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ABSTRACT

Deposition, concentrations in diet, and body burdens of ^{137}Cs have been measured since 1954 at various sites throughout the world. This report is a compilation and updating of various fallout ^{137}Cs measurements and an interpretation of transfer properties of ^{137}Cs from deposition to diet and from diet to man. An empirical model is used to correlate deposition and diet data. Direct foliar contamination, stored food supplies, and uptake from soil contribute to the dietary levels of ^{137}Cs. The accumulation of ^{137}Cs by man is described by a single exponential model. The inferred biological half-times, 200-400 days, are somewhat greater than the half-time of about 100 days obtained from shorter term studies. Differences in body burdens due to sex, age, and weight are discussed. During the period 1954-1974, the internal dose from fallout ^{137}Cs, based on average body burdens, is estimated to be 4-5% of the 21 year radiation dose from ^{40}K.

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INTRODUCTION

Following three decades of fallout from global atmospheric nuclear testing, ^{137}Cs is ubiquitous in the biosphere. The radionuclide is produced with a yield of about 6 atoms per 100 fissions of uranium or plutonium, and disintegrates by beta and gamma emissions with respective decay energies (MeV) of β^- 1.18 and 0.51 and γ 0.66. Because of the relatively long, 30 year half-life of ^{137}Cs, its similar biochemical behavior to the intracellular cation, K^+, and the penetrating gamma radiation, its concentration by biological systems is important.

Numerous measurements of ^{137}Cs were included in fallout study programs throughout the world, and several laboratories continue to measure its deposition and concentration in milk. Diet sampling and whole body measurements are performed at a few locations.

The deposition pattern of the nuclide parallels ^{90}Sr with an average $^{137}Cs/^{90}Sr$ ratio of 1.6.(1) The fallout rate follows a seasonal trend with maximal values occurring during the spring and summer.(2) Peak levels were attained in 1963, following the large scale testing by the USSR and the USA in 1961 and 1962. These levels rapidly diminished to a low fallout level which, since about 1967-1968, has been maintained fairly constant by Chinese and French atmospheric testing.

Various models have been developed to describe the movement of ^{137}Cs from deposition to its eventual accumulation in man. Because of the rapid binding of ^{137}Cs by most soils, the transfer of fallout ^{137}Cs to milk initially was hypothesized to occur by a direct linear process. However, investigations subsequently showed that, although the downward movement of ^{137}Cs in soil and its absorption by plants were minimal relative to ^{90}Sr, root uptake of ^{137}Cs does contribute to the concentration of the radionuclide in plants. Consequently, Bartlett and Mercer(3) extended a straightforward relationship, first introduced by Tajima(4) for ^{90}Sr, to ^{137}Cs. Milk ^{137}Cs concentrations were related to levels occurring in recent deposition and in two-year cumulative ^{137}Cs soil deposits. The model later was revised to include a lag-rate factor(5) which accounted for fallout occurring in the preceding year and which was stored in feed consumed by cattle. The model finally was formalized as:

$$C = p_r F_r + p_l F_l + p_d F_d$$

where

C = 12 month mean concentration of ^{137}Cs in milk (pCi/ℓ),

F_r = annual deposition of ^{137}Cs (mCi/km^2 per y),

F_l = deposition of ^{137}Cs in the last half of the preceding year (mCi/km^2),

F_d = previous two-year cumulative soil deposit (mCi/km^2), and

p_r, p_l, p_d = proportionality factors.

Aarkrog[6] showed that for Denmark and the Faroe Islands the above equation adequately predicted ^{137}Cs milk levels from ^{90}Sr fallout, and that the rate and lag terms could be expressed either as concentrations in air, precipitation or deposits.

Gustafson[7], in a comprehensive review of ^{137}Cs literature, noted that the entry of ^{137}Cs into cow's milk is primarily from direct deposition upon plant surfaces and ingestion of contaminated forage. Local changes in fallout, therefore, are readily observed in changes in ^{137}Cs milk concentrations. However, due to processing and storage of other diet items, several months may pass before fluctuations in ^{137}Cs deposition affect over-all dietary levels.

Lloyd _et al._[8] described a model which accurately predicts individual ^{137}Cs body burdens from corresponding milk levels. Essentially, the model is a single exponential model which estimates current ^{137}Cs body burdens from the sum of the preceding month's burden and ensuing contributions from milk, taking into account a constant intake rate and an exponential elimination rate. While milk may reflect local variations in ^{137}Cs fallout, the more uniform concentrations in meat and grain products may better reflect ^{137}Cs intake and population body burdens.[7]

Surgi _et al._[9] related ^{137}Cs body burdens with dietary intake using a previously measured value of body burden and accounting for subsequent periods of constant intake of ^{137}Cs, assigning best known values for fractional absorption and single exponential elimination. The data for comparisons were quite limited.

Two models are presented herein, which first, relate ^{137}Cs deposition with corresponding dietary concentrations and second, relate dietary concentrations with ultimate body burdens. Such a method necessitates the summary of acquired data and provides a current and comprehensive interpretation.

METHODS

In this report, a model previously used by UNSCEAR[10] to interpret fallout ^{90}Sr measurements has been employed to predict dietary ^{137}Cs concentrations from deposition data. By the method of least squares fitting, parameters were obtained which predict the contributions from direct ^{137}Cs foliar deposition and its uptake from cumulative deposits in soil. The long-term soil component includes an exponential term which accounts for the radioactive decay of ^{137}Cs and its reduced availability with time. A better fit was obtained when the soil factor included the total cumulative deposit of ^{137}Cs rather than the deposit of the preceding two years. A third component, a lag term, similar to that used by Bartlett[5] was introduced to account for dietary contamination due to foods produced in the preceding year and stored by market practices. The model, therefore, is represented by the following equation:

$$C_i = p_1 F_i + p_2 F_{i-1} + p_3 \sum_{n=1}^{\infty} F_{(i-n)} e^{-\mu n}$$

where

C_i = dietary level of ^{137}Cs in year i (pCi/g K),

F_i = deposition of ^{137}Cs in the current year, i, and for preceding years as represented by the subscripts (i-1) and (i-n) (mCi/km^2)

p_1, p_2, p_3 = proportionality coefficients (pCi/g K per mCi/km^2), and

μ = exponential decay and removal constant.

By comparing the relative magnitude of the proportionality coefficients, one is able to describe the contribution of ^{137}Cs to the diet from direct deposition, p_1, stored deposits, p_2, and long-term soil deposits, p_3.

Cesium-137 retention in the body can be described accurately by multiexponential models. Richmond et al.[11] reported ^{137}Cs retention in man following a single exposure and presented evidence for a double exponential retention function with one short - 1.39 day half-time component and one predominant, long - 133 day half-time component. Rundo[12] made similar observations concluding that 6-15% of ^{137}Cs excretion occurs with a half-time of 1-2 days, while 85-94% of its excretion occurs with a half-time of 50-150 days. Naversten and Liden[13] expressed ^{137}Cs retention as the sum of three exponentials with respective biological half-lives of 2-3 hours, 1 day and about 70 days. Although ^{137}Cs retention can be expressed as the linear sum of several exponentials, Richmond and Furchner[14] presented a model which explained the continuous retention of ^{137}Cs following varying intakes assuming a simplified single exponential retention system. Tissue uptake studies have shown the approximately equal distribution of ^{137}Cs among soft tissues.[15] Although some controversy exists over the accumulation of ^{137}Cs in bone, it appears that any radioactivity associated with the tissue is present in the marrow portion with only slight uptake by the hard tissue.[16]

In attempting to fit United States whole body data to dietary information, four models were tested:

Exponential $$Q_i = g \sum_{n=0}^{\infty} C_{(i-n)} e^{-\mu n}$$

Double Exponential $$Q_i = c \sum_{n=0}^{\infty} C_{(i-n)} e^{-\nu n} + g \sum_{m=0}^{\infty} C_{(i-m)} e^{-\mu m}$$

Rate + Exponential $$Q_i = cC_i + g \sum_{n=0}^{\infty} C_{(i-n)} e^{-\mu n}$$

Double Rate + Exponential $$Q_i = c_1 C_i + c_2 C_{(i-1)} + g \sum_{n=0}^{\infty} C_{(i-n)} e^{-\mu n}$$

where

Q_i = adult mean body burden in the year i (pCi ^{137}Cs/g K),

C = average dietary level for the current year, i, and for preceding years as represented by the subscripts (i-1), (i-n) and (i-m) (pCi ^{137}Cs/g K),

c,g = proportionality coefficients, and

ν, μ = the exponential decay and excretion constants.

For the environmental data reflecting yearly changes in ^{137}Cs levels, we were unable to identify a useful expression which contained more than a single exponential term. Therefore, from tissue investigations which have shown uniform ^{137}Cs soft tissue distribution, and retention studies which have indicated ^{137}Cs excretion predominantly via one long-term compartment, a single exponential model can effectively describe the transfer of ^{137}Cs from the diet to man. Consequently, this model was utilized in fitting the available data.

Body burden data, milk concentrations, dietary levels, and deposition information were compiled for various northern and southern hemisphere countries as referenced in Table 1 and interpreted by the methods outlined above. All data and corresponding model fits are compiled in the adjoining Appendices. Fits had correlation coefficients of at least .96 and most has coefficients of greater than .98.

RESULTS AND DISCUSSION

Transfer from Deposition to Diet

The U. S. Public Health Service has reported ^{137}Cs concentrations in weekly samples of pasturized milk for 63 sites in the United States and its territories from 1960 to 1973.[17] A summary of the average annual concentrations in four regionally distinct cities and the country average is shown in Figure 1. As indicated, peak milk levels were attained during 1963 - 1964. Since then, the levels have declined rapidly and, except for Tampa, remain below 5 pCi per g K. Data collected by ANL for Chicago compares well with the PHS values. Chicago concentrations closely follow the national average while New York measurements are somewhat above the country-wide mean and San Francisco's are below.

Although Florida's ^{137}Cs deposition was not different from national levels, milk from Tampa showed extraordinarily elevated concentrations. Porter et al.[18] studied this phenomenon and identified pangola hay, a Florida grown feed grain, as a major contributor. When grown under similar environmental conditions, pangola hay showed an increased affinity for ^{137}Cs compared to alfalfa. By growing oats in various soils, Cummings et al.[19] showed that grain grown in Florida soil fixed ^{137}Cs better than grain grown in soils representative of Ohio, thereby illustrating the dependence of ^{137}Cs uptake upon soil conditions. Wrenn and co-workers[20] investigated the bioamplification of ^{137}Cs in the Jamaican food chain. Since soil ^{137}Cs concentrations were not variable and no particular grass species was indigenous to the island, they concluded that deposition and grass type alone were not responsible for the elevated milk ^{137}Cs concentrations occurring there. Rather, a soil factor was implicated from the observation that, between the years 1966 and 1968, the deposition rate was declining faster than milk concentrations. An inverse relationship was proposed between soil potassium content and ^{137}Cs grass concentrations, and, concomitantly, between soil potassium and milk ^{137}Cs levels. They hypothesized that areas characterized by organic type soils low in potassium and having a relatively high moisture content would yield grasses and, thus, milk with elevated ^{137}Cs content. A comparison of the deposition transfer functions, given in Table 2, confirms these findings. These values illustrate the occasional large regional differences in the importance of foliar retention and soil uptake of ^{137}Cs. P_{23}, the cumulative transfer coefficient,[10] is 3.2 times greater for Tampa than the national average. The relatively large values for parameters p_1 and p_3 in Tampa, indicating large uptakes from direct and cumulative deposits, account for the high ^{137}Cs milk concentrations.

The transfer of ^{137}Cs to milk from fallout was compared among six northern hemisphere and three southern hemisphere countries. The results are shown in Table 3 and Figure 2. The transfer coefficient varies from 3.6 to 8.0 pCi y (g K)$^{-1}$ per mCi km^{-2} for milk in most areas of the U. S. and other countries except for Norway, the Faroe Islands, New Zealand and Australia which have coefficients greater than 12.0. The U. S., Great Britain and Denmark show similar ^{137}Cs milk concentrations and transfer properties. The U.S.S.R. has a slightly higher transfer coefficient, which from the model fit, is attributed to greater adsorption from direct foliar deposition. It is not known whether the grass characteristics justify this inference. Norway, the Faroe

Islands and New Zealand each have large transfer parameters and elevated milk concentrations. All three countries, with soil conditions presumably similar to the Florida situation, show large uptakes of ^{137}Cs from cumulative soil deposits, and also high transfer from direct deposition. In addition, Norway and the Faroe Islands have considerable transfer from stored feed supplies. While Australia and Argentina have lower ^{137}Cs milk concentrations than northern hemisphere countries, the transfer coefficients were large for both. Australia has a large transfer of ^{137}Cs from direct deposition and stored feed, but little uptake from cumulative deposits in the soil. Large transfers from direct deposition and cumulative deposits occur in Argentina, but no contribution to ^{137}Cs concentrations is inferred from stored feed, which agrees with Argentine agricultural practices of exclusively providing feed during the year within which it is grown.

In general, therefore, direct deposition is the more important factor in the transfer of ^{137}Cs activity to milk. However, when deposition is low, as in current years, or when certain soil conditions prevail, the long term component can be significant.

Cesium-137 concentrations in 19 food items including milk and comprising five food categories have been measured quarterly in Chicago since 1961.(21) Figure 3 summarizes the data for each food group. Seasonal variations are observed in all foods with annual maxima occurring during spring and summer months (see Appendix B). Peak levels were measured in 1964, six months past peak deposition. Of all 19 foods, whole wheat products showed the highest ^{137}Cs concentrations per kg, which is ascribed to the accumulation of direct deposition by the bran with translocation to the germ.(22) Due to storage practices, processed foods show lower levels extended over longer periods of time than their fresh equivalents.

The long-term transfer of ^{137}Cs from deposition to the total diet and several separate food categories, was evaluated for Chicago and Denmark. The parameters from the model fits are listed in Tables 4 and 5. The highest transfer coefficient was obtained for grain products, with somewhat less transfer per unit deposition to milk and meat. The lowest values were obtained for fruit and vegetables due to inferred low efficiency of uptake from direct deposition. When groups are weighted for their fractional contribution of potassium in the diet, the cumulative contribution to total dietary ^{137}Cs intake in Chicago from unit deposition is 34% from milk, 26% from meat, 23% from grain products, 10% from fruit and 7% from vegetables. The transfer of ^{137}Cs to the Denmark diet is 1.7 times greater than for Chicago. From the model fit, this can be attributed to the larger transfer of ^{137}Cs through Danish grain and meat products. The cumulative contributions to ^{137}Cs intake in the Denmark diet are 38% from grain, 33% from meat, 19% from milk, 7% from vegetables, and 3% from fruit. The frequent importance of grain and meat contributions exemplifies the pitfalls of utilizing milk concentrations as the sole indicator of dietary ^{137}Cs contamination.

Transfer from Diet to Man

Figure 4 summarizes ^{137}Cs body burden data for the U. S. and shows the predicted burdens from corresponding diet data. Body burdens parallel dietary concentrations with maximal levels occurring during 1964. Peak body burdens between 110 and 150 pCi/gK correspond to an average diet level of about 50 pCi/gK. The fact that the $^{137}Cs/K$ ratio in man is 2.5 to 3.0 times greater than in diet demonstrates the relative homeostatic control mechanisms for an important intracellular electrolyte, like K, which is regulated with a precision of ±10%, and for a trace mineral which does not activate similar control mechanisms.

The modeled transfer of ^{137}Cs from diet to man is presented in Table 6. The transfer coefficient, P_{34},[(10)] is 3.0 for the United States. By simply dividing ^{137}Cs body burdens by dietary levels, Gustafson[(7)] reported an approximate transfer factor of 3.0. When compared with U. S. body burdens and diet data, the Danish population showed elevated ^{137}Cs body burdens during 1963 to 1969 in response to greater dietary concentrations from 1963 to 1968. Current body burdens and dietary levels are similar for both countries. The transfer coefficient in Denmark is 1.2 times lower than in the U. S. From the regression fit, one infers somewhat less absorption but longer retention of ^{137}Cs for the Danish population.

Biological half-lives were estimated by the formulation:

$$T_{\frac{1}{2}} = \frac{.693}{\mu} \times 365 \text{ days/yr}$$

Inferred values are 230 days and 380 days for the U. S. and Denmark, respectively. These half-times are 2-4 times greater than previously reported values of approximately 100 days. Although these half-times give the best fit in the least squares sense, there is not always a significant difference from the fits with a 100 day half-time as shown in Figures 5 and 6. For the U. S. body burden data, the differences between the fits are within the errors of diet and body measurements. The transfer coefficient from the 100 day half-time fit, 2.9, remains in agreement with Gustafson.[7] However, for the Danish data, the 100 day half-time fit considerably underestimates body burdens between 1965 and 1970. This inconsistency is somewhat reduced by choosing a half-time of about 150 days. For the U. S., the adult mean biological half-life probably lies between 100 and 250 days; whereas for Denmark, values greater than 150 days seem appropriate.

Various factors have been suggested as affecting ^{137}Cs biological half-lives in man. Body burdens have been observed to vary according to age, sex, race, diet and body weight, and scientific debate continues as to the relative importance and interdependencies of each. Onstead et al.[23] measured ^{137}Cs body burdens in 6,000 individuals who resided in Germany. Cesium-137/gm K was much lower in children than in adults and increased from childhood to about 20 years when the ratio apparently became constant. Body burdens showed little sexual dependency until following puberty when women consistently had lower ^{137}Cs burdens than men. MacDonald et al.[24] reported similar sex differences for ^{137}Cs body burdens of 1000 adult subjects in California.

Statistically significant differences at the .01 level for sex, race, age and weight were reported by L. M. Scott[25] who based his findings upon 20,000 measurements from 1958 to 1968 in Oak Ridge, Tennessee. Women averaged 36% lower burdens than men, and blacks 24% less than whites. Cesium-137 burdens decreased exponentially from age 20 to 59 years. The fact that the ratio of ^{137}Cs/K is much lower in children than in adults indicates that children discriminate against cesium in favor of potassium, whereas discrimination in adults is somewhat less and may reflect an eventual loss of fine-tuned potassium control. In addition to lower absorption of ^{137}Cs, half-times of 10-25 days have been observed for children,[24,26] thus supporting the low body burdens which have been measured.

Differences due to weight were investigated by Scott.[25] Individuals weighing less than 63.5 kg had lower ^{137}Cs body burdens while no relationship was observed for persons weighing greater than 63.5 kg. Eberhardt[27] summarized this phenomenon with the fractional power function of weight for biological half-lives.

$$\text{Half-time} = 6\ W^{\frac{2}{3}}$$

where

W = body weight in kilograms

Clemente[28,29] and Lloyd[30] maintain that the lower ^{137}Cs biological half-life observed in women is not attributable to their lower body mass, but to a hormonal factor. They purport that the correlation of ^{137}Cs biological half-times with sex and mass are independent.

Maternal and infantile ^{137}Cs metabolism are special cases and show different kinetics.[26,31] Immediately post partum, three mothers showed 3.3 times shorter biological half-lives than non-pregnant women.[31] Infants had similarly short biological half-lives, 10 days, and low $^{137}Cs/K$ body burdens. The similarity between the ^{137}Cs body burdens of mothers and infants indicates a lack of placental control for these cations, while short biological half-lives, in addition to low body burdens, suggests that both groups discriminate against ^{137}Cs in favor of K. A possible explanation for these and other observed differences may be found in the indirect action of sex and growth hormones and the direct action of ACTH and ADH which regulate potassium excretion and retention.

Dose from Fallout ^{137}Cs

For ^{137}Cs, which decays by emitting both β particles and γ quanta, internal dose calculations must include separate estimates for the contributions from uniformly distributed β and γ radiation. Because of the short range of β radiation, calculations for the β contribution remain simple and yield a β dose estimate of .93 mrad/yr per 100 pCi/gm K.[32] Estimates for γ contributions, however, depend upon geometrical considerations and, for adults, have ranged between .90 and 1.30 mrad/yr per 100 pCi/gm K depending upon the method of calculation. It follows, then, that internal dose rates from ^{137}Cs to children are lower due to a higher fraction of γ radiation escaping. For a 70 kg man 170 cm in height, a γ dose rate of .90·mrad/yr per 100 pCi/gm K was adopted by UNSCEAR[10] yielding a total internal dose rate of 0.018 mrad/pCi/gm K per year. Radiation doses from internal ^{137}Cs exposure for adults were calculated based upon this estimate. Compiled body burden data and corresponding doses are presented in Table 7. Peak annual dose rates, in response to maximum body burdens, occurred during 1964-65. The 21 year integral doses from 1954 to 1974 for the U. S. and Denmark, are 16.0 mrads and 18.4 mrads, respectively. Gustafson[7] reports a U. S. average dose of

15.2 mrads from 1953 to 1967. When compared to the dose to soft tissue from ^{40}K, 19 mrad per year,[10] these ^{137}Cs doses are equivalent to 4-5% of the dose received from naturally occurring ^{40}K during the same interval. Relatively high fallout levels in 1959 and 1963 were accompanied by high body burdens in 1959-60 and 1964-65. Since then, exposure to ^{137}Cs has been minimal.

CONCLUSIONS AND SUMMARY

Two mathematical models have been presented which describe the movement of ^{137}Cs from deposition to diet to man. Peak deposition occurred during 1963. Shortly thereafter, maximum dietary concentrations and body burdens were measured. Dietary concentrations of ^{137}Cs are shown to be dependent upon direct contamination, stored supplies, and uptake from cummulative soil deposits. The long-term soil component becomes increasingly important when atmospheric nuclear testing and, thus, direct contamination become minimal.

Northern hemisphere countries have shown similar concentrations of ^{137}Cs in milk and diets with some notable exceptions; Norway, the Faroe Islands, and within the U. S.; Tampa, Florida. Due to lower fallout, southern hemisphere countries have had lower ^{137}Cs milk concentrations than northern hemisphere countries. However, the transfer of ^{137}Cs from deposition to milk in southern hemisphere countries was relatively high.

The transfer of ^{137}Cs from diet to man is effectively expressed as a single exponential function dependent upon uptake and removal parameters. The model seemingly exaggerates human biological half-lives for ^{137}Cs. It is probable, however, that the differences in the half-times are within the uncertainties of the estimates for ^{137}Cs dietary intakes and body burdens. Alternatively, the model may be sensing a longer term component of ^{137}Cs retention, perhaps by bone, which only now is becoming apparent as dietary ^{137}Cs intake continues to decline.

TABLE 1

SOURCES FOR ^{137}Cs DEPOSITION, DIET AND BODY BURDEN DATA

Country	References*
Argentina	33
Australia	34,35
Denmark	36
Faroe Island	37
Great Britain	38,39,40
New Zealand	41
Norway	42
USA	2,4,10,14,15,43,44,45,46,47
USSR	48

*When deposition data were not available, estimates were calculated from HASL ^{90}Sr inventory data for the appropriate latitude band based upon the $^{137}Cs/^{90}Sr$ ratio of 1.6.

TABLE 2

PARAMETERS OBTAINED BY FITTING LOCAL ^{137}Cs DEPOSITION TO MILK ^{137}Cs CONCENTRATION

	USA (avg.)	Chicago (ANL)	Chicago (PHS)	NYC	Tampa	San Francisco
p_1	2.28	2.23	2.19	1.92	4.38	1.86
p_2	1.34	1.22	1.29	1.13	.66	2.56
p_3	<0.01	.13	.07	.01	2.03	<0.01
μ	.05	.31	.67	.07	.27	.023
P_{23}	3.63	3.82	3.55	3.19	11.59	4.42

TABLE 3

PARAMETERS OBTAINED BY FITTING ^{137}Cs DEPOSITION DATA
TO $^{137}Cs/gK$ IN MILK

	USA	Great Britain	USSR	Norway	Denmark	Faroe Islands	New Zealand	Argentina	Australia
p_1	2.28	1.75	4.43	3.52	2.37	6.80	6.79	2.21	7.24
p_2	1.34	1.61	.22	2.26	.69	5.44	.68	0	4.78
p_3	$<.01$	.03	.31	2.63	.06	2.83	3.62	1.80	.30
μ	.05	.023	.18	.24	.30	.17	.51	.27	.18
P_{23}	3.63	4.75	6.22	15.48	3.23	27.51	12.91	8.02	13.59

TABLE 4

PARAMETERS OBTAINED BY FITTING ^{137}Cs DEPOSITION DATA TO CHICAGO DIETARY ^{137}Cs CONCENTRATIONS

	Milk	Grain	Meat	Vegetables	Fruit	Total
p_1	2.23	1.14	0.60	0.40	0.93	0.87
p_2	1.22	4.48	0	0	0	0
p_3	.13	.12	6.92	0.05	0.64	3.60
μ	.31	.12	1.33	0.24	0.52	1.20
P_{23}	3.82	6.58	3.10	0.59	1.87	2.42
W_j*	.227	.092	.220	.299	.134	1.00
$W_j P_{23}$	0.87	0.60	0.68	0.18	0.25	2.42
Total P_{23}			2.58			2.42

*Fractional contribution to K in the total diet.

TABLE 5

PARAMETERS OBTAINED BY FITTING ^{137}Cs DEPOSITION DATA TO DANISH DIETARY ^{137}Cs CONCENTRATIONS

	Milk	Grain	Meat	Vegetables	Fruit	Total
p_1	2.17	2.36	4.45	0.63	0.81	1.56
p_2	1.48	17.02	0	0	0.55	2.21
p_3	.05	–	17.24	0.006	0.08	.04
μ	.07	–	1.60	.02	0.30	.12
P_{23}	4.32	19.38	8.80	.92	1.59	4.08
W_j*	.20	.09	.17	.37	.09	1.00
$W_j P_{23}$	.86	1.74	1.50	.34	.14	4.08
Total P_{23}			4.58			4.08

*Fractional contribution to K in the total diet.

TABLE 6

PARAMETERS OBTAINED BY FITTING TOTAL DIETARY ^{137}Cs CONCENTRATIONS TO ^{137}Cs BODY BURDENS

Parameter	USA	Denmark
g	2.05	1.26
μ	1.12	.67
P_{34}	3.04	2.58
$T_{\frac{1}{2}}$ (days)	226	378

TABLE 7

^{137}Cs IN MAN AND CORRESPONDING INTERNAL DOSES

	USA		Denmark	
Year	Avg. Body Burden* (pCi/g K)	Annual Dose (mrads)	Avg. Body Burden* (pCi/g K)	Annual Dose (mrads)
1954	7.0	0.13	3.2	0.06
55	14.5	0.26	12.4	0.22
56	36.6	0.66	21.8	0.39
57	39.1	0.70	27.0	0.49
58	48.8	0.88	37.4	0.67
59	58.5	1.05	54.2	0.98
60	51.6	0.93	53.2	0.96
61	35.7	0.64	37.9	0.68
62	41.0	0.74	44.6	0.80
63	74.2	1.34	100.0	1.80
64	132.7	2.39	162.0	2.92
65	103.7	1.87	170.0	3.06
66	69.7	1.25	106.0	1.91
67	40.3	0.73	65.0	1.17
68	25.0	0.45	46.5	0.84
69	21.3	0.38	40.3	0.73
70	19.8	0.36	23.0	0.41
71	20.0	0.36	13.0	0.23
72	20.0	0.36	16.0	0.29
73	18.5	0.33	11.0	0.20
74	11.4	0.21	9.6	0.17
Total through 1974		16.02		18.98

*USA average body burdens were computed as means of values reported by ANL, BNL and LASL. Denmark burdens for the years 1954-1962 were estimated from diet data.

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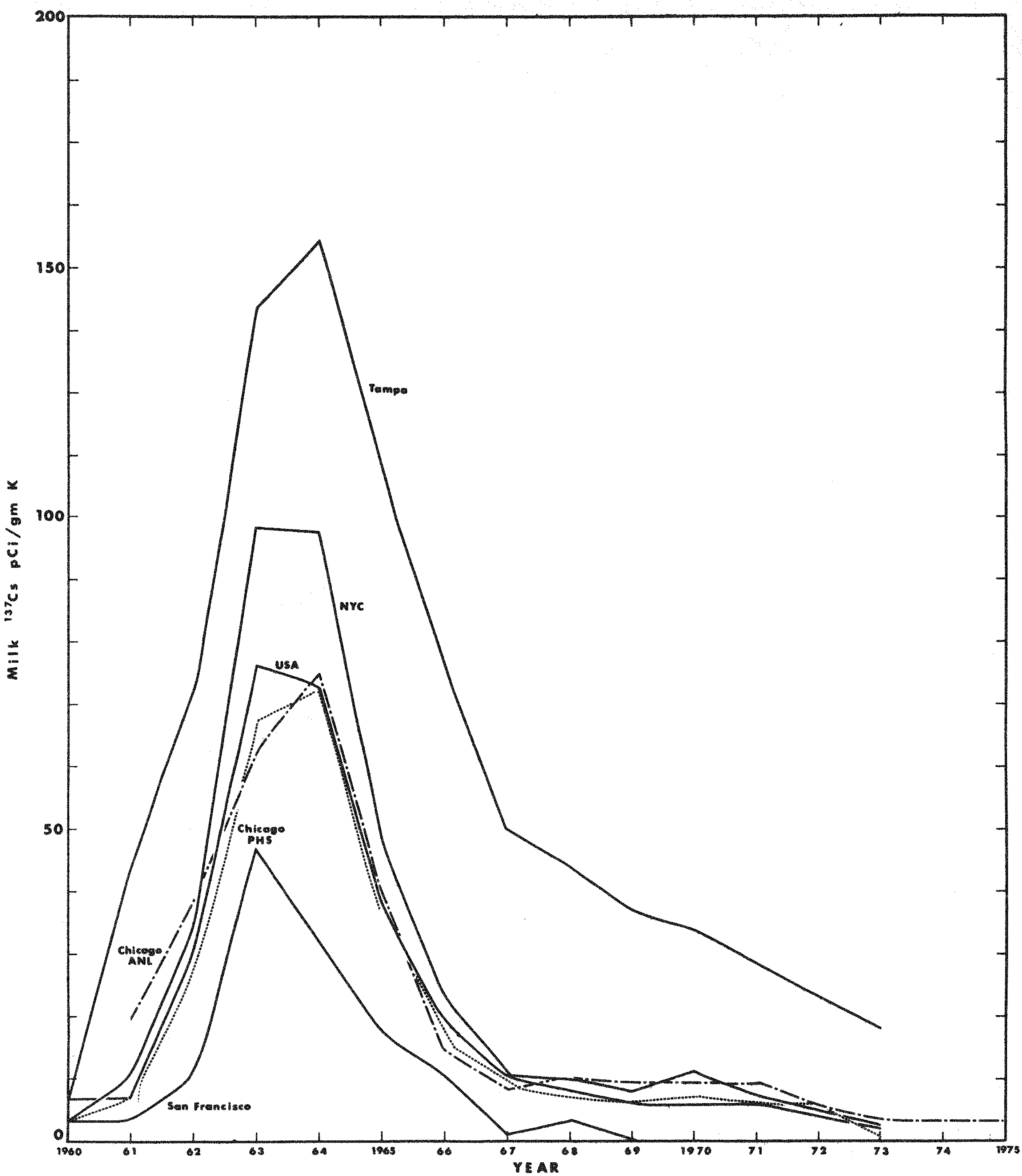


Figure 1. Distribution of milk ^{137}Cs concentrations in the U. S. and four U. S. cities.

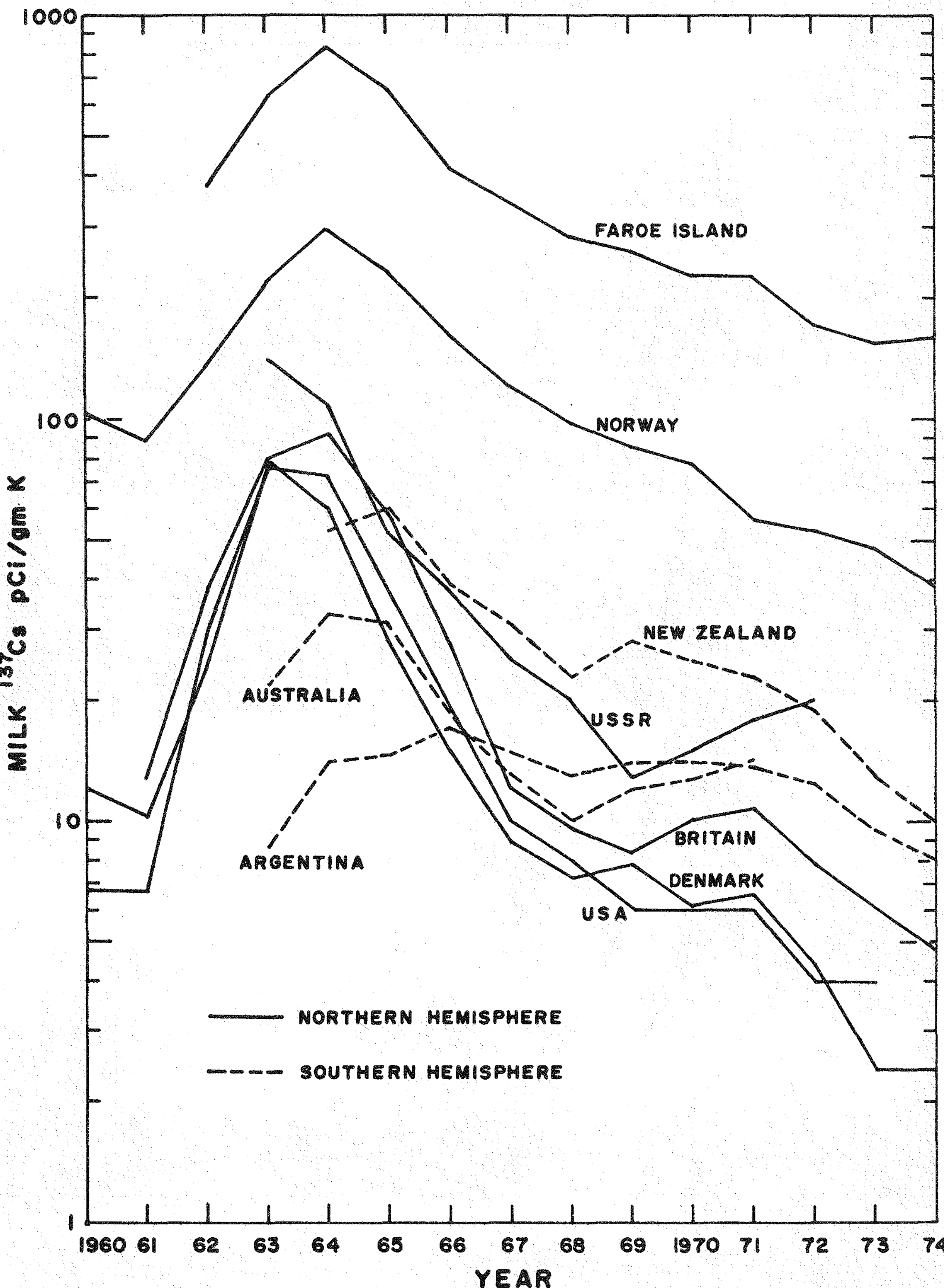


Figure 2. Distribution of milk ^{137}Cs concentrations in six northern hemisphere and three southern hemisphere countries.

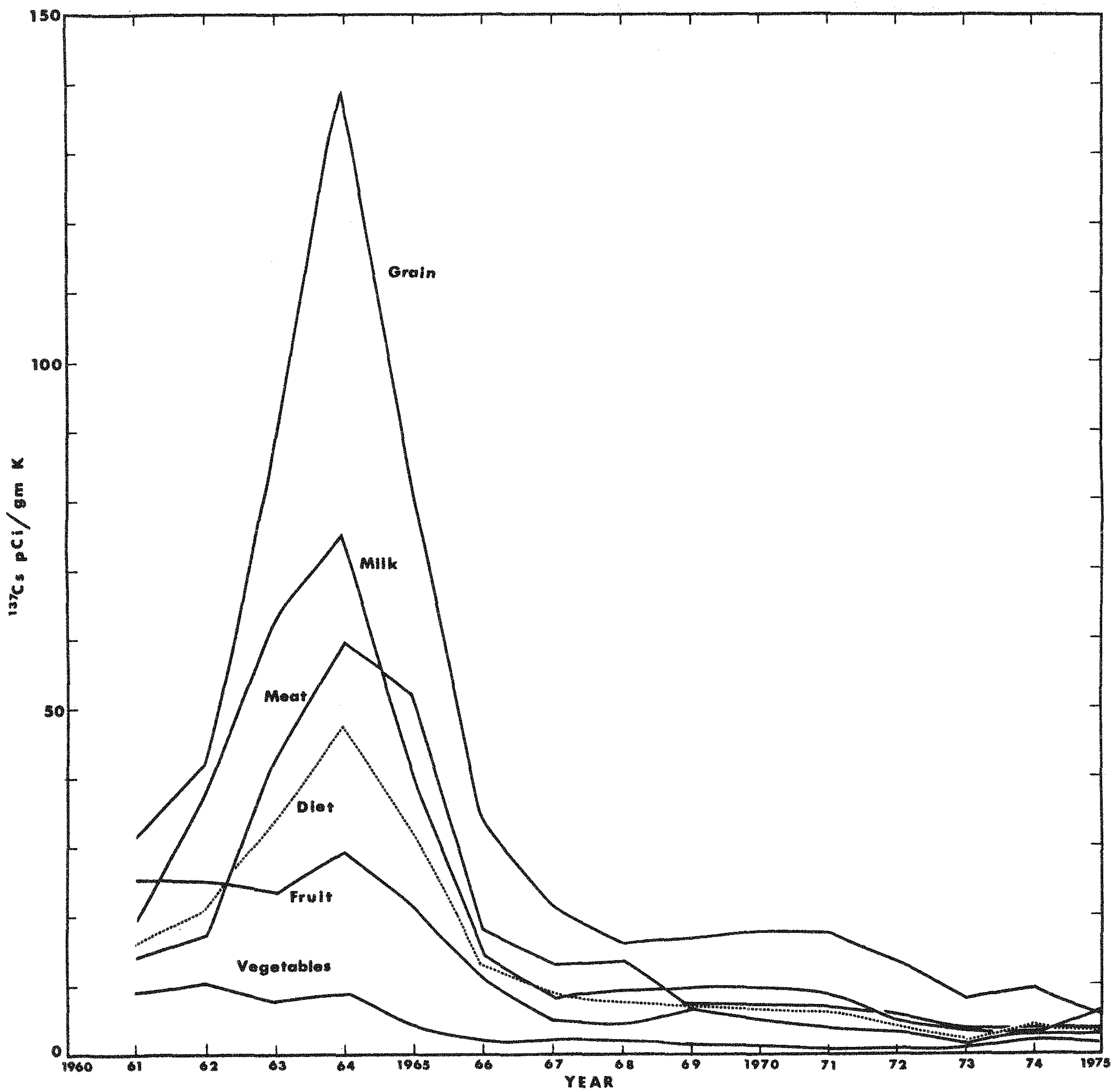


Figure 3. Distribution of ^{137}Cs concentrations in 5 food groups and the total diet in Chicago.

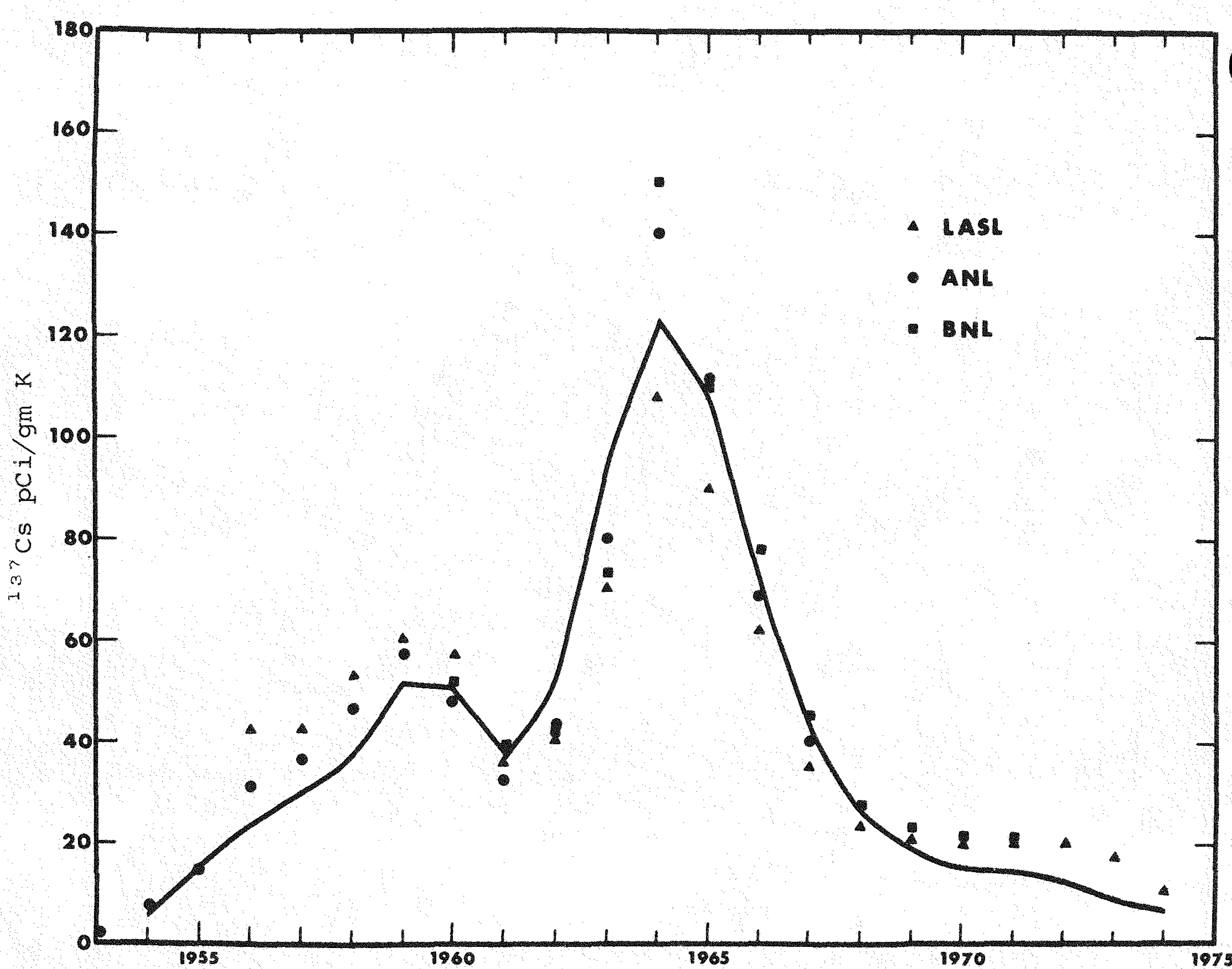


Figure 4. Observed ^{137}Cs body burdens at three U. S. laboratories and predicted burdens from Chicago diet data.

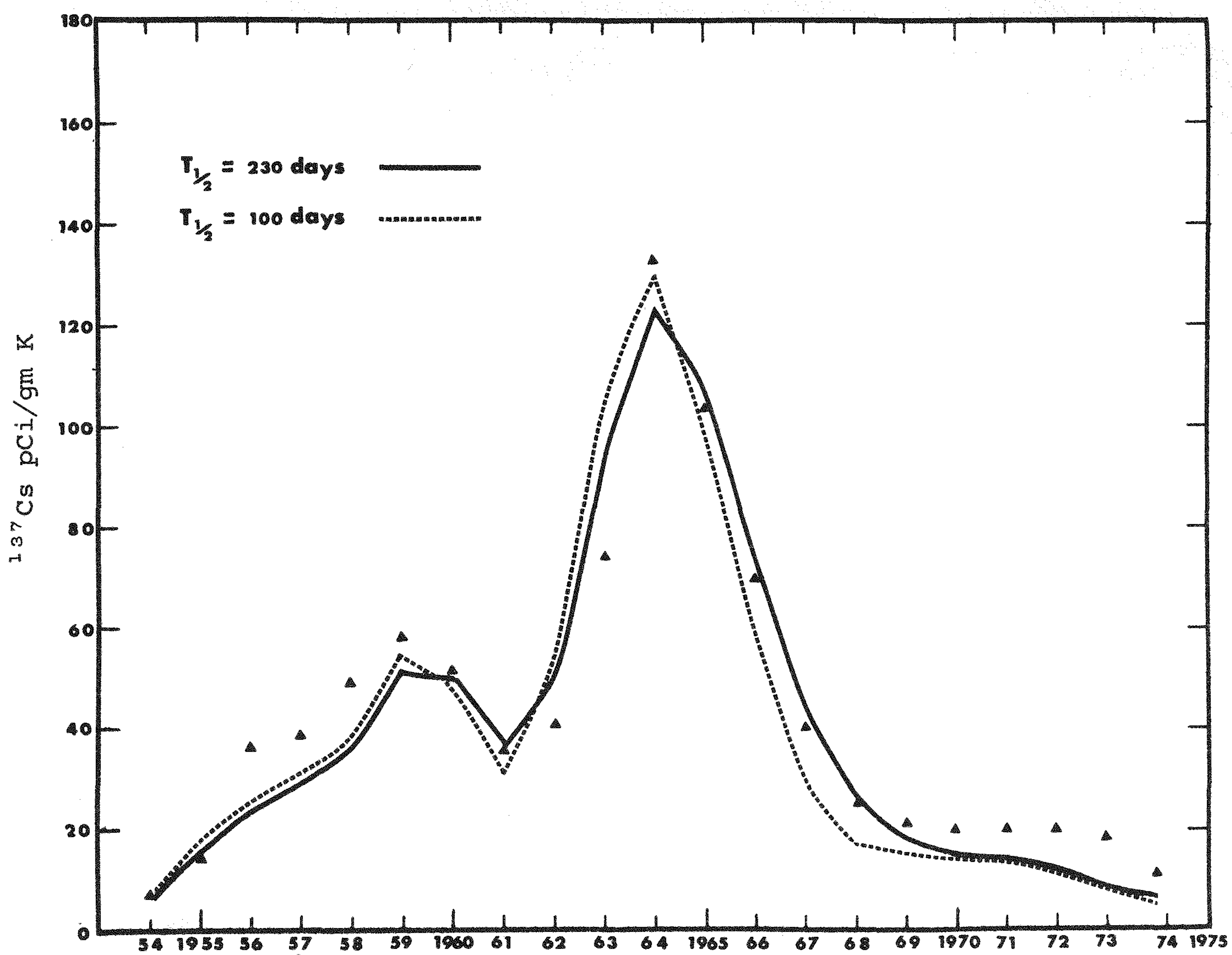


Figure 5. U. S. average ^{137}Cs body burdens (▲) and two predictions estimated with different biological half-lives from Chicago diet data.

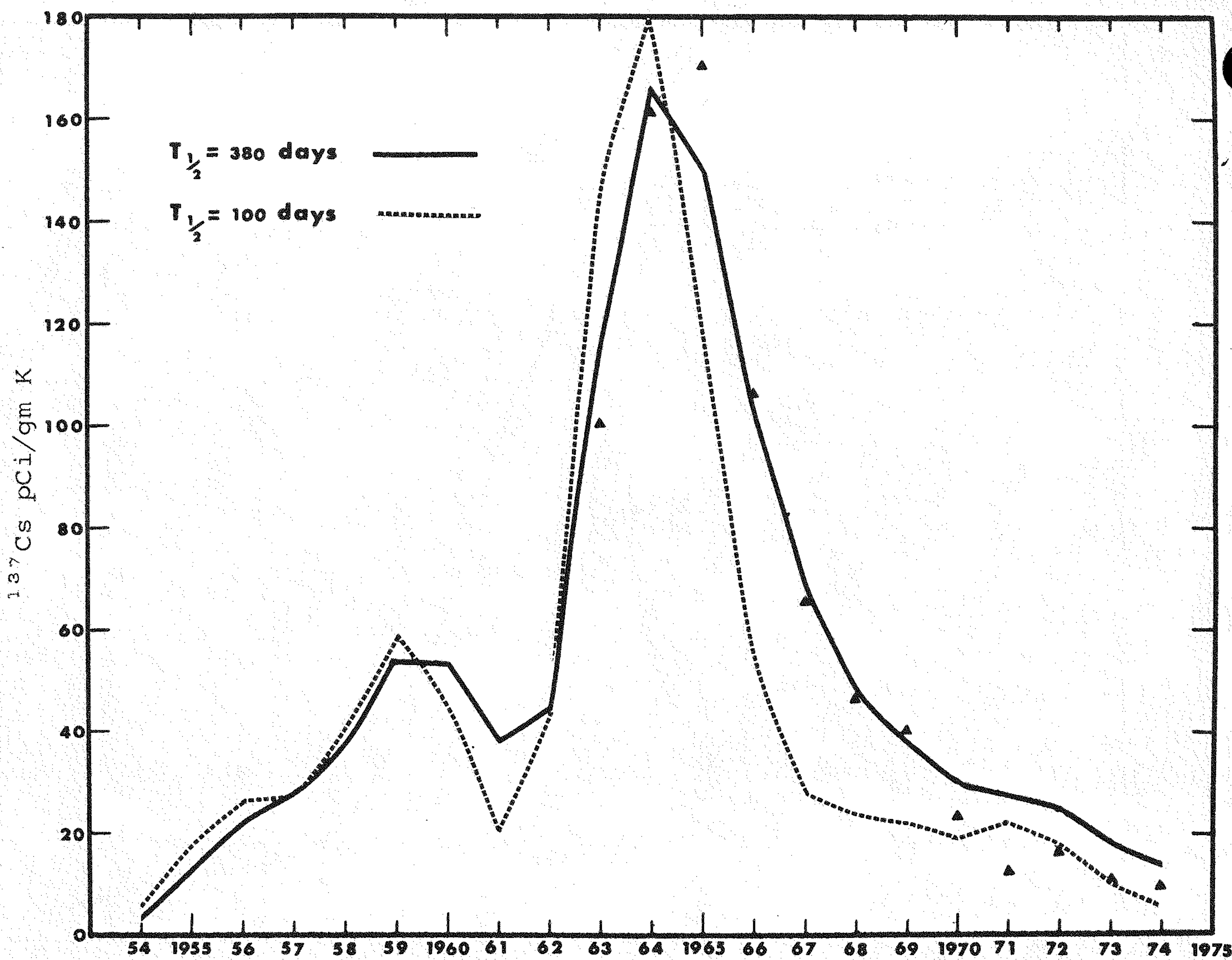
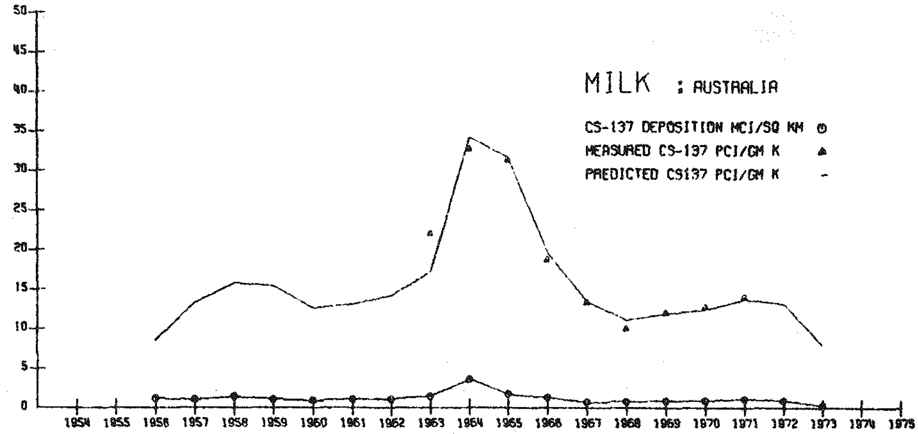
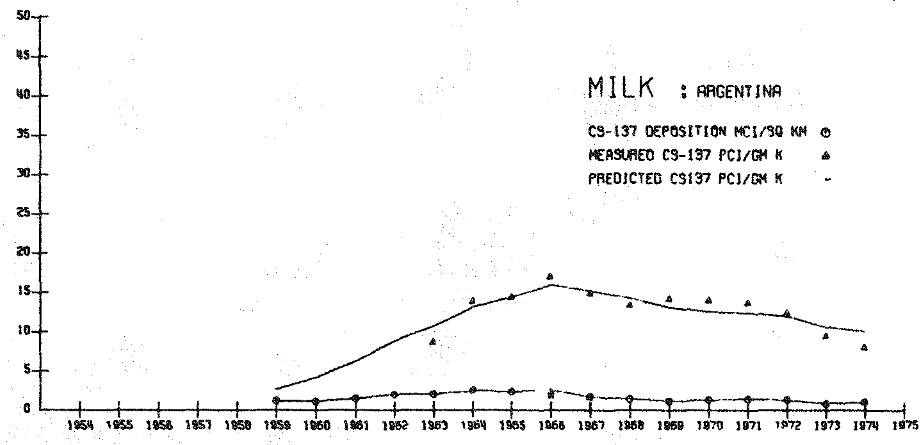


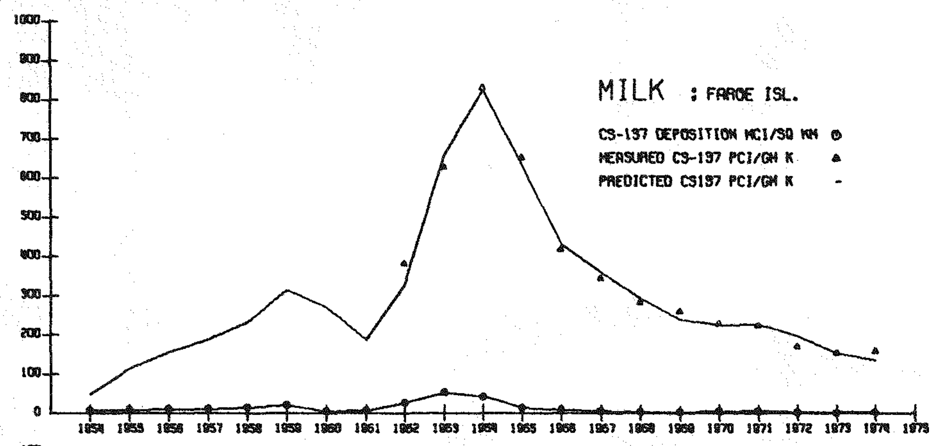
Figure 6. Denmark average ^{137}Cs body burdens (▲) and two predictions estimated with different biological half-lives from national diet data.

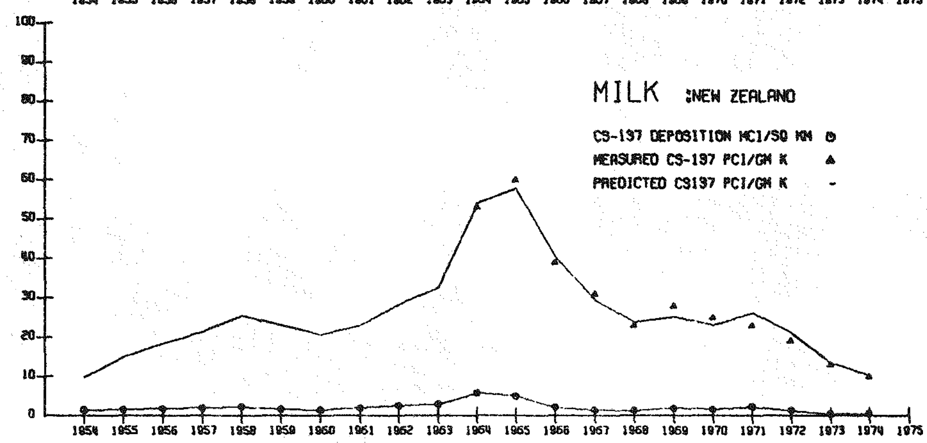
APPENDIX A

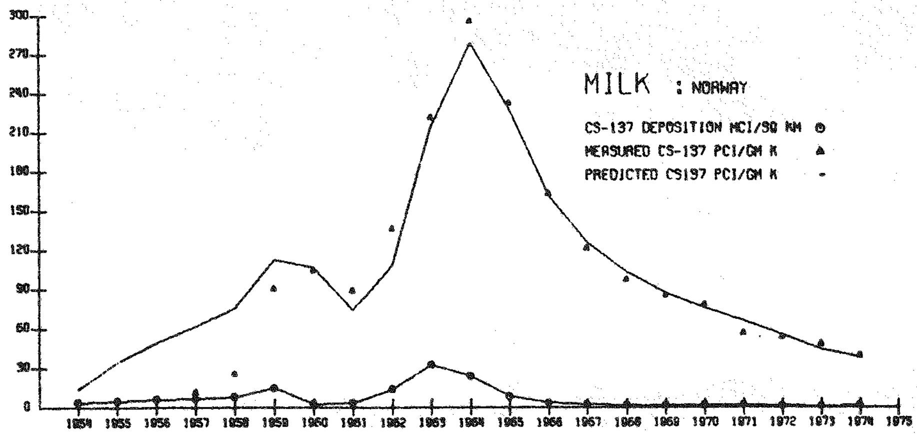
Summary of model fits: measured ^{137}Cs concentrations in milk, diets, and humans, with predicted concentrations from corresponding deposition and diet data.

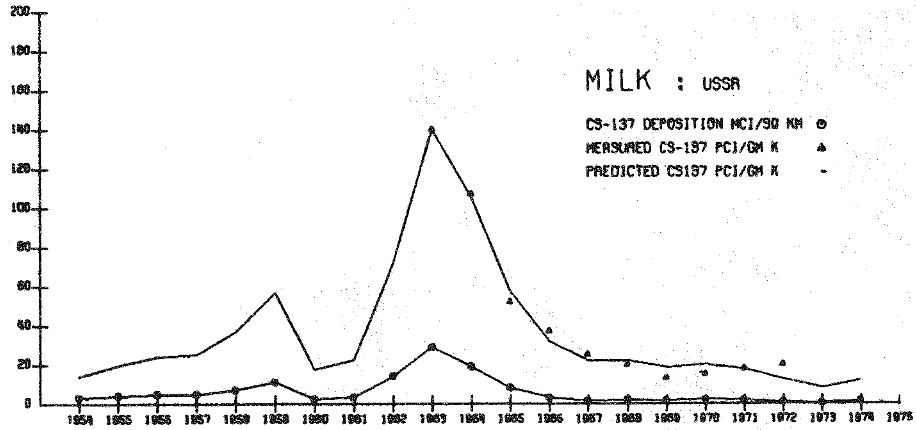

MILK : AUSTRALIA
CS-137 DEPOSITION MCI/SQ KM
MEASURED CS-137 PCI/GM K
PREDICTED CS137 PCI/GM K

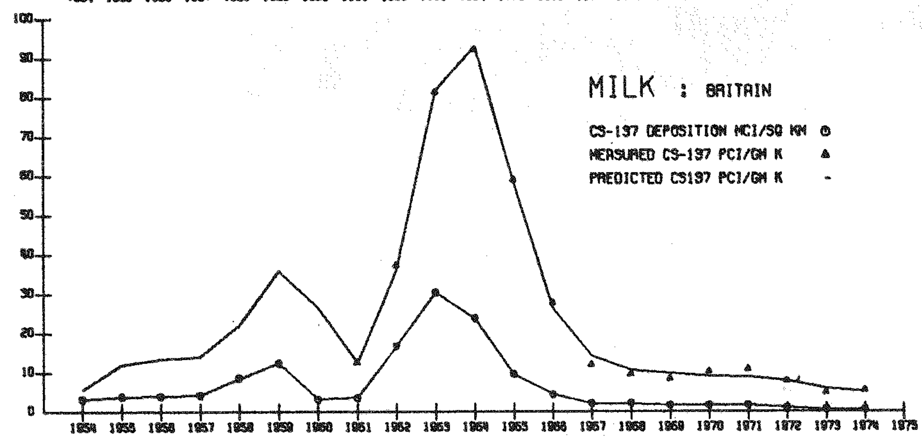

MILK : ARGENTINA
CS-137 DEPOSITION MCI/SQ KM
MEASURED CS-137 PCI/GM K
PREDICTED CS137 PCI/GM K

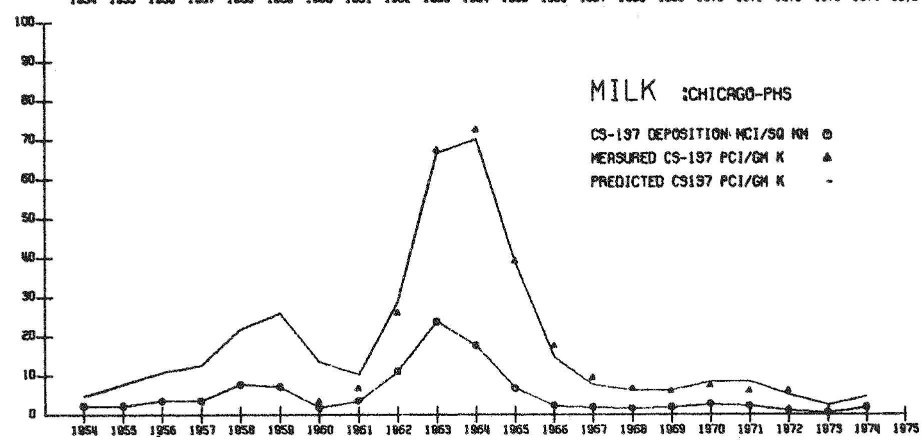

MILK : FAROE ISL.
CS-137 DEPOSITION MCI/SQ KM
MEASURED CS-137 PCI/GM K
PREDICTED CS137 PCI/GM K

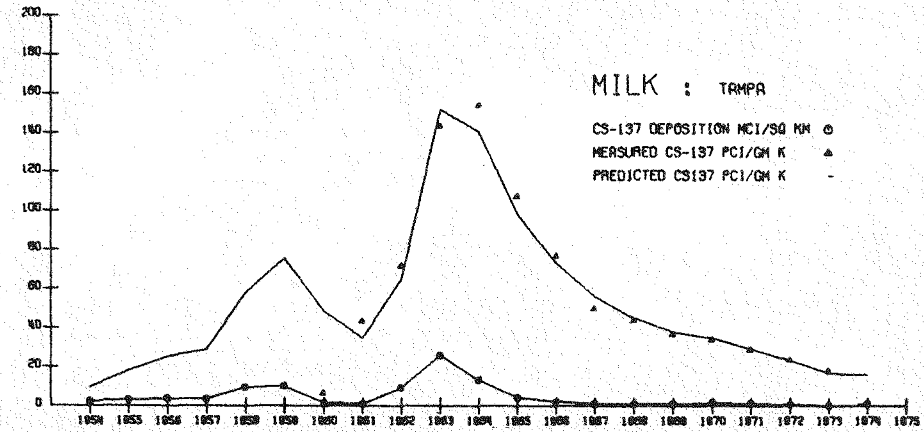

MILK :NEW ZEALAND
CS-137 DEPOSITION MCI/SQ KM
MEASURED CS-137 PCI/GM K
PREDICTED CS137 PCI/GM K

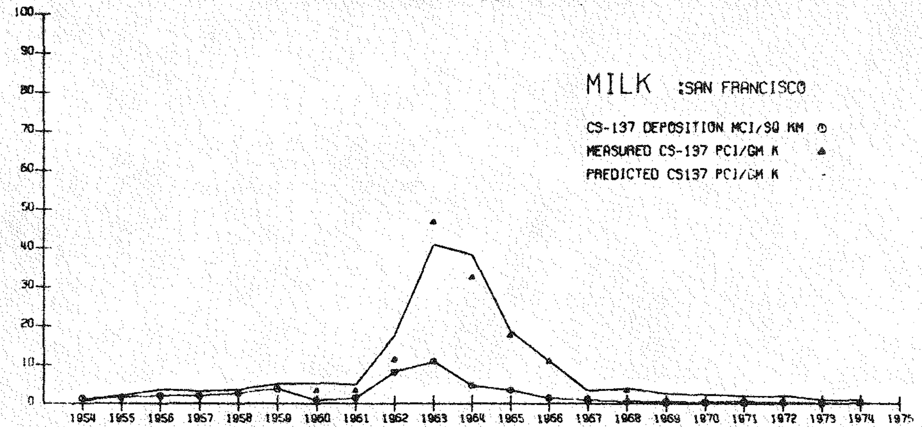

MILK : NORWAY
CS-137 DEPOSITION MCI/SQ KM
MEASURED CS-137 PCI/GM K
PREDICTED CS137 PCI/GM K

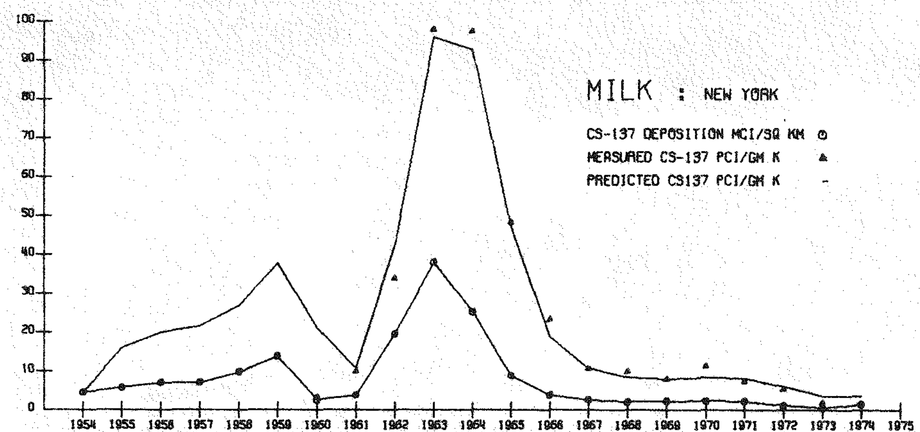

MILK : USSR
CS-137 DEPOSITION MCI/SQ KM
MEASURED CS-137 PCI/GM K
PREDICTED CS137 PCI/GM K

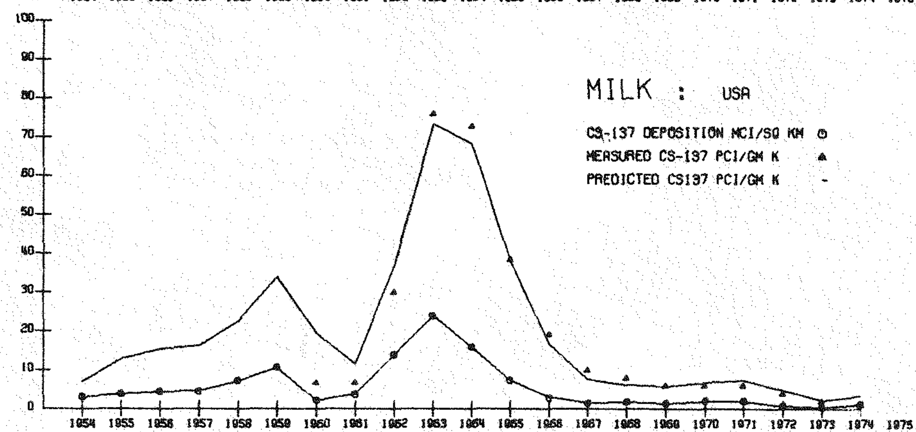

MILK : BRITAIN
CS-137 DEPOSITION MCI/SQ KM
MEASURED CS-137 PCI/GM K
PREDICTED CS137 PCI/GM K

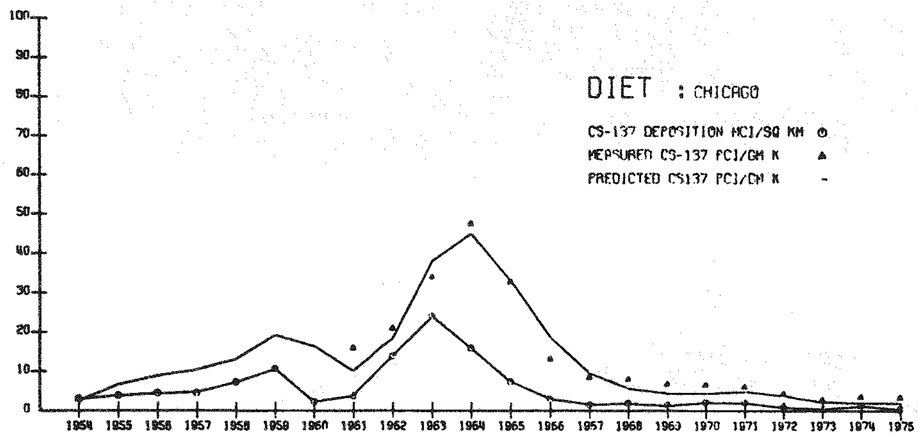

MILK :CHICAGO-PHS
CS-137 DEPOSITION MCI/SQ KM
MEASURED CS-137 PCI/GM K
PREDICTED CS137 PCI/GM K

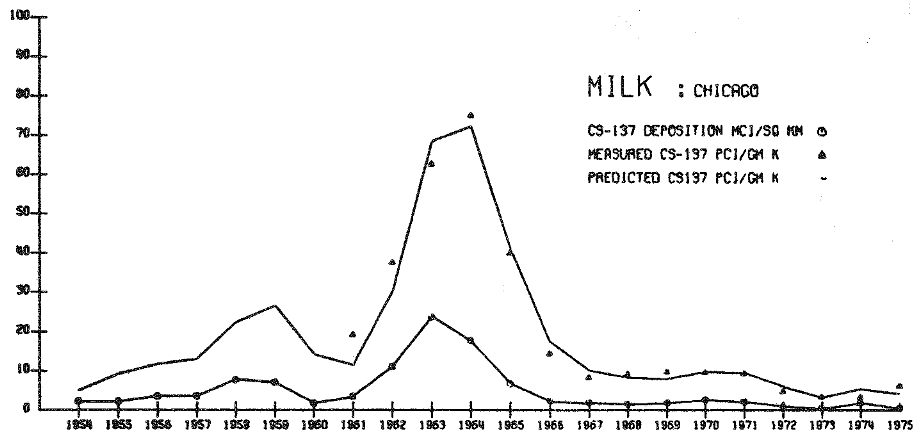

MILK : TAMPA
CS-137 DEPOSITION MCI/SQ KM
MEASURED CS-137 PCI/GM K
PREDICTED CS137 PCI/GM K

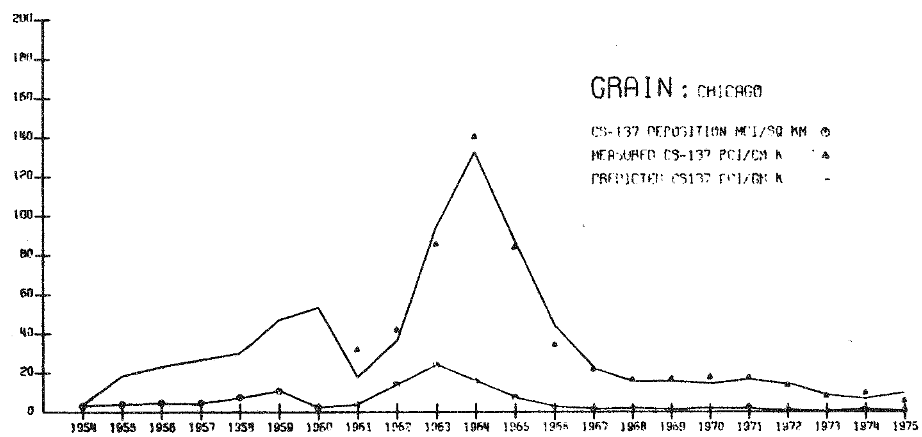

MILK :SAN FRANCISCO
CS-137 DEPOSITION MCI/SQ KM
MEASURED CS-137 PCI/GM K
PREDICTED CS137 PCI/GM K

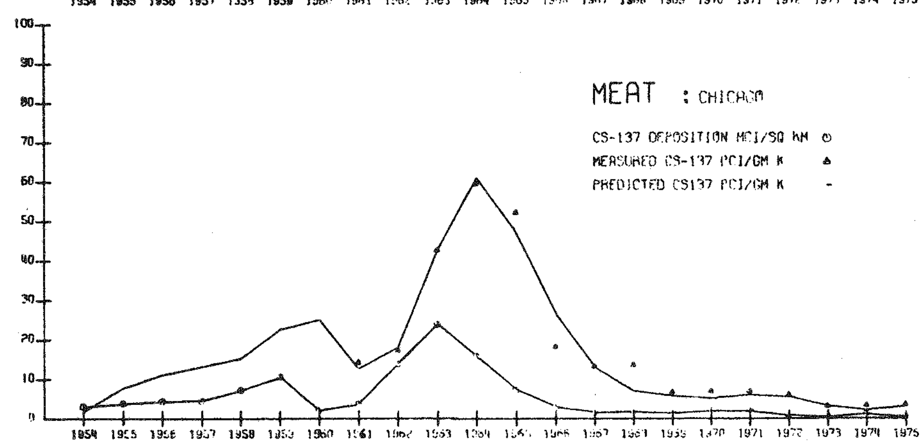

MILK : NEW YORK
CS-137 DEPOSITION MCI/SQ KM
MEASURED CS-137 PCI/GM K
PREDICTED CS137 PCI/GM K

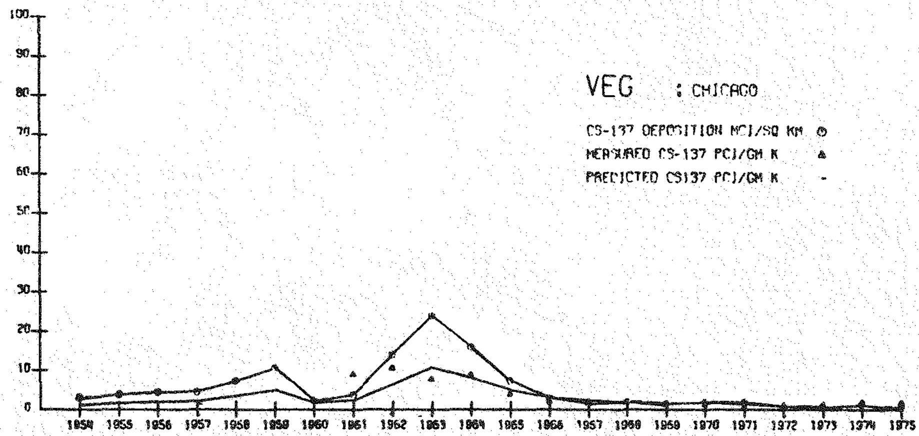

MILK : USA
CS-137 DEPOSITION MCI/SQ KM
MEASURED CS-137 PCI/GM K
PREDICTED CS137 PCI/GM K

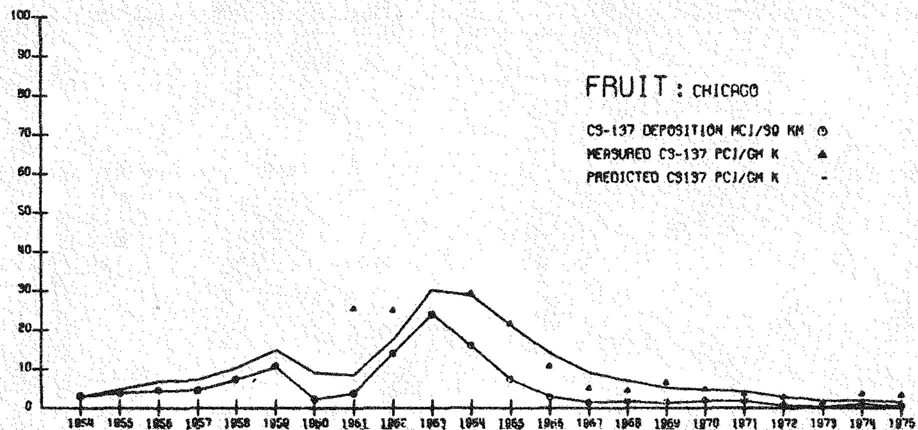

DIET : CHICAGO
CS-137 DEPOSITION MCI/SQ KM
MEASURED CS-137 PCI/GM K
PREDICTED CS137 PCI/GM K

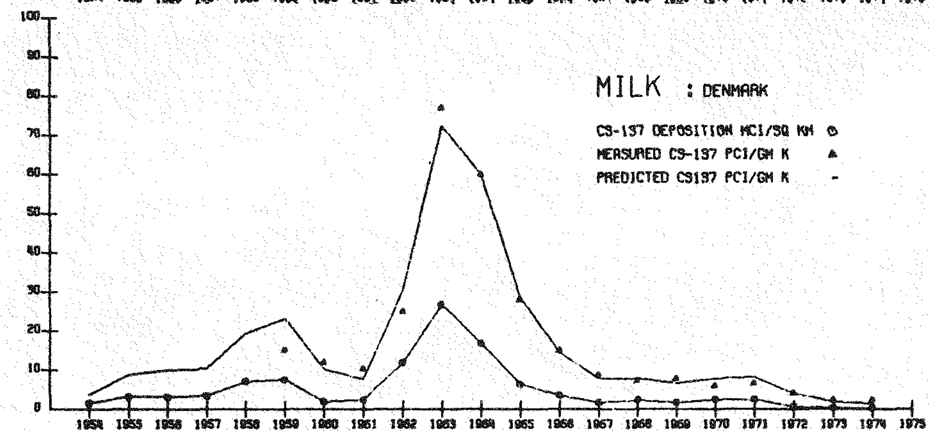

MILK : CHICAGO
CS-137 DEPOSITION MCI/SQ KM
MEASURED CS-137 PCI/GM K
PREDICTED CS137 PCI/GM K

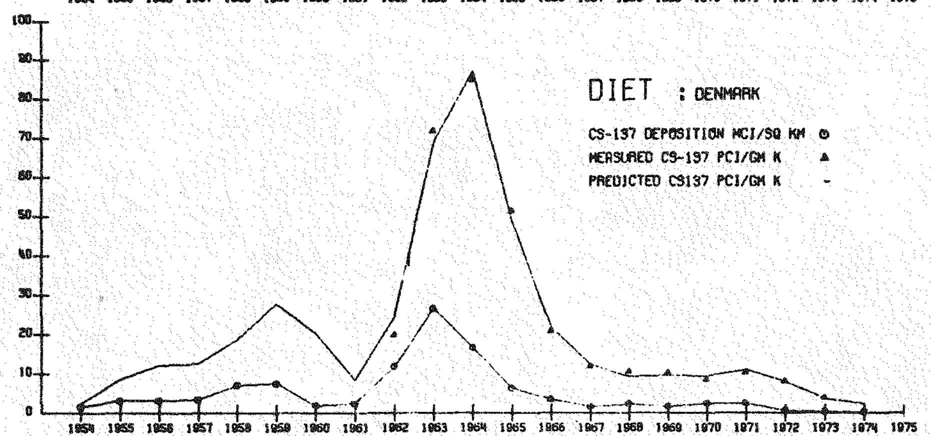

GRAIN : CHICAGO

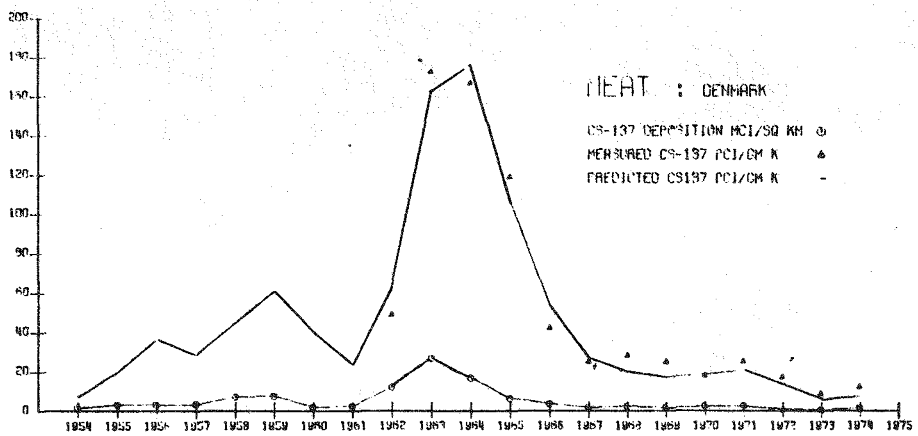

MEAT : CHICAGO
CS-137 DEPOSITION MCI/SQ KM
MEASURED CS-137 PCI/GM K
PREDICTED CS137 PCI/GM K

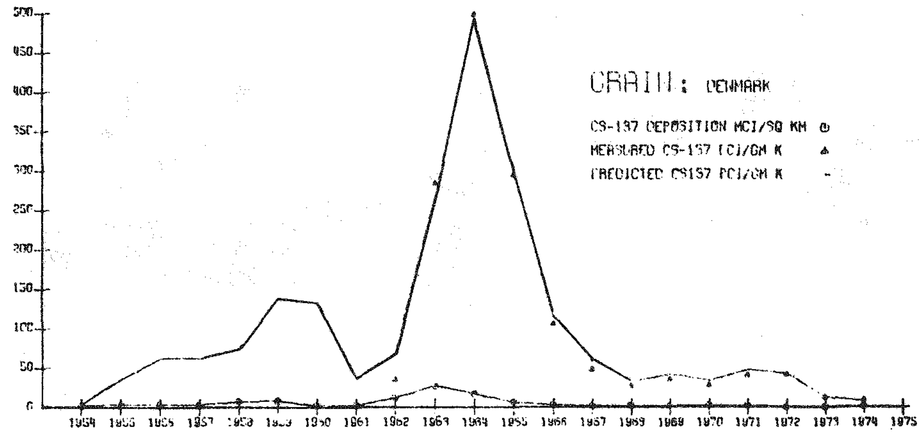

VEG : CHICAGO
CS-137 DEPOSITION MCI/SQ KM
MEASURED CS-137 PCI/GM K
PREDICTED CS137 PCI/GM K

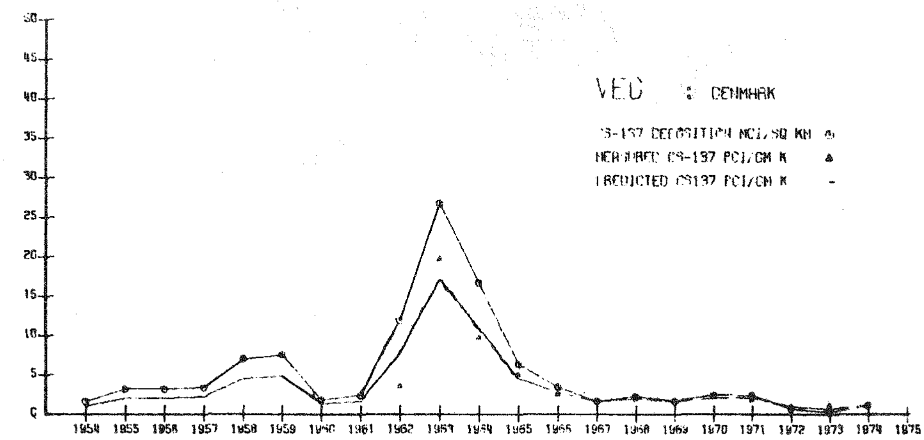

FRUIT : CHICAGO
CS-137 DEPOSITION MCI/SQ KM
MEASURED CS-137 PCI/GM K
PREDICTED CS137 PCI/GM K

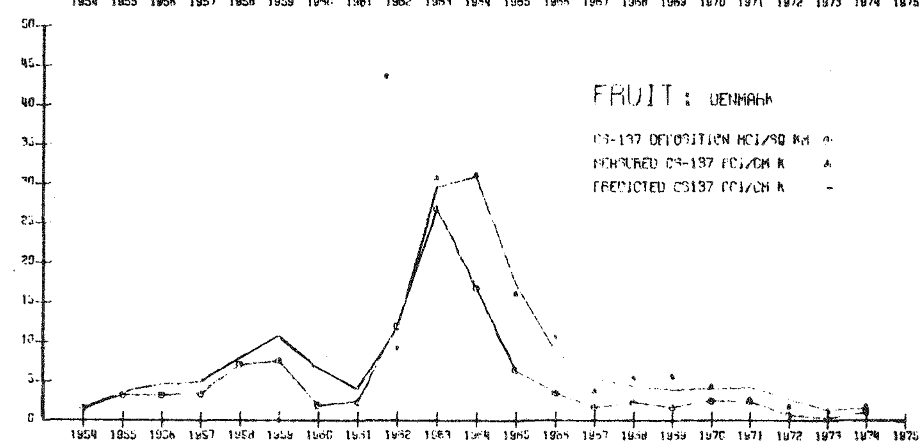

MILK : DENMARK
CS-137 DEPOSITION MCI/SQ KM
MEASURED CS-137 PCI/GM K
PREDICTED CS137 PCI/GM K

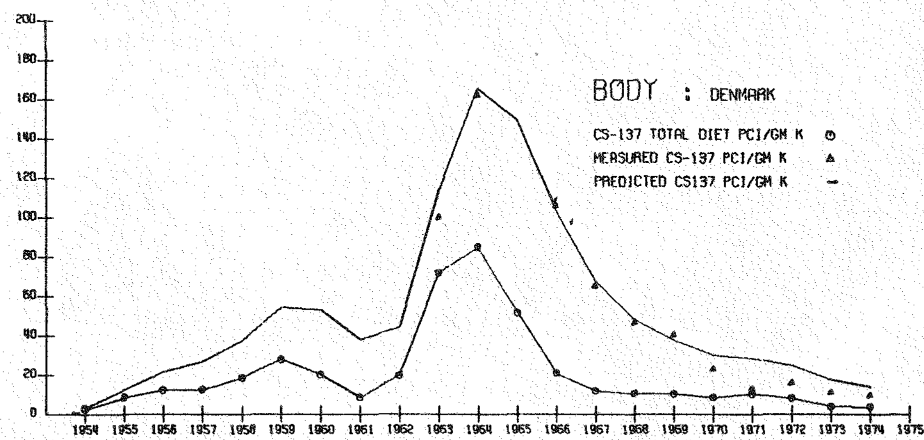

DIET : DENMARK
CS-137 DEPOSITION MCI/SQ KM
MEASURED CS-137 PCI/GM K
PREDICTED CS137 PCI/GM K


MEAT : DENMARK
CS-137 DEPOSITION MCI/SQ KM
MEASURED CS-137 PCI/GM K
PREDICTED CS137 PCI/GM K

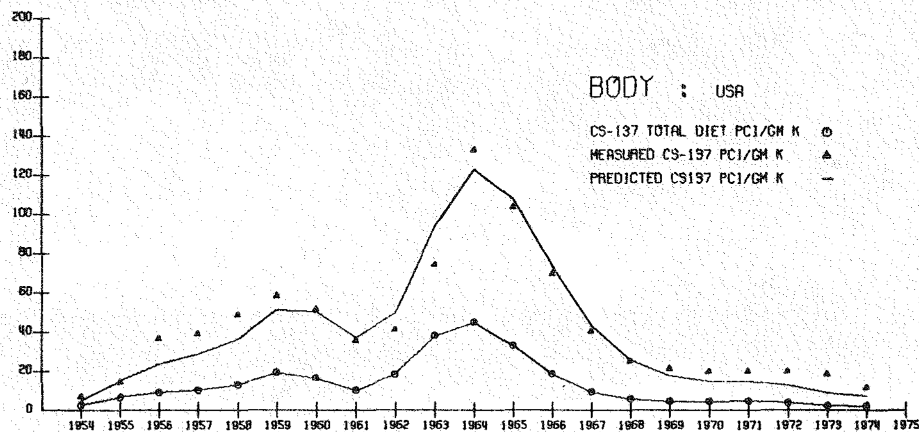

CRAIN : DENMARK
CS-137 DEPOSITION MCI/SQ KM
MEASURED CS-137 PCI/GM K
PREDICTED CS137 PCI/GM K


VEC : DENMARK
CS-137 DEPOSITION MCI/SQ KM
MEASURED CS-137 PCI/GM K
PREDICTED CS137 PCI/GM K


FRUIT : DENMARK
CS-137 DEPOSITION MCI/SQ KM
MEASURED CS-137 PCI/GM K
PREDICTED CS137 PCI/GM K



BODY : DENMARK
CS-137 TOTAL DIET PCI/GM K
MEASURED CS-137 PCI/GM K
PREDICTED CS137 PCI/GM K



BODY : USA
CS-137 TOTAL DIET PCI/GM K
MEASURED CS-137 PCI/GM K
PREDICTED CS137 PCI/GM K

CS-137 MILK

ARGENTINA

YEAR	DEPOSITION MCI/SQ KM	MEASURED PCI/GM K	PREDICTED PCI/GM K
1954	--	--	--
1955	--	--	--
1956	--	--	--
1957	--	--	--
1958	--	--	--
1959	1.23	--	2.72
1960	1.16	--	4.23
1961	1.55	--	6.29
1962	2.07	--	8.87
1963	2.09	8.70	10.77
1964	2.54	13.90	13.18
1965	2.39	14.40	14.54
1966	2.58	17.00	16.05
1967	1.71	14.90	15.22
1968	1.47	13.33	14.33
1969	1.20	14.20	13.13
1970	1.33	14.00	12.58
1971	1.47	13.70	12.44
1972	1.33	12.40	11.97
1973	0.87	9.50	10.64
1974	1.02	8.00	10.10
1975	--	--	--

CS-137 MILK

AUSTRALIA

YEAR	DEPOSITION MCI/SQ KM	MEASURED PCI/GM K	PREDICTED PCI/GM K
1954	--	--	--
1955	--	--	--
1956	1.17	--	8.47
1957	1.02	--	13.26
1958	1.44	--	15.81
1959	1.07	--	15.41
1960	0.91	--	12.62
1961	1.07	--	13.10
1962	1.10	--	14.18
1963	1.47	22.00	17.10
1964	3.56	32.70	34.16
1965	1.74	31.30	31.65
1966	1.26	18.70	19.58
1967	0.73	13.30	13.42
1968	0.78	10.00	11.08
1969	0.88	12.00	11.92
1970	0.89	12.70	12.39
1971	1.08	14.00	13.75
1972	0.87	--	13.13
1973	0.30	--	7.94
1974	--	--	--
1975	--	--	--

CS-137 MILK

BRITAIN

YEAR	DEPOSITION MCI/SQ KM	MEASURED PCI/GM K	PREDICTED PCI/GM K
1954	3.20	--	5.60
1955	3.84	--	11.96
1956	4.00	--	13.38
1957	4.16	--	14.04
1958	8.48	--	21.97
1959	12.32	--	35.89
1960	3.20	--	26.46
1961	3.52	12.60	12.46
1962	16.80	37.40	36.26
1963	30.40	81.30	81.87
1964	23.68	92.20	92.91
1965	9.44	59.00	57.91
1966	4.32	27.70	26.30
1967	2.08	12.00	14.21
1968	2.08	9.60	10.59
1969	1.60	8.40	9.74
1970	1.60	10.20	8.94
1971	1.60	10.80	8.90
1972	0.96	7.80	7.76
1973	0.48	4.80	5.84
1974	0.48	5.40	5.00
1975	--	--	--

CS-137 MILK

DENMARK

YEAR	DEPOSITION MCI/SQ KM	MEASURED PCI/GM K	PREDICTED PCI/GM K
1954	1.60	--	3.79
1955	3.20	--	8.75
1956	3.20	--	9.98
1957	3.36	--	10.46
1958	7.04	--	19.36
1959	7.52	15.10	23.26
1960	1.82	12.00	10.28
1961	2.37	10.30	7.54
1962	11.90	25.00	30.43
1963	26.72	77.00	72.48
1964	16.66	60.00	59.81
1965	6.32	28.00	28.66
1966	3.42	15.00	14.40
1967	1.63	8.80	7.82
1968	2.26	7.20	7.74
1969	1.66	7.80	6.53
1970	2.46	6.00	7.82
1971	2.42	6.60	8.17
1972	0.70	4.20	3.98
1973	0.30	2.40	1.72
1974	0.30	2.40	1.32
1975	--	--	--

CS-137 MILK

FAROE ISL.

YEAR	DEPOSITION MCI/SQ KM	MEASURED PCI/GM K	PREDICTED PCI/GM K
1954	7.06	--	48.00
1955	8.87	--	115.00
1956	10.81	--	157.00
1957	10.83	--	188.00
1958	14.71	--	232.00
1959	20.37	--	315.00
1960	4.40	--	271.00
1961	6.31	--	187.00
1962	26.08	382.00	328.00
1963	52.32	627.00	658.00
1964	41.22	829.00	825.00
1965	13.33	651.00	632.00
1966	8.67	417.00	431.00
1967	5.98	344.00	361.00
1968	2.16	282.00	292.00
1969	2.30	260.00	239.00
1970	4.21	228.00	225.00
1971	5.58	224.00	226.00
1972	1.94	170.00	196.00
1973	1.09	154.00	152.00
1974	2.00	158.00	135.00
1975	--	--	--

CS-137 MILK

NEW ZEALAND

YEAR	DEPOSITION MCI/SQ KM	MEASURED PCI/GM K	PREDICTED PCI/GM K
1954	1.44	--	9.78
1955	1.60	--	14.95
1956	1.76	--	18.40
1957	1.94	--	21.47
1958	2.30	--	25.37
1959	1.66	--	22.97
1960	1.44	--	20.65
1961	1.92	--	23.00
1962	2.56	--	28.36
1963	2.88	--	32.67
1964	5.76	53.00	54.10
1965	4.96	60.00	57.90
1966	2.08	39.00	40.50
1967	1.44	31.00	29.50
1968	1.28	23.00	23.80
1969	1.92	28.00	25.20
1970	1.60	25.00	23.10
1971	2.24	23.00	26.30
1972	1.28	19.00	21.10
1973	0.48	13.00	13.40
1974	0.48	10.00	10.20
1975	--	--	--

CS-137 MILK

NORWAY

YEAR	DEPOSITION MCI/SQ KM	MEASURED PCI/GM K	PREDICTED PCI/GM K
1954	3.84	--	13.52
1955	4.94	--	34.04
1956	6.14	--	49.29
1957	6.32	11.40	61.81
1958	7.95	25.40	75.57
1959	14.72	90.40	112.47
1960	2.64	104.00	106.56
1961	3.49	89.00	74.11
1962	13.92	136.00	108.10
1963	32.35	221.00	214.49
1964	23.82	295.00	278.27
1965	8.27	232.00	227.68
1966	3.38	163.00	161.60
1967	2.29	121.00	125.77
1968	1.84	97.00	102.98
1969	2.00	85.00	86.86
1970	2.06	78.00	75.43
1971	1.97	56.00	65.93
1972	1.06	53.00	55.01
1973	0.61	48.00	43.57
1974	1.31	39.00	37.96
1975	--	--	--

CS-137 MILK

USA

YEAR	DEPOSITION MCI/SQ KM	MEASURED PCI/GM K	PREDICTED PCI/GM K
1954	3.04	--	6.93
1955	3.84	--	12.83
1956	4.48	--	15.36
1957	4.51	--	16.28
1958	7.28	--	22.64
1959	10.64	--	34.02
1960	2.24	6.67	19.40
1961	3.77	6.67	11.60
1962	14.00	30.00	36.93
1963	24.00	76.00	73.42
1964	15.81	72.67	68.23
1965	7.34	38.33	37.97
1966	2.98	19.17	16.68
1967	1.54	10.00	7.56
1968	1.81	8.00	6.24
1969	1.50	6.00	5.89
1970	2.08	6.00	6.79
1971	2.02	6.00	7.43
1972	0.86	4.00	4.71
1973	0.42	2.00	2.15
1974	1.23	--	3.36
1975	--	--	--

CS-137 MILK

USSR

YEAR	DEPOSITION MCI/SQ KM	MEASURED PCI/GM K	PREDICTED PCI/GM K
1954	3.12	--	13.82
1955	4.06	--	19.69
1956	4.81	--	24.10
1957	4.84	--	25.19
1958	7.18	--	36.90
1959	11.15	--	56.64
1960	2.33	--	17.74
1961	3.42	--	22.26
1962	14.15	--	71.99
1963	28.90	140.00	139.94
1964	18.98	107.00	105.20
1965	8.09	52.00	57.17
1966	3.03	37.00	31.58
1967	1.57	25.00	22.07
1968	2.07	20.00	21.99
1969	1.54	13.00	18.22
1970	2.26	15.00	19.89
1971	1.97	18.00	17.77
1972	1.00	20.00	12.50
1973	0.32	--	7.84
1974	1.21	--	12.10
1975	--	--	--

CS-137 MILK

CHICAGO-PHS

YEAR	DEPOSITION MCI/SQ KM	MEASURED PCI/GM K	PREDICTED PCI/GM K
1954	2.21	--	4.84
1955	2.25	--	7.86
1956	3.55	--	10.79
1957	3.58	--	12.61
1958	7.73	--	21.77
1959	7.06	--	25.82
1960	1.74	3.33	13.35
1961	3.49	6.67	10.16
1962	11.02	26.00	28.87
1963	23.71	67.33	66.60
1964	17.63	72.50	70.24
1965	6.78	39.17	38.74
1966	2.27	17.50	14.54
1967	1.87	9.33	7.52
1968	1.57	6.67	6.17
1969	1.84	6.00	6.27
1970	2.69	7.33	8.43
1971	2.18	6.00	8.42
1972	0.91	6.00	4.97
1973	0.48	0.67	2.34
1974	1.82	--	4.69
1975	--	--	--

CS-137 MILK

NEW YORK

YEAR	DEPOSITION MCI/SC KM	MEASURED PCI/GM K	PREDICTED PCI/GM K
1954	4.42	--	4.42
1955	5.71	--	15.95
1956	7.09	--	20.06
1957	7.10	--	21.64
1958	9.86	--	26.95
1959	13.89	--	37.81
1960	2.53	3.33	21.10
1961	3.89	10.00	10.84
1962	19.73	34.00	42.78
1963	38.06	98.00	96.07
1964	25.36	97.50	92.88
1965	8.85	48.34	47.07
1966	3.89	23.34	18.89
1967	2.62	10.67	10.79
1968	2.11	10.00	8.31
1969	2.29	8.00	8.02
1970	2.37	11.33	8.32
1971	2.26	7.33	8.15
1972	1.20	5.33	5.94
1973	0.67	2.00	3.67
1974	1.49	--	3.62
1975	--	--	

CS-137 MILK

SAN FRANCISCO

YEAR	DEPOSITION MCI/SQ KM	MEASURED PCI/GM K	PREDICTED PCI/GM K
1954	1.24	--	0.69
1955	1.59	--	2.10
1956	1.96	--	3.70
1957	1.96	--	3.12
1958	2.70	--	3.59
1959	3.77	--	4.96
1960	0.88	3.33	5.26
1961	1.49	3.33	4.95
1962	8.16	11.33	17.63
1963	10.82	46.67	41.00
1964	4.62	32.50	38.42
1965	3.47	17.50	18.86
1966	1.44	10.83	10.84
1967	1.02	1.33	3.32
1968	0.54	3.33	3.80
1969	0.61	0.01	2.54
1970	0.38	0.01	2.36
1971	0.54	0.01	1.97
1972	0.26	0.01	1.97
1973	0.19	0.01	1.05
1974	0.30	0.01	1.03
1975	--	--	--

CS-137 MILK

TAMPA

YEAR	DEPOSITION MCI/SQ KM	MEASURED PCI/GM K	PREDICTED PCI/GM K
1954	2.23	--	9.77
1955	3.02	--	18.13
1956	3.65	--	25.27
1957	3.50	--	28.74
1958	9.57	--	58.18
1959	10.02	--	75.63
1960	1.60	6.67	48.63
1961	1.07	43.33	34.97
1962	9.23	72.00	65.08
1963	25.87	143.33	151.92
1964	13.39	154.17	140.64
1965	4.35	107.50	98.26
1966	2.26	76.67	73.26
1967	1.15	50.00	56.22
1968	1.07	44.00	45.16
1969	1.18	36.67	37.85
1970	1.74	34.00	34.64
1971	1.23	28.67	29.26
1972	0.69	23.33	23.09
1973	0.14	18.00	16.84
1974	0.83	--	16.07
1975	--	--	--

CS-137 DIET

CHICAGO

YEAR	DEPOSITION MCI/SQ KM	MEASURED PCI/GM K	PREDICTED PCI/GM K
1954	3.04	--	2.64
1955	3.84	--	6.64
1956	4.48	--	9.06
1957	4.51	--	10.33
1958	7.28	--	13.15
1959	10.64	--	19.21
1960	2.24	--	16.48
1961	3.77	15.90	10.10
1962	14.00	20.90	18.38
1963	24.00	34.00	38.01
1964	15.81	47.50	44.96
1965	7.34	32.80	32.93
1966	2.98	13.10	18.54
1967	1.54	8.40	9.38
1968	1.81	8.00	5.67
1969	1.50	6.80	4.50
1970	2.08	6.50	4.41
1971	2.02	6.10	4.80
1972	0.86	4.30	3.85
1973	0.42	2.80	2.23
1974	1.23	3.50	2.09
1975	0.50	3.40	2.08

CS-137 MILK

CHICAGO

YEAR	DEPOSITION MCI/SQ KM	MEASURED PCI/GM K	PREDICTED PCI/GM K
1954	2.21	--	4.93
1955	2.25	--	9.27
1956	3.55	--	11.83
1957	3.58	--	12.96
1958	7.73	--	22.43
1959	7.06	--	26.51
1960	1.74	--	14.14
1961	3.49	19.20	11.31
1962	11.02	37.50	30.19
1963	23.71	62.60	68.38
1964	17.63	74.90	72.14
1965	6.78	40.00	41.22
1966	2.27	14.40	17.34
1967	1.87	8.30	10.09
1968	1.57	9.20	8.27
1969	1.84	9.70	8.00
1970	2.69	9.60	9.87
1971	2.18	9.30	9.61
1972	0.91	4.80	5.98
1973	0.48	3.30	3.21
1974	1.82	3.30	5.44
1975	0.50	6.10	4.11

CS-137 MEAT

CHICAGO

YEAR	DEPOSITION MCI/SQ KM	MEASURED PCI/GM K	PREDICTED PCI/GM K
1954	3.04	--	1.82
1955	3.84	--	7.86
1956	4.48	--	11.18
1957	4.51	--	13.16
1958	7.28	--	15.39
1959	10.64	--	22.62
1960	2.24	--	25.11
1961	3.77	14.30	12.67
1962	14.00	17.20	18.12
1963	24.00	42.70	42.74
1964	15.81	59.40	61.04
1965	7.34	52.20	47.03
1966	2.98	18.20	26.51
1967	1.54	13.20	12.92
1968	1.81	13.60	7.09
1969	1.50	6.70	5.81
1970	2.08	6.90	5.30
1971	2.02	7.00	6.10
1972	0.86	6.00	5.52
1973	0.42	3.20	3.15
1974	1.23	3.30	2.28
1975	0.50	3.50	2.96

CS-137 GRAIN

CHICAGO

YEAR	DEPOSITION PCI/SQ KM	MEASURED PCI/GM K	PREDICTED PCI/GM K
1954	3.04	--	3.47
1955	3.84	--	18.32
1956	4.48	--	23.01
1957	4.51	--	26.30
1958	7.28	--	29.95
1959	10.64	--	46.80
1960	2.24	--	53.18
1961	3.77	31.60	17.26
1962	14.00	41.50	35.83
1963	24.00	85.00	94.24
1964	15.81	139.90	131.88
1965	7.34	83.50	86.54
1966	2.98	33.80	43.59
1967	1.54	21.50	21.91
1968	1.81	16.30	15.16
1969	1.50	16.70	15.52
1970	2.08	17.70	14.30
1971	2.02	17.40	16.47
1972	0.86	13.40	14.56
1973	0.42	8.00	8.44
1974	1.23	9.60	6.97
1975	0.50	5.60	9.48

CS-137 VEG

CHICAGO

YEAR	DEPOSITION MCI/SQ KM	MEASURED PCI/GM K	PREDICTED PCI/GM K
1954	3.04	--	1.22
1955	3.84	--	1.66
1956	4.48	--	2.04
1957	4.51	--	2.17
1958	7.28	--	3.38
1959	10.64	--	4.91
1960	2.24	--	1.83
1961	3.77	9.00	2.36
1962	14.00	10.50	6.44
1963	24.00	7.70	10.86
1964	15.81	8.80	8.28
1965	7.34	4.00	5.10
1966	2.98	2.00	3.19
1967	1.54	2.00	2.31
1968	1.81	2.10	2.12
1969	1.50	1.50	1.76
1970	2.08	1.30	1.81
1971	2.02	0.60	1.66
1972	0.86	0.80	1.10
1973	0.42	1.10	0.80
1974	1.23	1.90	1.00
1975	0.50	1.70	0.65

CS-137 FRUIT

CHICAGO

YEAR	DEPOSITION MCI/SQ KM	MEASURED PCI/GM K	PREDICTED PCI/GM K
1954	3.04	--	2.83
1955	3.84	--	4.73
1956	4.48	--	6.73
1957	4.51	--	7.17
1958	7.28	--	10.26
1959	10.64	--	14.74
1960	2.24	--	9.01
1961	3.77	25.30	8.50
1962	14.00	24.90	17.43
1963	24.00	23.50	30.30
1964	15.81	29.20	28.62
1965	7.34	21.60	21.14
1966	2.98	10.70	14.08
1967	1.54	5.10	9.30
1968	1.81	4.50	6.95
1969	1.59	6.60	5.22
1970	2.08	4.90	4.78
1971	2.02	3.80	4.36
1972	0.86	3.00	3.05
1973	0.42	1.50	2.05
1974	1.23	3.80	2.30
1975	0.50	3.30	1.62

CS-137 DIET

DENMARK

YEAR	DEPOSITION MCI/SQ KM	MEASURED PCI/GM K	PREDICTED PCI/GM K
1954	1.60	--	2.50
1955	3.20	--	8.59
1956	3.20	--	12.22
1957	3.36	--	12.57
1958	7.04	--	18.76
1959	7.52	--	27.85
1960	1.82	--	20.22
1961	2.37	--	8.46
1962	11.90	20.00	24.59
1963	26.72	72.00	69.10
1964	16.66	85.00	87.12
1965	6.32	51.60	49.23
1966	3.42	21.00	21.83
1967	1.63	12.00	12.48
1968	2.26	10.50	9.30
1969	1.66	10.30	9.61
1970	2.46	8.50	9.36
1971	2.42	10.30	10.96
1972	0.70	8.20	8.09
1973	0.30	3.90	3.51
1974	0.30	--	2.48
1975	--	--	--

CS-137 MILK PROD

DENMARK

YEAR	DEPOSITION MCI/SQ KM	MEASURED PCI/GM K	PREDICTED PCI/GM K
1954	1.60	--	3.47
1955	3.20	--	9.38
1956	3.20	--	11.90
1957	3.36	--	12.25
1958	7.04	--	20.74
1959	7.52	--	27.52
1960	1.82	--	16.16
1961	2.37	--	8.92
1962	11.90	30.80	30.47
1963	26.72	76.50	77.22
1964	16.66	80.30	78.38
1965	6.32	39.10	41.63
1966	3.42	19.20	20.12
1967	1.63	12.10	11.87
1968	2.26	13.50	10.45
1969	1.66	11.40	9.97
1970	2.46	9.90	10.69
1971	2.42	9.90	11.70
1972	0.70	7.80	7.83
1973	0.30	4.30	4.26
1974	1.14	5.20	5.34
1975	--	--	--

CS-137 MEAT

DENMARK

YEAR	DEPOSITION MCI/SQ KM	MEASURED PCI/GM K	PREDICTED PCI/GM K
1954	1.60	--	7.12
1955	3.20	--	19.81
1956	3.20	--	36.50
1957	3.36	--	28.56
1958	7.04	--	45.77
1959	7.52	--	60.88
1960	1.82	--	39.81
1961	2.37	--	23.29
1962	11.90	48.80	63.80
1963	26.72	172.20	162.57
1964	16.66	166.30	175.98
1965	6.32	118.60	106.67
1966	3.42	41.90	53.08
1967	1.63	24.90	26.80
1968	2.26	28.00	19.68
1969	1.66	24.90	17.20
1970	2.46	17.80	18.71
1971	2.42	25.10	20.90
1972	0.70	17.20	13.58
1973	0.30	8.70	5.88
1974	1.14	11.90	7.04
1975	--	--	--

CS-137 GRAIN

DENMARK

YEAR	DEPOSITION MCI/SQ KM	MEASURED PCI/GM K	PREDICTED PCI/GM K
1954	1.60	--	3.78
1955	3.20	--	34.78
1956	3.20	--	62.02
1957	3.36	--	62.39
1958	7.04	--	73.80
1959	7.52	--	137.57
1960	1.82	--	132.29
1961	2.37	--	36.57
1962	11.90	34.30	68.45
1963	26.72	284.00	265.65
1964	16.66	498.00	494.06
1965	6.32	294.10	298.43
1966	3.42	105.40	115.63
1967	1.63	48.00	62.05
1968	2.26	26.80	33.08
1969	1.66	35.00	42.38
1970	2.46	27.70	34.07
1971	2.42	40.30	47.60
1972	0.70	41.50	42.89
1973	0.30	12.40	12.75
1974	1.14	9.30	8.12
1975	--	--	--

CS-137 VEG

DENMARK

YEAR	DEPOSITION MCI/SQ KM	MEASURED PCI/GM K	PREDICTED PCI/GM K
1954	1.60	--	1.01
1955	3.20	--	2.02
1956	3.20	--	2.03
1957	3.36	--	2.17
1958	7.04	--	4.51
1959	7.52	--	4.85
1960	1.82	--	1.30
1961	2.37	--	1.65
1962	11.90	3.50	7.72
1963	26.72	19.70	17.19
1964	16.66	9.70	10.94
1965	6.32	5.00	4.50
1966	3.42	2.50	2.69
1967	1.63	1.70	1.56
1968	2.26	1.90	1.96
1969	1.66	1.80	1.58
1970	2.46	2.50	2.09
1971	2.42	1.90	2.07
1972	0.70	1.00	0.98
1973	0.30	1.10	0.72
1974	1.14	1.20	1.25
1975	--	--	--

CS-137 FRUIT

DENMARK

YEAR	DEPOSITION PCI/SQ KM	MEASURED PCI/GM K	PREDICTED PCI/GM K
1954	1.60	--	1.30
1955	3.20	--	3.56
1956	3.20	--	4.61
1957	3.36	--	4.86
1958	7.04	--	8.03
1959	7.52	--	10.73
1960	1.82	--	6.63
1961	2.37	--	3.87
1962	11.90	9.10	11.73
1963	26.72	30.60	29.51
1964	16.66	31.00	30.76
1965	6.32	16.00	17.14
1966	3.42	10.50	8.72
1967	1.63	3.70	5.22
1968	2.26	5.30	4.32
1969	1.66	5.60	3.90
1970	2.46	4.30	3.98
1971	2.42	2.70	4.25
1972	0.70	1.80	2.74
1973	0.30	1.20	1.29
1974	1.14	1.80	1.59
1975	--	--	--

CS-137 BODY

DENMARK

YEAR	TOTAL DIET PCI/GM K	MEASURED PCI/GM K	PREDICTED PCI/GM K
1954	2.50	--	3.15
1955	8.59	--	12.44
1956	12.22	--	21.76
1957	12.57	--	26.97
1958	18.76	--	37.44
1959	27.85	--	54.25
1960	20.22	--	53.24
1961	8.46	--	37.90
1962	20.00	--	44.59
1963	72.00	100.00	113.70
1964	85.00	162.00	165.43
1965	51.60	170.00	149.76
1966	21.00	106.00	103.13
1967	12.00	65.00	67.91
1968	10.50	46.50	48.00
1969	10.30	40.30	37.56
1970	8.50	23.00	29.94
1971	10.30	13.00	28.32
1972	8.20	16.00	24.84
1973	3.90	11.00	17.63
1974	3.80	9.60	13.82
1975	--	--	--

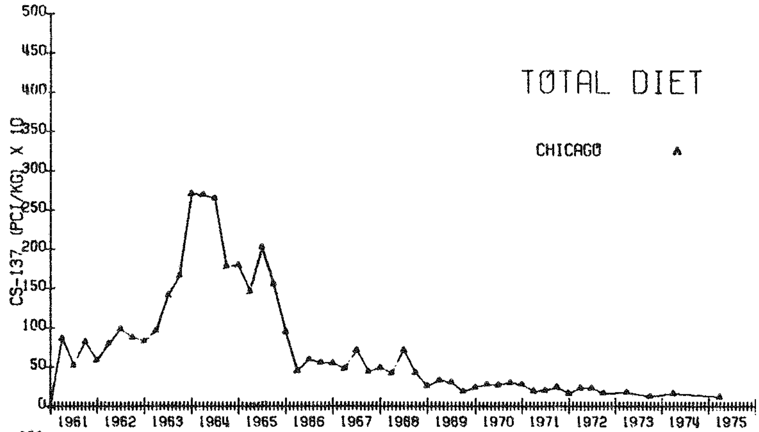
CS-137 BODY

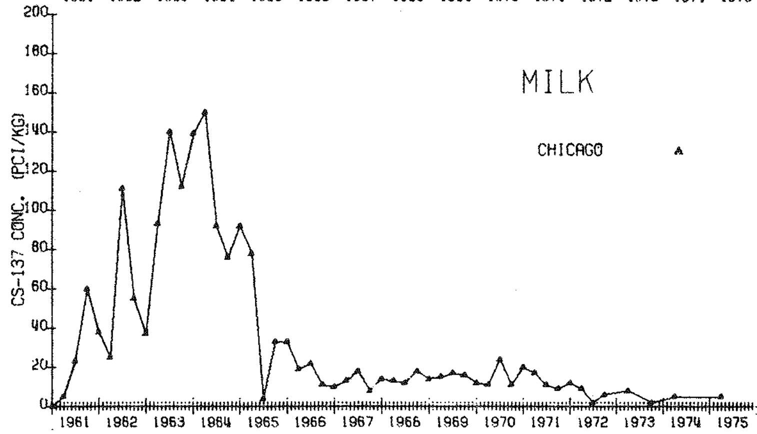
USA

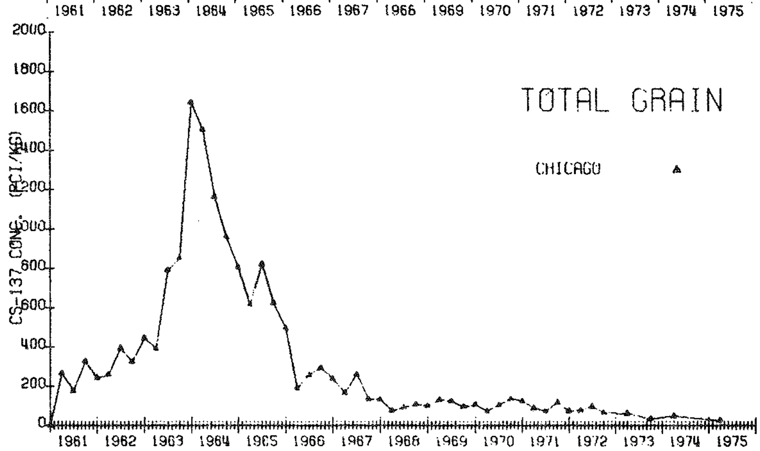
YEAR	TOTAL DIET PCI/GM K	MEASURED PCI/GM K	PREDICTED PCI/GM K
1954	2.64	7.00	5.40
1955	6.64	14.50	15.36
1956	9.06	36.60	23.56
1957	0.33	39.10	28.84
1958	3.15	48.80	36.33
1959	19.21	58.50	51.18
1960	16.48	51.60	50.44
1961	10.10	35.70	37.13
1962	18.38	41.00	49.74
1963	38.01	74.20	94.05
1964	44.96	132.70	122.73
1965	32.93	103.70	107.46
1966	18.54	69.70	73.02
1967	9.38	40.30	43.03
1968	5.67	25.00	25.65
1969	4.50	21.30	17.58
1970	4.41	19.80	14.76
1971	4.80	20.00	14.64
1972	3.85	20.00	12.66
1973	2.23	18.50	8.70
1974	2.09	11.40	7.12
1975	--	--	--

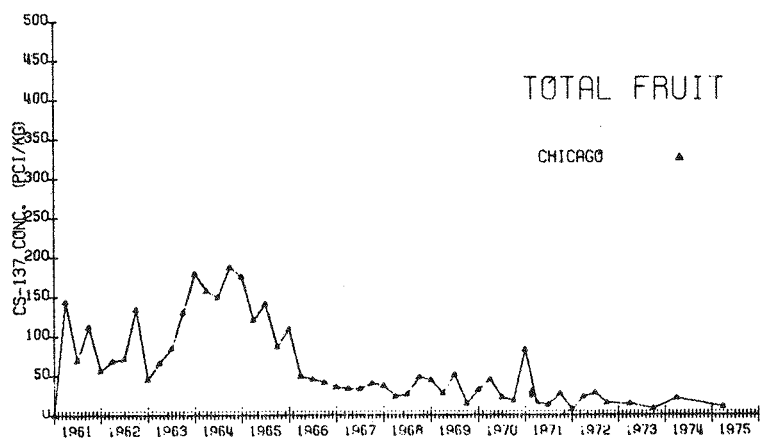
APPENDIX B

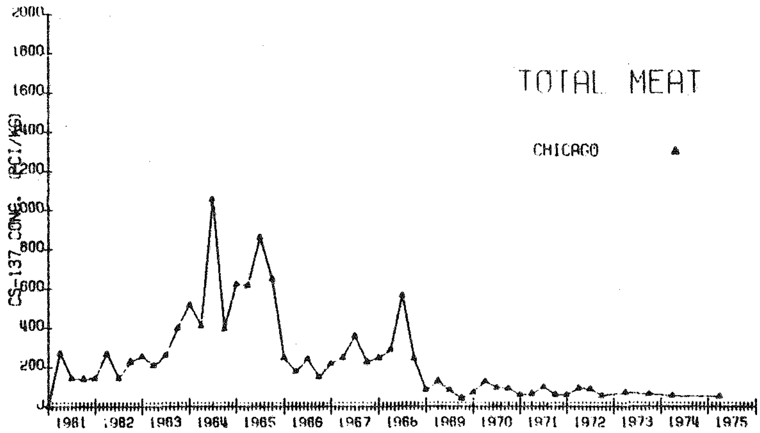
Chicago diet data: quarterly ^{137}Cs concentrations in the total diet, 5 food groups and 19 food items.

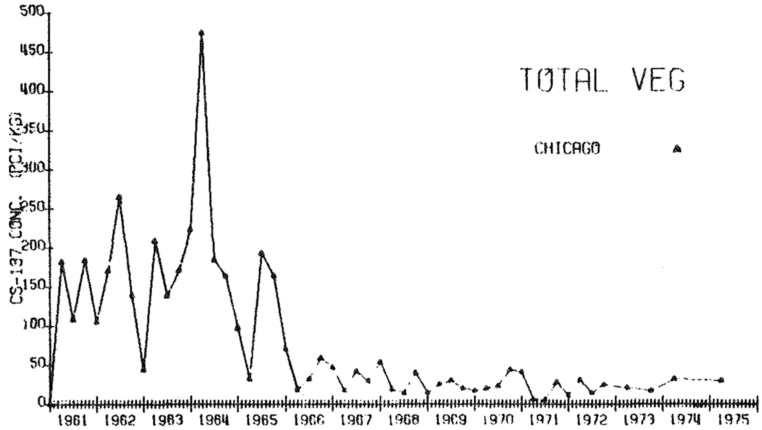

TOTAL DIET
CHICAGO
CS-137 (PCI/KG) X 10
500
450
400
350
300
250
200
150
100
50
0
1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975

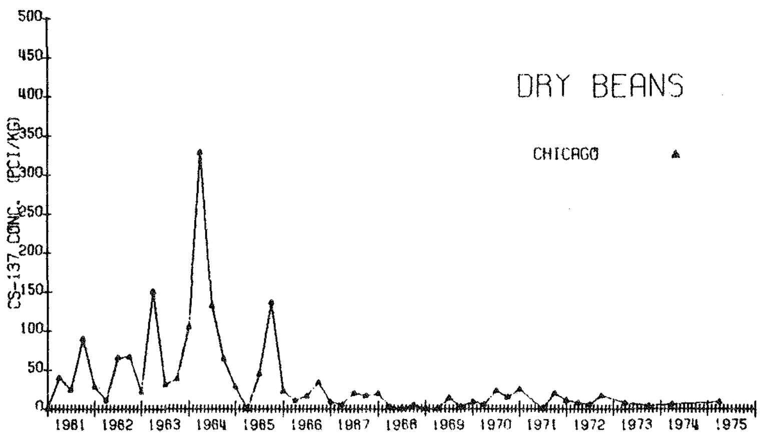

MILK
CHICAGO
CS-137 CONC. (PCI/KG)
200
180
160
140
120
100
80
60
40
20
0
1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975

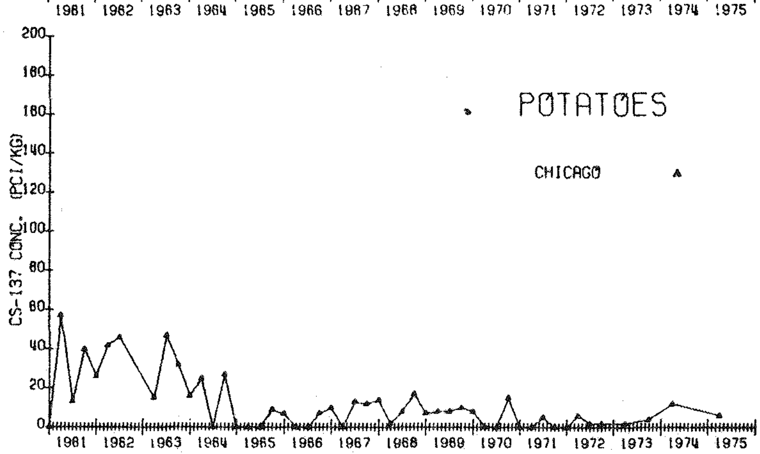

TOTAL GRAIN
CHICAGO
CS-137 CONC. (PCI/KG)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975

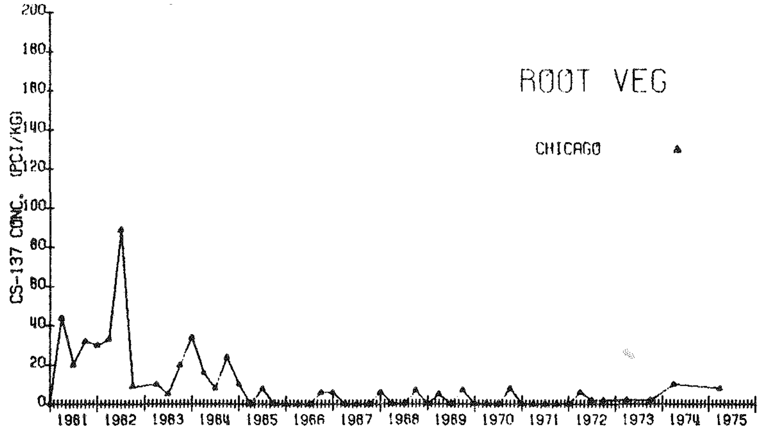

TOTAL FRUIT
CHICAGO
CS-137 CONC. (PCI/KG)
500
450
400
350
300
250
200
150
100
50
0
1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975

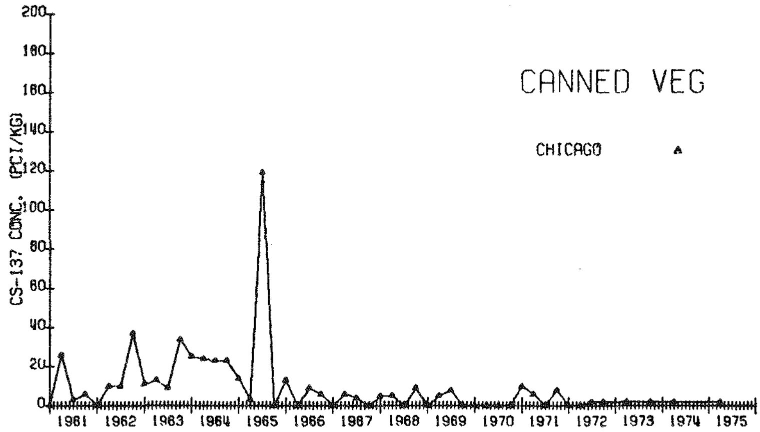

TOTAL MEAT
CHICAGO
CS-137 CONC. (PCI/KG)
1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975

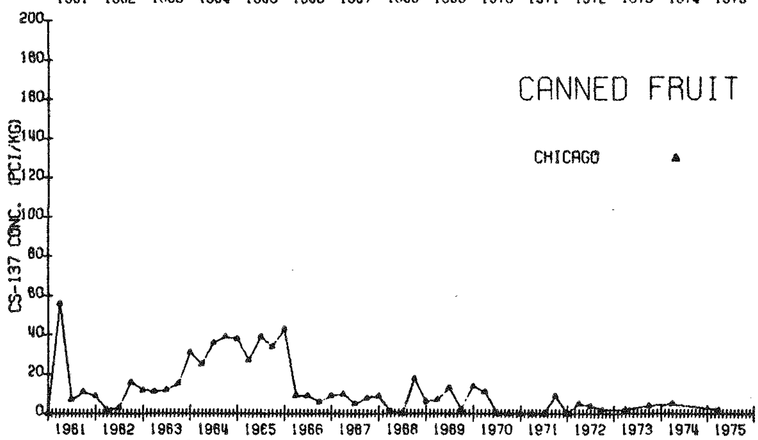

TØTAL VEG
CHICAGO
CS-137 CONC. (PCI/KG)
1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975


DRY BEANS
CHICAGO
CS-137 CONC. (PCI/KG)
1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975


PØTATØES
CHICAGO
CS-137 CONC. (PCI/KG)
1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975


ROOT VEG
CHICAGO
CS-137 CONC. (PCI/KG)
1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975


CANNED VEG
CHICAGO
CS-137 CONC. (PCI/KG)
1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975


CANNED FRUIT
CHICAGO
CS-137 CONC. (PCI/KG)
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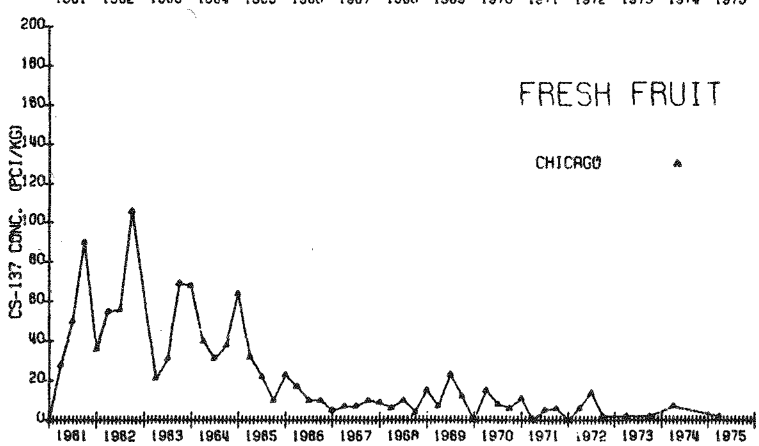
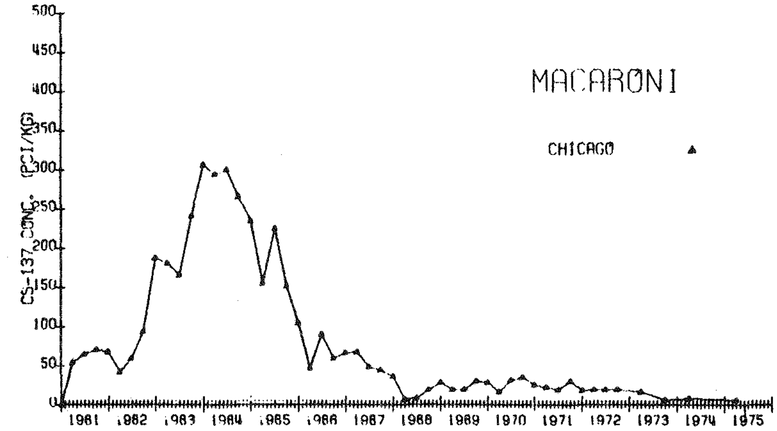

FRESH FRUIT
CHICAGO
CS-137 CONC. (PCI/KG)
1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975


RICE
CHICAGO
CS-137 CONC. (PCI/KG)
1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975


MACARONI
CHICAGO
CS-137 CONC. (PCI/KG)
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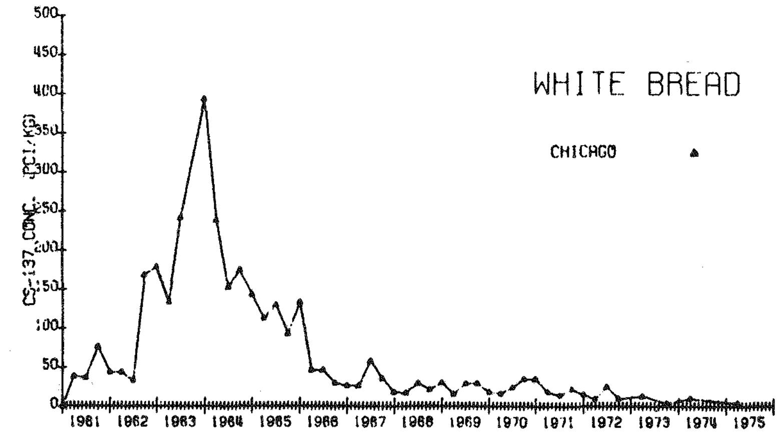
1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975


WHITE BREAD
CHICAGO
CS-137 CONC. (PCI/KG)
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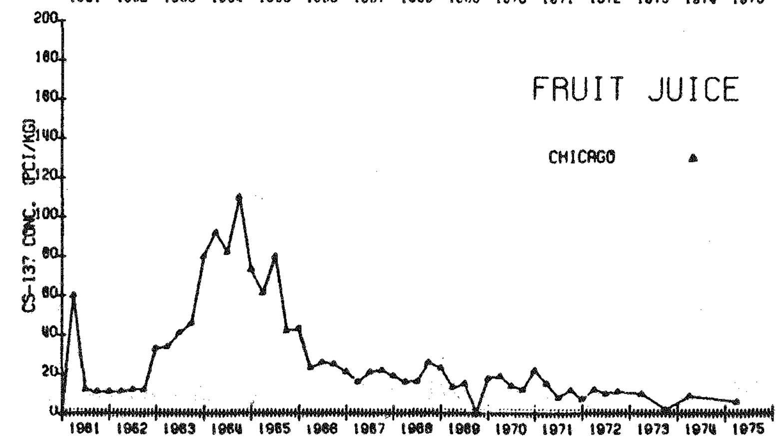
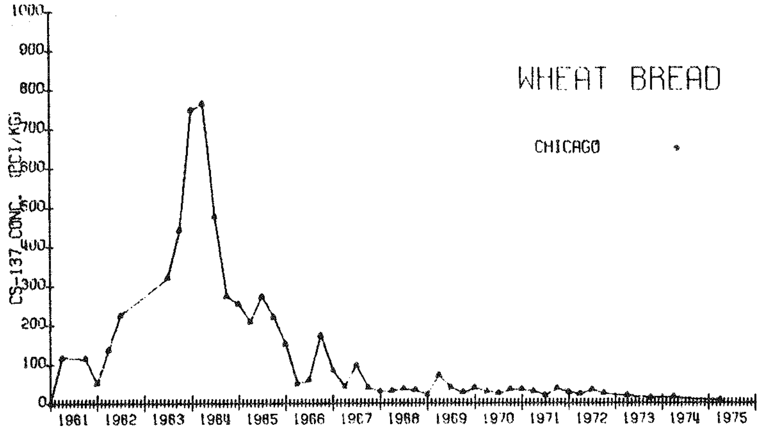
1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975


FRUIT JUICE
CHICAGO
CS-137 CONC. (PCI/KG)
1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975


WHEAT BREAD
CHICAGO
CS-137 CONC. (PCI/KG)
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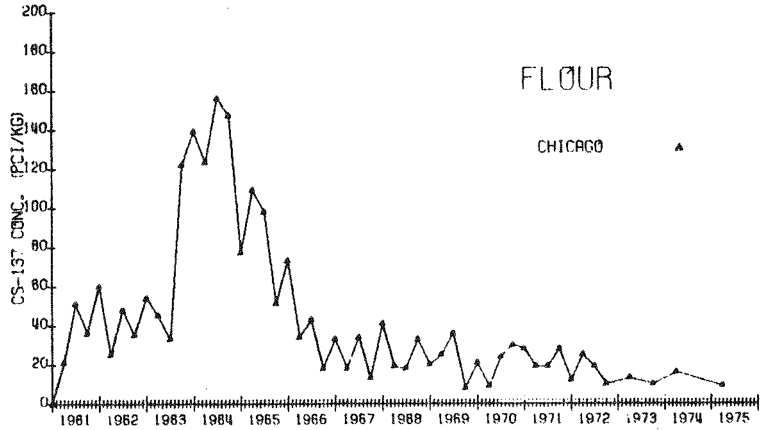
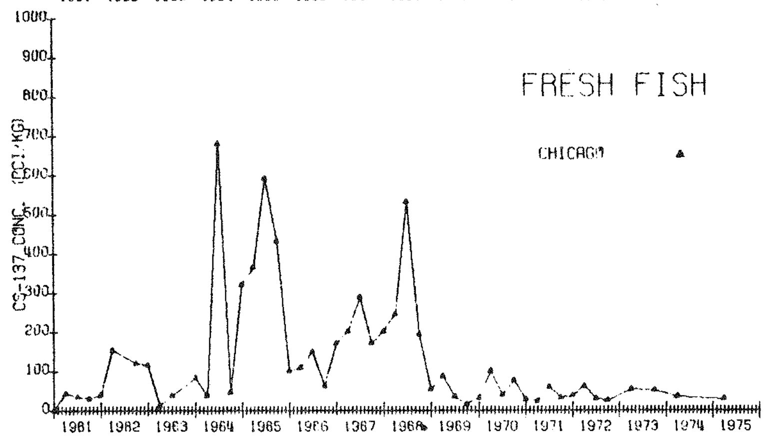

FLOUR
CHICAGO
CS-137 CONC. (PCI/KG)
1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975


FRESH FISH
CHICAGO
CS-137 CONC. (PCI/KG)
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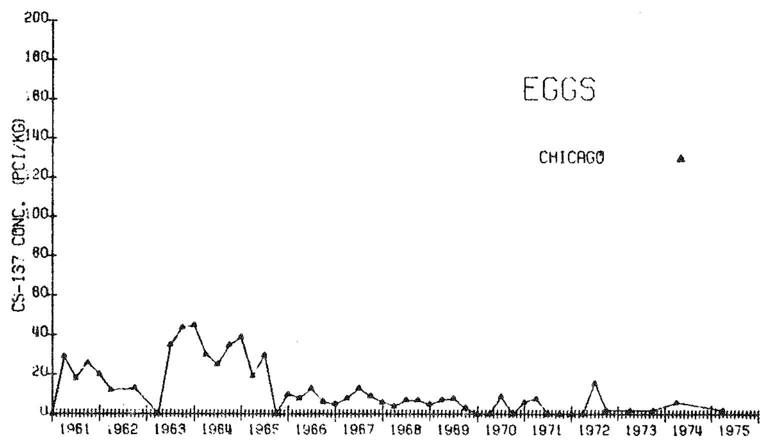
EGGS
CHICAGO
CS-137 CONC. (PCI/KG)
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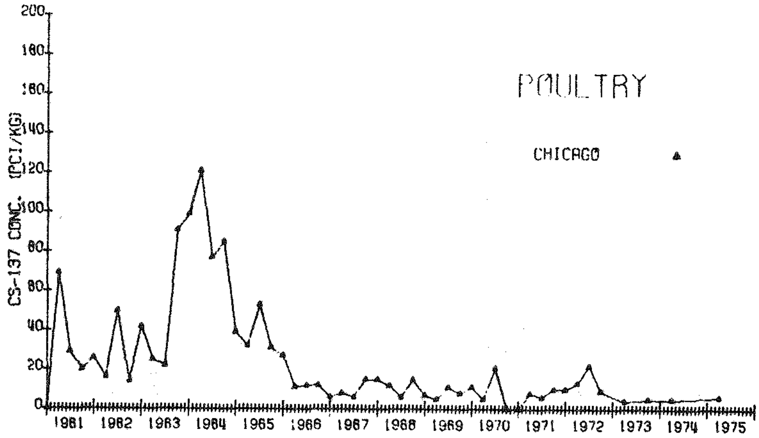
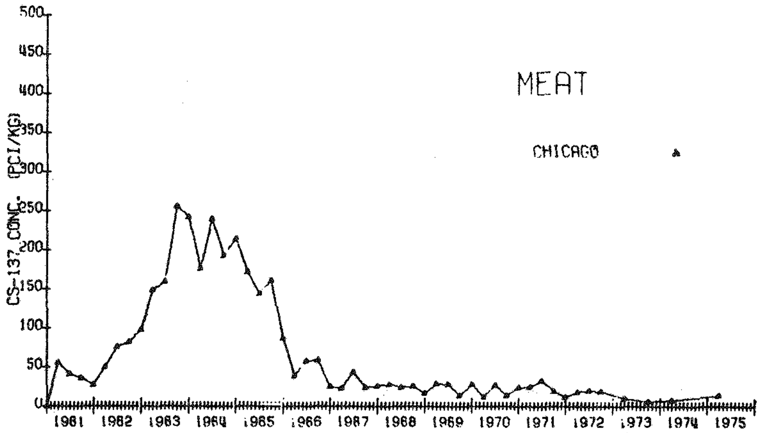
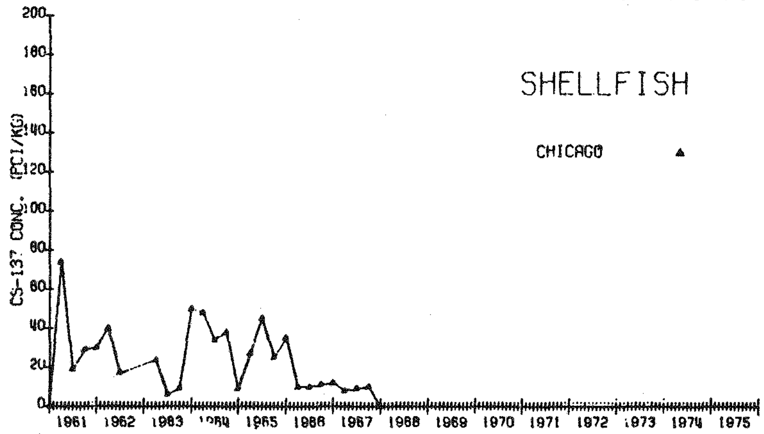
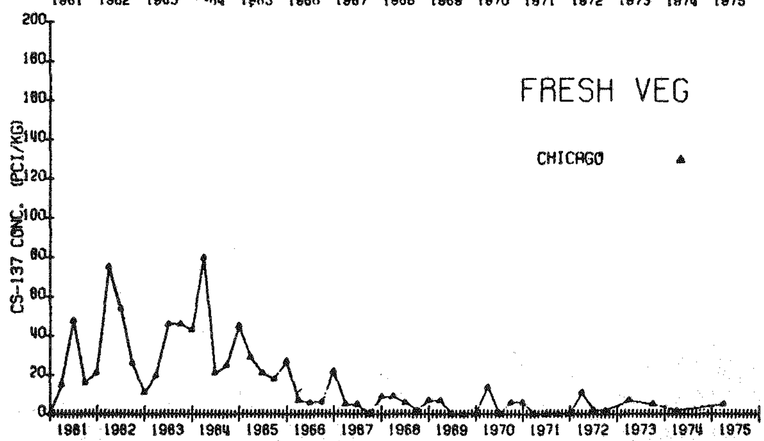

POULTRY
CHICAGO
CS-137 CONC. (PCI/KG)


MEAT
CHICAGO
CS-137 CONC. (PCI/KG)


SHELLFISH
CHICAGO
CS-137 CONC. (PCI/KG)


FRESH VEG
CHICAGO
CS-137 CONC. (PCI/KG)

CHICAGO: CS-137 TOTAL DIET
(PCI/GM K)

YEAR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	YEARLY AVG
1961	--	12.2	13.4	22.4	15.9
1962	13.6	15.0	31.0	24.4	20.9
1963	21.7	30.0	37.7	47.1	34.0
1964	55.1	53.5	45.0	36.2	47.5
1965	41.4	34.2	30.8	24.6	32.8
1966	20.7	10.0	12.1	9.5	13.1
1967	8.6	7.0	11.6	6.6	8.4
1968	8.3	6.4	8.5	9.2	8.0
1969	6.7	6.6	8.0	5.8	6.8
1970	5.6	8.4	5.8	6.5	6.5
1971	7.8	5.9	5.6	5.3	6.1
1972	4.0	4.9	4.8	3.6	4.3
1973	--	3.5	--	2.0	2.8
1974	--	3.5	--	--	3.5
1975	--	2.2	--	4.6	3.4

CHICAGO: CS-137 TOTAL MEAT
(PCI/GM K)

YEAR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	YEARLY AVG
1961	--	19.2	12.5	11.5	14.3
1962	9.5	16.6	20.4	22.8	17.2
1963	27.5	37.7	38.9	67.6	42.7
1964	64.0	48.4	76.2	50.7	59.4
1965	60.2	50.3	51.3	48.5	52.2
1966	23.9	13.2	18.8	16.2	18.2
1967	11.0	10.9	19.0	11.8	13.2
1968	11.3	13.0	19.5	11.3	13.6
1969	5.6	8.8	8.1	4.2	6.7
1970	7.5	5.7	9.2	5.0	6.9
1971	6.5	6.8	8.3	6.0	7.0
1972	4.3	6.4	8.2	5.4	6.0
1973	--	3.5	--	2.9	3.2
1974	--	3.3	--	--	3.3
1975	--	3.8	--	3.2	3.5

CHICAGO: CS-137 TOTAL GRAIN
(PCI/GM K)

YEAR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	YEARLY AVG
1961	--	24.3	33.4	37.5	31.6
1962	33.3	27.1	38.7	67.6	41.5
1963	76.8	74.9	64.1	125.5	85.0
1964	185.1	152.2	121.3	103.2	139.9
1965	90.5	85.5	95.0	64.4	83.5
1966	49.8	24.3	29.6	26.3	33.8
1967	22.2	15.9	33.5	14.9	21.5
1968	18.7	12.8	14.4	19.9	16.3
1969	16.5	15.0	20.9	13.7	16.7
1970	17.4	10.9	19.7	23.0	17.7
1971	22.1	14.9	13.4	18.8	17.4
1972	11.8	14.1	18.4	9.8	13.4
1973	--	9.6	--	6.2	8.0
1974	--	9.6	--	--	9.6
1975	--	5.1	--	6.0	5.6

CHICAGO: CS-137 TOTAL VEG
(PCI/GM K)

YEAR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	YEARLY AVG
1961	--	11.9	4.3	10.8	9.0
1962	6.1	13.3	14.3	8.2	10.5
1963	5.2	5.4	10.0	10.3	7.7
1964	8.9	14.3	4.3	7.5	8.8
1965	5.6	3.0	4.0	3.6	4.0
1966	4.2	0.7	1.1	1.9	2.0
1967	3.9	0.9	2.2	1.4	2.0
1968	3.1	1.1	1.5	2.8	2.1
1969	1.4	1.9	1.3	1.3	1.5
1970	0.9	1.4	0.2	2.7	1.3
1971	1.2	0.3	0.6	0.5	0.6
1972	0.1	1.7	0.6	0.8	0.8
1973	--	1.1	--	1.1	1.1
1974	--	1.9	--	--	1.9
1975	--	1.6	--	1.9	1.7

CHICAGO: CS-137 TOTAL FRUIT
(PCI/GM K)

YEAR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	YEARLY AVG
1961	--	23.0	18.9	34.2	25.3
1962	14.7	20.5	24.6	39.8	24.9
1963	28.9	15.9	17.1	32.2	23.5
1964	36.7	28.2	23.4	28.5	29.2
1965	33.8	20.3	20.2	11.9	21.6
1966	18.3	10.0	7.5	7.8	10.7
1967	5.4	4.8	4.5	5.9	5.1
1968	5.5	2.8	3.9	6.3	4.5
1969	11.2	2.1	8.0	5.9	6.6
1970	3.3	9.0	4.0	3.7	4.9
1971	7.0	1.5	2.6	4.8	3.8
1972	0.7	3.2	5.4	2.2	3.0
1973	--	1.9	--	1.0	1.5
1974	--	3.8	--	--	3.8
1975	--	1.6	--	5.0	3.3

CHICAGO: CS-137 MILK
(PCI/GM K)

YEAR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	YEARLY AVG
1961	--	3.3	15.1	39.4	19.2
1962	24.9	16.4	72.8	36.1	37.5
1963	24.3	61.0	91.8	73.4	62.6
1964	91.2	98.4	60.3	49.8	74.9
1965	60.3	51.2	26.9	21.6	40.0
1966	22.0	12.7	15.7	7.3	14.4
1967	7.2	8.6	12.0	5.3	8.3
1968	8.7	8.1	7.5	12.9	9.2
1969	8.7	9.4	10.6	10.0	9.7
1970	8.0	7.3	16.0	7.3	9.6
1971	12.5	11.3	7.3	6.0	9.3
1972	8.0	6.0	1.3	4.0	4.8
1973	--	5.0	--	1.4	3.3
1974	--	3.3	--	--	3.3
1975	--	3.3	--	8.7	6.1

CHICAGO: CS-137 WHITE BREAD
(PCI/GM K)

YEAR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	YEARLY AVG
1961	--	22.6	21.9	46.1	30.2
1962	25.7	25.7	19.6	101.2	43.0
1963	104.2	107.2	80.0	145.7	109.3
1964	237.1	155.6	92.1	105.0	147.4
1965	107.2	84.6	97.4	69.5	89.7
1966	55.3	27.0	28.8	20.6	35.6
1967	18.5	16.3	39.0	18.5	22.7
1968	12.8	12.1	18.2	17.7	15.1
1969	23.1	8.3	22.4	20.6	17.6
1970	18.0	12.3	21.7	23.1	18.7
1971	24.9	16.2	14.0	15.6	17.9
1972	13.5	8.1	22.6	9.2	13.3
1973	--	10.0	--	4.0	7.5
1974	--	8.3	--	--	8.3
1975	--	3.5	--	4.5	4.0

CHICAGO: CS-137 WHEAT BREAD
(PCI/GM K)

YEAR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	YEARLY AVG
1961	--	31.3	31.0	30.7	31.0
1962	13.7	36.7	60.3	73.0	45.9
1963	73.0	73.0	85.7	118.0	87.4
1964	199.7	204.0	127.3	72.7	150.9
1965	84.7	69.3	91.3	73.3	79.7
1966	31.0	15.3	17.5	51.7	29.2
1967	23.1	12.5	30.8	11.6	19.5
1968	8.9	11.0	10.2	8.7	9.6
1969	6.5	17.8	12.9	10.4	12.3
1970	14.8	11.8	10.6	15.4	13.2
1971	13.3	10.6	7.3	14.0	11.2
1972	11.0	9.0	12.9	9.2	10.4
1973	--	10.0	--	6.4	8.3
1974	--	5.5	--	--	5.5
1975	--	3.6	--	5.5	4.7

CHICAGO: CS-137 FLOUR
(PCI/GM K)

YEAR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	YEARLY AVG
1961	--	19.6	47.7	33.6	33.6
1962	56.1	23.4	44.9	32.7	39.3
1963	50.5	42.1	30.9	114.0	59.4
1964	129.9	115.0	145.8	118.7	127.4
1965	72.0	101.9	92.2	47.7	78.3
1966	59.3	28.1	39.3	14.9	35.6
1967	23.6	16.5	31.1	11.9	21.1
1968	31.5	15.7	14.9	33.0	23.4
1969	18.3	22.9	25.8	8.0	19.5
1970	19.2	9.0	24.0	27.4	20.1
1971	25.6	17.4	17.4	25.6	21.5
1972	11.0	22.9	19.0	11.0	16.1
1973	--	9.3	--	7.7	8.5
1974	--	13.2	--	--	13.2
1975	--	7.1	--	7.7	7.4

CHICAGO: CS-137 MACARONI
(PCI/GM K)

YEAR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	YEARLY AVG
1961	--	26.5	32.0	35.0	31.2
1962	33.5	20.5	29.5	46.5	32.5
1963	93.5	90.0	82.5	120.5	96.7
1964	153.0	147.0	150.0	132.5	145.7
1965	117.0	77.0	112.5	75.5	95.5
1966	52.0	19.7	38.6	25.3	32.0
1967	33.0	28.7	24.0	21.8	28.0
1968	18.0	3.5	3.4	11.4	8.7
1969	12.0	9.5	8.1	15.0	12.0
1970	12.0	8.0	15.5	17.5	13.7
1971	12.5	9.4	9.5	15.0	12.0
1972	9.0	9.5	11.4	9.5	9.3
1973	--	8.0	--	3.6	6.0
1974	--	6.2	--	--	6.2
1975	--	4.0	--	3.3	3.6

CHICAGO: CS-137 RICE
(PCI/GM K)

YEAR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	YEARLY AVG
1961	--	43.2	30.3	34.8	36.0
1962	24.0	13.2	33.6	31.2	25.6
1963	31.2	36.0	36.0	52.8	39.2
1964	67.2	98.4	93.6	115.2	93.6
1965	116.4	34.8	114.0	129.6	98.8
1966	43.5	18.0	18.0	12.0	21.2
1967	26.0	12.0	21.0	--	14.7
1968	--	--	--	--	--
1969	--	--	--	--	--
1970	--	--	--	--	--
1971	--	--	--	--	--
1972	--	--	--	--	--
1973	--	--	--	--	--
1974	--	--	--	--	--
1975	--	--	--	--	--

CHICAGO: CS-137 MEAT
(PCI/GM K)

YEAR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	YEARLY AVG
1961	--	17.9	12.9	11.6	14.2
1962	8.5	15.7	23.9	25.8	18.5
1963	30.8	46.9	50.0	83.7	52.9
1964	76.2	55.4	75.8	60.7	67.0
1965	67.6	54.1	45.3	50.7	54.4
1966	27.1	13.4	18.7	19.1	19.8
1967	8.1	7.0	14.2	8.6	9.4
1968	7.6	8.5	7.8	7.9	7.9
1969	5.2	8.5	8.5	4.5	6.7
1970	8.5	4.0	9.0	4.2	6.4
1971	8.0	7.6	9.2	6.5	7.9
1972	4.0	5.8	7.4	6.3	5.9
1973	--	2.8	--	1.9	2.4
1974	--	2.8	--	--	2.8
1975	--	3.9	--	3.3	3.6

CHICAGO: CS-137 POULTRY
(PCI/GM K)

YEAR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	YEARLY AVG
1961	--	27.3	11.5	7.9	15.6
1962	10.3	6.3	19.8	5.5	10.5
1963	16.6	9.9	8.7	36.0	17.8
1964	39.1	47.8	30.4	33.6	37.8
1965	15.4	12.6	21.0	12.3	15.3
1966	10.7	4.4	6.4	6.0	7.2
1967	3.0	3.7	2.8	6.2	4.0
1968	5.8	4.6	2.5	5.5	4.6
1969	2.8	1.9	5.0	3.2	3.1
1970	4.6	2.3	9.2	TRACE	4.1
1971	TRACE	3.2	2.1	4.0	2.2
1972	3.9	5.1	7.3	2.6	4.7
1973	--	1.3	--	1.6	1.4
1974	--	1.8	--	--	1.8
1975	--	2.1	--	1.6	1.9

CHICAGO: CS-137 EGGS
(PCI/GM K)

YEAR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	YEARLY AVG
1961	--	21.1	13.1	18.9	17.7
1962	14.6	8.7	9.4	9.4	10.6
1963	5.1	TRACE	25.4	32.0	15.6
1964	32.7	21.8	18.2	25.4	24.6
1965	28.4	13.8	21.8	TRACE	16.0
1966	7.3	6.1	9.4	4.0	6.7
1967	3.6	5.8	11.0	5.5	6.4
1968	4.4	2.7	4.7	4.7	4.0
1969	3.3	5.1	5.8	2.3	4.2
1970	TRACE	TRACE	6.6	TRACE	1.6
1971	4.4	6.1	TRACE	TRACE	2.6
1972	TRACE	TRACE	36.6	1.4	4.0
1973	--	1.3	--	1.2	1.2
1974	--	3.8	--	--	3.8
1975	--	1.4	--	1.2	1.3

CHICAGO: CS-137 FRESH FISH
(PCI/GM K)

YEAR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	YEARLY AVG
1961	--	13.3	10.4	9.2	11.0
1962	11.8	45.9	TRACE	35.6	23.3
1963	35.0	34.1	3.8	11.3	21.0
1964	24.6	11.0	201.2	13.3	62.5
1965	95.4	108.2	175.4	128.0	126.7
1966	30.8	29.3	40.0	16.5	29.1
1967	54.7	62.2	92.5	50.7	64.1
1968	57.7	98.4	157.3	57.5	90.2
1969	16.3	26.1	10.8	4.4	14.2
1970	8.5	28.9	14.2	23.7	19.2
1971	8.2	6.9	18.5	10.7	11.1
1972	11.0	19.8	7.4	7.4	11.7
1973	--	16.0	--	14.8	15.4
1974	--	9.0	--	--	9.0
1975	--	7.5	--	6.2	6.9

CHICAGO: CS-137 SHELLFISH
(PCI/GM K)

YEAR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	YEARLY AVG
1961	--	74.0	19.0	29.0	41.0
1962	31.0	40.0	17.0	20.0	27.0
1963	20.0	24.0	6.0	9.0	15.0
1964	50.0	48.0	34.0	38.0	42.0
1965	9.0	27.0	45.0	25.0	26.0
1966	35.0	10.0	10.0	11.0	16.0
1967	12.0	8.0	9.0	10.0	10.0
1968	.--	--	--	--	--
1969	--	--	--	--	--
1970	--	--	--	--	--
1971	--	--	--	--	--
1972	--	--	--	--	--
1973	--	--	--	--	--
1974	--	--	--	--	--
1975	--	--	--	--	--

CHICAGO: CS-137 CANNED VEG
(PCI/GM K)

YEAR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	YEARLY AVG
1961	--	17.5	2.5	5.0	8.3
1962	TRACE	8.3	8.3	30.8	11.9
1963	9.2	10.0	7.5	28.3	13.8
1964	20.8	20.0	19.2	18.3	19.6
1965	11.7	2.5	15.8	TRACE	7.5
1966	9.3	TRACE	5.3	4.0	4.7
1967	TRACE	5.0	2.9	TRACE	1.9
1968	33.3	3.3	TRACE	6.9	4.3
1969	TRACE	6.2	8.9	TRACE	3.0
197C	TRACE	TRACE	TRACE	TRACE	.1
1971	6.7	5.4	TRACE	11.4	5.7
1972	TRACE	TRACE	2.0	1.3	.8
1973	--	1.5	--	1.2	1.4
1974	--	1.5	--	--	1.5
1975	--	1.8	--	4.6	3.2

CHICAGO: CS-137 POTATO
(PCI/GM K)

YEAR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	YEARLY AVG
1961	--	12.4	2.8	8.7	8.0
1962	5.6	9.1	10.0	6.7	7.9
1963	6.7	3.3	10.2	7.0	6.8
1964	3.5	5.4	TRACE	5.9	3.7
1965	TRACE	TRACE	TRACE	2.0	.5
1966	1.6	TRACE	TRACE	1.4	.7
1967	2.6	TRACE	3.0	3.1	2.0
1968	3.7	0.4	1.7	3.8	2.2
1969	1.4	1.5	1.6	2.1	1.6
1970	1.9	TRACE	TRACE	3.3	1.3
1971	TRACE	TRACE	1.3	TRACE	.3
1972	TRACE	1.3	0.5	0.4	.5
1973	--	0.4	--	0.9	.6
1974	--	2.9	--	--	2.9
1975	--	1.4	--	1.5	1.4

CHICAGO: CS-137 DRIED BEANS
(PCI/GM K)

YEAR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	YEARLY AVG
1961	--	3.0	1.8	6.8	3.8
1962	2.1	0.8	5.0	5.0	3.2
1963	1.6	11.3	2.3	2.9	4.6
1964	7.9	24.7	9.9	4.8	11.8
1965	2.1	TRACE	8.3	10.3	5.2
1966	3.6	0.8	1.1	2.4	1.7
1967	0.6	2.0	1.4	1.2	1.3
1968	1.3	0.2	TRACE	0.4	0.5
1969	TRACE	TRACE	1.3	0.2	0.3
1970	0.7	0.4	1.8	1.3	1.0
1971	2.0	--	TRACE	1.7	1.2
1972	0.8	0.6	0.4	1.4	.8
1973	--	0.5	--	0.3	.4
1974	--	0.4	--	--	.4
1975	--	0.6	--	0.2	.4

CHICAGO: CS-137 ROOT VEG
(PCI/GM K)

YEAR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	YEARLY AVG
1961	--	14.7	6.9	10.5	10.7
1962	10.2	10.8	29.1	2.9	13.2
1963	3.3	3.3	1.6	6.5	3.7
1964	11.1	5.6	2.6	7.8	6.8
1965	3.3	TRACE	2.6	TRACE	1.5
1966	TRACE	TRACE	TRACE	1.9	.5
1967	2.2	TRACE	TRACE	TRACE	.6
1968	2.1	TRACE	TRACE	2.4	1.1
1969	TRACE	1.6	TRACE	2.0	0.9
1970	TRACE	TRACE	TRACE	2.4	.7
1971	TRACE	TRACE	TRACE	TRACE	TRACE
1972	TRACE	1.5	0.8	1.2	.9
1973	--	0.7	--	0.6	.6
1974	--	3.0	--	--	3.0
1975	--	3.0	--	0.7	1.8

CHICAGO: CS-137 FRESH VEG
(PCI/GM K)

YEAR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	YEARLY AVG
1961	--	11.8	6.8	17.2	11.9
1962	7.5	26.9	19.7	9.7	16.0
1963	3.9	7.2	16.5	16.5	11.0
1964	15.4	28.7	7.5	9.0	15.1
1965	16.1	10.4	7.5	6.4	10.1
1966	9.0	2.6	2.9	2.2	4.3
1967	9.6	1.7	1.8	TRACE	2.9
1968	2.6	2.4	2.9	0.9	2.3
1969	2.8	2.9	TRACE	TRACE	1.4
1970	TRACE	3.9	TRACE	2.6	1.7
1971	2.5	TRACE	TRACE	TRACE	.5
1972	TRACE	2.8	0.7	0.8	1.3
1973	--	2.8	--	2.0	2.4
1974	--	0.6	--	--	.6
1975	--	1.7	--	3.1	2.4

CHICAGO: CS-137 FRESH FRUIT
(PCI/GM K)

YEAR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	YEARLY AVG
1961	--	13.9	23.9	43.1	27.0
1962	17.2	26.3	31.6	50.8	31.5
1963	32.1	12.9	14.8	33.0	23.2
1964	32.6	19.2	14.8	18.2	21.2
1965	30.6	15.3	10.5	4.8	15.3
1966	11.5	9.0	4.2	5.0	7.2
1967	2.8	3.0	2.9	4.4	3.3
1968	3.9	2.0	3.6	2.1	2.9
1969	11.6	TRACE	7.4	8.6	6.2
1970	TRACE	7.5	3.8	3.2	3.5
1971	6.9	TRACE	2.5	3.2	2.9
1972	TRACE	2.2	5.4	1.1	2.4
1973	--	1.0	--	0.3	.7
1974	--	3.3	--	--	3.3
1975	--	1.0	--	5.2	3.0

CHICAGO: CS-137 CANNED FRUIT
(PCI/GM K)

YEAR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	YEARLY AVG
1961	--	58.2	5.2	18.7	27.4
1962	10.4	5.2	6.2	19.8	10.4
1963	22.9	27.0	20.8	33.3	26.0
1964	45.8	45.8	38.5	40.6	42.6
1965	39.5	28.1	40.6	35.4	35.9
1966	48.6	10.2	20.0	15.8	23.3
1967	10.2	11.3	5.6	8.0	8.7
1968	9.0	1.0	TRACE	15.1	6.5
1969	6.0	7.3	10.9	2.3	7.1
1970	14.0	11.9	TRACE	TRACE	6.8
1971	TRACE	TRACE	TRACE	10.2	2.3
1972	TRACE	5.0	4.8	2.0	2.9
1973	--	2.0	--	4.5	3.2
1974	--	6.2	--	--	6.2
1975	--	2.5	--	2.3	2.4

CHICAGO: CS-137 FRUIT JUICE
(PCI/GM K)

YEAR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	YEARLY AVG
1961	--	35.6	7.1	6.5	16.4
1962	6.5	6.5	7.7	7.1	7.0
1963	19.6	20.2	24.3	27.9	23.0
1964	48.1	54.6	49.3	64.7	54.2
1965	43.3	36.2	47.5	24.9	38.0
1966	25.5	14.6	13.7	13.2	16.4
1967	11.1	8.0	11.1	10.4	10.0
1968	9.5	10.1	8.9	13.7	10.8
1969	14.6	8.5	9.5	TRACE	8.1
1970	10.7	14.4	8.3	9.1	10.7
1971	14.4	9.5	5.2	7.6	9.0
1972	4.2	7.9	5.9	5.8	5.9
1973	--	5.3	--	1.3	3.4
1974	--	4.8	--	--	4.8
1975	--	3.5	--	6.5	5.0