptake is even more difficult to assess due to the almost complete lack of data. This lack of data is one cogent reason for the continuation of the food sampling programs as these will directly indicate the degree of dietary contamination resulting from radiocesium already on the ground. The assumption is generally made that ^{137}Cs in foods depends almost entirely upon fallout coming down during or shortly prior to the growing season. On the basis of relatively sketchy experimental evidence the portion of

^{137}Cs in foods which derives from past deposition ranges somewhere between 0 and 10 percent (37). As time goes by it is conceivable that deposited ^{137}Cs may be weathered and become biologically available, or it may be windblown and hence deposit like fresh fallout, so that a persistent low level contamination may occur. For the sake of computation this persistent level has been taken to be equivalent to 5MT of ^{137}Cs deposited per year, and hence the dose is the same, 0.12 mrad/year as in the case above in which 5MT is injected per annum. The result of a persistent input of this magnitude on the 30- and 70-year doses is also shown in Table II.

The doses computed and listed in Table II are for the average population and extremes above and below these levels are to be expected. Smaller groups of the population may receive lower doses because of eating habits, for example vegetarians who do not use dairy products might receive the lowest dose. On the other hand heavy meat eaters, and people eating quantities of freshwater fish might receive considerably larger radiation exposures. Furthermore, the distribution of ^{137}Cs in man (as is true of ^{137}Cs and other trace elements in biological systems in general) has been shown to be log-normal (38). Hence certain probabilities of exceeding a specific exposure relative to a given mean exist, and vary according to the parmeters of the distribution.

CONCLUSIONS

The relatively uniform levels of ^{137}Cs in the human diet which exist in the United States have made it possible to compute with some validity a mean radiation exposure for the U. S. adult population. Annual radiation exposures have followed the patterns of fallout deposition quite closely. The high body burdens observed in 1959 and 1964 were accompanied by correspondingly high radiation exposures (Table I). A close relation exists between diet and body burden and, through early 1967, these parameters were declining with essentially an 18 month half time. Adults receive a somewhat higher dose than do children because of longer biological half time for ^{137}Cs in the former, and an increment in the $^{137}Cs/K$ ratio in going from diet to man which is not so pronounced in the case of the young. Teenagers may receive more exposure from ^{137}Cs due to their higher potassium intake.

The mean dose to the U. S. population based upon empirical measurements of ^{137}Cs body burdens was 15 mrads from 1953 through 1967. Projections, based upon a continuation of the present rate of ^{137}Cs loss, yield figures of 17.5 mrads for the 30- and 70-year dose commitments respectively, there being essentially no additional exposure after 1980 (Case A, Table II).

The commitment to the whole body from a postulated bone compartment for ^{137}Cs retention is calculated to be 2.0 and 3.4 mrads for 30- and 70-year intervals, (Case C, Table II); restricting this ^{137}Cs, and resultant dose, to bone, the 30- and 70-year bone doses are 20 and 34 mrads (Case D, Table II). Contamination from ^{137}Cs slowly entering into the biosphere taken as equivalent to the ^{137}Cs from 5MT of fission will produce increments of 1.9 and 6.7 mrads in the 30- and 70-year dose summed from 1953 (Case B, Table II). Similarly an input of 5MT of fission products into the atmosphere per year would produce a further increment of 1.9 and 6.7 mrads in the 30- and 70-year doses (Case B, Table II). A worst case estimate, involving all of the foregoing parcels to the whole body is 23.3 mrads for the 30-year dose and 34.3 mrads for the 70-year dose (Case E, Table II). These should be compared with the dose for the same time intervals which derives from natural sources, cosmic radiation, natural radioactivity in the environment, and internal natural emitters which amounts, on the average, to 120 mrads per year or 3600 and 8400 mrads for 30 and 70 years respectively.

It is somewhat more difficult to compute a national average for the external dose to man from fallout radionuclides because of the variability of fallout as illustrated in Figure 6. Data collected at Argonne were used to compute the dose from external sources at that locality from 1953 through 1966 and for 30 and 70 years commencing in 1953 as shown in Table III. A summary of the 1953 - 1967, 30- and 70-year doses are also indicated for several other situations in Table III.

It is of interest to compare the 1953 to 1967 and the 30- and 70-year integral doses discussed above with the dose to bone from ^{90}Sr as is done in Table III. If we assume that the external dose from fallout and the internal dose from ^{137}Cs pertains to bone as well as to the soft tissue of the body, then the total dose to bone is more than twice that attributed to ^{90}Sr alone over the next few decades. It is also apparent from Table III that the external exposure dose exceeds that from internal ^{137}Cs by roughly a factor of 7. It should be stressed that these relationships apply strictly to the Chicago area, and will vary depending upon fallout deposition.

SUMMARY

The results of diet and whole body counting programs have been used to derive the mean integral dose to the average U. S. population from ^{137}Cs. The uniformity of body burden throughout the adult population is attributed to the homogenizing effect of food distribution within the country. Cesium-137 is clearly dependent to a first approximation on fallout rate and diminishes with an environmental half time of about 18 months. The internal dose from ^{137}Cs has increased the total dose attributable to fallout by approximately 10 percent over a period of years. The total dose from fallout amounts to only a few percent of that from natural background over the times considered.

The study of ^{137}Cs in the human environment may have application to the study of other pollutants and may at the very least provide useful guidelines for such studies.

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TABLE I

^{137}Cs IN MAN AND CALCULATED INTERNAL DOSE

Year	Average Body Burden (pCi/ g K)	Annual Dose* (mrads)
1953	2**	0.04
1954	7**	0.14
1955	14.5	0.29
1956	31.5	0.63
1957	36.5	0.73
1958	47	0.94
1959	57	1.14
1960	48	0.96
1961	32.5	0.65
1962	43	0.86
1963	79.5	1.59
1964	140	2.80
1965	111.5	2.23
1966	69	1.38
1967	41	0.82

Total 1953 through 1967 15.2 mrads

* On the basis that 1 pCi ^{137}Cs/g K in man produces a dose of 0.02 mrad/year.

** Estimated from deposition data.

TABLE II

INTEGRAL DOSE FROM ^{137}Cs FOR THE PERIOD 1953-1967 AND FOR 30- AND 70-YEARS AFTER 1953

Exposure Condition	Dose in mrads per Time Interval 1953-1967	30 Years	70 Years
A. Current situation with no new input of ^{137}Cs	15.0	17.5	17.5
B. ^{137}Cs dose from 5MT input per year starting in 1967	--	1.9	6.7
C. Whole-body dose from bone compartment ^{137}Cs, no new input	0.7	2.0	3.4
D. Bone dose from bone compartment ^{137}Cs, no new input	7.0	20	34
E. Worst case whole-body dose A + 2B + C	15.7	23.3	34.3
F. Worst case bone only A + 2B + D	22.0	41.3	64.9

TABLE III

WHOLE BODY AND BONE INTEGRAL DOSE FROM VARIOUS SOURCES DURING 1953-1967, 1953 + 30 YEARS, AND 1953 + 70 YEARS

Conditions & Source	Dose in mrads per Time Interval		
	1953-1967	1953 + 30 Years	1953 + 70 Years
A. Worst case whole-body from ^{137}Cs	15	23	34
B. Worst case bone from ^{137}Cs	22	41	65
C. External fallout, no new inputs	100 mR*	175 mR*	270 mR*
D. Bone from ^{90}Sr	16 (89)**	--	170***
E. Natural background	1800	3600	8400

* Reduced to 40 percent of open field value due to shielding.
** To children 4 years of age in 1967.
*** Individuals who were children in 1967.

<u>Figure 1</u>

^{137}Cs IN SOIL, DIET, AND MAN

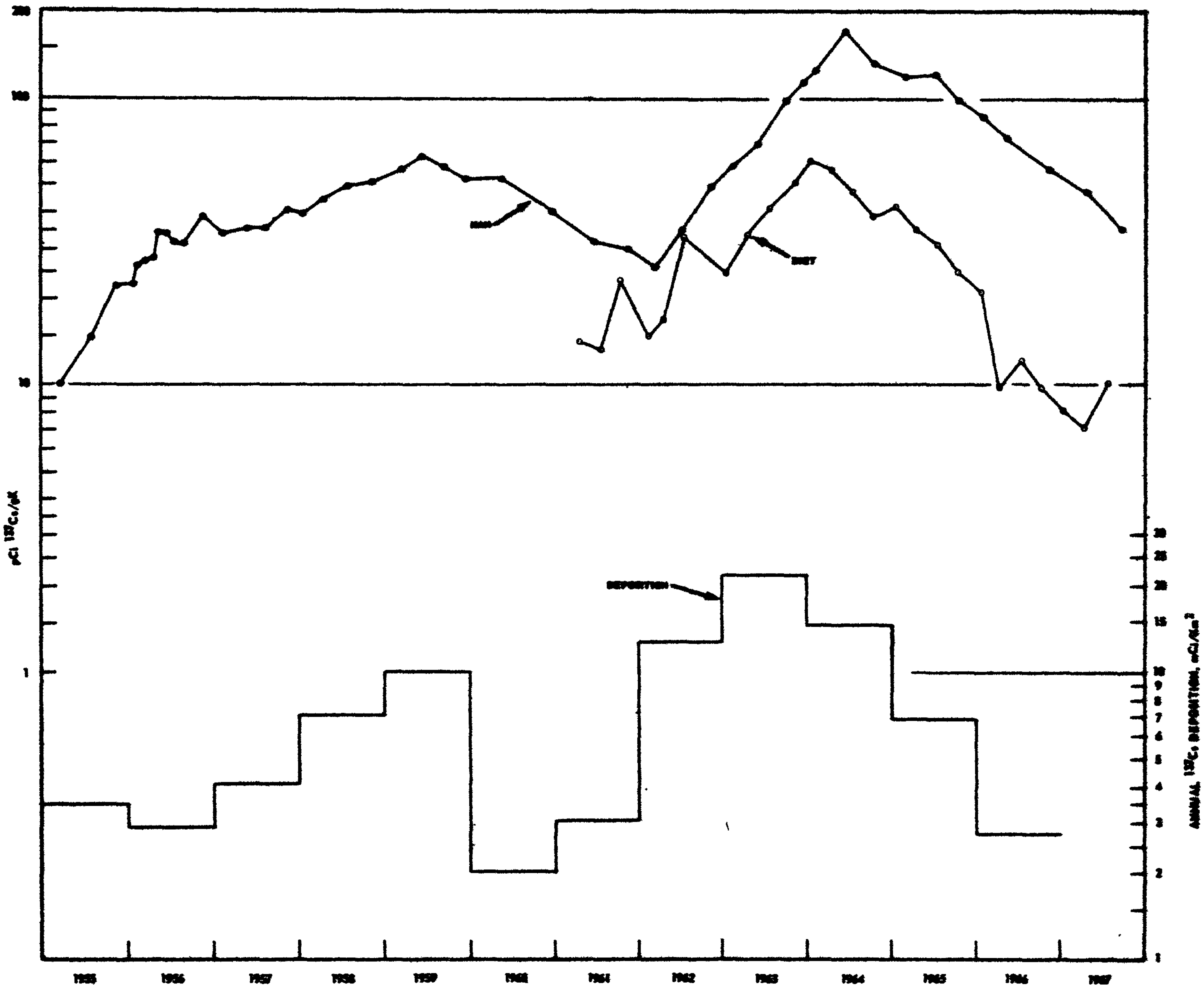


Figure 2

^{137}Cs IN VARIOUS DIETS (CHICAGO, ILLINOIS)

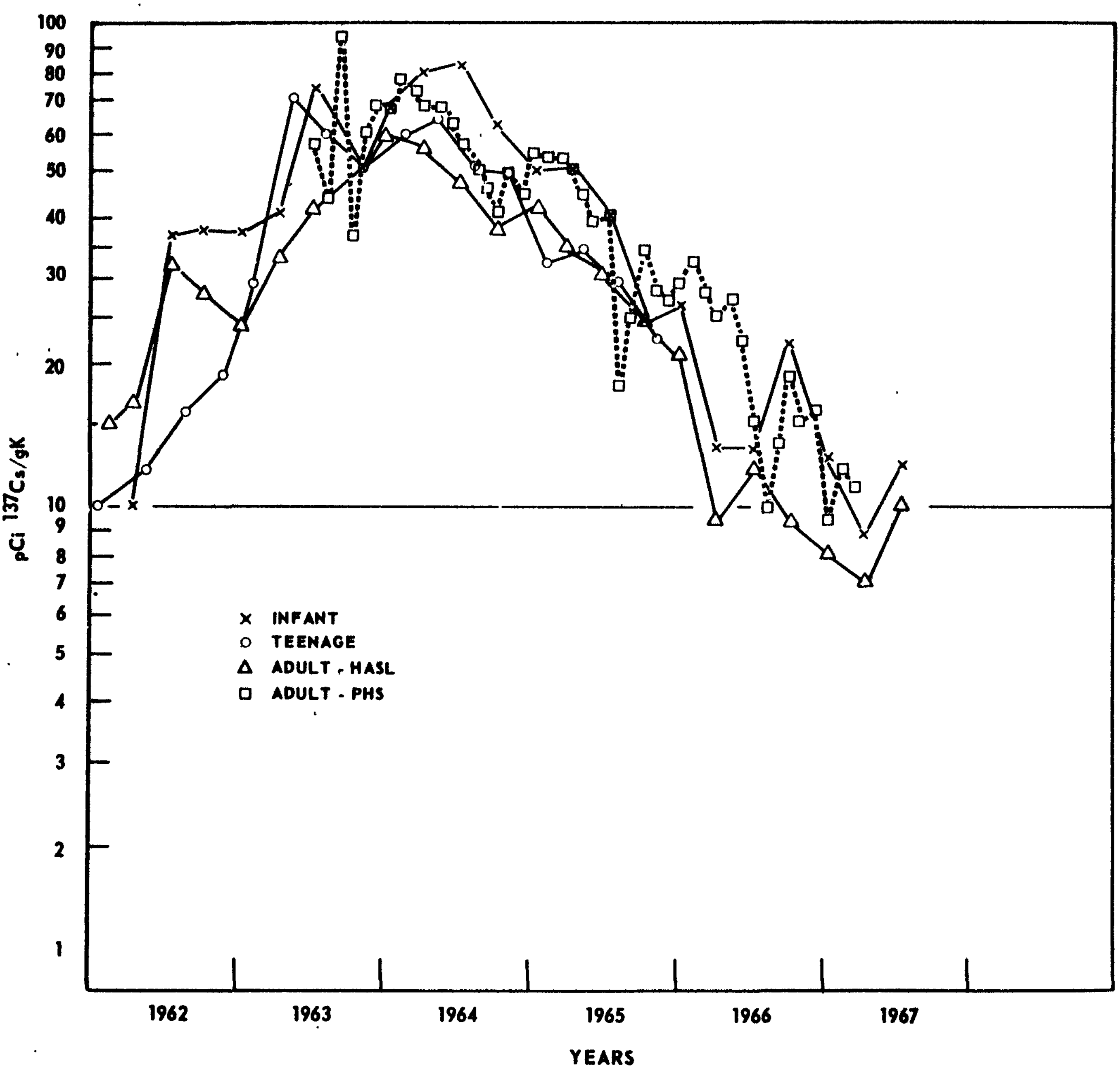
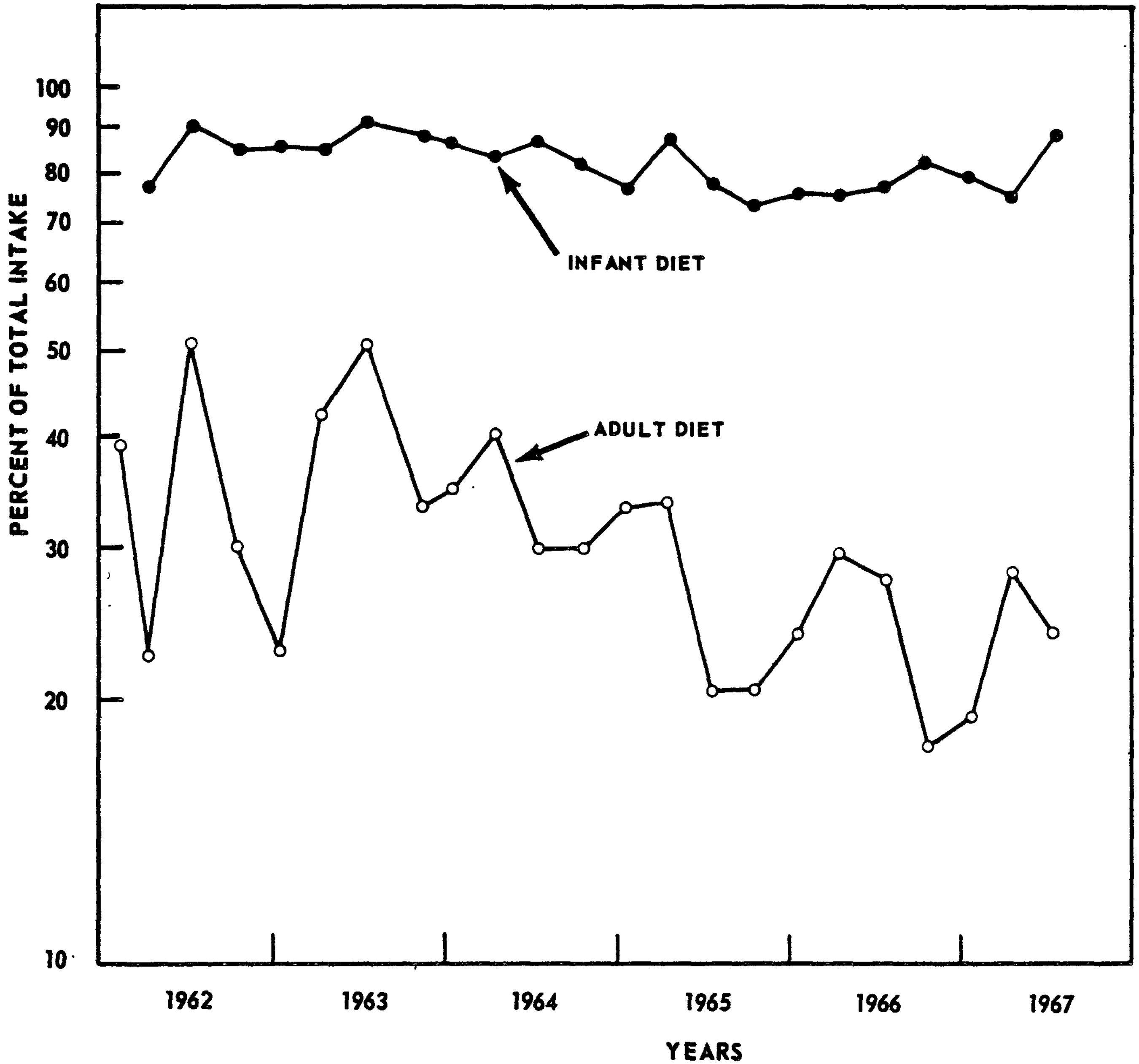


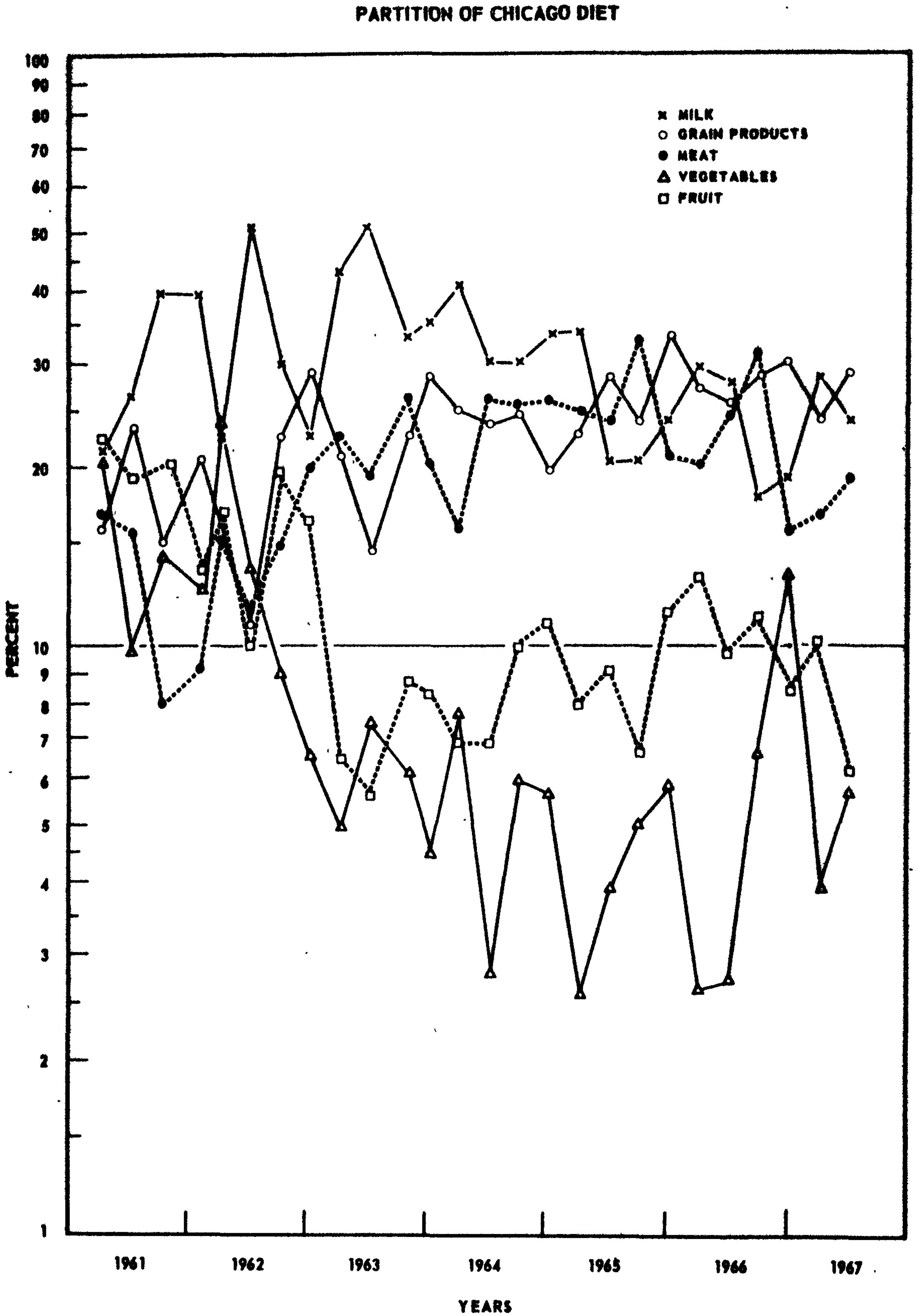
Figure 3

^{137}Cs INTAKE FROM COW'S MILK



1 - 47

Figure 4



PARTITION OF CHICAGO DIET
MILK
GRAIN PRODUCTS
MEAT
VEGETABLES
FRUIT
PERCENT
100
90
80
70
60
50
40
30
20
10
9
8
7
6
5
4
3
2
1
1961
1962
1963
1964
1965
1966
1967
YEARS

Figure 5

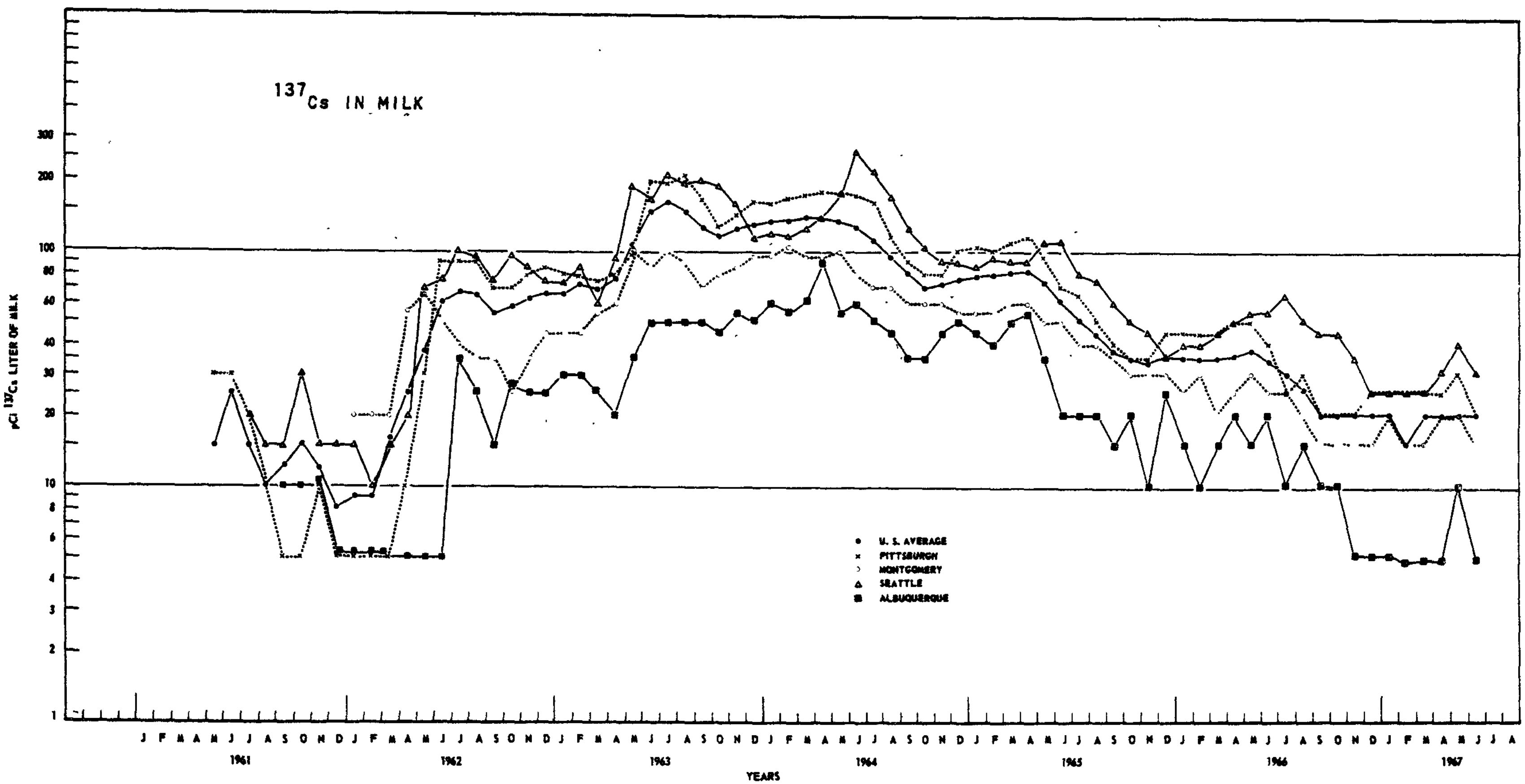

137Cs IN MILK
pCi 137Cs LITER OF MILK
300
200
100
80
60
40
30
20
10
8
6
4
3
2
1
U. S. AVERAGE
PITTSBURGH
MONTGOMERY
SEATTLE
ALBUQUERQUE
1961
1962
1963
1964
1965
1966
1967
YEARS

Figure 6

CESIUM-137 CUMULATIVE DEPOSITION FOR PERIOD 1959-1965

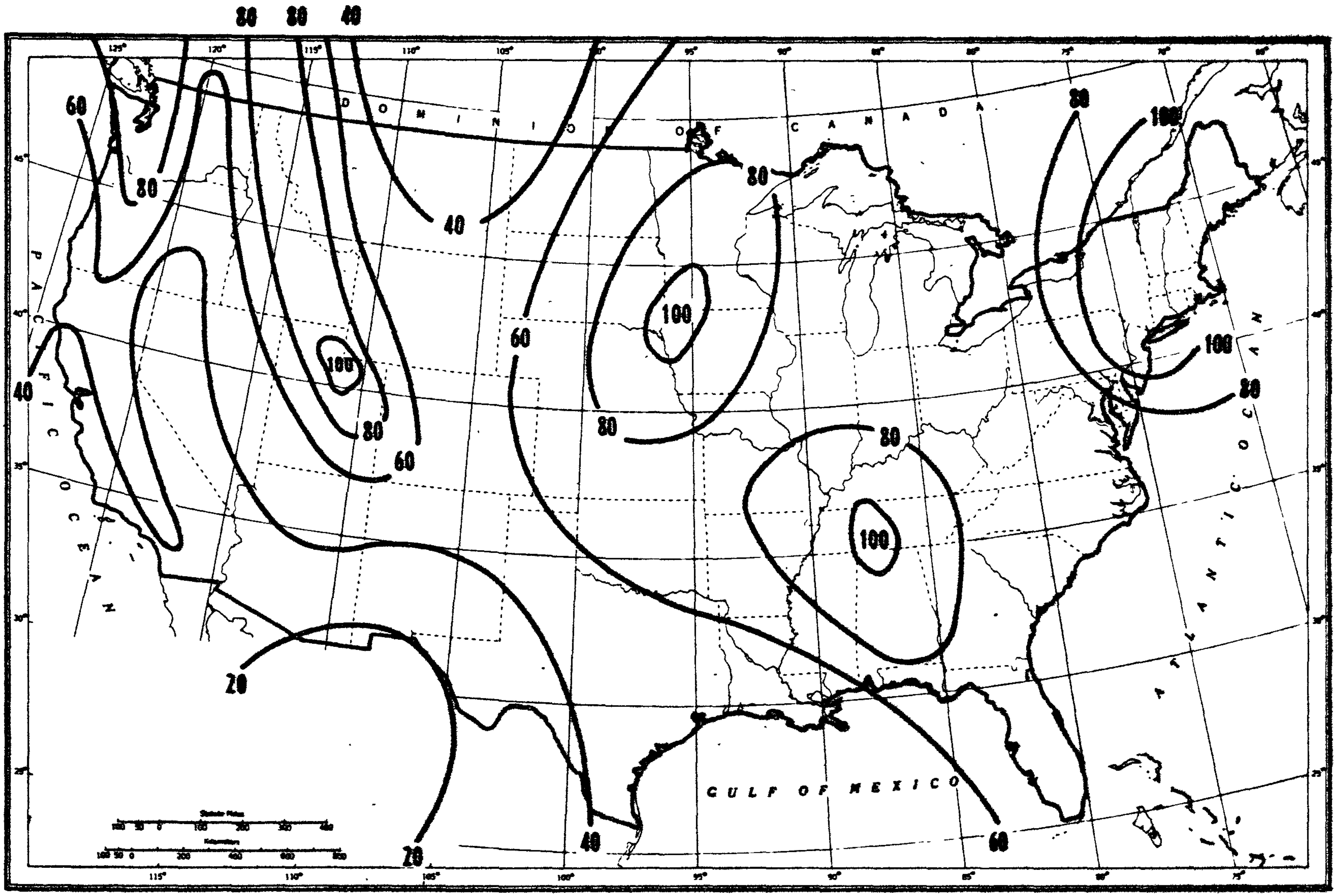
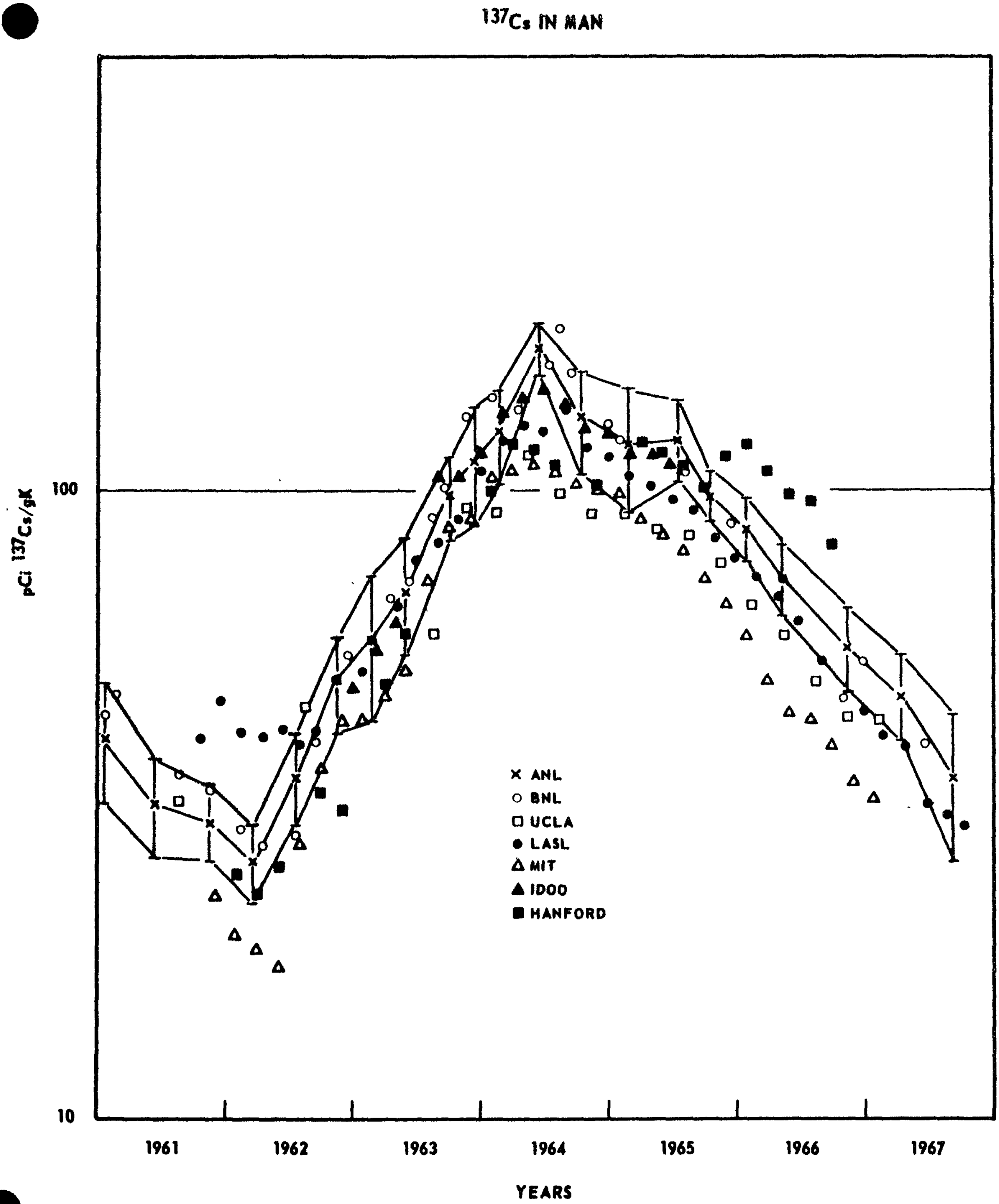
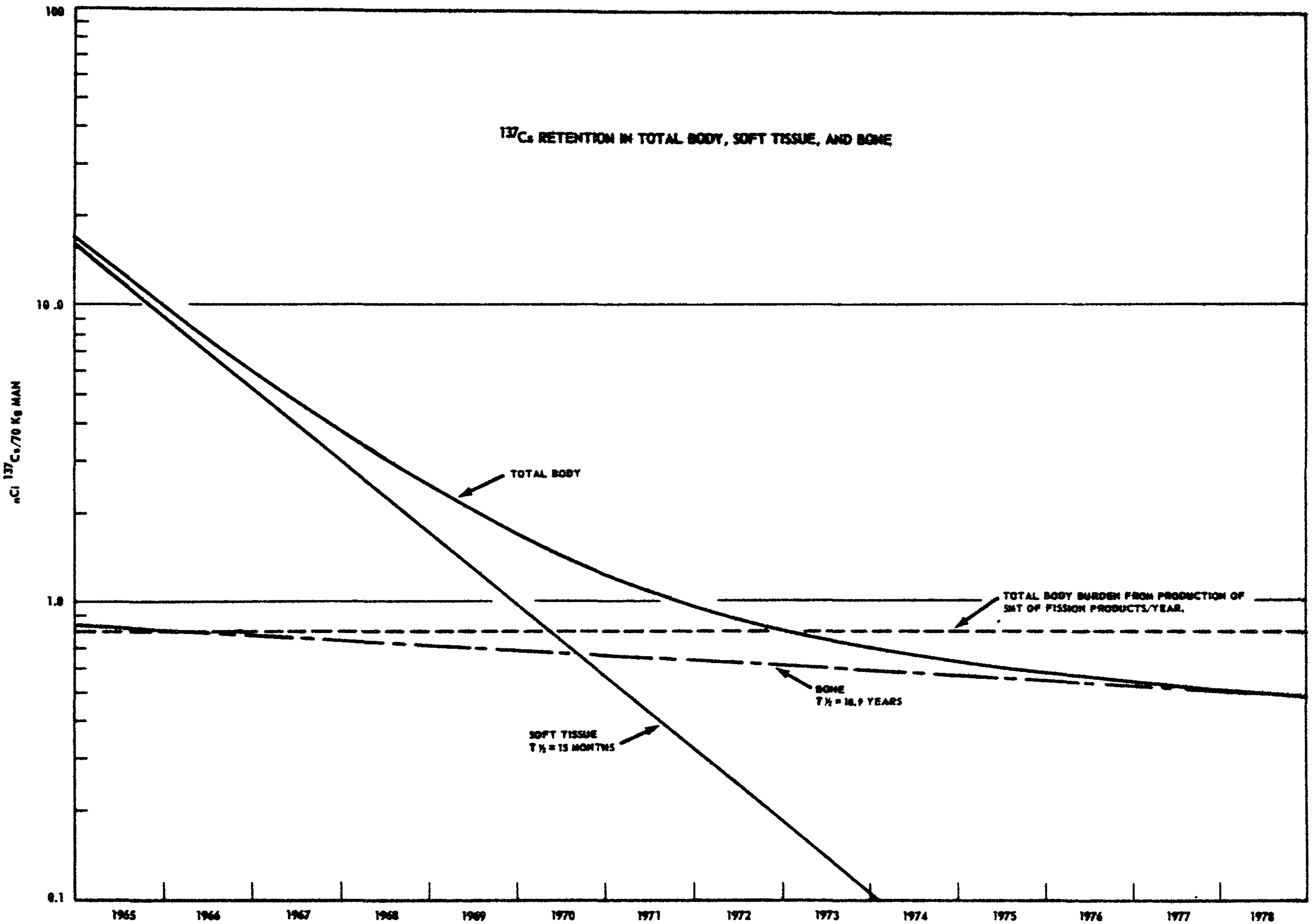


Figure 7



137Cs IN MAN
pCi 137Cs/gK
100
10
1961
1962
1963
1964
1965
1966
1967
YEARS
× ANL
○ BNL
□ UCLA
● LASL
△ MIT
▲ IDOO
■ HANFORD

Figure 8



^{137}Cs RETENTION IN TOTAL BODY, SOFT TISSUE, AND BONE
nCi ^{137}Cs/70 Kg MAN
100
10.0
1.0
0.1
TOTAL BODY
TOTAL BODY BURDEN FROM PRODUCTION OF 5MT OF FISSION PRODUCTS/YEAR.
BONE
SOFT TISSUE
T ½ = 15 MONTHS
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978

The Seasonal Stratospheric Distribution of Cadmium-109, Plutonium-238 and Strontium-90

by

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1. Introduction

Two unique radioactive tracers used to study atmospheric motions are Cadmium-109 (Cd-109) and Plutonium-238 (Pu-238). Background information on these two isotopes is given in Table I (List et al, 1966). Strontium-90 (Sr-90) is another isotope, which although not unique, has been the subject of many measurement programs and used in atmospheric motions studies.

Since there are numerous sources of data for these three isotopes, the primary purposes of this report are to document all of the known stratospheric data in the form of latitudinal cross sections of mean seasonal stratospheric concentrations and to list their inventories in the hope that it will be beneficial to the understanding and modeling of stratospheric motions through the use of radioactive tracers.

In this paper only certain general observations will be discussed. A more detailed report on the possible meteorological factors that caused changes in the observed concentration of the three isotopes was presented at the International Union of Geodesy and Geophysics, Lucerne, Switzerland during October 1967 (List and Telegadas, to be published).

2. Data

All of the radioactivity data discussed here results from the filtration of particles from the atmosphere. Samples up to about 70,000 feet (21 km) were obtained by the Defense Atomic Support Agency and by a cooperative effort of the U.S. Department of Defense, Atomic Energy Commission and Environmental Science Services Administration using aircraft. Samples from about 80,000 to 135,000 feet (24 to 41 km) were obtained by the USAEC high-altitude balloon program. The publications from which these data were extracted are listed in Table II.

a. Cd-109

Cadmium-109, placed high into the atmosphere on July 1962 by a nuclear rocket detonation, was first detected over Mildura, Australia (34°S) on December 1962 at about 105,000 feet (Salter, 1965a). The data and analysis covers the period from December 1962 to August 1966.

Due to the half-life of Cd-109 (410 days) and the relatively small volumes of air collected by the balloon samplers the data in 1965 and 1966 contain large uncertainties (Feely et al, 1966b). The stratospheric analysis of Cd-109 concentrations after August 1965 was restricted to aircraft altitudes.

b. Pu-238

The inadvertent burnup of a SNAP-9A nuclear power source containing Pu-238 occurred in April 1964. It was not until August 1964 that this material was first detected, again by the AEC sponsored balloon operation at Mildura, Australia (Salter, 1965b). The data and analysis of this isotope encompasses the period August 1964 to February 1967.

c. Sr-90

Radioactive Sr-90 is produced in all nuclear explosions, it is not a uniqje tracer as are Cd-109 and Pu-238. The presentation of the Sr-90 data is in the form of mean seasonal concentration isopleths for the period. March 1963 to February 1967.

Due to recalibration of the Sr-90 standards the reported balloon values measured by Isotopes Inc. from March 1963 to November 1964 should be reduced by 17% and from December 1964 to June 1966 by 8.5% (Krey, personal communication). This correction was applied to the Sr-90 data.

Prior to 1966 all isotopic concentration data were reported in units of disintegrations per minute per 1000 standard cubic feet of air (dpm/1000 SCF). Beginning in 1966 the concentration data were reported in units of picocuries per 100 standard cubic meters of air (pCi/100 SCM). The concentration isolines presented in this report are all in units of dpm/1000 SCF. Multiply dpm/1000 SCF by 1.6 to obtain pCi/100 SCM or by 0.013 to obtain pCi/kg of air.

3. Analysis and General Comments

Individual balloon samples are represented on the latitudinal diagrams by crosses. The enormous amount of aircraft data was stratified into latitude and altitude bands and average monthly concentrations were computed. Each monthly average is represented by a solid circle on the cross sections. A schematic tropopause, denoted by the heavy line on the cross sections separate the stratosphere and troposphere.

a. Cd-109

The limits of detection of Cd-109 concentrations correspond to 5×10^{-18} parts of the tracer produced per 1000 SCF of air (List et al, 1966), about 3 dpm/1000 SCF for production of 250 kilocuries. Feely et al, (1966b) account for about 75 kilocuries in their atmospheric inventory and explains the discrepancy as due to both the uncertainty in the production value and also the escape of some Cd-109 into the exosphere. The limit of detection from a 75 kilocurie source would correspond to a concentration of about 1 dpm/1000 SCF. This concentration was therefore used as the lower limit in the analyses. Figures 1-15 show the series of seasonal latitudinal cross sections for Cd-109 concentrations.

The first detection of this tracer in the Southern Hemisphere, shown in figure 1, occurred over the Mildura balloon station at 34°S while figure 2 denotes its arrival at the San Angelo balloon station (31°N). An examination of figures 1-15 indicates that the maximum concentrations observed in the Southern Hemisphere progress downward in time in the polar regions, with a minimum in the equatorial regions. This feature is less discernible in the Northern Hemisphere.

The 1 dpm/1000 SCF isoline, (the approximate limit of detection), has been used as an indicator of the first arrival time at various levels and latitudes. This isoline can be seen to progress downward, more rapidly in the fall and winter seasons than during the spring and summer. Figure 7 indicates the arrival of Cd-109 debris into the lower polar stratospheric compartment of the Southern Hemisphere during the winter (June-August) of 1964 (see fig. 43 for the identification of stratospheric compartments), while surface air measurements show its arrival in the spring (September-November) of 1964 (Krey, 1966a, b, c). This same feature is noticed in the Northern Hemisphere where figure 9 indicates the arrival of Cd-109 into the lower polar stratosphere during the winter (December-February) of 1964-1965, while the surface air measurements indicate its arrival in the spring of 1965.

b. Pu-238

There is a small background of Pu-238 in the atmosphere as a result of nuclear testing. Prior to the SNAP-9A event it corresponded to about 0.03 dpm/1000 SCF (List et al, 1966). The ratio of background Pu-238 to Pu-239 from nuclear testing is fairly uniform and therefore departures from this ratio could be used to discriminate the burnup of Pu-238 from the testing background. List et al (1966) have used a concentration of 0.2 dpm/1000 SCF with an activity ratio of Pu-238 to Pu-239 of 0.2 or larger as positive evidence of Pu-238 from SNAP-9A. These numbers were used as a lower limit in the analysis of the Pu-238 data presented in the series of seasonal latitudinal cross sections (figures 16-26).

Features similar to those observed for Cd-109 are apparent in the Pu-238 cross sections. The first detection at the highest altitude of the balloon collection at 34°S is shown in figure 16 while figure 18 indicates its first detection in the Northern Hemisphere. The maximum concentrations in the Southern Hemisphere are seen to progress downward as a function of time as did the Cd-109 maximum concentrations. Again, this feature is not as noticeable in the Northern Hemisphere.

The 0.2 dpm/1000 SCF isoline is seen to progress downward, more rapidly in the fall and winter seasons than during the spring and summer. The arrival of this debris into the lower polar stratospheric compartment of the Southern Hemisphere is shown in figure 23 (March-May 1966) while its arrival in the comparable zone of the Northern Hemisphere is shown in figures 25 and 26 (September 1966-February 1967). This debris was first detected at the surface in precipitation samples collected at Melbourne, Australia and at New York (Volchok, 1967). The highest deposition values of Melbourne were observed during the Southern Hemisphere spring of 1966 while at New York, it occurred during the Northern Hemisphere spring and summer of 1967 (Volchok, personal communication).

c. Sr-90

The seasonal latitudinal cross sections for Sr-90 concentrations are shown in figures 27 to 42. The highest observed concentrations are in the northern polar stratosphere at about 60,000 feet (Figs. 27 to 32). For this period (March 1963-August 1964) no data were available from the equatorial regions above 70,000 feet. In October 1964 the USAEC extended its balloon operation to the Panama Canal Zone (9°N). As seen in figure 33 and subsequent figures the observed concentrations at about 80,000 feet in equatorial latitudes are as high or higher as those in the northern polar regions at about 60,000 feet. The persistence of a maximum concentration in the equatorial regions is indicative of an absence of large scale organized circulation in that area. The Cd-109 and Pu-238 analyses which indicate a polar maximum and equatorial minimum supports this interpretation.

4. Stratospheric Inventories of Cd-109, Pu-238, and Sr-90

The stratospheric inventories of Cd-109, Pu-238 and Sr-90 are based on all available data. In this study, the stratosphere has been divided into 8 compartments (4 in each hemisphere) as shown schematically in figure 43. This partioning together with the latitudinal cross sections presented earlier (figure 1-42) can be used to ascertain where the largest uncertainties exist in the compartment inventories due to lack of data. The number in each compartment represent the percentage of the total stratospheric mass between the tropopause and 120,000 feet., 1.1 x 10^{18} kilograms of air. Similar stratospheric inventories of Cd-109, Pu-238, Sr-90 and other radioisotopes have been presented by Feely et al (1966a, b).

An examination of average monthly meteorological cross sections for 1 year during the IGY period (U.S. Weather Bureau, 1961) indicate that the average height of the equatorial tropopause oscillates between about 50,000 to 55,000 feet while the mean polar tropopause varies from about 30,000 feet in winter to 45,000 feet in summer. As will be shown later, the relatively large difference in the polar tropopause height does not seriously affect the inventory calculations when one uses the compartments shown schematically in figure 43.

a. Cd-109

The seasonal stratospheric burdens of Cd-109 from December 1962 to August 1966 have been calculated from the distributions shown in figures 1 to 15. The seasonal burden calculations for each stratospheric compartment are summarized in Table 3 and shown graphically in figure 44. Tabulation of the data to tenths of a kilocurie is not intended to imply this degree of accuracy, but is used to avoid any anomalies in the calculation that could rise from rounding off.

As mentioned previously, the large uncertainties in the balloon samples beginning in early 1965 prevented calculation of the stratospheric burden of the upper stratosphere compartments after November 1964. The total Northern and Southern Hemisphere stratospheric inventory is presented in fig. 44 up to this time, and a stratospheric inventory to 70,000 feet is presented for the total period under investigation. The time history of the Cd-109 increase and depletion for the four Northern Hemisphere stratospheric compartments is shown in figure 44b. The progression of the significant inventories is from the upper stratosphere into the middle polar compartment, then to the equatorial portion of the stratosphere and finally into the lower polar stratosphere. This same sequence of events is noticeable for Southern Hemisphere (fig. 44c). The inventory for June-August 1963 in the Southern Hemisphere upper stratosphere was interpolated since the computed burden appeared to be inconsistent with the period before and after this date. This inconsistency suggests that the upper stratosphere was not well mixed at this time.

The stratospheric burdens of Cd-109 presented by Feely et al (1966a, b) were divided into 4 compartments, 2 in the Northern and Southern Hemispheres above and below 70,000 feet. Feely found the maximum global stratospheric burden to be 75 kilocuries during the period September-December 1964 while Table 3 indicates a burden of 70 kilocuries for September-November 1964. The Northern and Southern Hemisphere burdens below 70,000 feet of Feely et al. were 9 and 34 kilocuries respectively compared to 9 and 39 from Table 3. The largest differences existed in the upper stratosphere where only limited balloon data are available for an analysis.

b. Pu-238

The stratospheric burdens of Pu-238 from June 1964 to February 1967 have been calculated from the distributions shown in figures 16 to 26. The seasonal inventory calculations for each stratospheric compartment are summarized in Table 4 and shown graphically in figure 45.

The Pu-238 burdens for the various compartments show features similar to the Cd-109 inventories. The first appearance noticed in the upper stratospheric compartment of both hemispheres progresses downward into the middle polar stratosphere then to the equatorial stratosphere and finally into the lower polar stratosphere.

The stratospheric burdens of Pu-238 presented by Feely et al (1966b) were divided into compartments comparable to those presented in Table 4, although for slightly different periods. Comparison of the individual and total compartmental burdens listed in Table 4 with those of Feely show very little differences. A total stratospheric burden of 12 kilocuries of Pu-238 was found during the period January-April 1966 by Feely which, compares very well with the inventory of 13 for March-May 1966 in Table 4. After this period the total stratospheric inventory appears to decrease. Since 17 kilocuries were injected into the stratosphere Feely et al. (1966b) suggest that possible causes of the difference between observed and input amounts of Pu-238 are (1) "collections efficiencies of the balloon samplers are less than 100%" and (2) "concentration measured at 34°S by the balloon program are often not representative of those in the southern polar stratosphere". Since Pu-238 did not enter the troposphere in any significant quantities until after September-November 1966, see figure 25, deposition would not account for this discrepancy.

c. Sr-90

The stratospheric burdens of Sr-90 from March 1963 to February 1967 have been calculated from the distributions shown in figures 27 to 42. The seasonal inventory calculations for each stratospheric compartment are summarized in Table 5 and shown graphically in figure 46.

The stratospheric burdens of Sr-90 presented by Feely et al. (1966a, b) were divided into a Northern and Southern Hemisphere compartment. The total Northern burdens listed in Table. 5 compare well with Feely's calculations. For the total Southern Hemisphere burdens, those listed in Table 5 are consistently higher than Feely's calculations by as much as 25%. This difference appears to arise primarily from the analyses in the southern equatorial region above 70,000 feet where data are virtually non-existent.

One noteworthy feature of figure 45 (b, c) that stands out is the cyclical behavior of the lower polar stratospheric burden. In general, for both hemispheres the amount of Sr-90 is a maximum in the winter and spring seasons and a minimum in the summer and fall periods. This suggest an influx of debris from above during fall and winter. In the spring, the period of maximum deposition, debris is transferred into the troposphere. Another possible explanation for the cyclical behavior is that the use of a fixed volume for the lower polar stratosphere compartment for all seasons, introduced a bias in the calculations. As noted previously, the polar tropopause oscillates between 30,000 to 45,000 feet during the year. Integration of the concentrations in this compartment were performed by assuming the mean winter and spring polar tropopause extends from 90° to 50° at 30,000 feet and from 50° to 30° at 35,000 feet (U.S. Weather Bureau, 1961). For the summer and fall period the mean polar tropopause is assumed to extend from 90° to 50° at 35,000 feet and from 50° to 30° at 45,000 feet. A comparison of these average seasonal tropopause boundaries with the fixed boundary method indicates a decrease of the winter and spring burdens by about 10% of those listed in Table 5 and a little less than 10% for the summer and fall burdens. These differences could not explain the cyclical behavior of the lower polar stratospheric burden.

5. Remarks

The main purpose of this report has been to present a series of latitudinal cross sections of the stratospheric concentrations of Cd-109, Pu-238 and Sr-90 in one publication using all available data. A detailed discussion of the possible causes for the observed changes in the stratospheric distribution and inventories is reserved for a future paper.

Acknowledgement

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Table I. Unique Radioactive Tracers

	Cd-109	Pu-238
Date of injection	July 1962	April 1964
Type	Nuclear Test	Re-entry Burnup
Altitude	400 Km	40-60 Km
Latitude	17°N	Indian Ocean
Source (Kilocuries)	250[a]	17
Half-life	410 days	86 years

[a] Best estimate.

Table II. Data References

Isotope		1963	1964	1965	1966
Cd-109	Aircraft	1, 6, 8	2, 3, 6, 8, 10	3, 11, 13, 14, 15	13, 16, 17, 18
	Balloon	8	8, 11	11, 12, 13	12, 13, 17, 18
Pu-238	Aircraft		3, 9, 10	3, 9, 11, 13, 14, 15	13, 16, 17, 18
	Balloon		8, 9, 11	9, 11, 12, 13	12, 13, 17, 18
Sr-90	Aircraft	1, 2, 3, 4, 5	2, 3, 9, 10	3, 9, 10, 11, 13, 14, 15	13, 16, 17, 18
	Balloon	7	7, 8, 9, 11	9, 11, 12, 13	12, 13, 17, 18

Numbers refer to data references at the end of the paper.

TABLE 3. STRATOSPHERIC BURDENS OF CADMIUM-109 (Kilocuries)

NORTHERN HEMISPHERE

Latitude (Altitude (1000 Ft.)	0-90 70-120	30-90 50-70	0-30 50-70	30-90 30-50	Total to 120,000 ft.	Total to 70,000 ft.	World to 120,000	Total to 70,000
Quarter								
12/62 - 2/63	0	0	0	0	0	0	15.5	0
3/63 - 5/63	1.3	0	0	0	1.3	0	18.5	0
6/63 - 8/63	3.2	0	0	0	3.2	0	(22.4)	0.7
9/63 - 11/63	3.1	0	0	0	3.1	0	25.5	2.6
12/63 - 2/64	6.7	0.8	0	0	7.5	0.8	52.3	15.3
3/64 - 5/64	10.9	2.9	0	0	13.8	2.9	57.3	20.3
6/64 - 8/64	13.4	4.6	0.7	0.3	19.0	5.6	65.6	36.1
9/64 - 11/64	10.9	6.5	1.3	1.1	19.8	8.9	69.7	47.8
12/64 - 2/65	*	7.1	1.7	1.8	-	10.6	-	49.2
3/65 - 5/65	*	6.8	3.2	4.6	-	14.6	-	41.7
6/65 - 8/65	*	7.4	3.3	4.1	-	14.8	-	43.5
9/65 - 11/65	*	5.6	2.9	3.9	-	12.4	-	38.1
12/65 - 2/66	*	4.9	2.9	4.9	-	12.7	-	29.9
3/66 - 5/66	*	4.7	2.1	4.8	-	11.6	-	28.4
6/66 - 8/66	*	4.3	2.4	3.0	-	9.7	-	25.2

SOUTHERN HEMISPHERE

12/62 - 2/63	15.5	0	0	0	15.5	0
3/63 - 5/63	17.2	0	0	0	17.2	0
6/63 - 8/63	(18.5)	0.7	0	0	(19.2)	0.7
9/63 - 11/63	19.8	2.6	0	0	22.4	2.6
12/63 - 2/64	30.3	13.9	0.6	0	44.8	14.5
3/64 - 5/64	26.1	16.2	0.9	0.3	43.5	17.4
6/64 - 8/64	16.1	18.4	3.6	8.5	46.6	30.5
9/64 - 11/64	11.0	18.4	4.8	15.7	49.9	38.9
12/64 - 2/65	*	20.0	5.0	13.6	-	38.6
3/65 - 5/65	*	10.5	5.0	11.6	-	27.1
6/65 - 8/65	*	11.0	5.4	12.3	-	28.7
9/65 - 11/65	*	10.3	4.8	10.6	-	25.7
12/65 - 2/66	*	6.8	3.5	6.9	-	17.2
3/66 - 5/66	*	7.1	2.8	6.9	-	16.8
6/66 - 8/66	*	5.3	3.0	7.2	-	15.5

* Stratospheric burden for this compartment not calculated due to large uncertainties in the data.

() Interpolated value, computed burden of 7.1 was inconsistent with other data.

All data decay corrected to July 9, 1962.

TABLE 4. STRATOSPHERIC BURDENS OF SNAP-9A PLUTONIUM-238 (Kilocuries)

	NORTHERN HEMISPHERE					SOUTHERN HEMISPHERE					
Latitude Altitude (1000 Ft.)	0-90 70-120	30-90 50-70	0-30 50-70	30-90 30-50	Total	0-90 70-120	30-90 50-70	0-30 50-70	30-90 30-50	Total	World Total
Quarter											
6/64 - 8/64	0	0	0	0	0	0.1	0	0	0	0.1	0.1
9/64 - 11/64	0	0	0	0	0	0.4	0	0	0	0.4	0.4
12/64 - 2/65	0.8	0	0	0	0.8	3.4	0	0	0	3.4	4.2
3/65 - 5/65	1.6	0	0	0	1.6	3.6	0	0	0	3.6	5.2
6/65 - 8/65	1.7	0	0	0	1.7	2.6	0.8	0.1	0	3.5	5.2
9/65 - 11/65	1.5	0	0	0	1.5	3.5	2.3	0.3	0	6.1	7.6
12/65 - 2/66	1.7	0.5	0.1	0	2.3	3.6	2.2	0.5	0.2	6.5	8.8
3/66 - 5/66	1.9	1.0	0.2	0.2	3.3	4.1	3.7	0.7	1.0	9.5	12.8
6/66 - 8/66	1.5	1.1	0.4	0.2	3.2	2.3	3.5	0.8	1.4	8.0	11.2
9/66 - 11/66	1.4	0.9	0.4	0.2	2.9	1.8	2.6	0.9	1.8	7.1	10.0
12/66 - 2/67	1.3	1.1	0.6	0.7	3.7	1.6	2.5	1.0	1.6	6.7	10.4

TABLE 5. STRATOSPHERIC BURDENS OF STRONTIUM-90 (Kilocuries)

	NORTHERN HEMISPHERE					SOUTHERN HEMISPHERE					
Latitude Altitude (1000 Ft.)	0-90 70-120	30-90 50-70	0-30 50-70	30-90 30-50	Total	0-90 0-120	30-90 50-70	0-30 50-70	30-90 30-50	Total	World Total
Quarter											
3/63 - 5/63	1220	1960	590	1480	5250	410	100	150	40	700	5950
6/63 - 8/63	1150	1600	660	730	4140	660	150	200	100	1110	5250
9/63 - 11/63	930	1250	570	460	3210	500	270	290	180	1240	4450
12/63 - 2/64	590	910	440	690	2630	390	190	240	72	892	3522
3/64 - 5/64	390	700	350	590	2030	330	210	190	130	860	2890
6/64 - 8/64	340	540	310	260	1450	240	200	210	130	780	2230
9/64 - 11/64	290	400	280	200	1170	180	170	160	170	680	1850
12/64 - 2/65	220	350	230	250	1050	150	130	140	120	540	1590
3/65 - 5/65	200	260	150	240	850	160	90	110	67	427	1277
6/65 - 8/65	160	220	110	140	630	130	110	91	120	451	1081
9/65 - 11/65	150	180	90	100	520	110	100	70	100	380	900
12/65 - 2/66	130	150	70	130	480	83	80	48	61	272	752
3/66 - 5/66	100	120	55	120	395	71	66	38	42	217	612
6/66 - 8/66	73	100	54	81	308	57	67	49	51	224	532
9/66 - 11/66	60	85	52	37	234	47	52	43	60	202	436
12/66 - 2/67	37	53	32	35	157	45	45	34	40	164	321

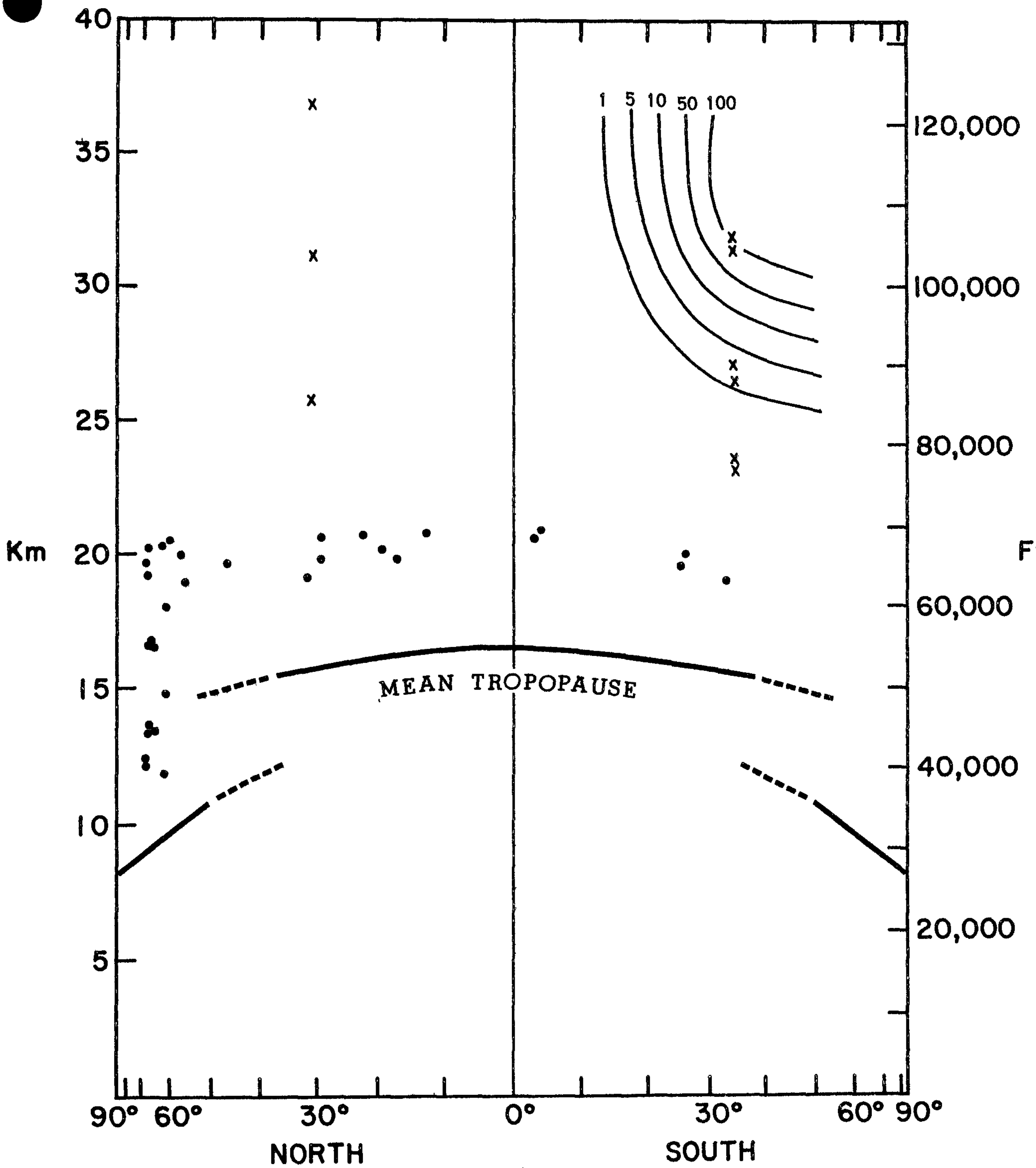
FIGURES 1-15

Latitudinal Cross Sections of Mean Seasonal

Cadmium-109 Stratospheric Concentrations

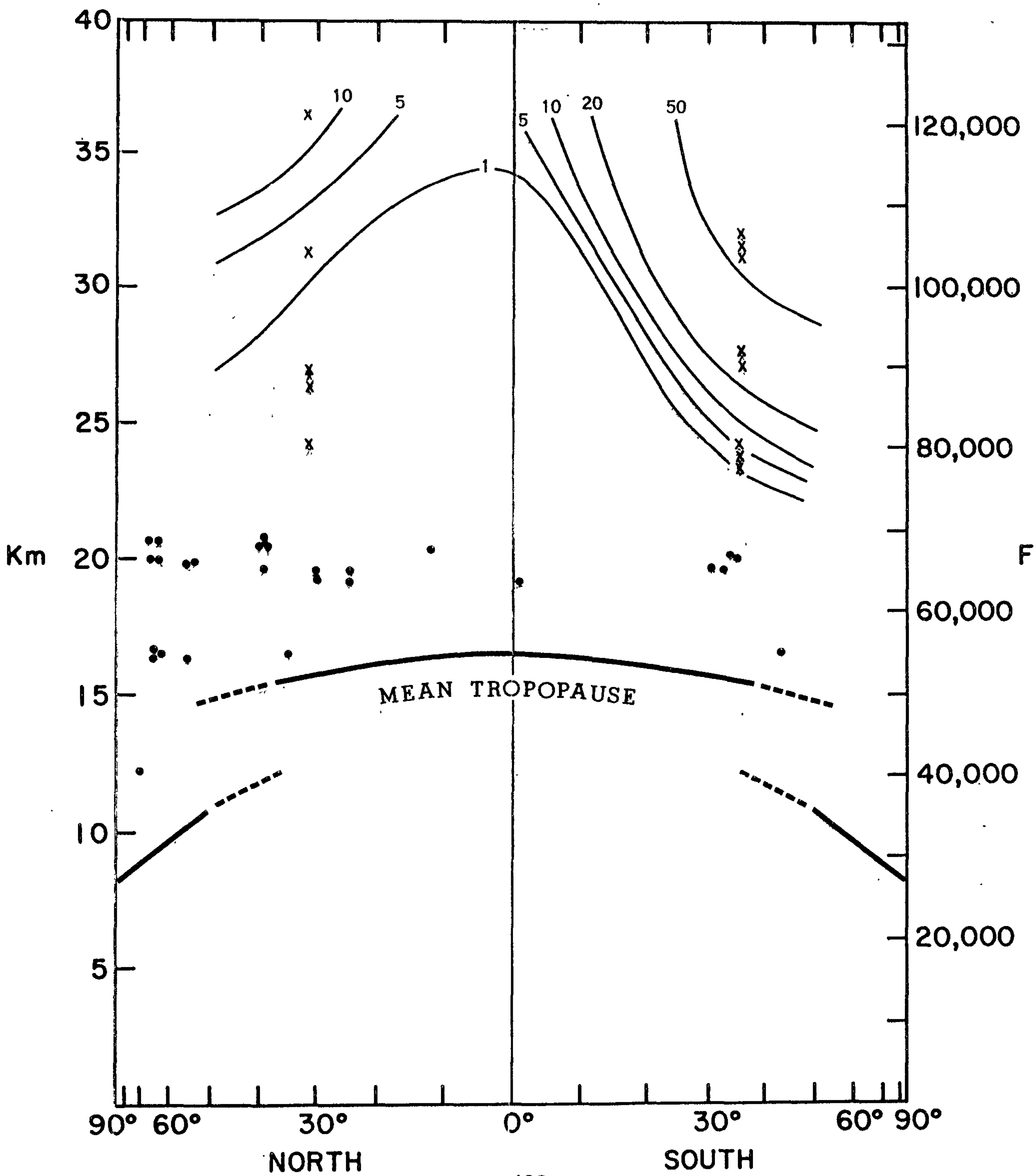
[December 1962-August 1966]

Units: disintegrations per minute per 1000 standard cubic feet of air (decay corrected to July 9, 1962). Crosses represent individual balloon samples, solid circles represent average monthly aircraft data.



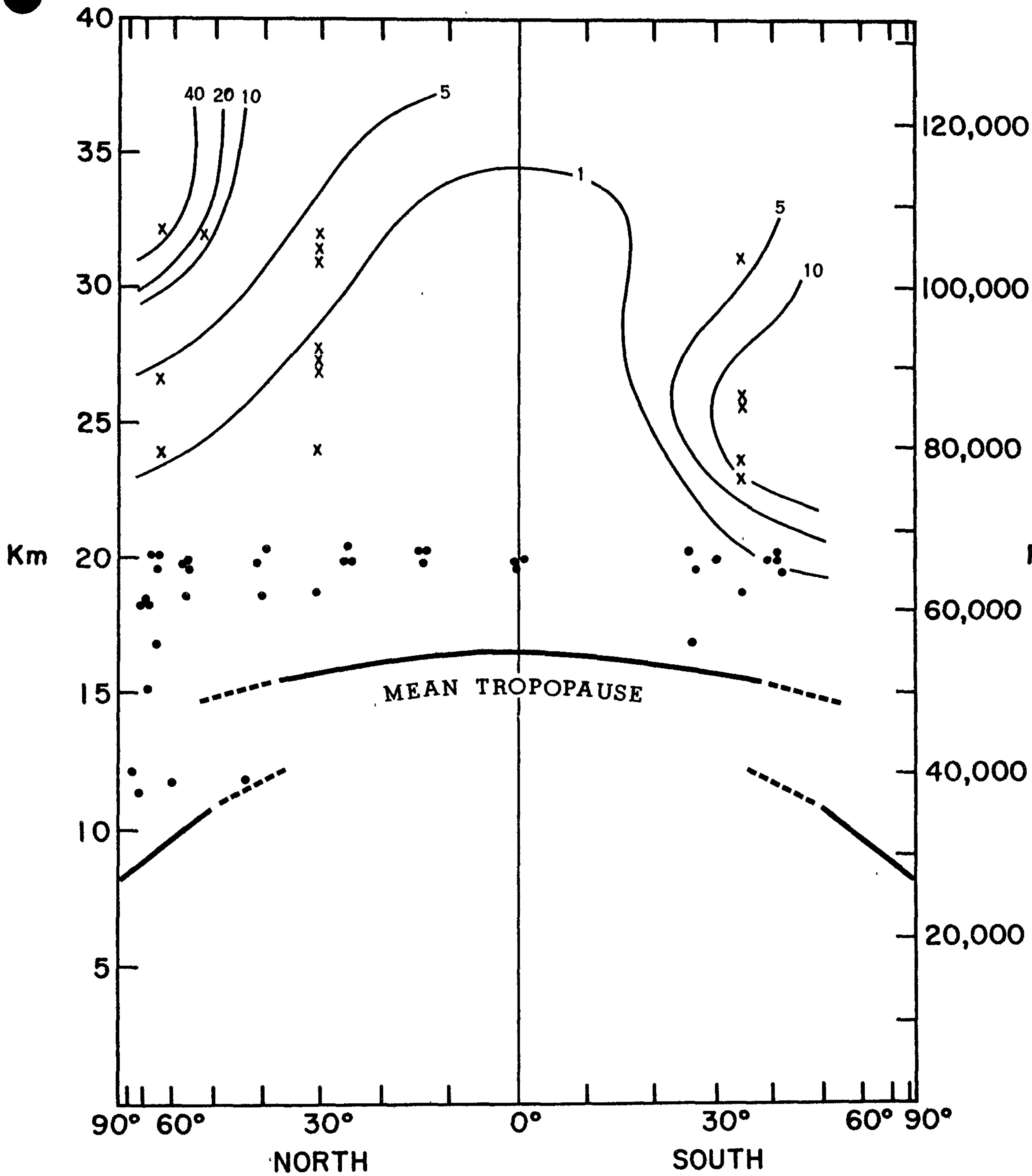
Cd109

Figure 1 DECEMBER 1962 - FEBRUARY 1963



Cd^{109}

Figure 2 MARCH - MAY 1963



Cd^{109}

Figure 3 JUNE - AUGUST 1963

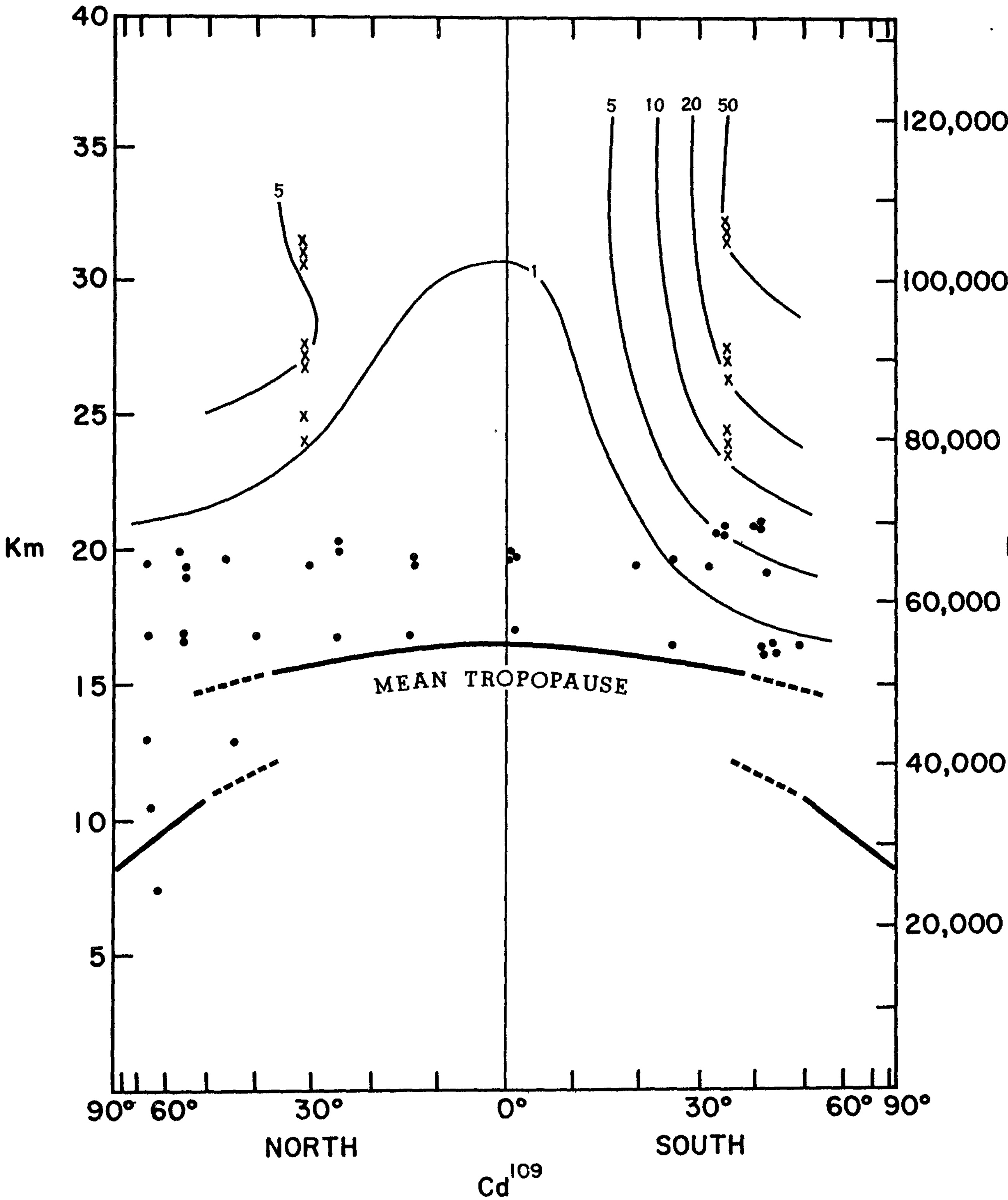
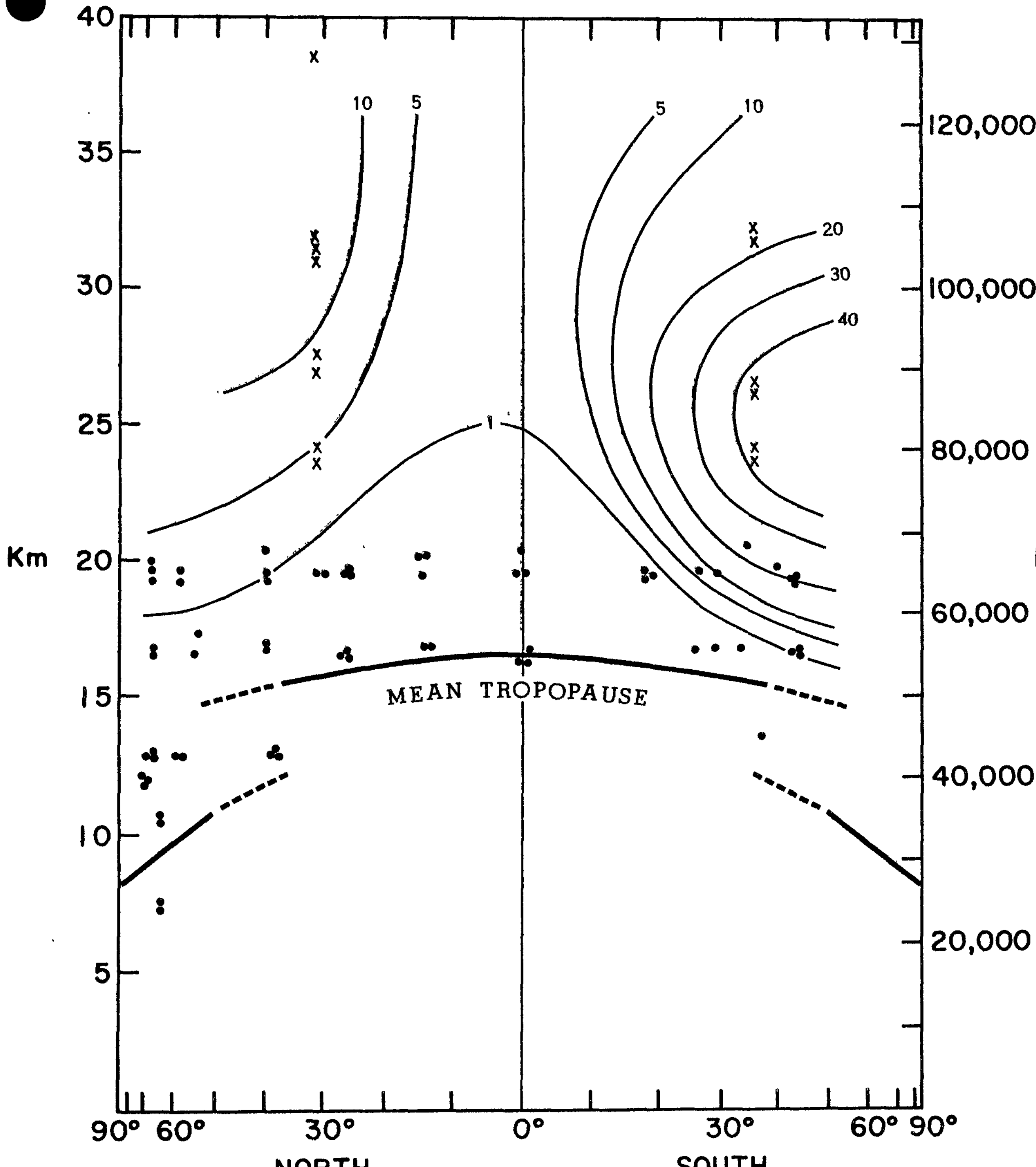


Figure 4 SEPTEMBER - NOVEMBER 1963



Cd^{109}

Figure 5 DECEMBER 1963 - FEBRUARY 1964

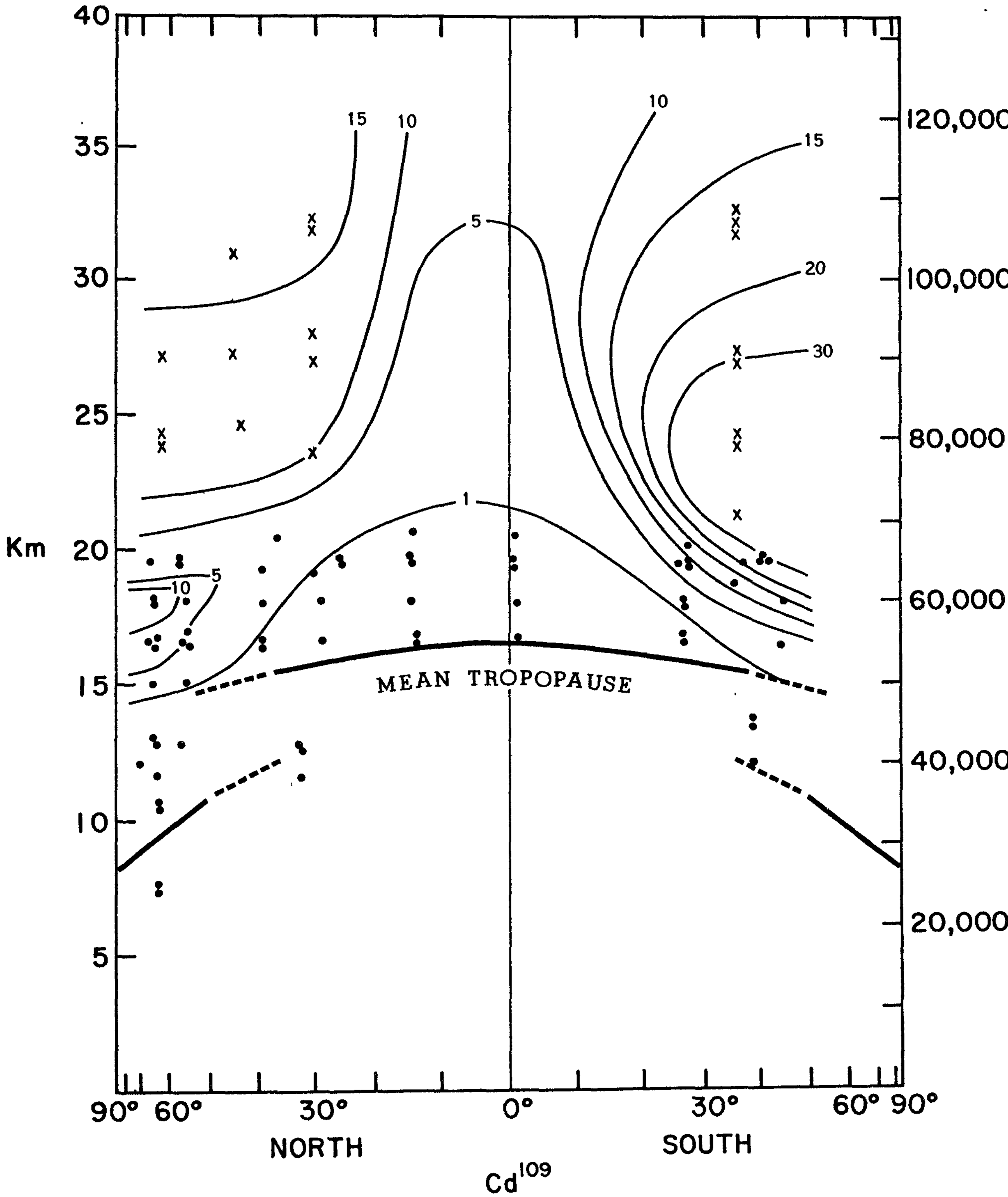
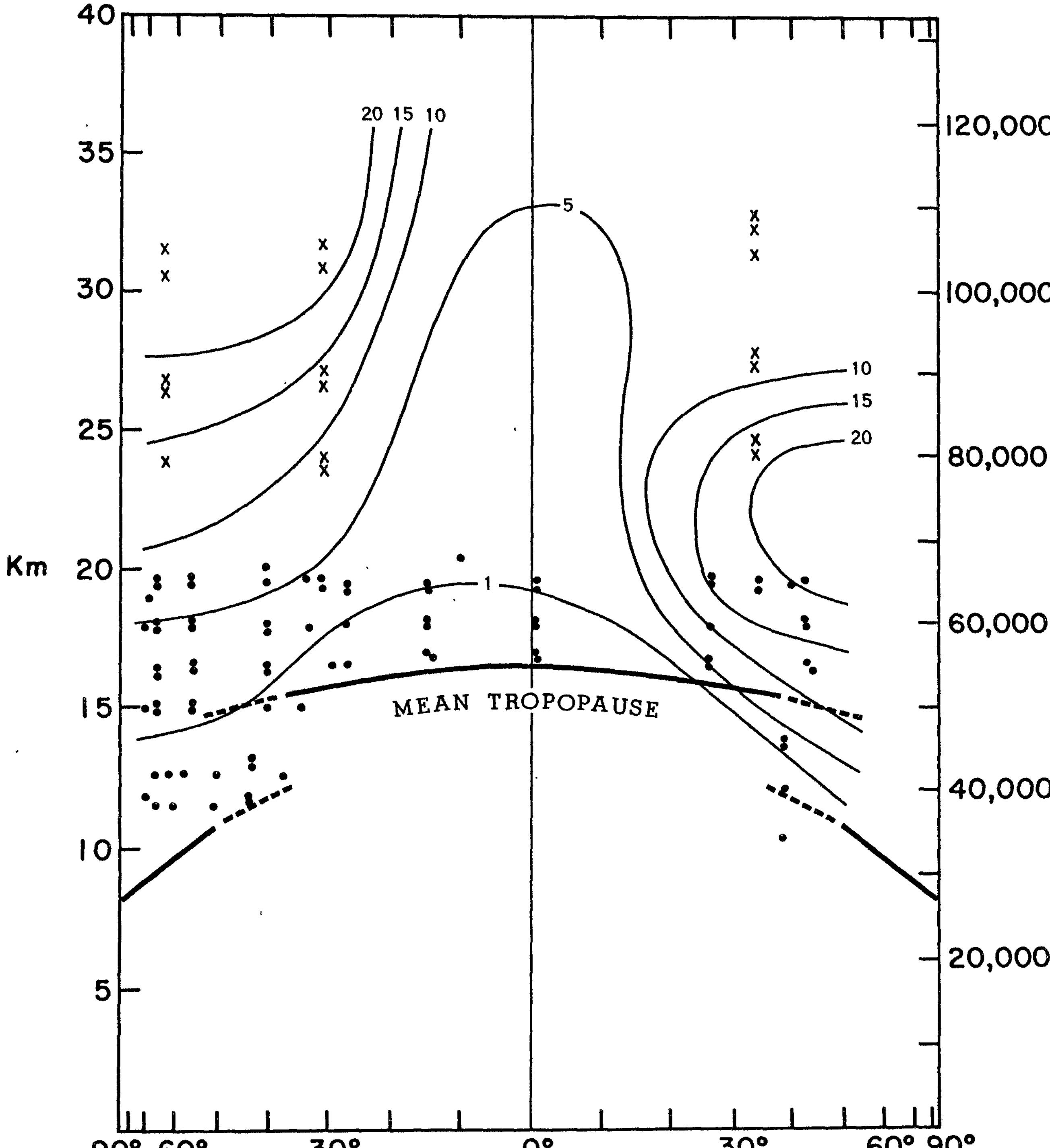


Figure 6 MARCH - MAY 1964



Cd^{109}

Figure 7 JUNE - AUGUST 1964

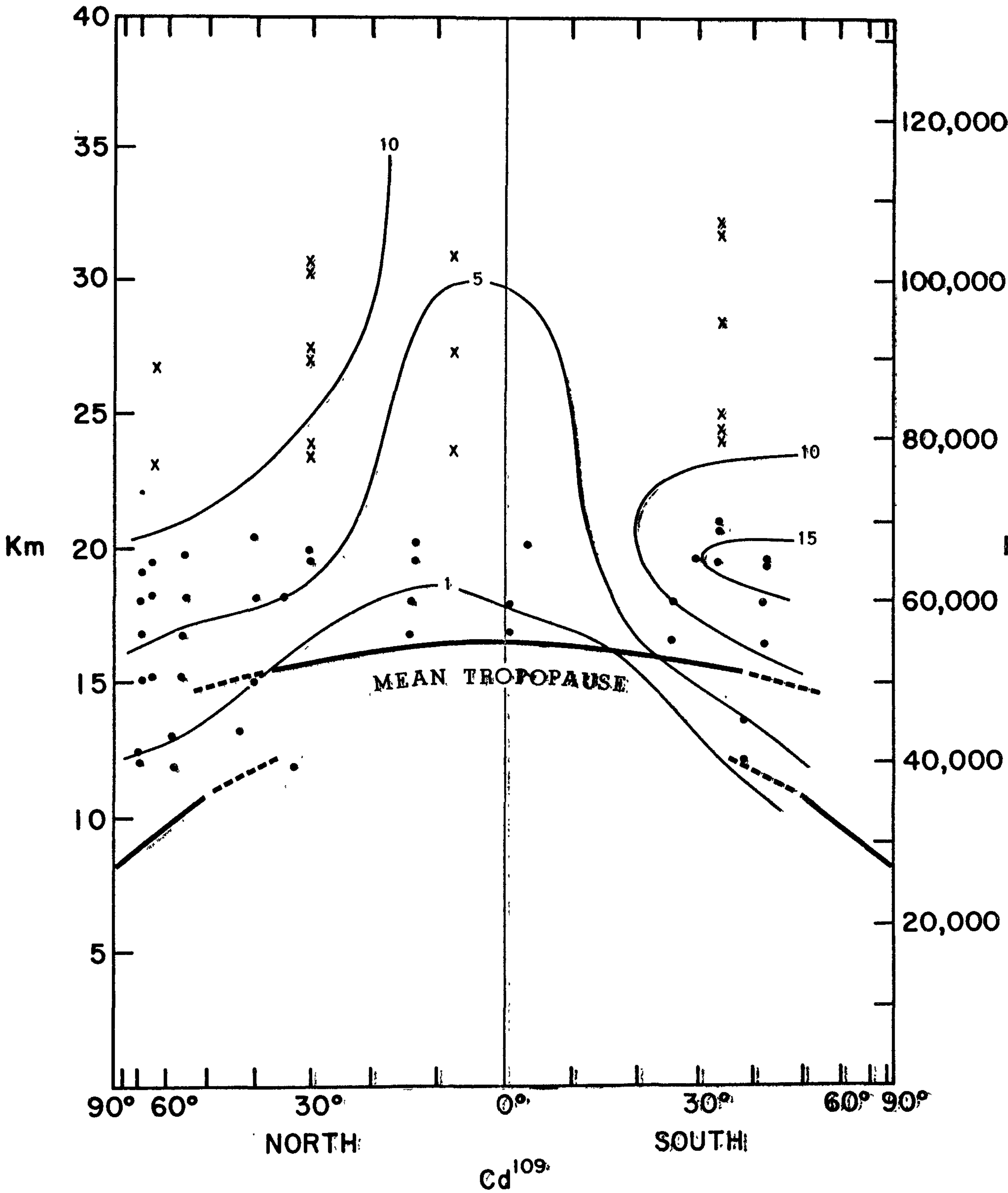
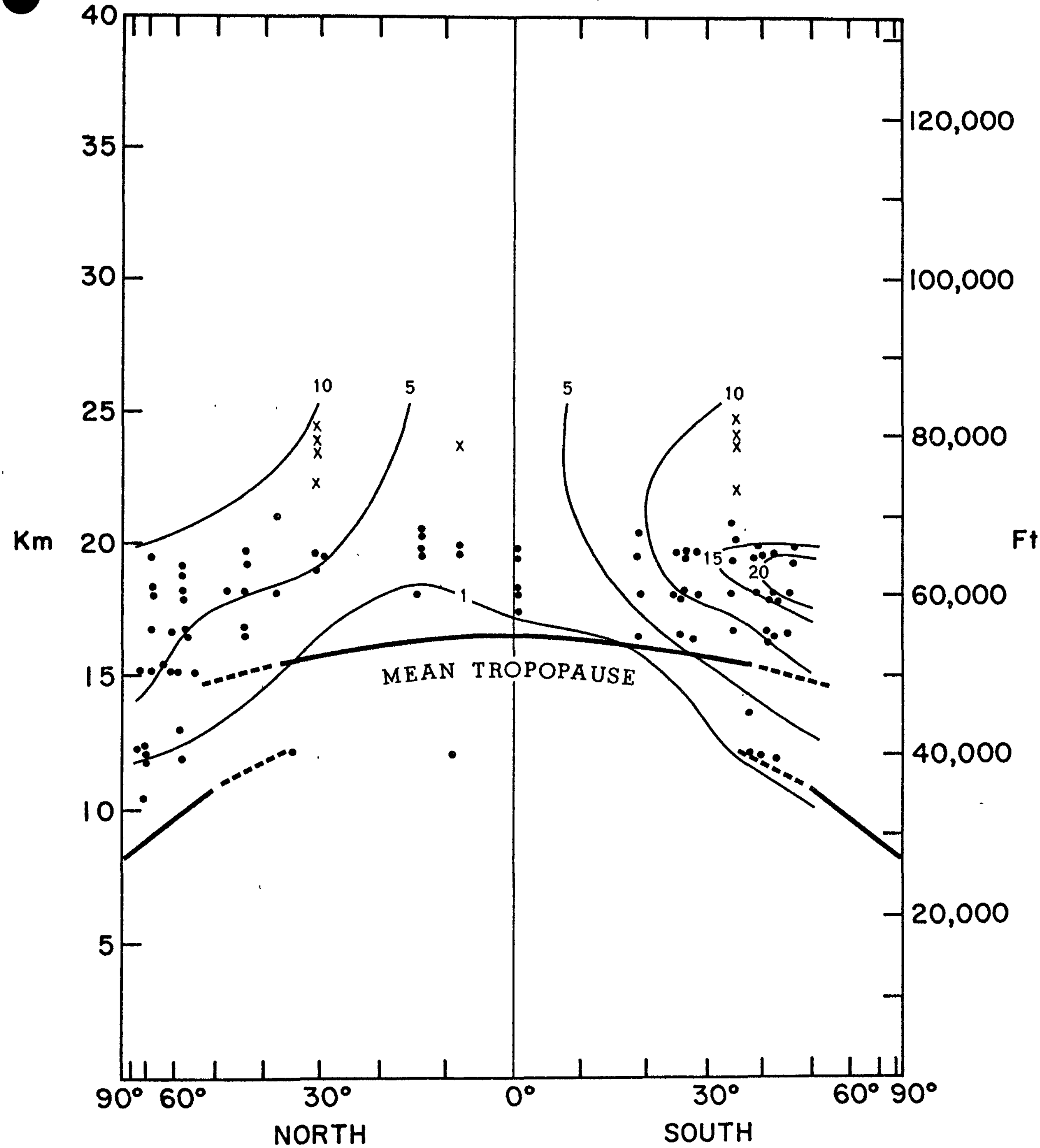


Figure 8 SEPTEMBER - NOVEMBER 1964



Cd^{109}

Figure 9 DECEMBER 1964 - FEBRUARY 1965

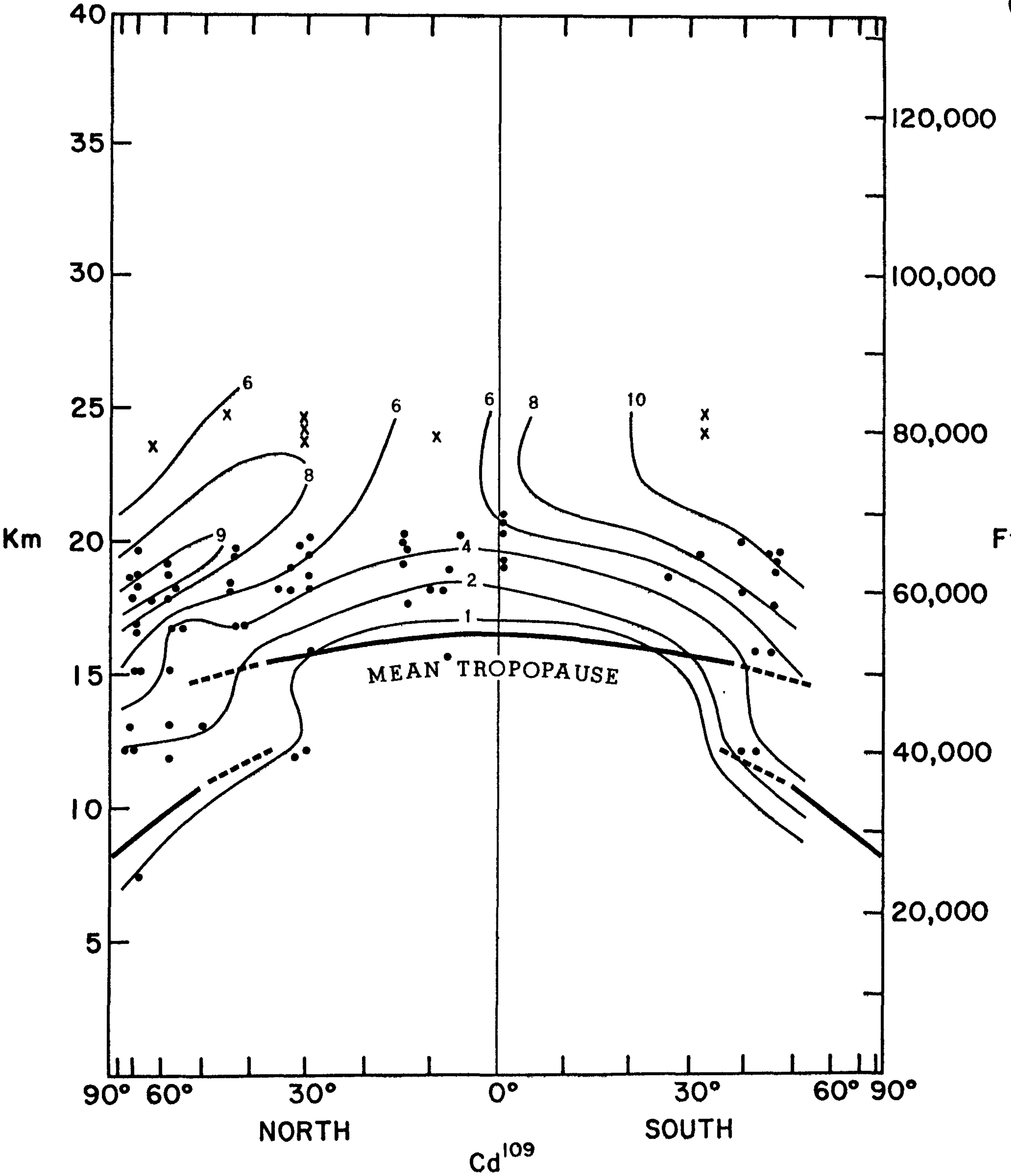


Figure 10 MARCH-MAY 1965

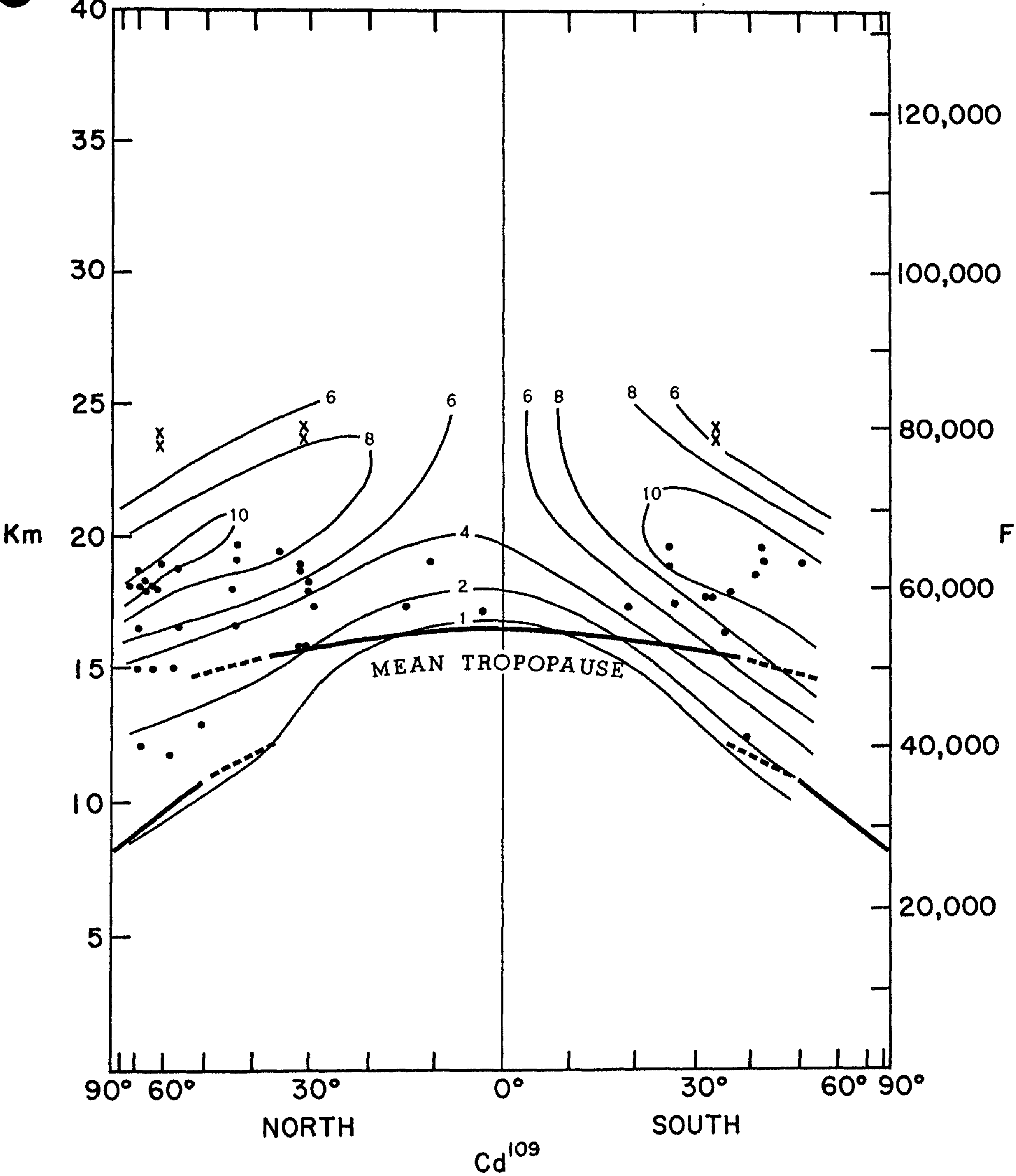
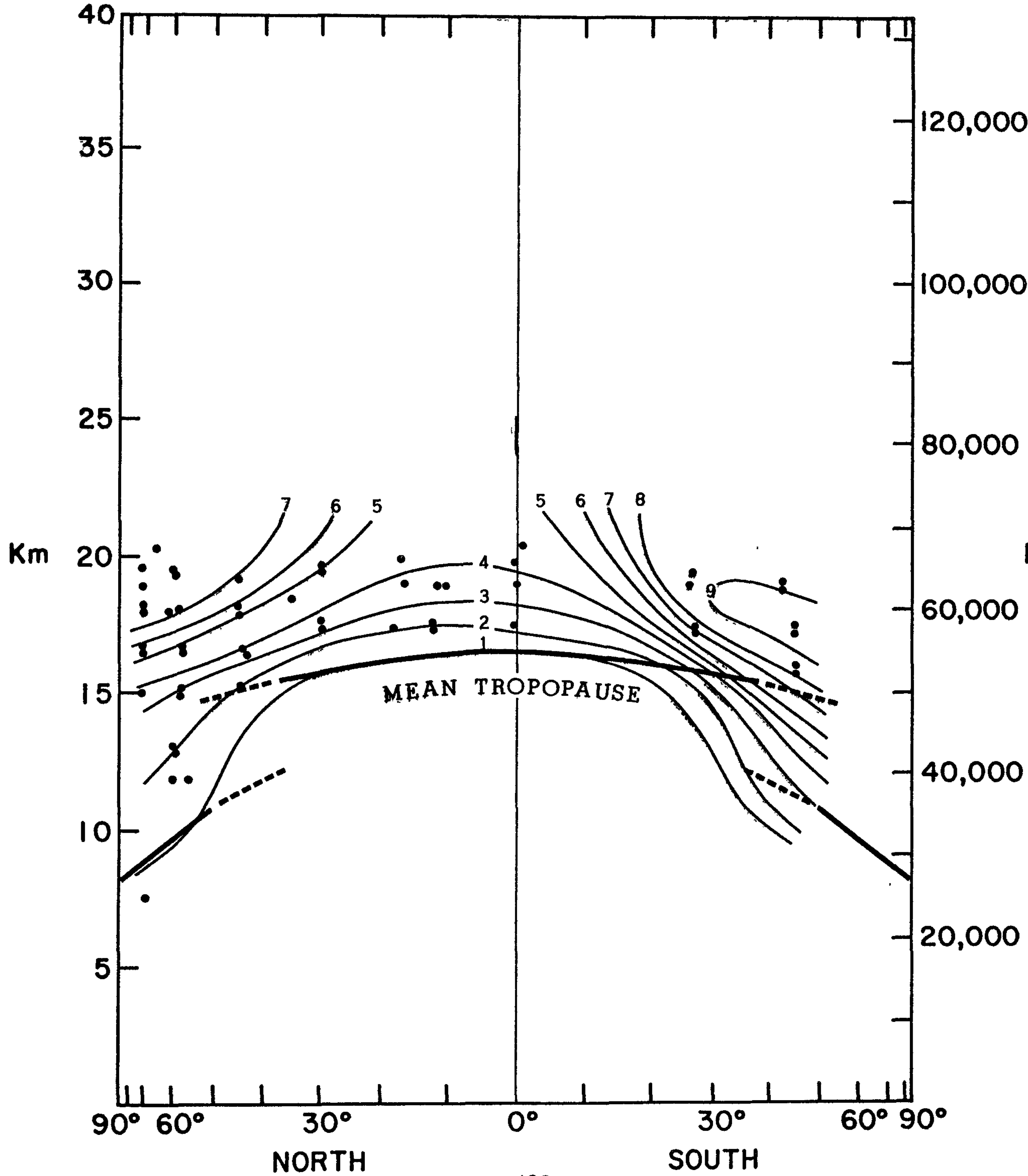


Figure 11 JUNE - AUGUST 1965



Cd^{109}

Figure 12 SEPTEMBER - NOVEMBER 1965

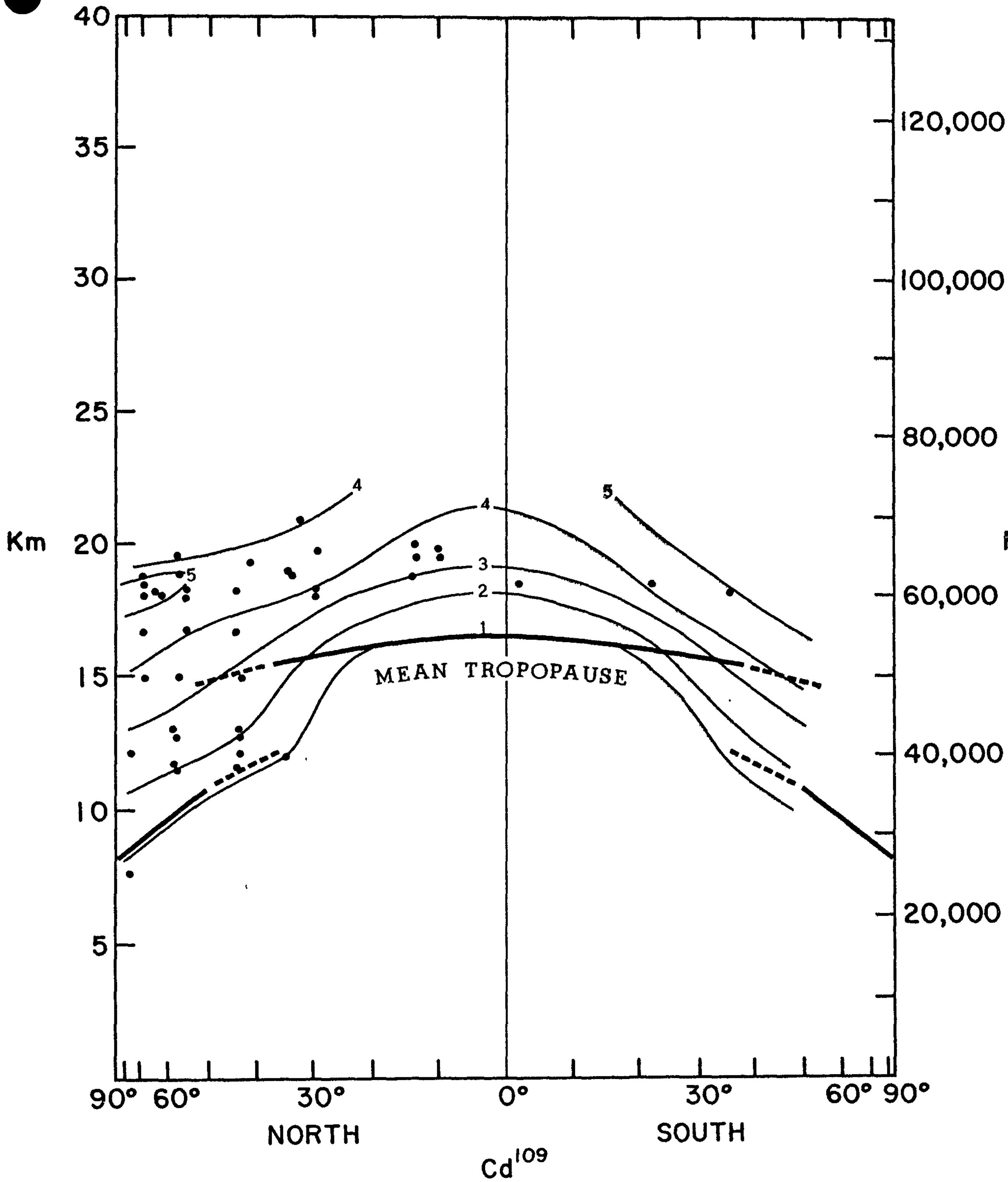


Figure 13 DECEMBER 1965 - FEBRUARY 1966

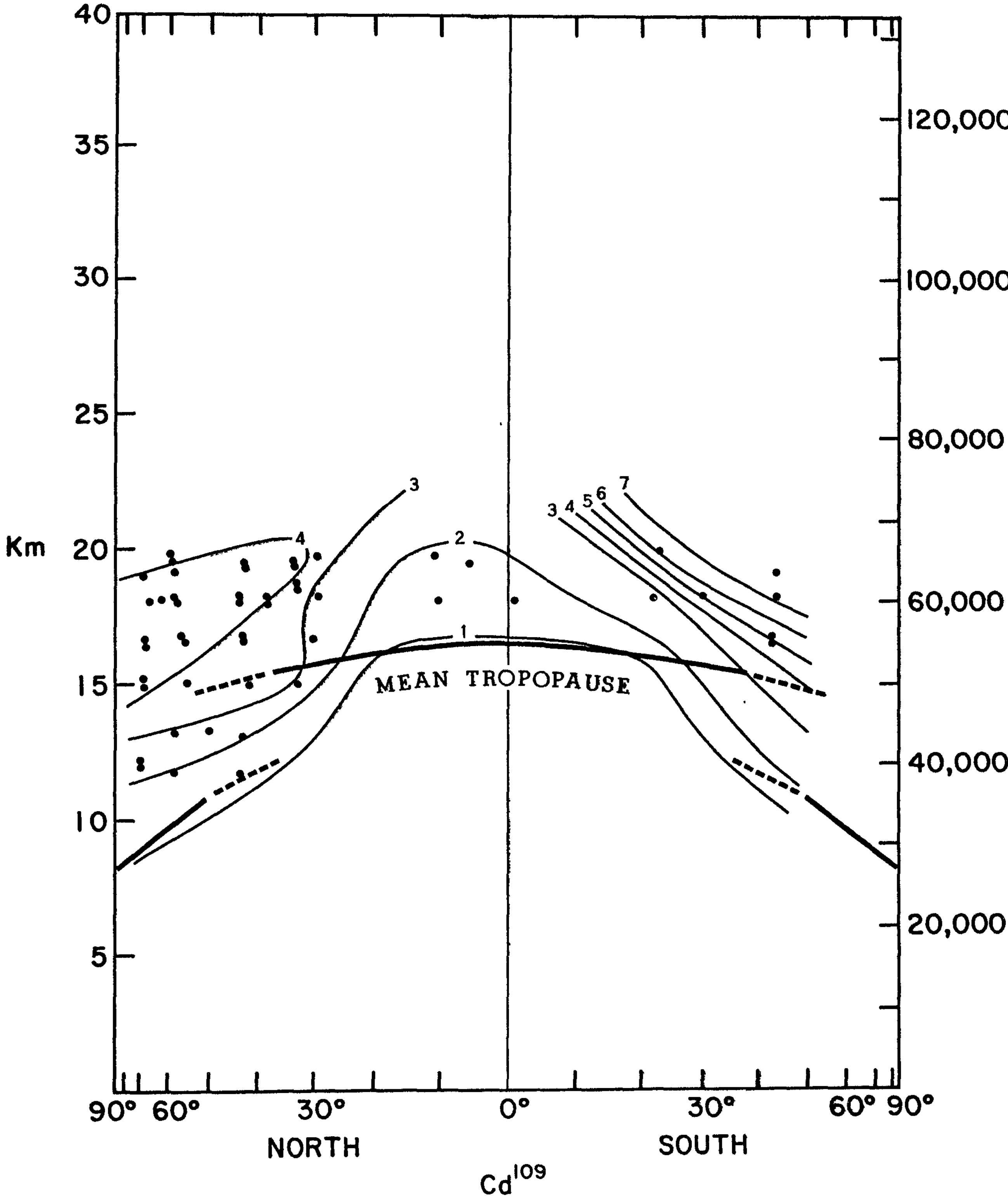


Figure 14 MARCH - MAY 1966

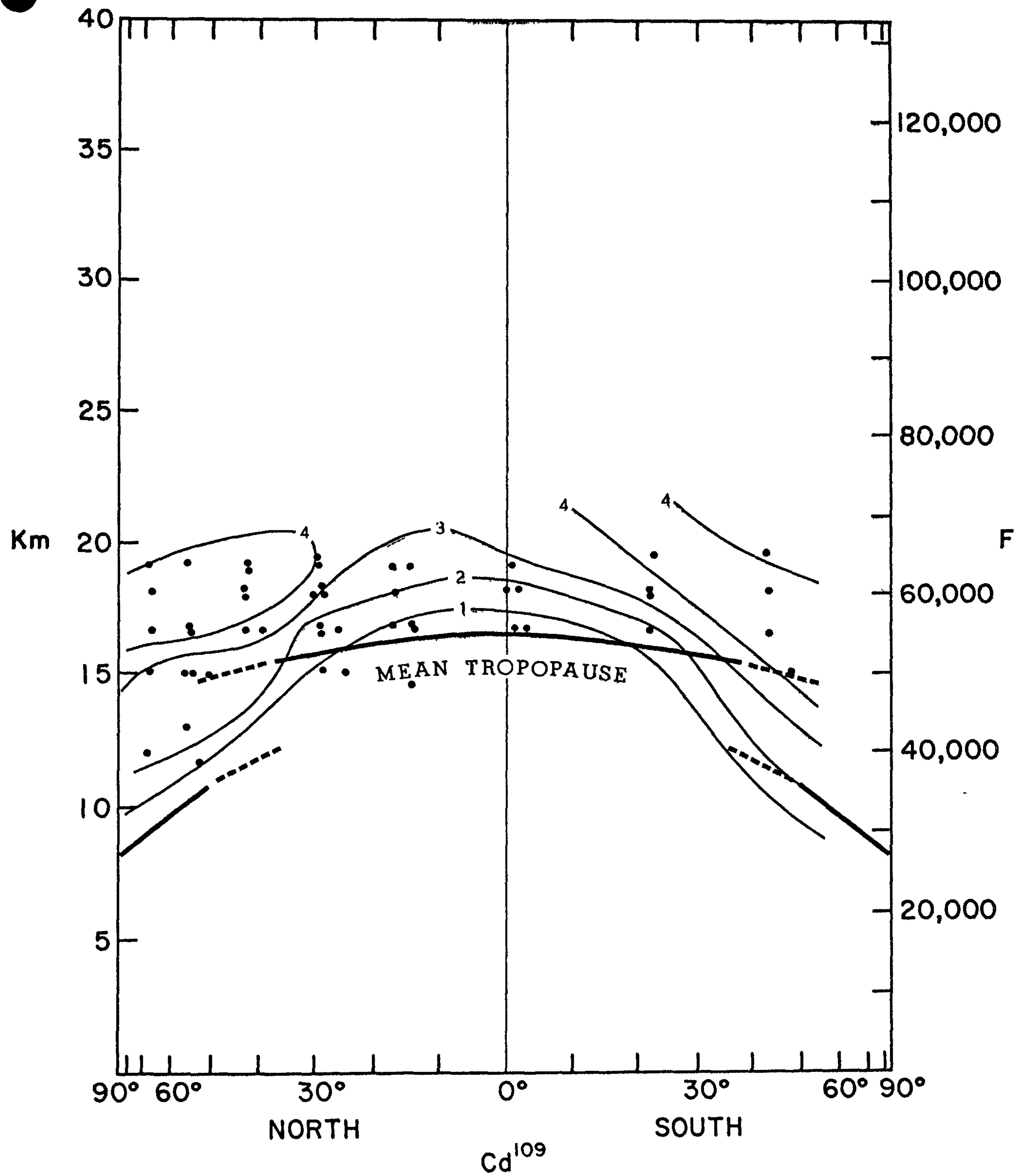


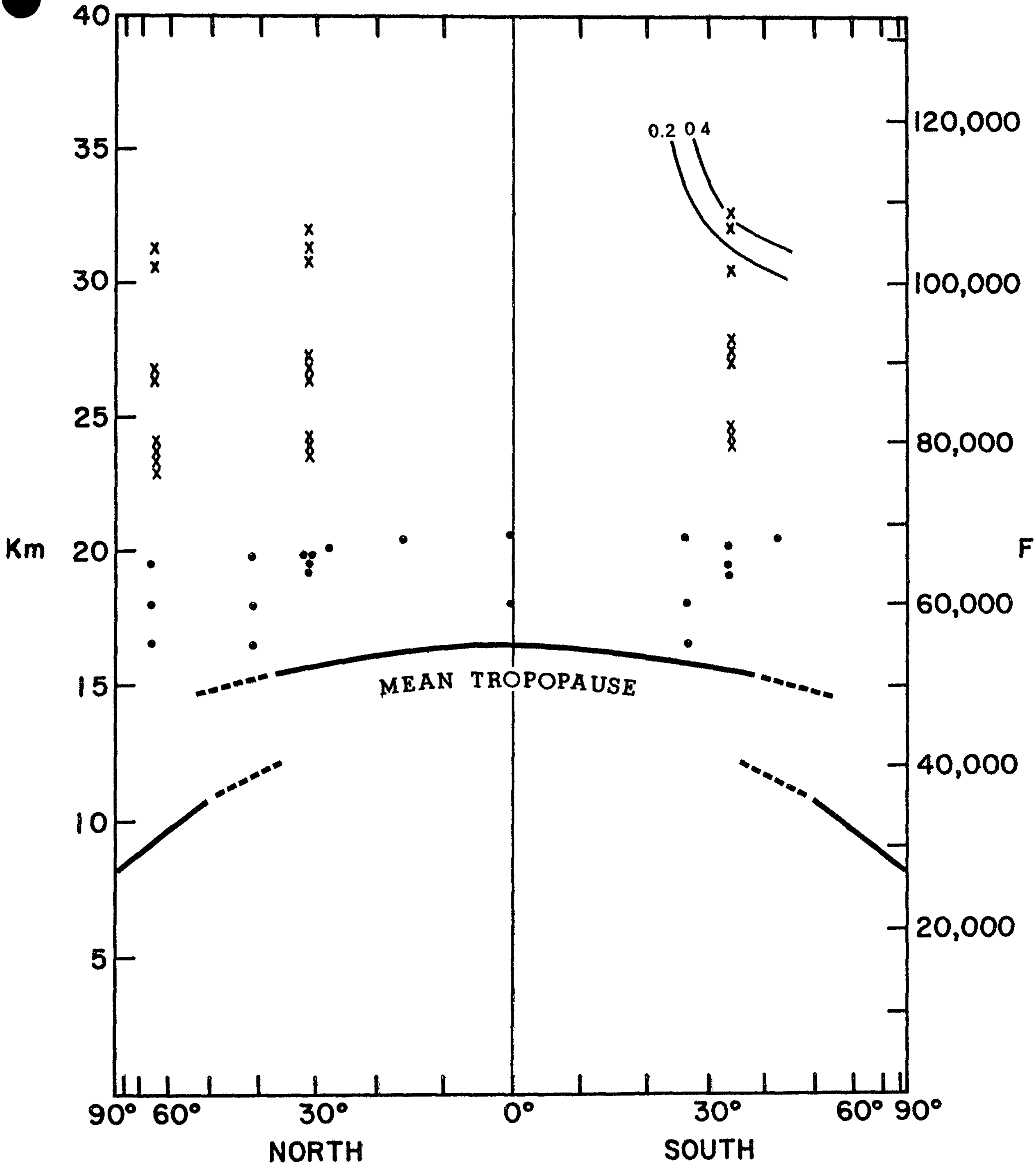
Figure 15 JUNE - AUGUST 1966

FIGURES 16-26

Latitudinal Cross Sections of Mean Seasonal SNAP-9A Plutonium-238 Concentrations.

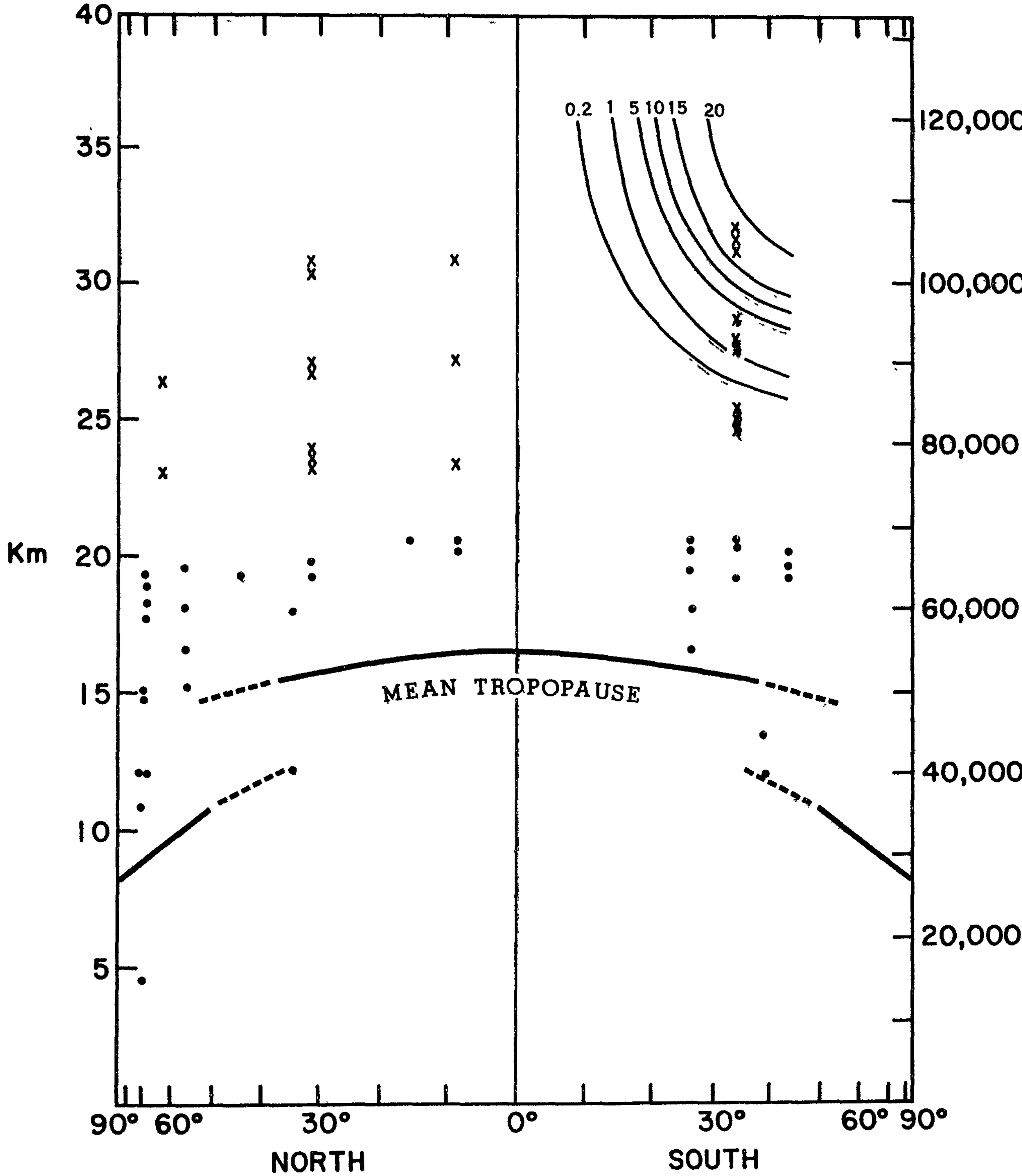
[June 1964-February 1967]

Units: disintegrations per minute per 1000 standard cubic feet of air at sampling time. Crosses represent individual balloon samples, solid circles represent average monthly aircraft data.



Pu^{238}

Figure 16 JUNE - AUGUST 1964



Pu^{238}

Figure 17 SEPTEMBER - NOVEMBER 1964

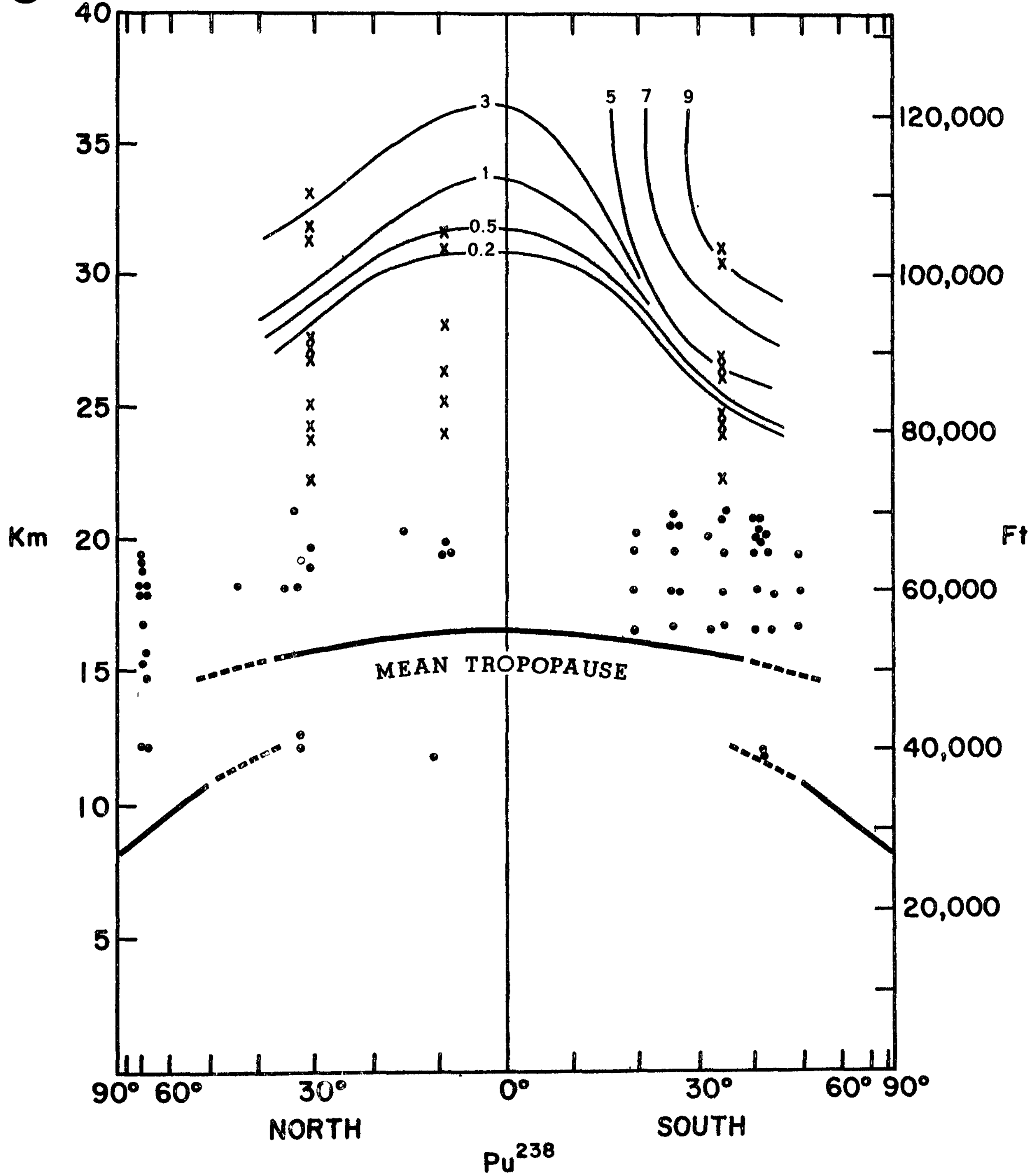
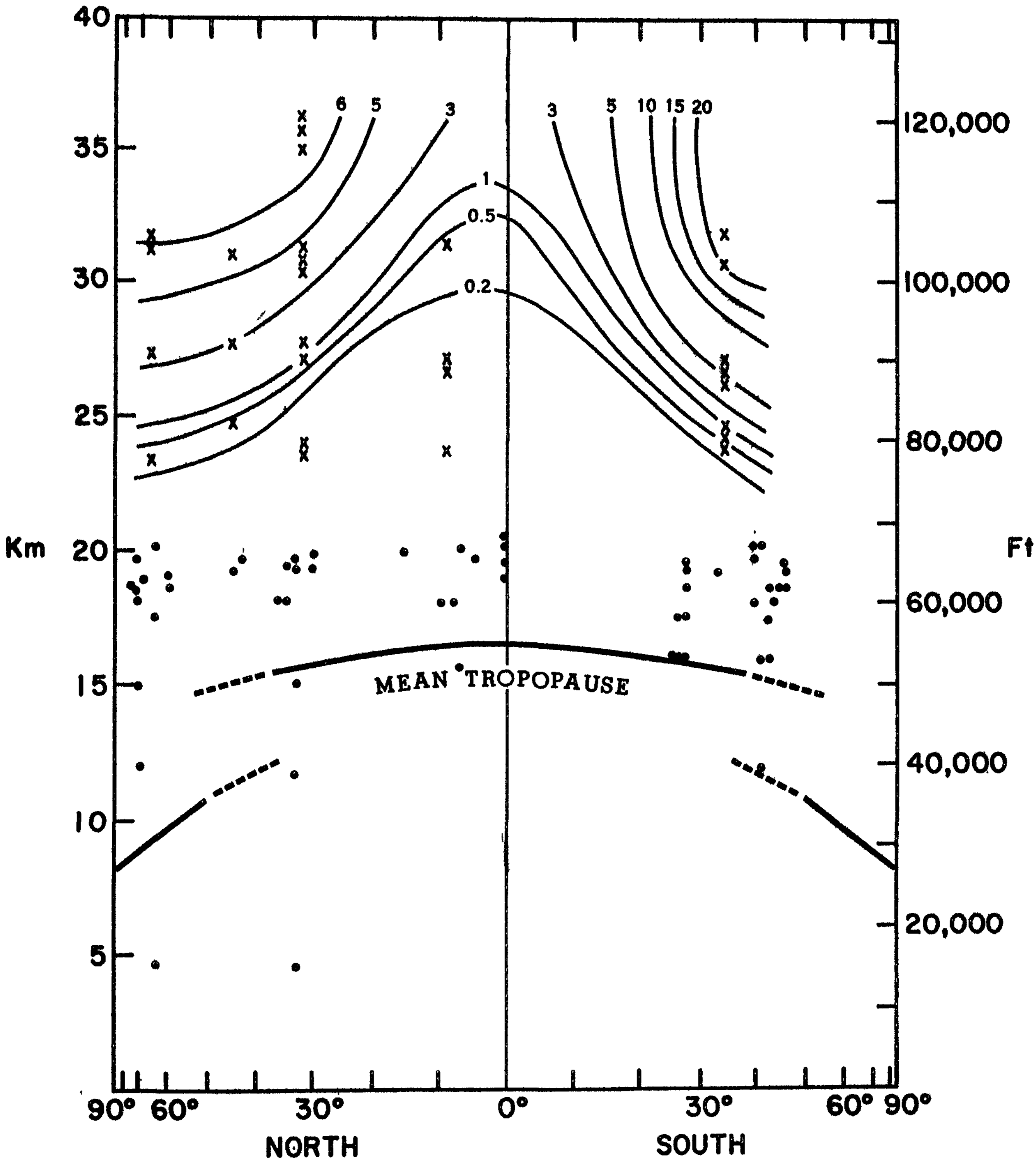


Figure 18 DECEMBER 1964 - FEBRUARY 1965



Pu^{238}

Figure 19 MARCH-MAY 1965

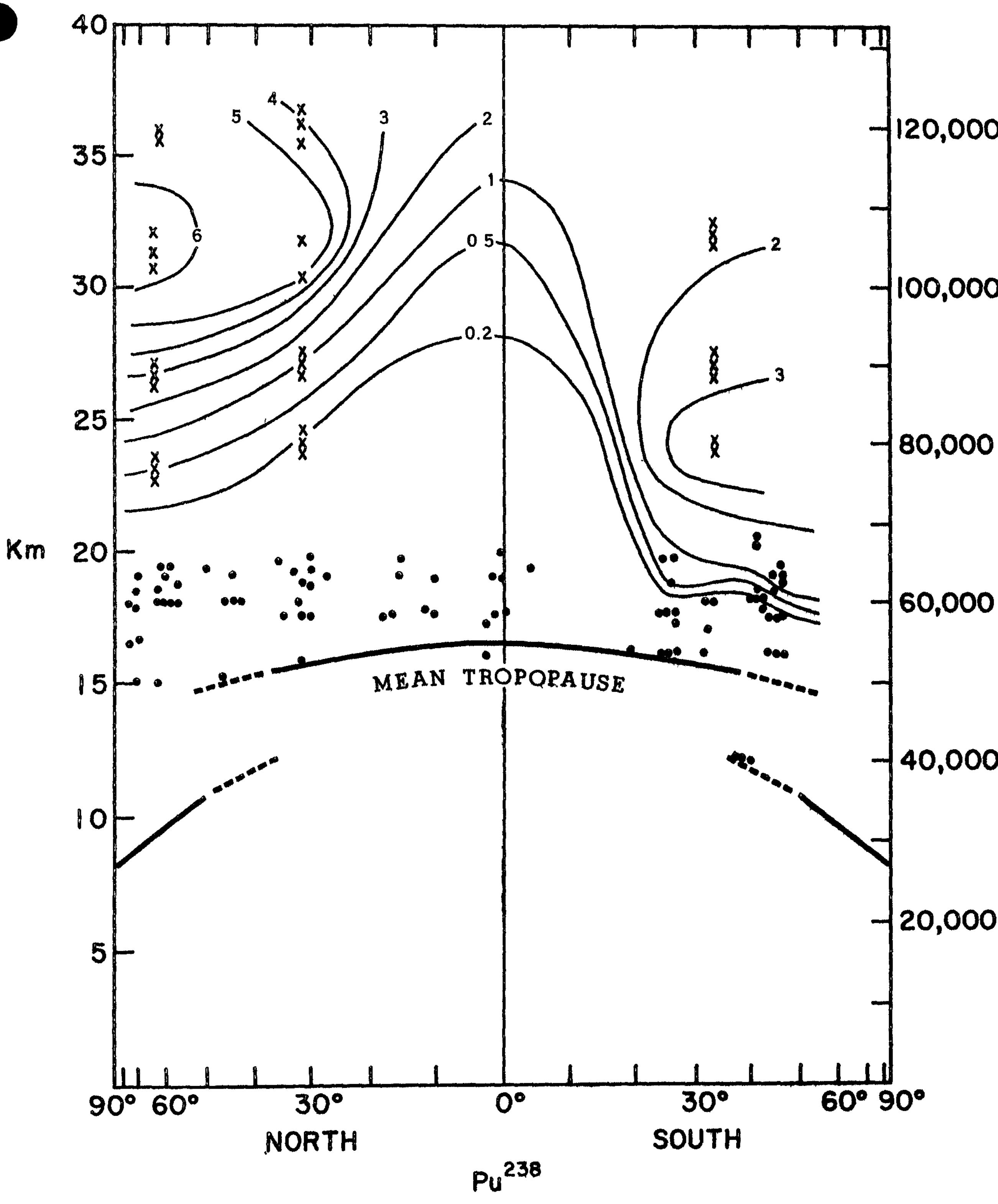
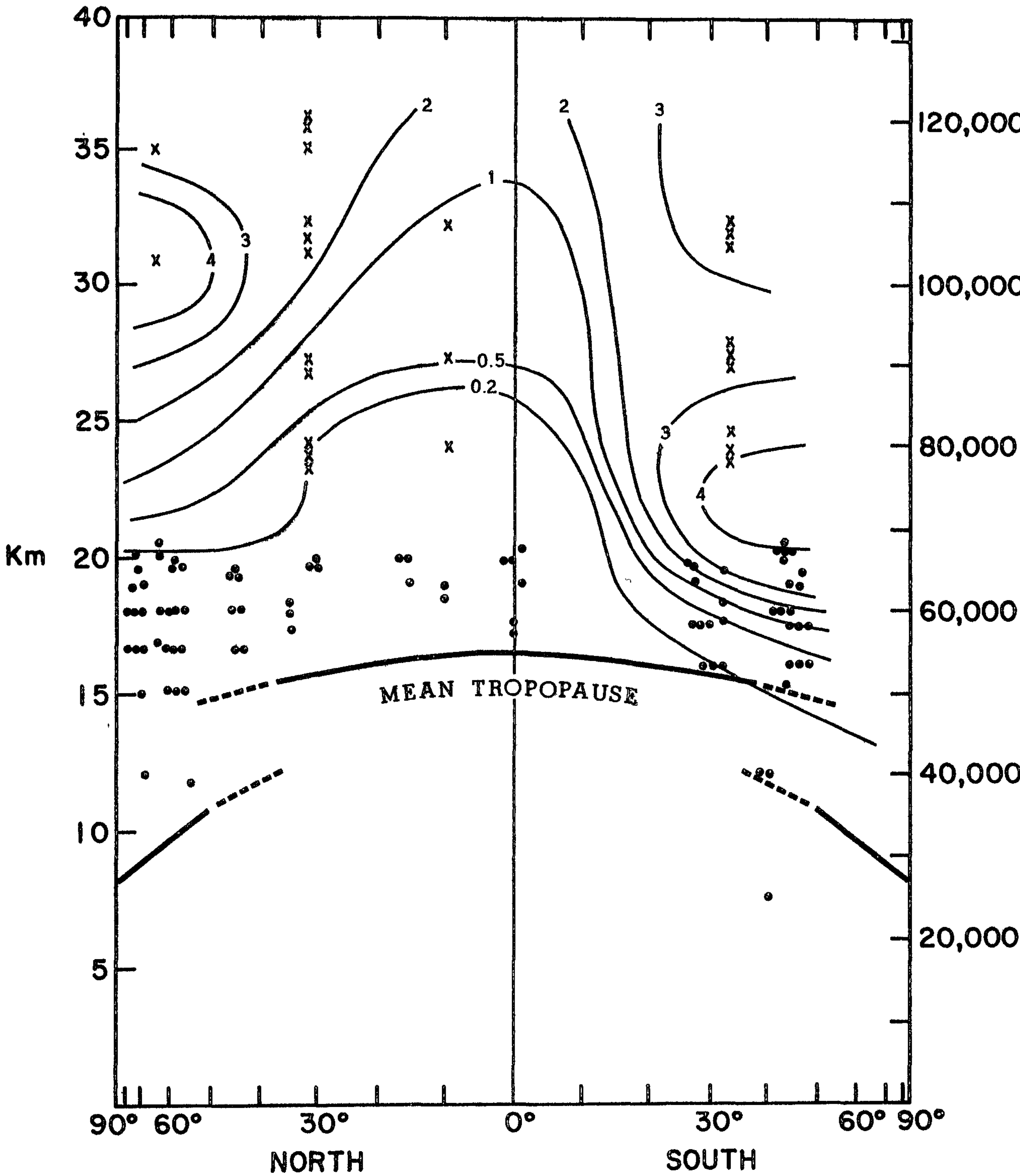


Figure 20 JUNE - AUGUST 1965



Pu^{238}

Figure 21 SEPTEMBER - NOVEMBER 1965

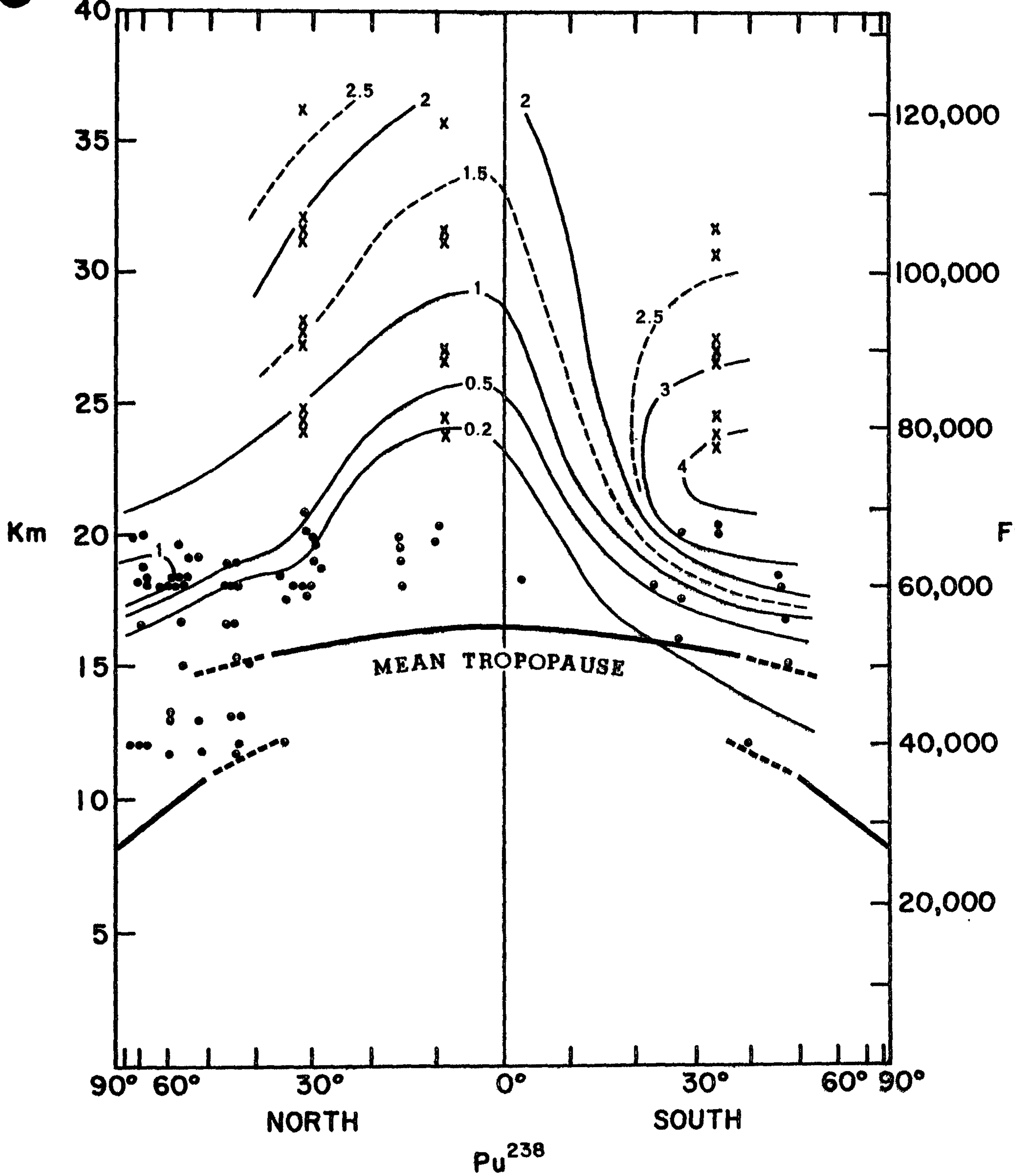
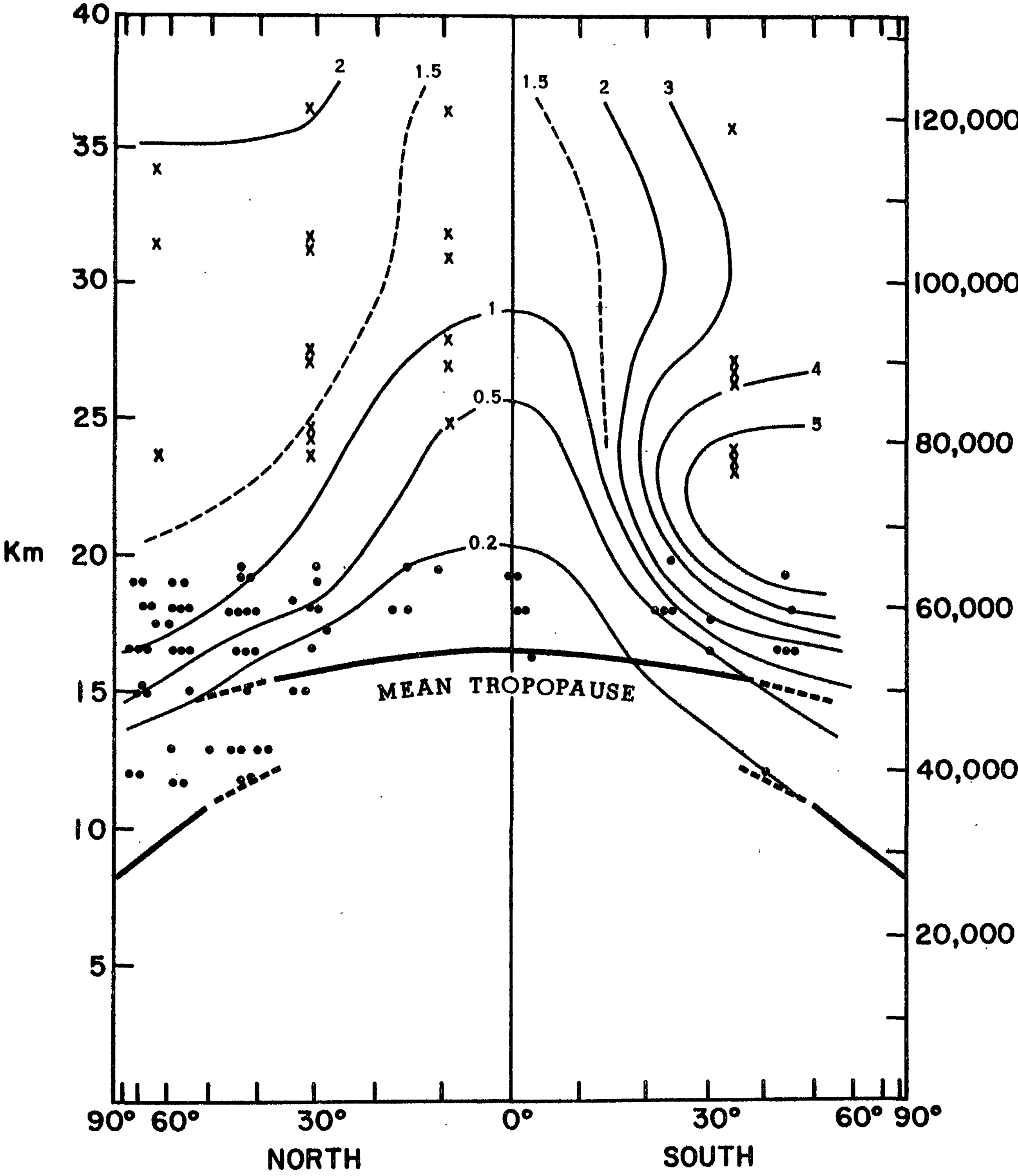


Figure 22 DECEMBER 1965 - FEBRUARY 1966



Pu^{238}

Figure 23 MARCH - MAY 1966

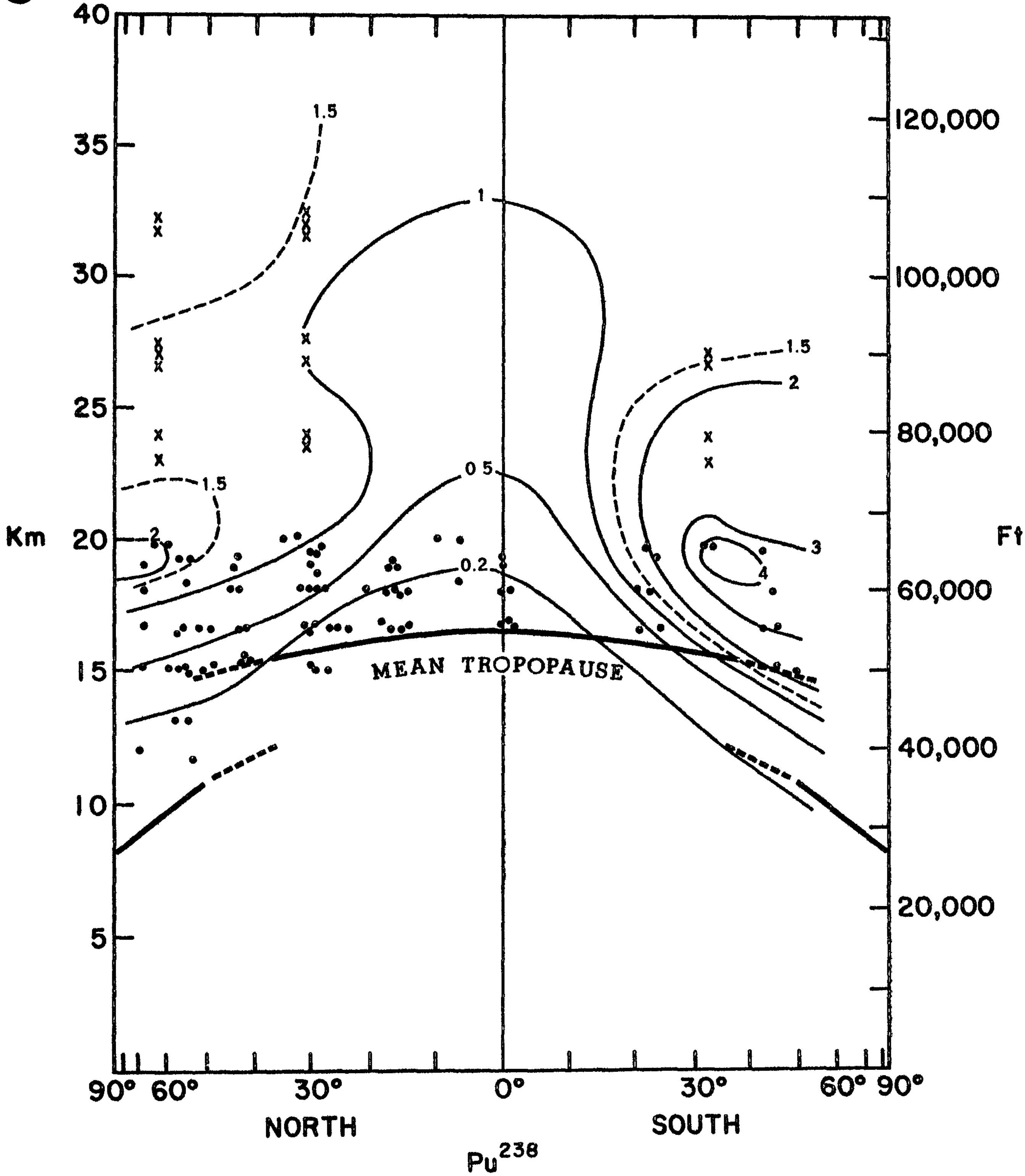
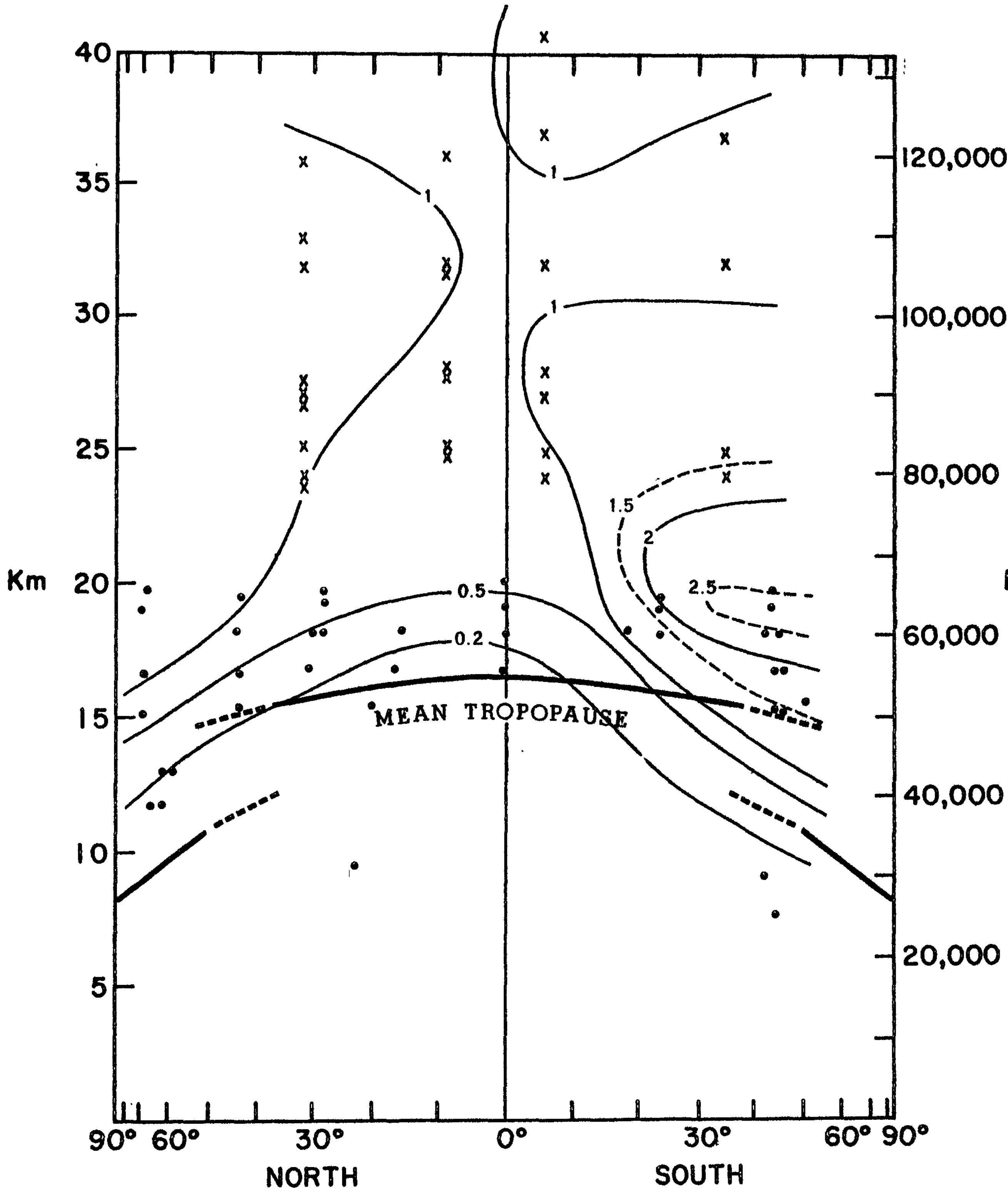
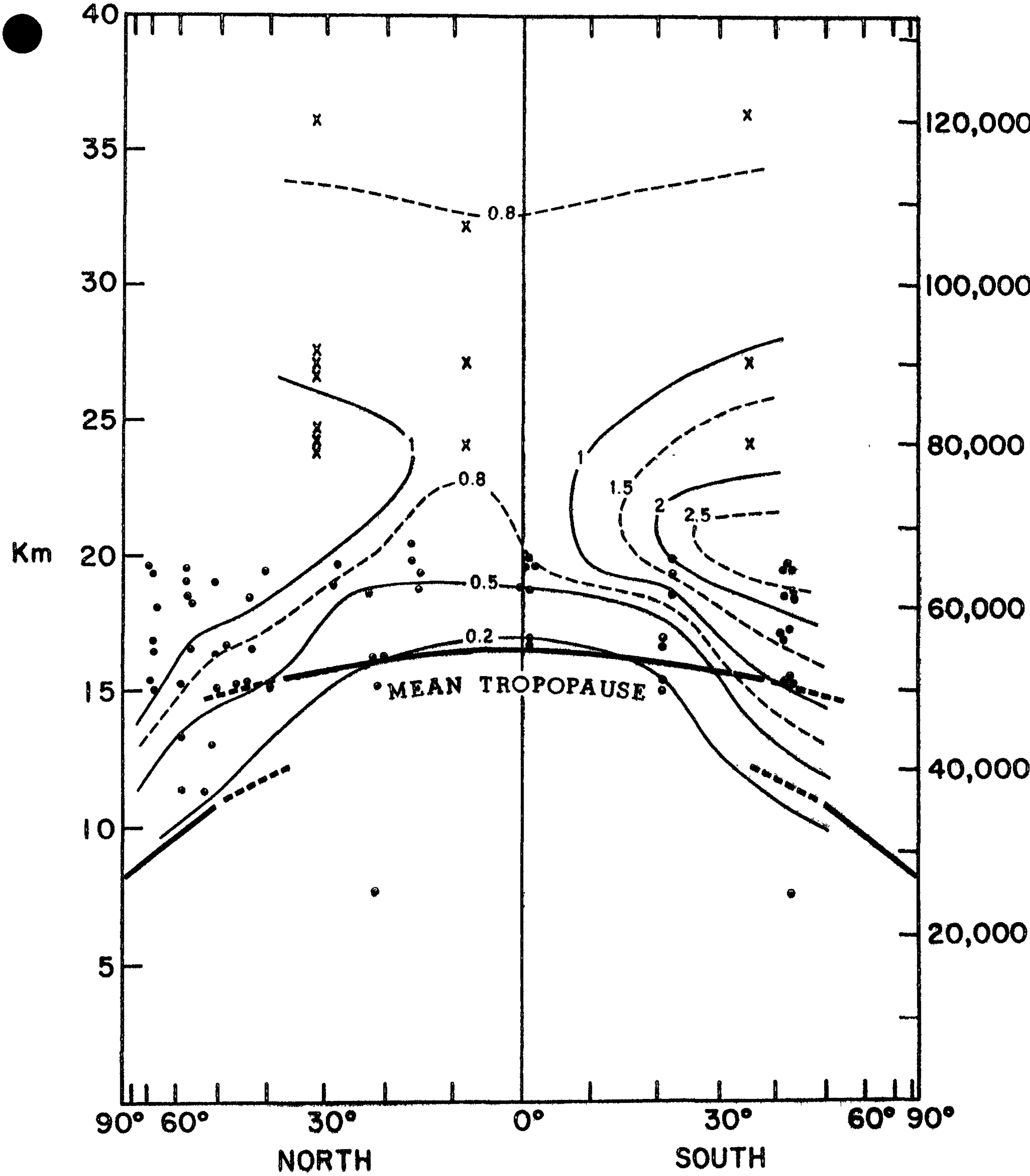


Figure 24 JUNE - AUGUST 1966



Pu^{238}

Figure 25 SEPTEMBER - NOVEMBER 1966



Pu^{238}

Figure 26 DECEMBER 1966-FEBRUARY 1967

FIGURES 27-42

Latitudinal Cross Sections of Mean Seasonal Strontium-90 Concentrations

(March 1963-February 1967)

Units: disintegrations per minute per 1000 standard cubic feet of air at sampling time. (Numbers in italics refer to mean monthly tropospheric values.). Crosses represent individual balloom samples, solid circles represent average monthly aircraft data.

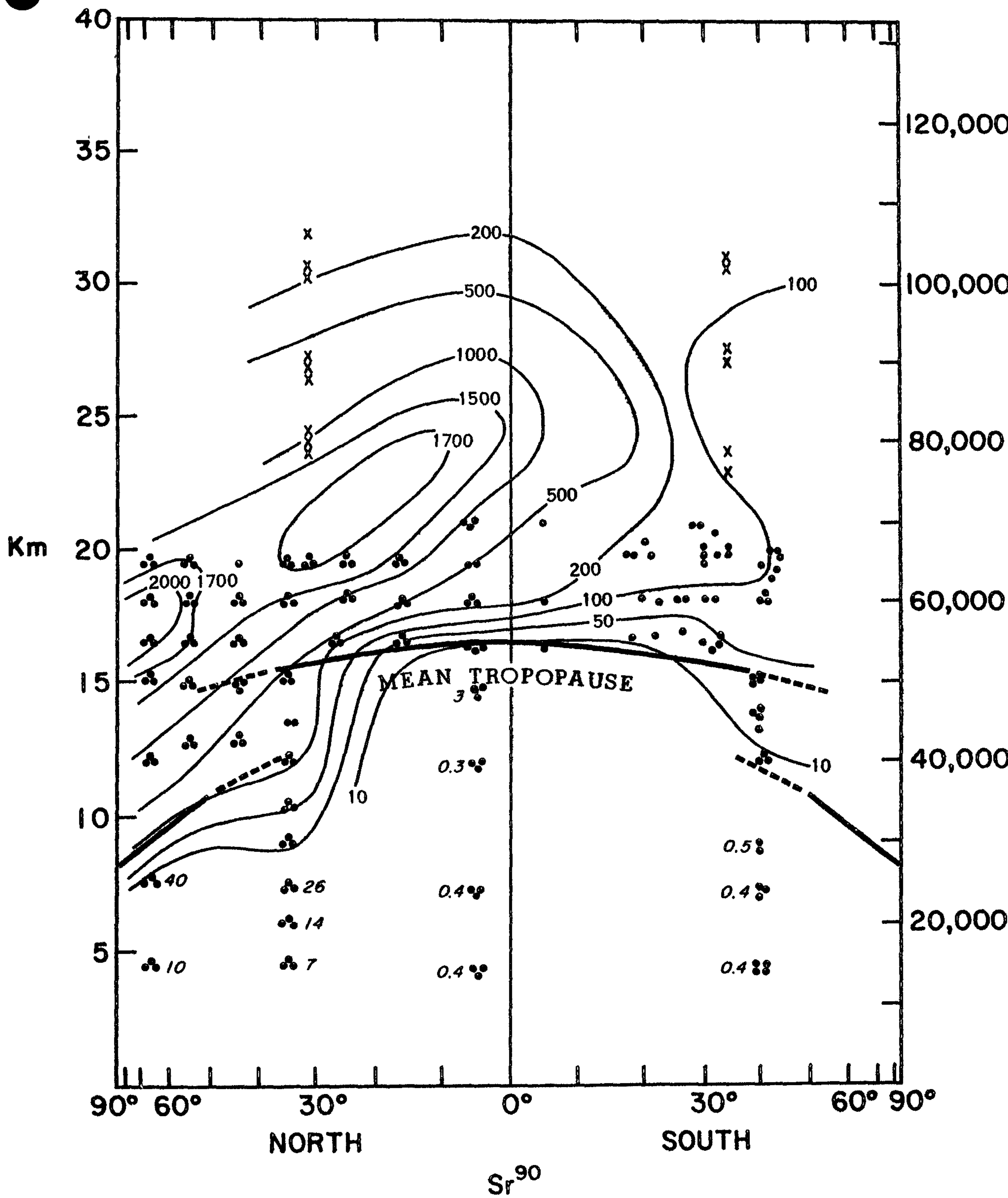
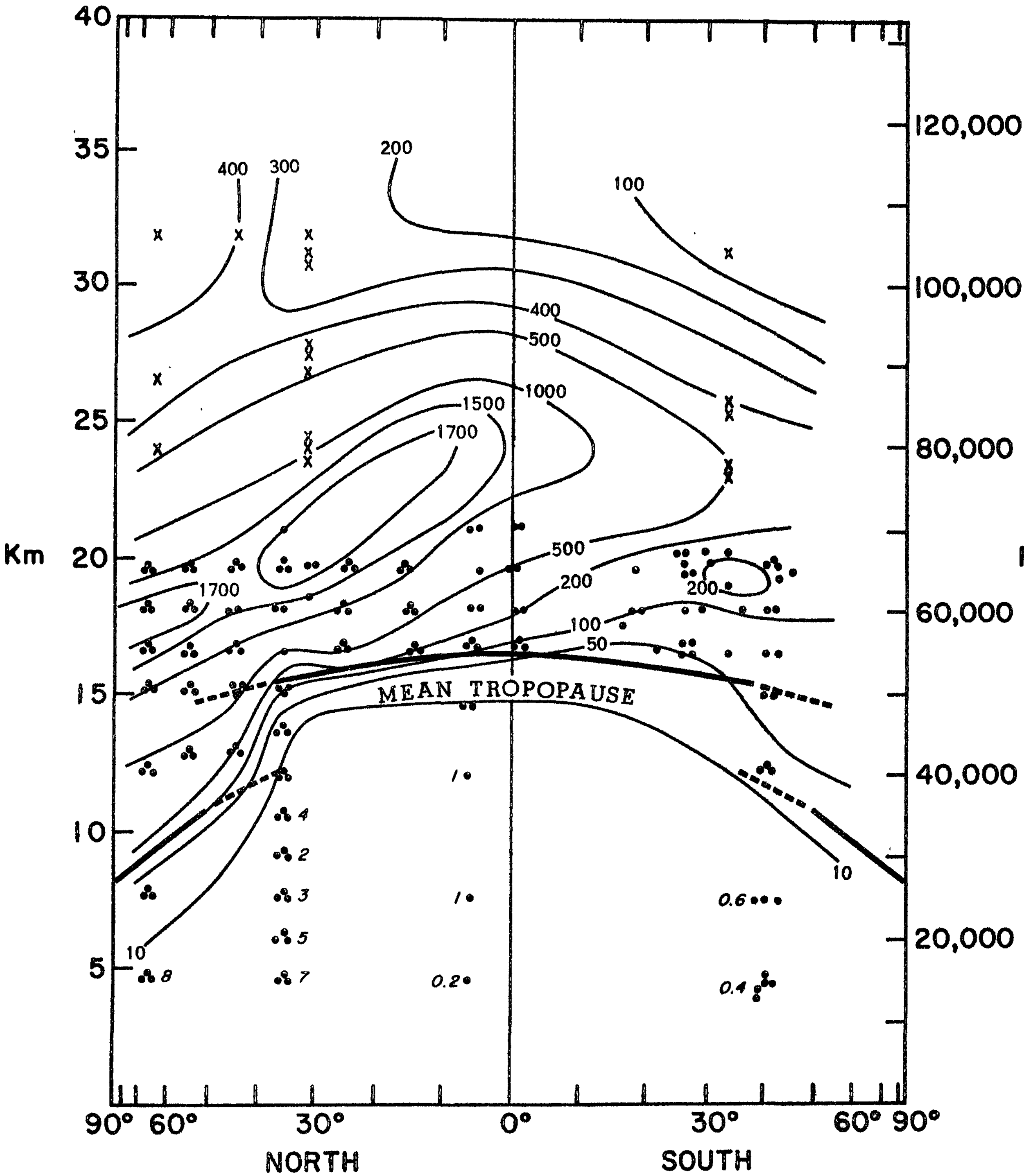


Figure 27 MARCH - MAY 1963



Sr90

Figure 28 JUNE - AUGUST 1963

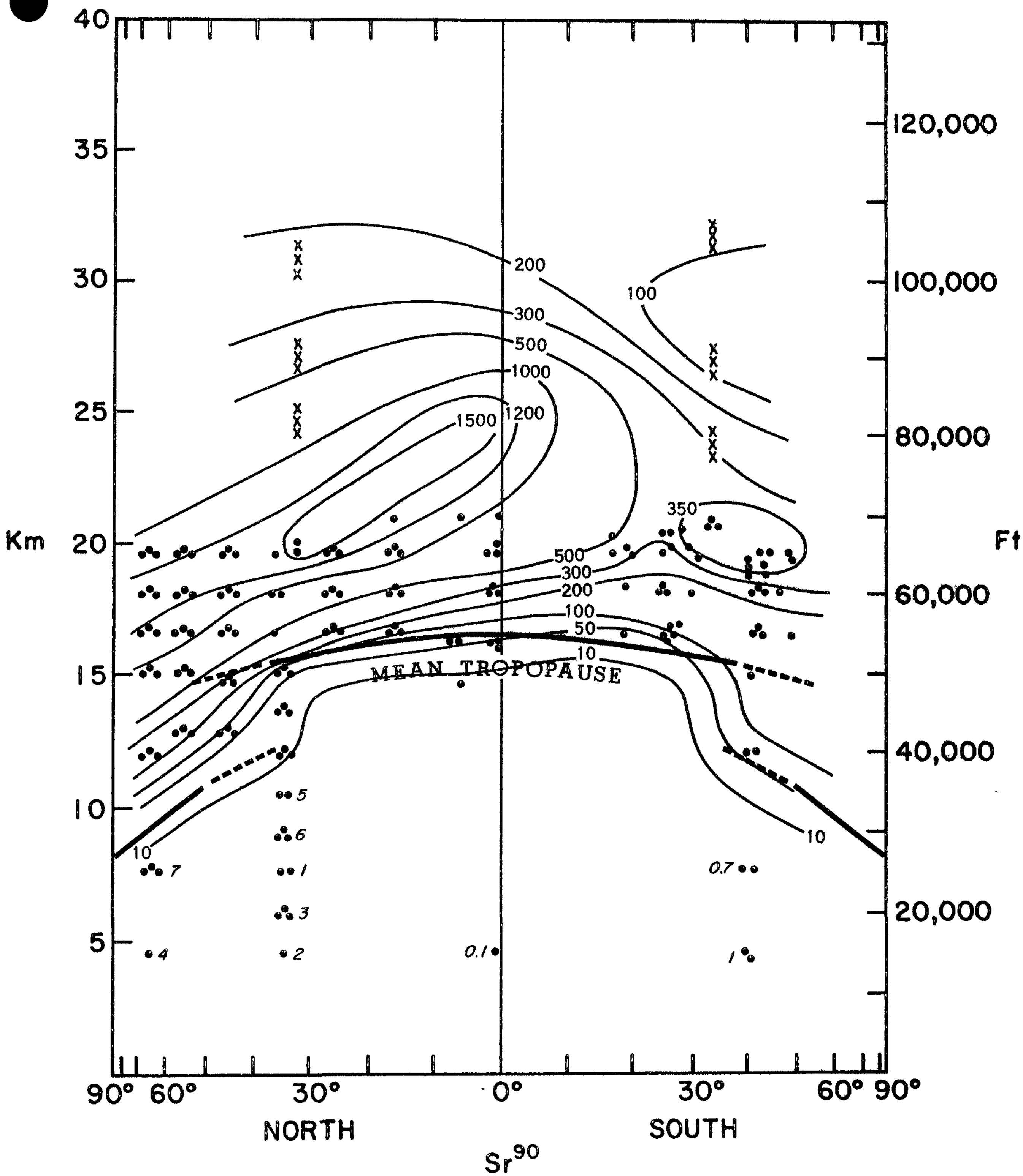


Figure 29 SEPTEMBER - NOVEMBER 1963

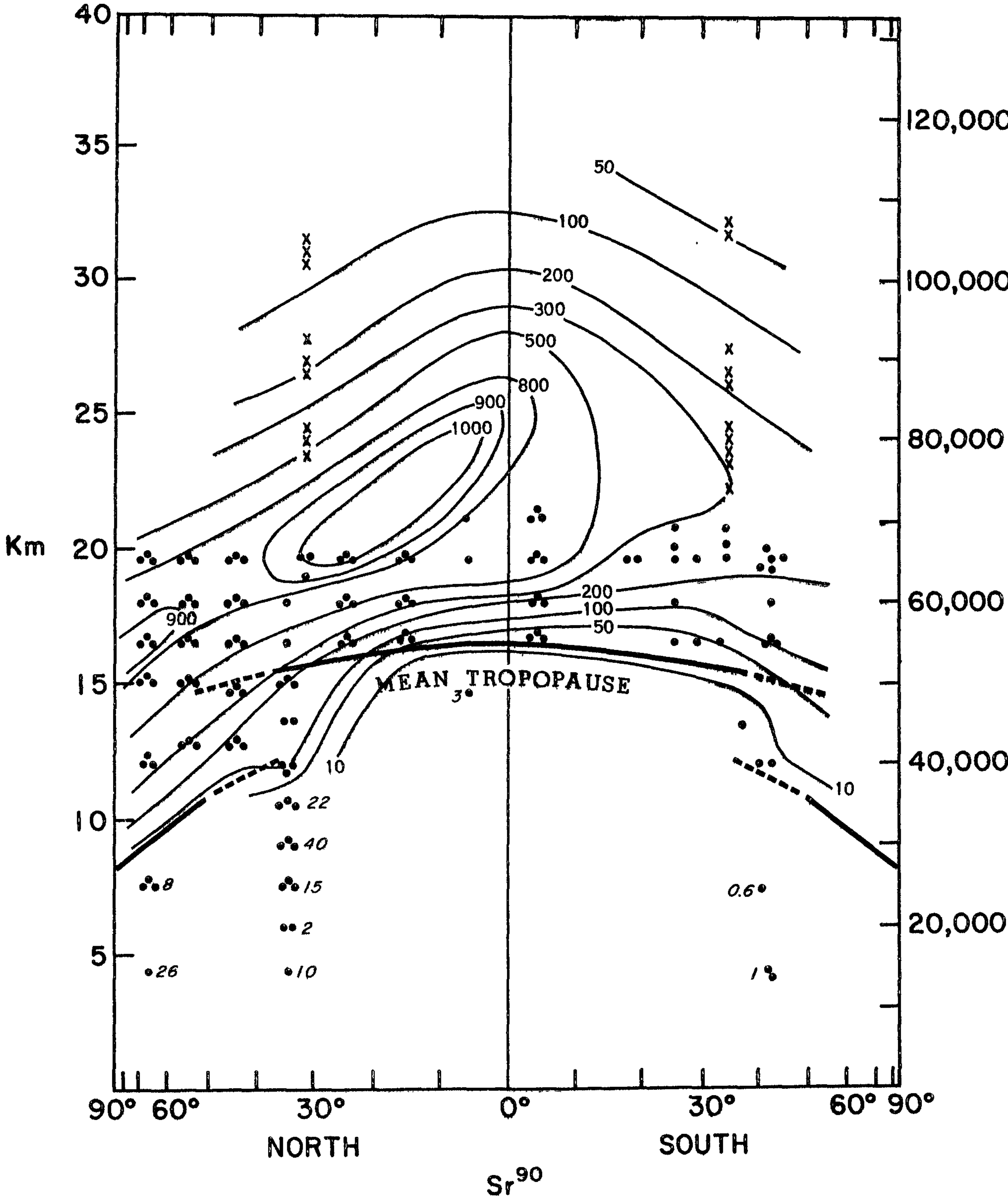
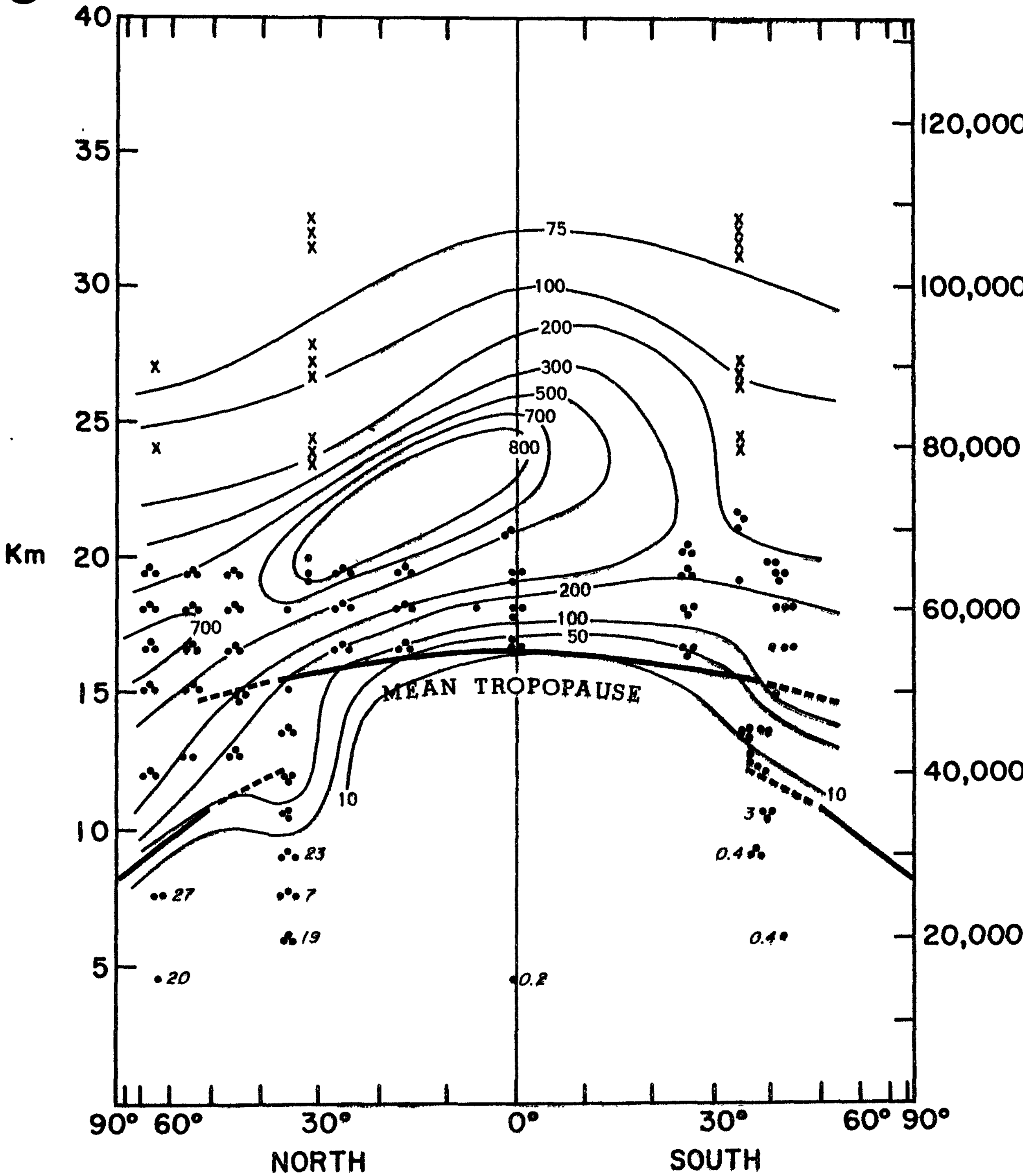


Figure 30 DECEMBER 1963 - FEBRUARY 1964



Sr^{90}

Figure 31 MARCH - MAY 1964

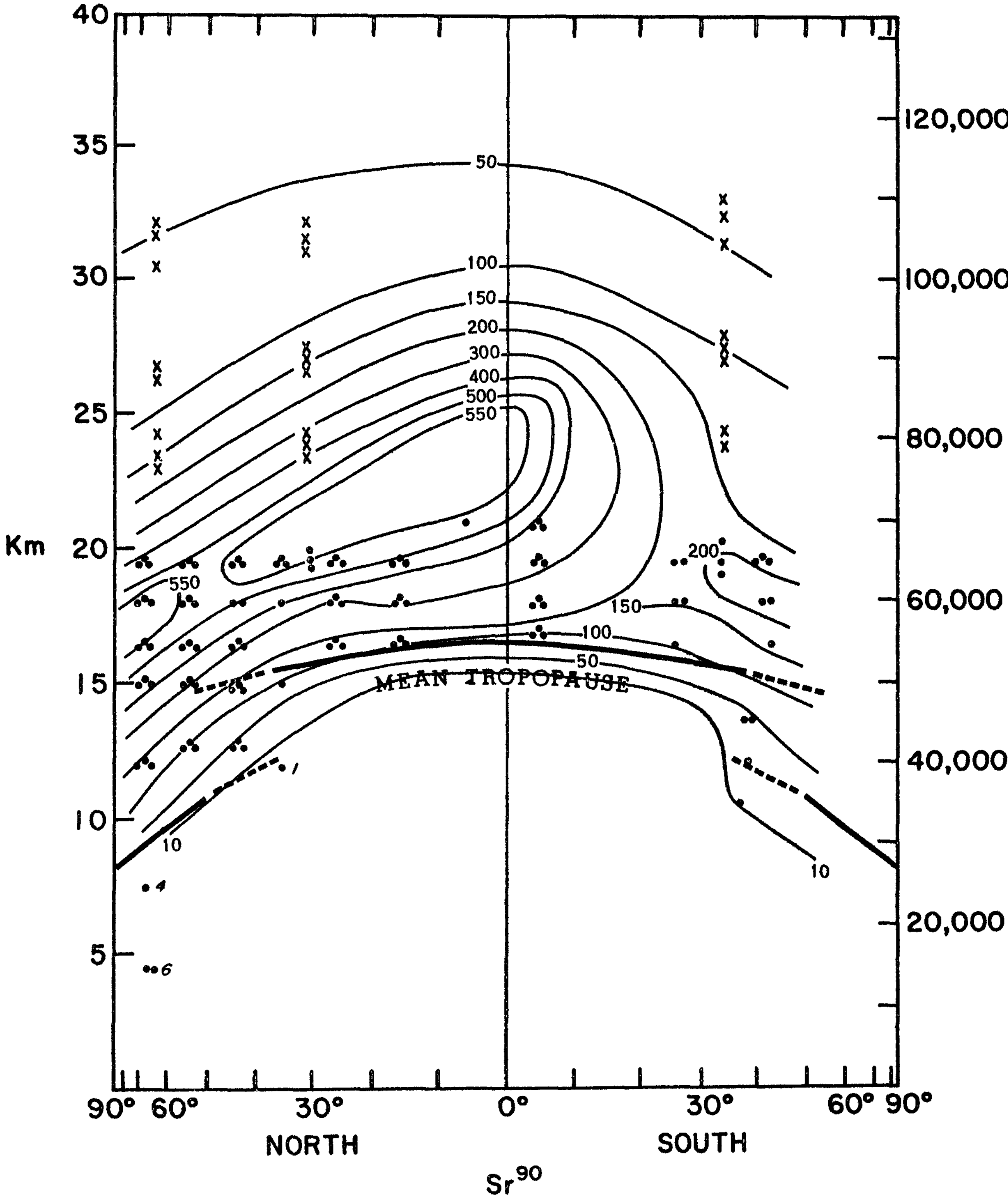


Figure 32 JUNE - AUGUST 1964

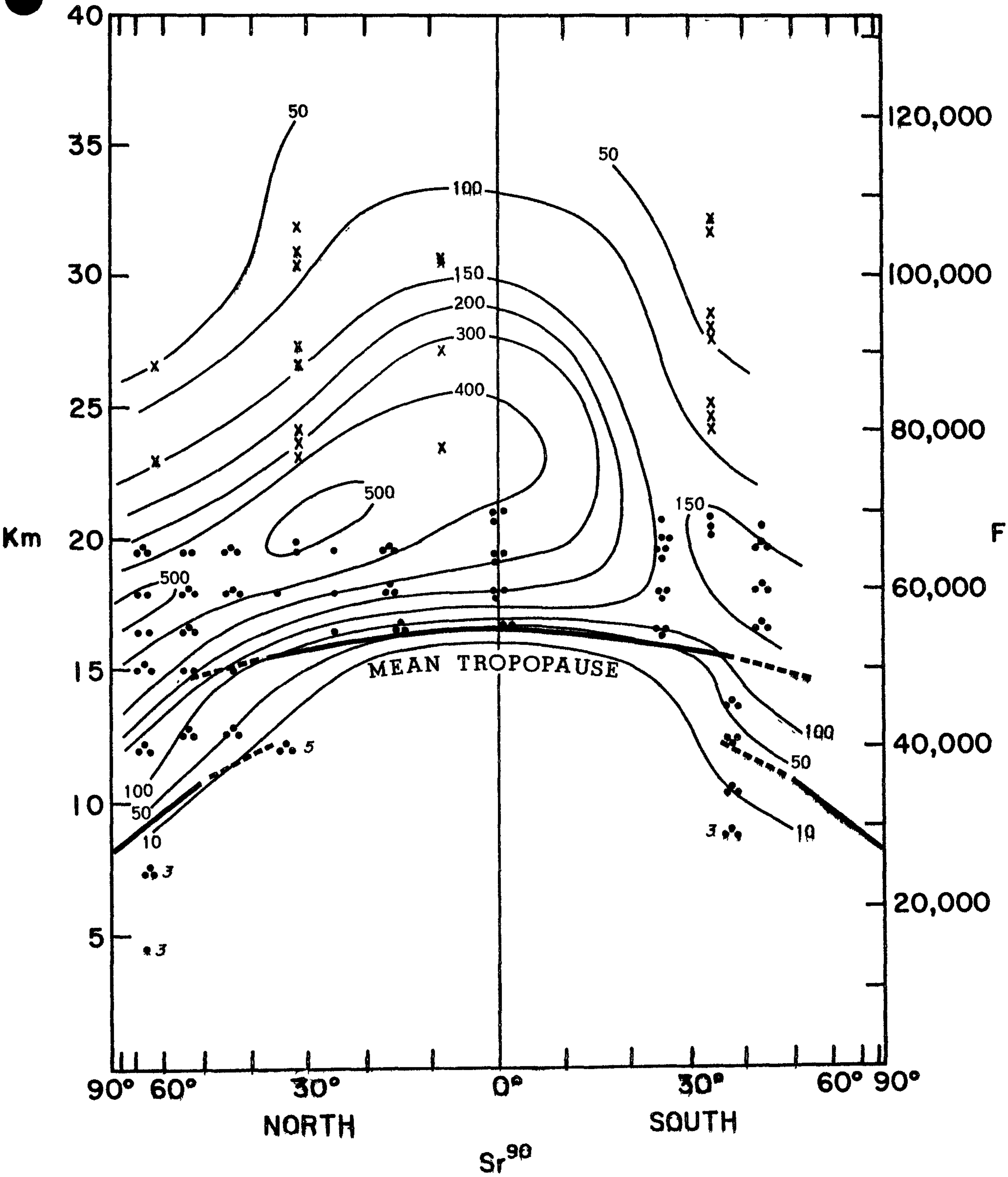
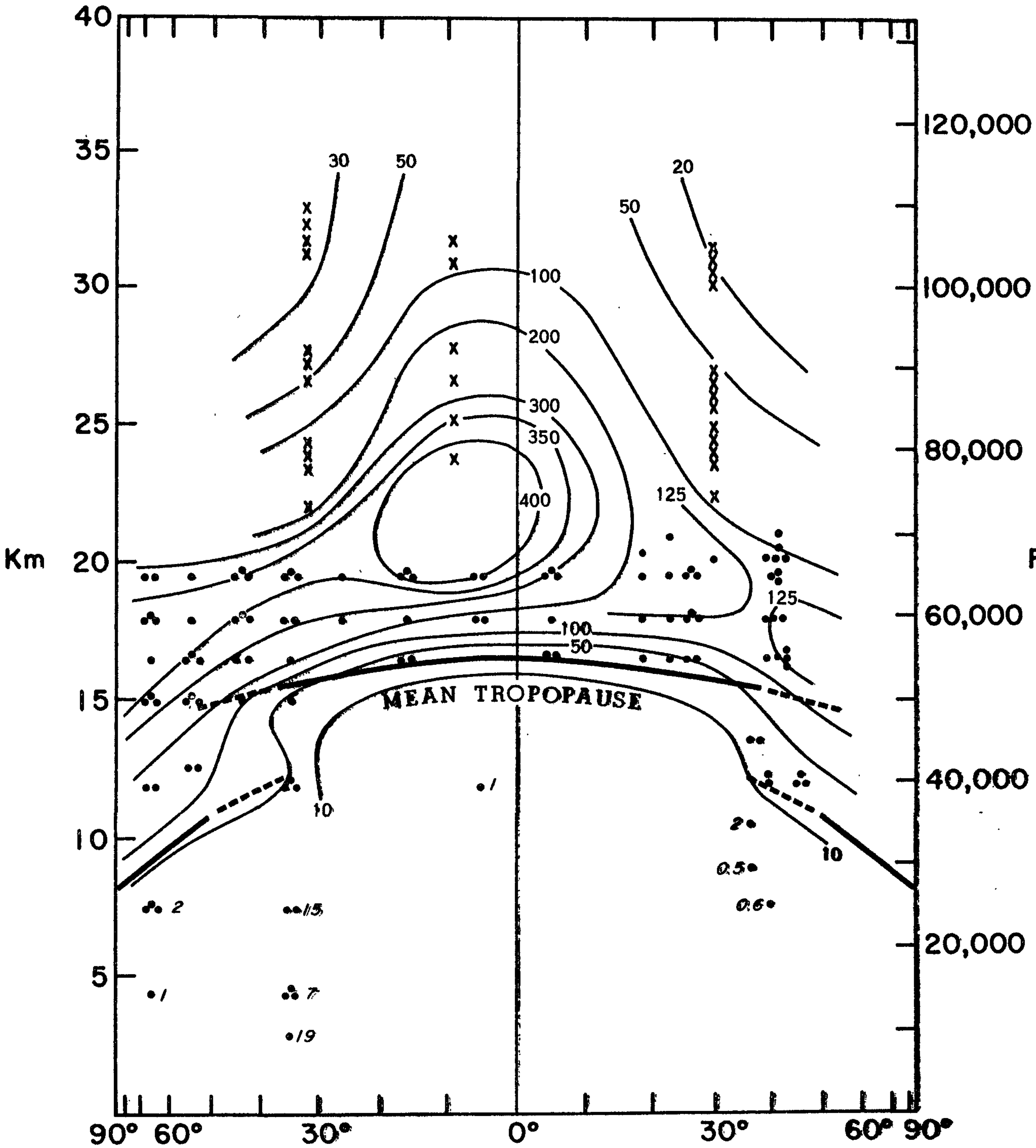
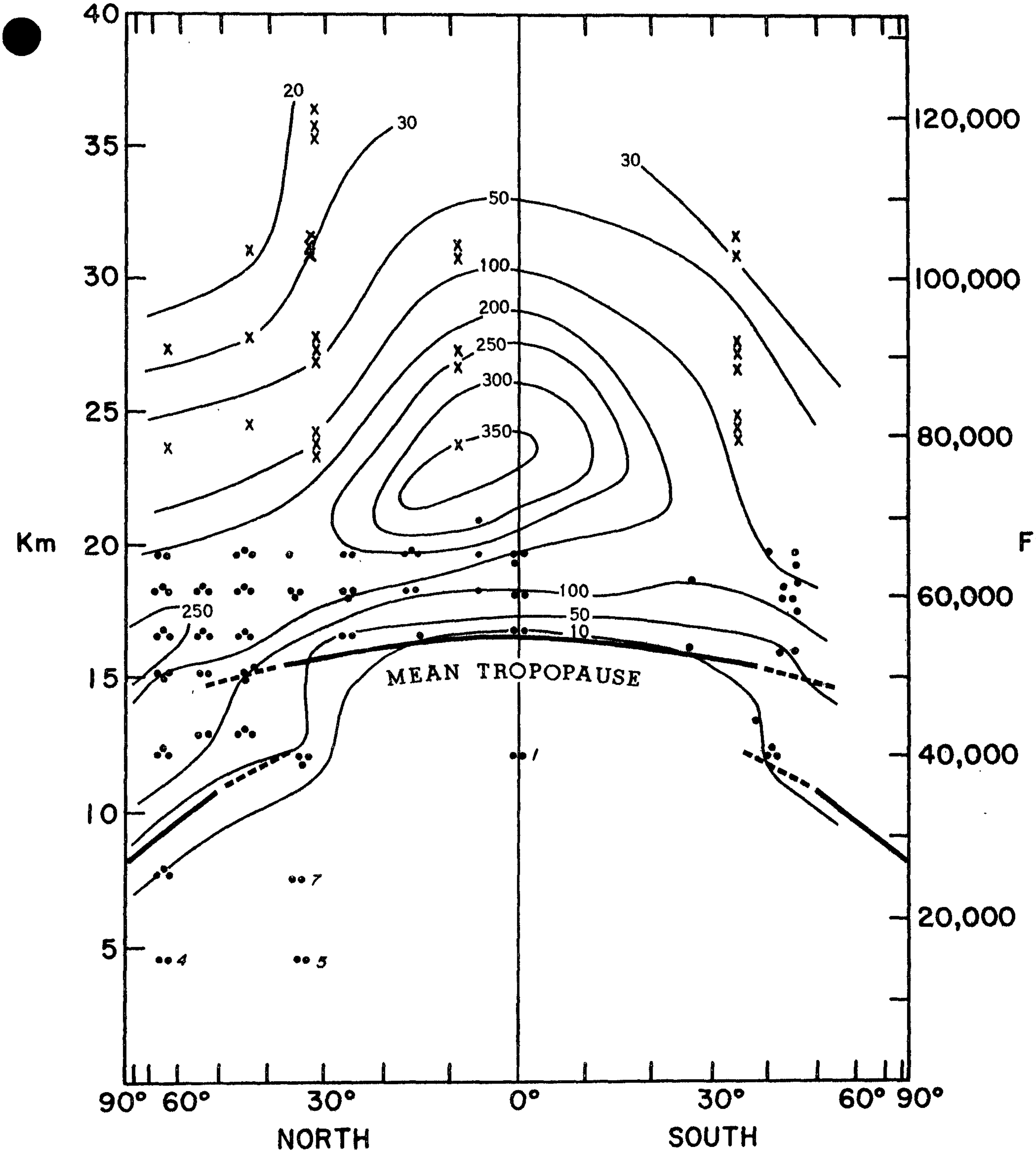


Figure 33 SEPTEMBER - NOVEMBER 1964



Sr^{90}

Figure 34 **DECEMBER 1964 - FEBRUARY 1965**



Sr^{90}

Figure 35 MARCH-MAY 1965

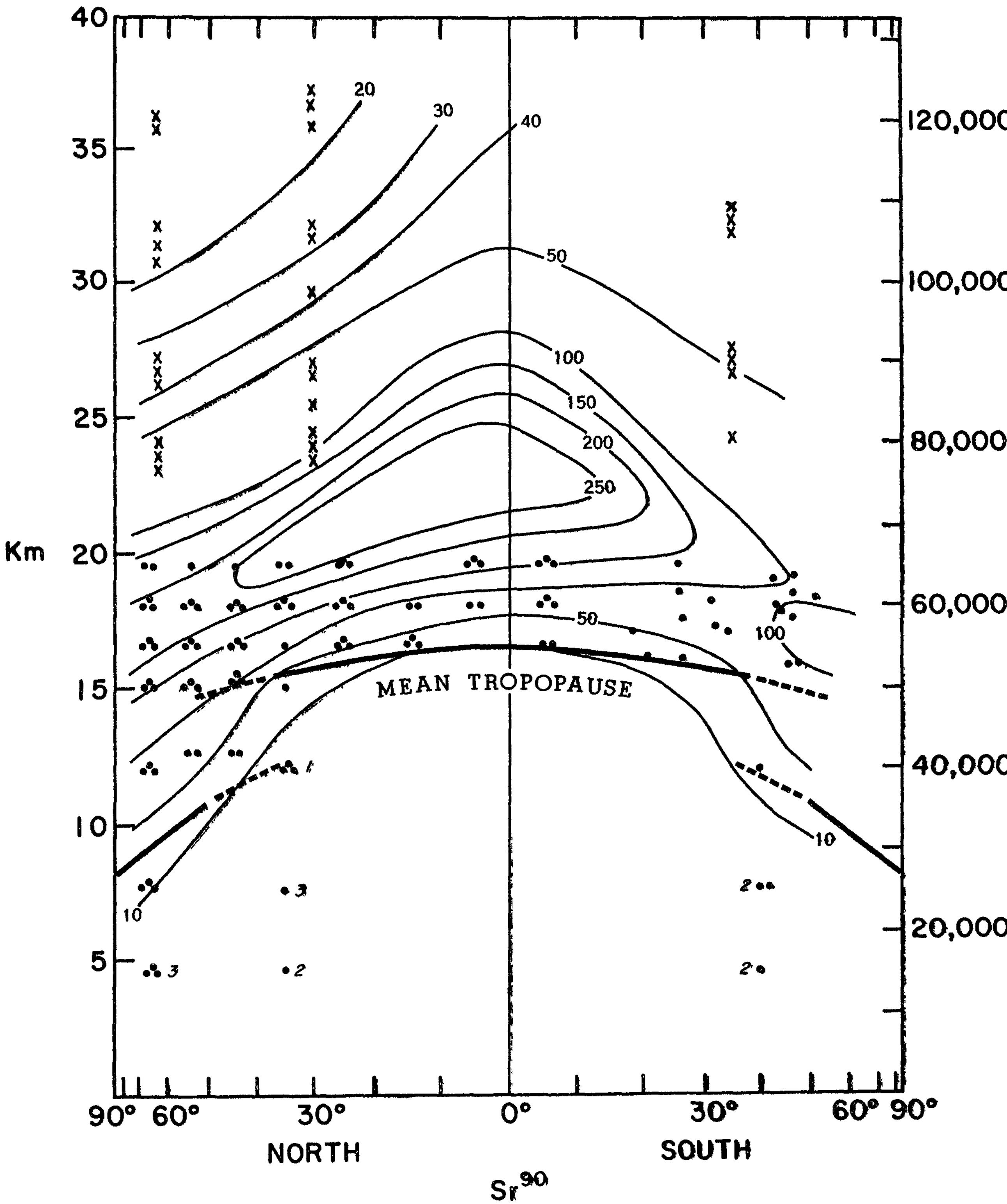


Figure 36 JUNE - AUGUST 1965

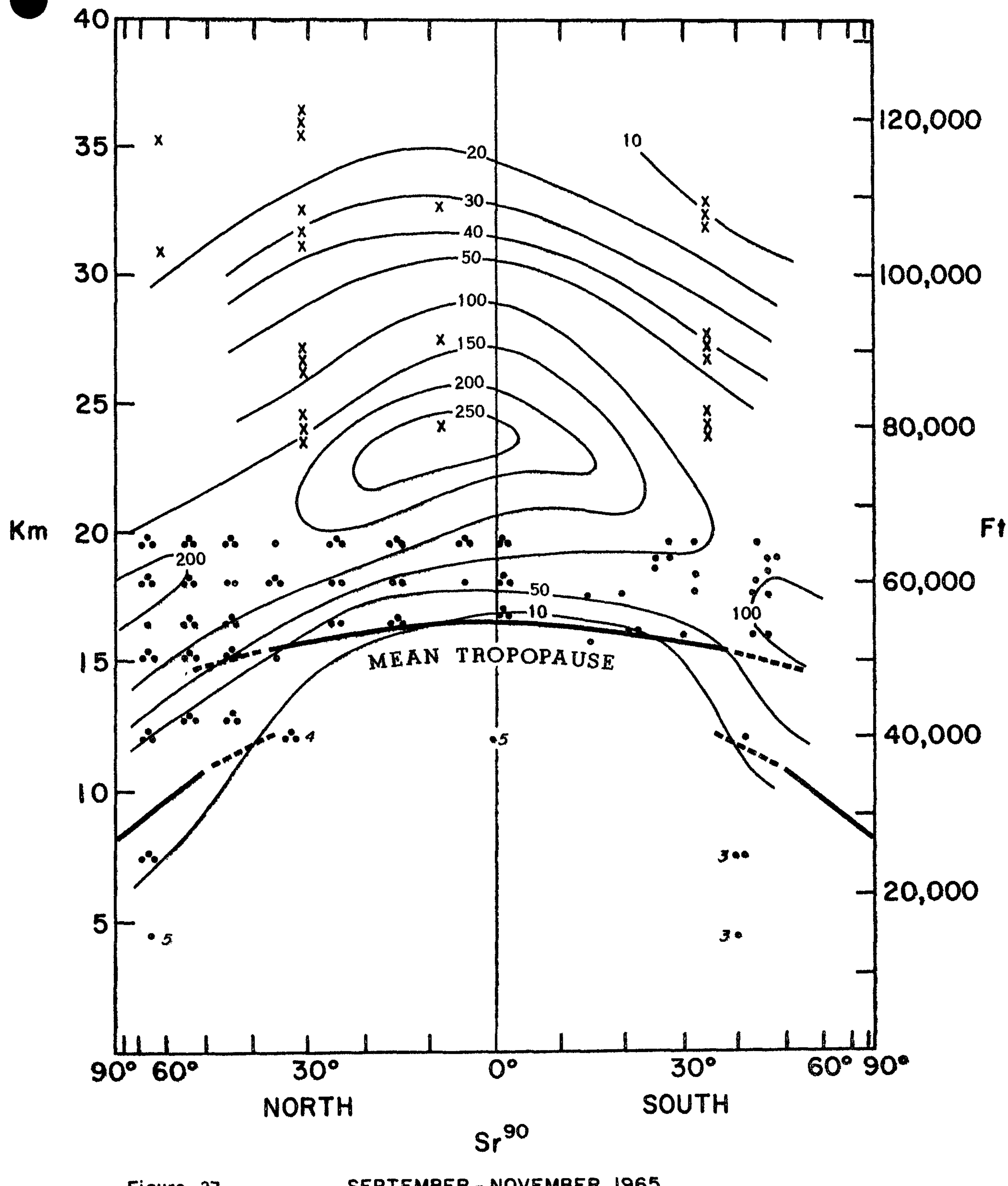


Figure 37 SEPTEMBER - NOVEMBER 1965

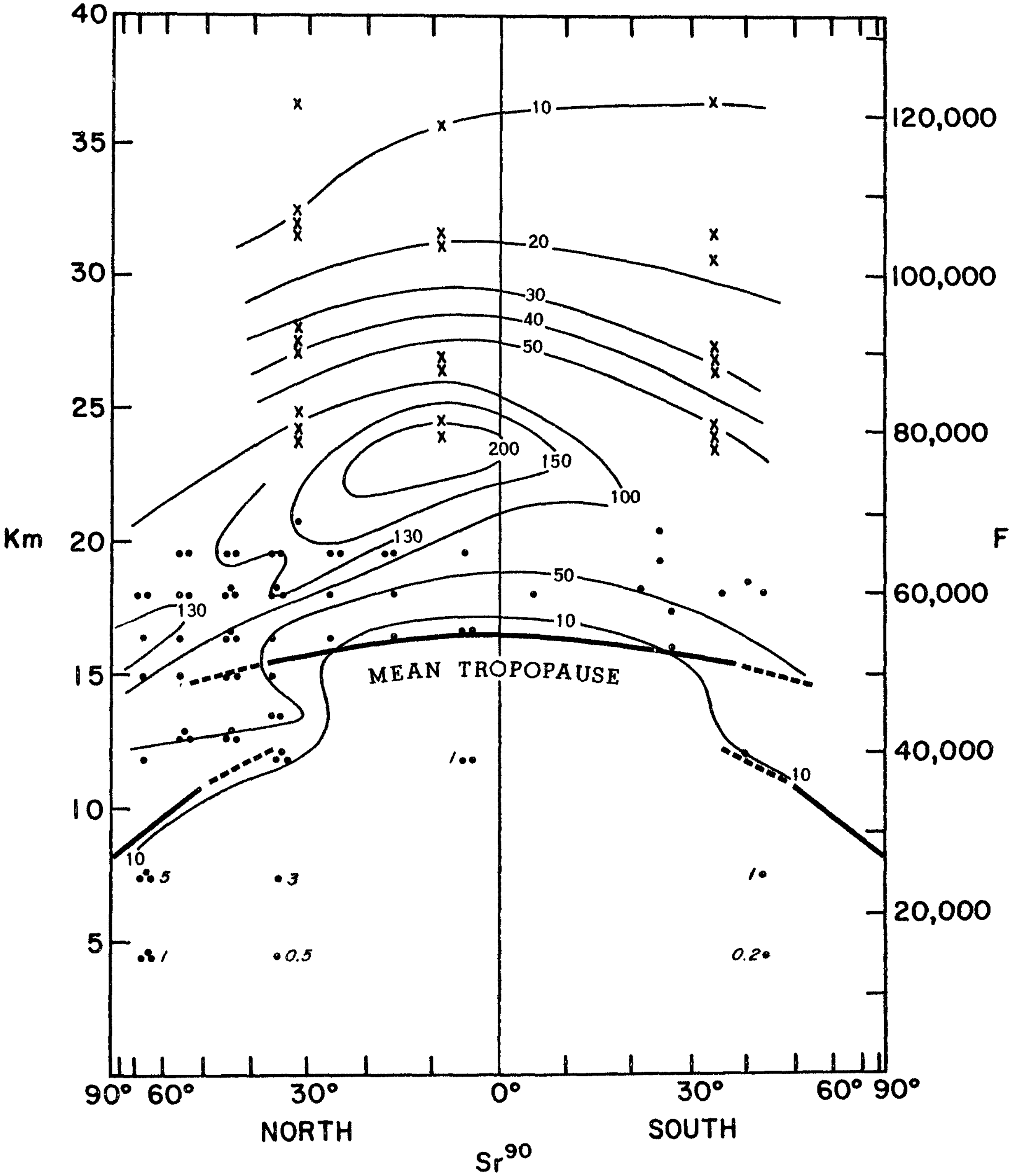


Figure 38 DECEMBER 1965 - FEBRUARY 1966

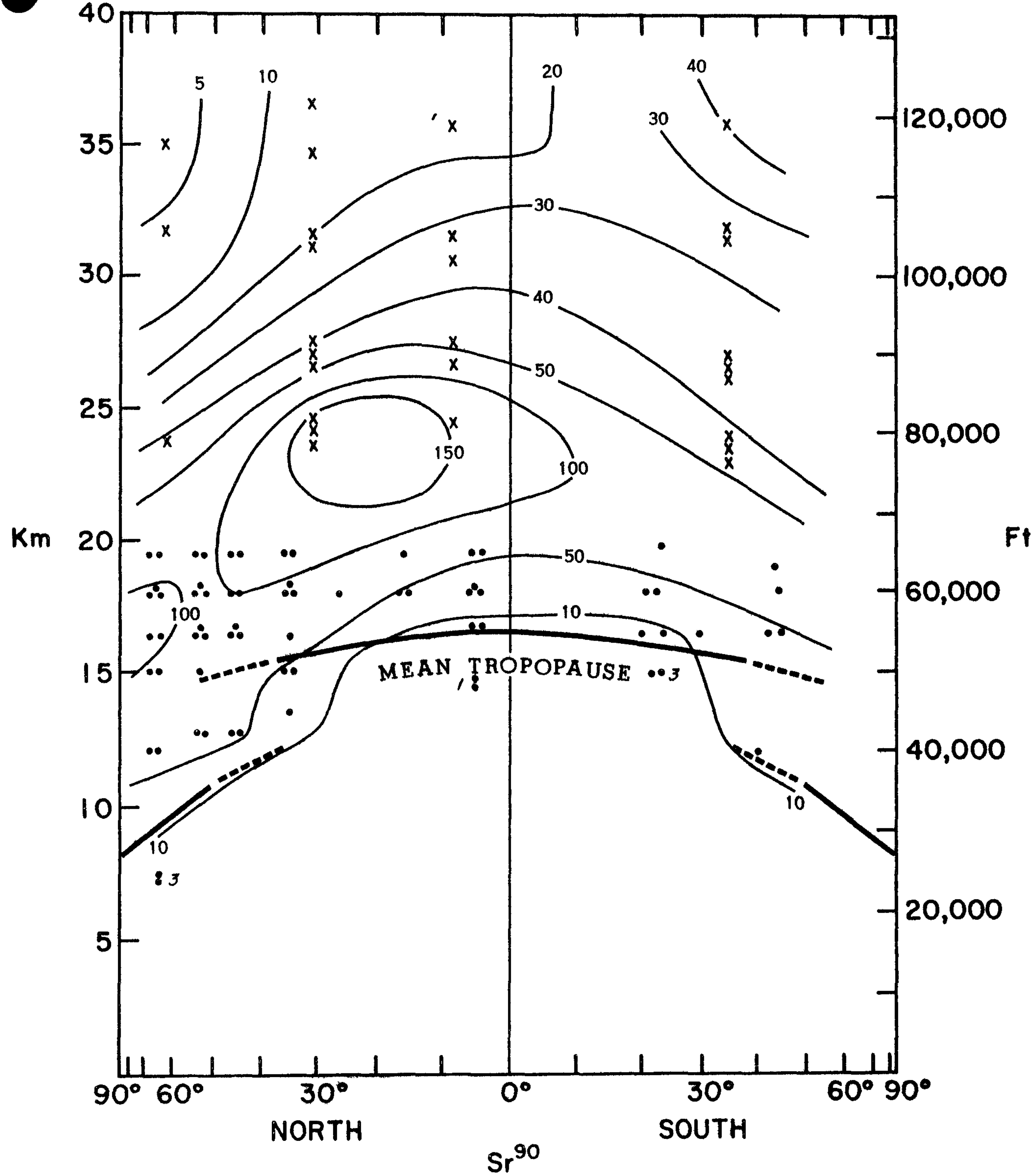


Figure 39 MARCH-MAY 1966

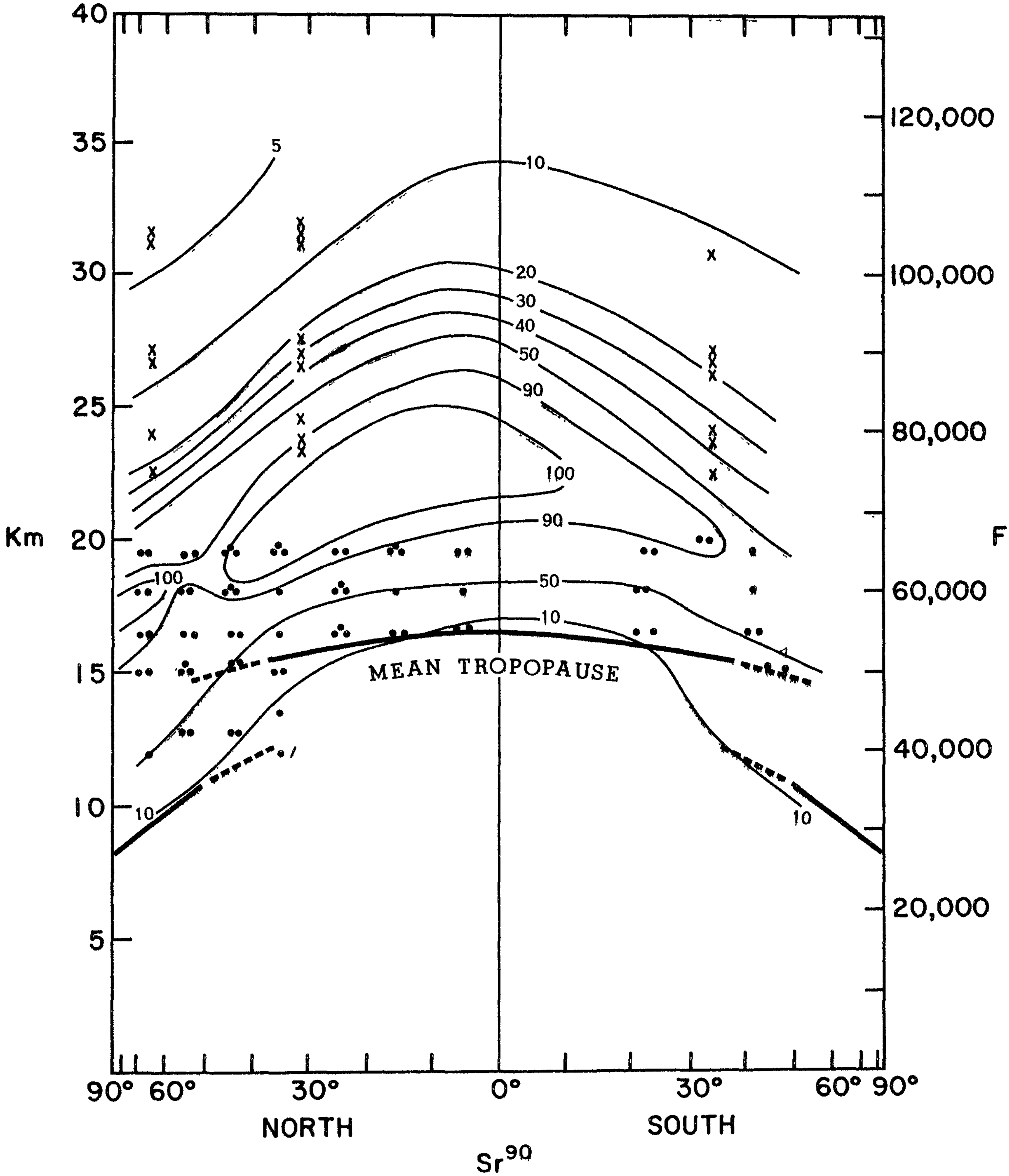
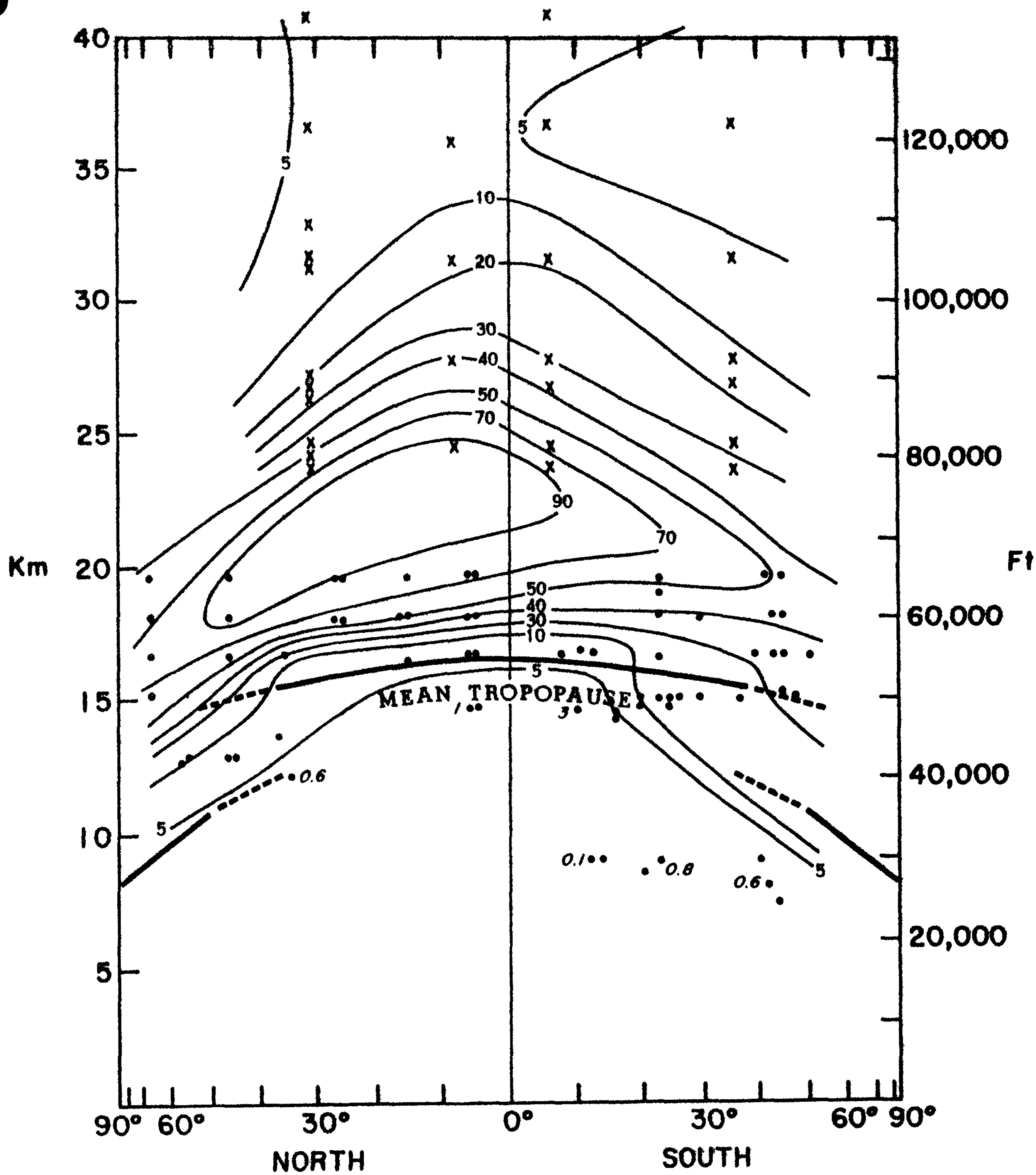
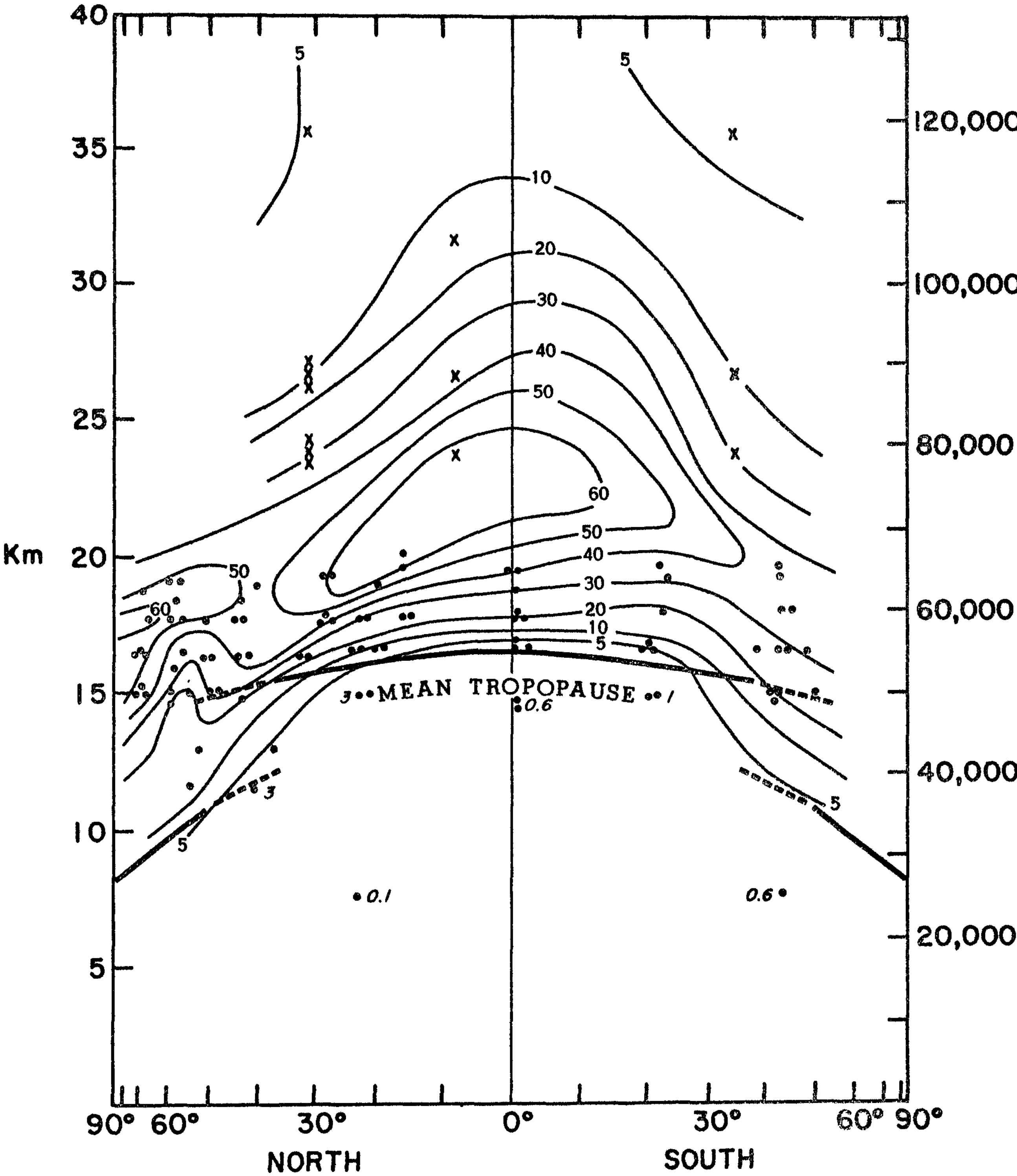


Figure 40 JUNE - AUGUST 1966



Sr^{90}

Figure 41 SEPTEMBER - NOVEMBER 1966



Sr^{90}

Figure 42 DECEMBER 1966 - FEBRUARY 1967

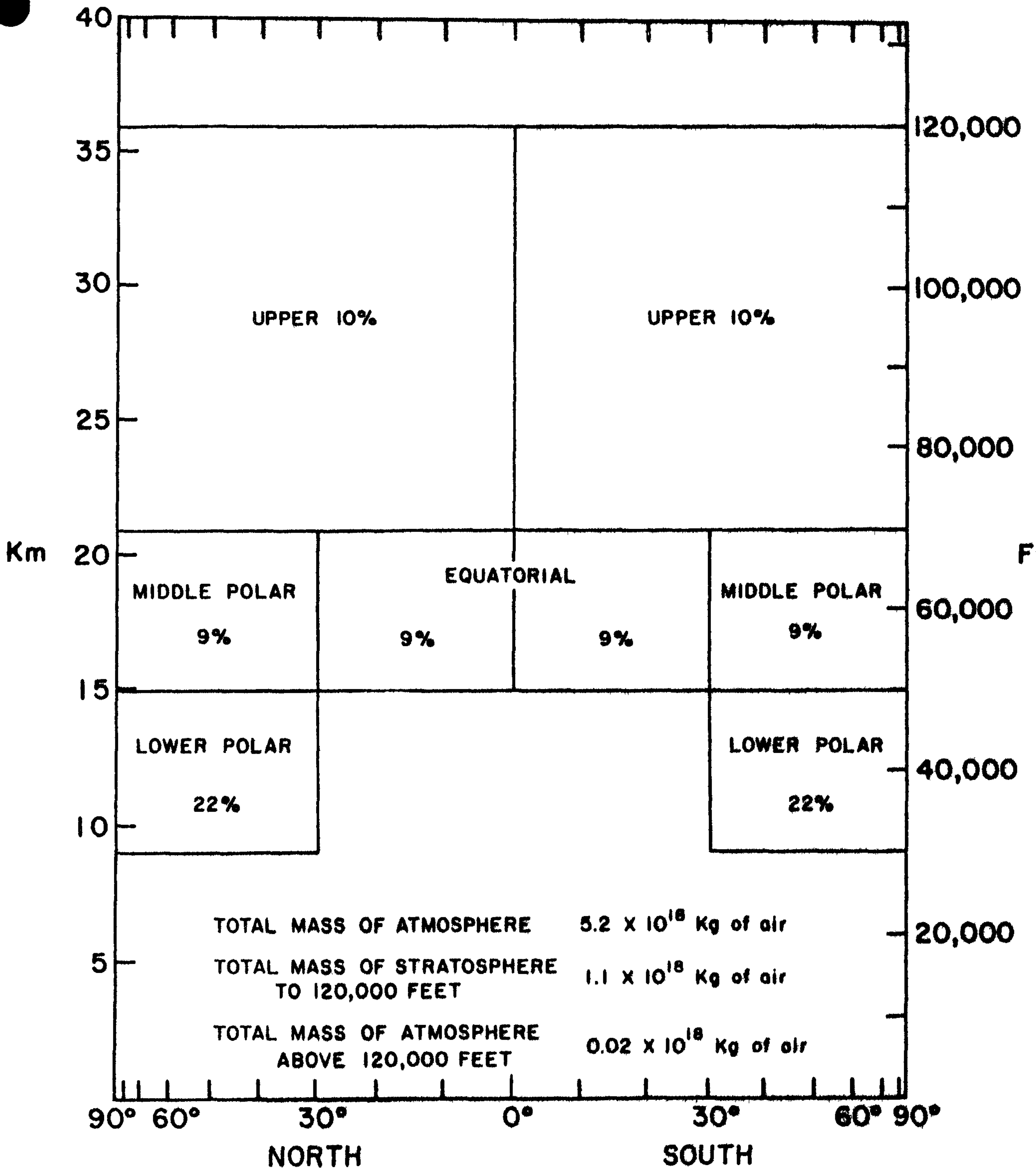


Figure 43 SCHEMATIC STRATOSPHERIC COMPARTMENTS

(Numbers represent percentage of total stratospheric mass)

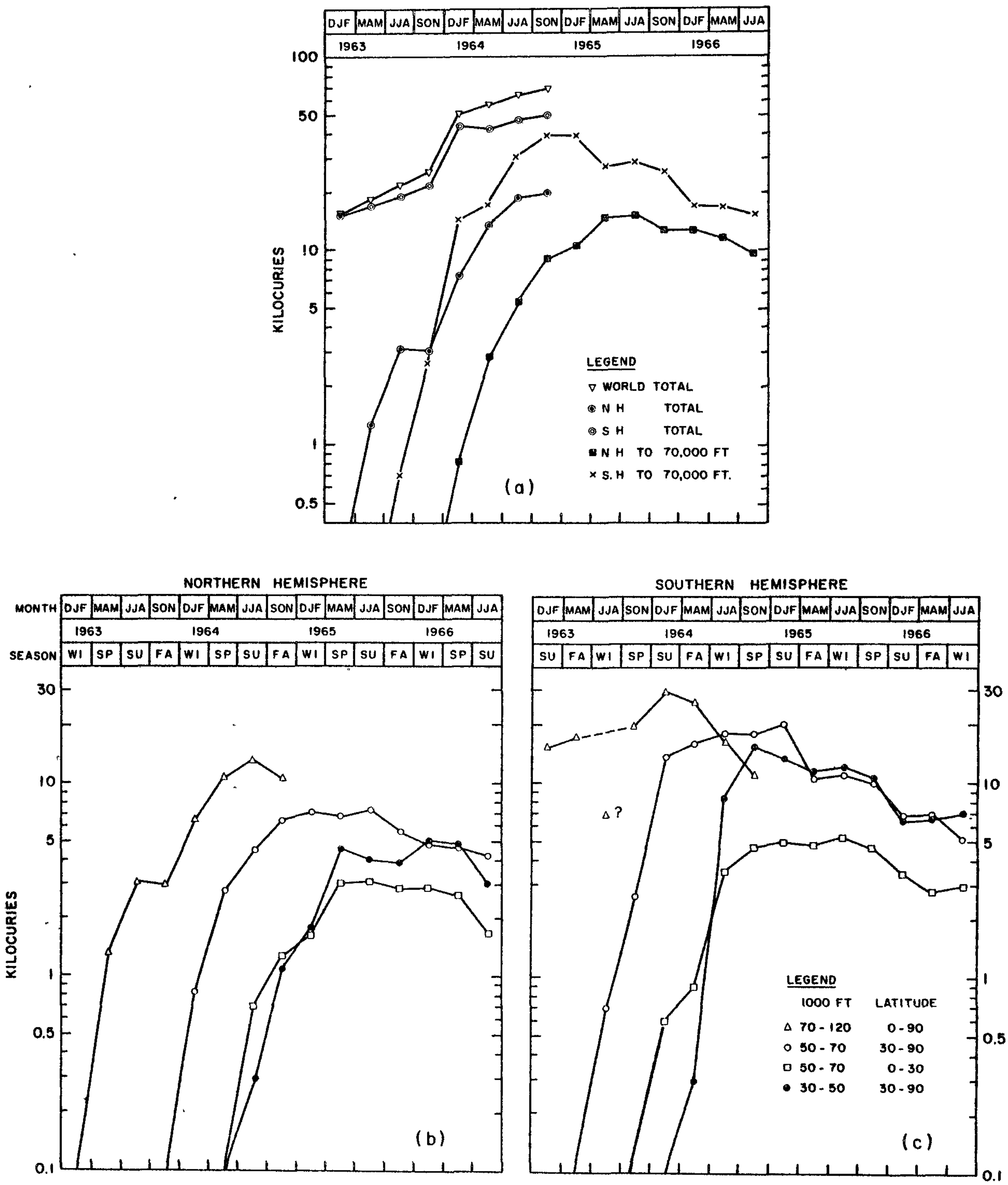
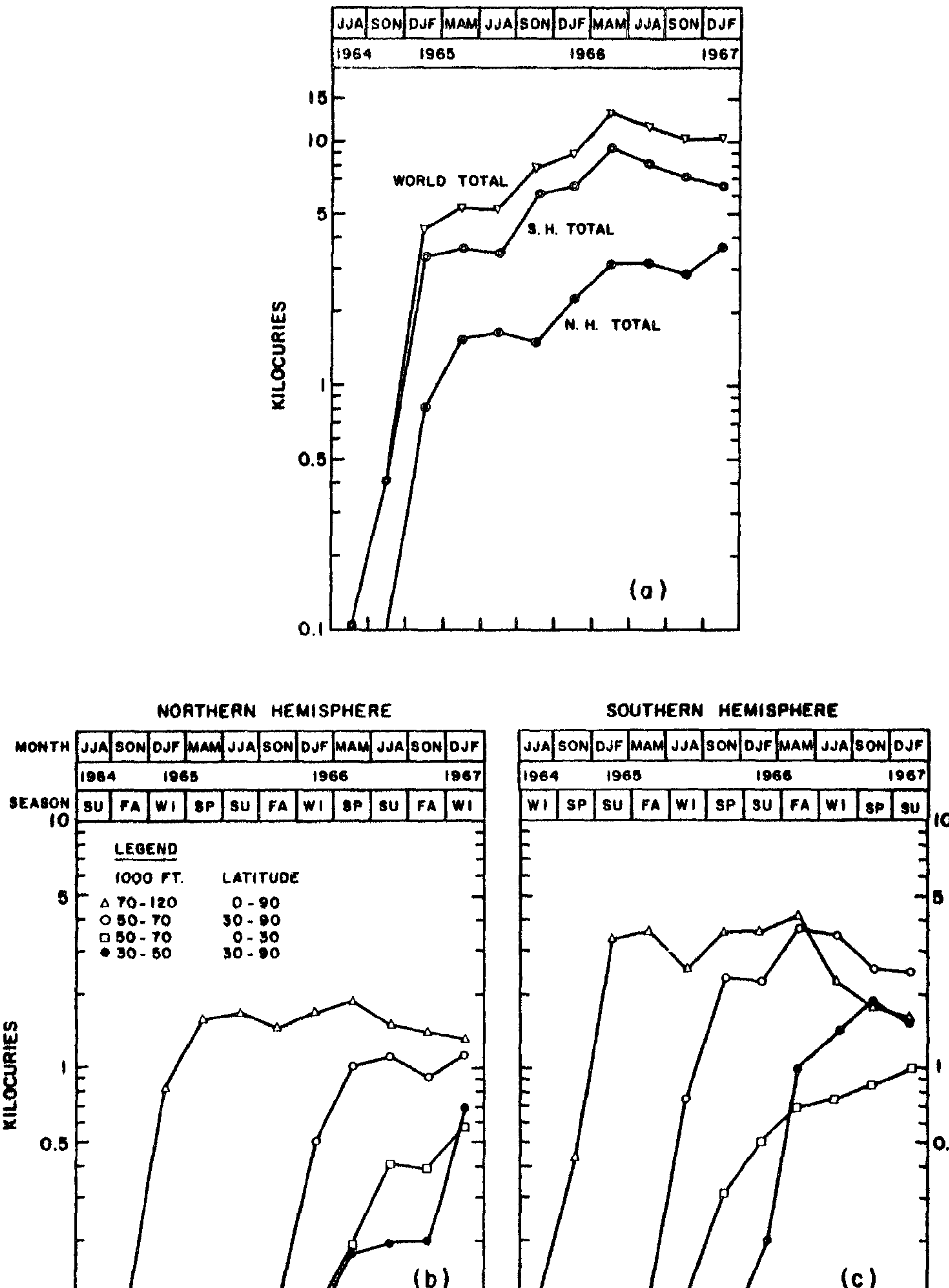


Figure 44

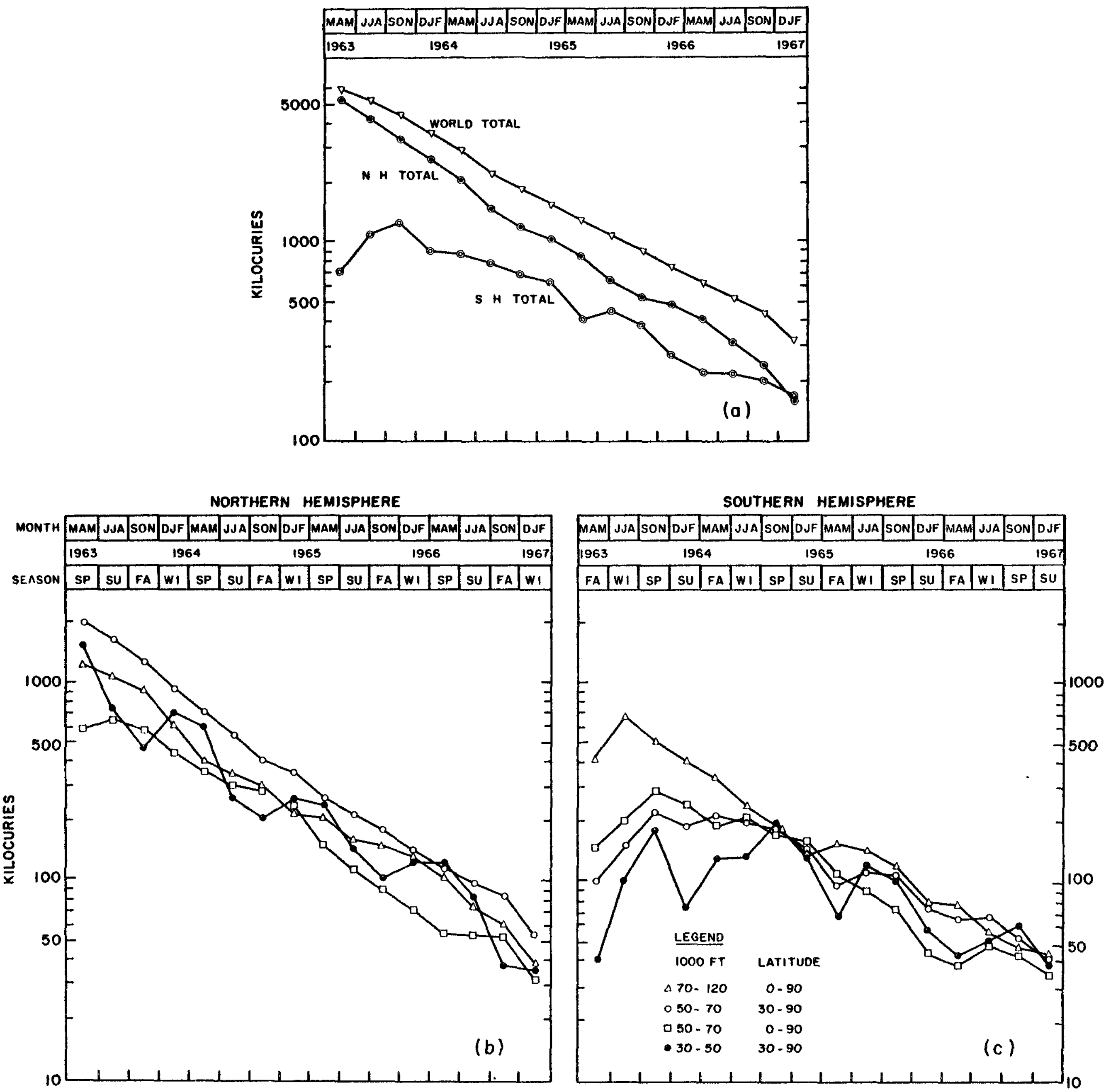
STRATOSPHERIC BURDENS OF Cd^{109}
Below 120,000 feet



STRATOSPHERIC BURDENS OF SNAP-9A PU^{238}

Figure 45

Below 120,000 feet



STRATOSPHERIC BURDENS OF Sr^{90}

Figure 46

Below 120,000 feet

PROJECT AIRSTREAM

by Philip W. Krey (HASL)

Project Airstream is HASL's study of radioactivity in the lower stratosphere employing the RB-57F Aircraft as a sampling platform. The aircraft are flown by the 58th Weather Reconnaissance Squadron under the direction of the 9th Weather Wing of the Air Weather Service. This project is a follow-on of the Defense Atomic Support Agency's Project Stardust except that Airstream's sampling missions are limited to only one per season. The missions are scheduled for early August, November, February, and May with a ± one month slippage. However, each mission must be completed within a nine-day interval. The flight trajectory is given in Fig. 1 and the anticipated altitude coverage is shown in Fig. 2.

The coverage shown in Fig. 2 extends continuously at the indicated altitudes from 75°N to 51°S latitude except for a slight gap between 10 - 16°S. The mission is accomplished by flying the aircraft from four bases of operation:

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

The gap may be closed at the lower altitudes by sampling during the redeployment of aircraft from Mendoza AFB, Argentina after the mission is completed. Redeployment sampling from the other remote bases to the home base at Kirtland AFB may also provide data on the short term variability of the radioactive environment and on the representativeness of the sampling program.

AIR FILITER SAMPLES

Air Filter samples are collected during a latitude increment of approximately 3 - 4° at prescribed altitudes using the U-1 foil system. This system permits the sequence insertion of up to 12 IPC #1478 filter papers (diameter 16-3/8") into the sampling duct near the bomb bay on the right side of the aircraft. Estimates of the volumes sampled by each filter are made using the calculations developed under Project Stardust.

Upon arrival at HASL, the filters are coded, logged and quartered. The entire sample (or a representative fraction if the activity is too high) is folded and placed in a plastic box, 8 cm x 6.5 cm x 3.1 cm deep, for gamma spectrometric analysis on an 8" x 4" NaI(Tl) crystal. The total gamma activity is integrated between 100 Kev and 3.0 Mev, and the complex spectrum submitted for computer resolution by least squares fitting into its component members. Based upon these measurements, quadrants of the filter are combined into appropriate composites which are sent to contractor laboratories for detailed radiochemical analyses including

Fe-55	Ce-144
Sr-89	Pb-210
Sr-90	Po-210
Zr-95	Pu-238
Cd-109	Pu-239,240
Ce-141	

RADON SAMPLES

Radon samples are recovered by inserting the HASL Radon sampler into the normal gas sampling system (P System) of the aircraft. The HASL sampler consists of a 190 gram charcoal trap housed within a 13" diameter sphere (Fig. 3). The charcoal used was specially selected for its low radium contamination and yielded <0.3 picocuries of radon per trap at equilibrium. Laboratory tests in a High Altitude Chamber have shown the charcoal to be greater than 80 percent retentive for influent radon provided the air temperature is below $-18^{\circ}C$ (1). Several measurements have shown that the temperature of the charcoal in the trap while sampling is not widely different from that of ambient air at sampling altitudes, so that the temperature requirement is readily satisfied.

The volume of air routinely sampled by each trap is about 6 SCM. The installation and operation of the radon sampler have been described earlier (2). Special shipping procedures bring the traps back to HASL as soon as possible after sampling. Radon is de-emanated from the traps and assayed in low level ionization chambers.

RESULTS

The Airstream missions for August and November 1967 have been completed. An error was made in the volume calculations of the August samples, so that the concentrations previously reported in HASL-183 (2) are incorrect. The corrected volumes and gamma concentrations on sampling date for the August mission together with the collection parameters are given in Table 1. One standard deviation of the counting error of any total gamma measurement is generally less than ±5 percent.

The initial results of the August Airstream mission and of the High Altitude Balloon program depicted a strangely stratified cloud from the sixth Chinese nuclear test on June 17, 1967. To obtain additional information on the distribution of this debris, three additional flights were conducted in early October. One was an altitude profile flight at 31°N with samples collected at every 0.92 km increments from 12.2 km to 19.2 km. The other two flights combined to give transects at altitudes of 15.2, 16.8, 18.3 and 19.2 km on a northeasterly course from Kirtland AFB to Sioux Falls, South Dakota. These flights were designed to correlate with balloon missions from 21 to 41 km conducted at 31°N and at Foss Field (44°N) at similar times. The results of the special Airstream flights are also presented in Table 1.

The concentrations of individual gamma emitting nuclides on collection date derived from a computer least squares resolution of the complex gamma spectrum of each sample are also presented in Table 1. These data supercede the limited gamma spectral results published in HASL-183. The major revision reflects a calibration change by a factor of 10 for the Zr-95 activities. The Zr-95 concentrations represent the total Zr-95-Nb-95 mixtures in each sample decay corrected from the measurement date to the sampling date with the 65 day half life of Zr-95. Ba-140 concentrations reflect Ba-140+La-140 equilibrium values. Mn-54 is decay corrected to October 15, 1961, its apparent production date, and is the only nuclide not reported on its collection date.

Because the gamma spectrum measurements are performed routinely on hundreds of samples each month for prolonged counting intervals and because the bias and gain adjustments are made manually, the exact electronic conditions pertaining to each radioassay cannot be scrupulously maintained. Consequently, one standard deviation of the precision error is estimated to be ±15 percent. Revised estimates of the reliability of these measurements will be made when detailed radiochemistry data of similar samples become available.

Table 2 presents the collection parameters, total gamma concentrations and available nuclide concentrations from spectra resolutions of the samples collected during the November 1966 mission. Plots of the corrected gross gamma concentrations on collection dates versus latitude for the August mission and for the November mission are shown in Figures 4 and 5, respectively. A similar plot of the Zr-95 concentrations on collection date for the August mission is given in Fig. 6. Fig. 7 illustrates the distribution of the Zr-95/Ce-144 ratio in the lower stratosphere during August 1967.

The radon-222 concentrations at the midpoint of collection obtained from the November mission are reported in Table 3. The data are grouped according to decreasing altitude of collection and sub-grouped by decreasing latitude. The Rn^{222} content of two blank traps which were flown in the stratosphere under routine conditions but through which little or no air was drawn are also presented in Table 3. These data are corrected for the approximate average radon background of the charcoal traps, but not for the observed values of the blank traps.

DISCUSSION

DISTRIBUTION AND CHARACTER OF DEBRIS FROM THE CHINESE 7th NUCLEAR TEST - AUGUST 1967

The distribution of the revised total gamma concentrations in August 1967 (Fig. 4) is not markedly different from that presented in HASL-183. The main core of the Chinese cloud is concentrated above 18 km directly over the point of detonation. The debris was transported both equatorward and poleward with a downward vector in each direction, although the downward movement was apparently inhibited by the high tropopause in the equatorial regions. The cell of high activity in the Southern Hemisphere from the French tests in June and July 1967 is clearly visible. This cell appears to extend unnaturally high into the equatorial stratosphere, and may actually be due in part to the most southward migration of the Chinese debris.

The distribution of the Zr-95 concentration in Figure 6 essentially reflects the same pattern as the gross gamma concentrations. Zr-95 concentrations in the lower stratosphere of the Northern Hemisphere just prior to the 6th Chinese test are unavailable. However, based upon Sr-89 concentrations in early 1967, the Zr-95 concentrations should be less than 0.15 pCi/SCM (3) if one assumes that most of the Northern Hemispheric burden of these two nuclides was generated by the 5th Chinese nuclear test of December 28, 1966. The 0.20 pCi/SCM contour of the Chinese cloud is drawn to have reached only $3^{o}N$ latitude which automatically and arbitrarily dictates the altitude to which one can ascribe the ascent of the Zr-95 from the French clouds.

The distribution of the Zr-95/Ce-144 ratios at collection time in Fig. 7 parallels those in Figures 4 and 6. The ratio reaches a maximum of about 4 in the core of greatest Chinese debris and decreases toward lower concentrations of that debris. As in the case of Zr-95, no Ce-144 concentrations are available for the lower stratosphere just prior to the 6th Chinese test. However, the High Altitude Balloon data in early 1967 suggests a Ce-144/Sr-90 ratio of about 0.6 would be appropriate for relatively old stratospheric debris in August 1967 (4). Stardust data for early 1967 showed relatively little increase in the lower stratosphere of Sr-90 from the 5th Chinese nuclear test (3). Therefore the Ce-144 concentrations would not be drastically affected, and we assume that the extrapolated ratio of 0.6 for Ce-144/Sr-90 in August calculated from the balloon data applies to the lower stratosphere. Extrapolating the Stardust Sr-90 concentrations to August and applying this 0.6 Ce-144/Sr-90 ratio gives a probable Ce-144 concentration of about 450 pCi/KSCM above 15 km in the mid latitudes. This is a significant part of the total Ce-144 measured in the August samples, and, in general, it explains why the Zr-95/Ce-144 ratio falls off as the background Ce-144 becomes a major contributor at the edges of the Chinese 6th test cloud.

Although there were three samples with Zr-95/Ce-144 ratios of about 5.9, a more representative ratio of the Chinese debris collected in August seems to be about 3.0. If all ratios above 1.6 are averaged (25 samples), the average ratio is 3.0. If only those samples with Zr-95 concentrations >2000 pCi/KSCM are averaged (10 samples), the value is 3.1. If only those 4 samples in which the assumed background Ce-144 represents 30% or less are averaged, the average ratio is 2.7. Decay

Correcting this 3.0 average value back to shot time, gives a Zr-95/Ce-144 ratio of 2.6 which is about half the expected value of 4.7 (5). This result is surprising because in the lower regions of a nuclear cloud where these samples were apparently collected, one would not expect enhancement of Ce-144 over the refractory nuclide, Zr-95.

The Ba-140/Zr-95 ratios derived from the data in Table 1 show two slight trends. One is a minimum in the ratio (~0.20) generally coinciding with the lobe of Chinese 6th debris extending into the lower polar stratosphere (Figures 4 and 6). The second trend is the higher ratios (~1.0) in the Southern Hemisphere and at some of the lower altitudes in the low latitudes of the Northern Hemisphere, presumably the effect of the French tests in the Southern Hemisphere. Selecting the same set of 10 highest activity samples chosen in the Zr-95/Ce-144 discussion yields a ratio of 0.30 at collection date. Averaging all the ratios from 10°N poleward gives a ratio of 0.44. Accepting the higher value and making the appropriate decay corrections to shot time gives an average production ratio of 5.9 which is in good agreement with the 5.2 reference value for a large megaton shot (5).

OCTOBER - NOVEMBER 1967

The stratospheric distribution of relatively fresh fission products during November 1967 is illustrated in Fig. 5. The fresh debris in the Northern Hemisphere was produced by the Chinese 6th nuclear weapons test, and remarkable changes in the concentrations of this debris have occurred during the months when Project Airstream was sampling. The fresh debris from the French tests in mid 1967 which was evident in the Southern Hemisphere during August (Fig. 4) is no longer observable during November.

The 6th Chinese test occurred at $42^{\circ}N$ on June 17, 1967 (6) and the resultant cloud was shown to be centralized above that latitude between 18 and 24 km in August 1967 (2). The special Airstream flights in early October indicated that maximum concentrations were still at or above 18.3 km, but that the maximum concentrations at 18.3 km had shifted northward to $49^{\circ}N$ or higher latitudes. Fig. 5 clearly shows that by November debris from this test had already deeply penetrated the polar stratosphere and had descended in that region to as low as 12 km.

In addition to the polar compartment, there was a second cell of Chinese debris observable during November. This was a smaller cell than the polar compartment, but with a higher concentration core extending downward from the upper altitudes at about $22^{\circ}N$. It may be a more intense development at a slightly lower latitude of a similar lobe of fresh debris visible in the August distribution (Fig. 4). Correcting for decay, the highest concentrations in the November gross gamma distributions were greater than those found in August indicating that larger amounts of the Chinese cloud were descending into the Airstream sampling profile.

In Fig. 5 a lobe of the fresh fission products assigned to the 6th Chinese test is depicted to have reached $10^{\circ}S$ latitude at about 17 km. In Figures 4, 6, and 7 representing the August distributions, high values in this region were assigned, without strong foundation, to the debris from the French tests in the Southern Hemisphere in mid 1967. With no other evidence of French debris apparent in the November stratosphere, it seems reasonable to assign the higher gamma concentrations still existing in this region to the Chinese test. One strong reason for this November assignment is that the gross gamma concentrations in this region when corrected for decay back to the August collections are greater than those measured in August. The French clouds situated in the low stratosphere of the Southern Hemisphere cannot reasonably support this region with additional debris especially since these French clouds appear to have disappeared by November. The bulk of the Chinese cloud in the higher stratosphere to the north of this region should be in a better position to supply the additional fresh debris. Further consideration will be given to the possibility of extending even the August distributions of the Chinese debris further south to incorporate this debris of questionable origin at 10^{o}S.

It appears that significant changes in debris concentrations were occurring over a period of a few days during the November mission. For example, sample Nos. 348 and 349 were flown south of Eielson on November 5, 1967 three days after sample Nos. 294 and 295 were collected at identical locations. The concentrations of the later samples were 4 to 7 times higher than the earlier collections. Similar circumstances apply to samples 330 and 308 flown south of Eielson and to samples 279 and 375 collected north of Albrook with even greater differences.

The reproducibility of collection was demonstrated for areas of low total gamma concentrations by flight 298 on November 6, 1967 south of Albrook. Four samples were collected at specific latitude intervals at 15.2 km on the outbound track of the flight, and these exact intervals were resampled at the same altitude on the inbound track. The average percent standard deviation of the four sets of duplicate collections was ±16 percent.

RADON CONCENTRATIONS

The two sets of duplicate radon collections in Table 3 show a standard deviation of ±9 and ±41% [statistical treatment by Volk (7)], similar to earlier measurements (2). While not exactly duplicates, sampler Nos. 13 and 14 were collected only about 4^o apart at the same altitude (18.3 km) and on the same day. Assuming that the radon concentrations would be equivalent in these samples, the standard deviation of the two is a reasonable ±21%. It would be desirable during future missions to obtain duplicate samples with greatly differing volumes. Unfortunately, this is not readily attainable with the P system in the aircraft. Nevertheless, the duplicate collections analyzed during the last two Airstream missions indicate a precision of about ±30%.

The charcoal in sampler #9, one of the two blank samplers, was from the same batch of charcoal used in all the other samples in Table 3. A blank sampler is one in which the device is flown under routine conditions although little or no air is drawn through the sampler. Analyses of blank samplers indicate the level of radon contamination which is injected into the system during routine handling. The charcoal in sampler No. 18 was taken from a new batch which later was shown to be highly contaminated with radium-226. The 17 pCi of Rn-222 reported is the excess over and above this background contamination. No explanation is offered for this high value. However, since the trap is already suspect because of the contaminated charcoal, no further consideration will be given to it until additional blank traps are analyzed. A number of blank samplers will have been assayed before the next mission (February 1968) will begin.

The value of blank sampler No. 9 should represent an upper limit of the contamination level because air was drawn through this sampler for about one minute at 7.6 km where the radon concentration is relatively high. This level is generally less than 35% of the radon content found in the exposed radon samplers. However, it represents more than the total radon found in Sampler No. 7. As more blank data become available, appropriate values will be subtracted from the total content of each sampler. Unless some unforseen and serious problem arises, it is not anticipated that this correction will reduce concentrations by more than about 35%.

The radon concentrations given in Table 3 are lower, sometimes by a factor of 1/10, than the Airstream values reported earlier (2). The radon concentrations during November appear to decrease with increasing altitude as they did in the mid-latitudes in August. Further, the concentrations in the equatorial stratosphere are lower than those in the mid-latitudes at similar altitudes. Additional data and testing should be awaited before discussions of these changes in terms of environmental parameters or sampling artifacts can be fruitful.

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AIRSTREAM FLIGHT TRAJECTORY

Fig. 1

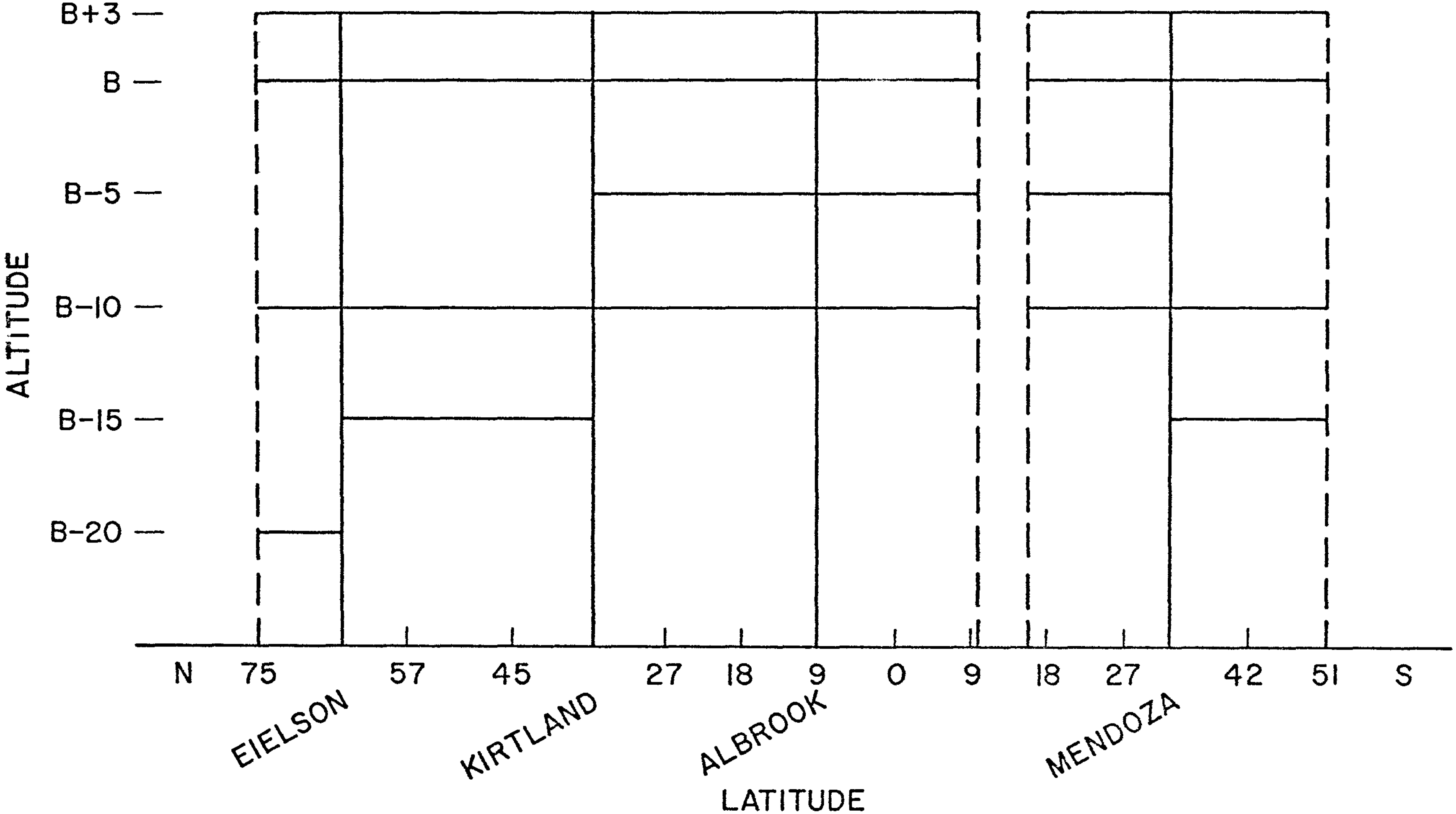


Fig. 2 - Project Airstream Altitude and Latitude Coverage

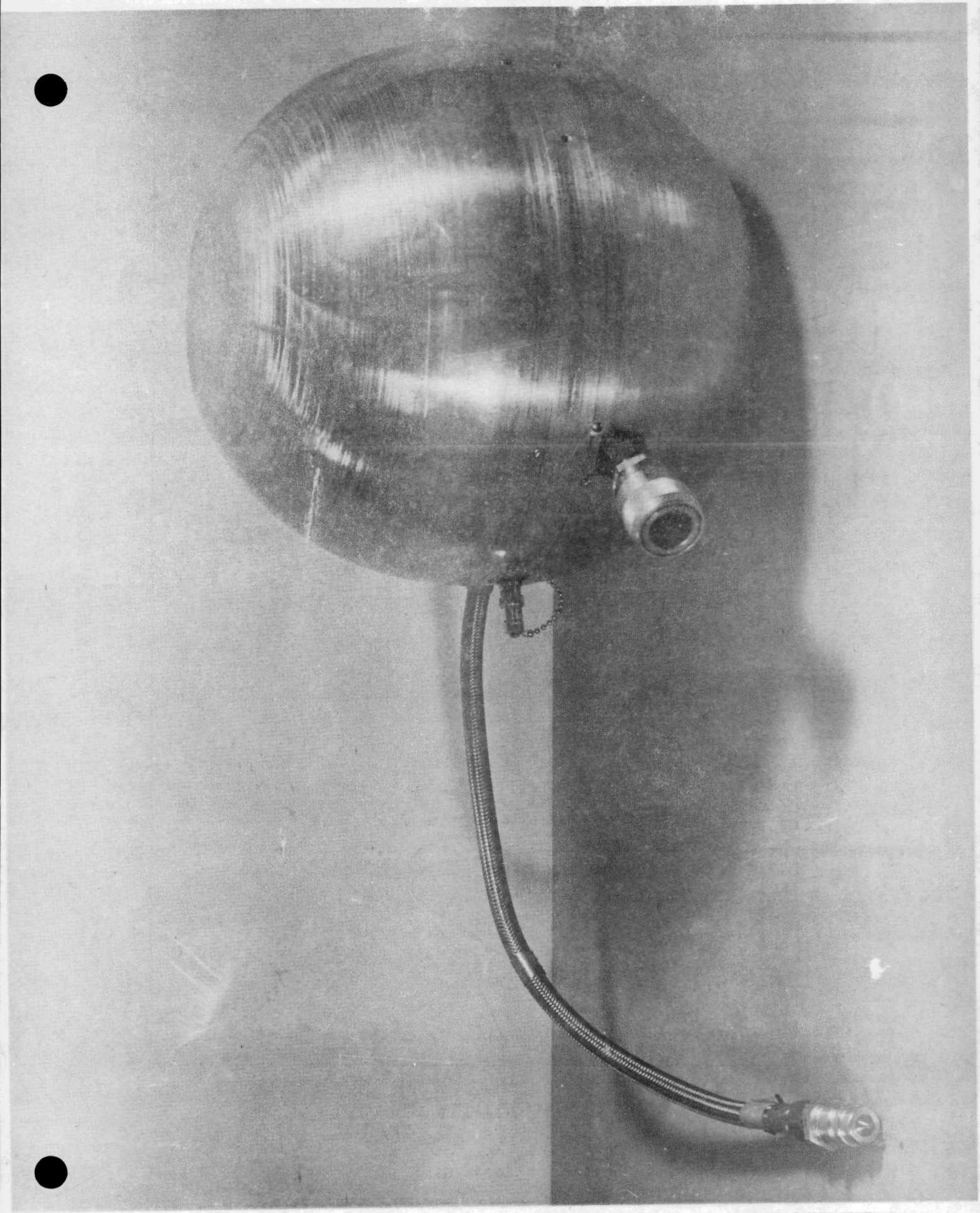


Fig. 3 HASL Radon Sampler

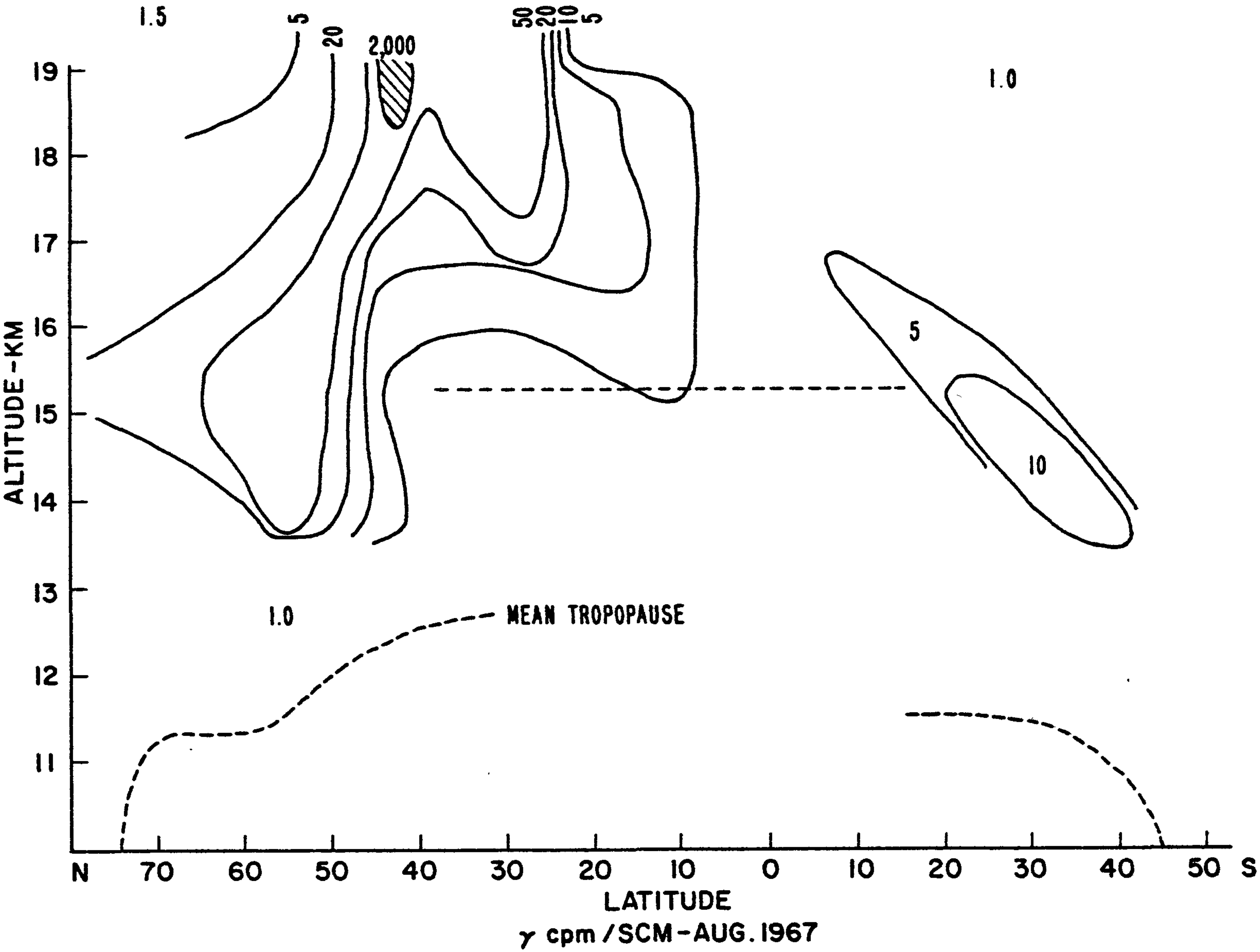


Fig. 4 - Distribution of Gross Gamma Activity - Aug. 1967

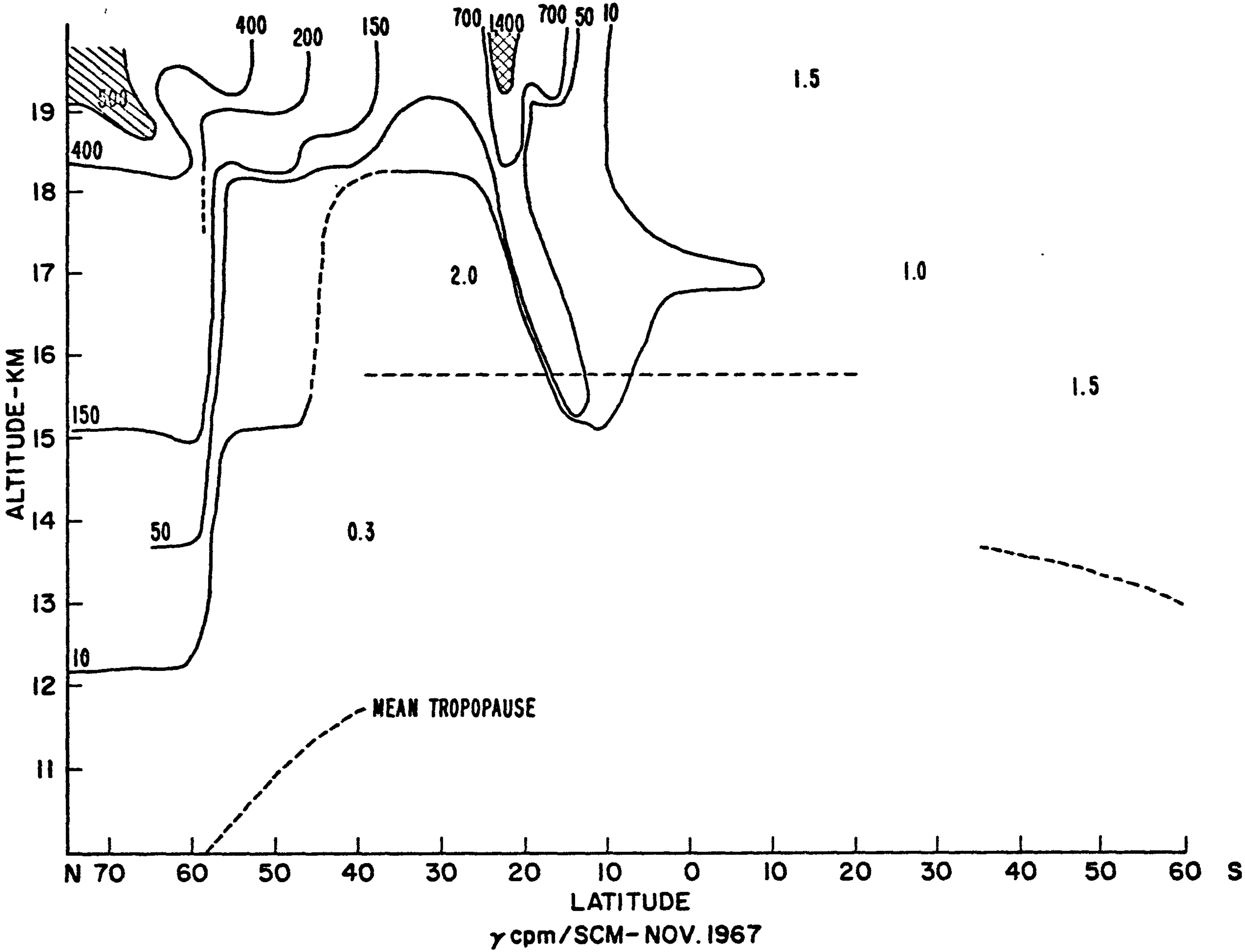


Fig. 5 - Distribution of Gross Gamma Activity - Nov. 1967

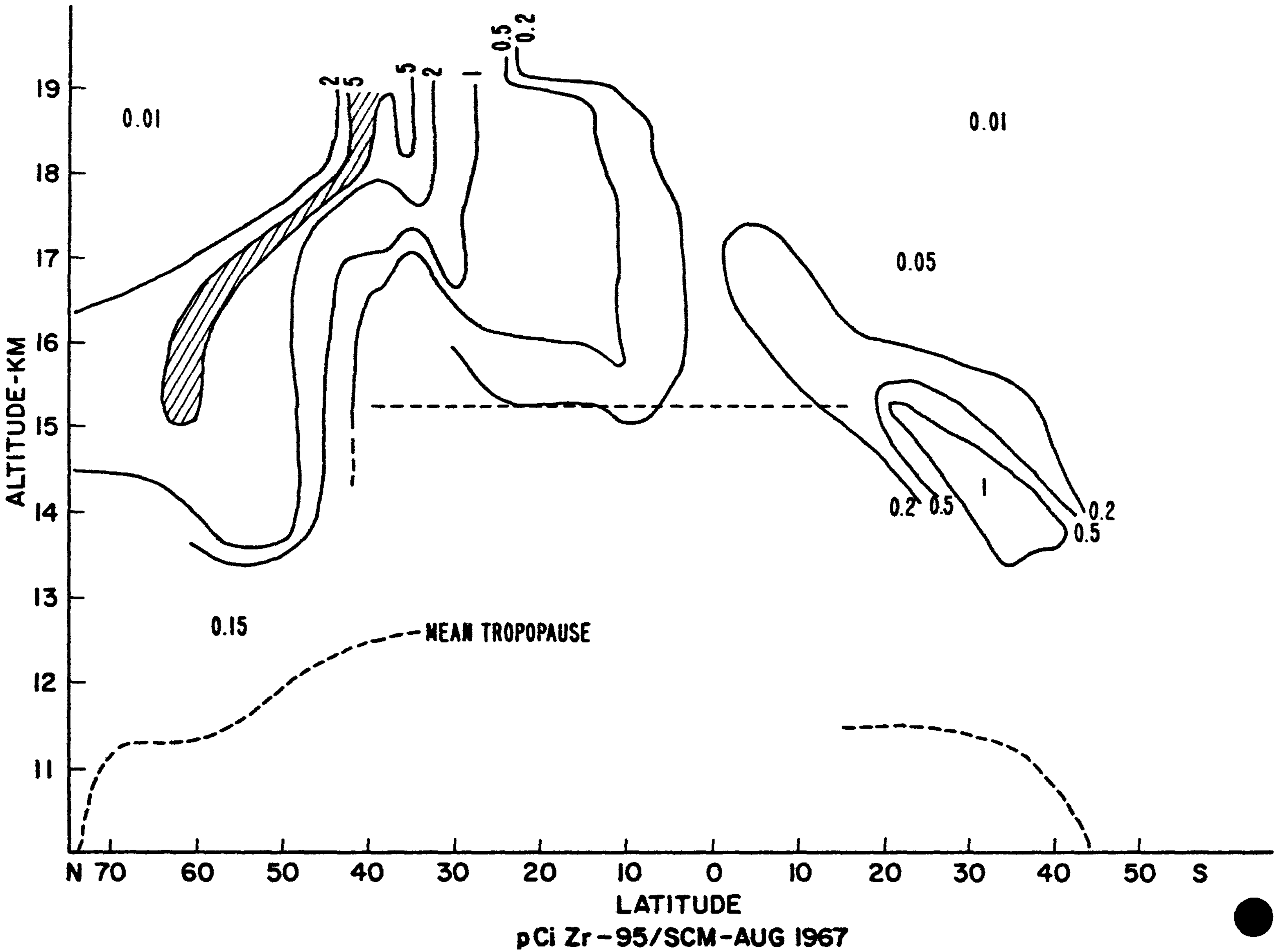
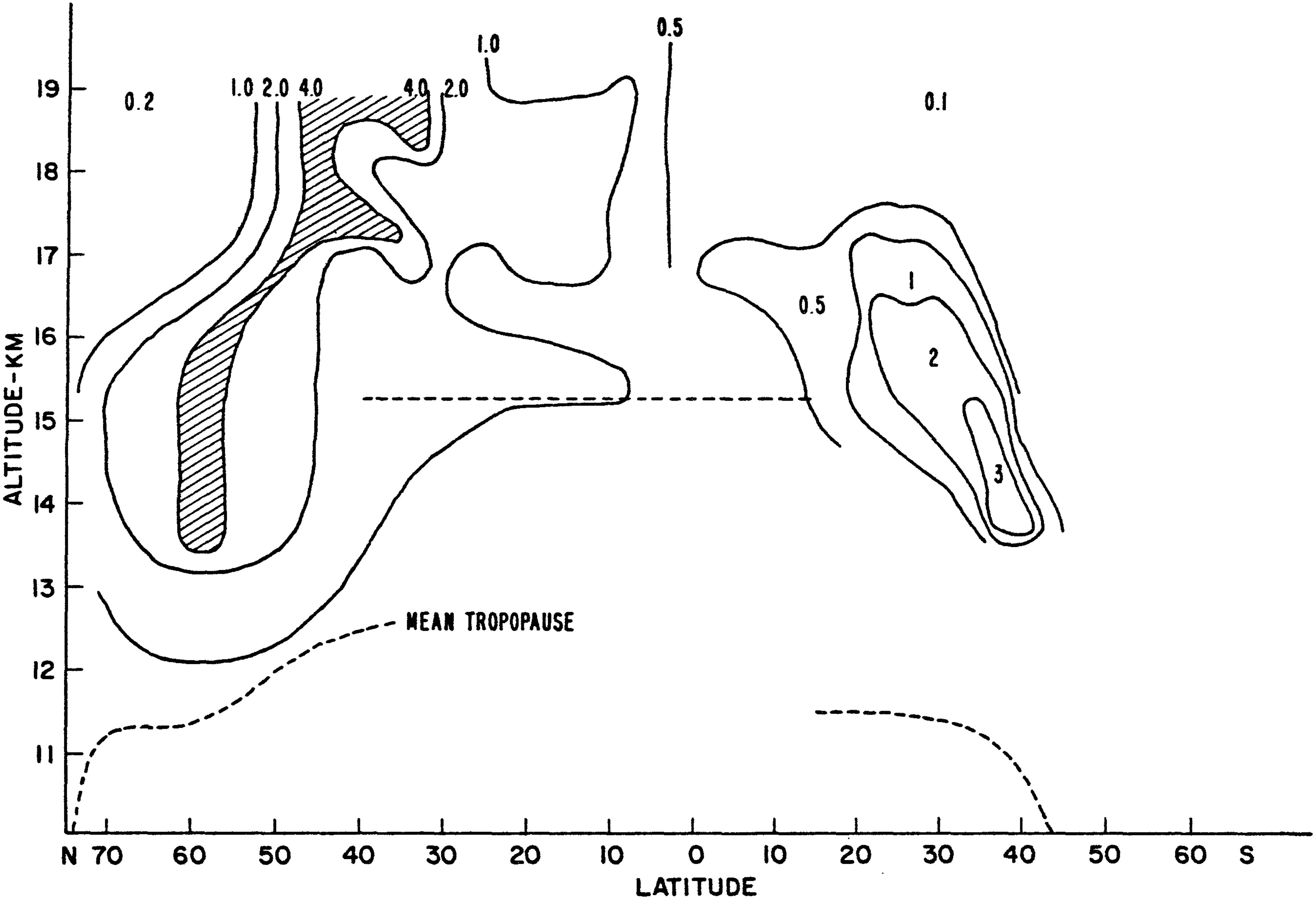


Fig. 6 - Distribution Zr^{95} Activity - Aug. 1967

Fig. 7 - Zr^{95}/Ce^{144} Ratio - Aug. 1967



Zr-95/Ce-144 RATIO-AUG 1967

Table 1

NORTH OF EIELSON
(75N-64N)
ALTITUDE 19.2 KM

SAMPLE #	193	194	195
FLIGHT #	288	288	288
DATE	8/ 3/67	8/ 3/67	8/ 3/67
BEGIN-			
TIME	2100	2124	2200
LAT.	75-00N	72-00N	68-00N
LONG.	143-00W	143-25W	144-30W
END-			
TIME	2124	2200	2230
LAT.	72-00N	68-00N	64-00N
LONG.	143-25W	144-30W	147-00W
VOL. OF AIR (100 CU.M.)	1.91	2.86	2.38
GROSS GAMMA/ M/100 CU.M.	170	160	150

DPM/100 CU.M.

BE-7	46600.	34900.	31300.
MN-54	1070.A	755.A	718.A
ZR-95	*	18.	11.A
RU-103	*	236.A	359.
RU-106	195.A	187.A	212.
SB-125	109.	80.	52.
I-131	*	*	*
CS-137	79.	69.	83.
BA-140	*	*	*
CE-141	*	*	*
CE-144	252.A	227.	46.A

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table I (Cont'd)

NORTH OF EIELSON
(75N-64N)
ALTITUDE 18.3 KM

SAMPLE #	191	190
FLIGHT #	288	288
DATE	8/ 3/67	8/ 3/67
BEGIN-		
TIME	1957	1931
LAT.	68-00N	64-00N
LONG.	144-30W	147-00W
END-		
TIME	2030	1957
LAT.	72-00N	68-00N
LONG.	143-25W	144-30W
VOL. OF AIR (100 CU.M.)	3.15	2.43
GROSS GAMMA/ M/100 CU.M.	190	210

I - 139

DPM/100 CU.M.

BE-7	48300.	28700.
MN-54	975.	2110.
ZR-95	10.A	70.
RU-103	*	477.
RU-106	198.	231.
SB-125	78.	83.
I-131	*	*
CS-137	137.	159.
BA-140	*	*
CE-141	*	43.A
CE-144	65.A	63.A

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

NORTH OF EIELSON
(75N-64N)
ALTITUDE 15.2 KM

SAMPLE #	104	105	106
FLIGHT #	292	292	292
DATE	8/ 3/67	8/ 3/67	8/ 3/67
BEGIN-			
TIME	2342	13	47
LAT.	75-00N	72-00N	68-00N
LONG.	143-00W	143-20W	144-30W
END-			
TIME	13	47	118
LAT.	72-00N	68-00N	64-00N
LONG.	143-20W	144-30W	147-00W
VOL. OF AIR (100 CU.M.)	5.77	6.37	5.77
GROSS GAMMA/ M/100 CU.M.	4100	3100	2700

DPM/100 CU.M.

BE-7	137000.	65800.A	111000.
MN-54	5650.A	13400.A	3920.A
ZR-95	78300.	62200.	54100.
RU-103	4800.	3990.	3080.
RU-106	716.A	1000.A	549.A
SB-125	236.A	228.A	198.A
I-131	537.A	1090.A	432.A
CS-137	130.A	289.	123.
BA-140	3240.	2070.	2240.
CE-141	1650.	1900.	919.
CE-144	6200.	2720.	4990.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

NORTH OF EIELSON
(75N-64N)
ALTITUDE 12.2 KM

SAMPLE #	103	102	101
FLIGHT #	292	292	292
DATE	8/ 3/67	8/ 3/67	8/ 3/67
BEGIN-			
TIME	2312	2227	2140
LAT.	72-00N	68-00N	64-00N
LONG.	143-20W	144-30W	147-00W
END-			
TIME	2342	2312	2227
LAT.	75-00N	72-00N	68-00N
LONG.	143-00W	143-20W	144-30W
VOL. OF AIR (100 CU.M.)	7.92	12.20	13.80
GROSS GAMMA/ M/100 CU.M.	270	130	130

DPM/100 CU.M.

BE-7	22600.	15700.	3140.
MN-54	1030.	689.	420.A
ZR-95	381.	1020.	3360.
RU-103	69.A	*	107.
RU-106	167.	104.	*
SB-125	128.	87.	*
I-131	*	*	*
CS-137	73.	59.	4.A
BA-140	179.	*	*
CE-141	*	15.A	22.
CE-144	538.	159.	210.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd

SOUTH OF EIELSON
(64N-53N)
ALTITUDE 19.2 KM

SAMPLE #	176	175	174
FLIGHT #	288	288	288
DATE	8/ 4/67	8/ 4/67	8/ 4/67
BEGIN-			
TIME	2154	2135	2055
LAT.	62-00N	60-00N	56-51N
LONG.	145-00W	140-30W	135-30W
END-			
TIME	2211	2154	2135
LAT.	64-00N	62-00N	60-00N
LONG.	145-50W	145-00W	140-30W
VOL. OF AIR (100 CU.M.)	1.51	1.68	3.54
GROSS GAMMA/ M/100 CU.M.	130	140	150

DPM/100 CU.M.

BE-7	22800.	22700.	41000.
MN-54	*	*	548.A
ZR-95	13.A	20.	*
RU-103	381.	358.	*
RU-106	*	198.A	173.
SB-125	*	48.	47.
I-131	*	*	*
CS-137	101.	99.	91.
BA-140	*	*	*
CE-141	*	*	*
CE-144	*	59.A	38.A

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

SOUTH OF EIELSON
(64N-53N)
ALTITUDE 18.3 KM

SAMPLE #	99	171	98	172	97	173
FLIGHT #	292	288	292	288	292	288
DATE	7/29/67	8/ 4/67	7/29/67	8/ 4/67	7/29/67	8/ 4/67
BEGIN-						
TIME	2219	1927	2151	1945	2115	2008
LAT.	62-00N	64-00N	60-00N	62-00N	56-51N	60-00N
LONG.	145-00W	145-50W	140-40W	145-00W	135-33W	140-30W
END-						
TIME	2245	1945	2219	2008	2151	2043
LAT.	64-40N	62-00N	62-00N	60-00N	60-00N	56-51N
LONG.	147-06W	145-00W	145-00W	140-30W	140-40W	135-30W
VOL. OF AIR (100 CU.M.)	2.73	1.85	2.94	2.36	3.78	3.44
GROSS GAMMA/ M/100 CU.M.	950	250	170	190	1100	170

DPM/100 CU.M.

BE-7	54200.	31800.	17900.	32100.	51100.	28900.
MN-54	4540.	2830.	1570.	966.A	7750.	1060.A
ZR-95	1640.	182.	55.	8.A	1390.	8.A
RU-103	828.	270.A	388.	274.	1350.	*
RU-106	505.A	172.A	*	103.A	505.A	195.
SB-125	233.	103.	28.A	76.	237.	146.
I-131	451.A	*	134.A	*	7940.	*
CS-137	197.	148.	129.	185.	161.	148.
BA-140	447.	*	*	*	870.	*
CE-141	370.	*	*	*	90.A	*
CE-144	1140.	273.	241.	244.	1670.	190.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table I (Cont'd)

SOUTH OF EIELSON
(64N-53N)
ALTITUDE 15.2 KM

SAMPLE #	183	182	181
FLIGHT #	292	292	292
DATE	8/ 4/67	8/ 4/67	8/ 4/67
BEGIN-			
TIME	2204	2137	2105
LAT.	62-00N	60-00N	56-51N
LONG.	145-00W	140-40W	135-35W
END-			
TIME	2220	2204	2137
LAT.	64-00N	62-00N	60-00N
LONG.	145-45W	145-00W	140-40W
VOL. OF AIR (100 CU.M.)	3.16	5.33	6.44
GROSS GAMMA/ M/100 CU.M.	7500	4500	3700

DPM/100 CU.M.

BE-7	175000.	61700.A	120000.
MN-54	8040.A	23600.A	4770.A
ZR-95	22700.	12700.	10100.
RU-103	5660.	4900.	3180.
RU-106	1060.A	1310.A	644.A
SB-125	342.A	*	214.A
I-131	*	4350.A	*
CS-137	312.A	326.A	194.A
BA-140	4020.	2420.A	1850.
CE-141	3860.	3450.	1880.
CE-144	7090.	2250.A	3630.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

SOUTH OF EIELSON
(64N-53N)
ALTITUDE 13.7 KM

SAMPLE #	117	116	178	115	179	114	180
FLIGHT #	288	288	292	288	292	288	292
DATE	7/29/67	7/29/67	8/ 4/67	7/29/67	8/ 4/67	7/29/67	8/ 4/67
BEGIN-							
TIME	2205	2140	1933	2115	1953	2040	2021
LAT.	64-00N	62-00N	64-00N	60-00N	62-00N	56-45N	60-00N
LONG.	145-30W	141-20W	145-45W	140-00W	145-00W	135-40W	140-40W
END-							
TIME	2217	2205	1953	2140	2021	2115	2100
LAT.	64-40N	64-00N	62-00N	62-00N	60-00N	60-00N	56-51N
LONG.	147-06W	145-30W	145-00W	141-20W	140-40W	140-00W	135-35W
VOL. OF AIR (100 CU.M.)	2.68	5.59	4.56	5.59	6.46	7.82	8.80
GROSS GAMMA/ M/100 CU.M.	700	890	870	370	860	2100	590

DPM/100 CU.M.

BE-7	*	29900.	9540.	*	25500.	59000.A	20900.
MN-54	131000.	5510.	1200.	1010.A	*	9570.A	2260.
ZR-95	293.	1880.	399.	780.	2260.	5650.	1500.
RU-103	1800.	2090.	191.A	2060.	1110.	2470.	741.
RU-106	720.A	*	*	*	*	730.A	133.A
SB-125	232.A	130.	38.	92.	169.	180.A	123.
I-131	*	*	170.A	*	*	2110.A	*
CS-137	*	94.	22.	*	41.A	252.	104.
BA-140	970.A	2420.A	*	415.	452.	1590.A	*
CE-141	743.	673.	119.	243.	678.	1430.	374.
CE-144	*	646.	206.	403.	381.	1820.A	264.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

SOUTH OF EIELSON
(64N-53N)
ALTITUDE 13.7 KM

SAMPLE #	113	112
FLIGHT #	288	288
DATE	7/29/67	7/29/67
BEGIN-		
TIME	2033	1950
LAT.	56-45N	52-00N
LONG.	135-40W	129-30W
END-		
TIME	2040	2033
LAT.	56-45N	56-45N
LONG.	135-40W	135-40W
VOL. OF AIR (100 CU.M.)	1.62	10.80
GROSS GAMMA/ M/100 CU.M.	9800	10000

DPM/100 CU.M.

BE-7	317000.	*
MN-54	16500.A	55100.A
ZR-95	25400.	20600.
RU-103	12000.	26500.
RU-106	2180.A	3360.A
SB-125	*	*
I-131	*	10300.A
CS-137	*	401.A
BA-140	11700.	11200.
CE-141	5650.	11700.
CE-144	11000.	*

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

NORTH OF KIRTLAND
(53N-35N)
ALTITUDE 19.2 KM

SAMPLE #	268	269	270	271	272
FLIGHT #	295	295	295	295	295
DATE	10/ 5/67	10/ 5/67	10/ 5/67	10/ 5/67	10/ 5/67
BEGIN-					
TIME	1936	2008	2042	2112	2145
LAT.	49-16N	47-00N	44-35N	42-04N	39-26N
LONG.	87-20W	91-40W	95-25W	99-00W	102-15W
END-					
TIME	2008	2042	2112	2145	2217
LAT.	42-00N	44-35N	42-04N	39-26N	36-40N
LONG.	91-40W	95-25W	99-00W	102-15W	105-15W
VOL. OF AIR (100 CU.M.)	2.63	2.80	2.58	2.82	2.74
GROSS GAMMA/ M/100 CU.M.	40000	29000	30000	31000	36000

DPM/100 CU.M.

BE-7	*	4430000.	380000.	624000.	*
MN-54	344000.A	364000.A	185000.	*	272000.A
ZR-95	87800.	704000.	74000.	70200.	75900.
RU-103	59300.	203000.	24800.	28100.	52900.
RU-106	19900.A	96400.	11200.	11800.	17200.A
SB-125	*	16900.A	2430.A	1790.A	*
I-131	*	*	*	*	*
CS-137	*	*	2630.	*	2010.A
BA-140	*	12900.A	1600.A	1510.A	*
CE-141	24900.	135000.	12300.	15600.	22000.
CE-144	*	110000.	19500.	12400.	*

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

NORTH OF KIRTLAND
(53N-35N)
ALTITUDE 18.3 KM

SAMPLE #	247	18	248	19	20	249	250
FLIGHT #	295	289	295	289	289	295	295
DATE	10/ 9/67	8/ 5/67	10/ 9/67	8/ 5/67	8/ 5/67	10/ 9/67	10/ 9/67
BEGIN-							
TIME	1847	1941	1915	2029	2121	1948	2019
LAT.	49-20N	47-27N	47-00N	44-00N	40-00N	44-30N	42-00N
LONG.	87-30W	122-15W	91-30W	115-53W	110-00W	95-25W	99-00W
END-							
TIME	1915	2029	1948	2121	2156	2019	2050
LAT.	47-00N	44-00N	44-30N	40-00N	36-30N	42-00N	39-25N
LONG.	91-30W	115-53W	95-25W	110-00W	107-50W	99-00W	102-15W
VOL. OF AIR (100 CU.M.)	2.93	1.32	3.53	0.16	3.89	3.31	3.31
GROSS GAMMA/ M/100 CU.M.	53000	22000	41000	28200000	2800	27000	24000

DPM/100 CU.M.

BE-7	785000.	91800.	*	7240000.	49600.	381000.A	332000.
MN-54	*	16700.	314000.A	*	14600.A	*	141000.
ZR-95	110000.	10500.	81600.	394000.	51900.	58300.	53500.
RU-103	56700.	6680.	61500.	231000.	1140.A	27300.	20600.
RU-106	23300.	1020.A	19900.A	48700.	*	5290.A	9370.
SB-125	4610.A	291.A	4820.A	*	241.A	3870.	2110.A
I-131	*	*	*	*	388.A	*	*
CS-137	*	401.	*	*	344.	*	2260.
BA-140	2440.A	3160.	*	190000.	751.	915.A	1150.A
CE-141	30000.	3010.	24300.	82100.	1160.	11900.	9850.
CE-144	*	2650.	*	240000.	2130.	17300.	16100.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

NORTH OF KIRTLAND
(53N-35N)
ALTITUDE 18.3 KM

SAMPLE #	251	21
FLIGHT #	295	289
DATE	10/ 9/67	8/ 5/67
BEGIN-		
TIME	2050	2156
LAT.	39-25N	36-30N
LONG.	102-15W	107-50W
END-		
TIME	2122	2210
LAT.	36-40N	35-00N
LONG.	105-15W	106-47W
VOL. OF AIR (100 CU.M.)	3.44	0.38
GROSS GAMMA/ M/100 CU.M.	26000	130000

DPM/100 CU.M.

BE-7	314000.A	538000.
MN-54	*	84200.A
ZR-95	58100.	54300.
RU-103	26300.	45200.
RU-106	5350.	8290.A
SB-125	3690.	*
I-131	*	*
CS-137	*	1390.A
BA-140	936.A	22300.
CE-141	9740.	18800.
CE-144	19700.	17800.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

NORTH OF KIRTLAND
(53N-35N)
ALTITUDE 16.8 KM

SAMPLE #	267	17	266	265	16	264	15
FLIGHT #	295	289	295	295	289	295	289
DATE	10/ 5/67	8/ 5/67	10/ 5/67	10/ 5/67	8/ 5/67	10/ 5/67	8/ 5/67
BEGIN-							
TIME	1845	1819	1815	1744	1727	1715	1652
LAT.	47-00N	44-00N	44-35N	42-04N	40-00N	39-26N	36-30N
LONG.	91-40W	115-53W	95-25W	99-00W	110-00W	102-15W	107-50W
END-							
TIME	1915	1909	1845	1815	1819	1744	1727
LAT.	49-16N	47-27N	47-00N	44-35N	44-00N	42-04N	40-00N
LONG.	87-20W	122-15W	91-40W	95-25W	115-53W	99-00W	110-00W
VOL. OF AIR (100 CU.M.)	4.11	7.15	4.03	4.48	7.82	4.18	5.35
GROSS GAMMA/ M/100 CU.M.	5900	1900	5300	2000	1400	1600	1300

DPM/100 CU.M.

BE-7	127000.A	20700.A	76700.	31500.	35400.	34400.	41900.
MN-54	*	*	30300.	10300.	6020.A	9520.	1930.A
ZR-95	28200.	35700.	12300.	5110.	19300.	4380.	19300.
RU-103	12500.	1660.	3970.	1210.	1140.	888.A	763.
RU-106	2000.A	*	1740.	618.	390.A	560.A	153.A
SB-125	1850.	245.	484.A	228.	121.A	114.A	116.
I-131	*	114.A	*	*	206.A	522.A	104.
CS-137	*	66.A	529.	254.	141.	186.	92.
BA-140	377.A	755.	199.A	*	666.	*	600.
CE-141	4620.	860.	1760.	563.	481.	450.	241.
CE-144	8810.	1450.	3900.	1650.	1730.	1690.	2410.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd

NORTH OF KIRTLAND
(53N-35N)
ALTITUDE 16.8 KM

SAMPLE #	263	14
FLIGHT #	295	289
DATE	10/ 5/67	8/ 5/67
BEGIN-		
TIME	1643	1637
LAT.	36-40N	35-00N
LONG.	105-15W	106-47W
END-		
TIME	1715	1652
LAT.	39-26N	36-30N
LONG.	102-15W	107-50W
VOL. OF AIR (100 CU.M.)	4.99	2.40
GROSS GAMMA/ M/100 CU.M.	1300	2900

DPM/100 CU.M.

BE-7	29100.	14500.
MN-54	*	1190.A
ZR-95	3990.	671.
RU-103	275.A	663.
RU-106	289.A	*
SB-125	116.A	98.
I-131	*	*
CS-137	28.A	36.
BA-140	*	*
CE-141	265.	258.
CE-144	1200.	244.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

NORTH OF KIRTLAND
(53N-35N)
ALTITUDE 15.2 KM

SAMPLE #	246	245	185	244	186	243	187
FLIGHT #	295	295	288	295	288	295	288
DATE	10/ 9/67	10/ 9/67	8/ 5/67	10/ 9/67	8/ 5/67	10/ 9/67	8/ 5/67
BEGIN-							
TIME	1805	1735	2126	1703	2210	1631	2305
LAT.	47-00N	44-30N	47-24N	42-00N	44-00N	39-25N	40-00N
LONG.	91-30W	95-25W	122-19W	99-00W	116-45W	102-15W	110-30W
END-							
TIME	1834	1805	2210	1735	2305	1703	2344
LAT.	49-20N	47-00N	44-00N	44-30N	40-00N	42-00N	36-30N
LONG.	87-30W	91-30W	116-40W	95-25W	110-30W	99-00W	107-50W
VOL. OF AIR (100 CU.M.)	5.51	5.77	8.63	6.37	11.10	6.30	8.15
GROSS GAMMA/ M/100 CU.M.	6200	2900	760	1000	450	1100	99

DPM/100 CU.M.

BE-7	57200.A	58900.	20600.	16000.	26100.	22500.	5470.
MN-54	42800.A	*	2210.A	5370.	844.A	*	659.A
ZR-95	13200.	6550.	1820.	2170.	1000.	2560.	221.
RU-103	4280.A	1080.	1890.	251.A	468.	171.A	97.A
RU-106	2720.A	958.	242.A	264.A	102.A	251.A	*
SB-125	*	166.A	119.	72.A	47.A	90.A	19.A
I-131	797.A	*	*	87.A	*	*	255.
CS-137	475.A	*	82.	110.	34.	*	12.
BA-140	*	*	815.	*	393.	*	*
CE-141	1940.	692.	747.	143.A	197.	157.	65.
CE-144	4100.A	2250.	394.	904.	694.	857.	115.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

NORTH OF KIRTLAND
(53N-35N)
ALTITUDE 15.2 KM

SAMPLE #	242	188
FLIGHT #	295	288
DATE	10/ 9/67	8/ 5/67
BEGIN-		
TIME	1556	2344
LAT.	36-40N	36-30N
LONG.	105-15W	107-50W
END-		
TIME	1631	2358
LAT.	39-25N	35-03N
LONG.	102-15W	106-36W
VOL. OF AIR (100 CU.M.)	7.11	2.85
GROSS GAMMA/ M/100 CU.M.	360	63

DPM/100 CU.M.

BE-7	7510.	4210.A
MN-54	1600.	*
ZR-95	865.	123.
RU-103	111.A	*
RU-106	64.A	*
SB-125	44.	35.A
I-131	*	*
CS-137	43.	*
BA-140	*	*
CE-141	59.	22.A
CE-144	288.	*

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

NORTH OF KIRTLAND
(53N-35N)
ALTITUDE 13.7 KM

SAMPLE #	111	110	109	108
FLIGHT #	288	288	288	288
DATE	7/29/67	7/29/67	7/29/67	7/29/67
BEGIN-				
TIME	1900	1810	1710	1635
LAT.	48-00N	44-00N	40-00N	36-50N
LONG.	122-50W	116-30W	110-20W	108-10W
END-				
TIME	1950	1900	1810	1710
LAT.	52-00N	48-00N	44-00N	40-00N
LONG.	129-30W	122-50W	116-30W	110-20W
VOL. OF AIR (100 CU.M.)	13.10	13.70	15.90	9.70
GROSS GAMMA/ M/100 CU.M.	2200	1200	3500	230

DPM/100 CU.M.

BE-7	76300.	63800.	17500.	*
MN-54	2630.A	5790.	*	950.A
ZR-95	47400.	2470.	589.	3490.
RU-103	4290.	2040.	596.	408.
RU-106	*	555.	37.A	*
SB-125	235.	209.	94.	46.
I-131	*	*	*	94.A
CS-137	80.A	110.	31.	36.
BA-140	2440.	2040.	433.	202.
CE-141	1730.	193.A	221.	131.
CE-144	1810.	2990.	387.	279.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

SOUTH OF KIRTLAND
(35N-24N)
ALTITUDE 18.3 KM

SAMPLE #	10	9	8	7
FLIGHT #	289	289	289	289
DATE	8/ 4/67	8/ 4/67	8/ 4/67	8/ 4/67
BEGIN-				
TIME	2128	2047	2014	1949
LAT.	32-00N	29-00N	26-00N	24-00N
LONG.	099-00W	094-40W	091-15W	089-00W
END-				
TIME	2230	2128	2047	2014
LAT.	35-00N	32-00N	29-00N	26-00N
LONG.	106-50W	099-00W	094-40W	091-15W
VOL. OF AIR (100 CU.M.)	1.70	4.50	3.61	2.78
GROSS GAMMA/ M/100 CU.M.	44000	3700	6000	5000

DPM/100 CU.M.

BE-7	172000.	27800.	65400.	21900.A
MN-54	23500.	3960.A	2590.A	*
ZR-95	19100.	2120.	2040.	14200.
RU-103	16100.	804.A	1450.	2560.
RU-106	1910.A	307.A	332.A	*
SB-125	463.A	128.	188.	247.
I-131	*	1220.A	*	249.
CS-137	531.	169.	135.	103.A
BA-140	8180.	440.A	839.	982.
CE-141	6350.	444.	427.	727.
CE-144	4650.	1120.	2070.	1280.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

SOUTH OF KIRTLAND
(35N-24N)
ALTITUDE 17.7 KM

SAMPLE #	259
FLIGHT #	295
DATE	10/ 7/67
BEGIN-	
TIME	1854
LAT.	31-15N
LONG.	100-10W
END-	
TIME	1928
LAT.	31-00N
LONG.	100-00W
VOL. OF AIR (100 CU.M.)	3.83
GROSS GAMMA/ M/100 CU.M.	8500

DPM/100 CU.M.

BE-7	156000.
MN-54	11900.A
ZR-95	19500.
RU-103	5510.
RU-106	2160.A
SB-125	687.A
I-131	*
CS-137	*
BA-140	*
CE-141	2850.
CE-144	5720.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

SOUTH OF KIRTLAND
(35N-24N)
ALTITUDE 16.8 KM

SAMPLE #	3	4	258	5	6
FLIGHT #	289	289	295	289	289
DATE	8/ 4/67	8/ 4/67	10/ 7/67	8/ 4/67	8/ 4/67
BEGIN-					
TIME	1651	1759	1830	1842	1920
LAT.	35-00N	32-00N	31-20N	29-00N	26-00N
LONG.	106-50W	099-00W	100-05W	094-40W	091-15W
END-					
TIME	1759	1842	1851	1920	1945
LAT.	32-00N	29-00N	31-50N	26-00N	24-00N
LONG.	099-00W	94-40W	100-35W	091-15W	089-00W
VOL. OF AIR (100 CU.M.)	2.58	6.57	3.32	5.81	3.82
GROSS GAMMA/ M/100 CU.M.	4200	2800	1600	3000	3900
	DPM/100 CU.M.				
BE-7	156000.	37100.A	16500.A	43000.	30100.
MN-54	11900.A	*	*	2070.A	3040.A
ZR-95	1740.	32000.	3520.	16000.	14400.
RU-103	1370.	4230.	898.	1340.	1760.
RU-106	111.A	*	*	*	*
SB-125	121.	394.	238.	107.A	120.A
I-131	*	192.A	*	269.	317.
CS-137	88.	78.A	50.A	67.	106.
BA-140	585.	1550.	*	821.	856.
CE-141	601.	1260.	304.	322.	510.
CE-144	488.	2220.	1150.	2410.	1700.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table I (Cont'd)
SOUTH OF KIRTLAND
(35N-24N)
ALTITUDE 15.9 KM

SAMPLE #	257
FLIGHT #	295
DATE	10/ 7/67
BEGIN-	
TIME	1808
LAT.	31-25N
LONG.	99-55W
END-	
TIME	1828
LAT.	31-35N
LONG.	100-00W
VOL. OF AIR (100 CU.M.)	3.70
GROSS GAMMA/ M/100 CU.M.	880

DPM/100 CU.M.

BE-7	21300.
MN-54	5220.
ZR-95	2050.
RU-103	234.A
RU-106	335.A
SB-125	66.A
I-131	117.A
CS-137	107.
BA-140	*
CE-141	149.
CE-144	932.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

SOUTH OF KIRTLAND
(35N-24N)
ALTITUDE 14.9 KM

SAMPLE #	256
FLIGHT #	295
DATE	10/ 7/67
BEGIN-	
TIME	1745
LAT.	21-15N
LONG.	100-10W
END-	
TIME	1805
LAT.	31-45N
LONG.	100-05W
VOL. OF AIR (100 CU.M.)	4.55
GROSS GAMMA/ M/100 CU.M.	320

DPM/100 CU.M.

BE-7	5780.
MN-54	3230.
ZR-95	831.
RU-103	111.A
RU-106	*
SB-125	43.A
I-131	*
CS-137	*
BA-140	*
CE-141	43.A
CE-144	288.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)
SOUTH OF KIRTLAND
(35N-24N)
ALTITUDE 14.0 KM

SAMPLE #	255
FLIGHT #	295
DATE	10/ 7/67
BEGIN-	
TIME	1723
LAT.	31-30N
LONG.	100-10W
END-	
TIME	1743
LAT.	31-20N
LONG.	100-00W
VOL. OF AIR (100 CU.M.)	4.93
GROSS GAMMA/ M/100 CU.M.	1000

DPM/100 CU.M.

BE-7	3550.A
MN-54	454.A
ZR-95	241.
RU-103	55.A
RU-106	*
SB-125	39.
I-131	*
CS-137	*
BA-140	*
CE-141	22.
CE-144	65.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

SOUTH OF KIRTLAND
(35N-24N)
ALTITUDE 13.7 KM

SAMPLE #	254
FLIGHT #	295
DATE	10/ 7/67
BEGIN-	
TIME	1700
LAT.	31-35N
LONG.	100-45W
END-	
TIME	1720
LAT.	31-40N
LONG.	100-10W
VOL. OF AIR (100 CU.M.)	5.15
GROSS GAMMA/ M/100 CU.M.	370

DPM/100 CU.M.

BE-7	1830.
MN-54	307.A
ZR-95	81.
RU-103	*
RU-106	*
SB-125	8.A
I-131	*
CS-137	*
BA-140	*
CE-141	8.A
CE-144	26.A

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

SOUTH OF KIRTLAND
(35N-24N)
ALTITUDE 12.2 KM

SAMPLE #	253
FLIGHT #	295
DATE	10/ 7/67
BEGIN-	
TIME	1638
LAT.	31-45N
LONG.	101-03W
END-	
TIME	1658
LAT.	31-30N
LONG.	100-50W
VOL. OF AIR (100 CU.M.)	5.69
GROSS GAMMA/ M/100 CU.M.	1000

DPM/100 CU.M.

BE-7	2710.
MN-54	1060.
ZR-95	236.
RU-103	*
RU-106	38.A
SB-125	11.A
I-131	*
CS-137	6.A
BA-140	*
CE-141	20.A
CE-144	115.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

NORTH OF ALBROOK
(24N-09N)
ALTITUDE 19.2 KM

SAMPLE #	82	83	84	85	86
FLIGHT #	298	298	298	298	298
DATE	8/ 2/67	8/ 2/67	8/ 2/67	8/ 2/67	8/ 2/67
BEGIN-					
TIME	1605	1647	1729	1800	1829
LAT.	24-00N	20-00N	16-00N	16-00N	10-00N
LONG.	89-00W	86-00W	83-15W	81-50W	80-15W
END-					
TIME	1647	1729	1800	1829	1843
LAT.	20-00N	16-00N	13-00N	10-00N	08-50N
LONG.	86-00W	85-15W	81-50W	80-15W	79-30W
VOL. OF AIR (100 CU.M.)	3.83	3.93	2.91	2.73	1.34
GROSS GAMMA/ M/100 CU.M.	360	150	100	87	210

DPM/100 CU.M.

BE-7	26100.	10600.	7320.A	2700.A	7610.
MN-54	2310.	1410.	1170.	1290.	4150.
ZR-95	4200.	868.	550.	527.	188.
RU-103	355.	104.A	*	211.	523.
RU-106	242.A	136.	70.A	*	*
SB-125	182.	124.	78.	56.	81.
I-131	*	80.A	*	*	*
CS-137	140.	131.	99.	87.	160.
BA-140	142.A	*	*	*	*
CE-141	76.A	22.A	34.A	43.	81.A
CE-144	726.	234.	90.A	66.A	199.A

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

NORTH OF ALBROOK
(24N-09N)
ALTITUDE 18.3 KM

SAMPLE #	32	33	34	35	36
FLIGHT #	298	298	298	298	298
DATE	8/ 8/67	8/ 8/67	8/ 8/67	8/ 8/67	8/ 8/67
BEGIN-					
TIME	1626	1716	1758	1828	1858
LAT.	24-00N	20-00N	16-00N	13-00N	10-00N
LONG.	89-00W	86-00W	83-15W	81-50W	80-10W
END-					
TIME	1716	1758	1828	1858	1910
LAT.	20-00N	16-00N	13-00N	10-00N	8-57N
LONG.	86-00W	83-15W	81-50W	80-10W	79-35W
VOL. OF AIR (100 CU.M.)	5.10	4.36	3.17	3.13	1.25
GROSS GAMMA/ M/100 CU.M.	820	1600	850	1200	640

DPM/100 CU.M.

BE-7	40200.	30700.A	23800.	49200.	*
MN-54	*	*	2540.A	2170.A	*
ZR-95	4730.	21900.	1090.	14300.	7010.
RU-103	2240.	3280.	1310.	1260.	1380.
RU-106	157.A	*	192.A	249.A	*
SB-125	296.	319.	154.	160.	225.
I-131	*	77.A	79.A	100.A	*
CS-137	133.	93.A	121.	128.	106.
BA-140	*	1180.	571.	764.	308.
CE-141	941.	860.	360.	269.	330.
CE-144	1430.	1950.	1070.	2410.	630.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

NORTH OF ALBROOK
(24N-09N)
ALTITUDE 16.8 KM

SAMPLE #	31	30	29	28
FLIGHT #	298	298	298	298
DATE	8/ 8/67	8/ 8/67	8/ 8/67	8/ 8/67
BEGIN-				
TIME	1533	1452	1424	1353
LAT.	20-00N	16-00N	13-00N	10-00N
LONG.	86-00W	83-15W	81-50W	80-10W
END-				
TIME	1614	1535	1452	1424
LAT.	24-00N	20 00N	16-00N	13-00N
LONG.	89-90W	86-00W	83-15W	81-50W
VOL. OF AIR (100 CU.M.)	6.06	6.10	4.14	4.53
GROSS GAMMA/ M/100 CU.M.	1400	1100	1400	830
			DPM/100 CU.M.	
BE-7	36500.	47700.	29200.	18700.
MN-54	*	2280.A	3840.	*
ZR-95	17500.	14900.	2270.	11300.
RU-103	2010.	1340.	2210.	1650.
RU-106	*	161.A	241.A	*
SB-125	248.	115.	122.	172.
I-131	78.A	100.A	*	46.A
CS-137	55.A	58.	122.	34.A
BA-140	807.	707.	713.	554.
CE-141	617.	270.	778.	424.
CE-144	1390.	2260.	647.	940.

A:COUNTING ERROR IS 20 50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

NORTH OF ALBROOK
(24N-09N)
ALTITUDE 15.2 KM

SAMPLE #	81	80	79	78	77
FLIGHT #	298	298	298	298	298
DATE	8/ 2/67	8/ 2/67	8/ 2/67	8/ 2/67	8/ 2/67
BEGIN-					
TIME	1504	1420	1350	1317	1305
LAT.	40-00N	16-00N	13-00N	10-00N	08-50N
LONG.	86-00W	83-15W	81-50W	80-15W	79-30W
END-					
TIME	1545	1504	1420	1350	1317
LAT.	24-00N	20-00N	16-00N	13-00N	10-00N
LONG.	89-00W	86-00W	83-15W	81-50W	80-15W
VOL. OF AIR (100 CU.M.)	8.20	9.16	6.44	7.11	2.67
GROSS GAMMA/ M/100 CU.M.	360	330	590	370	590

DPM/100 CU.M.

BE-7	7890.A	10700.	19300.	22400.	10600.A
MN-54	*	533.A	2140.A	941.A	*
ZR-95	6570.	5320.	8660.	5920.	9550.
RU-103	1140.	965.	1430.	648.	2370.
RU-106	*	*	188.A	65.A	*
SB-125	134.	51.	43.A	25.A	187.
I-131	344.A	57.A	370.A	100.A	*
CS-137	49.A	*	28.A	7.A	63.A
BA-140	*	639.	913.	567.	*
CE-141	277.	282.	415.	153.	509.
CE-144	506.	395.	797.	823.	933.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

SOUTH OF ALBROOK
(09N-09S)
ALTITUDE 19.2 KM

SAMPLE #	62	61	60	59	58
FLIGHT #	293	293	293	293	293
DATE	8/ 3/67	8/ 3/67	8/ 3/67	8/ 3/67	8/ 3/67
BEGIN-					
TIME	1812	1739	1703	1623	1544
LAT.	07-00N	3-00N	01-00S	05-00S	09-00S
LONG.	79-35W	79-40W	79-25W	79-04W	78-31W
END-					
TIME	1826	1812	1739	1703	1623
LAT.	08-47N	07-00N	03-00N	01-00S	05-00S
LONG.	79-35W	79-35W	79-40W	79-25W	79-04W
VOL. OF AIR (100 CU.M.)	1.29	2.98	3.26	3.50	3.43
GROSS GAMMA/ M/100 CU.M.	170	160	420	100	180
	DPM/100 CU.M.				
BE-7	*	6340.	275000.	3570.	9560.
MN-54	2200.	1950.	*	1300.	1990.
ZR-95	1260.	49.	18300.	28.	46.
RU-103	343.A	124.A	15500.	45.A	*
RU-106	149.A	122.A	1910.A	92.A	109.A
SB-125	57.A	141.	798.	71.	125.
I-131	*	*	2580.A	*	69.A
CS-137	122.	220.	162.A	141.	235.
BA-140	*	*	9200.	32.A	62.A
CE-141	82.	*	7360.	*	*
CE-144	111.A	219.	5370.	131.	190.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table I (Cont'd)

SOUTH OF ALBROOK
(09N-09S)
ALTITUDE 18.3 KM

SAMPLE #	73	72	71	70
FLIGHT #	294	294	294	294
DATE	8/ 6/67	8/ 6/67	8/ 6/67	8/ 6/67
BEGIN-				
TIME	1942	1908	1831	1753
LAT.	03-00N	01-00S	05-00S	09-09S
LONG.	79-40W	79-10W	78-05W	76-55W
END-				
TIME	2017	1942	1908	1831
LAT.	07-00N	03-00N	01-00S	05-00S
LONG.	79-35W	79-40W	79-10W	78-05W
VOL. OF AIR (100 CU.M.)	3.96	3.97	4.35	4.34
GROSS GAMMA/ M/100 CU.M.	95	100	87	110

DPM/100 CU.M.

BE-7	2830.A	9870.	6230.	5740.
MN-54	1180.	1010.	975.	1710.
ZR-95	417.	208.	163.	276.
RU-103	209.	*	*	128.
RU-106	*	71.A	93.A	*
SB-125	95.	70.	78.	69.
I-131	*	39.A	*	*
CS-137	116.	140.	123.	150.
BA-140	*	*	*	*
CE-141	22.A	*	*	*
CE-144	72.A	78.	134.	106.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

SOUTH OF ALBROOK
(09N-09S)
ALTITUDE 16.8 KM

SAMPLE #	49	53	48	54	47	55	46
FLIGHT #	298	293	298	293	298	293	298
DATE	7/31/67	8/ 3/67	7/31/67	8/ 3/67	7/31/67	8/ 3/67	7/31/67
BEGIN-							
TIME	2027	1247	1947	1303	1909	1337	1831
LAT.	07-00N	08-47N	03-00N	07-00N	01-00S	03-00N	05-00S
LONG.	079-35W	79-35W	79-40W	79-35W	79-10W	79-40W	78-05W
END-							
TIME	2042	1303	2027	1337	1947	1411	1909
LAT.	08-50N	07-00N	07-00N	03-00N	03-00N	01-00S	01-00S
LONG.	79-30W	79-35W	79-30W	79-40W	79-40W	79-25W	79-10W
VOL. OF AIR (100 CU.M.)	2.42	2.54	6.51	5.34	6.25	5.31	6.14
GROSS GAMMA/ M/100 CU.M.	270	130	440	200	360	130	480

DPM/100 CU.M.

BE-7	6820.A	8350.	23000.	11900.	7460.A	6400.	19700.
MN-54	1630.A	1390.	833.A	468.A	*	706.	736.A
ZR-95	3450.	1720.	6160.	272.	4350.	155.	5680.
RU-103	645.	292.	575.	219.	1090.	203.	922.
RU-106	*	*	90.A	69.A	*	*	79.A
SB-125	55.A	45.	64.	46.	133.	25.	81.
I-131	82.A	47.A	51.A	*	160.A	33.A	133.
CS-137	20.A	8.A	37.	*	54.	11.	24.
BA-140	189.	48.A	413.	305.	152.A	203.	744.
CE-141	124.	85.	123.	37.	230.	19.A	319.
CE-144	698.	275.	900.	455.	518.	305.	546.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

SOUTH OF ALBROOK
(09N-09S)
ALTITUDE 16.8 KM

SAMPLE #	56	45	57	94
FLIGHT #	293	298	293	296
DATE	8/ 3/67	7/31/67	8/ 3/67	8/ 8/67
BEGIN-				
TIME	1141	1755	1443	1913
LAT.	01-00S	09-09S	05-00S	09-09S
LONG.	79-25W	076-55W	79-04W	76-55W
END-				
TIME	1443	1831	1520	1944
LAT.	05-00S	05-00S	09-00S	05-00S
LONG.	79-04W	78-05W	78-31W	78-05W
VOL. OF AIR (100 CU.M.)	5.24	5.62	5.93	4.92
GROSS GAMMA/ M/100 CU.M.	190	580	350	480

DPM/100 CU.M.

BE-7	10900.	16900.	12300.	22000.
MN-54	542.A	2440.A	1610.A	2340.A
ZR-95	248.	6350.	450.	6830.
RU-103	261.	1210.	661.	892.
RU-106	72.A	165.A	121.A	168.A
SB-125	12.A	42.A	24.A	71.A
I-131	70.A	402.	134.A	159.A
CS-137	*	36.	24.	60.
BA-140	250.	922.	482.	502.
CE-141	74.	358.	197.	244.
CE-144	357.	792.	491.	821.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

NORTH OF MENDOZA
(09S 33S)
ALTITUDE 19.2 KM

SAMPLE #	125	126	127	128	129
FLIGHT #	294	294	294	294	294
DATE	8/ 4/67	8/ 4/67	8/ 4/67	8/ 4/67	8/ 4/67
BEGIN-					
TIME	1645	1714	1746	1823	1858
LAT.	15-25S	19-00S	23-00S	27-00S	31-00S
LONG.	75-20W	74-05W	72-30W	70-50W	68-50W
END-					
TIME	1714	1746	1823	1858	1914
LAT.	19-00S	23-00S	27-00S	31-00S	32-50S
LONG.	74-05W	72-30W	70-50W	68-50W	68-47W
VOL. OF AIR (100 CU.M.)	2.64	2.97	3.39	3.09	1.41
GROSS GAMMA/ M/100 CU.M.	110	100	110	110	140

DPM/100 CU.M.

BE-7	9510.	10700.	12900.	13900.	16700.
MN-54	1420.	1300.	773.A	922.	2020.
ZR-95	20.	14.	13.	9.A	16.A
RU-103	*	79.A	*	105.A	196.A
RU-106	138.A	92.A	193.	*	*
SB-125	78.	48.	89.	41.	122.
I-131	*	*	*	*	*
CS-137	148.	141.	123.	124.	140.
BA-140	*	*	*	*	*
CE-141	*	*	*	*	*
CE-144	170.	109.	73.	106.	161.A

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

NORTH OF MENDOZA
(09S 33S)
ALTITUDE 18.3 KM

SAMPLE #	138	139	140	141	142
FLIGHT #	294	294	294	294	294
DATE	8/ 3/67	8/ 3/67	8/ 3/67	8/ 3/67	8/ 3/67
BEGIN-					
TIME	2015	2042	2116	2150	2225
LAT.	15-25S	19-00S	23-00S	27-00S	31-00S
LONG.	75-20W	74-15W	72-30W	70-50W	68-47W
END-					
TIME	2042	2116	2150	2225	2241
LAT.	19-00S	23-00S	27-00S	31-00S	32-50S
LONG.	74-15W	72-30W	70-50W	68-50W	68-47W
VOL. OF AIR (100 CU.M.)	3.04	3.79	3.70	3.82	1.75
GROSS GAMMA/ M/100 CU.M.	92	100	130	120	150

DPM/100 CU.M.

BE-7	6480.	11400.	16200.	15000.	18500.
MN-54	1200.	929.	1110.A	1250.	1560.A
ZR-95	19.	16.	9.A	14.	16.A
RU-103	142.A	115.A	121.A	*	*
RU-106	*	112.A	*	137.A	*
SB-125	97.	64.	81.	118.	105.
I-131	*	*	*	*	*
CS-137	113.	124.	146.	129.	166.
BA-140	*	*	*	*	*
CE-141	*	*	*	*	*
CE-144	113.A	87.	203.	168.	155.A

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)
NORTH OF MENDOZA
(09S 33S)
ALTITUDE 16.8 KM

SAMPLE #	44	43	93	137	42	92	136
FLIGHT #	298	298	296	294	298	296	294
DATE	7/31/67	7/31/67	8/ 8/67	8/ 3/67	7/31/67	8/ 8/67	8/ 3/67
BEGIN-							
TIME	1655	1620	1739	1937	1544	1705	1858
LAT.	15-21S	19-00S	19-00S	19-00S	23-00S	23-00S	23-00S
LONG.	75-10W	73-55W	73-50W	74-15W	072-30W	72-30W	72-30W
END-							
TIME	1755	1655	1817	2010	1620	1739	1937
LAT.	09-09S	15-21S	15-21S	15-25S	19-00S	19-00S	19-00S
LONG.	76-55W	75-10W	75-10W	75-20W	073-55W	73-50W	74-15W
VOL. OF AIR (100 CU.M.)	9.35	5.29	5.92	5.05	5.51	5.30	6.01
GROSS GAMMA/ M/100 CU.M.	370	47	520	110	130	330	93

DPM/100 CU.M.

BE-7	24500.	955.A	30400.	11500.	7950.	22800.	7500.
MN-54	1190.	682.	1650.A	1190.	1050.	1920.	1080.
ZR-95	4020.	325.	7350.	133.	976.	732.	94.
RU-103	483.	160.	813.	140.A	198.	685.	185.
RU-106	128.A	*	130.A	68.A	38.A	186.A	61.A
SB-125	71.	29.	70.	40.	60.	74.	42.
I-131	158.	66.	*	*	77.	*	*
CS-137	52.	24.	42.	38.	63.	51.	45.
BA-140	547.	*	532.	*	92.	574.	*
CE-141	112.	23.	167.	35.A	55.	90.	51.
CE-144	796.	31.A	1110.	190.	114.	745.	52.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

NORTH OF MENDOZA
(09S 33S)
ALTITUDE 16.8 KM

SAMPLE #	91	135
FLIGHT #	296	294
DATE	8/ 8/67	8/ 3/67
BEGIN-		
TIME	1625	1818
LAT.	27-00S	27-00S
LONG.	70-50W	70-50W
END-		
TIME	1705	1858
LAT.	23-00S	23-00S
LONG.	72-30W	72-30W
VOL. OF AIR (100 CU.M.)	6.10	6.18
GROSS GAMMA/ M/100 CU.M.	210	110

DPM/100 CU.M.

BE-7	16300.	15500.
MN-54	1170.	644.
ZR-95	370.	89.
RU-103	349.A	*
RU-106	70.A	81.
SB-125	93.	67.
I-131	*	*
CS-137	41.	64.
BA-140	310.	54.A
CE-141	69.	48.
CE-144	384.	74.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

NORTH OF MENDOZA
(09S 33S)
ALTITUDE 16.2 KM

SAMPLE #	40
FLIGHT #	298
DATE	7/31/67
BEGIN-	
TIME	1421
LAT.	31-00S
LONG.	063-50W
END-	
TIME	1503
LAT.	27-00S
LONG.	070-50W
VOL. OF AIR (100 CU.M.)	6.32
GROSS GAMMA/ M/100 CU.M.	99

DPM/100 CU.M.

BE-7	13000.
MN-54	733.
ZR-95	18.
RU-103	*
RU-106	107.
SB-125	73.
I-131	*
CS-137	94.
BA-140	*
CE-141	*
CE-144	75.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

NORTH OF MENDOZA
(09S 33S)
ALTITUDE 16.8 KM

SAMPLE #	90	134	133
FLIGHT #	296	294	294
DATE	8/ 8/67	8/ 3/67	8/ 3/67
BEGIN-			
TIME	1545	1739	1721
LAT.	31-00S	31-00S	32-50S
LONG.	68-50W	68-50W	68-47W
END-			
TIME	1625	1818	1739
LAT.	27-00S	27-00S	31-00S
LONG.	70-50W	70-50W	68-50W
VOL. OF AIR (100 CU.M.)	5.94	5.97	2.66
GROSS GAMMA/ M/100 CU.M.	200	90	110

DPM/100 CU.M.

BE-7	17300.	4420.	9470.
MN-54	1100.	1680.	812.A
ZR-95	1670.	76.	73.
RU-103	161.A	285.	261.A
RU-106	136.A	*	*
SB-125	102.	32.	60.
I-131	*	*	*
CS-137	77.	49.	82.
BA-140	82.A	*	*
CE-141	66.	48.	35.A
CE-144	313.	48.A	65.A

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

NORTH OF MENDOZA
(09S 33S)
ALTITUDE 15.2 KM

SAMPLE #	69	124	68	123	67	122	66
FLIGHT #	294	294	294	294	294	294	294
DATE	8/ 6/67	8/ 4/67	8/ 6/67	8/ 4/67	8/ 6/67	8/ 4/67	8/ 6/67
BEGIN-							
TIME	1618	1601	1538	1523	1457	1442	1416
LAT.	19-00S	19-00S	23-00S	23-00S	27-00S	27-00S	31-00S
LONG.	74-55W	74-05W	72-30W	72-30W	70-55W	70-50W	68-50W
END-							
TIME	1655	1636	1618	1601	1538	1523	1457
LAT.	15-20S	15-25S	19-00S	19-00S	23-00S	23-00S	27-00S
LONG.	75-10W	75-20W	74-55W	74-05W	72-30W	72-30W	70-55W
VOL. OF AIR (100 CU.M.)	8.04	7.60	8.69	8.25	8.68	8.82	8.50
GROSS GAMMA/ M/100 CU.M.	520	380	1800	300	1200	230	1000
	DPM/100 CU.M.						
BE-7	*	25000.	46700.	13500.	63800.	10500.	20500.A
MN-54	*	720.A	7180.A	691.A	2200.A	*	*
ZR-95	6680.	593.	23900.	465.	15800.	355.	12400.
RU-103	1690.	611.	4290.	702.	1990.	652.	3270.
RU-106	*	87.A	626.A	121.A	315.A	*	*
SB-125	149.	24.A	*	33.	73.A	48.	374.
I-131	249.A	*	727.A	164.A	340.	*	569.A
CS-137	45.A	*	65.A	22.	34.A	10.A	125.A
BA-140	243.A	616.	2620.	475.	1680.	374.	506.A
CE-141	377.	103.	1250.	251.	491.	214.	712.
CE-144	710.	895.	2210.	267.	2320.	181.	1560.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)
NORTH OF MENDOZA
(09S 33S)
ALTITUDE 15.2 KM

SAMPLE #	121	120
FLIGHT #	294	294
DATE	8/ 4/67	8/ 4/67
BEGIN-		
TIME	1401	1345
LAT.	31-00S	32-50S
LONG.	68-50W	68-47W
END-		
TIME	1442	1401
LAT.	27-00S	31-00S
LONG.	70-50W	68-50W
VOL. OF AIR (100 CU.M.)	8.50	3.26
GROSS GAMMA/ M/100 CU.M.	220	550

DPM/100 CU.M.

BE-7	11000.	18500.
MN-54	1210.	*
ZR-95	318.	840.
RU-103	587.	1610.
RU-106	*	87.A
SB-125	35.A	105.
I-131	*	*
CS-137	23.	18.A
BA-140	*	951.
CE-141	184.	537.
CE-144	142.	402.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

SOUTH OF MENDOZA
(33S 50S)
ALTITUDE 19.2 KM

SAMPLE #	168	167	166	165	164
FLIGHT #	296	296	296	296	296
DATE	8/ 2/67	8/ 2/67	8/ 2/67	8/ 2/67	8/ 2/67
BEGIN-					
TIME	1905	1828	1746	1711	1646
LAT.	35-00S	39-00S	43-00S	47-00S	50-00S
LONG.	68-47W	68-13W	68-47W	67-30W	68-35W
END-					
TIME	1922	1905	1828	1746	1711
LAT.	32-50S	35-00S	39-00S	43-00S	47-00S
LONG.	68-47W	68-25W	68-13W	68-47W	67-30W
VOL. OF AIR (100 CU.M.)	1.55	3.38	3.52	3.37	2.27
GROSS GAMMA/ M/100 CU.M.	120	100	140	120	110
			DPM/100 CU.M.		
BE-7	26500.	16000.	22200.	17900.	14800.
MN-54	1320.A	1040.	1060.	875.A	749.A
ZR-95	*	6.A	13.	10.A	9.A
RU-103	*	208.	*	97.A	151.A
RU-106	179.A	57.A	277.	133.A	149.A
SB-125	79.	43.	134.	109.	54.
I-131	*	*	*	*	*
CS-137	119.	136.	155.	112.	109.
BA-140	*	*	*	*	*
CE-141	*	*	*	*	*
CE-144	*	138.	162.	145.	57.A

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

SOUTH OF MENDOZA
(33S 50S)
ALTITUDE 18.3 KM

SAMPLE #	159	160	161	162	163
FLIGHT #	296	296	296	296	296
DATE	8/ 2/67	8/ 2/67	8/ 2/67	8/ 2/67	8/ 2/67
BEGIN-					
TIME	1414	1433	1507	1541	1614
LAT.	32-50S	35-00S	39-00S	43-00S	47-00S
LONG.	68-47W	68-25W	68-13W	67-47W	67-30W
END-					
TIME	1433	1507	1541	1614	1640
LAT.	35-00S	39-00S	43-00S	47-00S	50-00S
LONG.	68-25W	68-13W	67-47W	67-30W	68-35W
VOL. OF AIR (100 CU.M.)	2.12	3.77	3.71	3.41	2.78
GROSS GAMMA/ M/100 CU.M.	110	110	130	150	93
	DPM/100 CU.M.				
BE-7	21800.	12900.	17500.	24500.	33000.
MN-54	1020.A	1080.	1280.	1030.A	899.A
ZR-95	*	14.	7.A	15.	*
RU-103	*	102.A	89.A	109.A	*
RU-106	194.	153.	100.A	163.A	189.
SB-125	108.	73.	73.	138.	90.
I-131	*	*	*	*	*
CS-137	127.	134.	144.	136.	137.
BA-140	*	*	*	*	*
CE-141	*	*	*	*	*
CE-144	109.A	83.	135.	171.	120.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

SOUTH OF MENDOZA
(33S 50S)
ALTITUDE 15.2 KM

SAMPLE #	155	154	153	152	151
FLIGHT #	294	294	294	294	294
DATE	8/ 2/67	8/ 2/67	8/ 2/67	8/ 2/67	8/ 2/67
BEGIN-					
TIME	1917	1851	1816	1740	1714
LAT.	35-00S	39-00S	43-00S	47-00S	50-00S
LONG.	68-25W	68-10W	67-50W	67-50W	68-40W
END-					
TIME	1945	1927	1851	1816	1740
LAT.	32-50S	35-00S	39-00S	43-00S	47-00S
LONG.	68-47W	68-25W	68-10W	67-50W	67-50W
VOL. OF AIR (100 CU.M.)	3.58	7.17	6.81	6.77	4.97
GROSS GAMMA/ M/100 CU.M.	360	430	120	79	150

DPM/100 CU.M.

BE-7	16900.	30800.	13700.	6600.A	24100.
MN-54	1680.A	506.A	683.A	703.A	1210.
ZR-95	578.	621.	19.	31.	15.
RU-103	1080.	930.	*	279.A	113.A
RU-106	*	106.A	292.	122.A	111.A
SB-125	84.	132.	454.	*	94.
I-131	*	*	*	*	*
CS-137	60.	76.	*	76.	157.
BA-140	*	675.	*	*	*
CE-141	360.	424.	*	*	*
CE-144	153.A	250.	253.	*	177.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 1 (Cont'd)

SOUTH OF MENDOZA
(33S 50S)
ALTITUDE 13.7 KM

SAMPLE #	146	147	148	149	150
FLIGHT #	294	294	294	294	294
DATE	8/ 2/67	8/ 2/67	8/ 2/67	8/ 2/67	8/ 2/67
BEGIN-					
TIME	1430	1448	1526	1604	1640
LAT.	32-50S	35-00S	39-00S	43-00S	47-00S
LONG.	68-47W	68-25W	68-10W	67-50W	67-50W
END-					
TIME	1448	1526	1604	1640	1709
LAT.	35-00S	39-00S	43-00S	47-00S	50-00S
LONG.	68-25W	68-10W	67-50W	67-50W	68-40W
VOL. OF AIR (100 CU.M.)	4.42	9.24	8.93	8.50	6.67
GROSS GAMMA/ M/100 CU.M.	2400	1500	1400	340	140

DPM/100 CU.M.

BE-7	147000.	44400.A	48900.	27200.	20700.
MN-54	4000.A	*	3700.A	1350.A	1290.
ZR-95	4300.	2620.	2430.	419.	94.
RU-103	5320.	5510.	4460.	564.	151.A
RU-106	810.A	*	566.A	229.	71.A
SB-125	*	233.	217.	109.	75.
I-131	1130.A	*	1100.A	285.A	*
CS-137	69.A	62.A	130.	92.	91.
BA-140	5410.	3040.	3020.	402.	142.
CE-141	1780.	1790.	1610.	208.	30.
CE-144	3670.	804.	651.	389.	149.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 2

NORTH OF EIELSON
(75N-64N)
ALTITUDE 19.2 KM

SAMPLE #	313	314	315
FLIGHT #	288	288	288
DATE	11/ 6/67	11/ 6/67	11/ 6/67
BEGIN-			
TIME	2208	2248	2308
LAT.	75-00N	71-00N	68-00N
LONG.	143-00W	143-20W	144-30W
END-			
TIME	2245	2308	2338
LAT.	71-00N	68-00N	64-34N
LONG.	143-20W	144-30W	147-48W
VOL. OF AIR (100 CU.M.)	3.16	1.70	2.48
GROSS GAMMA/ M/100 CU.M.	54000	52000	46000

Table 1 (Cont'd)

NORTH OF EIELSON
(75N-64N)
ALTITUDE 18.3 KM

SAMPLE #	312	311	310
FLIGHT #	288	288	288
DATE	11/ 6/67	11/ 6/67	11/ 6/67
BEGIN-			
TIME	2132	2106	2042
LAT.	71-00N	68-00N	65-00N
LONG.	143-20W	144-30W	146-35W
END-			
TIME	2202	2132	2106
LAT.	75-00N	71-00N	68-00N
LONG.	143-00W	143-20W	144-30W
VOL. OF AIR (100 CU.M.)	3.18	2.71	2.43
GROSS GAMMA/ M/100 CU.M.	42000	34000	41000

Table 2 (Cont'd)

NORTH OF EIELSON
(75N-64N)
ALTITUDE 15.2 KM

SAMPLE #	320	321	322
FLIGHT #	293	293	293
DATE	11/ 6/67	11/ 6/67	11/ 6/67
BEGIN-			
TIME	2148	2226	2255
LAT.	75-00N	71-00N	68-00N
LONG.	143-00W	143-00W	144-30W
END-			
TIME	2226	2255	2324
LAT.	71-00N	68-00N	65-00N
LONG.	143-00W	144-30W	146-30W
VOL. OF AIR (100 CU.M.)	6.91	5.19	5.19
GROSS GAMMA/ M/100 CU.M.	16000	17000	6100

Table 2 (Cont'd)

NORTH OF EIELSON
(75N-64N)
ALTITUDE 12.2 KM

SAMPLE #	319	318	317
FLIGHT #	293	293	293
DATE	11/ 6/67	11/ 6/67	11/ 6/67
BEGIN-			
TIME	2056	2023	1950
LAT.	71-00N	68-00N	65-00N
LONG.	143-00W	144-30W	146-30W
END-			
TIME	2139	2056	2023
LAT.	75-00N	71-00N	68-00N
LONG.	143-00W	143-00W	144-30W
VOL. OF AIR (100 CU.M.)	11.80	9.14	9.08
GROSS GAMMA/ M/100 CU.M.	740	1300	1000

DPM/100 CU.M.

BE-7	17500.		20200.
MN-54	*		5110.
ZR-95	1640.		2250.
RU-103	216.		346.
RU-106	112.A		309.
SB-125	114.		134.
I-131	*		*
CS-137	21.A		119.
BA-140	*		*
CE-141	142.		177.
CE-144	359.		735.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 2 (Cont'd)

SOUTH OF EIELSON
(64N-53N)
ALTITUDE 19.2 KM

SAMPLE #	338	337	336	335
FLIGHT #	288	288	288	288
DATE	11/ 4/67	11/ 4/67	11/ 4/67	11/ 4/67
BEGIN-				
TIME	0003	2340	2306	2232
LAT.	61-00N	59-00N	56-00N	53-00N
LONG.	139-00W	135-30W	131-20W	128-00W
END-				
TIME	0053	0003	2340	2306
LAT.	65-00N	61-00N	59-00N	56-00N
LONG.	148-00W	139-00W	135-30W	131-20W
VOL. OF AIR (100 CU.M.)	4.19	1.93	2.93	2.62
GROSS GAMMA/ M/100 CU.M.	24000	27000	38000	42000

Table 2 (Cont'd)

SOUTH OF EIELSON
(64N-53N)
ALTITUDE 18.3 KM

SAMPLE #	309	308	330	331	332
FLIGHT #	288	288	288	288	288
DATE	11/ 6/67	11/ 6/67	11/ 4/67	11/ 4/67	11/ 4/67
BEGIN-					
TIME	1953	1947	2002	2024	2056
LAT.	60-00N	61-30N	61-00N	59-00N	56-00N
LONG.	139-05W	140-00W	139-00W	135-30W	131-20W
END-					
TIME	2042	1953	2024	2056	2125
LAT.	65-00N	61-00N	59-00N	56-00N	53-00N
LONG.	146-35W	139-05W	135-30W	131-20W	138-00W
VOL. OF AIR (100 CU.M.)	4.93	0.61	2.34	3.41	3.17
GROSS GAMMA/ M/100 CU.M.	46000	39000	4400	9700	430
			DPM/100 CU.M.		
BE-7		389000.			
MN-54		*			
ZR-95		80300.			
RU-103		35900.			
RU-106		11700.			
SB-125		3980.			
I-131		*			
CS-137		*			
BA-140		*			
CE-141		17400.			
CE-144		*			

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 2 (Cont'd)

SOUTH OF EIELSON
(64N-53N)
ALTITUDE 15.2 KM

SAMPLE #	295	349	294	348	293	347	292
FLIGHT #	293	293	293	293	293	293	293
DATE	11/ 2/67	11/ 5/67	11/ 2/67	11/ 5/67	11/ 2/67	11/ 5/67	11/ 2/67
BEGIN-							
TIME	2300	0003	2236	2339	2203	2309	2127
LAT.	61-00N	61-00N	59-00N	59-00N	56-00N	56-00N	53-00N
LONG.	139-00W	139-05W	135-40W	135-45W	131-30W	131-30W	127-50W
END-							
TIME	0025	0044	2300	0003	2236	2339	2203
LAT.	64-40N	64-34N	61-00N	61-00N	59-00N	59-00N	56-00N
LONG.	147-06W	149-00W	139-00W	139-05W	135-40W	135-45W	131-30W
VOL. OF AIR (100 CU.M.)	15.80	7.24	4.39	4.22	6.10	5.67	6.65
GROSS GAMMA/ M/100 CU.M.	3900	16000	2500	18000	1300	5100	1300

DPM/100 CU.M.

BE-7	34400.
MN-54	15400.
ZR-95	5580.
RU-103	1280.
RU-106	859.
SB-125	271.
I-131	*
CS-137	269.
BA-140	*
CE-141	487.
CE-144	2180.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 2 (Cont'd)
SOUTH OF EIELSON
(64N-53N)
ALTITUDE 15.2 KM

SAMPLE #	346
FLIGHT #	293
DATE	11/ 5/67
BEGIN-	
TIME	2232
LAT.	53-00N
LONG.	127-55W
END-	
TIME	2309
LAT.	56-00N
LONG.	131-30W
VOL. OF AIR (100 CU.M.)	7.38
GROSS GAMMA/ M/100 CU.M.	380

	DPM/100 CU.M.
BE-7	9910.
MN-54	741.A
ZR-95	997.
RU-103	108.A
RU-106	77.A
SB-125	40.
I-131	*
CS-137	20.A
BA-140	*
CE-141	60.
CE-144	331.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

<u>Table 2</u> (Cont'd)

SOUTH OF EIELSON
(64N-53N)
ALTITUDE 13.7 KM

SAMPLE #	340	341	342	343
FLIGHT #	293	293	293	293
DATE	11/ 5/67	11/ 5/67	11/ 5/67	11/ 5/67
BEGIN-				
TIME	1946	1951	2017	2049
LAT.	61-30N	61-00N	59-00N	56-00N
LONG.	140-00W	139-05W	135-45W	131-30W
END-				
TIME	1951	2017	2049	2124
LAT.	61-00N	59-00N	56-00N	53-00N
LONG.	139-05W	135-45W	131-30W	127-55W
VOL. OF AIR (100 CU.M.)	0.93	6.16	7.92	8.74
GROSS GAMMA/ M/100 CU.M.	6200	3200	510	50
		DPM/100 CU.M.		
BE-7	92900.A	53600.		2390.
MN-54	*	24500.		289.A
ZR-95	15700.	8250.		126.
RU-103	3640.	1300.		*
RU-106	771.A	1280.		*
SB-125	1220.	378.		11.A
I-131	*	*		*
CS-137	*	365.		*
BA-140	*	*		*
CE-141	855.	378.A		*
CE-144	6620.	3510.		64.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 2 (Cont'd)

NORTH OF KIRTLAND
(53N-35N)
ALTITUDE 19.2 KM

SAMPLE #	334	356	357	358	359	360
FLIGHT #	288	292	292	292	292	292
DATE	11/ 4/67	11/ 6/67	11/ 6/67	11/ 6/67	11/ 6/67	11/ 6/67
BEGIN-						
TIME	2210	2021	2043	2110	2134	2158
LAT.	51-00N	49-00N	47-00N	45-00N	43-00N	41-00N
LONG.	126-00W	124-00W	121-25W	118-01W	115-07W	111-41W
END-						
TIME	2232	2043	2110	2134	2158	2222
LAT.	53-00N	47-00N	45-00N	43-00N	41-00N	39-00N
LONG.	128-00W	121-25W	118-01W	115-07W	111-41W	108-47W
VOL. OF AIR (100 CU.M.)	1.81	2.09	2.66	2.37	2.37	2.49
GROSS GAMMA/ M/100 CU.M.	22000	29000	19000	18000	17000	14000

Table 2 (Cont'd)

NORTH OF KIRTLAND
(53N-35N)
ALTITUDE 18.3 KM

SAMPLE #	333	355	354	353	352	351	472
FLIGHT #	288	292	292	292	292	292	294
DATE	11/ 4/67	11/ 6/67	11/ 6/67	11/ 6/67	11/ 6/67	11/ 6/67	11/ 9/67
BEGIN-							
TIME	2125	1942	1915	1850	1821	1754	1915
LAT.	53-00N	47-00N	45-00N	43-00N	41-00N	39-00N	39-02N
LONG.	128-00W	121-25W	118-01W	115-07W	111-41W	108-47W	108-48W
END-							
TIME	2144	2004	1942	1915	1850	1821	1953
LAT.	51-00N	49-00N	47-00N	45-00N	43-00N	41-00N	35-00N
LONG.	126-00W	124-00W	121-25W	118-01W	115-07W	111-41W	106-50W
VOL. OF AIR (100 CU.M.)	2.09	2.54	3.26	3.02	3.50	3.25	4.45
GROSS GAMMA/ M/100 CU.M.	14000	14000	7400	4500	5700	4400	1600

DPM/100 CU.M.

BE-7	76000.A
MN-54	*
ZR-95	14300.
RU-103	4490.
RU-106	1390.
SB-125	1040.
I-131	*
CS-137	*
BA-140	*
CE-141	954.
CE-144	6630.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 2 (Cont'd)

NORTH OF KIRTLAND
(53N-35N)
ALTITUDE 18.3 KM

SAMPLE #	345
FLIGHT #	293
DATE	11/ 5/67
BEGIN-	
TIME	2157
LAT.	50-00N
LONG.	125-00W
END-	
TIME	2232
LAT.	53-00N
LONG.	127-55W
VOL. OF AIR (100 CU.M.)	7.35
GROSS GAMMA/ M/100 CU.M.	140

DPM/100 CU.M.

BE-7	4330.
MN-54	1360.
ZR-95	373.
RU-103	*
RU-106	*
SB-125	24.
I-131	*
CS-137	19.
BA-140	*
CE-141	7.A
CE-144	132.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 2 (Cont'd)

NORTH OF KIRTLAND
(53N-35N)
ALTITUDE 15.2 KM

SAMPLE #	368	290	289	367	288	366	287
FLIGHT #	292	293	293	292	293	292	293
DATE	11/ 7/67	11/ 2/67	11/ 2/67	11/ 7/67	11/ 2/67	11/ 7/67	11/ 2/67
BEGIN-							
TIME	1944	2016	1943	1909	1913	1838	1844
LAT.	47-00N	43-00N	45-00N	45-00N	43-00N	43-00N	41-00N
LONG.	121-25W	121-20W	117-35W	118-00W	114-30W	115-05W	111-20W
END-							
TIME	2022	2053	2016	1944	1943	1909	1913
LAT.	50-00N	50-00N	47-00N	47-00N	45-00N	45-00N	43-00N
LONG.	125-15W	125-00W	121-20W	121-25W	117-35W	118-00W	114-20W
VOL. OF AIR (100 CU.M.)	7.49	6.93	6.37	7.03	5.79	6.36	5.60
GROSS GAMMA/ M/100 CU.M.	650	2200	450	270	410	88	360

DPM/100 CU.M.

BE-7	11600.	12400.
MN-54	3490.	*
ZR-95	943.	889.
RU-103	136.A	93.A
RU-106	148.A	127.A
SB-125	64.A	63.
I-131	*	*
CS-137	61.	19.A
BA-140	*	*
CE-141	35.A	41.
CE-144	542.	413.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 2 (Cont'd)

NORTH OF KIRTLAND
(53N-35N)
ALTITUDE 15.2 KM

SAMPLE #	365	286	364	471	363
FLIGHT #	292	293	292	294	292
DATE	11/ 7/67	11/ 2/67	11/ 7/67	11/ 9/67	11/ 7/67
BEGIN-					
TIME	1812	1814	1744	1823	1725
LAT.	41-00N	39-00N	39-00N	35-00N	37-00N
LONG.	111-45W	108-45W	108-50W	106-50W	108-50W
END-					
TIME	1838	1844	1812	1901	1732
LAT.	43-00N	41-00N	41-00N	39-02N	38-00N
LONG.	115-05W	111-20W	111-45W	108-48W	108-10W
VOL. OF AIR (100 CU.M.)	5.34	6.02	5.85	7.95	1.46
GROSS GAMMA/ M/100 CU.M.	42	270	41	240	120

DPM/100 CU.M.

BE-7		7440.			
MN-54		1620.			
ZR-95		523.			
RU-103		90.A			
RU-106		83.A			
SB-125		46.			
I-131		*			
CS-137		34.			
BA-140		*			
CE-141		37.			
CE-144		188.			

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 2 (Cont'd)

NORTH OF KIRTLAND
(53N-35N)
ALTITUDE 13.7 KM

SAMPLE #	344	369	370	371	372	373	374
FLIGHT #	293	292	292	292	292	292	292
DATE	11/ 5/67	11/ 7/67	11/ 7/67	11/ 7/67	11/ 7/67	11/ 7/67	11/ 7/67
BEGIN-							
TIME	2124	2027	2106	2138	2208	2233	2301
LAT.	53-00N	50-00N	47-00N	45-00N	43-00N	41-00N	39-00N
LONG.	127-55W	125-15W	121-25W	118-00W	115-05W	111-45W	108-50W
END-							
TIME	2153	2106	2138	2208	2233	2301	2338
LAT.	50-00N	47-00N	45-00N	43-00N	41-00N	39-00N	35-00N
LONG.	125-00W	121-25W	118-00W	115-05W	111-45W	108-50W	106-50W
VOL. OF AIR (100 CU.M.)	7.53	9.80	7.38	7.37	6.06	7.00	9.19
GROSS GAMMA/ M/100 CU.M.	26	160	150	69	22	32	15

DPM/100 CU.M.

	344	369	370	371	372	373	374
BE-7	2010.A						
MN-54	205.A						
ZR-95	64.						
RU-103	*						
RU-106	*						
SB-125	13.A						
I-131	*						
CS-137	*						
BA-140	*						
CE-141	6.A						
CE-144	14.A						

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 2 (Cont'd)
SOUTH OF KIRTLAND
(35N-24N)
ALTITUDE 19.2 KM

SAMPLE #	493	492	491	490	489
FLIGHT #	292	292	292	292	292
DATE	11/ 8/67	11/ 8/67	11/ 8/67	11/ 8/67	11/ 8/67
BEGIN-					
TIME	2155	2122	2044	2001	1938
LAT.	33-00N	31-00N	29-00N	26-00N	24-00N
LONG.	102-15W	98-10W	94-37W	91-15W	89-00W
END-					
TIME	2235	2155	2122	2044	2001
LAT.	35-00N	33-00N	31-00N	29-00N	26-00N
LONG.	106-40W	102-15W	98-10W	94-37W	91-15W
VOL. OF AIR (100 CU.M.)	3.71	3.06	3.64	4.02	2.19
GROSS GAMMA/ M/100 CU.M.	4100	5100	6700	8200	9000

Table 2 (Cont'd)

SOUTH OF KIRTLAND
(35N-24N)
ALTITUDE 18.3 KM

SAMPLE #	473	275	485	276	486	277	487
FLIGHT #	294	290	292	290	292	290	292
DATE	11/ 9/67	10/31/67	11/ 8/67	10/31/67	11/ 8/67	10/31/67	11/ 8/67
BEGIN-							
TIME	1953	1607	1719	1640	1756	1710	1827
LAT.	35-00N	33-00N	33-00N	31-00N	31-00N	29-00N	29-00N
LONG.	106-50W	102-00W	102-15W	098-00W	98-10W	094-35W	94-37W
END-							
TIME	2032	1640	1756	1710	1827	1750	1908
LAT.	33-00N	31-00N	31-00N	29-00N	29-00N	26-00N	26-00N
LONG.	102-00W	098-00W	98-10W	094-35W	94-37W	091-20W	91-15W
VOL. OF AIR (100 CU.M.)	4.46	3.55	4.25	3.29	3.56	4.57	4.71
GROSS GAMMA/ M/100 CU.M.	3100	29000		16000		3600	

Table 2 (Cont'd)

SOUTH OF KIRTLAND
(35N-24N)
ALTITUDE 18.3 KM

SAMPLE #	278	488
FLIGHT #	290	292
DATE	10/31/67	11/ 8/67
BEGIN-		
TIME	1750	1908
LAT.	26-00N	26-00N
LONG.	091-20W	91-15W
END-		
TIME	1815	1931
LAT.	24-00N	24-00N
LONG.	089-00W	89-00W
VOL. OF AIR (100 CU.M.)	2.93	2.68
GROSS GAMMA/ M/100 CU.M.	2800	

<u>Table 2</u> (Cont'd)
SOUTH OF KIRTLAND
(35N-24N)
ALTITUDE 16.8 KM

SAMPLE #	482	299	481	300	480	301
FLIGHT #	293	291	293	291	293	291
DATE	11/ 9/67	10/31/67	11/ 9/67	10/31/67	11/ 9/67	10/31/67
BEGIN-						
TIME	2144	1622	2111	1651	2036	1728
LAT.	31-00N	31-00N	29-00N	29-00N	26-00N	26-00N
LONG.	98-12W	098-00W	94-35W	094-45W	91-15W	091-20W
END-						
TIME	2220	1651	2144	1728	2111	1754
LAT.	33-00N	29-00N	31-00N	26-00N	29-00N	24-00N
LONG.	102-12W	094-45W	98-12W	091-20W	94-35W	089-00W
VOL. OF AIR (100 CU.M.)	5.63	4.17	5.16	5.60	5.44	4.33
GROSS GAMMA/ M/100 CU.M.		220		35		180

DPM/100 CU.M.

BE-7		4100.A		6880.		3420.
MN-54		*		2630.		*
ZR-95		525.		866.		462.
RU-103		130.A		66.A		52.A
RU-106		*		67.A		*
SB-125		67.		38.		17.A
I-131		*		*		*
CS-137		*		39.		*
BA-140		*		*		*
CE-141		32.		50.		20.A
CE-144		150.		239.		188.

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 2 (Cont'd)
SOUTH OF KIRTLAND
(35N-24N)
ALTITUDE 15.2 KM

SAMPLE #	470	274	475	476	477	478
FLIGHT #	294	290	293	293	293	293
DATE	11/ 9/67	10/31/67	11/ 9/67	11/ 9/67	11/ 9/67	11/ 9/67
BEGIN-						
TIME	1741	1535	1753	1831	1902	1942
LAT.	33-00N	34-30N	33-00N	31-00N	29-00N	26-00N
LONG.	102-00W	105-00W	102-12W	98-12W	94-35W	91-15W
END-						
TIME	1823	1607	1831	1902	1942	2003
LAT.	35-00N	33-00N	31-00N	29-00N	26-00N	24-00N
LONG.	106-50W	102-00W	98-12W	94-35W	91-15W	89-00W
VOL. OF AIR (100 CU.M.)	8.78	5.20	7.80	6.36	8.25	4.33
GROSS GAMMA/ M/100 CU.M.	140	9200	39	38	40	

Table 2 (Cont'd)

NORTH OF ALBROOK
(24N-09N)
ALTITUDE 19.2 KM

SAMPLE #	376	377	378	379	380
FLIGHT #	289	289	289	289	289
DATE	11/ 4/67	11/ 4/67	11/ 4/67	11/ 4/67	11/ 4/67
BEGIN-					
TIME	1758	1831	1901	1932	2002
LAT.	24-00N	21-00N	18-00N	15-00N	12-00N
LONG.	089-00W	086-30W	084-25W	082-50W	081-15W
END-					
TIME	1831	1901	1932	2002	2023
LAT.	21-00N	18-00N	15-00N	12-00N	09-00N
LONG.	086-00W	084-25W	082-50W	081-15W	079-40W
VOL. OF AIR (100 CU.M.)	3.23	2.83	2.90	2.76	2.03
GROSS GAMMA/ M/100 CU.M.	130000	52000	71000	360	1200

Table 2 (Cont'd)

NORTH OF ALBROOK
(24N-09N)
ALTITUDE 18.3 KM

SAMPLE #	279	375	280	584	281	583	282
FLIGHT #	290	289	290	289	290	289	290
DATE	10/31/67	11/ 4/67	10/31/67	11/ 4/67	10/31/67	11/ 4/67	10/31/67
BEGIN-							
TIME	1815	1716	1852	1644	1925	1614	1952
LAT.	24-00N	21-00N	21-00N	18-00N	18-00N	15-00N	15-00N
LONG.	089-00W	086-30W	087-30W	084-25W	084-30W	082-50W	082-50W
END-							
TIME	1852	1749	1925	1716	1952	1644	2020
LAT.	21-00N	24-00N	18-00N	21-00N	15-00N	18-00N	12-00N
LONG.	087-30W	089-00W	084-30W	086-30W	082-50W	084-25W	081-20W
VOL. OF AIR (100 CU.M.)	4.38	3.87	3.95	3.94	3.22	3.69	3.33
GROSS GAMMA/ M/100 CU.M.	2200	73000	1400		860	4	1600
				DPM/100 CU.M.			
BE-7	27400.		33200.		9750.		
MN-54	12000.		*		3660.		
ZR-95	4630.		2990.		1050.		
RU-103	1200.		481.		176.A		
RU-106	742.		484.		200.A		
SB-125	237.		156.		85.		
I-131	*		*		27.A		
CS-137	260.		108.		89.		
BA-140	*		*		*		
CE-141	521.		236.		75.A		
CE-144	1680.		1450.		519.		

A:COUNTING ERROR IS 20-50 PER CENT
B:COUNTING ERROR IS 51-100 PERCENT
*:NOT DETECTABLE

Table 2 (Cont'd)
NORTH OF ALBROOK
(24N-09N)
ALTITUDE 18.3 KM

SAMPLE #	582	283	397
FLIGHT #	289	290	289
DATE	11/ 4/67	10/31/67	11/ 7/67
BEGIN-			
TIME	1546	2020	1839
LAT.	12-00N	12-00N	09-00N
LONG.	081-15W	081-20W	079-35W
END-			
TIME	1614	2050	1911
LAT.	15-00N	09-00N	12-00N
LONG.	082-50W	079-40W	081-42W
VOL. OF AIR (100 CU.M.)	3.39	3.57	3.88
GROSS GAMMA/ M/100 CU.M.	430	3200	570

Table 2 (Cont'd)

NORTH OF ALBROOK

(24N-09N)

ALTITUDE 16.8 KM

SAMPLE #	302	433	303	434	304	435	305
FLIGHT #	291	298	291	298	291	298	291
DATE	10/31/67	11/ 4/67	10/31/67	11/ 4/67	10/31/67	11/ 4/67	10/31/67
BEGIN-							
TIME	1754	1705	1828	1736	1902	1808	1931
LAT.	24-00N	24-00N	21-00N	21-00N	18-00N	18-00N	15-00N
LONG.	089-00W	89-00W	086-30W	86-30W	084-25W	84-25W	082-50W
END-							
TIME	1828	1736	1902	1808	1931	1835	2001
LAT.	21-00N	21-00N	18-00N	18-00N	15-00N	15-00N	12-00N
LONG.	086-30W	86-30W	084-25W	84-25W	082-50W	82-50W	081-20W
VOL. OF AIR (100 CU.M.)	5.78	5.37	5.78	5.42	4.97	4.61	5.17
GROSS GAMMA/ M/100 CU.M.	140		5800		5400		4

DPM/100 CU.M.

BE-7	3750.						
MN-54	1440.						
ZR-95	313.						
RU-103	80.A						
RU-106	*						
SB-125	26.						
I-131	*						
CS-137	16.						
BA-140	*						
CE-141	18.A						
CE-144	182.						

A:COUNTING ERROR IS 20-50 PER CENT

B:COUNTING ERROR IS 51-100 PERCENT

*:NOT DETECTABLE

<u>Table 2</u> (Cont'd)

NORTH OF ALBROOK
(24N-09N)
ALTITUDE 16.8 KM

SAMPLE #	436	437
FLIGHT #	298	298
DATE	11/ 4/67	11/ 4/67
BEGIN-		
TIME	1835	1904
LAT.	15-00N	12-00N
LONG.	82-50W	81-20W
END-		
TIME	1904	1936
LAT.	12-00N	09-00N
LONG.	81-20W	79-40W
VOL. OF AIR (100 CU.M.)	5.02	5.46
GROSS GAMMA/ M/100 CU.M.	5700	22

Table 2 (Cont'd)
NORTH OF ALBROOK
(24N-09N)
ALTITUDE 15.2 KM

SAMPLE #	432	431	430	429	394
FLIGHT #	298	298	298	298	289
DATE	11/ 4/67	11/ 4/67	11/ 4/67	11/ 4/67	11/ 7/67
BEGIN-					
TIME	1626	1555	1525	1456	1640
LAT.	21-00N	18 00N	15-00N	12-00N	12-00N
LONG.	86 30W	84 25W	82 50W	81-20W	081-42W
END-					
TIME	1659	1626	1555	1525	1721
LAT.	24 00N	21 00N	18-00N	15-00N	09 00N
LONG.	89 00W	86 30W	84 25W	82 50W	079-35W
VOL. OF AIR (100 CU.M.)	7.43	7.07	6.75	6.61	9.02
GROSS GAMMA/ M/100 CU.M.	72	130	25		1600

Table 2 (Cont'd)
SOUTH OF ALBROOK
(09N-09S)
ALTITUDE 19.2 KM

SAMPLE #	446	445	444	443
FLIGHT #	289	289	289	289
DATE	11/ 6/67	11/ 6/67	11/ 6/67	11/ 6/67
BEGIN-				
TIME	1729	1655	1622	1557
LAT.	01-00N	03-00S	07-00S	10-00S
LONG.	79-40W	78-45W	77-45W	77-00W
END-				
TIME	1804	1729	1655	1622
LAT.	05-00N	01-00N	03-00S	07-00S
LONG.	79-30W	79-40W	78-45W	77-45W
VOL. OF AIR (100 CU.M.)	3.49	3.39	3.31	2.45
GROSS GAMMA/ M/100 CU.M.	160	160	120	150

Table 2 (Cont'd)

SOUTH OF ALBROOK
(09N-09S)
ALTITUDE 18.3 KM

SAMPLE #	396	439	440	441	442
FLIGHT #	289	289	289	289	289
DATE	11/ 7/67	11/ 6/67	11/ 6/67	11/ 6/67	11/ 6/67
BEGIN-					
TIME	1806	1345	1418	1452	1525
LAT.	05-00N	05-00N	01-00N	03-00S	07-00S
LONG.	079-37W	79-30W	79-40W	78-45W	77-45W
END-					
TIME	1838	1418	1452	1525	1551
LAT.	09-00N	01-00N	03-00S	07-00S	10-00S
LONG.	079-35W	79-40W	78-45W	77-45W	77-00W
VOL. OF AIR (100 CU.M.)	3.66	3.90	3.99	3.87	3.05
GROSS GAMMA/ M/100 CU.M.	390	340	270	160	200

Table 2 (Cont'd)

SOUTH OF ALBROOK
(09N-09S)
ALTITUDE 16.8 KM

SAMPLE #	412	404	411	405	410	406	409
FLIGHT #	298	298	298	298	298	298	298
DATE	11/ 6/67	11/ 6/67	11/ 6/67	11/ 6/67	11/ 6/67	11/ 6/67	11/ 6/67
BEGIN-							
TIME	1909	1437	1834	1512	1759	1549	1725
LAT.	05-00N	05-00N	01-00N	01-00N	03-00S	03-00S	07-00S
LONG.	79-35W	79-35W	79-35W	79-35W	78-40W	78-40W	77-40W
END-							
TIME	1958	1512	1909	1549	1834	1628	1759
LAT.	09-00N	01-00N	05-00N	03-00S	01-00N	07-00S	03-00S
LONG.	79-30W	79-35W	79-35W	78-40W	79-35W	77-40W	78-40W
VOL. OF AIR (100 CU.M.)	8.58	5.76	6.12	6.23	5.81	6.39	5.63
GROSS GAMMA/ M/100 CU.M.		440	940	530	810	780	650

Table 2 (Cont'd)

SOUTH OF ALBROOK
(09N-09S)
ALTITUDE 16.8 KM

SAMPLE #	407	408
FLIGHT #	298	298
DATE	11/ 6/67	11/ 6/67
BEGIN-		
TIME	1628	1658
LAT.	07-00S	10-00S
LONG.	77-40W	77-00W
END-		
TIME	1654	1725
LAT.	10-00S	07-00S
LONG.	77-00W	77-40W
VOL. OF AIR (100 CU.M.)	4.35	4.70
GROSS GAMMA/ M/100 CU.M.	990	840

Table 2 (Cont'd)
SOUTH OF ALBROOK
(09N-09S)
ALTITUDE 15.2 KM

SAMPLE #	395	399	400	401	402
FLIGHT #	289	289	289	289	289
DATE	11/ 7/67	11/ 5/67	11/ 5/67	11/ 5/67	11/ 5/67
BEGIN-					
TIME	1722	1451	1529	1608	1650
LAT.	09-00N	05-00N	01-00N	03-00S	07-00S
LONG.	079-35W	079-34W	079-37W	078-40W	077-44W
END-					
TIME	1758	1529	1608	1650	1720
LAT.	05-00N	01-00N	03-00S	07-00S	10-00S
LONG.	079-37W	079-37W	078-40W	077-44W	077-00W
VOL. OF AIR (100 CU.M.)	8.11	8.00	8.12	8.84	6.32
GROSS GAMMA/ M/100 CU.M.	76	34	160	29	

Table 2 (Cont'd)

NORTH OF MENDOZA
(09S 33S)
ALTITUDE 19.2 KM

SAMPLE #	521	522	523	524	525
FLIGHT #	299	299	299	299	299
DATE	11/ 8/67	11/ 8/67	11/ 8/67	11/ 8/67	11/ 8/67
BEGIN-					
TIME	1618	1654	1724	1752	1825
LAT.	16-00S	20-00S	23-00S	26-00S	29-00S
LONG.	75-00W	73-35W	72-30W	71-20W	69-50W
END-					
TIME	1654	1724	1752	1825	1903
LAT.	20-00S	23-00S	26-00S	29-00S	33-00S
LONG.	73-35W	72-30W	71-20W	69-50W	68-50W
VOL. OF AIR (100 CU.M.)	3.43	2.88	2.67	3.11	3.54
GROSS GAMMA/ M/100 CU.M.	160	130	140	73	150

Table 2 (Cont'd)

NORTH OF MENDOZA
(09S 33S)
ALTITUDE 18.3 KM

SAMPLE #	520	519	518	517	529
FLIGHT #	299	299	299	299	291
DATE	11/ 8/67	11/ 8/67	11/ 8/67	11/ 8/67	11/ 8/67
BEGIN-					
TIME	1537	1507	1445	1414	1448
LAT.	20-00S	23-00S	26-00S	29-00S	29-00S
LONG.	73-35W	72-30W	71-20W	69-50W	70-00W
END-					
TIME	1613	1537	1507	1445	1529
LAT.	16-00S	20-00S	23-00S	26-00S	33-00S
LONG.	75-00W	73-35W	72-30W	71-20W	68-45W
VOL. OF AIR (100 CU.M.)	4.25	3.58	2.63	3.69	5.00
GROSS GAMMA/ M/100 CU.M.	130	160	140		

Table 2 (Cont'd)

NORTH OF MENDOZA
(09S 33S)
ALTITUDE 16.8 KM

SAMPLE #	576	577	578	579	516	580
FLIGHT #	291	291	291	291	299	291
DATE	11/ 6/67	11/ 6/67	11/ 6/67	11/ 6/67	11/ 8/67	11/ 6/67
BEGIN-						
TIME	1615	1650	1725	1755	1350	1825
LAT.	16-00S	20-00S	23-00S	26-00S	31-00S	29-00S
LONG.	75-00W	73-35W	72-25W	71-20W	67-30W	69-50W
END-						
TIME	1650	1725	1755	1825	1414	1855
LAT.	20-00S	23-00S	26-00S	29-00S	29-00S	33-00S
LONG.	73-35W	72-25W	71-20W	69-50W	69-50W	68-55W
VOL. OF AIR (100 CU.M.)	5.70	5.54	4.75	4.69	3.59	4.69
GROSS GAMMA/ M/100 CU.M.	83	99	100	120		120

Table 2 (Cont'd)

NORTH OF MENDOZA
(09S 33S)
ALTITUDE 15.2 KM

SAMPLE #	575	574	573	572	571	528
FLIGHT #	291	291	291	291	291	291
DATE	11/ 6/67	11/ 6/67	11/ 6/67	11/ 6/67	11/ 6/67	11/ 8/67
BEGIN-						
TIME	1530	1458	1428	1357	1335	1359
LAT.	20-00S	23-00S	26-00S	29-00S	31-00S	33-00S
LONG.	73-35W	72-25W	71-20W	69-50W	68-50W	68-45W
END-						
TIME	1610	1530	1458	1428	1357	1436
LAT.	16-00S	20-00S	23-00S	26-00S	29-00S	29-00S
LONG.	75-00W	73-35W	72-25W	71-20W	69-50W	70-00W
VOL. OF AIR (100 CU.M.)	8.45	6.75	6.50	6.38	4.53	7.32
GROSS GAMMA/ M/100 CU.M.	25	35	50	81	110	

Table 2 (Cont'd)

SOUTH OF MENDOZA
(33S 50S)
ALTITUDE 19.2 KM

SAMPLE #	556	555	554	553	552	551
FLIGHT #	299	299	299	299	299	299
DATE	11/ 6/67	11/ 6/67	11/ 6/67	11/ 6/67	11/ 6/67	11/ 6/67
BEGIN-						
TIME	1839	1814	1749	1724	1659	1646
LAT.	37-00S	40-00S	43-00S	46-00S	49-00S	51-00S
LONG.	68-45W	68-45W	68-45W	68-45W	68-45W	68-45W
END-						
TIME	1914	1839	1814	1749	1724	1659
LAT.	33-00S	37-00S	40-00S	43-00S	46-00S	49-00S
LONG.	68-45W	68-45W	68-45W	68-45W	68-45W	68-45W
VOL. OF AIR (100 CU.M.)	3.21	2.30	2.23	2.21	2.15	1.10
GROSS GAMMA/ M/100 CU.M.						

Table 2 (Cont'd)

SOUTH OF MENDOZA
(33S 50S)
ALTITUDE 18.3 KM

SAMPLE #	530	545	546	547	548	549	550
FLIGHT #	291	299	299	299	299	299	299
DATE	11/ 8/67	11/ 6/67	11/ 6/67	11/ 6/67	11/ 6/67	11/ 6/67	11/ 6/67
BEGIN-							
TIME	1529	1436	1441	1506	1530	1555	1620
LAT.	33-00S	36-15S	37-00S	40-00S	43-00S	46-00S	49-00S
LONG.	68-45W	68-45W	68-45W	68-45W	68-45W	68-45W	68-45W
END-							
TIME	1605	1441	1506	1530	1555	1620	1637
LAT.	37-00S	37-00S	40-00S	43-00S	46-00S	49-00S	51-00S
LONG.	68-45W	68-45W	68-45W	68-45W	68-45W	68-45W	68-45W
VOL. OF AIR (100 CU.M.)	4.36	0.56	2.74	2.63	2.67	2.68	1.76
GROSS GAMMA/ M/100 CU.M.		140	130	110	170	11	

Table 2 (Cont'd)

SOUTH OF MENDOZA
(33S 50S)
ALTITUDE 18.3 KM

SAMPLE #	527
FLIGHT #	291
DATE	11/ 8/67
BEGIN-	
TIME	1350
LAT.	34-15S
LONG.	68-45W
END-	
TIME	1359
LAT.	33-00S
LONG.	68-45W
VOL. OF AIR (100 CU.M.)	1.78
GROSS GAMMA/ M/100 CU.M.	

Table 2 (Cont'd)

SOUTH OF MENDOZA
(33S 50S)
ALTITUDE 15.2 KM

SAMPLE #	569	568	567	566	565	564
FLIGHT #	291	291	291	291	291	291
DATE	11/ 5/67	11/ 5/67	11/ 5/67	11/ 5/67	11/ 5/67	11/ 5/67
BEGIN-						
TIME	1807	1740	1713	1645	1621	1603
LAT.	37-00S	40-00S	43-00S	46-00S	49-00S	51-00S
LONG.	68-45W	68-45W	68-45W	68-45W	68-45W	68-45W
END-						
TIME	1835	1807	1740	1713	1645	1621
LAT.	33-00S	37-00S	40-00S	43-00S	46-00S	49-00S
LONG.	68-45W	68-45W	68-45W	68-45W	68-45W	68-45W
VOL. OF AIR (100 CU.M.)	5.70	5.46	5.48	5.66	4.85	3.64
GROSS GAMMA/ M/100 CU.M.	91	99		130	150	140

Table 2 (Cont'd)

SOUTH OF MENDOZA
(33S 50S)
ALTITUDE 13.7 KM

SAMPLE #	558	559	560	561	562	563
FLIGHT #	291	291	291	291	291	291
DATE	11/ 5/67	11/ 5/67	11/ 5/67	11/ 5/67	11/ 5/67	11/ 5/67
BEGIN-						
TIME	1325	1342	1412	1441	1509	1538
LAT.	35-00S	37-00S	40-00S	43-00S	46-00S	49-00S
LONG.	68-45W	68-45W	68-45W	68-45W	68-45W	68-45W
END-						
TIME	1342	1412	1441	1509	1538	1603
LAT.	37-00S	40-00S	43-00S	46-00S	49-00S	51-00S
LONG.	68-45W	68-45W	68-45W	68-45W	68-45W	68-45W
VOL. OF AIR (100 CU.M.)	3.97	7.12	6.88	6.60	6.72	5.79
GROSS GAMMA/ M/100 CU.M.	180	1	110	91	76	56

Table 3

Stratospheric Radon-222 Concentrations

Alt Km	Sampler #	Coll Date	Start Lat.	Start Long.	End Lat.	End Long.	Vol. SCM	Rn^{222} pCi/SCM
19.2	8	11/4/67	24°N	89°W	13°N	81°W	6 46	0.85
	12	11/6/67	10°S	77°W	5°S	80°W	7.20	0.61
18.3	14	11/6/67	43°N	115°W	46°N	120°W	3.43	2.89
	13	11/6/67	39°N	109°W	43°N	114°W	3.24	2.27
	20	11/9/67	39°N	109°W	33°N	102°W	3.77	1.91
	19	11/8/67	33°N	102°W	24°N	93°W	6.12	1.28
	7	11/4/67	12°N	81°W	24°N	89°W	4.45	0.24
	11	11/6/67	5°N	80°W	10°S	77°W	4.89	0.86
16.8	6	11/8/67	12°N	81°W	22°N	88°W	7.00	0.84
	10	11/6/67	5°N	80°W	6°S	79°W	7.29	0.76
15.2	15	11/7/67	39°N	109°W	41°N	111°W	3.08	2.04))dupl.
	16	"	"	"	"	"	2.54	3.28)
	17	11/9/67	33°N	103°W	39°N	109°W	4.75	2.91
	4	11/8/67	33°N	102°W	24°N	89°W	6.70	10.1
	1	11/4/67	12°N	81°W	15°N	83°W	2.96	2.68))dupl.
	5	"	"	"	"	"	2.75	2.93)
	2	11/5/67	5°N	80°W	6°S	78°W	7.58	1.09
13.7	3	11/7/67	50°N	125°W	44°N	112°W	6.70	1.15
Blanks	9	11/5/67					-	1.96 *(a)
	18	11/8/67					-	17.0 *

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*Total pCi of Rn-222 in trap corrected to midpoint of flight.
(a)Operated for approximately 1 minute at 7.6 km at about 9°N.

ANALYSES OF QUALITY CONTROL SAMPLES AT HASL AND OTHER LABORATORIES DURING 1967

by E. Hardy (HASL)

It has been customary to present the results of quality control analyses performed at HASL and contractor laboratories on an annual basis (1 - 6). With each group of air particulate, water, soil, food, or bone samples submitted in-house or to contractor laboratories for radiochemical or stable element analyses, at least ten percent of the samples are for quality control purposes. This report covers the quality control data obtained by the Health and Safety Laboratory for biological and monthly fallout samples analyzed during the period from January 1967 through December 1967. Similar data for air particulate and soil samples are reported separately in these Quarterly reports.

The quality control samples consist of blanks, natural samples analyzed repeatedly over a long period of time, and replicates of unknowns. In the accompanying tables, the Health and Safety Laboratory is identified as HASL and contractor laboratories by code letters. Following is a summary of quality control data for bone ash, milk ash, vegetation ash, ion-exchange resin and simulated pot samples analyzed during 1967. Results of individual analyses and average values for 1. Blanks, 2. natural samples, 3. replicates, and 4. spikes, are given in the Tables.

Summary of Results

1. Blanks

The average value obtained at HASL for 12 analyses of calcium phosphate during 1967 was 0.07 ± 0.04 dpm Sr^{90} per gram. The error term is one standard deviation from the mean. Laboratory Q averaged 0.11 ± 0.07 dpm Sr^{90} per gram for 8 blind analyses and laboratory F, 0.10 ± 0.03 dpm per gram for 3 analyses.

Only two analyses of pre-1945 powdered milk ash were made at HASL. Both results were less than or equal to the single Poisson standard deviation due to counting.

Seventy gram aliquots of Dowex-50 WX-12 cation exchange resin, conditioned at HASL and used in monthly ion-exchange column fallout collections were analyzed as blanks. Contractor laboratory NN analyzed three unexposed resin samples per month and averaged over a year's time, 1.5 ± 1.4 dpm Sr^{90}. Contractor laboratory CC performed five analyses of blank resin during the first quarter of 1967 and averaged 1.0 ± 0.5 dpm Sr^{90}. Five resin blanks were analyzed at HASL during 1967 and the average value found was 1.4 ± 1.1 dpm Sr^{90}. These blank levels are considered acceptable in terms of the activity level required to measure 0.01 mCi Sr^{90} per Km^2 which is the lowest monthly deposition rate reported. The simulated pot collections analyzed as blanks showed similar Sr^{90} levels. Contractor NN found 1.3 ± 1.7 dpm Sr^{90} over the twelve month term of the contract while HASL, based on only 6 analyses, averaged 0.8 ± 0.5 dpm Sr^{90}.

2. Natural Samples

Ashed natural samples of human bone, animal bone, powdered milk and hay have been analyzed repetitively at HASL for Sr^{90} for several years. The averages of all results reported through December 1967 have Gaussian standard deviations of ten percent or less. Contractor laboratory F analyzed three samples of hay ash (HASL No. V0214) in June 1967. The results were unacceptable from the standpoint of reproducibility and accuracy.

3. Replicates

HASL and Contractor laboratory Q analyzed blind duplicate human bone ash samples during 1967. The average percent deviation from the mean was less than 10 percent for both laboratories. The HASL results were obtained periodically during the year while the contractor analyzed the entire set during November 1967.

Blind replicates of ashed food analyzed by HASL during 1967 showed an average deviation from the mean of 8.5 percent. Laboratory Q averaged 15 percent deviation from the mean for a set of ashed foods analyzed in March 1967. The results were considered acceptable.

A set of blind duplicate food ash samples analyzed by Contractor laboratory F, however, were not acceptable. The average percent deviation from the mean for Sr^{90} was 23 percent with a range of from 1 to 60 percent. The calcium analyses showed even poorer reproducibility. Subsequent re-milkings demonstrated no improvement.

4. Spikes

Known amounts of standardized Sr^{90} solutions are added to simulated pot and unexposed resin samples and submitted with unknowns to HASL and contractor laboratories.

Average recovery values for analyses performed over the past year are shown below:

Type sample	dpm Sr^{90} added	% Sr^{90} recovered NN	CC	HASL
resin	24	104 ± 16	100 ± 17	108 ± 12
	43	88 ± 10		
	54	96 ± 14	102 ± 13	102 ± 7
pot	24	112 ± 30		112 ± 7
	43	79 ± 20		91 ± 8
	54	100 ± 13		92 ± 8

The lower recoveries reported by Contractor laboratory NN for the spiked samples containing 43 dpm Sr^{90}, were obtained during the early phases of the contract period. This apparent problem was rectified after a standard used at HASL was sent to the Contractor.

The short-lived isotope, Sr^{89}, was measured in monthly fallout samples by contractor laboratory NN during the past year. Known amounts of Sr^{89} were added to simulated pot and unexposed resin samples. Average recovery values are shown below:

Type Sample	dpm range of Sr^{89} added	% Sr^{89} recovered
resin	200 - 300	102 ± 17
	1000 - 3000	91 ± 14
pot	200 - 500	106 ± 21
	1000 - 1500	90 ± 24

The quality control results for monthly fallout samples submitted to contractor NN during the last contract period indicate acceptable performance.

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USAEC Report HASL-165, p. 332, January (1966)

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USAEC Report HASL-174, p. I-16, January (1967)

LIST OF TABLES

1. BLANKS *

A. Calcium Phosphate (Orig. HASL No. 8849), Sr^{90}

Data Period: Jan - Dec 1967
Laboratory : HASL

dpm Sr^{90}/gram

0.05
≤0.11
≤0.06
≤0.01
≤0.02
0.08
0.04
≤0.05
≤0.13
0.07
≤0.12
≤0.08

12 analyses: avg. 0.07 ± 0.04 dpm Sr^{90} per gram

Data Period: Mar. 1967 and Nov. 1967
Laboratory : Q

dpm Sr^{90}/gram

0.04
0.18
0.22
0.18
0.11
0.09
0.02
0.07

8 analyses: avg. 0.11 ± 0.07 dpm Sr^{90} per gram

Data Period: June 1967
Laboratory : F

dpm Sr^{90}/gram

0.13
0.09
0.07

3 analyses: avg. 0.10 ± 0.03 dpm Sr^{90} per gram

*A less than or equal sign (≤) preceds the Poisson Standard deviation in those cases where the value obtained was less than.

1. BLANKS (cont'd)

B. Powdered Milk Ash - Pre-1945 (Orig. HASL No. M0209), Sr^{90}

Data Period: Jan.-Dec. 1967
Laboratory : HASL

dpm Sr^{90}/ gram
≤0.14
≤0.08

1. BLANKS (Cont'd)

C. Ion-Exchange Resin, Sr^{90}

Data Period: Oct. 1966 - Oct. 1967: Lab. NN
Jan. 1967 - Apr. 1967: Lab. CC
Jan. 1967 - Dec. 1967: HASL

dpm Sr^{90}		
Lab. NN	Lab CC	HASL
≤0.7	≤1.5	≤0.8
2.1	≤0.9	≤0.2
2.0	≤1.4	2.0
5.0	≤0.6	3.1
1.9	≤0.4	≤1.1
1.0		
3.9	5 analyses:	5 analyses
2.5	avg. 1.0 ± 0.5 dpm Sr^{90}	avg. 1.4 ± 1.1 dpm Sr^{90}
≤0.6		
≤0.5		
≤0.5		
≤0.6		
≤0.4		
≤0.3		
≤0.4		
≤0.4		
1.2		
1.2		
1.4		
1.5		
≤0.3		
5.5		
≤0.4		
3.6		
2.2		
1.4		
3.6		
≤0.4		
≤0.4		
1.4		
≤0.4		
2.0		
4.0		
≤0.4		
≤0.4		
≤0.4		

36 analyses
avg. 1.5 ± 1.4 dpm Sr^{90}

1. BLANKS - cont'd

D. Simulated Pot Collection, Sr^{90}

Data Period: Oct. 1966 - Oct. 1967: Lab NN
Jan. 1967 - Dec. 1967: HASL

dpm Sr^{90}

Lab NN	HASL
≤0.6	≤0.7
1.0	≤1.2
≤0.2	≤0.6
1.4	≤0.3
1.4	≤1.5
6.0	≤0.5
≤0.3	
≤0.4	
≤0.7	
≤0.4	
≤0.4	
1.8	
≤0.4	
≤0.4	
≤0.4	
≤0.4	
≤0.4	
≤0.4	
6.4	
4.5	
≤0.4	
≤0.4	
≤1.5	
3.5	
≤0.5	
≤0.4	
≤0.4	
2.3	
≤0.4	

HASL: 6 analyses
avg. 0.8 ± 0.5 dpm Sr^{90}

Lab NN: 29 analyses

avg. 1.3 ± 1.7 dpm Sr^{90}

2. NATURAL SAMPLES

A. Human Bone Ash (Orig. HASL No. 5407), Sr^{90}

Data Period: Jan. - Dec. 1967
Laboratory: HASL

dpm Sr^{90}/gram(1)
1.25
0.93
1.41
1.41
1.28
1.26

avg. of results from July 1957 to Dec. 1967 -

dpm Sr^{90}/gram(1): 1.27 ± 0.13 (10.2%) (2,3)

(1) decay corrected to 7/1/57
(2) error term is one std. dev. of the mean
(3) based on 48 blind analyses at HASL

B. Animal Bone Ash (Orig. HASL No. B0126)

Data Period: Jan. - Dec. 1967
Laboratory: HASL

dpm Sr^{90}/gram (1)
19.5
14.6
17.2

Avg. of results from April 1961 to Dec. 1967 -

dpm Sr^{90}/gram(1): 18.2 ± 1.5 (8.2%) (2,3)

(1) decay corrected to 4/1/61
(2) error term is one std. dev. of the mean
(3) based on 49 blind analyses at HASL

Data Period: Nov. 1967
Laboratory: Q

dpm Sr^{90}/gram(1)	gCa/gram
18.7	0.364
13.5	0.368

(1) decay corrected to 4/1/61.

2. NATURAL SAMPLES - Cont'd

C. Powdered Milk Ash (Orig. HASL No. 7604)

Data Period: Jan. - Dec. 1967
Laboratory: HASL

dpm Sr^{90}/gram (1)
2.15
2.23
1.99

avg. of results from March 1959 to Dec. 1966 -

dpm Sr^{90}/gram(1): 2.24 ± 0.18 (8.0%) (2,3)

(1) decay corrected to 3/1/59
(2) error term is one std. dev. of the mean
(3) based on 65 blind analyses at HASL

2. NATURAL SAMPLES - cont'd

D. Hay Ash (Orig. HASL No. V0214)

Data Period: Jan. - Dec. 1967
Laboratory: HASL

dpm Sr^{90}/gram(1)
25.2
24.1
26.5
26.0
23.5
25.9
26.0

Avg. of results from July 1963 to Dec. 1967

dpm Sr^{90}/gram(1): 24.9 ± 1.5 (6.0%)(2,3)

(1) decay corrected to 7/1/63
(2) error term is one Std. deviation of the mean
(3) based on 28 blind analyses at HASL

Data Period: Mar 1967
Laboratory: Q

dpm Sr^{90}/gram(1)	g Ca/gram
24.8	0.125
23.3	0.106
25.3	0.094

(1) decay corrected to 7/1/63

Data Period: June 1967
Laboratory: F

dpm Sr^{90}/gram(1)	g Ca/gram
8.88	0.079
9.05	0.052
16.1	0.141

(1) decay corrected to 7/1/63

3. BLIND DUPLICATES

A. Human Bone Ash

Data Period: Jan. - Dec. 1967
Laboratory: HASL

HASL No.	dpm Sr^{90}/gram
HB 975	2.74
HB 991	3.06
HB 989	3.16
HB 990	2.88
HB 1005	1.35
HB 1006	1.39
HB 1029	1.5
HB 1030	1.4
HB 1034	0.7
HB 1035	0.8
HB 1036	0.88
HB 1068	1.0
HB 1037	1.01
HB 1069	1.1
HB 1038	1.10
HB 1070	0.9
HB 1042	2.01
HB 1071	1.5
HB 1072	3.64
HB 1075	3.39
HB 1097	1.14
HB 1100	1.13

11 sets of blind duplicates

avg. percent deviation from mean: 9.0%
range: 2 - 20%

3. BLIND DUPLICATES (Cont'd)

A. Human Bone Ash

Data Period: November 1967
Laboratory: Q

HASL No.	dpm Sr^{90}/gm	gCa/gm
B1843	1.26	0.365
B1844	1.31	0.364
B1845	1.66	0.346
B1846	2.53	0.350
B1852	1.86	0.361
B1853	2.00	0.358
B1858	0.91	0.356
B1859	0.89	0.369
B1860	0.75	0.369
B1861	0.75	0.367
B1862	0.71	0.368
B1863	0.71	0.374
B1864	0.86	0.369
B1865	0.71	0.369
B1866	0.86	0.371
B1867	0.95	0.382
B1868	0.80	0.378
B1869	0.60	0.382
B1870	0.82	0.367
B1871	0.98	0.363
B1873	1.31	0.353
B1874	1.31	0.355
B1875	2.22	0.360
B1876	2.15	0.355
B1880	1.50	0.380
B1881	1.29	0.375
B1886	1.00	0.369
B1887	0.84	0.366
B1888	1.09	0.365
B1889	0.91	0.359
B1890	0.95	0.382
B1891	0.86	0.353
B1892	0.78	0.346
B1893	0.71	0.351
B1894	0.95	0.356
B1895	0.80	0.359
B1896	0.89	0.349
B1897	0.71	0.363
B1898	0.75	0.347
B1899	0.82	0.351
B1900	1.13	0.358
B1901	0.73	0.355

21 sets of blind duplicates

Sr^{90}: avg. percent deviation
from mean: 9.9%
range: 1 - 30%

Ca : avg. percent deviation
from mean: 1.1%
range: 0.4 - 5.4%

3. BLIND DUPLICATES - Cont'd

B. Vegetation and Food Ash

Data Period: Jan. - Dec. 1967
Laboratory: HASL

HASL No.	dpm Sr^{90}/gram
F1728	2.94
F1742	2.78
F1735	1.96
F1743	1.68
F1820	7.35
F1837	7.06
F1827	10.7
F1838	11.4
F1939	4.34
F1987	4.23
F1946	2.17
F1988	1.79
F2014	1.77
F2064	2.43
F2015	2.03
F2065	2.54
F2016	2.25
F2066	1.64
F1813	3.60
F2067	3.54
F1972	2.02
F2035	2.51
F1979	3.22
F2036	3.15
F1997	1.22
F2057	1.22
F2004	0.89
F2058	0.95

14 sets of blind duplicates
avg. percent deviation from mean: 8.5%
range: 1 - 22%

3. BLIND DUPLICATES - Cont'd

B. Vegetation and Food Ash

Data Period: Mar. 1967
Laboratory: Q

HASL No.	dpm Sr^{90}/gram	gCa/gram
F1752	1.93	0.043
F1764	1.73	0.048
F1759	1.82	0.019
F1765	1.13	0.016
F1774	6.66	0.051
F1786	6.44	0.044
F1781	1.35	0.015
F1787	1.95	0.015
F1796	5.55	0.047
F1832	6.08	0.047
F1803	1.40	0.014
F1833	1.60	0.015
F1888	0.11	0.028
F1893	0.33	0.030
F1896	0.33	0.039
F1900	1.00	0.041
F1903	0.42	0.035
F1908	0.36	0.034
F1895	19.9	0.021
F1902	14.2	0.022
F1910	17.8	0.021

10 sets of blind replicates

Sr^{90}: avg. percent deviation from mean: 14.7% (1)
range: 2 - 33% (1)

(1) excluding two samples below 1 dpm/gm

Ca: avg. percent deviation from mean: 5.1%
range: 0 - 10%

3. BLIND DUPLICATES - Cont'd

B. Vegetation and Food Ash

Data Period: June 1967
Laboratory: F

HASL No.	dpm Sr^{90}/gram	gCa/gram
F1847	2.89	0.040
F1859	2.90	0.046
F1854	0.82	0.006
F1860	1.04	0.021
F1869	3.00	0.020
F1929	1.22	0.022
F1875	2.00	0.008
F1930	2.09	0.015
F1917	0.60	0.003
F1956	0.40	0.036
F1924	1.04	0.015
F1957	1.51	0.014

6 sets of blind duplicates

Sr^{90}: avg. percent deviation from mean: 22.6%
range: 1 - 60%

Ca: avg. percent deviation from mean: 42.7%
range: 5 - 115%

4. SPIKES

A. Ion-Exchange Resin Sr^{90}

Data Period: Oct. 1966 - Oct. 1967: Lab NN
Jan. 1967 - Apr. 1967: Lab CC
Jan. 1967 - Dec. 1967: HASL

Lab NN			Lab CC		HASL	
dpm Sr^{90} added			dpm Sr^{90} added		dpm Sr^{90} added	
24	43	54	24	54	24	54
dpm found			dpm found		dpm found	
29	30	43	29	58	24	58
18	32	36	25	52	25	56
21	43	50	20	60	27	58
29	39	61	24	62	30	49
26	40	47		45		
25	39	39	4 results avg. 24±4 dpm Sr^{90}	5 results avg. 55±7 dpm Sr^{90}	4 results avg. 26±3 dpm Sr^{90}	4 results avg. 55±4 dpm Sr^{90}
21	34	52				
27	31	54				
26	30	50				
25	34	56				
21	41	57				
26	40	55				
28	32	54				
24	42	51				
25	32	53				
24	34	62				
33	46	50				
26	41	62				
25	38	53				
28	32	47				
35	47	32				
21	46	52				
25	37	66				
25	43	53				
27		54				
24		61				
23		52				
27		52				
23		53				
27		56				
31 results avg: 25±4 dpm Sr^{90}	25 results avg. 38±4 dpm Sr^{90}	31 results avg: 52±7 dpm Sr^{90}				

4. SPIKES - Cont'd

B. Simulated Pot Collection - Sr^{90}

Data Period: Oct. 1966 - Oct. 1967: Lab NN
Jan. 1967 - Dec. 1967: HASL

Lab NN

dpm Sr^{90} added: 24	43	54
dpm found		
25	34	54
29	34	50
23	40	55
10	36	51
25	38	50
24	20	55
23	41	48
26	25	45
26	22	51
25	38	55
19	13	37
25	34	51
14	39	57
26	42	49
25	38	46
24	38	64
28	42	58
33	52	54
26	20	59
26	44	52
27		63
35		56
26		58
26		54
29		63
52		50
21		49
23		53
28		70
54		54
25		49
25		57
27		
30		
34 results avg. 27±8 dpm Sr^{90}	20 results avg. 34±7 dpm Sr^{90}	32 results avg. 54±7 dpm Sr^{90}

HASL

dpm Sr^{90} added: 24	43	54
dpm found		
26	38	55
27	44	50
29	37	44
	38	50
3 results avg. 27±2 dpm Sr^{90}	4 results avg. 39±3 dpm Sr^{90}	4 results avg. 50±4 dpm Sr^{90}

4. SPIKES - Cont'd

D. Simulated Pot Collection - Sr^{89}

Data Period: Oct. 1966 - Oct. 1967
Laboratory: NN

dpm Sr^{89} expected	dpm Sr^{89} found
440	440
440	440
290	280
290	290
250	250
250	300
230	250
230	280
250	270
250	340
240	170
240	310
210	340
210	220
230	220
230	260
230	230
230	250
230	210
230	210
220	240
220	140

22 pairs of results
avg. percent recovered:
106±21%

dpm Sr^{89} expected	dpm Sr^{89} found
1450	500
1450	1400
1200	1020
1200	1140
940	990
940	830
1240	1290
1240	220
1200	1240
1200	1400
1140	1100
1140	1120
1220	1200
1220	1160
1140	1070
1140	1050
1150	1060
1150	1170
1230	1190
1230	1180

20 pairs of results
avg. percent recovered:
90±24%

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 - First Quarter, 1967

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.

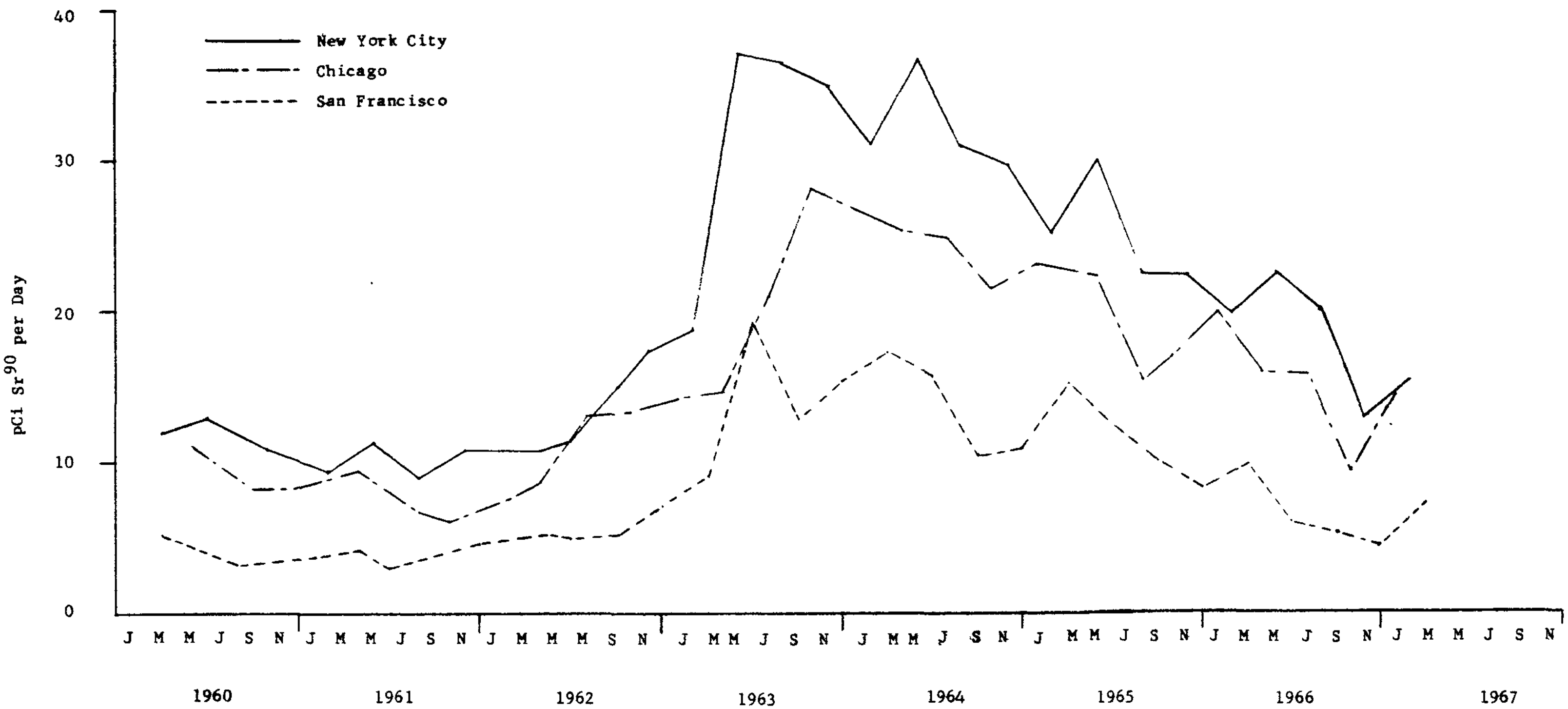
The results of the analyses of foods and estimates of the intake of Sr-90 at each of the cities made this way are shown in Table 3. The estimated average daily intakes of Sr-90 at each of the cities since the tri-city diet studies began are shown in Figure 3.

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).

STRONTIUM-90 IN TRI-CITY DIETS - FIRST QUARTER - 1967

			CHICAGO - 1/67		NEW YORK CITY - 2/67		SAN FRANCISCO - 3/67	
	kg/yr	gCa/yr	pCi/kg	pCi/yr	pCi/kg	pCi/yr	pCi/kg	pCi/yr
MILK	221	234.5	6.0	1326	10.4	2298	3.5	774
FRESH FRUIT	68	12.9	7.0	476	14.6	993	7.9	537
FRESH VEGETABLES	43	15.3	17.7	761	9.6	413	4.0	172
ROOT VEGETABLES	17	6.3	10.4	177	9.3	158	6.9	117
POTATOES	45	4.9	13.6	612	0.9	41	2.3	104
MACARONI	3	0.6	7.4	22	7.4	22	4.6	14
RICE	3	1.0	1.7	5	3.5	11	1.9	6
FRUIT JUICES	19	1.7	4.1	78	7.1	135	5.6	106
CANNED VEGETABLES	20	4.2	11.0	220	16.3	326	6.0	120
CANNED FRUIT	26	1.3	2.6	68	3.3	86	1.1	29
DRIED BEANS	3	3.1	21.1	63	16.2	49	1.2	4
FLOUR	43	8.6	12.4	533	12.0	516	2.9	125
BAKERY PRODUCTS	37	39.2	9.4	348	5.3	196	4.9	181
WHOLE GRAIN PRODUCTS	11	10.1	39.6	436	11.0	121	17.4	191
FRESH FISH	8	8.4	4.3	34	0.6	5	0.4	3
SHELL FISH	1	1.2	0.3	0	1.8	2	1.7	2
POULTRY	17	8.2	1.3	22	1.4	24	3.4	58
MEAT	73	11.7	0.7	51	1.3	95	1.3	95
EGGS	16	9.3	2.9	46	7.1	114	1.4	22
TOTAL				5278		5605		2660
pCi/Sr^{90}/day				14.4		15.4		7.3
pCi/Sr^{90}/g Ca				13.8		14.6		6.9

DAILY INTAKE OF STRONTIUM-90



SURFACE AIR SAMPLING PROGRAM

by Herbert L. Volchok (HASL) and
Michael T. Kleinman (HASL)

Since January 1963, the Health and Safety Laboratory (HASL) has been conducting the Surface Air Sampling Program. This study is a direct outgrowth of a program initiated by the U. S. Naval Research Laboratory (NRL) in 1957 and continued through 1962, for sampling and analysis of radioactivity in the surface air along the 80th Meridian (west). The primary objective of this program is to study the spatial and temporal distribution of nuclear weapons debris in the surface air.

Sampling Sites

Most of the original NRL sites, which grouped roughly along the 80th Meridian (west) have been continued in the current program. Since 1963 a number of other sites were added to investigate the possible effects of longitude, elevation and proximity to coastlines; and in late 1965 samplers were placed on four Atlantic Ocean weather ships to extend the surface air study over the marine environment. The present network extends from about 76° North to 63° South. Table 4a lists the sampling stations along with their coordinates and elevations.

Sampling Collection and Analysis

For the routine 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 first, 8th, 15th and 22nd of the month or more frequently if the filter becomes clogged. Under normal conditions, the filters from each station are compressed into a monthly composite and the gamma spectrum of the composite is obtained with an 8" x 4" NaI (Tl) crystal approximately two weeks after the last collection in the month.

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/$10^3 m^3$. 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.

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, Ce-144, Pu-238 and Pu-239. In samples collected after May 1966, following the Chinese and French nuclear weapons tests, additional shorter lived nuclides were analyzed such as Sr-89, Zr-95, and Ce-141.

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 re-entry 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, 6, and 7).

Results

The activity concentrations in surface air during 1966 of all the radionuclides investigated in this program are presented in Tables 4-b through 4-1. The sites are listed according to latitude beginning with the most northern site at Thule, Greenland.

The concentrations are reported at the midpoint of the collection month for the plutonium isotopes and the fission products and on the specified dates for the following 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 ±20% unless otherwise indicated by the following symbols:

A: One standard deviation of the counting error between 20 - 100%

B: One standard deviation of the counting error greater than 100% (Data do not appear in the tables).

Data Reliability

Quality of the radiochemical analyses is monitored through the use of various "knowns" submitted to the contractor each month along with the regular samples. There are basically three kinds of quality control samples: blanks, standards and duplicates.

A blank is prepared by sprinkling a small amount of pre-1945 soil (10 mg) onto an unexposed Microsorban filter. Then carbon soot from burning napthalene 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. Table 4-m lists the results of analyses of blanks in 1966. The Table summarizes the average dpm reported from blanks sent out each month. It is evident from a review of these data that the contamination problem has been quite variable, and consequently low level concentrations in the real samples must be considered with care.

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 fibers of the Microsorban filter.

Table 4-n presents the results of these analyses for each nuclide in 1966. The values are average percent deviations of the reported analyses from the known. Again the results are seen to be extremely variable and generally non-systematic.

Duplicate collections are made monthly at the New York site. These samples are composited and split before analysis thereby providing a measure of the reproducibility of the radiochemical procedures. The results of these tests are shown as the % standard deviation from the mean, in Table 4-o.

REFERENCES

(1) Volchok, H. L.
The HASL Surface Air Sampling Program - Summary Report for 1963
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(7) Krey, P. W.
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USAEC Report HASL-182, July (1967)

Table 4-a

HASL SURFACE AIR SAMPLING STATIONS

STATIONS	LATITUDE	LONGITUDE	ELEVATION(m)
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° 30' W	10
Delta Ocean Station	49° 00' N	41° 00' W	0
Seattle, Washington	47° 36' N	122° 20' W	3
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
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
Balboa, Panama Canal Zone	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
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
Pedro Aguirre Cerda, Chile	62° 56' S	60° 36' W	16

Table 4-B

MANGANESE - 54 CONCENTRATIONS IN SURFACE AIR DURING 1966

(DPM / KSCM)

SITE	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
THULE, GREENLAND	*******	243.86	286.08	237.98	*******	*******	*******	*******	*******	*******	*******	*******
CHARLIE	*******	50.29	391.12	126.95	*******	*******	*******	*******	*******	*******	*******	*******
BRAVO	*******	80.20	128.02	215.02	*******	*******	*******	*******	*******	*******	*******	*******
MOOSONEE, ONTARIO	95.67	115.67	152.26	96.76	*******	*******	*******	*******	*******	*******	*******	*******
DELTA	*******	97.87	151.90	125.05	*******	*******	*******	*******	*******	*******	*******	*******
WESTWOOD, NEW JERSEY	*******	*******	*******	160.33	*******	*******	*******	*******	*******	*******	*******	*******
NEW YORK, NEW YORK	110.79	93.65	201.61	147.55	*******	*******	*******	*******	*******	*******	*******	*******
STERLING, VIRGINIA	77.78	96.02	157.73	90.63	*******	*******	*******	*******	*******	*******	*******	*******
ECHO	*******	212.11	182.02	143.05	*******	*******	*******	*******	*******	*******	*******	*******
MIAMI, FLORIDA	133.25	149.16	258.97	276.19	*******	*******	*******	*******	*******	*******	*******	*******
MAUNA LOA, HAWAII	189.52	163.00	340.00	207.48	*******	*******	*******	*******	*******	*******	*******	*******
SAN JUAN, PUERTO RICO	53.22	131.44	235.64	108.79	*******	*******	*******	*******	*******	*******	*******	*******
BALBOA, PANAMA	53.91	97.46	139.08	75.00	*******	*******	*******	*******	*******	*******	*******	*******
GUAYAQUIL, ECUADOR	19.69A	24.09A	38.54A	16.72A	*******	*******	*******	*******	*******	*******	*******	*******
LIMA, PERU	51.77	75.91	48.22	14.08A	*******	*******	*******	*******	*******	*******	*******	*******
CHACALTAYA, BOLIVIA	30.24A	*******	54.98A	50.93A	*******	*******	*******	*******	*******	*******	*******	*******
ANTOFAGASTA, CHILE	50.68	52.69	34.15A	38.70A	*******	*******	*******	*******	*******	*******	*******	*******
SANTIAGO, CHILE	63.66	71.08	43.34A	*******	*******	*******	*******	*******	*******	*******	*******	*******
PUERTO MONTT, CHILE	33.92	44.85	36.96	49.74	*******	*******	*******	*******	*******	*******	*******	*******
PUNTA ARENAS, CHILE	30.36	16.93A	36.34	22.79A	*******	*******	*******	*******	*******	*******	*******	*******

NOTES

******* - NO DATA

ERRORS ARE LESS THAN 20% EXCEPT:

A - ERROR BETWEEN 20% AND 100%

B - ERROR GREATER THAN 100%

Table 4-C

IRON - 55 CONCENTRATIONS IN SURFACE AIR DURING 1966

(DPM / KSCM)

SITE	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
THULE, GREENLAND	*******	209.12	319.59	163.80	141.80	122.03	99.68	84.27	16.04	58.49	27.37	47.92
CHARLIE	*******	61.40	395.79	82.32	87.72	62.57	124.04	40.29	14.80	13.77	28.26	18.27
BRAVO	*******	69.59	169.96	177.09	67.87	70.33	47.65	58.49	16.37	9.80	19.61	19.64
MOOSONEE, ONTARIO	83.89	103.66	192.40	114.21	119.95	138.15	166.32	69.34	36.67	28.89	24.40	32.81
DELTA	*******	104.88	220.44	100.92	149.04	91.86	81.48	45.60	25.55	23.72	32.65	10.31A
SEATTLE, WASHINGTON	83.20	103.36	183.77	146.15	152.78	104.23	80.23	107.14	34.07	20.27A	0.0	25.07A
WESTWOOD, NEW JERSEY	80.28	84.73	149.44	160.33	176.52	222.46	173.39	65.75	42.78	*******	*******	*******
NEW YORK, NEW YORK	134.69	97.62	265.16	153.60	265.00	319.49	260.00	95.17	40.05A	*******B	211.87A	54.04A
STERLING, VIRGINIA	89.86	114.85	246.38	124.30	214.69	263.94	235.48	126.53	22.30A	59.07	13.69A	44.94A
ECHO	*******	161.97	254.13	163.00	199.01	67.86	*******	51.95	*******	18.88	27.22	22.51
MIAMI, FLORIDA	159.08	136.52	341.03	291.07	141.79	104.70	82.13	1.51A	6.07A	28.91	30.28A	70.18
BIMINI, BAHAMAS	*******	*******	*******	*******	*******	*******	53.39	106.25	46.61A	104.17	112.15	59.53A
MAUNA LOA, HAWAII	213.31	246.26	327.17	267.35	234.26	218.85	174.52	65.89	11.67A	19.53A	25.56A	33.54
SAN JUAN, PUERTO RICO	62.18	147.49	313.86	129.30	117.97	110.64	71.81	74.28	16.31A	8.34A	16.09A	36.09
BALBOA, PANAMA	60.89	86.35	154.89	92.33	38.58	100.00	25.04	6.55A	*******	0.0	*******B	*******B
GUAYAQUIL, ECUADOR	13.94A	25.88	17.45A	34.78A	*******	17.38A	28.65A	44.53	*******	0.0	*******B	22.53A
LIMA, PERU	60.22	58.84	66.85	36.87A	34.48	32.68	72.22	59.79A	30.65A	*******	24.28A	108.36
CHACALTAYA, BOLIVIA	32.92	28.36	34.98	25.67A	26.54	58.02	68.72	78.42	172.83	61.50	71.49	48.42
ANTOFAGASTA, CHILE	60.96	52.69	42.01	47.79	30.26	24.41A	59.29	98.55	9.49A	49.75	95.23	19.53A
PORTILLO, CHILE	*******	*******	*******	*******	157.30	44.84	364.00	244.05	*******	*******	*******	312.00
SANTIAGO, CHILE	85.71	152.96	138.91	109.32A	*******	21.20A	69.07A	39.38A	*******	42.49A	*******B	58.52A
PUERTO MONTT, CHILE	43.29	52.65	54.68	46.41	18.40	11.76	21.96	41.16	6.80A	15.48	0.0	63.54A
PUNTA ARENAS, CHILE	*******	54.66	49.74	25.63A	8.49A	12.32	17.23	22.32	*******	0.0	0.0	29.06A

NOTES

******* - NO DATA

ERRORS ARE LESS THAN 20% EXCEPT:

A - ERROR BETWEEN 20% AND 100%

B - ERROR GREATER THAN 100%

Table 4-D

STRONTIUM - 89 CONCENTRATIONS IN SURFACE AIR DURING 1966

(DPM / KSCM)

SITE	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
THULE, GREENLAND	*******	*******	*******	*******	93.65A	*******	8.08	4.94	9.60	4.34A	103.52	34.47
CHARLIE	*******	*******	*******	*******	*******	*******	9.90	6.27	1.44A	0.81A	36.32	12.12
BRAVO	*******	*******	*******	*******	2.16	4.84	2.20A	9.20	*******	0.0	14.30	10.49
MOOSONEE, ONTARIO	*******	*******	*******	*******	*******	25.07	*******	6.55	*******	0.0	46.93	13.26
DELTA	*******	*******	*******	*******	*******	14.20	20.60	6.45	*******	*******B	36.11	13.42
SEATTLE, WASHINGTON	*******	*******	*******	*******	*******	5.11	10.00	16.00	12.47A	0.0	25.80	4.76
NEW YORK, NEW YORK	*******	*******	*******	*******	228.57	538.46	292.50	9.43A	6.64	4.68A	57.99	36.26
STERLING, VIRGINIA	*******	*******	*******	*******	22.53	65.63	55.11	7.98	6.30A	0.0	51.46	10.32A
ECHO	*******	*******	*******	*******	0.66A	15.89	*******	5.89	*******	*******B	30.89	0.0
MIAMI, FLORIDA	*******	*******	*******	*******	110.51	103.87	24.64	11.96	1.78A	12.20	141.11	0.0
BIMINI, BAHAMAS	*******	*******	*******	*******	*******	*******	29.82A	7.23	17.24	13.26A	139.50	20.29
MAUNA LOA, HAWAII	*******	*******	*******	*******	121.51	366.92	44.49	7.29	4.57A	0.0	8.78A	0.0
SAN JUAN, PUERTO RICO	*******	*******	*******	*******	43.49	76.75	32.98	*******	*******	*******B	18.26	0.0
BALBOA, PANAMA	*******	*******	*******	*******	20.33	9.97	8.90	4.66	3.87	5.92	12.18	5.89A
GUAYAQUIL, ECUADOR	*******	*******	*******	*******	*******	3.36	230.95	5.75	11.76	144.82	175.26	74.15
LIMA, PERU	*******	*******	*******	*******	0.61A	5.84	526.46	44.50	25.57A	1108.70	332.37	83.57
CHACALTAYA, BOLIVIA	*******	*******	*******	*******	*******	37.92	1859.03	253.53	12,746	1478.87	337.72	84.21
ANTOFAGASTA, CHILE	*******	*******	*******	*******	*******	*******	261.90	43.48	*******	826.63	131.03	63.06
PORTILLO, CHILE	*******	*******	*******	*******	8.46	*******	7933.33	145.83	*******	*******	*******	222.40
SANTIAGO, CHILE	*******	*******	*******	*******	*******	*******	251.89	44.86	80.69	202.07	117.54	60.45
PUERTO MONTT, CHILE	*******	*******	*******	*******	*******	*******	2.01	22.92	5.09	19.43	47.53	23.46
PUNTA ARENAS, CHILE	*******	*******	*******	*******	0.76	*******	1.08	4.64	4.72	13.59	15.25	6.28

NOTES

******* - NO DATA

ERRORS ARE LESS THAN 20% EXCEPT:

A - ERROR BETWEEN 20% AND 100%

B - ERROR GREATER THAN 100%

Table 4-E

STRONTIUM - 90 CONCENTRATIONS IN SURFACE AIR DURING 1966

(DPM / KSCM)

SITE	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
THULE, GREENLAND	*******	26.04	26.29	27.80	3.54	14.70	7.95	6.32	5.46	4.74	2.44	5.11
CHARLIE	*******	5.26	41.50	15.31	8.42	5.45	3.30	4.33	2.17	1.62	2.39	1.48
BRAVO	*******	8.80	12.60	20.91	5.99	7.05	3.79	4.08	1.95A	0.91	1.38	1.69
MOOSONEE, ONTARIO	9.74	12.09	12.47	12.94	17.37	14.77	14.90	6.05	4.14	2.72	3.31	2.06
DELTA	*******	9.18	16.39	13.50	14.79	11.49	7.15	3.20	4.16	2.23	2.70	1.63
SEATTLE, WASHINGTON	8.15	9.76	14.23	15.31	10.83	10.18	6.16	5.57A	3.60	2.34	2.69	1.97
WESTWOOD, NEW JERSEY	12.28	13.68	22.54	19.10	24.90	34.77	21.40	9.64	5.98	*******	*******	*******
NEW YORK, NEW YORK	12.42	8.85	20.10	18.93	22.50	27.38	19.45	9.27	6.71	4.50	3.95	3.12
STERLING, VIRGINIA	9.93	11.14	17.10	13.22	23.92A	26.76	17.98	8.91	5.38	4.46	3.58	3.80
ECHO	*******	17.01	17.60	19.51	22.22	5.29	*******	5.04	4.33	2.03	2.40	1.71
MIAMI, FLORIDA	13.45	12.70	21.74	32.44	*******	12.51	6.11	1.08	1.89	3.13	5.94	4.27
BIMINI, BAHAMAS	*******	*******	*******	*******	*******	*******	16.61	9.96	4.08	5.42	7.38	4.20
MAUNA LOA, HAWAII	18.06	18.81	36.68	30.85	31.59	21.88	15.25	5.78	4.33	2.45	2.44	4.46
SAN JUAN, PUERTO RICO	6.16	14.28	18.32	13.41	12.19	14.68	6.25	5.85	2.95	1.24	2.41	2.56
BALBOA, PANAMA	6.48	10.22	11.90	9.23	3.18	0.73	1.08	1.16	0.24A	0.20A	1.39	1.36
GUAYAQUIL, ECUADOR	2.07	2.38	1.33	1.27	1.17	1.75	2.56	3.56	1.75	2.24	4.77	2.77
LIMA, PERU	8.42	7.71	5.12	3.97	2.73	2.65	7.04	5.01	7.17	12.61	9.08	5.27
CHACALTAYA, BOLIVIA	3.70	2.20	3.47	2.59	3.19	6.04	14.54	6.27	27.81A	10.42	6.80	3.81
ANTOFAGASTA, CHILE	7.36	5.98	3.58	3.19	2.85	2.51	5.79	4.28	5.33	12.16	4.08	2.93
PORTILLO, CHILE	*******	*******	*******	*******	8.18	5.08	152.00A	27.68	*******	*******	*******	21.60
SANTIAGO, CHILE	9.13	11.05	5.80	4.91A	3.43	2.71	6.70	5.41	3.74	5.05	5.66	3.92
PUERTO MONTT, CHILE	4.86	5.54	3.32	3.00	1.78	1.59A	1.46	3.34	1.78	2.00	3.35	1.43
PUNTA ARENAS, CHILE	2.84	2.72	3.14	1.88	1.29	1.30	1.55	2.12	1.34	0.72	0.83A	1.03

NOTES ---

******* - NO DATA

ERRORS ARE LESS THAN 20% EXCEPT:

A - ERROR BETWEEN 20% AND 100%

B - ERROR GREATER THAN 100%

Table 4-F

ZIRCONIUM - 95 CONCENTRATIONS IN SURFACE AIR DURING 1966

(DPM / KSCM)

SITE	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
THULE, GREENLAND	*******	*******	*******	*******	5.16A	39.15	10.45	3.29	2.50	1.45A	29.00	12.35
CHARLIE	*******	*******	*******	*******	5.34	6.60	10.80	4.08	2.46	1.07A	23.66	4.83A
BRAVO	*******	*******	*******	*******	2.65A	7.20	13.50	86.31	2.72	3.75	12.29	11.36A
MOOSONEE, ONTARIO	*******	*******	*******	*******	9.60	27.79	13.83	2.47	2.34A	3.19	31.47	8.46
DELTA	*******	*******	*******	*******	8.64	26.78	34.97	1.79	2.73	6.07	36.89	4.07A
SEATTLE, WASHINGTON	*******	*******	*******	*******	58.06	17.98	12.76	4.60	2.26A	1.60	15.65	2.26
NEW YORK, NEW YORK	*******	*******	*******	*******	34.61	68.21	39.50	5.47	3.15	5.89	88.81	12.82
STERLING, VIRGINIA	*******	*******	*******	*******	32.22	85.07	271.51	6.76	3.59A	1.47A	41.38	11.73
ECHO	*******	*******	*******	*******	37.98	20.79	*******	3.29	1.70	1.24A	24.96	*******B
MIAMI, FLORIDA	*******	*******	*******	*******	64.36	131.22	17.52	37.00	1.01A	6.92	167.50	9.21
BIMINI, BAHAMAS	*******	*******	*******	*******	*******	*******	123.21	14.15	4.52A	7.54	160.22	9.63
MAUNA LOA, HAWAII	*******	*******	*******	*******	90.44	453.85	55.89	6.09	4.73	19.53	18.41	17.12
SAN JUAN, PUERTO RICO	*******	*******	*******	*******	97.14	144.26	62.23	7.51	2.93A	10.77	15.13	11.00
BALBOA, PANAMA	*******	*******	*******	*******	16.94	16.81	10.73	5.45	2.62A	12.12	11.06	5.97
GUAYAQUIL, ECUADOR	*******	*******	*******	*******	*******	11.96	42.41	5.40	28.61	16.50	207.47	112.27
LIMA, PERU	*******	*******	*******	*******	5.99A	6.45	767.20	154.42	96.13	1266.30	595.38	274.93
CHACALTAYA, BOLIVIA	*******	*******	*******	*******	3.93A	52.36	4537.45	614.11	14,498	2784.04	758.77	204.21
ANTOFAGASTA, CHILE	*******	*******	*******	*******	1.38A	*******	585.71	103.62	8.36	19.80	251.99	109.76
PORTILLO, CHILE	*******	*******	*******	*******	46.29	*******B	15,775	410.71	*******	*******	*******	514.40
SANTIAGO, CHILE	*******	*******	*******	*******	*******	*******	450.17	172.26	16.48	2.64A	272.92	138.26
PUERTO MONTT, CHILE	*******	*******	*******	*******	*******	*******	44.63	56.68	12.75	46.67	122.35	50.00
PUNTA ARENAS, CHILE	*******	*******	*******	*******	*******	*******	6.45	12.15	8.38	24.24	28.31	26.35

NOTES

******* - NO DATA

ERRORS ARE LESS THAN 20% EXCEPT:

A - ERROR BETWEEN 20% AND 100%

B - ERROR GREATER THAN 100%

Table 4-G

CADMIUM - 109 CONCENTRATIONS IN SURFACE AIR DURING 1966

(DPM / KSCM) X 100

SITE	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
THULE, GREENLAND	*******	*******	78.87	80.12	77.25	*******	*******	*******	23.93	0.0	0.0	24.45
CHARLIE	*******	1301.17	62.15	61.05	12.29	37.99	*******	26.75	52.01	0.0	0.0	0.0
BRAVO	*******	*******	50.92	27.09	15.83	40.23	*******	*******	26.96	20.60	34.31	54.71
MOOSONEE, ONTARIO	18.13	*******	68.65	59.35	39.14	*******	53.63	*******	*******	0.0	0.0	0.0
DELTA	*******	*******	56.91	*******	58.15	*******	11.61	*******	20.98	37.50	0.0	37.80
SEATTLE, WASHINGTON	41.05	*******	62.90	*******	45.00	108.46	*******	117.43	*******	77.03	0.0	47.35
WESTWOOD, NEW JERSEY	*******	*******	*******	59.78	79.55	63.08	108.12	63.29	25.95	*******	*******	*******
NEW YORK, NEW YORK	48.98	*******	84.19	46.11	94.64	119.49	58.50	75.53	497.63	657.89	121.00	15.47
STERLING, VIRGINIA	*******	140.85	104.35	80.25	55.15	*******	194.35	31.03	*******	0.0	0.0	67.41
ECHO	*******	*******	90.91	2.69	43.95	9.89	*******	*******	125.96	0.0	0.0	49.19
MIAMI, FLORIDA	62.15	*******	62.05	109.52	54.62	84.25	*******	*******	*******	80.11	61.11	65.17
BIMINI, BAHAMAS	*******	*******	*******	*******	*******	*******	310.71	339.29	47.06	0.0	0.0	53.26
MAUNA LOA, HAWAII	52.02	50.22	153.96	267.35	169.72	30.46	*******	109.30	*******	0.0	0.0	25.00
SAN JUAN, PUERTO RICO	24.51	*******	381.19	*******	58.07	22.80	*******	50.39	*******	0.0	13.91	65.91
BALBOA, PANAMA	17.93	80.00	58.91	*******	28.04	*******	566.20	*******	*******	74.38	0.0	80.56
GUAYAQUIL, ECUADOR	*******	*******	153.12	*******	*******	*******	65.62	36.32	*******	0.0	12.37	0.0
LIMA, PERU	96.46	*******	219.18	*******	44.03	*******	*******	*******	48.51	0.0	0.0	62.25
CHACALTAYA, BOLIVIA	47.12	*******	76.78	263.92	*******	*******	85.46	65.15	112.08	384.98	22.37	116.84
ANTOFAGASTA, CHILE	81.51	37.39	135.23	121.30	*******	*******	47.86	*******	47.22	9.55	0.0	21.11
PORTILLO, CHILE	*******	*******	*******	*******	161.80	*******	167.33	280.36	*******	*******	*******	170.40
SANTIAGO, CHILE	*******	*******	275.43	*******	22.45	167.44	41.24	40.07	42.68	0.0	0.0	60.13
PUERTO MONTT, CHILE	62.53	42.34	36.71	37.18	20.95	*******	*******	46.93	*******	250.00	0.0	0.0
PUNTA ARENAS, CHILE	*******	*******	80.41	30.87	43.27	*******	162.18	*******	53.03	0.0	0.0	146.55

NOTES

******* - NO DATA

ERRORS ARE LESS THAN 20% EXCEPT:

A - ERROR BETWEEN 20% AND 100%

B - ERROR GREATER THAN 100%

Table 4-H

CESIUM - 137 CONCENTRATIONS IN SURFACE AIR DURING 1966

(DPM / KSCM)

SITE	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
THULE, GREENLAND	*******	37.54	42.27	37.98	*******	*******	*******	*******	*******	*******	*******	*******
CHARLIE	*******	7.13	55.61	17.60	*******	*******	*******	*******	*******	*******	*******	*******
BRAVO	*******	11.20	16.50	25.37	*******	*******	*******	*******	*******	*******	*******	*******
MOOSONEE, ONTARIO	15.34	16.87	24.23	17.46	*******	*******	*******	*******	*******	*******	*******	*******
DELTA	*******	15.91	21.64	15.51	*******	*******	*******	*******	*******	*******	*******	*******
WESTWOOD, NEW JERSEY	*******	*******	*******	27.07	*******	*******	*******	*******	*******	*******	*******	*******
NEW YORK, NEW YORK	24.64	15.75	39.35	26.66	*******	*******	*******	*******	*******	*******	*******	*******
STERLING, VIRGINIA	15.24	16.07	29.47	16.48	*******	*******	*******	*******	*******	*******	*******	*******
ECHC	*******	24.31	29.75	22.65	*******	*******	*******	*******	*******	*******	*******	*******
MIAMI, FLORIDA	24.07	21.80	44.10	44.05	*******	*******	*******	*******	*******	*******	*******	*******
MAUNA LOA, HAWAII	38.99	24.80	57.74	41.16	*******	*******	*******	*******	*******	*******	*******	*******
SAN JUAN, PUERTO RICO	10.76	22.58	30.50	18.28	*******	*******	*******	*******	*******	*******	*******	*******
BALBOA, PANAMA	9.94	14.63	18.33	14.01	*******	*******	*******	*******	*******	*******	*******	*******
GUAYAQUIL, ECUADOR	3.80	3.70	2.79	2.16	*******	*******	*******	*******	*******	*******	*******	*******
LIMA, PERU	13.71	12.29	7.45	5.34	*******	*******	*******	*******	*******	*******	*******	*******
CHACALTAYA, BOLIVIA	9.29	3.61	5.12	4.68	*******	*******	*******	*******	*******	*******	*******	*******
ANTOFAGASTA, CHILE	8.70	9.46	19.51	5.56	*******	*******	*******	*******	*******	*******	*******	*******
SANTIAGO, CHILE	20.06	18.68	10.03	6.56	*******	*******	*******	*******	*******	*******	*******	*******
PUERTO MONTT, CHILE	9.77	7.99	5.32	4.38	*******	*******	*******	*******	*******	*******	*******	*******
PUNTA ARENAS, CHILE	5.79	4.10	5.18	3.17	*******	*******	*******	*******	*******	*******	*******	*******

NOTES

******* - NO DATA

ERRORS ARE LESS THAN 20% EXCEPT:

A - ERROR BETWEEN 20% AND 100%

B - ERROR GREATER THAN 100%

Table 4-I

CERIUM - 141 CONCENTRATIONS IN SURFACE AIR DURING 1966

(DPM / KSCM)

SITE	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
THULE, GREENLAND	*******	*******	*******	*******	608.47A	22.03	36.69A	*******	*******	0.0	46.88A	0.0
CHARLIE	*******	*******	*******	*******	*******	33.62A	*******	*******	101.93A	0.0	94.37A	0.0
BRAVO	*******	*******	*******	*******	261.76	17.97	32.10	81.88	41.54A	0.0	80.39A	*******B
MOOSONEE, ONTARIO	*******	*******	*******	*******	*******	64.03	*******	*******	103.06A	21.61A	44.53A	*******B
DELTA	*******	*******	*******	*******	*******	39.05	28.24A	27.52A	69.72A	0.0	88.23A	221.65A
SEATTLE, WASHINGTON	*******	*******	*******	*******	21.89A	28.10	28.92A	*******	108.52A	40.27A	0.0	0.0
NEW YORK, NEW YORK	*******	*******	*******	*******	496.43	166.15	52.75A	54.38A	78.91A	19.63A	*******	102.08A
STERLING, VIRGINIA	*******	*******	*******	*******	35.31A	105.63	108.60	33.16A	*******	26.68A	117.51A	0.0
ECHO	*******	*******	*******	*******	26.53A	37.86A	*******	72.37	44.09A	0.0	0.0	94.90A
MIAMI, FLORIDA	*******	*******	*******	*******	261.54	166.30	63.47	65.42A	95.22A	13.40A	0.0	0.0
BIMINI, BAHAMAS	*******	*******	*******	*******	*******	*******	105.36	79.91A	414.93	0.0	134.53A	0.0
MAUNA LOA, HAWAII	*******	*******	*******	*******	294.42	646.15	141.83	52.71	*******	0.0	0.0	0.0
SAN JUAN, PUERTO RICO	*******	*******	*******	*******	125.52	147.90	84.57	*******	*******	0.0	0.0	0.0
BALBOA, PANAMA	*******	*******	*******	*******	33.83A	16.44	18.42A	40.27	51.86A	0.0	0.0	323.94A
GUAYAQUIL, ECUADOR	*******	*******	*******	*******	*******	16.96A	593.12	18.01A	77.27A	428.57A	0.0	845.95A
LIMA, PERU	*******	*******	*******	*******	3.24A	16.82	1240.74	154.42	*******	2078.80A	0.0	1135.45A
CHACALTAYA, BOLIVIA	*******	*******	*******	*******	13.88	88.21	7224.67	684.65A	*******A	2281.69A	0.0	0.0
ANTOFAGASTA, CHILE	*******	*******	*******	*******	*******	*******	854.76	200.24A	*******	2369.35	0.0	0.0
PORTILLO, CHILE	*******	*******	*******	*******	30.11A	18.37	*******	123.81A	*******	*******	*******	0.0
SANTIAGO, CHILE	*******	*******	*******	*******	*******	4.11A	652.92	222.60	210.28A	0.0	0.0	*******B
PUERTO MONTT, CHILE	*******	*******	*******	*******	*******	*******	11.81	152.71	208.19A	0.0	764.71A	0.0
PUNTA ARENAS, CHILE	*******	*******	*******	*******	*******	3.75A	10.56	32.92	84.85A	0.0	201.56A	0.0

NOTES

******* - NO DATA
ERRORS ARE LESS THAN 20% EXCEPT:
A - ERROR BETWEEN 20% AND 100%
B - ERROR GREATER THAN 100%

Table 4-J

CERIUM - 144 CONCENTRATIONS IN SURFACE AIR DURING 1966

(DPM / KSCM)

SITE	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
THULE, GREENLAND	*******	55.09	46.65	46.88	31.75	21.78	11.01	9.38	6.99	6.58	9.24	10.39
CHARLIE	*******	9.53	70.56	27.37	13.77	8.29	5.35	6.15	2.77	2.12	8.59	3.78
BRAVO	*******	17.41	21.61	25.12	8.07	10.90	5.02	6.70	2.85	0.91	4.56	3.77
MOOSONEE, ONTARIO	18.75	23.03	26.13	19.10	24.55	22.26	25.23	9.36	5.89	4.19	10.88	4.84
DELTA	*******	21.10	27.45	20.63	23.48	18.79	13.99	4.62	5.02	2.44	11.26	3.73
SEATTLE, WASHINGTON	15.07	18.29	25.97	25.78	27.11	15.92	12.88	8.20	4.89	3.62	1.13	3.59
WESTWOOD, NEW JERSEY	24.22	24.49	34.36	27.99	52.78	57.23	31.37	11.64	6.49	*******	*******	*******
NEW YORK, NEW YORK	26.24	17.66	36.77	28.70	47.86	56.92	40.25	14.86	7.01	*******B	36.30	9.52
STERLING, VIRGINIA	19.71	22.41	30.43	18.73	38.92	49.30	30.65	12.76	6.59	5.80	13.40	7.36
ECHO	*******	34.08	34.50	30.27	35.66	12.89	*******	7.16	5.12	2.75	8.43	2.69
MIAMI, FLORIDA	33.76	31.74	51.54	50.60	*******B	*******B	13.76	7.91	2.60	5.52	33.89	10.29
BIMINI, BAHAMAS	*******	*******	*******	*******	*******	*******	27.50	15.09	6.20	8.98	51.93	14.05
MAUNA LOA, HAWAII	45.56	39.12	62.64	43.54	127.89	*******B	29.96	8.29	5.55	3.85	8.56	10.00
SAN JUAN, PUERTO RICO	12.75	29.16	28.71	20.92	26.30	*******	17.34	9.69	4.14	3.39	6.43	5.34
BALBOA, PANAMA	12.21	22.60	19.31	17.30	7.33	2.48	3.63	2.65	0.87	2.74	4.66	3.24
GUAYAQUIL, ECUADOR	3.77	4.37	2.22	2.03	1.70	*******B	43.84	6.72	5.78	56.30	31.96	42.82
LIMA, PERU	14.20	13.75	8.41	5.45	3.69	6.26	110.58	23.70	24.35	277.17	178.32	95.97
CHACALTAYA, BOLIVIA	6.42	5.55	5.02	4.79	4.38	18.58	647.58	114.94	1573.58	461.03	182.46	71.05
ANTOFAGASTA, CHILE	12.81	10.23	5.42	4.81	3.95	5.73	95.71	16.14	18.89	250.00	93.37	46.17
PORTILLO, CHILE	*******	*******	*******	*******	16.97	12.22	2460.00	108.93	*******	*******	*******	269.60
SANTIAGO, CHILE	13.98	15.54	9.18	6.16	4.67	4.11	749.14	33.01	16.98	79.02	85.23	67.85
PUERTO MONTT, CHILE	8.71	9.39	5.67	8.03	2.67	3.65	2.98	12.09	8.06	9.67	36.00	16.77
PUNTA ARENAS, CHILE	5.10	4.53	4.54	2.90	1.83	1.58	2.34	3.85	2.95	5.24	9.35	7.00

NOTES
- ******* - NO DATA
- ERRORS ARE LESS THAN 20% EXCEPT:
- A - ERROR BETWEEN 20% AND 100%
- B - ERROR GREATER THAN 100%

Table 4-K

PLUTONIUM - 238 CONCENTRATIONS IN SURFACE AIR DURING 1966

(DPM / KSCM) X 100

SITE	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
THULE, GREENLAND	*******	0.93	0.96	2.18	1.09	1.50	0.51	10.20	3.10	2.32	0.41	0.30
CHARLIE	*******	*******	2.56	4.34	0.96	1.03	0.49	1.39	0.70	1.22	2.94	0.0
BRAVO	*******	*******	*******	2.64	0.87	0.80	1.55	*******	1.10	2.52	2.27	0.0
MOOSONEE, ONTARIO	*******	1.93	0.55	*******	0.97	0.81	1.72	3.07	2.67	1.58	0.89	0.77
DELTA	*******	1.15	0.82	1.37	1.02	3.55	0.53	0.75	0.55	1.83	1.87	0.0
SEATTLE, WASHINGTON	1.30	*******	0.62	3.26	1.34	*******	5.58	0.95	3.32	2.03	2.35	1.39
WESTWOOD, NEW JERSEY	0.87	0.52	0.89	8.21	1.87	2.32	*******	*******	*******	*******	*******	*******
NEW YORK, NEW YORK	1.71	2.06	0.74	5.65	4.86	8.00	2.95	2.08	2.35	2.50	3.68	2.31
STERLING, VIRGINIA	*******	0.49	0.64	*******	98.45	2.08	2.90	4.40	5.49	1.87	0.0	1.56
ECHO	*******	*******	0.87	3.27	2.21	0.73	*******	4.86	3.39	2.81	1.95	0.0
MIAMI, FLORIDA	1.29	*******	1.61	2.13	2.56	1.71	1.46	*******	1.94	1.27	1.58	0.74
BIMINI, BAHAMAS	*******	*******	*******	*******	*******	*******	2.20	5.89	*******	3.37	4.53	0.0
MAUNA LOA, HAWAII	0.77	2.21	1.86	5.58	2.73	2.26	2.10	6.20	*******	1.88	0.0	9.00
SAN JUAN, PUERTO RICO	2.67	0.91	0.51	*******	2.19	0.90	0.77	3.25	4.58	3.95	0.0	1.28
BALBOA, PANAMA	0.94	*******	0.41	*******	*******	*******	*******	*******	1.35	2.59	2.64	4.25
GUAYAQUIL, ECUADOR	*******	*******	0.34	*******	0.35	2.00	*******	2.10	4.84	6.78	2.45	6.29
LIMA, PERU	0.08	*******	10.30	0.54	1.72	1.43	5.40	5.66	14.91	27.72	1.79	13.60
CHACALTAYA, BOLIVIA	0.61	*******	0.50	6.86	3.13	10.05	15.15	10.83	99.62	25.82	4.25	8.42
ANTOFAGASTA, CHILE	0.29	1.05	0.46	1.67	1.58	2.13	20.76	5.72	14.62	26.88	1.83	7.04
PORTILLO, CHILE	*******	*******	*******	*******	10.40	8.17	76.00	42.14	*******	*******	*******	50.64
SANTIAGO, CHILE	1.65	0.52	1.26	1.08	*******	4.84	2.77	1.68	16.73	4.79	2.77	8.59
PUERTO MONTT, CHILE	0.47	1.03	*******	2.49	0.71	2.70	1.73	12.31	37.97	3.69	4.29	2.14
PUNTA ARENAS, CHILE	*******	*******	0.06	1.78	0.51	1.78	*******	3.76	4.97	3.97	3.38	3.25

NOTES

******* - NO DATA

ERRORS ARE LESS THAN 20% EXCEPT:

A - ERROR BETWEEN 20% AND 100%

B - ERROR GREATER THAN 100%

Table 4-L

PLUTONIUM - 239 CONCENTRATIONS IN SURFACE AIR DURING 1966

(DPM / KSCM) X 100

SITE	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
THULE, GREENLAND	*******	36.84	41.24	52.23	39.42	22.58	9.12	6.04	33.13	3.85	3.20	4.40
CHARLIE	*******	7.81	0.26	30.74	16.87	6.84	3.97	6.83	2.50	3.88	6.82	2.04
BRAVO	*******	9.20	19.41	45.32	15.09	10.80	4.09	3.24	9.30	2.43	6.47	2.61
MOOSONEE, ONTARIO	8.65	14.60	28.98	32.67	25.51	21.80	17.67	5.66	20.19	5.72	3.68	3.75
DELTA	*******	12.20	33.27	25.05	25.88	14.10A	6.77	2.78	10.80	27.98	2.75	1.72
SEATTLE, WASHINGTON	8.71	13.06	26.90	40.05	27.69	14.23	13.87	1.95	21.95	6.43	10.77	3.57
WESTWOOD, NEW JERSEY	31.94	18.74	34.08	52.72	52.02	78.15	*******	*******	*******	*******	*******	*******
NEW YORK, NEW YORK	20.41	6.71	38.71	51.58	123.57	41.38	27.75	20.85	12.89	23.58	9.52	9.79
STERLING, VIRGINIA	14.71	10.93	32.37	29.87	44.85	40.85	26.18	12.04	50.54	9.17	7.45	5.56
ECHO	*******	13.89	32.02	41.26	39.80	5.21	*******	15.10	7.60	6.02	7.19	4.85
MIAMI, FLORIDA	30.18	*******	54.62	67.26	18.33	19.03	8.93	2.03	12.61	6.29	5.14	6.20
BIMINI, BAHAMAS	*******	*******	*******	*******	*******	*******	15.36	14.24	216.74	10.64	40.06	6.95
MAUNA LOA, HAWAII	31.69	26.96	64.53	55.78	49.40	42.31	18.78	12.40	*******	4.96	4.11	9.12
SAN JUAN, PUERTO RICO	10.67	27.29	34.46	27.36	27.60	15.66	8.46	8.66	92.26	8.21	2.28	5.94
BALBOA, PANAMA	10.00	10.19	19.57	1.32	7.80	0.94	2.90	4.03	15.79	4.13	4.89	5.92
GUAYAQUIL, ECUADOR	2.57	5.21	3.23	3.36	1.82	2.05	33.24	5.02	7.43	12.02	3.66	7.31
LIMA, PERU	7.63	17.29	1.33	*******	5.78	3.55	47.35	6.14	18.42	30.43	2.63	16.28
CHACALTAYA, BOLIVIA	6.56	8.98	6.82	21.06	3.75	9.53	68.72	29.00	172.83	48.83	6.23	16.11
ANTCFAGASTA, CHILE	11.95	10.03	5.72	8.05	5.78	5.02	47.86	10.19	65.40	31.91	15.65	9.74
PORTILLO, CHILE	*******	*******	*******	*******	13.48	10.28	596.00	5.68	*******	*******	*******	42.64
SANTIAGO, CHILE	7.64	10.98	9.01	10.29	*******	5.89	15.50	12.05	14.98	11.66	12.71	13.41
PUERTO MONTT, CHILE	7.65	12.79	5.75	6.95	2.98	4.00	5.18	9.93	27.54	7.14	10.18	6.82
PUNTA ARENAS, CHILE	5.13	4.78	5.21	4.67	2.26	2.25	3.30	10.09	19.02	3.47	7.79	4.51

NOTES

******* - NO DATA

ERRORS ARE LESS THAN 20% EXCEPT:

A - ERROR BETWEEN 20% AND 100%

B - ERROR GREATER THAN 100%

Table 4-m

Quality Control Results on Blank Samples - 1966
(Average Values in dpm per sample)

	Mn-54	Fe-55	Sr-89	Sr-90	Zr-95	Cd-109	Cs-137	Ce-141	Ce-144	Pu-238	Pu-239
Jan.	288	47 A		1.0 B		16 B	1.1 B		0	0.1 B	0.1 B
Feb.	150 A	47 A		1.0 B		20 A	2.0 B		1.3 B	0.1 B	0.3 B
Mar.	475	123 A		0.2 B		0	44.5		0	0	0.1 B
April	0	207		0.6 B		0	3.3 B		3 B	0.1 B	0
May		0	8 B	0	0	0		0	0	0.3 B	0.1 B
June		104 A	0	0	0	0		56 A	4 B	0.1 B	1.0 B
July		139	0	0	310	0		100 A	4 B	0.1 B	1.0 B
Aug.		0	0	0	102	14 B		0	0	0	0
Sept.		0	2 B	0.4 B	0	0		584	0	0.8 B	13.0 A
Oct.		0	0	0	47 A	27 B		4000	0	1.3 B	3.7 B
Nov.		0	33 A	0	12 B	54 A		0 B	2 B	0.3 B	0.2 B
Dec.		0	0	0.7 B	0 B	0 B		0 B	1 B	0	0.2 B

One standard deviation of counting error is ±20% except for:

A = ±20% to ±100%

B = Greater than ±100%

Table 4-n

Quality Control Results on Standard Samples - 1966
(Average values in % Deviation)

	Mn-54	Fe-55	Sr-89	Sr-90	Zr-95	Cd-109	Cs-137	Ce-141	Ce-144	Pu-238	Pu-239
Jan.	-2	-17		-2		-28	-1		+15		-8
Feb.	+10	-18		-10		-86	0		+38		-46
Mar.	-50	+13		-6		+4	-34		-14		-10
April	-2	+5		-30		-75	-40		-14		+16
May		-10		-4		-2			-1		+10
June		-58	-18	+12	+19	-17		-1	-10		+10
July		+43	-24	-11	+23	-26		-72	+20		-58
Aug.		+2	-32	+10	+29	-19		+700	-24	-23	+30
Sept.		-36	-40	-9	+25	-40		+250	-9	-36	+870
Oct.		-1	-24	-8	+100	-34		+1000	-100	-24	+2
Nov.		+28	-15	+2	-8	-14		+10	+16	+200	+62
Dec.		+31	+49	-78	-9	-22		+69	+109	-93	-59

Table 4-o

Quality Control Results on Duplicate Samples - 1966
(Values are ± % Standard Deviation)

	Mn-54	Fe-55	Sr-89	Sr-90	Zr-95	Cd-109	Cs-137	Ce-141	Ce-144	Pu-238	Pu-239
Jan.	9	4		9		176	8		2	70	5
Feb.	10	6		4		-	1		2	45	14
Mar.	5	13		5		64	2		1	42	4
April	3	10		1		-	3		2	-	32
May		11	2	8	24	54		54	3	96	16
June		18	28	2	31	27		17	2	90	38
July		3	36	1	11	5		38	14	33	76
Aug.		176	5	38	27	-		2	6	15	20
Sept.		46	-	10	8	74		-	58	76	23
Oct.		37	16	9	45	-		37	16	58	9
Nov.		11	43	3	61	40		-	76	9	36
Dec.		23	-	32	13	-		21	2	61	74

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 October 1966 through June 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 5a. Because of unique activity distributions which were observed after the 6th Chinese nuclear test (1), a special set of balloon flights were conducted during early October from Foss Field, South Dakota (43° 34' N).

Aircraft samples collected at 15 to 20 Km during the period February 1966 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 5b and 5c, 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 5d, 5e and 5f.

Previous reports containing data from this program are given in references 2 through 13.

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 5b. 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 (14).

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 (15).

A larger model Air Ejector system has been developed by the Applied Science Division (16) to sample greater volumes of air particularly at the upper altitudes. This system, identified as HV3K in Table 5b, uses 8 square feet of IPC filter paper and filters about 50% more volume at sampling altitude than 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 times. In Table 5b, 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.

GAMMA ACTIVITY MEASUREMENTS

The gross gamma activity concentrations (Gr Gamma) expressed as counts per minute per 10^3 standard cubic meters of air (cpm/KSCM) are reported in Tables 5b and 5c 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 sumbol ≠. Only 3 figures of the gross gamma concentrations are significant, the additional figures are the result of a machine computation and are not meaningful.

To indicate the current distribution of the debris from the Chinese 6th nuclear weapons test, the gross gamma activities of all samples received to date, even though no specific radiochemical data are yet available, are presented at the end of each section in Table 5b.

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 (17).

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 5b and 5c are expressed in picocuries per 10^3 standard cubic meters of air (pCi/KSCM). The volume of air was computed at 1013 millibars and $15^{\circ}C$, such that 1SCM = 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.

No new data from Isotopes, Inc. have been submitted since the last report on this program. Consequently, the evaluation of Isotopes, Inc. performance reported in reference 13 remains unchanged.

The analyses of the blank samples in Table 5d 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.

At the higher altitudes, similar conditions prevail with the exception that for the very small concentrations of many nuclides, the blank levels for these nuclides sometimes represent as much as 50% of the activity collected by the filter. However, the concentrations reported by Tracerlab are corrected for the average blank value, and the uncertainty of the reported data include the variability of the blank. 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 (18), an estimate of the standard deviation of a measurement can be obtained by the equation:

$$\sigma = 0.8862d$$

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

A summary of the duplicate analyses reported by Tracerlab in Tables 5b and 5c is given in Table 5e where the average percent standard deviation is listed for each nuclide with the number of duplicate analyses involved. Only duplicates in which the counting error was less than 20% were included. The average percent standard deviation was about ±10% or less for all nuclides measured during this reporting period.

Table 5f presents the analyses of coded standard samples performed by Tracerlab since February 1966, the earliest collection date covered by this report. The average percent deviation for each nuclide is recorded at the bottom of Table 5f calculated from individual analyses in which the precision of measurement was ±20% or less. These average deviations are less than ±10% for all nuclides except the following:

Zr-95	-15%
Cd-109	-14%
Sb-125	-14%
Po-210	-30%

While there is some variability in the above deviations for individual analyses, it appears likely at this time that a negative bias in calibration of radioassay equipment is primarily responsible for these differences.

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 ±20% and usually less than ±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 ±20 - 50%.
- B: One standard deviation of the counting error is between ±51 - 100%.
- *: Activity is not detectable. This designation is applied to data when an equal to or less than value (≤) 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 altitude 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.

DISCUSSION

In an attempt to increase the volume of air of the balloon samples, experimental flights of a light weight IPC paper with a lower pressure drop have been conducted at San Angelo, Texas in late 1967. In these tests, the face velocity across the light weight filter paper was equal to the face velocity across the standard IPC paper which was flown as a separate unit on the same balloon. A comparison of the gamma activity concentrations reflected by these two filters in Table 5b indicates that their filter efficiencies are essentially equivalent. Additional comparisons are scheduled wherein the face velocity of the light weight paper will be increased to effect larger sampling volumes.

While no radiochemical data for samples collected after the 6th Chinese nuclear test of June 17, 1967 are yet available, good indication of the behavior of debris from this event at the balloon sampling altitudes can be derived from the gross gamma concentrations in Table 5b. No indication of fresh fission products have yet been observed at 21.8 km or above at Albrook, Natal or Mildura. At San Angelo as was described earlier (1), fresh Chinese debris was absent during July from 24.1 to 31.8 km only to appear at 40 km. This stratified pattern, although on the wane, can still be observed during August and September, and the top of the Chinese cloud in September extended to 21.7 km. In October at both Foss Field, South Dakota and San Angelo, the top of the Chinese cloud rose still higher to 24.4 km. However, at 41 km at Foss Field in October, very little fresh fission products can be discerned.

These and future trends as well as those obtained from Project Airstream will be studied to evaluate the significance of diffusion, mass motion and particle setting velocity (if any) to mixing of the Chinese debris in the stratosphere. A limited study of the radioactive particle size distribution of the Chinese debris in different regions of the stratosphere would offer valuable information toward this end.

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Table 5a

HIGH ALTITUDE BALLOON LAUNCHING SITES

LOCATION	LATITUDE	FREQUENCY	FLIGHT ORGANIZATION
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

TABLE 5b

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING JUNE 1967
LATITUDE, 65N EILSON AIR FORCE BASE, ALASKA

ALTITUDE (KM)	23	23	27	27	32	32@
FLIGHT DAY	08	14	07	12	06	11
HASL NUMBER	2701	2714	2700	2705	2698	2704
COLLECTION UNIT	D7-1	D7-1	D7-1	D7-1	AE-1	AE-1
ANALYTICAL LABORATORY	TLW	TLW	TLW	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	1332.4#	1248.2#	1810.7#	1389.3#	1086.5#	1147.6#
			PC/KSCM			
ANTIMONY-125		64.7A	*	*	*	*
CESIUM-137	135	237	144	101	65.5	73.7
CERIUM-144	55.5A	103	41.3A	30.7B	*	52.4B
PLUTONIUM-238	11.8	10.9	9.60	10.6	2.71B	6.62
PLUTONIUM-239	1.33A	2.46	.543B	.772A	*	*

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
@: VOLUME ESTIMATED
#: GROSS GAMMA COUNT MORE THAN TWO WEEKS AFTER COLLECTION

TABLE 5b

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

BALLOON SAMPLES COLLECTED DURING JUNE 1967
LATITUDE, 65N EILSON AIR FORCE BASE, ALASKA

ALTITUDE (KM)	36	37	40@	41
FLIGHT DAY	10	03	02	13
HASL NUMBER	2706	2697	2715	2709
COLLECTION UNIT	AE-1	AE-1	HV3K	AE-1
ANALYTICAL LABORATORY	TLW	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	808.3#	1177.0#	490.4#	546.0#
	PC/KSCM			
ANTIMONY-125	*	*	*	*
CESIUM-137	51.1A	53.2A	44.5	54.6
CERIUM-144	*	*	*	*
PLUTONIUM-238	10.5	6.09A	7.51	6.55A
PLUTONIUM-239	.851B	*	*	1.09B

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
@: VOLUME ESTIMATED
#: GROSS GAMMA COUNT MORE THAN TWO WEEKS AFTER COLLECTION

Table 5b (Cont'd)

GROSS GAMMA ACTIVITY MEASUREMENTS OF SUBSEQUENT SAMPLES AT 44°N

Foss Field, South Dakota

HASL #	Collection Month	Day	Altitude Km	Gross Gamma cpm/KSCM
2768	Oct. 67	5	20.8	7.1×10^5
2774	"	10	24.4	3.7×10^4
2775	"	11	27.2	1.7×10^3
2780	"	17	42.3	9.2×10^2

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	8950	814B	*
STRONTIUM-89	*	*	*
STRONTIUM-90	897	128A	80.7
ZIRCONIUM-95	*	*	*
CADMIUM-109	*	*	*
CERIUM-141	*	*	*
CERIUM-144	965	143	71.3
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
#: GROSS GAMMA COUNT MORE THAN TWO WEEKS AFTER COLLECTION

TABLE 5b (Cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

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

ALTITUDE (KM)	24	27	42@
FLIGHT DAY	12	05	20
HASL NUMBER	2565	2563	2639
COLLECTION UNIT	D7-1	D7-1	HV3K
ANALYTICAL LABORATORY	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	3472.8	3509.2	620.2#
		PC/KSCM	
IRON-55	1050A	2270A	*
STRONTIUM-89	51.0A	88.9A	*
STRONTIUM-90	149	163	86.8A
ZIRCONIUM-95	91.7A	100B	*
CADMIUM-109	*	*	*
CERIUM-141	*	*	*
CERIUM-144	174	206	50.6B
LEAD-210	*	10.2B	*
POLONIUM-210	4.66	18.7	21.5
PLUTONIUM-238	17.4	13.3	13.3A
PLUTONIUM-239	2.91A	3.49	2.86B

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
@: VOLUME ESTIMATED
#: GROSS GAMMA COUNT MORE THAN TWO WEEKS AFTER COLLECTION

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

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

ALTITUDE (KM)	24	27	31	31	31	36
FLIGHT DAY	07	02	12	03	03	28
HASL NUMBER	2583	2580	2610	2601	2602	2612
COLLECTION UNIT	D7-1	D7-1	AE-1	AE-1	HV3K	AE-1
ANALYTICAL LABORATORY	TLW	TLW	TLW	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	1649.2	816.4	668.8#	631.6#	388.3#	588.5#
			PC/KSCM			
MANGANESE-54	*	*				
IRON-55	3640	837B	*	*	*	*
STRONTIUM-89	33.6B	*	*	74.1B	*	*
STRONTIUM-90	358	111	54.6A	49.1A	69.9	46.3A
ZIRCONIUM-95	*	*	*	*	*	*
CADMIUM-109	*	*	*	*	*	*
ANTIMONY-125	165	48.0A				
CESIUM-137	499	157				
CERIUM-141	*	*	*	*	260B	*
CERIUM-144	324	102	41.2B	50.8A	40.2A	31.3B
PROMETHIUM-147	764	237				
LEAD-210	*	*	*	*	*	*
POLONIUM-210	5.92	4.08A	2.94A	3.72	13.5	6.99
PLUTONIUM-238	15.0	8.78	10.7	10.3	9.89	19.1
PLUTONIUM-239	6.98	2.04A	1.34A	1.14B	.705B	*

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

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

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

ALTITUDE (KM)	36
FLIGHT DAY	28
HASL NUMBER	2613
COLLECTION UNIT	HV3K
ANALYTICAL LABORATORY	TLW
GROSS GAMMA (CPM/KSCM)	642.0#
	PC/KSCM
IRON-55	*
STRONTIUM-89	*
STRONTIUM-90	51.9
ZIRCONIUM-95	*
CADMIUM-109	*
CERIUM-141	*
CERIUM-144	30.4B
LEAD-210	*
POLONIUM-210	11.4
PLUTONIUM-238	8.39
PLUTONIUM-239	.987B

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

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

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

ALTITUDE (KM)	24	27	32	32	32	40
FLIGHT DAY	8	07	22	22	16	17
HASL NUMBER	2616	2615	2642	2643	2634	2640
COLLECTION UNIT	D7-1	D7-1	AE-1	AE-2	AE-1	HV3K
ANALYTICAL LABORATORY	TLW	TLW	TLW	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	964.9	816.2#	427.9#	557.5#	1017.4#	647.8#
			PC/KSCM			
IRON-55	2040A	573B	*	*	*	*
STRONTIUM-89	106A	*	*	*	*	*
STRONTIUM-90	198	92.5	54.6	97.1	49.7A	62.5A
ZIRCONIUM-95	*	*	*	*	*	*
CADMIUM-109	*	*	*	*	*	*
CERIUM-141	*	*	*	*	*	*
CERIUM-144	165	76.8A	*	*	26.9B	*
LEAD-210	*	*	*	*	*	14.8B
POLONIUM-210	5.94	2.27	5.34A	11.2	3.29A	19.8
PLUTONIUM-238	10.7	7.59	6.78	11.6	10.1	8.75
PLUTONIUM-239	3.69	2.27	*	*	1.50A	.648B

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 5b (Cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

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

ALTITUDE (KM)	24	27	30
FLIGHT DAY	07	04	22
HASL NUMBER	2663	2657	2683
COLLECTION UNIT	D7-1	D7-1	AE-1
ANALYTICAL LABORATORY	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	581.8#	548.3#	1003.1#
		PC/KSCM	
IRON-55	949B	*	1480B
STRONTIUM-89	*	*	*
STRONTIUM-90	164A	99.6	239
ZIRCONIUM-95	*	83.0B	*
CADMIUM-109	*	*	*
CERIUM-141	*	*	*
CERIUM-144	139	60.0A	139A
LEAD-210	*	*	*
POLONIUM-210	*	3.51A	3.61B
PLUTONIUM-238	11.3	8.77	15.6
PLUTONIUM-239	2.41	1.97A	1.61A

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 5b (Cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

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

ALTITUDE (KM)	24	27	31	31	31	41
FLIGHT DAY	8	3	17	17	2	23
HASL NUMBER	2686	2685	2688	2689	2684	2692
COLLECTION UNIT	D7-1	D7-1	AE-1	AE-2	AE-1	HV3K
ANALYTICAL LABORATORY	TLW	TLW	TLW	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	1970.8#	1321.6#	666.2#	437.2#	611.7#	627.6#
			PC/KSCM			
IRON-55	897B	641B	*	*	*	*
STRONTIUM-89	*	*	*	*	*	*
STRONTIUM-90	210	84.7A	149A	81.0A	58.1	50.6B
ZIRCONIUM-95	*	*	*	*	*	*
CADMIUM-109	*	*	*	*	*	*
CERIUM-141	*	*	*	*	*	*
CERIUM-144	143	57.1A	45.6B	41.7B	30.0B	82.7A
LEAD-210	*	*	18.7B	*	16.7B	*
POLONIUM-210	1.64A	4.53A	11.7	17.8?	3.05B	11.4
PLUTONIUM-238	10.3	8.26	7.66	6.39	7.23	5.49A
PLUTONIUM-239	3.28	*	1.67A	*	.834B	*

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 5b (Cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

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

ALTITUDE (KM)	24	27	32	37
FLIGHT DAY	05	19	6	27
HASL NUMBER	2702	2717	2703	2722
COLLECTION UNIT	D7-1	D7-1	AE-1	AE-1
ANALYTICAL LABORATORY	TLW	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	523.7#	746.5#	658.3#	6806.9#
		PC/KSCM		
ANTIMONY-125		63.3A	*	*
CESIUM-137	495	162	63.7	536A
CERIUM-144	221	58.7A	32.9B	*
PLUTONIUM-238	13.0	7.66	6.58	68.1
PLUTONIUM-239	5.91	1.41A	*	*

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 5b (Cont'd)

GROSS GAMMA ACTIVITY MEASUREMENTS OF SUBSEQUENT SAMPLES AT 31°N

San Angelo, Texas

HASL #	Collection Month	Day	Altitude Km	Gross Gamma cpm/KSCM	Comment
2725	July 67	12	24.1	1.1×10^3	
2731	"	25	26.7	1.3×10^3#	
2732	"	27	31.8	1.3×10^3	
2727	"	9	40	1.1×10^5	
2735	Aug. 67	9	36.1	5.6×10^2	
2736	"	10	41	2.6×10^4#	
2766	Sept.67	18	21.7	5.8×10^5#	
2764	"	12	24.2	1.3×10^3#	Standard Paper
2765	"	"	"	1.3×10^3#	Light Weight Paper
2762	"	19	26.8	1.2×10^3#	Standard Paper
2763	"	"	"	1.1×10^3#	Light Weight Paper
2756	"	24	31.4	5.3×10^2#	
2754	"	23	41	1.9×10^3#	
2767	Oct. 67	4	21.7	7.2×10^5	
2784	"	9	24.3	6.5×10^3	
2773	"	10	27.1	1.2×10^3	
2776	"	11	32.4	6.4×10^2	

#: Gross Gamma Count more than Two Weeks after Collection

TABLE 5b (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	
IRON-55	10300	5760	3270A
STRONTIUM-89	*	*	*
STRONTIUM-90	973	586	268
ZIRCONIUM-95	*	*	*
CADMIUM-109	*	*	*
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

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

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

ALTITUDE (KM)	25	27	32
FLIGHT DAY	12	10	11
HASL NUMBER	2597	2593	2596
COLLECTION UNIT	D7-1	D7-1	AE-1
ANALYTICAL LABORATORY	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	2353.9#	1111.2#	625.3#
		PC/KSCM	
MANGANESE-54	*		
IRON-55	11800	4650	3780A
STRONTIUM-89	124B	*	*
STRONTIUM-90	1040	451	346
ZIRCONIUM-95	*	*	*
CADMIUM-109	*	*	*
ANTIMONY-125	463		
CESIUM-137	1540		
CERIUM-141	329B	*	*
CERIUM-144	886	382	278
LEAD-210	*	*	*
POLONIUM-210	7.33B	5.68	7.36
PLUTONIUM-238	6.44	12.6	11.8
PLUTONIUM-239	17.8	8.89	4.78

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

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

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

ALTITUDE (KM)	25	27	32
FLIGHT DAY	16	10	14
HASL NUMBER	2635	2620	2622
COLLECTION UNIT	D7-1	D7-1	AE-1
ANALYTICAL LABORATORY	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	1890.2#	1549.1	767.6#
		PC/KSCM	
IRON-55	10400	7030	3870A
STRONTIUM-89	120A	105A	134A
STRONTIUM-90	928	667	325
ZIRCONIUM-95	*	*	*
CADMIUM-109	*	*	*
CERIUM-141	*	*	*
CERIUM-144	725	530	276
LEAD-210	*	*	*
POLONIUM-210	6.01	5.01	9.21
PLUTONIUM-238	7.89	14.6	10.0
PLUTONIUM-239	16.0	11.2	6.44

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

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

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

ALTITUDE (KM)	23	27	32	36	40
FLIGHT DAY	07	03	06	05	02
HASL NUMBER	2661	2655	2660	2659	2672
COLLECTION UNIT	D7-1	D7-1	AE-1	AE-1	HV3K
ANALYTICAL LABORATORY	TLW	TLW	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	1631.3#	1061.5#	4935.9#	417.7#	5313.7#
			PC/KSCM		
IRON-55	6940	3460A	1750B	*	*
STRONTIUM-89	*	*	*	*	*
STRONTIUM-90	729	546	198	68.7A	56.8A
ZIRCONIUM-95	*	*	*	*	*
CADMIUM-109	*	*	*	*	*
CERIUM-141	*	*	1550B	*	*
CERIUM-144	507	385	111A	*	*
LEAD-210	*	*	*	*	*
POLONIUM-210	8.67	5.41A	11.3A	13.3	*
PLUTONIUM-238	7.42	4.97	7.59A	5.31A	5.49
PLUTONIUM-239	11.6	9.31	2.65A	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 5b (Cont'd)

GROSS GAMMA ACTIVITY MEASUREMENTS OF SUBSEQUENT SAMPLES AT 9°N

Albrook AFB, Canal Zone

HASL #	Collection Month	Day	Altitude Km	Gross Gamma cpm/KSCM
2760	Sept.67	16	21.8	1.3×10^3#
2757	"	15	25.1	8.5×10^2#
2758	"	11	26.6	7.8×10^2#
2761	"	1	31.7	5.6×10^2#
2759	"	13	37.0	8.5×10^2#
2753	"	12	41.4	3.9×10^2#

#: Gross Gamma Count more than Two Weeks after Collection

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	D7-1	D7-1	D7-1	D7-2	D7-1	D7-1
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	11100	5600	4100	1580	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	1580	623	599	372	595
CERIUM-141		*		*	*	
CERIUM-144		1120		475	297	
PROMETHIUM-147	2510		1190		973	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	6.5

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

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	*	489B	*
ANTIMONY-125	*	*	*
CESIUM-137	103	82.3A	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	1.41A	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 5b (Cont'd)

GROSS GAMMA ACTIVITY MEASUREMENTS OF SUBSEQUENT SAMPLES AT 6°S

Natal, Brazil

HASL #	Collections Month	Day	Altitude Km	Gross Gamma cpm/KSCM
2786	Oct. 67	19	24	1.2×10^3
2787	"	20	27.6	1.4×10^3
2785	"	28	37.1	*

*: Standard Deviation Greater than Data Value

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

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

ALTITUDE (KM)	32
FLIGHT DAY	24
HASL NUMBER	2254
COLLECTION UNIT	D7-2
ANALYTICAL LABORATORY	TLW
GROSS GAMMA (CPM/KSCM)	1324.1
	PC/KSCM
IRON-55	5650A
STRONTIUM-90	670
CADMIUM-109	*
CERIUM-144	1280
LEAD-210	*
PLUTONIUM-238	22.6
PLUTONIUM-239	13.1

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

TABLE 5b (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	D7-1	D7-1	D7-1	AE-1	AE-2
ANALYTICAL LABORATORY	II	II	II	TLW	TLW
GROSS GAMMA (CPM/KSCM)	2250.5	1932.8	985.4#	3026.6#	1986.2#
			PC/KSCM		
IRON-55	4690	4920	1160A	6890	6350A
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

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

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	D7-1	D7-1	D7-1
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

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

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

ALTITUDE (KM)	23	27
FLIGHT DAY	12	28
HASL NUMBER	2380	2396
COLLECTION UNIT	D7-1	D7-1
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	19.4B	34.8A
ANTIMONY-125	409	
CESIUM-137	939	
CERIUM-141	124B	*
CERIUM-144	827	293
PROMETHIUM-147	1610	641
LEAD-210	4.23A	3.00B
POLONIUM-210	4.23A	7.39B
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

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

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 5b (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	D7-1	D7-1	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	1.20B

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 5b (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	D7-1	D7-1	D7-1	D7-1	D7-1
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	78.1A
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	1.45A	3.34	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
#: GROSS GAMMA COUNT MORE THAN TWO WEEKS AFTER COLLECTION

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
IRON-55	*
STRONTIUM-89	*
STRONTIUM-90	63.7A
ZIRCONIUM-95	*
CADMIUM-109	*
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

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	
IRON-55	3210	1420A
STRONTIUM-89	*	*
STRONTIUM-90	296	156
ZIRCONIUM-95	*	*
CADMIUM-109	*	*
CERIUM-141	*	*
CERIUM-144	269	156
LEAD-210	*	*
POLONIUM-210	2.37A	3.85
PLUTONIUM-238	26.2	16.0
PLUTONIUM-239	5.10	2.48A

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

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

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

ALTITUDE (KM)	25	27	32
FLIGHT DAY	20	15	12
HASL NUMBER	2605	2590	2588
COLLECTION UNIT	D7-1	D7-1	D7-1
ANALYTICAL LABORATORY	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	1219.7#	1207.9#	971.0#
		PC/KSCM	
MANGANESE-54	10900B		
IRON-55	3480	1470A	*
STRONTIUM-89	*	121A	*
STRONTIUM-90	300	168	95.8
ZIRCONIUM-95	*	*	*
CADMIUM-109	*	*	*
ANTIMONY-125	133		
CESIUM-137	469		
CERIUM-141	*	*	*
CERIUM-144	274	158	97.5A
LEAD-210	*	*	*
POLONIUM-210	5.78A	3.48A	6.62A
PLUTONIUM-238	28.4	21.7	8.83
PLUTONIUM-239	5.14	3.48	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
#: GROSS GAMMA COUNT MORE THAN TWO WEEKS AFTER COLLECTION

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

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

ALTITUDE (KM)	24	27	32@	37
FLIGHT DAY	22	10	17	29
HASL NUMBER	2632	2618	2630	2644
COLLECTION UNIT	D7-1	D7-1	D7-1	AE-1
ANALYTICAL LABORATORY	TLW	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	388.2	1451.0	894.5#	747.0#
	PC/KSCM			
IRON-55	3600	2500A	*	*
STRONTIUM-89	179	*	*	*
STRONTIUM-90	367	117A	55.9A	78.8
ZIRCONIUM-95	*	*	*	*
CADMIUM-109	*	*	*	*
CERIUM-141	*	*	*	*
CERIUM-144	268	70.6A	62.1B	*
LEAD-210	*	*	*	*
POLONIUM-210	3.72		5.17A	21.0A
PLUTONIUM-238	28.0	11.5	7.05A	2.03B
PLUTONIUM-239	6.19	2.42A	*	.678B

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
@: VOLUME ESTIMATED
#: GROSS GAMMA COUNT MORE THAN TWO WEEKS AFTER COLLECTION

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

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

ALTITUDE (KM)	24	27	32
FLIGHT DAY	13	06	11
HASL NUMBER	2667	2650	2665
COLLECTION UNIT	D7-1	D7-1	D7-1
ANALYTICAL LABORATORY	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	1805.7#	1091.7#	2247.0#
		PC/KSCM	
IRON-55	1770A	1410A	*
STRONTIUM-89	*	*	*
STRONTIUM-90	235	213	47.7
ZIRCONIUM-95	*	*	*
CADMIUM-109	*	*	*
CERIUM-141	*	*	*
CERIUM-144	195	132	*
LEAD-210	*	*	*
POLONIUM-210	3.80A	3.94A	9.17A
PLUTONIUM-238	24.7	17.1	6.87
PLUTONIUM-239	4.41	4.41	*

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 5b (Cont'd)

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

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

ALTITUDE (KM)	24	27	32
FLIGHT DAY	09	02	04
HASL NUMBER	2681	2674	2677
COLLECTION UNIT	D7-1	D7-1	D7-1
ANALYTICAL LABORATORY	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	842.6	1776.8	3119.1#
		PC/KSCM	
IRON-55	1520A	1450A	*
STRONTIUM-89	*	*	*
STRONTIUM-90	166	109A	78.3A
ZIRCONIUM-95	*	*	*
CADMIUM-109	*	*	*
CERIUM-141	*	*	*
CERIUM-144	95.9	76.9B	53.6B
LEAD-210	*	*	*
POLONIUM-210	2.81A	*	10.0A
PLUTONIUM-238	16.3	20.4A	8.83A
PLUTONIUM-239	2.00A	9.00B	*

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

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

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

ALTITUDE (KM)	27
FLIGHT DAY	15
HASL NUMBER	2712
COLLECTION UNIT	D7-1
ANALYTICAL LABORATORY	TLW
GROSS GAMMA (CPM/KSCM)	518.1#
	PC/KSCM
ANTIMONY-125	62.2A
CESIUM-137	233
CERIUM-144	96.1
PLUTONIUM-238	12.9
PLUTONIUM-239	2.88

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

Table 5b (Cont'd)

GROSS GAMMA ACTIVITY MEASUREMENTS OF SUBSEQUENT SAMPLES AT 34°S

Milldura, Australia

HASL #	Collection Month	Day	Altitude Km	Gross Gamma cpm/KSCM
2718	July 67	2	32.1	2.8×10^2
2751	Sept.67	25	21.8	8.7×10^2#
2740	"	5	24.3	8.9×10^2#
2744	"	7	26.9	8.7×10^2
2750	"	22	37.3	7.3×10^2#
2772	"	28	41.5	5.9×10^2#

#: Gross Gamma Count more than Two Weeks after Collection

TABLE 5c

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

AIRCRAFT SAMPLES COLLECTED DURING FEBRUARY 1966

LATITUDE	64N	64N	34N	10N	10N
ALTITUDE (KM)	18	18	20	20	20
FLIGHT DAY	27	27	28	28	28
HASL NUMBER	2292A	2292B	2293A	2295A	2295B
COLLECTION UNIT	AC-1	AC-1	AC-1	AC-1	AC-1
ANALYTICAL LABORATORY	TLW	TLW	II	TLW	II
GROSS GAMMA (CPM/KSCM)	3129.3#	3155.3#	4217.7#	2783.3#	2783.3#
			PC/KSCM		
MANGANESE-54	3880?		*	10600	*
IRON-55	16700	7760	17000	15700	
STRONTIUM-90	1230	1620	2160	1350	1450
CADMIUM-109	54.7	*	*	*	88.2A
CADMIUM-113M	22.8A		*	*	20.9A
ANTIMONY-125	928		1270	739	1170
CESIUM-137	1710		3050	2030	4320?
CERIUM-144	2120	2550	4060	2320	3220
PROMETHIUM-147			4020	15100?	8480
LEAD-210	3.85B	*	31.0	7.69	
POLONIUM-210		.751B			
PLUTONIUM-238	15.8	16.1	43.4	.831A	3.32?
PLUTONIUM-239	17.9	19.6	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

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 5c (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	12100
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 5c (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

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

AIRCRAFT SAMPLES COLLECTED DURING JUNE 1966

LATITUDE	34N	34N	30N	06N
ALTITUDE (KM)	20	20	18	18
FLIGHT DAY	22	22	14	17
HASL NUMBER	2524A	2524B	2528A	2527A
COLLECTION UNIT	AC-1	AC-2	AC-1	AC-1
ANALYTICAL LABORATORY	TLW	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	3276.3#	3275.8#	1569.3#	871.6#
	PC/KSCM			
IRON-55	16300	22900	7930	4240
STRONTIUM-90	1760	2430	827	472
CADMIUM-109	1110A	*	*	*
CERIUM-144	2480	3590	1130	606
LEAD-210		*		
POLONIUM-210		8.08		
PLUTONIUM-238	17.5	28.9	58.3?	1.03A
PLUTONIUM-239	27.3	42.1	10.8	6.65

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

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

AIRCRAFT SAMPLES COLLECTED DURING JULY 1966

LATITUDE	62N	62N	34N	34N	10N	32S
ALTITUDE (KM)	20	20	20	20	20	20
FLIGHT DAY	17	17	20	20	18	19
HASL NUMBER	2529A	2529B	2531A	2531B	2533A	2535A
COLLECTION UNIT	AC-1	AC-2	AC-1	AC-1	AC-1	AC-1
ANALYTICAL LABORATORY	TLW	TLW	TLW	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	2604.8#	2634.3#	1943.6#	1954.0#	1607.8#	3607.7#
			PC/KSCM			
IRON-55	12000	9900	9210		13100	15100
STRONTIUM-89	*		1210B		*	*
STRONTIUM-90	1230	1070	960		944	1860
ZIRCONIUM-95	*		*		*	*
CADMIUM-109	*	*	*		*	*
ANTIMONY-125				485		
CESIUM-137				1610		
CERIUM-141	*		*		*	*
CERIUM-144	1600	1620	1290	1430	1280	2620
PROMETHIUM-147	2760		2270		2360	
LEAD-210	*	*	*		*	*
POLONIUM-210	3.47A	1.68B	3.89A		6.61	6.91
PLUTONIUM-238	16.8	17.4	8.75	11.2	2.84A	93.6
PLUTONIUM-239	18.4	21.3	16.8	16.1	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

STRATOSPHERIC RADIONUCLIDE CONCENTRATIONS

AIRCRAFT SAMPLES COLLECTED DURING AUGUST 1966

LATITUDE	63N	34N	34N	07N	32S
ALTITUDE (KM)	20	20	20	20	20
FLIGHT DAY	14	15	15	19	17
HASL NUMBER	2537A	2539A	2539B	2541A	2543A
COLLECTION UNIT	AC-1	AC-1	AC-2	AC-1	AC-1
ANALYTICAL LABORATORY	TLW	TLW	TLW	TLW	TLW
GROSS GAMMA (CPM/KSCM)	3244.8#	4647.7#	4602.9#	2326.6#	2301.1#
			PC/KSCM		
IRON-55	9890	24200	24100	16900	10600
STRONTIUM-89	*	*	14000B	*	*
STRONTIUM-90	1250	2620	2750	1520	1080
ZIRCONIUM-95	*	*	*	*	*
CADMIUM-109	*	*	*	*	*
CERIUM-141	*	*	*	*	*
CERIUM-144	1530	3340	3500	1890	1390
LEAD-210			*		
POLONIUM-210			7.25A		
PLUTONIUM-238	23.9	18.4	22.3	3.83	53.5
PLUTONIUM-239	18.1	37.7	43.4	22.3	17.9

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 5d

ANALYSES OF CODED BLANK SAMPLES

Anal. Lab.	Sample #	Report Date	dpm/Sample 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
Tracerlab - West																		
	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	1.04A	1.24		0.43B		0.16B		*	0.04A
	2323	5/1 /66	*	89.1	*	*		*		*	0.59A		*	1.75B	*		0.18A	0.08A
	2376	7/1 /66		*	*	0.30B		*				*	*	*	*	*	0.08B	0.03B
	2384	7/1 /66		*	*	1.62		2.32B				*	*				0.13A	0.04A
	2466	9/1 /66		*		0.87A	*	*				*	*		0.29B	*	*	*
	2463	10/3 /66		*	*	*	*	*				*	*	*			*	*
	2495	11/1 /66		*	*	0.92B	*	*				*	2.35		*	0.16A	0.09B	0.05B
	2549	12/15/66		*	*	0.96B	*	*				*	*				*	0.03B
	2582	2/2 /67	*	*	*	*	*	*		2.07A	*	*	2.95B		*	0.31B?	0.54?	0.15?
	2626	3/1 /67		*	*	*	*	*				*	*		*	0.23A	*	0.15A
	2669	4/1 /67			*	*	*					*	*		*	0.29B?	*	*
	2699	6/1 /67								*	*		*				*	*
	2710	4/14/67		*	*	2.80A	*	*				*	*		*	0.71A	*	*

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

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

*: Not detectable

?: Data Suspect

Table 5e

RECENT STANDARD DEVIATION OF ANALYSIS BY TRACERLAB OF

CODED DUPLICATE SAMPLES

Nuclide	% Standard Deviation	# of Duplicates
Fe-55	8.6	6
Sr-90	8.8	8
Ce-144	9.7	9
Pm-147	4.5	1
Pu-238	11	7
Pu-239	10	9

TRACERLAB - WEST

ANALYSES OF CODED STANDARD SAMPLES

dpm

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
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	435		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	269			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					-0.7A				-4.3	-11
2646	1/1 /67	Added	112000	8830	332	19.3	418	759	500	25.1	0	62.0		3.86	7.61	6.59	3.65
		Found	102000	9470	301	15.9	364	478	456	25.9	260B	64.9		2.89A	3.54	6.70	3.37
		% Deviation	-8.9	+7.2	-9.3	-18	-13	-37	-8.8	+3.2		+4.5		-25	-53	+1.6	-7.7
2647	3/8 /67	Added		5080	180	29.5	274	932			0	39.0		5.61	8.36	7.15	2.81
		Found		5520	180	29.9	246	712			*	43.4		4.32A	5.26	6.59	2.56
		% Deviation		+8.7	0	+1.4	-10	-24				+11		-23	-37	-7.8	-8.9

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

Table 5f (Cont'd)

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
2691	4/17/67	Added		7210	79.0	34.1	200	512			344	39.5		5.23	7.40	4.98	3.80
		Found		6800	74.9	32.6	183	392			294	43.5		*?	4.51	4.53	3.28
		% Deviation		-5.7	-5.2	-4.4	-8.5	-23			-14	+10			-39	-9.0	-13.7
2624	7/20/67	Added				60.7								3.72			
		Found				58.3								2.85A			
		% Deviation				-4.0								-23			
2720	5/5 /67	Added		6760	78.5	35.9	141	704			233	33.2		5.35	7.41	6.25	2.90
		Found		6250	60.7B	36.3	100	557			160B	37.9		5.33	4.21	6.27	2.61
		% Deviation		-7.5	-23	+1.1	-29	-21			-31	+14		-0.4	-43	+0.3	-10
2746	6/ 1 /67	Added							852	36.5		18.5				9.40	3.77
		Found							703	34.9		19.2				8.60	3.30
		% Deviation							-17	-4.4		+3.8				-8.1	-12
Average % Deviation			-1.2	-1.6	-6.2	-3.0	-15	-14	-14	+2.5	-14	+6.6	+5.6	-10	-30	-5.4	-6.5

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

Part III

DATA FROM SOURCES OTHER THAN HASL

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

1.

The Twentieth Progress Report on
Project Stardust

FLIGHT DATA AND RESULTS OF RADIOCHEMICAL ANALYSES OF FILTER SAMPLES COLLECTED DURING APRIL-JUNE 1967

4 to 6 1967

by

Herbert W. Feely
David Katzman
Stephen Kaminsky

A report on work performed under contract DA-49-146-XZ-079
prepared for the Defense Atomic Support Agency
Washington, D. C. 20305

October 31, 1967

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Westwood, New Jersey

This is the tenth 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
October - December 1966	HASL-182, pp III-2 to III-29 (Corrections: HASL-183, pp III-2 to III-5)
January - March 1967	HASL-183, pp III-6 to III-30

The present report contains data for all air filter samples collected during April to June 1967 for Project Stardust. This is the final report in this series, because the collection of samples for analyses during Project Stardust was terminated in June 1967.

The Stardust Sampling and Analytical Program

From early 1965 to mid-1967, the General Dynamics' RB-57F aircraft was the primary sampling vehicle used during Project Stardust. To obtain maximum performance from this aircraft, it was employed primarily at altitudes of about fifteen kilometers and higher. Other aircraft, including the RB-57C, were 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 had prime responsibility for the collection of samples.

Stratospheric sampling was begun in Project Stardust in June 1961. By January 1967 the regular sampling corridor extended from 75°N, 143°W to 52°S, 68°W. Between 75°N or 65°N and 31°N sampling missions were 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 52°S they were flown only at 50, 55, 60, and about 65 thousand feet.

The program of radiochemical analysis of filter samples evolved into a system which, by the time the program ended, consisted of three basic groups. Samples included in the first of these, designated the "SF" group, were analyzed for fission products such as strontium-90 and strontium-89. 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, were 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, was measured in the third group, the "SX" samples, together with plutonium-238 and plutonium-239. Strontium-90 and sometimes strontium-89 were 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 April to June 1967 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. The only aircraft used during 1967 were the RB-57F and the RB-57C. 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:

Filter Designation	Aircraft Type	Sampler Type	Exposed Area (cm^2)
U	RB-57F	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 was generally kept at one altitude during the collection of each filter. On normal Stardust missions it was only when the vehicle was attempting to attain its maximum altitude that a change in altitude during filter collection was 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 depended 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 were measured using a disk of approximately one inch diameter cut from each filter.

In the eighth column of Table 1 the samples which were 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 April to June 1967 are summarized in Table 2. The nuclides listed in Table 2 are the fission products strontium-90 and strontium-89, the activation product - cadmium-109, the nuclear weapon component - plutonium-239, and the tracer for the April 1964 SNAP-9A power source burn-up - plutonium 238.

In Table 2 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 "L". 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.

ISOTOPES, INCORPORATED

TABLE 1 FLIGHT DATA FOR STARDUST FILTERS COLLECTED DURING 1967

FILTER NUMBER	TIME (Z)	LATITUDE	LONGITUDE	ALTITUDE (KM)	VOLUME (100 SCM)	BETA (PC/SCM)	SAMPLES AND ALIQUOTS
01 APR 1967	AIRCRAFT = RB-57F A/C 292						
23921U	012115/012155	10-00 /14-00N	80-12 / 82-25W	18.2	4.9	6.8	
23922U	012155/012235	14-00 /18-00N	82-25 / 84-25W	18.3	4.8	7.8	SF-8392(2/4)
23923U	012235/012317	18-00 /22-00N	84-25 / 87-00W	18.3	5.0	8.7	SF-8392(2/4)
23924U	012317/012358	22-00 /25-30N	87-00 / 90-45W	19.4	3.9	9.5	SQ-8384(2/4)
23925U	012358/020039	25-30 /29-00N	90-45 / 94-45W	19.8	3.5	13.2	SQ-8384(2/4)
23926U	020039/020124	29-00 /32-00N	94-45 / 99-50W	19.9	3.6	11.4	SQ-8384(2/4)
23927U	020124/020215	32-00 /35-00N	99-50 /105-45W	20.1	3.9	13.5	SQ-8384(2/4)
01 APP 1967	AIRCRAFT = RB-57F A/C 301						
23912U	011317/011400	31-00 /27-00S	68-50 / 70-51W	16.8	6.7	2.7	SF-8405(1/4)
23913U	011400/011445	27-00 /23-00S	70-51 / 72-35W	16.8	7.2	3.0	SF-8405(1/4)
23914U	011445/011518	23-00 /19-00S	72-35 / 73-55W	16.8	5.4	1.7	SF-8405(1/4)
23915U	011518/011553	19-00 /15-00S	73-55 / 75-14W	16.8	5.6	1.1	SF-8405(1/4)
23916U	011553/011628	15-00 /11-00S	75-14 / 76-25W	16.8	5.6	1.7	SF-8405(1/4)
23917U	011643/011722	09-00 /05-00S	76-58 / 78-05W	19.2	3.5	9.2	SF-8406(3/4)
11 APR 1967	AIRCRAFT = RB-57C A/C 851						
23986F	120005/120058	55-00 /60-00N	133-30 /140-40W	11.9	33.8	8.4	SQ-8413(2/4)
23987F	120058/120143	60-00 /64-00N	140-40 /145-40W	11.9	29.7	9.2	SQ-8413(2/4)
11 APR 1967	AIRCRAFT = RB-57C A/C 842						
23992F	112355/120053	55-00 /59-52N	133-30 /140-25W	13.1	28.0	6.8	SQ-8414(2/4)
23993F	120053/120143	59-52 /64-00N	140-25 /145-43W	13.1	24.2	6.3	SQ-8414(2/4)
11 APR 1967	AIRCRAFT = RB-57C A/C 851						
23998F	111740/111818	41-13 /44-17N	112-06 /117-09W	11.9	24.7	6.1	SQ-8415(2/4), SF-8517(1/4)
23999F	111818/111857	44-17 /47-26N	117-09 /122-18W	11.9	24.9	7.9	SQ-8415(2/4), SF-8517(1/4)
11 APR 1967	AIRCRAFT = RB-57C A/C 842						
24004F	111735/111816	41-13 /44-17N	112-06 /117-09W	13.1	19.2	7.6	SQ-8416(2/4)
24003F	111816/111858	44-17 /47-26N	117-09 /122-19W	13.1	21.0	4.0	SQ-8416(2/4)
12 APR 1967	AIRCRAFT = RB-57C A/C 842						
24009F	121845/121937	55-00 /50-32N	133-30 /127-00W	11.9	32.6	6.0	SF-8421(1/4), SF-8518(2/4)
24010F	121937/122010	50-32 /47-26N	127-00 /122-18W	11.9	20.7	0.3	SF-8422(2/4)
12 APR 1967	AIRCRAFT = RB-57C A/C 837						
24015F	122028/122131	55-00 /50-32N	133-30 /127-00W	13.1	27.3	6.1	SF-8423(1/4)
24016F	122131/122206	50-32 /47-25N	127-00 /122-45W	13.1	17.5	5.1	SF-8423(1/4)
12 APR 1967	AIRCRAFT = RB-57C A/C 851						
24020F	130118/130140	41-13 /39-00N	112-06 /110-40W	13.1	11.5	3.0	SF-8424(1/4)
24021F	130140/130221	39-00 /35-03N	110-40 /106-49W	13.1	21.4	3.5	SF-8424(1/4)
13 APR 1967	AIRCRAFT = RB-57C A/C 842						
24024F	132316/132345	41-13 /39-03N	112-06 /108-47W	11.9	17.8	3.9	SF-8425(2/4)
24025F	132345/140022	39-03 /35-00N	108-47 /106-30W	11.9	22.7	7.0	SF-8426(1/4)

TABLE 1 FLIGHT DATA FOR STARDUST FILTERS COLLECTED DURING 1967

FILTER NUMBER	TIME (Z)	LATITUDE	LONGITUDE	ALTITUDE (KM)	VOLUME (100 SCM)	BETA (PC/SCM)	SAMPLES AND ALIQUOTS
23 APR 1967	AIRCRAFT = RB-57F A/C 298						
24049U	231751/231828	35-00 /32-00N	101-15 / 97-45W	15.2	7.7	0.9	SF-8427(2/4)
24050U	231828/231901	32-00 /28-00N	97-45 / 93-20W	15.2	7.0	1.3	SF-8427(2/4)
24051U	231901/231942	28-00 /25-30N	93-20 / 90-45W	15.2	9.0	0.9	SF-8427(2/4)
24052U	231942/232020	25-30 /22-00N	90-45 / 87-00W	15.2	8.4	0.2	SF-8427(2/4)
24053U	232026/232106	22-00 /18-00N	87-00 / 84-20W	18.3	4.7	4.1	SF-8429(1/4)
24054U	232106/232145	18-00 /14-00N	84-20 / 82-20W	18.3	4.9	7.8	SF-8429(1/4)
24055U	232145/232225	14-00 /10-00N	82-20 / 80-10W	18.3	4.7	8.5	SF-8429(1/4)
24056U	232225/232238	10-00 /09-00N	80-10 / 79-30W	18.3	1.6	17.6	SF-8429(1/4)
23 APR 1967	AIRCRAFT = RB-57F A/C 293						
24031U	231824/231901	35-00 /32-00N	101-15 / 97-40W	16.8	5.7	3.2	SF-8428(1/4)
24032U	231901/231933	32-00 /29-00N	97-40 / 94-35W	16.8	4.8	2.7	SF-8428(1/4)
24033U	231933/232019	29-00 /25-30N	94-35 / 90-30W	16.8	6.8	3.6	SF-8428(1/4)
24034U	232019/232050	25-30 /23-00N	90-30 / 88-00W	16.8	4.8	2.2	SF-8428(1/4)
24035U	232100/232141	22-00 /18-00N	87-00 / 84-20W	19.2	3.5	18.3	SQ-8417(2/4)
24036U	232141/232222	18-00 /14-00N	84-20 / 82-20W	19.4	3.3	15.9	SQ-8417(2/4)
24037U	232222/232256	14-00 /10-00N	82-20 / 80-10W	19.7	2.7	16.2	SQ-8417(2/4)
24 APR 1967	AIRCRAFT = RB-57F A/C 294						
24113U	241945/242018	36-45 /40-00N	108-06 /110-10W	16.8	4.8	13.4	SQ-8438(1/4), SF-8519(1/4)
24114U	242018/242109	40-00 /43-30N	110-10 /116-00W	16.8	7.3	10.9	SQ-8438(1/4), SF-8519(1/4)
24115U	242109/242150	43-30 /47-00N	116-00 /121-25W	16.8	6.0	17.3	SQ-8438(1/4), SF-8519(1/4)
24116U	242150/242221	47-00 /50-00N	121-25 /125-10W	16.8	4.6	15.6	SQ-8438(1/4), SF-8519(1/4)
24117U	242221/242258	50-00 /54-00N	125-10 /129-00W	16.8	5.4	12.8	SQ-8438(1/4), SF-8519(1/4)
24118U	242258/242338	54-00 /58-00N	129-00 /133-43W	16.8	5.9	11.5	SQ-8438(1/4), SF-8519(1/4)
24119U	242338/240010	58-00 /61-00N	133-43 /138-20W	16.8	4.7	11.2	SQ-8438(1/4), SF-8519(1/4)
24120U	240010/240046	61-00 /64-00N	138-20 /145-45W	16.8	5.2	13.6	SQ-8438(1/4), SF-8519(1/4)
25 APR 1967	AIRCRAFT = RB-57F A/C 294						
24124U	252031/252107	62-00 /59-00N	150-45 /156-02W	18.3	3.7	14.2	SQ-8439(2/4), SF-8521(1/4)
24125U	252107/252143	59-00 /56-00N	156-02 /161-30W	18.3	3.9	7.6	SQ-8439(2/4), SF-8521(1/4)
24126U	252143/252218	56-00 /53-00N	161-30 /166-07W	18.3	3.9	12.8	SQ-8439(2/4), SF-8521(1/4)
24127U	252218/252250	53-00 /50-00N	166-07 /170-00W	18.3	3.4	12.8	SQ-8439(2/4), SF-8521(1/4)
24128U	252255/252325	50-00 /53-00N	170-00 /166-07W	19.1	2.7	11.4	SQ-8441(2/4), SF-8522(1/4)
24129U	252325/252357	53-00 /56-00N	166-07 /161-30W	19.3	2.6	16.8	SQ-8441(2/4), SF-8522(1/4)
24131U	260029/260102	59-00 /62-00N	156-02 /150-45W	19.4	2.7	17.1	SQ-8441(2/4), SF-8522(1/4)
24132U	260102/260120	62-00 /63-22N	150-45 /148-30W	19.4	1.5	14.5	SQ-8441(2/4), SF-8522(1/4)
25 APR 1967	AIRCRAFT = RB-57F A/C 298						
24068U	251550/251626	08-00 /03-00N	79-30W	15.2	7.4	1.0	SF-8451(2/4)
24069U	251626/251703	03-00N/01-00S	79-30 / 79-10W	15.2	8.2	0.5	SF-8451(2/4)
24070U	251703/251740	01-00 /05-00S	79-10 / 78-05W	15.2	8.4	0.5	SF-8451(2/4)
24071U	251740/251817	05-00 /09-00S	78-05 / 77-00W	15.2	8.4	0.3	SF-8451(2/4)
24072U	251817/251857	09-00 /13-00S	77-00 / 75-45W	15.2	9.1	0.8	SF-8451(2/4)
24073U	251905/251953	14-00 /19-00S	75-30 / 73-50W	18.3	5.7	10.1	SF-8448(1/4)
24074U	251953/252030	19-00 /23-00S	73-50 / 72-40W	18.3	4.3	14.3	SF-8448(1/4)
24075U	252030/252109	23-00 /27-00S	72-40 / 71-00W	18.3	4.4	14.3	SF-8448(1/4)
24076U	252109/252155	27-00 /32-00S	71-00 / 68-40W	18.3	5.1	10.3	SF-8448(1/4)

ISOTOPES, INCORPORATED

TABLE 1 FLIGHT DATA FOR STARDUST FILTERS COLLECTED DURING 1967

FILTER NUMBER	TIME (Z)	LATITUDE	LONGITUDE	ALTITUDE (KM)	VOLUME (100 SCM)	BETA (PC/SCM)	SAMPLES AND ALIQUOTS
26 APR 1967	AIRCRAFT = RB-57F A/C 293						
24155U	261546/261622	07-00 /03-00N	79-35W	16.8	5.9	1.0	SF-8452(2/4)
24156U	261622/261700	03-00N/01-00S	79-35 / 79-10W	16.8	6.3	1.4	SF-8452(2/4)
24157U	261700/261737	01-00 /05-00S	79-10 / 78-05W	16.8	5.9	1.4	SF-8452(2/4)
24158U	261737/261814	05-00 /09-00S	78-05 / 77-00W	16.8	5.9	1.3	SF-8452(2/4)
24159U	261814/261858	09-00 /12-20S	77-00 / 76-00W	16.8	6.9	1.2	SF-8452(2/4)
24160U	261910/261951	14-00 /19-00S	75-30 / 73-50W	19.1	3.6	13.5	SQ-8444(2/4), SF-8523(1/4)
24161U	261951/262030	19-00 /23-00S	73-50 / 72-25W	19.4	3.4	15.1	SQ-8444(2/4), SF-8523(1/4)
24162U	262030/262107	23-00 /27-00S	72-25 / 70-50W	19.7	2.9	10.6	SQ-8444(2/4), SF-8523(1/4)
24163U	262107/262151	27-00 /31-35S	70-50 / 68-35W	19.9	3.2	17.6	SQ-8444(2/4), SF-8523(1/4)
26 APR 1967	AIRCRAFT = RB-57F A/C 298						
24167U	261427/261508	35-00 /39-00S	68-23 / 68-15W	15.2	8.4	1.7	SQ-8445(2/4), SF-8524(1/4)
24168U	261508/261546	39-00 /43-00S	68-15 / 68-05W	15.2	7.9	2.1	SQ-8445(2/4), SF-8524(1/4)
24169U	261546/261619	43-00 /47-00S	68-05 / 67-50W	15.2	6.6	3.5	SQ-8445(2/4), SF-8524(1/4)
24170U	261619/261646	47-00 /50-00S	67-50 / 67-45W	15.2	5.3	4.1	SQ-8445(2/4), SF-8524(1/4)
24171U	261646/261703	50-00 /52-00S	67-45W	15.2	3.4	6.0	SQ-8445(2/4), SF-8524(1/4)
24172U	261706/261722	52-00 /50-00S	67-45W	16.8	2.3	16.2	SQ-8446(2/4), SF-8525(1/4)
24173U	261722/261748	50-00 /47-00S	67-45 / 67-50W	16.8	3.8	10.1	SQ-8446(2/4), SF-8525(1/4)
24174U	261748/261822	47-00 /43-00S	67-50 / 68-05W	16.8	4.9	8.6	SQ-8446(2/4), SF-8525(1/4)
24175U	261822/261857	43-00 /39-00S	68-05 / 68-15W	16.8	5.4	9.7	SQ-8446(2/4), SF-8525(1/4)
24176U	261857/261942	39-00 /34-00S	68-15 / 68-45W	16.8	7.1	4.9	SQ-8446(2/4), SF-8525(1/4)
27 APR 1967	AIRCRAFT = RB-57F A/C 294						
24136U	271804/271841	64-00 /68-00N	145-45 /144-45W	15.2	7.1	14.8	SF-8453(1/4)
24137U	271841/271916	68-00 /72-00N	144-45 /143-25W	15.2	6.8	14.7	SF-8453(1/4)
24138U	271916/271942	72-00 /75-00N	143-25 /143-00W	15.2	5.1	13.1	SF-8453(1/4)
24139U	271942/271947	75-00N	143-00W	16.0	0.8	17.6	
24140U	271947/272015	75-00 /72-00N	143-00 /143-25W	16.8	4.0	19.9	SF-8454(1/4)
24141U	272015/272048	72-00 /68-00N	143-25 /144-45W	16.8	4.7	18.8	SF-8454(1/4)
24142U	272048/272122	68-00 /64-00N	144-45 /145-45W	16.8	4.9	14.1	SF-8454(1/4)
24146U	270221/270256	64-00 /68-00N	145-45 /144-45W	18.3	3.4	9.0	SF-8455(1/4), SF-8526(1/4)
24147U	270256/270329	68-00 /72-00N	144-45 /143-25W	18.3	3.4	15.8	SF-8455(1/4), SF-8526(1/4)
24148U	270329/270357	72-00 /75-00N	143-25 /143-00W	18.3	2.9	12.8	SF-8455(1/4), SF-8526(1/4)
24149U	270357/270425	75-00 /72-00N	143-00 /143-25W	19.1	2.5	13.8	SQ-8434(2/4), SF-8527(1/4)
24150U	270425/270455	72-00 /68-00N	143-25 /144-45W	19.1	2.5	10.3	SQ-8434(2/4), SF-8527(1/4)
24151U	270455/270533	68-00 /64-00N	144-45 /145-45W	19.2	3.2	8.4	SQ-8434(2/4), SF-8527(1/4)
27 APR 1967	AIRCRAFT = RB-57F A/C 296						
24202U	271758/271835	36-50 /41-00N	108-00W	18.3	4.0	16.0	SF-8456(1/4), SF-8528(1/4)
24203U	271835/271900	41-00 /44-00N	108-00W	18.3	2.6	22.2	SF-8456(1/4), SF-8528(1/4)
24204U	271900/271921	44-00 /47-00N	108-00W	18.3	2.1	24.4	SF-8456(1/4), SF-8528(1/4)
24205U	271921/271950	47-00 /50-00N	108-00 /107-40W	18.3	2.9	19.9	SF-8456(1/4), SF-8528(1/4)
24206U	272000/272034	50-00 /47-00N	107-40 /108-00W	18.7	3.0	16.2	SQ-8435(2/4), SF-8529(1/4)
24207U	272034/272100	47-00 /44-00N	108-00W	19.1	2.1	12.8	SQ-8435(2/4), SF-8529(1/4)
24208U	272100/272126	44-00 /41-00N	108-00W	19.4	2.0	20.5	SQ-8435(2/4), SF-8529(1/4)
24209U	272126/272205	41-00 /36-50N	108-00W	19.7	2.8	17.4	SQ-8435(2/4), SF-8529(1/4)

ISOTOPES, INCORPORATED

TABLE 1 FLIGHT DATA FOR STARDUST FILTERS COLLECTED DURING 1967

FILTER NUMBER	TIME (Z)	LATITUDE	LONGITUDE	ALTITUDE (KM)	VOLUME (100 SCM)	BETA (PC/SCM)	SAMPLES AND ALIQUOTS
27 APR 1967	AIRCRAFT = RB-57F A/C 298						
24079U	271504/271535	35-00 /39-00S	68-35 / 68-15W	18.3	3.5	9.2	SQ-8442(2/4), SF-8531(1/4)
24080U	271535/271608	39-00 /43-00S	68-15 / 68-00W	18.3	3.5	15.0	SQ-8442(2/4), SF-8531(1/4)
24081U	271608/271644	43-00 /47-00S	68-00W	18.3	3.8	10.8	SQ-8442(2/4), SF-8531(1/4)
24082U	271644/271708	47-00 /50-00S	68-00 / 67-45W	18.3	2.6	12.3	SQ-8442(2/4), SF-8531(1/4)
24083U	271708/271728	50-00 /52-00S	67-45W	18.3	2.1	11.0	SQ-8442(2/4), SF-8531(1/4)
24084U	271728/271745	52-00 /50-00S	67-45W	19.1	1.6	12.0	SQ-8443(2/4), SF-8532(1/4)
24085U	271745/271808	50-00 /47-00S	67-45 / 68-00W	19.3	2.0	18.6	SQ-8443(2/4), SF-8532(1/4)
24086U	271808/271842	47-00 /43-00S	68-00W	19.5	2.8	11.4	SQ-8443(2/4), SF-8532(1/4)
24087U	271842/271917	43-00 /39-00S	68-00 / 68-15W	19.6	2.8	12.8	F 8532 1
24088U	271917/272000	39-00 /34-00S	68-15 / 68-35W	19.6	3.5	11.7	SQ-8443(2/4), SF-8532(1/4)
28 APR 1967	AIRCRAFT = RB-57F A/C 294						
24212U	280112/280153	64-00 /61-00N	145-45 /138-20W	15.2	8.2	11.6	SQ-8447(1/4)
24213U	280153/280225	61-00 /58-00N	138-20 /133-45W	15.2	6.4	13.6	SQ-8447(1/4)
24214U	280225/280305	58-00 /54-00N	133-45 /129-00W	15.2	7.5	17.1	SQ-8447(1/4)
24215U	280305/280345	54-00 /50-00N	129-00 /125-00W	15.2	7.6	22.1	SQ-8447(1/4)
24216U	280345/280420	50-00 /47-00N	125-00 /121-15W	15.2	6.6	15.0	SQ-8447(1/4)
24217U	280420/280504	47-00 /43-30N	121-15 /116-15W	15.2	8.4	16.9	SQ-8447(1/4)
24218U	280504/280555	43-30 /40-00N	116-15 /110-10W	15.2	10.1	11.2	SQ-8447(1/4)
24219U	280555/280627	40-00 /36-45N	110-10 /108-05W	15.2	6.3	11.6	SQ-8447(1/4)
24220U	280627/280643	36-45 /35-00N	108-05 /106-50W	15.2	3.2	8.9	SQ-8447(1/4)
28 APR 1967	AIRCRAFT = RB-57F A/C 293						
24180U	281540/281622	31-00 /27-00S	69-50 / 70-50W	15.2	8.8	1.9	SF-8457(2/4), SF-8533(1/4)
24181U	281622/281654	27-00 /23-00S	70-50 / 72-30W	15.2	6.8	1.3	SF-8457(2/4), SF-8533(1/4)
24182U	281654/281732	23-00 /19-00S	72-30 / 73-55W	15.2	7.9	0.5	SF-8457(2/4), SF-8533(1/4)
24183U	281732/281813	19-00 /15-00S	73-55 / 75-10W	15.2	8.9	0.3	SF-8457(2/4), SF-8533(1/4)
24184U	281813/281852	15-00 /11-00S	75-10 / 76-20W	15.2	8.4	0.4	SF-8457(2/4), SF-8533(1/4)
24185U	281907/281945	09-00 /05-00S	77-00 / 78-10W	18.3	4.5	12.0	SF-8449(1/4)
24186U	281945/282022	05-00 /01-00S	78-10 / 79-10W	18.3	4.2	10.4	SF-8449(1/4)
24187U	282022/282100	01-00S/03-00N	79-10 / 79-35W	18.3	4.5	9.7	SF-8449(1/4)
24188U	282100/282137	03-00 /07-30N	79-35W	18.3	4.4	9.9	SF-8449(1/4)
29 APR 1967	AIRCRAFT = RB-57F A/C 298						
24091U	291528/291608	31-00 /27-00S	69-00 / 71-00W	16.8	6.2	4.1	SF-8458(1/4)
24092U	291608/291646	27-00 /23-00S	71-00 / 72-30W	16.8	6.1	2.7	SF-8458(1/4)
24093U	291646/291724	23-00 /19-00S	72-30 / 74-00W	16.8	6.1	2.5	SF-8458(1/4)
24094U	291724/291753	19-00 /16-00S	74-00 / 75-00W	16.8	4.4	2.2	SF-8458(1/4)
24095U	291810/291855	14-00 /09-00S	75-30 / 77-00W	19.1	4.3	14.9	SQ-8436(2/4), SF-8534(1/4)
24096U	291855/291930	09-00 /05-00S	77-00 / 78-00W	19.4	3.1	14.5	SQ-8436(2/4), SF-8534(1/4)
24097U	291930/292007	05-00 /01-00S	78-00 / 79-25W	19.4	3.2	22.8	SQ-8436(2/4), SF-8534(1/4)
24098U	292007/292039	01-00S/03-00N	79-25 / 79-34W	19.6	2.7	3.9	SQ-8436(2/4), SF-8534(1/4)
24099U	292039/292125	03-00 /08-00N	79-34W	19.7	3.9	9.5	SQ-8436(2/4), SF-8534(1/4)

ISOTOPES, INCORPORATED

TABLE 1 FLIGHT DATA FOR STARDUST FILTERS COLLECTED DURING 1967

FILTER NUMBER	TIME (Z)	LATITUDE	LONGITUDE	ALTITUDE (KM)	VOLUME (100 SCM)	BETA (PC/SCM)	SAMPLES AND ALIQUOTS
30 APR 1967	AIRCRAFT = RB-57F A/C 293						
24059U	301422/301506	10-00 /14-00N	80-10 / 82-20W	16.8	6.9	0.7	SF-8459(2/4)
24060U	301506/301548	14-00 /18-00N	82-20 / 84-20W	16.8	6.8	1.5	SF-8459(2/4)
24061U	301548/301622	18-00 /21-00N	84-20 / 86-30W	16.8	5.7	1.5	SF-8459(2/4)
24062U	301632/301715	22-00 /25-30N	87-00 / 90-30W	18.8	4.3	6.9	SQ-8437(2/4)
24063U	301715/301800	25-30 /29-00N	90-30 / 94-40W	19.1	4.0	12.8	SQ-8437(2/4)
24064U	301800/301847	29-00 /32-00N	94-40 / 99-45W	19.1	4.0	12.2	SQ-8437(2/4)
24065U	301847/301943	32-00 /35-00N	99-45 /105-40W	19.4	4.5	9.7	SQ-8437(2/4)
01 MAY 1967	AIRCRAFT = RB-57F A/C 298						
24104U	011425/011510	10-00 /14-00N	80-10 / 82-20W	15.2	10.0	1.0	SF-8461(2/4)
24105U	011510/011554	14-00 /18-00N	82-20 / 84-30W	15.2	10.0	0.5	SF-8461(2/4)
24106U	011554/011638	18-00 /22-00N	84-30 / 87-00W	15.2	9.8	0.6	SF-8461(2/4)
24107U	011644/011722	22-30 /25-30N	87-30 / 90-50W	18.3	4.4	16.0	SF-8462(1/4), SF-8535(1/4)
24108U	011722/011806	25-30 /29-00N	90-50 / 94-30W	18.3	4.9	16.2	SF-8462(1/4), SF-8535(1/4)
24109U	011806/011841	29-00 /32-00N	94-30 / 98-00W	18.3	3.9	13.2	SF-8462(1/4), SF-8535(1/4)
08 MAY 1967	AIRCRAFT = RB-57F A/C 299						
24222U	082240/090017	36-00 /42-00N	107-30 /113-25W	11.9	28.1	0.8	SF-8465(2/4)
24223U	090017/090130	42-00 /47-00N	113-25 /117-30W	11.9	21.0	1.0	SF-8465(2/4)
09 MAY 1967	AIRCRAFT = RB-57F A/C 299						
24227U	091725/091838	48-00 /51-00N	119-00 /127-55W	11.9	19.4	9.4	SQ-8463(2/4)
24228U	091838/091940	51-00 /55-00N	127-55 /133-30W	11.9	18.0	10.4	SQ-8463(2/4)
24229U	091940/092041	55-00 /59-00N	133-30 /138-50W	11.9	17.3	4.7	SQ-8463(2/4)
24230U	092041/092156	59-00 /64-00N	138-50 /145-50W	11.9	21.3	5.5	SQ-8463(2/4)
11 MAY 1967	AIRCRAFT = RB-57F A/C 299						
24233U	111938/112052	64-00 /58-00N	145-50 /137-15W	13.1	17.8	8.2	SQ-8464(1/4)
24234U	112052/112205	58-00 /52-00N	137-15 /129-40W	13.1	17.9	5.0	SQ-8464(1/4)
24235U	112205/112315	52-00 /47-00N	129-40 /120-00W	13.1	17.4	13.2	SQ-8464(1/4)
24236U	112315/120030	47-00 /42-00N	120-00 /113-20W	13.1	18.7	12.3	SQ-8464(1/4)
24237U	120030/120148	42-00 /36-00N	113-20 /107-35W	13.1	19.8	5.5	SQ-8464(1/4)
25 MAY 1967	AIRCRAFT = RB-57F A/C 291						
24263U	251705/251737	36-45 /40-00N	108-05 /110-00W	16.7	5.2	6.4	SX-8466(1/4)
24264U	251737/251821	40-00 /43-30N	110-00 /115-00W	16.8	6.6	7.6	SX-8466(1/4)
24265U	251821/251910	43-30 /47-00N	115-00 /121-25W	16.8	7.1	7.0	SX-8466(1/4)
24266U	251910/251945	47-00 /50-00N	121-25 /125-05W	16.8	4.9	9.7	SX-8466(1/4)
24267U	251945/252025	50-00 /54-00N	125-05 /129-00W	16.8	5.6	14.4	SX-8466(1/4)
24268U	252025/252105	54-00 /58-00N	129-00 /133-45W	16.8	5.5	9.6	SX-8466(1/4)
24269U	252105/252137	58-00 /61-00N	133-45 /138-20W	16.8	4.4	16.6	SX-8466(1/4)
24270U	252137/252215	61-00 /64-00N	138-20 /145-45W	16.8	5.3	14.3	SX-8466(1/4)

ISOTOPES, INCORPORATED

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FILTER NUMBER	TIME (Z)	LATITUDE	LONGITUDE	ALTITUDE (KM)	VOLUME (100 SCM)	BETA (PC/SCM)	SAMPLES AND ALIQUOTS
26 MAY 1967	AIRCRAFT = RB-57F A/C 291						
24273U	261956/262030	64-00 /68-00N	145-40 /144-00W	15.2	6.4	9.6	SX-8467(2/4)
24274U	262030/262104	68-00 /72-00N	144-00 /143-00W	15.2	6.3	10.6	SX-8467(2/4)
24275U	262104/262130	72-00 /75-00N	143-00W	15.2	4.7	10.1	SX-8467(2/4)
24276U	262139/262204	75-00 /72-00N	143-00W	16.8	3.3	15.2	SX-8468(2/4)
24277U	262204/262240	72-00 /68-00N	143-00 /144-00W	16.8	4.8	13.1	SX-8468(2/4)
24278U	262240/262314	68-00 /64-00N	144-00 /145-40W	16.8	4.6	18.7	SX-8468(2/4)
26 MAY 1967	AIRCRAFT = RB-57F A/C 293						
24281U	261637/261708	37-00 /40-00N	108-10 /110-00W	18.3	3.4	12.8	SX-8471(2/4)
24282U	261708/261750	40-00 /43-30N	110-00 /115-05W	18.3	4.5	6.8	SX-8471(2/4)
24283U	261750/261838	43-30 /47-00N	115-05 /121-15W	18.3	5.1	15.8	SX-8471(2/4)
24284U	261838/261913	47-00 /50-00N	121-15 /125-05W	18.3	3.7	17.3	SX-8471(2/4)
24285U	261923/261955	51-00 /54-00N	126-00 /130-00W	19.2	2.7	12.4	SX-8469(2/4)
24286U	261955/262034	54-00 /58-00N	130-00 /133-50W	19.4	3.0	11.5	SX-8469(2/4)
24287U	262034/262104	58-00 /61-00N	133-50 /138-30W	19.6	2.2	13.4	SX-8469(2/4)
26 MAY 1967	AIRCRAFT = RB-57F A/C 299						
24320U	261353/261453	35-10 /32-00N	104-00 / 92-45W	15.2	11.6	0.11	SF-8495(1/4)
24321U	261453/261528	32-00 /29-00N	92-45 / 94-40W	15.2	6.8	0.02	SF-8495(1/4)
24322U	261528/261614	29-00 /25-30N	94-40 / 90-40W	15.2	9.1	0.10	SF-8495(1/4)
24323U	261614/261658	25-30 /22-00N	90-40 / 87-00W	15.2	8.8	0.6	SF-8495(1/4)
24324U	261658/261740	22-00 /18-00N	87-00 / 84-20W	15.2	8.4	0.8	SF-8495(1/4)
24325U	261740/261820	18-00 /14-00N	84-20 / 82-20W	15.2	8.0	1.4	SF-8495(1/4)
24326U	261820/261902	14-00 /10-00N	82-20 / 80-10W	15.2	6.4	0.6	SF-8495(1/4)
26 MAY 1967	AIRCRAFT = RB-57F A/C 290						
24329U	261512/261548	35-00 /32-00N	101-15 / 97-10W	18.3	3.7	11.8	SX-8472(1/4)
24330U	261548/261623	32-00 /29-00N	97-10 / 94-30W	18.3	3.6	12.8	SX-8472(1/4)
24331U	261623/261707	29-00 /25-30N	94-30 / 90-30W	18.3	4.5	13.1	SX-8472(1/4)
24332U	261707/261747	25-30 /22-00N	90-30 / 87-00W	18.3	4.3	10.7	SX-8472(1/4)
24333U	261747/261827	22-00 /18-00N	87-00 / 84-20W	18.3	4.3	11.9	SX-8472(1/4)
24334U	261827/261902	18-00 /14-00N	84-20 / 82-20W	18.3	3.6	9.3	SX-8472(1/4)
24335U	261902/261948	14-00 /09-50N	82-20 / 80-10W	18.3	5.1	10.8	SX-8472(1/4)
27 MAY 1967	AIRCRAFT = RB-57F A/C 293						
24290U	271935/272009	64-00 /68-00N	145-45 /144-35W	18.3	3.4	9.8	SX-8473(2/4)
24291U	272009/272041	68-00 /72-00N	144-35 /143-15W	18.3	3.2	12.8	SX-8473(2/4)
24292U	272041/272106	72-00 /75-00N	143-15 /143-00W	18.3	2.5	11.3	SX-8473(2/4)
24293U	272115/272139	75-00 /72-00N	143-00 /143-15W	18.8	2.1	12.2	SX-8474(2/4)
24294U	272139/272213	72-00 /68-00N	143-15 /144-35W	19.0	2.8	11.0	SX-8474(2/4)
24295U	272213/272250	68-00 /64-00N	144-35 /145-45W	19.1	3.0	7.7	SX-8474(2/4)

ISOTOPES, INCORPORATED

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FILTER NUMBER	TIME (Z)	LATITUDE	LONGITUDE	ALTITUDE (KM)	VOLUME (100 SCM)	BETA (PC/SCM)	SAMPLES AND ALIQUOTS
27 MAY 1967	AIRCRAFT = RB-57F	A/C 291					
24240U	271955/272022	64-00 /61-00N	145-45 /138-20W	15.2	5.2	9.1	SX-8475(1/4)
24241U	272022/272054	61-00 /58-00N	138-20 /133-45W	15.2	6.2	9.1	SX-8475(1/4)
24242U	272054/272136	58-00 /54-00N	133-45 /129-00W	15.2	8.2	9.5	SX-8475(1/4)
24243U	272136/272216	54-00 /50-00N	129-00 /125-05W	15.2	7.8	4.0	SX-8475(1/4)
24244U	272216/272249	50-00 /47-00N	125-05 /121-20W	15.2	6.6	7.6	SX-8475(1/4)
24245U	272249/272337	47-00 /43-30N	121-20 /115-05W	15.2	9.6	7.1	SX-8475(1/4)
24246U	272337/280018	43-30 /40-00N	115-05 /110-00W	15.2	8.2	5.6	SX-8475(1/4)
24247U	280018/280050	40-00 /36-45N	110-00 /108-05W	15.2	6.4	3.4	SF-8496(1/4)
24248U	280050/280108	36-45 /35-00N	108-05 /106-50W	15.2	3.6	2.8	SF-8496(1/4)
27 MAY 1967	AIRCRAFT = RB-57F	A/C 298					
24339U	271459/271536	35-00 /32-00N	102-10 / 97-45W	16.8	3.8	7.4	SX-8476(2/4)
24340U	271536/271609	32-00 /29-00N	97-45 / 94-35W	16.8	5.1	2.8	SX-8476(2/4)
24341U	271609/271652	29-00 /25-30N	94-35 / 90-35W	16.8	6.7	3.4	SX-8476(2/4)
24342U	271652/271735	25-30 /22-00N	90-35 / 87-00W	16.8	6.9	2.2	SX-8476(2/4)
24343U	271735/271815	22-00 /18-00N	87-00 / 84-20W	16.8	6.6	1.8	SF-8497(1/4)
24344U	271815/271854	18-00 /14-00N	84-20 / 82-20W	16.8	6.4	0.8	SF-8497(1/4)
24345U	271854/271934	14-00 /10-00N	82-20 / 80-15W	16.8	6.5	1.2	SF-8497(1/4)
24346U	271934/271949	10-00 /08-50N	80-15 / 79-30W	16.8	2.4	1.1	SF-8497(1/4)
28 MAY 1967	AIRCRAFT = RB-57	A/C 293					
24252U	281932/282003	63-30 /61-00N	144-00 /138-30W	18.3	3.0	9.8	SX-8477(2/4)
24253U	282003/282036	61-00 /58-00N	138-30 /133-50W	18.3	3.2	12.0	SX-8477(2/4)
24254U	282036/282116	58-00 /54-00N	133-50 /129-00W	18.3	4.0	15.1	SX-8477(2/4)
24255U	282116/282158	54-00 /50-00N	129-00 /125-05W	18.3	4.3	16.4	SX-8477(2/4)
24256U	282208/282230	49-00 /47-00N	124-00 /121-20W	19.2	1.8	12.8	SX-8478(2/4)
24257U	282230/282319	47-00 /43-30N	121-20 /115-15W	19.6	3.9	8.9	SX-8478(2/4)
24258U	282319/290002	43-30 /40-00N	115-15 /110-00W	20.0	3.2	10.0	SX-8478(2/4)
24259U	290002/290040	40-00 /36-00N	110-00 /107-30W	20.3	2.7	10.4	SX-8478(2/4)
28 MAY 1967	AIRCRAFT = RB-57F	A/C 290					
24298U	281343/281420	07-00 /03-00N	79-40W	16.8	5.8	3.8	SF-8498(1/4)
24299U	281420/281456	03-00N/01-00S	79-40 / 79-10W	16.8	5.8	1.8	SF-8498(1/4)
24300U	281456/281534	01-00 /05-00S	79-10 / 78-05W	16.8	6.1	1.5	SF-8498(1/4)
24301U	281534/281611	05-00 /09-00S	78-05 / 77-00W	16.8	6.0	0.9	SF-8498(1/4)
24302U	281611/281652	09-00 /14-00S	77-00 / 75-10W	16.8	6.7	0.8	SF-8498(1/4)
24303U	281652/281734	14-00 /19-00S	75-10 / 74-00W	16.8	6.3	4.3	SX-8479(2/4)
24304U	281734/281812	19-00 /23-00S	74-00 / 72-30W	16.8	5.7	3.4	SX-8479(2/4)
24305U	281812/281846	23-00 /27-00S	72-30 / 70-50W	16.8	5.1	4.0	SX-8479(2/4)
24306U	281846/281926	27-00 /32-00S	70-50 / 68-40W	16.8	6.1	8.2	SX-8479(2/4)

ISOTCPES, INCORPORATEC

TABLE 1 FLIGHT CATA FCR STARDUST FILTERS COLLECTED CURING 1967

FILTER NUMBER	TIME (Z)	LATITUDE	LONGITUDE	ALTITUDE (KM)	VOLUME (100 SCM)	BETA (PC/SCM)	SAMPLES AND ALIQUOTS
28 MAY 1967	AIRCRAFT = RB-57F A/C 299						
24350U	281506/281543	03-CON/01-00S	79-39 / 79-10W	18.3	4.2	9.5	SX-8481(1/4)
24351U	281543/281619	01-CO /C5-0CS	79-10 / 78-05W	18.3	4.1	18.1	SX-8481(1/4)
24352U	281619/281700	C5-00 /09-00S	78-05 / 76-55W	18.3	4.8	11.9	SX-8481(1/4)
24353U	2817CC/281738	09-00 /13-00S	76-55 / 75-45W	18.3	4.5	14.6	SX-8481(1/4)
24354U	281738/281831	13-0C /19-00S	75-45 / 73-55W	18.3	6.2	6.0	SX-8481(1/4)
24355U	281831/281902	19-00 /23-C0S	73-55 / 72-30W	18.3	3.6	18.2	SX-8481(1/4)
24356U	281902/281940	23-C0 /27-0CS	72-30 / 70-55W	18.3	4.0	12.8	SX-8481(1/4)
29 MAY 1967	AIRCRAFT = RB-57F A/C 298						
24371U	291439/291518	07-00 /03-00N	79-35 / 79-40W	15.2	8.5	0.8	SF-8499(1/4)
24372U	291518/291554	C3-CON/C1-00S	79-40 / 79-10W	15.2	7.7	0.7	SF-8499(1/4)
24373U	291554/291631	01-C0 /C5-0CS	79-10 / 78-C5W	15.2	7.8	0.6	SF-8499(1/4)
24374U	291631/291706	C5-CC /C9-00S	78-05 / 77-C0W	15.2	7.2	0.7	SF-8499(1/4)
24375U	291706/291743	C9-C0 /13-0CS	77-00 / 75-50W	15.2	7.9	1.C	SF-8499(1/4)
24376U	291752/291838	14-0C /19-00S	75-35 / 73-55W	19.1	4.6	16.7	SX-8482(2/4)
24377U	291838/291912	19-00 /23-0CS	73-55 / 72-25W	18.9	3.4	17.6	SX-8482(2/4)
24378U	291912/291946	23-00 /27-00S	72-25 / 7C-50W	19.1	3.2	9.8	SX-8482(2/4)
24379U	291946/292030	27-00 /32-0CS	70-50 / 68-40W	19.2	3.9	10.2	SX-8482(2/4)
30 MAY 1967	AIRCRAFT = RB-57F A/C 29C						
24360U	3016C2/301640	3C-20 /27-0CS	69-05 / 70-55W	15.2	7.6	4.9	SX-8483(2/4)
24361U	301640/301730	27-C0 /23-00S	70-55 / 72-30W	15.2	10.0	1.5	SX-8483(2/4)
24362U	30173C/3C1800	23-00 /19-00S	72-30 / 73-55W	15.2	6.4	0.3	SX-8483(2/4)
24363U	3C18CC/3C1844	19-00 /15-0CS	73-55 / 75-15W	15.2	9.6	1.6	SX-8483(2/4)
24364U	301844/3C1939	15-C0 /11-00S	75-15 / 76-25W	18.1	6.9	4.3	SX-8484(2/4)
24365U	302000/302032	C9-C0 /05-0CS	77-00 / 78-05W	18.7	3.3	19.0	SX-8484(2/4)
24366U	302032/302115	C5-CC /C1-0CS	78-05 / 79-15W	19.1	4.1	15.C	SX-8484(2/4)
24367U	302115/302150	C1-00S/C3-0CN	79-15 / 79-40W	19.4	3.1	6.2	SX-8484(2/4)
30 MAY 1967	AIRCRAFT = RB-57F A/C 298						
24383U	3C1425/301459	35-00 /39-00S	68-25 / 68-15W	15.2	7.0	3.3	SX-8485(2/4)
24384U	301459/301533	39-00 /43-00S	68-15 / 68-05W	15.2	7.0	4.8	SX-8485(2/4)
24385U	301533/3C1608	43-C0 /47-00S	68-05 / 67-50W	15.2	7.4	6.2	SX-8485(2/4)
24386U	3016C8/3C1633	47-00 /50-00S	67-50W	15.2	5.3	3.9	SX-8485(2/4)
24387U	301633/301651	50-00 /52-0CS	67-50 / 67-45W	15.2	3.8	3.4	SX-8485(2/4)
24388U	301655/301712	52-00 /50-00S	67-45 / 67-50W	16.8	2.5	12.8	SX-8486(2/4)
24389U	3C1712/3C1734	50-00 /47-00S	67-50W	16.8	3.3	2.6	SX-8486(2/4)
24390U	301734/301809	47-C0 /43-0CS	67-50 / 68-05W	16.8	5.2	9.4	SX-8486(2/4)
24391U	3018C9/301843	43-00 /39-00S	68-05 / 68-15W	16.8	5.0	11.3	SX-8486(2/4)
24392U	301843/301930	39-00 /34-00S	68-15 / 68-25W	16.8	7.2	15.0	SX-8486(2/4)

ISOTOPES, INCORPORATED

TABLE 1 FLIGHT DATA FOR STARDUST FILTERS COLLECTED DURING 1967

FILTER NUMBER	TIME (Z)	LATITUDE	LONGITUDE	ALTITUDE (KM)	VOLUME (100 SCM)	BETA (PC/SCM)	SAMPLES AND ALIQUOTS
31 MAY 1967	AIRCRAFT = RB-57F	A/C 299					
24396U	311415/311452	34-30 /39-00S	68-30 / 68-15W	18.3	4.0	11.4	SX-8487(2/4)
24397U	311452/311528	39-00 /43-00S	68-15 / 68-00W	18.3	3.9	14.6	SX-8487(2/4)
24398U	311528/311602	43-00 /47-00S	68-00 / 67-55W	18.3	3.6	15.8	SX-8487(2/4)
24399U	311602/311629	47-00 /50-00S	67-55 / 67-45W	18.3	2.9	14.7	SX-8487(2/4)
24400U	311629/311647	50-00 /52-00S	67-45W	18.3	2.0	11.4	SX-8487(2/4)
24401U	311649/311705	52-00 /50-00S	67-45W	19.1	1.4	22.4	SX-8488(2/4)
24402U	311705/311728	50-00 /47-00S	67-45 / 67-55W	19.3	2.0	20.0	SX-8488(2/4)
24403U	311728/311800	47-00 /43-00S	67-55 / 68-00W	19.4	2.6	16.4	SX-8488(2/4)
24404U	311800/311836	43-00 /39-00S	68-00 / 68-15W	19.6	2.8	16.3	SX-8488(2/4)
24405U	311836/311920	39-00 /34-00S	68-15 / 68-40W	19.8	3.3	14.7	SX-8488(2/4)
01 JUN 1967	AIRCRAFT = RB-57F	A/C 290					
24312U	011452/011519	10-00 /14-00N	80-10 / 83-20W	18.4	3.1	16.5	SX-8489(1/4)
24313U	011517/011600	14-00 /18-00N	83-20 / 84-30W	18.7	4.4	12.3	SX-8489(1/4)
24314U	011600/011630	18-00 /22-00N	84-30 / 87-00W	19.0	2.7	14.8	SX-8489(1/4)
24315U	011630/011727	22-00 /25-30N	87-00 / 90-45W	19.1	5.2	15.3	SX-8489(1/4)
24316U	011727/011813	25-30 /29-00N	90-45 / 94-40W	19.2	4.1	15.3	SX-8489(1/4)
24317U	011813/011901	29-00 /32-00N	94-40 /100-00W	19.3	4.0	27.8	SX-8489(1/4)
24318U	011901/011950	32-00 /35-10N	100-00 /106-40W	19.4	3.9	19.0	SX-8489(1/4)
06 JUN 1967	AIRCRAFT = RB-57C	A/C 944					
24432F	062221/062318	55-00 /60-00N	133-30 /140-40W	11.9	33.8	1.2	SX-8491(2/4)
24433F	062318/070005	60-00 /64-00N	140-40 /145-40W	11.9	27.9	1.6	SX-8491(2/4)
06 JUN 1967	AIRCRAFT = RB-57C	A/C 839					
24408F	062258/062350	55-00 /59-52N	131-30 /137-15W	13.1	27.1	9.8	SX-8492(2/4)
24409F	062350/070042	59-52 /64-00N	137-15 /145-43W	13.1	27.1	3.6	SX-8492(2/4)
06 JUN 1967	AIRCRAFT = RB-57C	A/C 944					
24438F	061641/061722	41-13 /44-17N	112-06 /117-09W	11.9	25.2	5.4	SX-8493(2/4)
24439F	061722/061805	44-17 /47-26N	117-09 /122-18W	11.9	26.4	3.1	SX-8493(2/4)
06 JUN 1967	AIRCRAFT = RB-57C	A/C 839					
24414F	061755/061835	41-13 /44-17N	112-06 /117-09W	13.1	20.8	10.2	SX-8494(2/4)
24415F	061835/061908	44-17 /47-33N	117-09 /117-40W	13.1	17.2	8.4	SX-8494(2/4)
07 JUN 1967	AIRCRAFT = RB-57C	A/C 839					
24420F	071908/071950	55-00 /50-32N	131-30 /126-50W	11.9	25.8	4.0	SF-8501(1/4)
24421F	071950/072025	50-32 /47-26N	126-50 /122-15W	11.9	21.5	6.3	SF-8501(1/4)
07 JUN 1967	AIRCRAFT = RB-57C	A/C 944					
24444F	071946/072006	55-00 /50-32N	133-30 /127-00W	13.1	10.4	1.5	SF-8502(1/4)
24445F	072006/072111	50-32 /47-26N	127-00 /122-19W	13.1	33.9	0.9	SF-8502(1/4)
07 JUN 1967	AIRCRAFT = RB-57C	A/C 839					
24426F	072324/072350	41-13 /39-03N	112-06 /108-47W	11.9	16.0	10.3	SF-8503(1/4)
24427F	072350/080023	39-03 /35-02N	108-47 /106-48W	11.9	20.3	2.1	SF-8503(1/4)

ISOTOPES, INCORPORATED

TABLE 1 FLIGHT DATA FOR STARDUST FILTERS COLLECTED DURING 1967

FILTER NUMBER	TIME (Z)	LATITUDE	LONGITUDE	ALTITUDE (KM)	VOLUME (100 SCM)	BETA (PC/SCM)	SAMPLES AND ALIQUOTS
09 JUN 1967	AIRCRAFT = RB-57C A/C 944						
24447F	091717/091745	41-13 /39-04N	112-06 /108-48W	13.1	14.0	2.2	SF-8504(1/4)
24448F	091745/091822	39-04 /35-03N	108-48 /106-49W	13.1	18.5	0.3	SF-8504(1/4)
25 JUN 1967	AIRCRAFT = RB-57F A/C 298						
24451U	251430/251500	35-00 /39-00S	68-25 / 68-15W	18.3	3.2	8.8	
24452U	251500/251531	39-00 /43-00S	68-15 / 68-00W	18.3	3.3	5.4	
24453U	251531/251605	43-00 /47-00S	68-00 / 67-50W	18.3	3.6	3.9	
24454U	251605/251630	47-00 /50-00S	67-50 / 67-45W	18.3	2.6	5.4	
24455U	251630/251644	50-00 /52-00S	67-45W	18.3	1.5	7.4	
24456U	251646/251704	52-00 /50-00S	67-45W	18.7	1.7	9.0	
24457U	251704/251732	50-00 /47-00S	67-45 / 67-50W	19.1	2.6	6.9	
24458U	251732/251809	47-00 /43-00S	67-50 / 68-00W	19.2	3.3	7.0	
24459U	251809/251845	43-00 /39-00S	68-00 / 68-15W	19.4	3.2	9.6	
24460U	251845/251930	39-00 /34-00S	68-15 / 68-45W	19.5	4.1	4.1	
26 JUN 1967	AIRCRAFT = RB-57F A/C 298						
24468U	261618/261658	31-00 /27-00S	68-50 / 70-55W	18.2	4.5	5.7	
24469U	261658/261737	27-00 /23-00S	70-55 / 73-00W	18.3	4.4	5.2	
24470U	261737/261815	23-00 /19-00S	73-00 / 74-50W	18.3	4.4	4.4	
24471U	261815/261846	19-00 /15-30S	74-50 / 76-30W	18.3	3.7	5.9	
24472U	261848/261925	15-30 /19-00S	76-30 / 74-50W	19.4	3.4	6.0	
24473U	261925/262000	19-00 /23-00S	74-50 / 73-00W	19.8	2.9	7.1	
24474U	262000/262035	23-00 /27-00S	73-00 / 70-55W	19.9	2.7	7.6	
24475U	262035/262119	27-00 /32-00S	70-55 / 68-40W	20.1	3.2	7.6	
26 JUN 1967	AIRCRAFT = RB-57F A/C 294						
24479U	261733/261805	35-00 /39-00S	68-25 / 68-15W	15.2	6.1	5.3	
24480U	261805/261838	39-00 /43-00S	68-15 / 68-00W	15.2	6.3	3.9	
24481U	261838/261909	43-00 /47-00S	68-00 / 67-50W	15.2	5.7	3.6	
24482U	261909/261934	47-00 /50-00S	67-50 / 67-45W	15.2	4.7	5.5	
24483U	261934/261957	50-00 /52-00S	67-45W	15.2	4.1	0.2	
27 JUN 1967	AIRCRAFT = RB-57F A/C 294						
24464U	271431/271503	30-00 /27-10S	69-25 / 70-50W	15.2	6.6	3.5	

ISOTOPES, INCORPORATED

TABLE 2 RADIONUCLIDES 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	PU 238	PU 239	CD 109
01 APR 1967										
SC-8384	35 /22N	106/ 87W	19.8	7.4	11.9	66. B	-	0.93B	1.37B	-
SC-8392	22 /14N	87/ 82W	18.3	4.9	8.2	56. B	-	0.58B	1.04B	-
SF-8406	05 /09S	78/ 77W	19.2	2.6	9.2	66. B	-	-	-	-
SF-8405	11 /31S	76/ 69W	16.8	7.6	2.1	8.2C	-	-	-	-
11 APR 1967										
SC-8413	64 /55N	146/134W	11.9	31.8	8.8	41. B	L 3.	0.45B	0.68A	-
SC-8414	64 /55N	146/134W	13.1	26.1	6.6	38. B	L 7.	0.46B	0.64B	-
SC-8415	47 /41N	122/112W	11.9	24.8	7.0	C 0.6C	L 0.9	0.62A	0.36A	-
SF-8517	47 /41N	122/112W	11.9	12.4	7.0	26. B	-	-	-	-
SC-8416	47 /41N	122/112W	13.1	20.1	5.7	29. B	L 5.	0.27B	0.52A	-
12 APR 1967										
SF-8421	55 /51N	134/127W	11.9	8.2	6.0	C 56. B	-	-	-	-
SF-8518	55 /51N	134/127W	11.9	16.3	6.0	C 14. B	-	-	-	-
SF-8422	51 /47N	127/122W	11.9	10.4	0.3	1.5C	-	-	-	-
SF-8423	55 /47N	134/123W	13.1	11.2	5.7	34. B	-	-	-	-
SF-8424	41 /35N	112/107W	13.1	8.2	3.3	18. B	-	-	-	-
13 APR 1967										
SF-8425	41 /39N	112/109W	11.9	8.9	3.9	13. B	-	-	-	-
SF-8426	39 /35N	109/106W	11.9	5.7	7.0	27. B	-	-	-	-
23 APR 1967										
SF-8427	35 /22N	101/ 87W	15.2	16.0	0.8	1.8C	-	-	-	-
SF-8428	35 /23N	101/ 88W	16.8	5.5	3.0	11. C	-	-	-	-
SF-8429	22 /09N	87/ 80W	18.3	4.0	7.9	33. B	-	-	-	-
SC-8417	22 /10N	87/ 80W	19.4	4.8	16.9	61. B	-	1.03B	1.33B	-
24 APR 1967										
SC-8438	64 /37N	146/108W	16.8	11.0	13.2	C 30. C	-	0.95A	0.87A	-
SF-8519	64 /37N	146/108W	16.8	11.0	13.2	56. B	-	-	-	-
25 APR 1967										
SC-8439	62 /50N	151/170W	18.3	7.4	11.8	33. B	-	1.18B	0.75B	-
SF-8521	62 /50N	151/170W	18.3	3.7	11.8	36. C	-	-	-	-
SC-8441	63 /50N	148/170W	19.3	6.2	14.3	36. B	-	1.66B	0.88B	-
SF-8522	63 /50N	148/170W	19.3	3.1	14.3	36. C	-	-	-	-
SF-8451	08N/13S	80/ 76W	15.2	20.8	0.6	0.6C	-	-	-	-
SF-8448	14 /32S	76/ 69W	18.3	4.9	12.0	48. B	L 28.	-	-	-

ISOTCPES, INCCRPCRATEC

TABLE 2 RACICNUCLIDES IN STARCUST SAMPLES

SAMPLE NUMBER	LATITUDE (DEG.)	LONGITUDE (DEG.)	ALTITUDE (KM)	VOLUME (100 SCM)	TOTAL BETA (PC/SCM)	ACTIVITIES (PC/100 SCM) SR 90	SR 89	PU 238	PU 239	CD 109
26 APR 1967										
SF-8452	C7N/12S	8C/ 76W	16.8	15.4	1.3	3.1B	-	-	-	-
SC-8444	14 /32S	76/ 69W	19.5	6.6	14.3	36. B	21.C	2.41B	0.83B	-
SF-8523	14 /32S	76/ 69W	19.5	3.3	14.3	47. C	-	-	-	-
SC-8445	35 /52S	68W	15.2	15.8	3.0	2.8C	L 12.	C.40B	0.13B	-
SF-8524	35 /52S	68W	15.2	7.9	3.0	9.1C	-	-	-	-
SC-8446	34 /52S	69/ 68W	16.8	11.8	8.7	23. B	L 2.	1.29B	0.51B	-
SF-8525	34 /52S	69/ 68W	16.8	5.9	8.7	26. C	-	-	-	-
27 APR 1967										
SF-8453	75 /64N	143/146W	15.2	4.8	14.3	55. B	-	-	-	-
SF-8454	75 /64N	143/146W	16.8	3.4	17.4	60. B	-	-	-	-
SF-8455	75 /64N	143/146W	18.3	2.4	12.5	33. C	-	-	-	-
SF-8526	75 /64N	143/146W	18.3	2.4	12.5	35. B	-	-	-	-
SC-8434	75 /64N	143/146W	19.1	4.1	10.6	C 24. B	-	1.25B	0.59A	-
SF-8527	75 /64N	143/146W	19.1	2.0	10.6	34. C	-	-	-	-
SF-8456	50 /37N	108W	18.3	2.9	19.9	C 14. C	-	-	-	-
SF-8528	50 /37N	108W	18.3	2.9	19.9	78. B	-	-	-	-
SC-8435	50 /37N	108W	19.2	5.0	16.7	46. B	-	1.22A	1.18A	-
SF-8529	50 /37N	108W	19.2	2.5	16.7	50. C	-	-	-	-
SC-8442	35 /52S	69/ 68W	18.3	7.8	11.7	C 27. B	-	2.44B	0.72B	-
SF-8531	35 /52S	69/ 68W	18.3	3.9	11.7	48. B	-	-	-	-
SC-8443	34 /52S	69/ 68W	19.4	5.0	13.0	C 23. C	-	3.09A	0.83A	-
SF-8532	34 /52S	69/ 68W	19.4	3.2	13.0	58. B	-	-	-	-
28 APR 1967										
SC-8447	64 /35N	146/107W	15.2	16.1	14.5	28. B	L 3.	C.74A	0.82A	-
SF-8449	08N/09S	80/ 77W	18.3	4.4	10.5	40. B	L 31.	-	-	-
SF-8457	11 /31S	76/ 70W	15.2	20.4	C.8	1.9C	-	-	-	-
SF-8533	11 /31S	76/ 70W	15.2	10.2	C.8	1.8C	-	-	-	-
29 APR 1967										
SC-8436	C8N/14S	80/ 76W	19.4	8.6	13.4	39. B	-	1.32A	1.06A	-
SF-8534	C8N/14S	80/ 76W	19.4	4.3	13.4	64. B	-	-	-	-
SF-8458	16 /31S	75/ 69W	16.8	5.7	3.0	9.6B	-	-	-	-
30 APR 1967										
SC-8437	35 /22N	106/ 87W	19.1	8.4	10.3	59. B	-	C.77B	1.01B	-
SF-8459	21 /10N	86/ 80W	16.8	9.7	1.2	4.9B	-	-	-	-
01 MAY 1967										
SF-8462	35 /22N	102/ 88W	18.3	3.3	15.2	47. B	-	-	-	-
SF-8535	35 /22N	102/ 88W	18.3	3.3	15.2	48. B	-	-	-	-
SF-8461	22 /10N	87/ 80W	15.2	14.9	C.7	1.2C	-	-	-	-
08 MAY 1967										
SF-8465	47 /36N	118/108W	11.9	24.6	C.9	3.2B	-	-	-	-

ISOTOPES, INCORPORATED

TABLE 2 RADIONUCLIDES 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	PU 238	PU 239	CD 109
09 MAY 1967										
SC-8463	64 /48N	146/119W	11.9	38.0	7.5	28. B	-	LOST	LOST	-
11 MAY 1967										
SC-8464	64 /36N	146/108W	13.1	22.9	8.8	25. B	-	0.51A	0.69A	-
25 MAY 1967										
SX-8466	64 /37N	146/108W	16.8	11.2	10.4	46. B	-	0.99B	1.00B	2.4C
26 MAY 1967										
SX-8467	75 /64N	143/146W	15.2	8.7	10.1	35. B	-	0.83B	0.75B	2.0C
SX-8468	75 /64N	143/146W	16.8	6.4	15.6	59. B	-	0.88B	1.20B	3.9C
SX-8469	61 /51N	138/126W	19.4	4.0	12.3	58. B	-	1.56B	1.63B	4.5D
SX-8471	50 /37N	125/108W	18.3	8.4	13.1	57. B	-	1.16A	1.21A	3.3B
SF-8495	35 /10N	104/ 80W	15.2	15.3	0.5	0.8C	-	-	-	-
SX-8472	35 /10N	101/ 80W	18.3	7.3	11.5	50. B	-	1.06B	1.14B	2.9C
27 MAY 1967										
SX-8473	75 /64N	143/146W	18.3	4.6	11.3	Q 21. C	-	1.97B	1.34B	2.7C
SX-8474	75 /64N	143/146W	19.0	4.0	10.1	49. C	-	1.37A	0.88B	3.2D
SX-8475	64 /40N	146/110W	15.2	13.0	7.3	40. B	-	0.60A	0.72A	2.0C
SF-8496	40 /35N	110/107W	15.2	2.5	3.2	19. C	-	-	-	-
SX-8476	35 /22N	102/ 87W	16.8	11.2	3.6	18. C	-	0.28B	0.38B	0.4D
SF-8497	22 /09N	87/ 80W	16.8	5.5	1.2	8.7C	-	-	-	-
28 MAY 1967										
SX-8477	64 /50N	144/125W	18.3	7.2	13.7	Q 24. C	-	1.11B	1.21B	3.2B
SX-8478	49 /36N	124/108W	19.8	5.8	10.2	33. C	-	1.36B	0.83B	L 0.6
SF-8498	07N/14S	80/ 75W	16.8	7.6	1.7	6.0C	-	-	-	-
SX-8481	03N/27S	80/ 71W	18.3	7.8	12.4	Q 2.4C	-	Q 1.43B	Q2.41B	3.7C
SX-8479	14 /32S	75/ 69W	16.8	11.6	5.0	24. B	-	1.02A	0.46B	1.3B
29 MAY 1967										
SF-8499	07N/13S	80/ 76W	15.2	9.8	0.8	0.5C	-	-	-	-
SX-8482	14 /32S	76/ 69W	19.1	7.6	13.8	32. C	-	1.12A	0.45A	1.8C
30 MAY 1967										
SX-8484	03N/15S	80/ 75W	18.8	8.7	10.0	49. B	-	0.89A	1.02A	Q 9.4A
SX-8483	15 /30S	75/ 69W	15.2	16.8	2.1	11. B	-	0.44B	0.19B	0.5C
SX-8485	35 /52S	68W	15.2	15.2	4.5	23. B	-	1.21C	0.61C	1.5C
SX-8486	34 /52S	68W	16.8	11.6	10.9	38. B	-	2.12A	0.63A	3.0B
31 MAY 1967										
SX-8487	34 /52S	68W	18.3	8.2	13.7	33. B	-	LOST	LOST	2.6C
SX-8488	34 /52S	69/ 68W	19.4	6.0	17.2	33. B	-	2.76A	0.61B	3.2C
01 JUN 1967										
SX-8489	35 /10N	107/ 80W	19.0	6.8	17.3	41. B	-	0.64B	0.68B	2.0C

ISOTOPES, INCORPORATED

TABLE 2 RADIONUCLIDES 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	PU 238	PU 239	CD 109
06 JUN 1967										
SX-8491	64 /55N	146/134W	11.9	30.8	1.4	15. B	-	0.18B	0.26B	0.5C
SX-8492	64 /55N	146/132W	13.1	27.1	6.7	22. B	-	0.38B	0.5CA	1.2C
SX-8493	47 /41N	122/112W	11.9	25.8	4.2	17. B	-	0.21A	0.31A	0.6C
SX-8494	48 /41N	118/112W	13.1	19.0	9.4	24. B	-	0.30B	0.44B	1.0B
07 JUN 1967										
SF-8501	55 /47N	132/122W	11.9	11.8	5.1	30. C	-	-	-	-
SF-8502	55 /47N	134/122W	13.1	11.1	1.0	12. B	-	-	-	-
SF-8503	41 /35N	112/107W	11.9	9.1	5.7	16. B	-	-	-	-
09 JUN 1967										
SF-8504	41 /35N	112/107W	13.1	8.1	1.1	7.3B	-	-	-	-

REPORT No.
N. R. L. F. 25.

DEPARTMENT OF HEALTH

2.

QUARTERLY REPORT

APRIL–JUNE 1967

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

SYMBOLS UNITS AND EQUIVALENTS

UNITS OF RADIOACTIVITY

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

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

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

NOTES

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

2. Radioactive fallout in rain is expressed as:

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

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

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

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

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

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

   One litre of whole milk contains approximately:

   1.2 g of calcium

   1.4 g of potassium.

CONTENTS

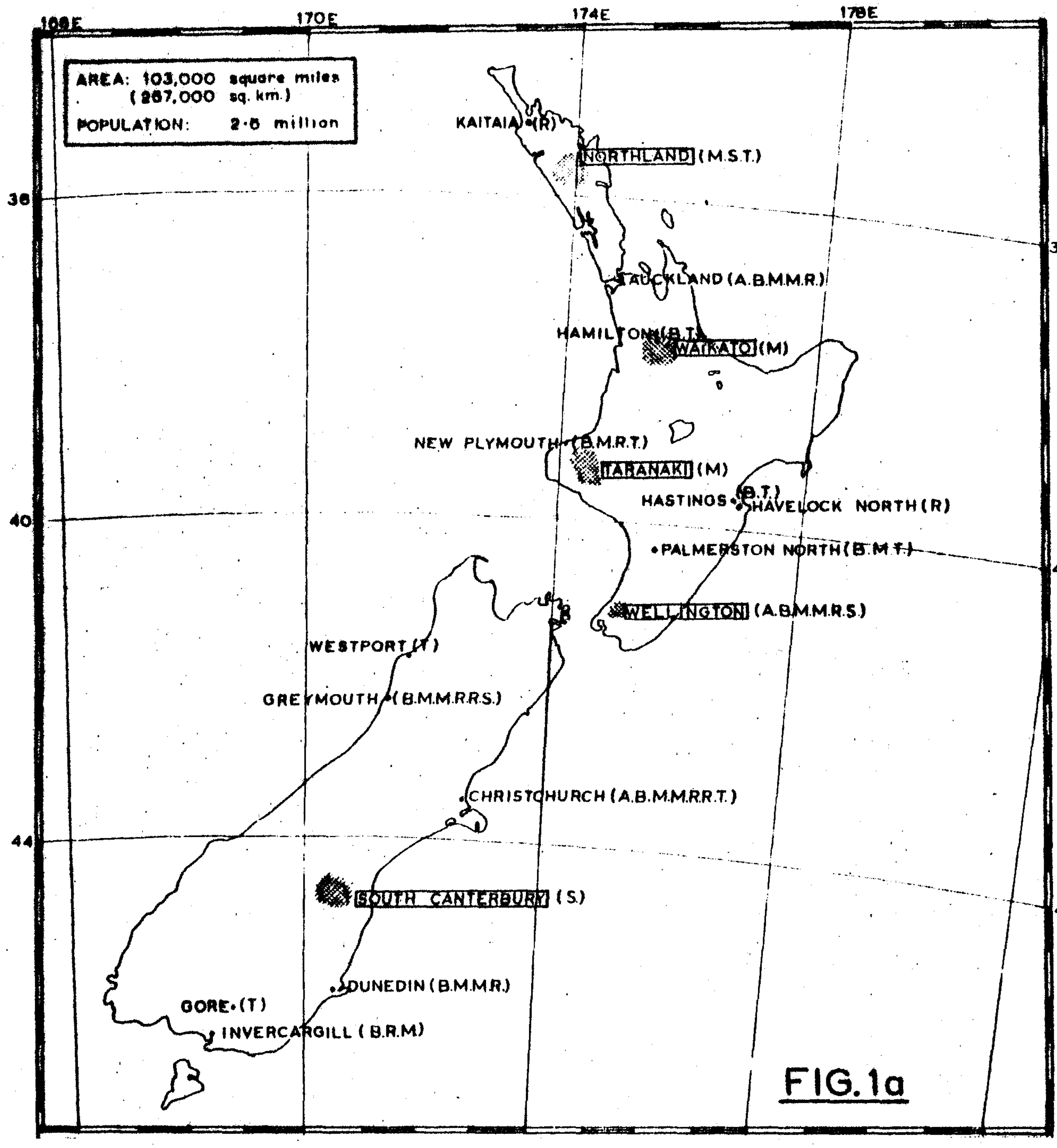
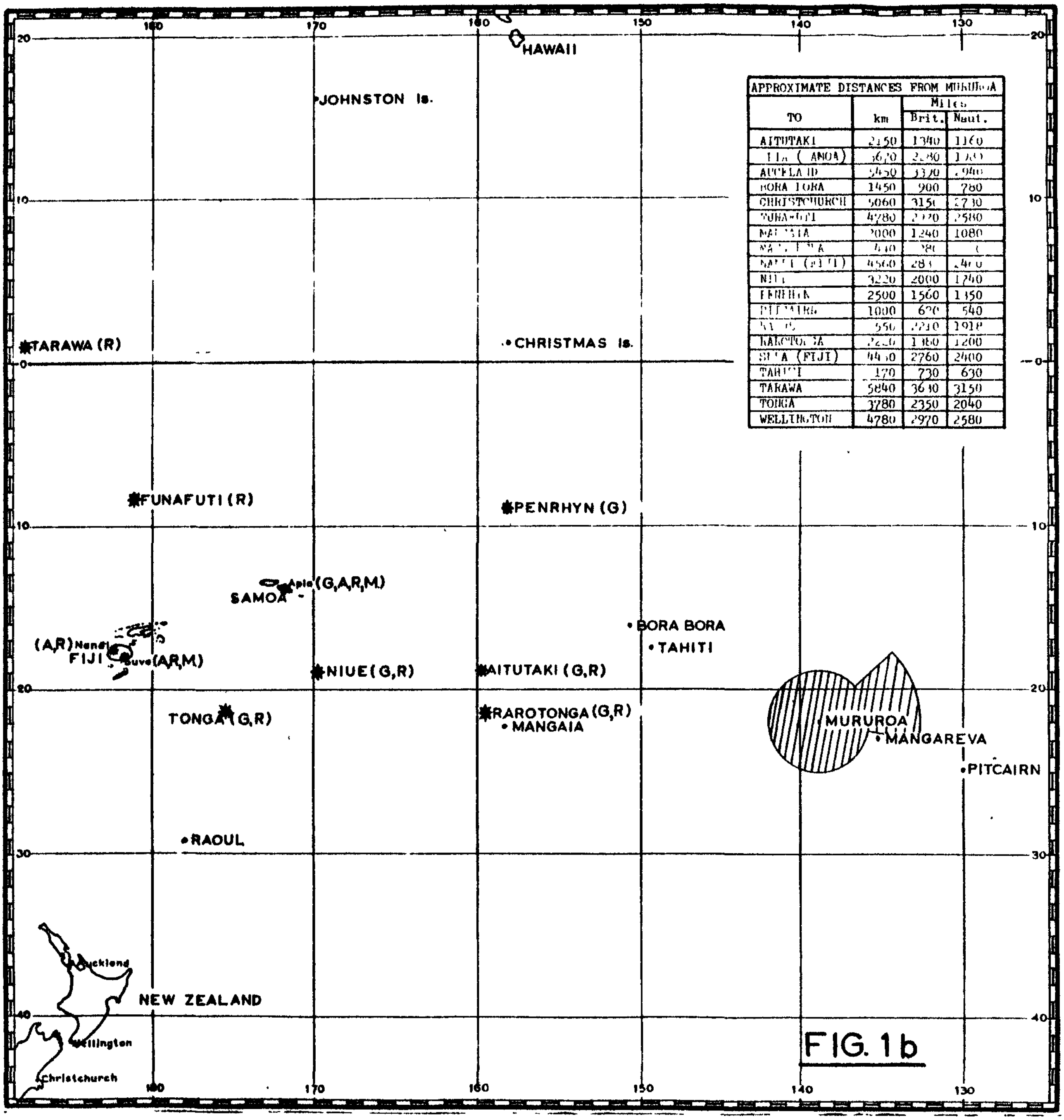


FIG.1a

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



APPROXIMATE DISTANCES FROM [illegible]			
TO	km	Miles	
		Brit.	Naut.
AITUTAKI	2150	1340	1160
[illegible] (ANOA)	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1450	900	780
CHRISTCHURCH	5060	[illegible]	[illegible]
[illegible]	4780	[illegible]	2580
[illegible]	2000	1240	1080
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	3220	2000	1740
[illegible]	2500	1560	[illegible]
[illegible]	1000	[illegible]	540
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	1200
[illegible] (FIJI)	[illegible]	2760	2400
[illegible]	[illegible]	730	630
TARAWA	5840	[illegible]	3150
TONGA	3780	2350	2040
WELLINGTON	4780	2970	2580

LOCATION OF MONITORING AND COLLECTING STATIONS ESTABLISHED BY THE NATIONAL RADIATION LABORATORY ON PACIFIC ISLANDS. GAMMA RADIATION MONITORING STATIONS (G), AND COLLECTING STATIONS FOR AIR (A), AND RAINWATER (R), AND MILK (M) SAMPLES ARE MARKED THUS * Officially proclaimed danger zone shown thus

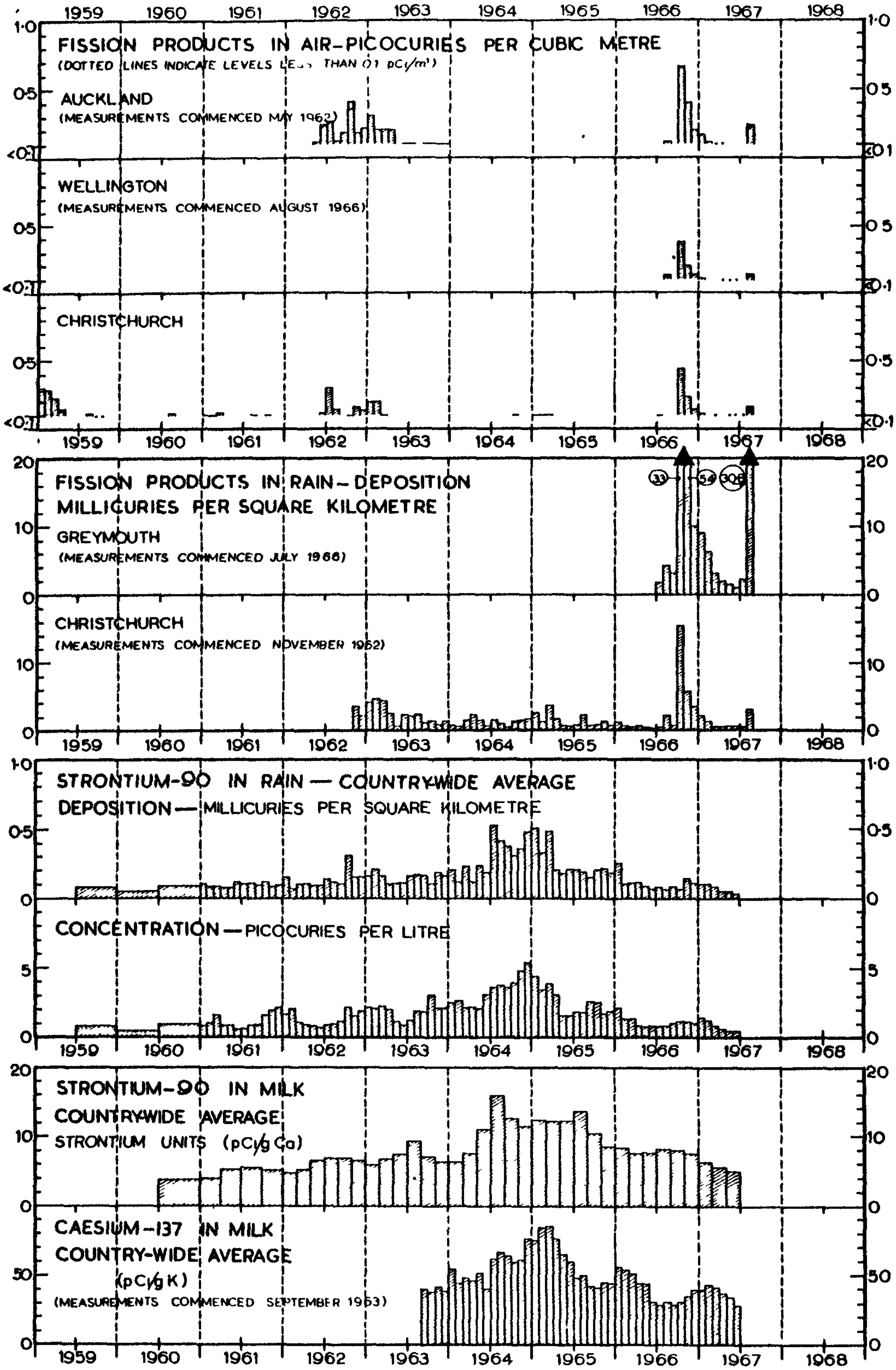


FIG. 2 SUMMARY OF LONG TERM MEASUREMENTS

SUMMARY

GENERAL

This report which is divided into two sections, gives in SECTION A, the results of routine monitoring of fallout during the second quarter 1967.

In SECTION B, the results of extended monitoring of fallout from the French nuclear tests in the Pacific are given. Three nuclear devices were exploded at Mururoa in the Tuamotu Archipelago during this year's test series. The reported dates of these tests were 6 June, 28 June and 3 July (New Zealand Standard Time). Our extended monitoring programme commenced on 1 June and results are given in this report for all samples which had been received and measured up to about the end of August. This covers the period of greatest interest. Subsequent results up to the end of September, when this extended monitoring programme will terminate, will be given in the next issue of this report, although it is not expected that these results will be of significant interest. The locations of collecting and monitoring stations and types of samples collected are shown in Fig. 1a for New Zealand, and Fig. 1b for the Pacific Area.

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 nuclear tests in the Pacific which, although showing increased levels of radioactivity during limited periods, are of less significance in assessing health hazards. The measurement of Strontium-89 in routine rain and milk samples has been continued since July 1966. Although these measurements are part of the extended monitoring programme, the results are included in Section A where comparisons are made with Strontium-90 levels.

(A) RESULTS OF ROUTINE MONITORING OF FALLOUT DURING SECOND QUARTER 1967

TOTAL BETA ACTIVITY

Fission products in air and rainwater, which showed significant increases during the fourth quarter 1966, had fallen steadily during the first quarter 1967 and have remained at pre-test levels during the second quarter 1967.

STRONTIUM-89

Strontium-89 levels in rain samples have remained at the minimum detectable level during the second quarter 1967. The levels in milk samples have fallen steadily from 12 pCi/g Ca for Jan. - Feb. to 5 pCi/g Ca for Mar. - Apr. and 1 pCi/g Ca for May - June 1967.

STRONTIUM-90 AND CAESIUM-137

The levels of these long lived fallout products have decreased during this quarter.

SUMMARY Cont.

The country-wide average deposition of Strontium-90 in rain has decreased from 0.30 mCi/km^2 during the first quarter to 0.13 mCi/km^2 during the second quarter. This level is about one tenth of the highest level previously recorded during the first quarter 1965.

The country-wide average level of Strontium-90 in milk has decreased slightly from 6.1 Strontium Units during Jan. - Feb. to 5.5 Strontium Units during Mar. - Apr. and 5.0 Strontium Units during May - June. The May - June level is less than one third of the highest level previously recorded which was 15.9 Strontium Units during July - August 1964.

The country-wide average level of Caesium-137 in milk has decreased from 42 pCi/gK during the first quarter to 32 pCi/gK during the second quarter. This level is less than one half of the highest level previously recorded which was 81 pCi/gK during the first quarter 1965.

The following table compares values obtained for this period with values for the previous period:

FISSION PRODUCTS IN AIR -		MEASUREMENTS AT SELECTED STATIONS	
		1st Quarter 1967	2nd Quarter 1967
Total Beta Activity pCi/m^3	Auckland	0.11	0.03
	Wellington	0.08	0.02
	Christchurch	0.08	0.03

FISSION PRODUCTS IN RAIN -		MEASUREMENTS AT SELECTED STATIONS	
		1st Quarter 1967	2nd Quarter 1967
Total Beta Activity mCi/km^2	Greymouth	18.5	4.7
	Christchurch	4.5	1.7

STRONTIUM RADIOISOTOPES IN RAIN -		COUNTRY-WIDE AVERAGE - 9 STATIONS	
		1st Quarter 1967	2nd Quarter 1967
Strontium-90*, Deposition	mCi/km^2	0.30	0.13
Strontium-90, Concentration	pCi/litre	1.2	0.6
Strontium-89*, Deposition	mCi/km^2	1.1	<0.1
Ratio Strontium-89/Strontium-90		4	1

STRONTIUM RADIOISOTOPES IN MILK -		COUNTRY-WIDE AVERAGE - 9 STATIONS		
		Jan.-Feb.	Mar.-Apr.	May-Jun.
Strontium-90	pCi/g Ca	6.1	5.5	5.0
Strontium-89	pCi/g Ca	12	5	1
Ratio Strontium-89/Strontium-90		2	1	<1

CAESIUM-137 IN MILK -		COUNTRY-WIDE AVERAGE - 9 STATIONS	
		1st Quarter 1967	2nd Quarter 1967
Caesium-137	pCi/g K	42	32

* These values are the sum of the monthly depositions during the quarter.

SUMMARY Cont.

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

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 six Pacific Island stations where these measurements were made.

TOTAL BETA ACTIVITY OF DAILY AIR FILTER SAMPLES

The results of measurements on daily air filter samples are tabled and graphed in Section B. Transient increases in air radioactivity have been detected at all stations during the monitoring period. The daily results have been averaged over each calendar month for each station and are summarized here:

AIR FILTERS -	1967 AVERAGE MONTHLY AIR ACTIVITY - pCi/m^3		
	June	July	August
Nandi, Fiji	0.06	0.73	0.54
Suva, Fiji	0.06	0.65	0.53
Apia, Samoa	1.40	2.49	0.45
Auckland	0.03	0.07	0.24
Wellington	0.02	0.05	0.14
Christchurch	0.05	0.06	0.16

The highest monthly averages recorded during the 1966 monitoring programme were;

4.40 pCi/m^3 at	Nandi	during September	1966
0.66 " " "	Auckland	" " October	1966
0.38 " " "	Wellington	" " " "	1966
0.44 " " "	Christchurch	" " " "	1966

Suva, Fiji and Apia, Samoa were included in the 1967 air monitoring programme for the first time. Comparisons cannot therefore be made for these two stations. The results show that fission product levels in air filter samples have been significantly lower this year. The highest daily level recorded this year was 30 pCi/m^3 at Apia Samoa on 14 July after the second and third nuclear explosions of 28 June and 3 July respectively. The levels of fission products in air are discussed further under "Hazard Assessment" in this Summary.

TOTAL BETA ACTIVITY OF WEEKLY RAINWATER SAMPLES

The results of measurements of weekly rainwater samples for fission product deposition are tabled and graphed in Section B. Increased levels have been detected at most stations during the extended monitoring period. The highest levels recorded are given in the following table:

SUMMARY Cont.

STATION	COLLECTION PERIOD	AVERAGE DAILY DEPOSITION DURING THE COLLECTION PERIOD mCi/km^2
Tarawa	15 July - 22 July	19.8
Funafuti	8 July - 14 July	15.6
"	14 July - 17 July	105.9
Aitutaki	9 July - 14 July	21.9

The concentration of fission products in rain (which is used for hazard assessment, based on maximum permissible levels in drinking water) is calculated from the total deposition and total rainfall for each month for each station. These values are also given in Section B, Table 2. For the three stations of greatest interest the values of fission product concentration in rainwater are given in the following table (a) for the month or period of highest concentration and (b) for the entire monitoring period to date.

STATION	PERIOD OF HIGHEST CONCENTRATION	CONCENTRATION pCi/litre	ENTIRE MONITORING PERIOD TO DATE	CONCENTRATION pCi/litre
Tarawa	1 July - 29 July	1,830	1 June - 27 Aug.	679
Funafuti	1 July - 29 July	1,528	1 June - 30 Aug.	596
Aitutaki	30 June - 21 July	2,185	2 June - 21 July	602

When the extended monitoring operation is terminated at the end of September, it is expected that the final evaluation of average concentration over the entire monitoring period will give lower values than the values listed in this table. The levels of fission products in rainwater are further discussed under "Hazard Assessment" in this Summary.

IODINE-131 IN MILK

The levels of iodine-131 in milk from seven New Zealand Collecting Stations and from Suva, Fiji and Apia, Samoa are listed in Section B, Table 3.

The levels in New Zealand milk have been significantly lower during the 1967 monitoring period, compared with the levels during the 1966 monitoring period. The highest level for an individual sample this year was 14 pCi/litre compared with 36 pCi/litre last year. The country-wide average over the period June-August 1967 inclusive was less than 5 pCi/litre, which is the minimum recording level. In 1966 the country-wide average over the period July-December inclusive was 7 pCi/litre.

In Suva, Fiji iodine-131 was first detected in milk on 29 June. A peak level of 151 pCi/litre was recorded on 27 July. Levels subsequently dropped to less than 5 pCi/litre at the end of August. The average level over the period 5 June - 8 September was 26 pCi/litre.

SUMMARY Cont.

In Apia, Samoa iodine-131 was first detected in milk on 16 June with a significant rise to 161 pCi/litre. Levels then decreased until 21 July when there was another significant rise to 346 pCi/litre. A peak level occurred on 25 July at 708 pCi/litre. Levels had dropped to less than 5 pCi/litre by 8 September. The average level over the period 2 June - 8 September was 85 pCi/litre

The levels of iodine-131 in milk are further discussed under "Hazard Assessment" in this Summary.

IODINE-131 IN CATTLE THYROIDS

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 in New Zealand during the present monitoring operations. Iodine-131 has been detected in cattle thyroids from all of the eight collecting stations within New Zealand. The results are tabled and graphed in Section B. The first indications of iodine-131 occurred in cattle slaughtered on 19 June. The highest individual station level, 169 pCi/g, occurred in cattle slaughtered at Westport on 14 August. The highest level recorded last year was 726 pCi/g at Gore on 31 October. The country-wide average level reached a maximum of 55 pCi/g on 14 August and values have been falling steadily since then reaching an average level of 19 pCi/g on 4 September.

(c) 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 averaged 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 June 1967 (6.7 Strontium Units) is thus less than:

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

SUMMARY Cont.

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 June 1967, (35 pCi/g K) is thus 0.5% of the above "permissible level" for the whole population.

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

In Air

Apia, Samoa was the station with the highest levels of fission products in air during the current extended monitoring programme. The average levels for June, July and August 1967 were 1.40, 2.49 and 0.45 pCi/m^3 respectively, giving a three monthly average level of 1.45 pCi/m^3 during the period June to August inclusive. This level is less than 0.5% of the "permissible" level for continuous breathing by the entire population.

In Rainwater

Tarawa was the station with the highest concentration of fission products in rainwater during the current extended monitoring programme. During the period 1 June - 27 August 1967 the average concentration was 679 pCi/litre. This level is approximately 11% of the maximum permissible concentration for continuous consumption. Over the entire year 1967 the average concentration would be expected to be about one quarter of this value or approximately 3% of the permissible concentration.

SUMMARY Cont.

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 correspondingly 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.

The country-wide average level of iodine-131 in New Zealand milk during the monitoring period was below the minimum recording level i.e. less than 5 pCi/litre. For the entire year 1967 the average level would be less than 0.5% of the "acceptable level" for any age group.

In Suva, Fiji and Apia, Samoa the average levels of iodine-131 in milk during the three monthly period June - August inclusive were 26 and 85 pCi/litre respectively. For the entire year 1967 the average values will be about one quarter of these values:

i.e.	For Suva, Fiji	approximately 3%)	of the "acceptable level"
	For Apia, Samoa	approximately 11%)	for any age group.

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

RESULTS OF ROUTINE MONITORING OF FALLOUT

DURING SECOND QUARTER 1967

TABLE 1 TOTAL BETA ACTIVITY OF AIR SAMPLES

In Picocuries per Cubic Metre Four Days after Collection.

Continuous Air Filter Sampling - Filters Changed 3 times each week.

AUCKLAND		WELLINGTON		CHRISTCHURCH	
Date Filter Removed	Total Beta Activity pCi/m³	Date Filter Removed	Total Beta Activity pCi/m³	Date Filter Removed	Total Beta Activity pCi/m³
3.4.67	0.02	3.4.67	0.02	3.4.67	0.02
5.4.67	0.03	5.4.67	0.02	5.4.67	0.02
7.4.67	0.04	7.4.67	0.04	7.4.67	0.04
10.4.67	0.02	10.4.67	<0.01	10.4.67	<0.01
12.4.67	0.02	12.4.67	0.01	12.4.67	0.02
14.4.67	0.01	14.4.67	0.02	14.4.67	0.04
17.4.67	0.02	17.4.67	0.02	17.4.67	0.02
19.4.67	0.04	19.4.67	0.05	19.4.67	0.03
21.4.67	0.03	21.4.67	0.03	21.4.67	0.02
24.4.67	0.05	24.4.67	0.04	24.4.67	0.02
26.4.67	0.04	26.4.67	0.02	26.4.67	<0.01
28.4.67	0.04	28.4.67	0.01	28.4.67	0.02
1.5.67	0.03	1.5.67	0.03	1.5.67	0.03
Average	0.03	Average	0.02	Average	0.02
3.5.67	0.04	3.5.67	0.01	3.5.67	0.02
5.5.67	0.01	5.5.67	0.01	5.5.67	0.02
8.5.67	0.04	8.5.67	0.03	8.5.67	0.03
10.5.67	0.03	10.5.67	0.03	10.5.67	0.03
12.5.67	0.02	12.5.67	0.01	12.5.67	<0.01
15.5.67	0.03	15.5.67	0.02	15.5.67	0.01
17.5.67	0.02	17.5.67	0.01	17.5.67	0.01
19.5.67	0.01	19.5.67	0.01	19.5.67	0.01
21.5.67	0.02	22.5.67	0.02	22.5.67	0.01
24.5.67	0.03	24.5.67	0.01	24.5.67	0.02
26.5.67	0.02	26.5.67	0.01	26.5.67	0.02
29.5.67	0.02	29.5.67	<0.01	29.5.67	0.01
31.5.67	0.02	31.5.67	0.01	1.6.67	0.01
Average	0.02	Average	0.01	Average	0.02
Average for June *	0.03	Average for June *	0.02	Average for June *	0.05
Quarterly Average	0.03	Quarterly Average	0.02	Quarterly Average	0.03

* From 1 June 1967, air filters were changed daily. Individual results for these collecting stations for June are given in Section B, Table 1, together with results for Nandi (Fiji), Suva (Fiji), and Apia (Samoa).

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

AT	DATE OF COLLECTION FROM	TO	DEPOSITION mCi/km^2	RAINFALL cm	CONCENTRATION pCi/litre
GREYMOUTH	1.4.67	7.4.67	0.6	13.18	
	7.4.67	15.4.67	0.2	3.10	
	15.4.67	22.4.67	0.6	1.83	
	22.4.67	29.4.67	(0.6)*	11.30	
	1.4.67	29.4.67	2.0	29.41	7
	29.4.67	6.5.67	0.5	4.83	
	6.5.67	13.5.67	0.5	7.16	
	13.5.67	20.5.67	0.3	2.72	
	20.5.67	27.5.67	0.3	5.22	
	27.5.67	3.6.67	0.1	1.52	
	29.4.67	3.6.67	1.7	21.45	8
	3.6.67	1.7.67**	1.0	5.99	17
	2nd QUARTER 1967		4.7	56.85	8
CHRISTCHURCH	30.3.67	7.4.67	0.1	0.08	
	7.4.67	14.4.67	0.2	0.81	
	14.4.67	21.4.67	<0.1	N I L	
	21.4.67	28.4.67	0.2	1.80	
	30.3.67	28.4.67	0.5	2.69	19
	28.4.67	8.5.67	0.2	0.13	
	8.5.67	12.5.67	0.2	4.24	
	12.5.67	19.5.67	0.1	0.99	
	19.5.67	26.5.67	<0.1	1.88	
	26.5.67	1.6.67	0.1	0.46	
	28.4.67	1.6.67	0.6	7.70	8
	1.6.67	30.6.67**	0.6	1.90	32
	2nd QUARTER 1967		1.7	12.29	14

* No Sample - estimated result required for averaging purposes.

** Individual results for June 1967 are given in Section B, Table 2 together with results from the Pacific Area monitoring programme which commenced on 1 June.

TABLE 3 STRONTIUM-90 IN RAIN SECOND QUARTER 1967

COLLECTING STATIONS	DEPOSITION mCi/km^2			RAINFALL cm			CONCENTRATION pCi/litre		
New Zealand	Apr.	May	Jun.	Apr.	May	Jun.	Apr.	May	Jun.
Kaitaia	0.08	0.03	0.03	4.3	7.3	5.7	1.8	0.4	0.5
Auckland	0.03	0.03	0.02	3.7	4.3	6.8	0.7	0.7	0.4
New Plymouth	0.05	0.06	0.05	7.5	14.9	13.9	0.7	0.4	0.4
Havelock North	0.03	0.01	0.03	6.0	2.4	7.3	0.5	0.4	0.4
Wellington	0.07	0.07	0.04	9.5	9.4	6.4	0.7	0.7	0.6
Greymouth	0.08	0.07	0.04	33.1	18.2	7.1	0.2	0.4	0.5
Christchurch	0.02	0.04	0.01	3.0	7.7	1.9	0.8	0.5	0.7
Dunedin	0.04	0.04	0.01	5.0	7.5	2.3	0.7	0.5	0.6
Invercargill	0.09	0.11	0.02	14.9	12.7	5.0	0.6	0.9	0.4
Country-wide Averages									
Monthly	0.05	0.05	0.03	9.7	9.4	6.3	0.7	0.5	0.5
Quarterly		0.13**						0.6	
Pacific Islands									
Suva, Fiji	0.07	0.04	0.09	44.2	20.0	5.4	0.1	0.2	1.7
Rarotonga	*	0.13	0.03	*	69.2	7.3	*	0.2	0.4

* No Sample

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

TABLE 4 STRONTIUM-89 IN RAIN SECOND QUARTER 1967

COLLECTING STATIONS	DEPOSITION mCi/km^2 (at mid-month)			RATIO Strontium-89/Strontium-90		
	Apr.	May	Jun.	Apr.	May	Jun.
New Zealand						
Kaitaia	<0.1	<0.1	0.1	<1	<1	4
Auckland	<0.1	<0.1	<0.1	2	<1	2
New Plymouth	<0.1	<0.1	<0.1	1	<1	2
Havelock North	<0.1	<0.1	<0.1	1	2	1
Wellington	<0.1	<0.1	<0.1	1	<1	2
Greymouth	0.1	<0.1	<0.1	1	1	3
Christchurch	<0.1	<0.1	<0.1	1	1	5
Dunedin	<0.1	<0.1	<0.1	2	<1	4
Invercargill	0.1	<0.1	<0.1	1	<1	3
Country-wide Averages						
Monthly	<0.1	<0.1	<0.1	1	<1	3
Quarterly		<0.1**			1	
Pacific Islands						
Suva, Fiji	<0.1	<0.1	0.6	1	<1	7
Rarotonga	*	<0.1	0.1	*	<1	5

* No Sample

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

TABLE 5	STRONTIUM-90, STRONTIUM-89 AND CAESIUM-137 IN MILK							1967
COLLECTING STATIONS	STRONTIUM-90 pCi/g Ca		STRONTIUM-89* pCi/g Ca		CAESIUM-137 pCi/g K			
	Mar.-Apr.	May-Jun.	Mar.-Apr.	May-Jun.	Apr.	May	Jun.	Average Apr.-Jun.
Northland	4.3	4.5	3	<1	30	30	24	28
Auckland	4.2	4.4	2	2	29	24	19	24
Waikato	3.1	4.4	5	2	60	53	43	52
Taranaki	8.9	9.4	5	4	143	144	103	130
Palmerston North	2.6	3.6**	3	1**	11	4	N.S.	8
Wellington	4.0	6.4	2	<1	12	10	12	11
Greymouth	17.7	16.4	16	<1	38	33	16	29
Christchurch	1.9	2.0	2	<1	2	2	3	2
Dunedin	2.5	2.9	7	<1	7	6	2	5
Country-wide Averages of these results	5.5	5.0	5	1	37	34	28	32
For 12 months ending	June 1967, 6.7				June 1967, 35			

* At mid sampling time.

** May sample only.

N.S. No Sample.

SECTION B

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

TABLE 1: TOTAL BETA ACTIVITY OF DAILY AIR FILTER SAMPLES STATED IN PICOCURIES PER CUBIC METRE ON DAY OF MEASUREMENT

COLLECTION: From 9.00 am 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.

June 1967	Nandi, Fiji	Suva, Fiji	Apia, Samoa	Auckland	Wellington	Christchurch
1	0.03	<0.01	N.S.	0.03	<0.01	0.02
2	0.03	0.02	<0.01(9)	0.04	0.01	0.02
3	<0.01	0.04	<0.01(8)	0.02	<0.01	0.02
4	0.03	0.04	<0.01(7)	<0.01	<0.01	0.03
5	0.02	0.03	<0.01(6)	<0.01	0.01	0.02
6	0.03	0.03	<0.01	<0.01	<0.01	<0.01
7	0.03	0.03	0.02	0.02	0.02	0.01
8	0.04	0.03	0.02	0.04	<0.01	0.03
9	0.06	0.04	0.01	0.03	0.02	0.02
10	0.02	<0.01	<0.01(8)	0.02	<0.01	0.02
11	<0.01	<0.01	0.85(7)	0.02	<0.01	0.02
12	0.01	0.02	15.65(6)	0.01	0.01	0.04
13	N.S.	0.03	14.92(5)	0.03	0.02	0.02
14	0.04	0.04	0.72	<0.01	<0.01	0.01
15	0.07	0.03	0.03	0.02	<0.01	0.05
16	0.03	0.02	0.04	<0.01	0.03	0.02
17	0.04	0.03	0.03	0.05	0.02	0.02
18	0.02	0.02	<0.01	0.04	<0.01	0.02
19	0.03	0.01	1.45	0.03	0.02	0.02
20	0.04	0.05	0.37	0.03	<0.01	0.07
21	0.04	0.02	0.25(6)	0.04	<0.01	0.02
22	0.02	0.03	0.27	0.04	0.04	0.03
23	0.02	0.06	1.25	0.04	0.02	0.17
24	0.06	0.09	1.82(5)	0.04	0.07	0.19
25	0.02	0.09	1.16	0.05	0.04	0.03
26	0.19	0.25	0.54	0.02	0.01	0.03
27	0.28	0.19	0.81	<0.01	0.03	0.05
28	0.17	0.17	0.26	0.02	0.12	0.19
29	0.27	0.32	0.06	0.15	0.07	0.13
30	0.16	0.07	0.03	0.12	0.04	0.04
Average	0.06	0.06	1.40	0.03	0.02	0.05

N.S. No Sample

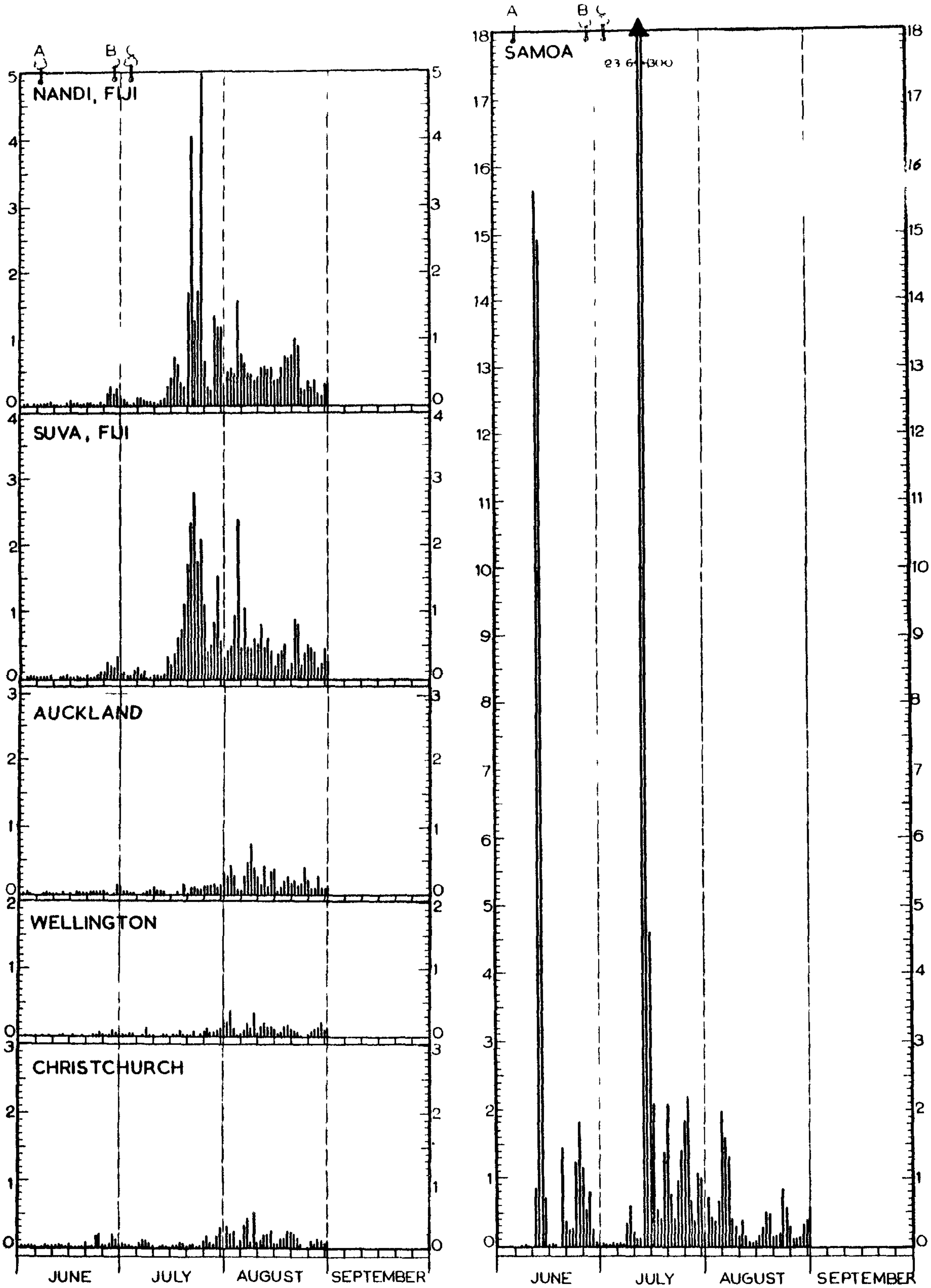
TABLE 1. (continued)

July 1967	Nandi, Fiji	Suva, Fiji	Apia, Samoa	Auckland	Wellington	Christchurch
1	0.10	0.09	0.04(5)	0.05	0.03	0.06
2	0.05	0.04	0.03	0.05	0.02	0.04
3	0.01	0.04	0.03	0.03	0.05	0.03
4	0.04	0.12	0.05	0.03	0.04	0.02
5	0.13	0.16	0.04	<0.01	<0.01	0.02
6	0.13	0.06	0.05	<0.01	0.01	0.06
7	0.08	0.12	0.03	0.02(9)	0.03	0.12
8	0.06	0.02	0.34(5)	0.04(8)	0.14	0.11
9	0.06	0.03	0.60	0.06(7)	0.03	0.07
10	0.05	0.05	0.21	0.11	0.02	0.03
11	0.03	0.05(6)	0.11	0.06	<0.01	<0.01
12	0.09	0.04	0.11	0.06	0.01	0.02
13	0.11	0.06	23.6 (5)	0.05	0.03	0.03
14	0.28	0.32	30.0	<0.01	0.02	0.02
15	0.41	0.21	4.60(5)	<0.01	<0.01	0.01
16	0.73	0.37	2.09	<0.01	0.03	0.03
17	0.62	0.62	0.56	0.04	0.02	0.03
18	0.35	0.74	0.42	<0.01	0.08	0.07
19	0.29	1.11	1.39(5)	0.15	0.03	0.07
20	1.69	1.70	2.08	0.02	0.02	0.02
21	4.04	2.34	0.76	0.11	0.02	0.04
22	1.29	2.78	0.42(5)	0.11	0.08	0.04
23	1.73	1.76	0.95	0.08(7)	<0.01	0.02
24	4.98	2.08(6)	1.41	0.08(7)	0.04	0.03
25	0.67	1.10	1.85(5)	0.13	0.08	0.10
26	0.28	0.42	2.19(6)	0.13	0.14	0.17
27	0.23	0.50	0.68(5)	0.14	0.06	0.06
28	1.36	0.84	0.39	0.15	0.06	0.05
29	1.18	1.54	1.06(5)	0.10	0.10	0.17
30	1.18	0.57	1.00	0.14	0.14	0.31
31	0.30	0.32	0.21	0.34	0.24	N.S.
Average	0.73	0.65	2.49	0.07	0.05	0.06

N.S. No Sample.

TABLE 1 (continued)

August 1967	Nandi, Fiji	Suva, Fiji	Apia, Samoa	Auckland	Wellington	Christchurch
1	0.51	0.43	0.73(5)	0.28	0.24	0.33
2	0.57	0.49	0.44(6)	0.43(7)	0.41	0.22
3	0.48	0.95(6)	0.38(5)	0.28(6)	0.14	0.25
4	1.57	2.38(5)	0.67	0.07	0.02	0.03
5	0.79	0.46	1.98(5)	0.05	0.04	0.11
6	0.65	1.05	1.59	0.28	0.11	0.34
7	0.49	0.47	1.31(3)	0.48(6)	0.21	0.44
8	0.47	0.45	0.42	0.75	0.15	0.08
9	0.38	0.58	0.30	0.40	0.36	0.54
10	0.44	0.51	0.16	0.27	0.07	0.09
11	0.57	0.80	0.39	0.15	0.17	0.13
12	0.59	0.47	0.16(8)	0.42	0.21	0.20
13	0.55	0.59	0.07(7)	0.13	0.16	0.20
14	0.57	0.41	0.06(6)	0.34(6)	0.16	0.26
15	0.39	0.19	0.08(5)	0.37	0.13	0.06
16	0.40	0.36	0.16	0.05(6)	0.04	0.05
17	0.57	0.42	0.28	0.12	0.08	0.13
18	0.75	0.50	0.50	0.19	0.16	0.13
19	0.72	0.13	0.49	0.26	0.19	0.26
20	0.76	0.21	0.15(7)	0.16	0.11	0.24
21	1.10	0.88(6)	0.17(6)	0.21	0.10	0.22
22	0.90	0.80(5)	0.21(5)	0.10	0.08	0.15
23	0.25	0.21	0.84	0.16	0.01	0.05
24	0.24	0.38	0.58	0.41	<0.01	<0.01
25	0.37	0.51	0.30(6)	0.21	0.04	0.01
26	0.26	0.45	0.12(5)	0.09	0.09	0.10
27	0.39	0.38	0.12	0.09	0.13	0.06
28	0.19	0.16	0.14(6)	0.27(6)	0.16(6)	0.13(6)
29	0.15(6)	0.24	0.33(5)	0.09	0.23	0.10
30	0.32(5)	0.44	0.39(6)	0.09	0.12	0.06
31	0.29(5)	0.25	0.56(5)	0.13	0.13	0.08
Average	0.54	0.53	0.45	0.24	0.14	0.16



TOTAL BETA ACTIVITIES OF DAILY AIR FILTER SAMPLES

Stated in pC/m³ on 4th day after collection unless otherwise noted in table 1

FIG 1

TABLE 2 TOTAL BETA ACTIVITY OF WEEKLY RAINWATER SAMPLES STATED IN MILLICURIES PER SQUARE KILOMETRE AT TIME OF MEASUREMENT

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 shows the average daily deposition over the collection period.

AT	Date of Collection From To	Date of Measurement	Rainfall cm	Total Beta Activity mCi/km^2	Average Daily Deposition mCi/km^2	Concentration pCi/litre
TARAWA	1 June - 3 June	8 June	TRACE	0.1	0.05	
	3 " - 10 "	19 "	3.86	0.3	0.04	
	10 " - 17 "	22 "	TRACE	0.3	0.04	
	17 " - 24 "	28 "	1.39	21.9	3.12	
	24 " - 1 July	6 July	3.32	5.2	0.74	
	1 June - 1 July		8.57	27.8		324
	1 July - 8 July	12 July	0.10	0.2	0.03	
	8 " - 15 "	20 "	2.89	1.5	0.22	
	15 " - 22 "	28 "	4.80	138.4	19.8	
	22 " - 29 "	3 Aug.	0.03	3.0	0.43	
	1 July - 29 July		7.82	143.1		1,830
	29 July - 5 Aug.	15 Aug.	4.67	9.7	1.39	
	5 Aug. - 12 "	22 "	4.70	<0.1	<0.01	
	12 " - 19 "	25 "	0.18	0.6	0.09	
	19 " - 27 "	1 Sept.	0.86	0.7	0.08	
	29 July - 27 Aug.		10.41	11.0		106
FUNAFUTI	1 June - 10 June	19 June	7.16	0.3	0.03	
	10 " - 16 "	22 "	11.99	0.4	0.06	
	16 " - 23 "	29 "	7.14	42.7	6.11	
	23 " - 1 July	6 July	2.62	3.1	0.39	
	1 June - 1 July		28.91	46.5		161
	1 July - 8 July	14 July	1.96	0.9	0.12	
	8 " - 14 "	20 "	6.35	93.9	15.6	
	14 " - 17 "	21 "	8.79	317.7	105.9	
	17 " - 22 "	28 "	5.92	18.0	3.6	
	22 " - 29 "	3 Aug.	5.92	11.8	1.68	
	1 July - 29 July		28.94	442.3		1,528
	29 July - 5 Aug.	15 Aug.	9.87	6.4	0.91	
	5 Aug. - 10 "	22 "	5.54	1.4	0.29	
	10 " - 19 "	25 "	1.68	2.0	0.22	
	19 " - 26 "	1 Sept.	3.07	1.6	0.22	
	26 " - 30 "	6 "	6.27	1.8	0.45	
	29 July - 30 Aug.		26.43	13.2		50

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	Concentration pCi/litre
NANDI, FIJI	1 June - 5 June	9 June	NIL	<0.1	<0.01	
	5 " - 12 "	20 "	TRACE	<0.1	<0.01	
	12 " - 19 "	23 "	TRACE	<0.1	<0.01	
	19 " - 26 "	12 July	NIL	0.3	0.04	
	26 " - 3 July	7 "	NIL	0.1	0.02	
	1 June - 3 July		TRACE	0.5		-
	3 July - 10 July	14 July	0.25	0.2	0.02	
	10 " - 17 "	21 "	0.69	0.3	0.04	
	17 " - 24 "	28 "	0.05	0.6	0.09	
	24 " - 31 "	4 Aug.	0.15	0.3	0.04	
	3 July - 31 July		1.14	1.4		123
	31 July - 7 Aug.	15 Aug.	NIL	0.2	0.03	
	7 Aug. - 14 "	22 "	TRACE	1.5	0.22	
	14 " - 21 "	29 "	0.15	0.5	0.07	
	21 " - 28 "	1 Sept.	NIL	0.2	0.03	
	31 July - 28 Aug.		0.15	2.4		-
SUVA, FIJI	1 June - 8 June	14 June	0.03	0.1	0.01	
	8 " - 15 "	20 "	0.68	0.3	0.04	
	15 " - 22 "	27 "	0.38	0.2	0.02	
	22 " - 29 "	4 July	3.92	2.4	0.35	
	1 June - 29 June		5.01	3.0		60
	29 June - 6 July	12 July	1.04	0.9	0.13	
	6 July - 13 "	21 "	1.04	0.8	0.11	
	13 " - 20 "	26 "	0.51	1.5	0.21	
	20 " - 27 "	3 Aug.	4.72	15.3	2.19	
	27 " - 3 Aug.	8 "	1.45	7.1	1.01	
	29 June - 3 Aug.		8.76	25.6		292
	3 Aug. - 10 Aug.	15 Aug.	0.66	4.0	0.58	
	10 " - 17 "	25 "	2.13	6.9	0.98	
	17 " - 24 "	29 "	0.23	0.7	0.10	
	24 " - 31 "	6 Sept.	1.12	2.6	0.37	
	3 Aug. - 31 Aug.		4.14	14.2		343

TABLE 2 (Continued)

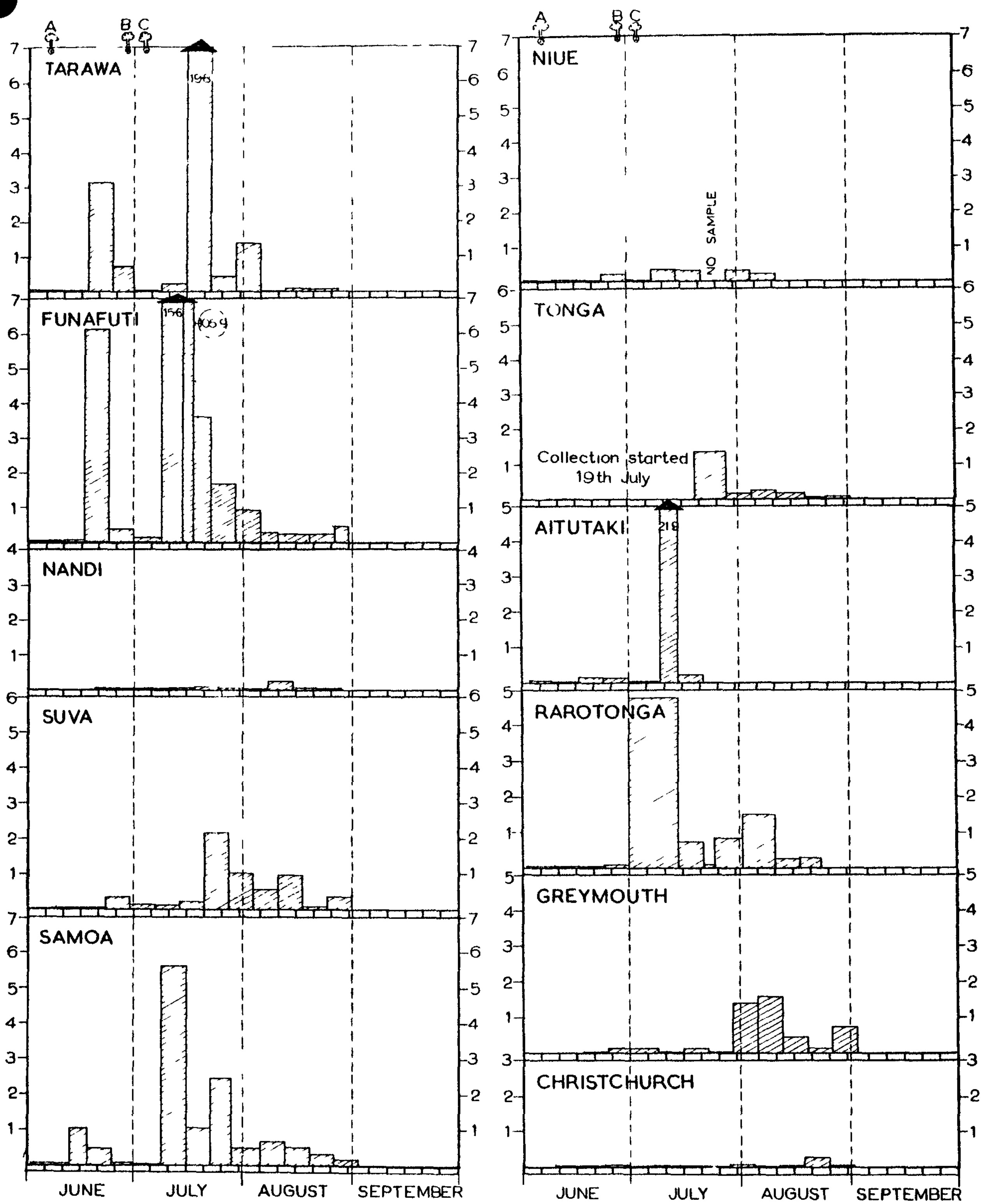
AT	Date of Collection From – To	Date of Measurement	Rainfall cm	Total Beta Activity mCi/km^2	Average Daily Deposition mCi/km^2	Concentration pCi/litre
SAMOA	2 June - 12 June	22 June	11.05	0.4	0.04	
	12 " - 17 "	22 "	0.56	5.0	1.01	
	17 " - 24 "	30 "	4.34	3.2	0.45	
	24 " - 1 July	6 July	4.55	0.4	0.06	
	2 June - 1 July		20.50	9.0		44
	1 July - 8 July	11 July	2.06	0.2	0.02	
	8 " - 15 "	19 "	6.05	39.2	5.60	
	15 " - 22 "	1 Aug.	2.01	7.3	1.04	
	22 " - 28 "	1 "	6.63	14.7	2.46	
	1 July - 28 July		16.75	61.4		367
	28 July - 5 Aug.	14 Aug.	2.56	3.9	0.49	
	5 Aug. - 12 "	17 "	10.31	4.5	0.65	
	12 " - 19 "	29 "	9.96	3.5	0.50	
	19 " - 26 "	6 Sept.	4.31	2.1	0.30	
	26 " - 2 Sept.	11 "	2.72	1.2	0.17	
	28 July - 2 Sept.		29.86	15.2		51
NIUE	2 June - 9 June	10 July	2.01	0.1	0.02	
	9 " - 16 "	11 "	3.14	0.2	0.03	
	16 " - 23 "	11 "	1.09	0.1	0.02	
	23 " - 30 "	7 Aug.	5.72	1.6	0.22	
	2 June - 30 June		11.96	2.0		17
	30 June - 7 July	3 Aug.	TRACE	0.2	0.03	
	7 July - 14 "	8 "	7.16	2.5	0.36	
	14 " - 21 "	3 "	TRACE	2.3	0.33	
	21 " - 28 "	-	(4.98)	Sample Lost		
	30 June - 21 July		7.16	5.0		70
	28 July - 4 Aug.	6 Sept.	1.60	2.3	0.33	
	4 Aug. - 11 "	6 "	0.53	1.7	0.24	
	28 July - 11 Aug.		2.13	4.0		188

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	Concentration pCi/litre
TONGA	Collection Started 19 July					
	19 July - 28 July	9 Aug.	5.00	12.1	1.35	
	28 July - 4 Aug.	15 Aug.	0.28	1.0	0.15	
	4 Aug. - 11 "	30 "	0.36	1.5	0.21	
	11 " - 19 "	29 "	2.59	1.5	0.18	
	19 " - 25 "	6 Sept.	0.08	0.2	0.03	
	25 " - 1 Sept.	11 "	0.15	0.5	0.07	
	28 July - 1 Sept.		3.46	4.7		136
AITUTAKI	2 June - 8 June	8 Aug.	2.82	0.5	0.09	
	8 " - 16 "	8 "	5.06	0.3	0.04	
	16 " - 23 "	8 "	5.36	1.2	0.17	
	23 " - 30 "	8 "	2.18	1.0	0.14	
	2 June - 30 June		15.42	3.0		20
	30 June - 9 July	8 Aug.	3.05	0.4	0.04	
	9 July - 14 "	8 "	1.65	109.3	21.9	
	14 " - 21 "	8 "	0.97	14.2	2.02	
	30 June - 21 July		5.67	123.9		2,185
RAROTONGA	2 June - 9 June	28 June	1.40	0.3	0.04	
	9 " - 16 "	28 "	2.26	0.3	0.04	
	16 " - 23 "	12 July	2.21	0.3	0.04	
	23 " - 30 "	12 "	1.19	0.7	0.10	
	2 June - 30 June		7.06	1.6		23
	30 June - 14 July	26 July	11.48	67.0	4.79	
	14 July - 21 "	8 Aug.	0.13	5.0	0.72	
	21 " - 24 "	8 "	TRACE	0.3	0.10	
	24 " - 1 Aug.	13 Sept.	4.11	5.8	0.83	
	30 June - 1 Aug.		15.72	78.1		497
	1 Aug. - 10 Aug.	13 Sept.	8.61	15.0	1.50	
	10 " - 17 "	13 "	0.41	1.8	0.26	
	17 " - 23 "	13 "	0.15	2.0	0.29	
	1 Aug. - 23 Aug.		9.17	18.8		205

TABLE 2 (Continued)

AT	Date of Collection From To	Date of Measurement	Rainfall cm	Total Beta Activity mCi/km²	Average Daily Deposition mCi/km²	Concentration pCi/litre
GREYMOUTH	3 June - 10 June	14 June	NIL	<0.1	<0.01	
	10 " - 17 "	21 "	NIL	<0.1	<0.01	
	17 " - 24 "	28 "	1.14	0.1	0.01	
	24 " - 1 July	5 July	4.85	0.9	0.13	
	3 June - 1 July		5.99	1.0		17
	1 July - 8 July	13 July	4.74	0.9	0.13	
	8 " - 15 "	19 "	0.08	0.2	0.02	
	15 " - 22 "	26 "	3.18	0.9	0.13	
	22 " - 29 "	2 Aug.	0.05	0.1	0.02	
	1 July - 29 July		8.05	2.1		25
	29 July - 5 Aug.	14 Aug.	10.21	9.9	1.41	
	5 Aug. - 12 "	17 "	10.90	11.2	1.60	
	12 " - 19 "	29 "	5.46	3.3	0.47	
	19 " - 26 "	30 "	0.33	1.1	0.15	
	26 " - 2 Sept.	11 Sept.	11.51	5.3	0.76	
	29 July - 2 Sept.		38.41	30.8		80
CHRISTCHURCH	1 June - 9 June	13 June	0.05	<0.1	<0.01	
	9 " - 16 "	20 "	0.48	0.1	0.02	
	16 " - 23 "	27 "	0.53	0.2	0.03	
	23 " - 30 "	4 July	0.84	0.3	0.05	
	1 June - 30 June		1.90	0.6		32
	30 June - 7 July	11 July	0.25	0.1	0.01	
	7 July - 14 "	18 "	NIL	0.2	0.02	
	14 " - 21 "	25 "	0.08	0.2	0.02	
	21 " - 28 "	1 Aug.	0.15	0.1	0.02	
	30 June - 28 July		0.48	0.6		130
	28 July - 4 Aug.	8 Aug.	0.76	0.5	0.07	
	4 Aug. - 11 "	15 "	0.33	0.1	0.01	
	11 " - 18 "	28 "	1.07	0.2	0.03	
	18 " - 25 "	29 "	5.33	2.0	0.29	
	25 " - 1 Sept.	6 Sept.	0.20	0.3	0.04	
	28 July - 1 Sept.		7.69	3.1		40



AVERAGE DAILY DEPOSITION OF FISSION PRODUCTS DURING THE COLLECTION PERIODS SHOWN
Stated in mCi/km² on day of measurement as given in table 2

FIG 2

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

DATE	AUCKLAND	NEW PLYMOUTH	WELLINGTON	GREYMOUTH	CHRISTCHURCH	DUNEDIN	INVERCARGILL
June 5	-	-	-	-	-	-	N.S.
" 7	-	-	-	-	-	-	-
" 9	-	-	-	-	-	-	-
" 12	-	-	-	-	-	-	-
" 14	-	-	-	-	-	-	-
" 16	-	-	-	-	-	-	-
" 19	-	-	-	-	-	-	-
" 21	-	-	-	-	-	-	-
" 23	-	6	-	<5	-	-	-
" 26	<5	<5	-	<5	<5	-	-
" 28	<5	<5	-	6	<5	-	-
" 30	<5	-	-	<5	-	-	-
July 3	<5	<5	<5	<5	-	<5	-
" 5	<5	<5	<5	<5	-	-	-
" 7	<5	-	-	<5	-	-	-
" 10	<5	<5	<5	<5	-	<5	<5
" 12	<5	-	-	<5	<5	-	<5
" 14	-	-	-	<5	-	-	<5
" 17	-	-	-	-	-	-	-
" 19	-	<5	-	<5	<5	-	<5
" 21	<5	<5	<5	<5	<5	<5	<5
" 24	<5	6	8	7	<5	N.S.	<5
" 26	5	7	<5	6	-	-	<5
" 28	<5	<5	<5	<5	-	<5	<5
" 31	-	<5	<5	<5	<5	-	-
Aug. 2	<5	<5	-	10	-	-	-
" 4	11	9	12	14	<5	<5	<5
" 7	8	<5	13	14	<5	-	<5
" 9	9	10	11	11	<5	<5	<5
" 11	<5	<5	7	8	-	-	-
" 14	6	9	10	10	<5	-	-
" 16	7	7	10	7	<5	<5	<5
" 18	7	<5	<5	6	<5	-	-
" 21	<5	7	<5	5	-	<5	-
" 23	6	-	-	6	-	-	-
" 25	7	6	9	<5	-	-	-
" 28	<5	9	N.S.	-	<5	-	-
" 30	-	-	N.S.	-	-	-	-
Sept. 1	-	-	8	<5	-	-	5

- Not Detectable

N.S. No Sample

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

DATE	SUVA, FIJI
June 1	-
" 8	-
" 15	-
" 22	-
" 29	10
July 6	8
" 13	<5
" 20	59
" 27	151
Aug. 3	56
" 10	50
" 17	40
" 24	9
" 31	-
Sept. 8	<5
Average	26

DATE	APIA, SAMOA
June 2	-
" 9	-
" 16	161
" 23	96
" 30	25
July 7	11
" 14	11
" 21	346
" 25	708
" 28	79
Aug. 1	219
" 4	74
" 8	51
" 11	16
" 15	17
" 18	32
" 22	10
" 24	-
" 29	-
Sept. 2	5
" 5	7
" 8	<5
Average	85

Not Detectable

TABLE 4: IODINE-131 IN CATTLE THYROIDS, STATED IN PICOCURIES

PER GRAM WET WEIGHT, AT TIME OF SLAUGHTER

DATE	NORTHLAND (MOEREWA)	HAMILTON (HOROTIU)	NEW PLYMOUTH (WAITARA)	HASTINGS (TOMOANA)	PALMERSTON NORTH (LONGBURN)	WESTPORT	CHRISTCHURCH (ISLINGTON)	GORE
JUNE								
6	-	-	-	-	N.S.	N.S.	-	N.S.
12	-	-	N.S.	-	-	-	-	-
19	2.0	-	1.4	-	1.5	-	0.6	-
26	26.7	13.3	10.3	25.7	10.5	6.2	2.1	0.9
JULY								
3	19.8	6.8	27.6	15.7	26.1	14.6	9.0	4.1
10	33.0	10.0	11.2	26.5	N.S.	20.7	25.3	1.2
17	12.2	15.8	8.3	18.9	N.S.	12.7	3.6	2.6
24	22.1	18.1	27.0	23.9	N.S.	23.8	7.9	4.1
31	50.2	13.3	30.3	14.5	16.0	21.8	4.6	3.4
AUG.								
7	80.4	64.5	55.6	28.8	52.1	115.6	0.8	26.2
14	48.6	20.9	56.2	52.4	N.S.	169.3	9.5	27.6
21	94.1	23.6	47.0	34.6	48.4	71.8	18.9	17.1
28	44.7	32.6	46.5	35.4	31.6	64.7	6.2	29.1
SEPT.								
4	13.7	24.5	27.0	17.9	28.5	32.9	<0.1	5.4

- Not Detectable

N.S. No Sample

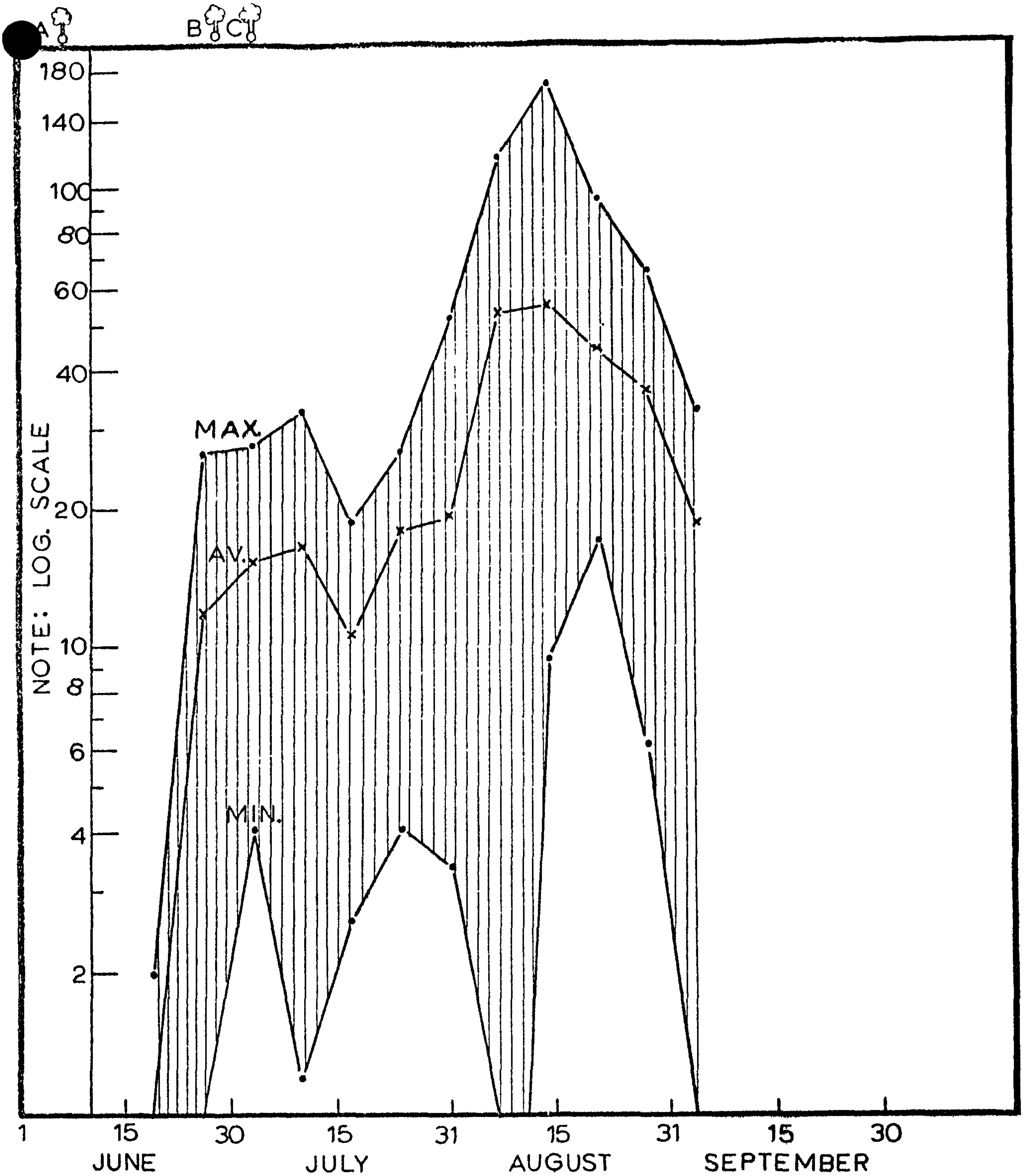


FIG. 3 I 131 IN CATTLE THYROIDS.

Activity in pCi/gram (wet weight) at time of slaughter. Results for eight stations.

3.

Cs-137 in Various Chicago Foods

(Collection Month Oct., 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[1,2,3,4,5] in bulk food samples by gamma-ray spectrometry.

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

Table I

Item	Potassium g/kg	Cesium-137 pCi/kg
White Bread (Dry)	2.4	44
Whole Wheat Bread (Dry)	4.2	49
Eggs	1.6	9
Fresh Vegetables:		
Cabbage	2.7	T
Lettuce	2.3	T
Spinach	7.6	T
Peas	1.6	10
Stringbeans	2.1	9
Tomatoes	2.3	T
Root Vegetables (Fresh):		
Turnips	3.4	T
Carrots	3.5	T
Onions	2.0	T
Milk (Fresh)	1.5	8
Poultry Muscle	2.4	15
Fresh Fish (Frozen):		
Lake Fillet	3.6	1416
Ocean Fillet	3.3	32
Halibut	3.6	39

Item	Potassium g/kg	Cesium-137 pCi/kg
Flour (White)	1.1	13
Macaroni	2.1	44
Rice	.7	T
Meat Muscle:		
Beef	2.7	17
Pork	2.9	31
Shellfish:		
Oysters	1.2	12
Shrimps	1.3	8
Dried Beans	13.5	17
Fresh Fruits:		
Melons	3.3	T
Apples	1.3	9
Bananas	4.1	T
Berries	1.2	21
Oranges	1.7	17
Potatoes	3.9	12
Canned Fruits:		
Apple Sauce	.9	10
Peaches	1.1	T
Pears	.6	T
Pineapple	1.5	21
Canned Juices:		
Grapefruit	2.0	13
Orange	2.2	24
Pineapple	1.6	11
Tomato	2.7	T
Canned Vegetables:		
Peas	1.1	T
Stringbeans	.8	T
Tomatoes	2.2	T
Baby Foods:		
Canned Milk	3.1	29
Formula Milk	2.1	27
Cereals	10.2	38
Fruits	1.2	T
Meats	2.1	19
Vegetables	1.7	5

T < 5 pCi/kg

Table II

Cs-137 in Chicago Diets

(Adults)

Oct., 1967

	kg/yr	Potassium g/kg	Cs-137 pCi/kg	Potassium g/yr	Cs-137 pCi/yr
White Bread	37	1.9	35	70	1295
Whole Wheat Bread	11	3.4	39	37	429
Eggs	16	1.6	9	26	144
Fresh Vegetables	43	3.1	T	133	
Root Vegetables	17	3.0	T	51	
Milk	221	1.5	8	332	1768
Poultry	17	2.4	15	41	255
Fresh Fish	8	3.4	171	27	1368
Flour	43	1.1	13	47	559
Macaroni	3	2.1	44	6	131
Rice	3	.7	T	2	
Meat	73	2.8	24	204	1752
Shellfish	1	1.2	10	1	10
Dried Beans	3	13.5	17	41	51
Fresh Fruit	68	2.3	10	156	680
Potatoes	45	3.9	12	176	540
Canned Fruit	26	1.0	8	26	208
Fruit Juices	19	2.1	22	40	418
Canned Vegetables	20	1.4	T	28	
Total/yr				1444	9608
Total/day				4.0	26

Table III

Cs-137 in Chicago Diets

(Infants)

<u>Oct., 1967</u>

	kg/yr	Potassium g/kg	Cs-137 pCi/kg	Potassium g/yr	Cs-137 pCi/yr
Evaporated Milk	137	3.1	29	425	3973
Formula Milk	37	2.1	27	78	999
Cereals	8	10.2	38	82	304
Fruits	23	1.2	T	28	
Meats	17	2.1	19	36	323
Vegetables	23	1.7	5	39	115
Total/yr				688	5714
Total/day				1.9	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. 228, 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 31,23,33,34, and 35 July, 1964.

(4) S. S. Brar and D. M. Nelson, USAEC Report No. Hasl-182 Cs-137 in Various Chicago Foods, pp. III-56 to III-60 July 1, 1967.

(5) S. S. Brar and D. M. Nelson, USAEC Report No. Hasl-183, Cs-137 in Various Chicago Foods, pp. III-48 to III-52 October 1, 1967.

4.

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 "Radiochemical Acta" 3, 193-199 (1964).

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

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

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

EXTRAPOLATION OF THE DATA

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

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

AIR RADIOACTIVITY

1967

Month	Gross beta pCi/m^3	^{90}Sr 10^{-3} pCi/m^3	^{137}Cs 10^{-3} pCi/m^3
July	0.06	2.2	3.5
August	0.05	1.4	2.2
September	0.06	1.4	2.2

MONTHLY FALLOUT DEPOSITION

1967

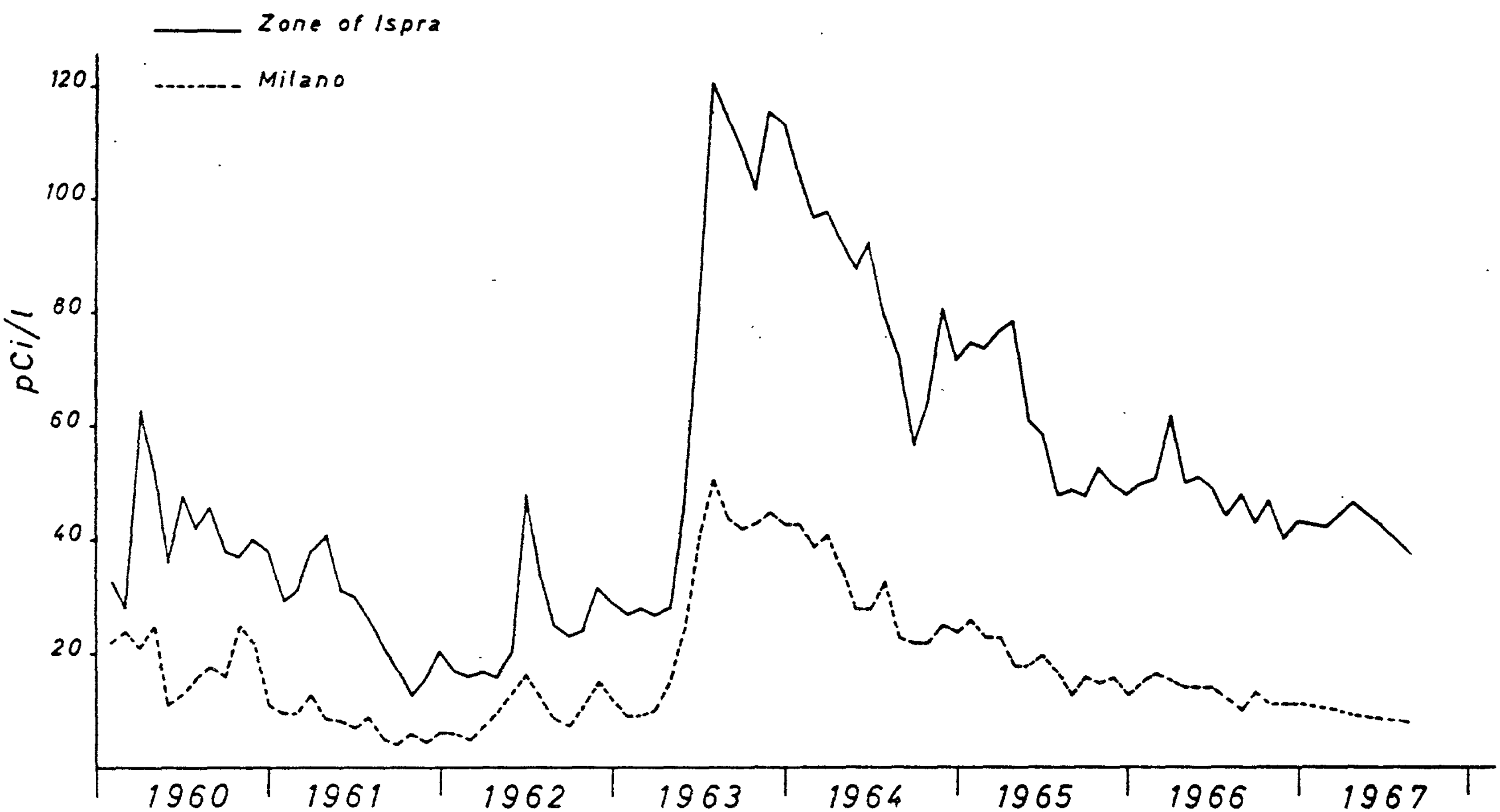
SITE : I S P R A LAT. 45° 49' N LONG. 8° 37' E ALT. 250 m

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
July	1.9	13.2	0.19	1.3	0.040	0.28	1.9	143.8
August	1.5	10.0	0.17	1.1	0.048	0.33	2.2	150.0
September	3.1	16.7	0.18	1.0	0.086	0.28	1.5	186.0

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
July	1.3	18.9	0.070	1.0	0.024	0.21	3.1	68.6
August	1.7	11.9	0.15	1.1	b	0.30	2.1	142.4
September	0.18	4.9	s	-	s	s	-	37.0

(1) Potassium-40 equivalent (40 mg / cm^2) ; b below detection limit ; s sample lost



Monthly Strontium-90 in the milk of Ispra and Milano

PART IV

RECENT PUBLICATIONS RELATED TO RADIONUCLIDE STUDIES

Recent Publications Related to Radionuclide Studies

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The Analyst, 92, No. 1099, October 1967

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