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CONTROLLED ENVIRONMENTAL RADIOIODINE TESTS AT THE NATIONAL REACTOR TESTING STATION 1965 PROGRESS REPORT

RELEASED FOR ANNOUNCEMENT
IN NUCLEAR SCIENCE ABSTRACTS

C. A. Hawley, Jr.
Editor
HEALTH AND SAFETY DIVISION
IDAHO OPERATIONS OFFICE
U. S. ATOMIC ENERGY COMMISSION

NATIONAL REACTOR TESTING STATION

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C. A. Hawley, Jr.
EDITOR

AUTHORS

D. R. Adams
D. F. Bunch
W. P. Gammill
C. A. Hawley, Jr.
E. H. Markee
M. W. Tiernan

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U. S. ATOMIC ENERGY COMMISSION

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	Division	Branch
G. J. Ball	Health & Safety Division	Health Physics Branch
J. Echo		
J. Detmer		
J. R. Horan		Director
L. Howard		Analytical Chemistry Branch
Dr. N. F. Islitzer	U. S. Weather Bureau	Meteorologist in Charge
J. Keller	Farm Manager	
R. McBride	Health & Safety Division	Health Physics Branch
B. Mortensen		
D. Newcomb		
L. J. O'Neill		
Conrad Willis		Analytical Chemistry Branch

SUMMARY

The CERT project consists of a series of planned releases of radioiodine over different vegetation and during various meteorological conditions, with the prime objective being to measure the relationships involved in the passage of radioiodine through the air-vegetation-cow-milk-human chain. This report deals with the results of the first five tests in the series, which started in the spring of 1963 and is continuing.

Each test was conducted under measured meteorological conditions and over prepared sampling and grazing courses. Two tests were made over open-range type vegetation, two over irrigated pastures, and one over snow-covered ground. Two tests were conducted under lapse conditions, two under inversion conditions, and one under neutral conditions. In each case, known quantities of elemental $^{131}I_2$ were released. Relationships determined include: (a) air-grass ratios (deposition velocities) which ranged from 0.1 to 1.0 cm/sec; (b) effective half-life of ^{131}I on grass of 3.5 days and 5.5 days; (c) the time of peak activity in milk is at two days following a release; (d) milk-grass ratio (Ci/l:Ci/g) is 130; (e) total ^{131}I secreted in milk by cows to that ingested by cows is about 9.5 percent; (f) adult human thyroid uptake fraction (ingestion) was 0.19; (g) adult human thyroid uptake fraction (inhalation) was 0.30; and (h) based on a breathing rate of 20 m^3/24 hours, the ratio between infinity mills ingestion dose and infinity inhalation dose for a single release was calculated to be an average of about 130.

Data, descriptions of methods, and calculations are reported. Discussions of resuspension factors and particle sizes and behavior are also included.

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1. CONTROLLED ENVIRONMENTAL RADIOIODINE TESTS AT THE NATIONAL REACTOR TESTING STATION

I. INTRODUCTION

The Controlled Environmental Radioiodine Tests (CERT) which are being conducted at the National Reactor Testing Station (NRTS) in Idaho consist of a series of planned atmospheric releases of radioiodine under varying conditions of meteorology, vegetation type, chemical form, and distance. The project began in the spring of 1963, when a preliminary experiment was conducted to ascertain if the general experimental design was adequate. A major test in the series was conducted in September of 1964, and a minor one in December of 1964. Two tests under inversion conditions were accomplished; a preliminary in May of 1965, and a follow-up test in June of 1965.

The primary objective of the project is to determine the quantitative behavior of radioiodine as it passes through the air-vegetation-cow-milk-human chain. To this end, measurements have included deposition velocities (air-ground ratios), milk-to-grass-activity ratios, half-times of radioiodine in milk and on grass, portable instrument readings relative to contamination levels, and human thyroid uptake fractions. The passage of radioiodine through a segment of the biosphere will be influenced by many factors. The CERT project is intended to define these factors as they apply to the NRTS and its environs, and to reveal which of these factors is the most significant. The resulting data can be of operational use at the NRTS in the development and review of reactor siting criteria, safety analysis report preparation, and in emergency planning and response. Since much of the investigation is of a rather basic nature, the USAEC's Division of Biology and Medicine has contributed support funds to the project.

The purpose of this report is to acquaint the reader with the development of the project, the data obtained thus far, a description of the experimental methods used, a comparison of the data with published information, and a discussion and interpretation of results. Since many readers will not be interested in experimental details or technical discussions, a summary of progress has been included in this report as Section II.

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II. SUMMARY OF PROGRESS TO DATE

As was stated in the introductory paragraph, five tests have been accomplished. Each of the five is discussed below. The first, or preliminary, experiment is designated as CERT I; the second, a major release over irrigated pasture, is designated as CERT II; and the third, a minor test over snow-covered ground, is designated as CERT III. The two inversion tests are identified as CERT IV and CERT V.

1. CERT 1

1.1 General Information

The preliminary experiment was conducted during May and June of 1963. The area chosen for this experiment was near the southern boundary of the NRTS in an area which had been planted to Crested Wheatgrass for the purpose of noxious weed control. Two pasture areas were established in this area, one for control purposes and one to be contaminated. No irrigation of the pastures was employed. Five iodine generators were oriented along a 150-meter line to simulate a short line source and assure lateral distribution of the radioiodine. The source line was 50 meters upwind from the "hot" pasture. A sampling grid based on pretest meteorological studies extended 300 meters downwind, with one additional arc at about 1000 meters. The release of approximately one curie of iodine-131 was accomplished on May 27, 1963. Six cows were procured through arrangement with Montana State College, Bozeman, Montana, and were acclimated for two weeks prior to placing them on the contaminated pasture May 28, 1963. Seven human volunteers consumed 500-ml portions of the resulting contaminated milk over an 18-day period. Human thyroid activities were measured periodically over a 39-day period. Full details of the experiment have been published in IDO-12035 [1].

1.2 Data Summary

About one curie of iodine-131 was released in the form of molecular, elemental I_2 gas under moderately unstable conditions and a wind speed of about 7 meters/sec.

Deposition velocities averaged 0.6 cm/sec.

Effective half-life on grass was 3.5 days.

Ratio of milk (pCi/l) to grass (pCi/g) was 240 [a].

Peak activity occurred in milk after 2 days.

Effective half-life in milk (after removal from the hot pasture) was 1 day.

Human thyroid uptake factor averaged 0.19.

2. CERT II

2.1 General Information

During the summer of 1963, construction began on the Experimental Dairy Farm which is located about seven miles northeast of the Chemical Processing Plant. The area was chosen because of the availability of the land, the existence of an adequate well, safety considerations, and relative accessibility. Twenty-seven acres of land were leveled, diked, and fenced. A dairy barn, pumphouse, sprinkler system, and corral were constructed. Construction problems resulted in the pasture grass being seeded too late for adequate fall growth; hence, the area was replanted in the spring of 1964. Growth of the grass was deemed to be adequate for test purposes in September of 1964, when CERT II was conducted. The experimental design was almost identical with that used during CERT I.

2.2 Meteorological Conditions

Approximately the same quantity of the same chemical form of iodine-131 was released under generally the same meteorological conditions which existed during the CERT I release. The wind speed was somewhat greater, being about 9 meters/sec. The deposition velocities (V_g) on various media for both tests are summarized in Table I.

The deposition velocities are generally higher for CERT II except on soil. It is interesting to note that if the

TABLE I

SUMMARY OF DEPOSITION DATA

Deposition Medium	V_g or Deposition Velocity (cm/sec)	
	Test I	Test II
Grass	0.61	0.98
Soil	0.84	0.38
Carbon	0.57	0.73
Sticky Paper	0.14	0.41

[a] The method used to calculate milk-to-grass ratios was changed after CERT II. The new method is explained in Section 2.2.

grass V_g's are divided by their particular average grass densities, 153 and 246 g/m^2 in CERT I and II, respectively, the deposition is practically the same during both tests. This shows the strong influence of grass density on the calculation of deposition velocities. The soil contamination indicates the same influence which manifests itself in an inverse relationship with grass density. The deposition velocities on carbon plates and sticky paper which were used as standard deposition media were significantly higher for CERT II. This suggests that the meteorological factors were different enough between the two tests to influence deposition rates. However, at present, no definite relationships to the friction velocity and the mean wind speed have been found.

2.21 Grass Half-Life. In the first test no specific area was used to measure the half-life on the grass. The daily samples which were taken to measure activity consumed by the cows were used to develop a half-life figure. This turned out to be 3 to 4 days whereas in the second case a plot was established which showed the half-life to be between 5 and 6 days. The latter value agrees well with the literature. The method used during CERT I was used as a check during CERT II. With this system, the half-life number came out to be 4 to 5 days. The reasons for these disagreements have not been determined and are discussed in Section III.

2.22 Milk Activities. In both tests the cows reached peak milk activity in about 2 days. During CERT I, activity levels in the milk produced by the high and the low cow were within a factor of two. In CERT II, the difference in activity levels between the high and the low cow was consistently about a factor of five. Possible reasons for this are discussed in Section III.

During CERT II, all six cows were placed under controlled grazing on the hot pasture for two weeks. Following this period, three cows were removed to the corrals and fed stored feed. The other three were allowed to graze the entire pasture without control. After five more days, all cows were placed on cold pasture. As can be seen in Section III of this report, milk activity decreased with a half-life of about 1 day for the first few days. The decay scheme then became a good deal more complex and varied widely between individual cows.

2.23 Milk-to-Grass Ratio. One of the objectives of the CERT project is to determine the relationship between the iodine concentration on the grass and in the milk. The most reasonable way to define this is by using the ratio of peak activity in the milk (pCi/l) to activity on the grass (pCi/g) at the time grazing was started. On CERT I, the average initial activity was 788 ± 153 pCi/g on the back

section of the pasture. There was a one-day delay before the cows were allowed to graze on the hot pasture. At this time, based on the observed 3-1/2 day effective half-life, the average activity would have been about 663 ± 232 pCi/g. The mean peak activity in the milk, which was observed two days later, was 89,000 ± 19,000 pCi/l. The resulting ratio of milk-to-grass activity is 130 ± 40. During CERT II, mean activity on the grass at the time grazing commenced was 532 ± 146 pCi/g. The mean peak activity in the milk was 71,000 ± 33,000 pCi/l, which again was observed two days later. The resulting ratio was 130 ± 70. In view of the uncertainty involved, it is fortuitous that the ratios compare so closely. Nevertheless, it would seem that a reasonably accurate prediction of mean peak activity for a small dairy herd could be obtained by use of a ratio of 130.

2.24 Human Thyroid Uptake Data. In the first test, one cow was selected to furnish milk for human volunteer consumption. The data from the counting of the human thyroids after ingesting the milk showed the uptake fraction to be 0.19 ± 0.04. In the second test, inhalation thyroid dose measurements were made on three people who were on the test grid during the time of cloud passage. The infinity thyroid dose measurements were 15, 7.7, and 6.1 mrad, and yielded inhalation uptake fractions of 0.46, 0.24, and 0.19. Based upon the ingestion-thyroid uptake factor of 0.19 observed during CERT I, a breathing rate of 10 m^3/8 hours, and upon the ICRP recommended value of 0.23 for the inhalation uptake fraction, the dose expected from ingestion of one liter of milk per day from the second test is roughly a factor of 75 greater than the inhalation dose. To obtain this ratio, it was necessary to correct for the nonuniformity of the pasture contamination and to assume that the test continued for several weeks. A similar treatment of CERT I data yielded an ingestion-to-inhalation-dose ratio of 120. A detailed description of these analyses is presented in Section II-1 of this report.

3. CERT III

The third release, a scaled-down version of the first two, was executed over the snow-covered pasture in December of 1964. The meteorological conditions were much more stable due to low cloudiness and the snow cover. The primary purpose of this test was to determine, through the use of various collection media (carbon plates, sand plates, sticky paper), the influence of the

more stable conditions on deposition and dispersion rates. Deposition velocity on the snow was found to be about 0.2 cm/sec, which is in fair agreement with other investigations [2]. However, the collection media showed an increase in deposition velocity, rather than the expected decrease, which indicated that the collection media themselves may be affected by temperature and humidity conditions.

4. CERT IV AND V

CERT IV involved the release in June of 1965 of 10 mCi of radioiodine through a CCl_4 extraction and subsequent evaporation. During the test, unstable wind conditions and uncertainties about the form of released iodine made some results undependable so only selected results are reported. A subsequent release (CERT V) of 100 mCi of element I-131 was made under early morning inversion conditions over open-range grass. No cows were employed during this test. The average deposition velocity on grass out to 1000 meters from the single ground-level release point was 0.1 cm/sec, or about 15 and 10 percent of those measured during CERT I and CERT II, respectively.

5. DATA SUMMARY

The following tabulation summarizes data accumulated to date:

Type of Data	CERT I	CERT II	CERT III[a]	CERT IV[a]	CERT V[a]
Time of Year	Late May	September	December	June	June
Temperature (°C)	22.3	16.8	-1.9	-1.8	9.9
Relative Humidity (%)	21.0	32.0	71.0	99.0	74.0
Wind Speed At 4m (m/s)	7.1	9.3	6.0	3.1	3.7
Stability Parameter (R_i)	-0.13	-0.10	-0.04	+0.54	+0.10
General Meteorological Condition	Lapse	Lapse	Neutral	Stable-Inversion	Stable-Inversion
Pasture Type	Open-Range	Irrigated	Snow-Cover	Open-Range	Open-Range
Average Grass Density Fresh (g/m^2)	153.0	246.0	--	--	127.0
Grass Condition	Green-Growing	Green-Growing	No Grass-Snow Cover	Green-Damp	Green-Damp
Deposition Velocity $\left(\frac{Ci/m^2}{Ci\text{-}sec/m^3}\right)$	0.58 (grass)	0.98 (grass)	0.22 (snow)	--	0.11 (grass)
Eff $T_{\frac{1}{2}}$ On Grass (Days)	3.5	5.5	--	--	--
Time Till Peak Activity In Milk (Days)	2.0	2.0	--	--	--
Eff $T_{\frac{1}{2}}$ In Milk (Days)	1 (until 5 days)	Changing See Page 20	--	--	--
Milk-Grass Ratio (pCi/l/pCi/g)	130.0	130.0	--	--	--
Percent Of Total Ingested By Cows To Total Excreted In Milk	9.3	9.7	--	--	--
Human Thyroid Uptake Fraction (Ingestion)	0.19	--	--	--	--
Human Thyroid Uptake Fraction (Inhalation)	Average	0.30	--	--	--
Calculated Ratio-Ingestion/Inhalation Dose	110.0	150.0 (Based on $20m^3$/24 hrs breathing rate. See page 33)	--	--	--

[a] Cows not involved in these tests.

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III. DESCRIPTION OF EXPERIMENTAL METHODS AND CONDITIONS

1. SAMPLING GRID AND TERRAIN

CERT I was conducted over somewhat rolling open range terrain, as shown in Figure 1, and the CERT II and III tests over flat terrain which included an irrigated field of mixed pasture grasses. CERT IV and CERT V employed the same general terrain and grass cover as CERT I.

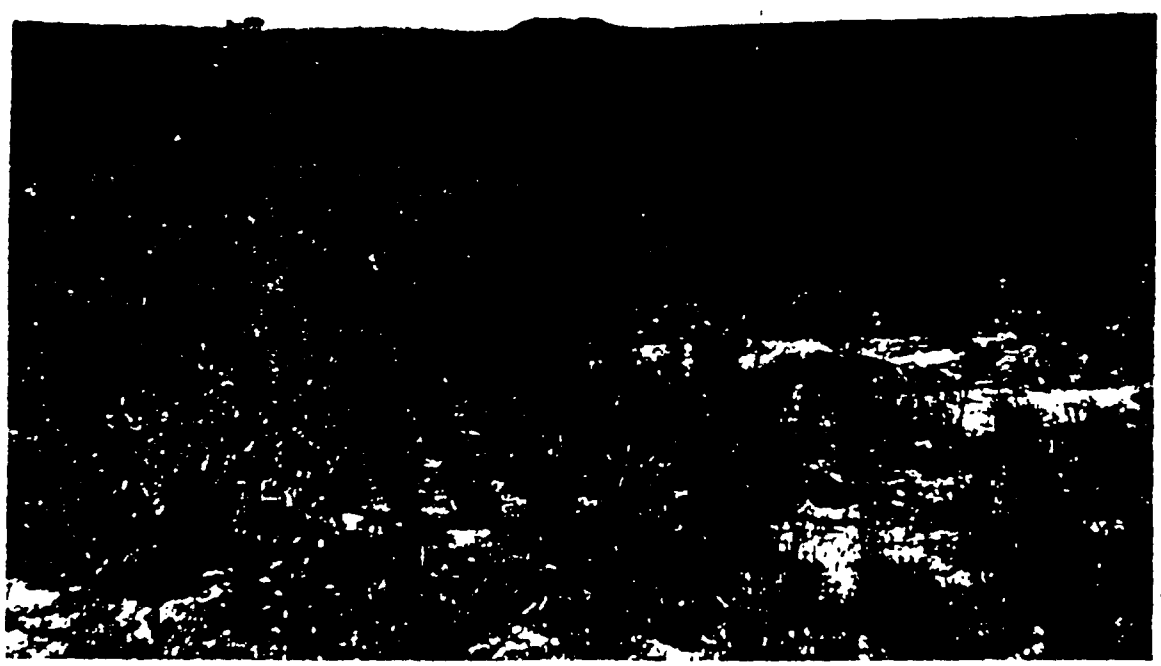

Fig. 1 View of pasture area used during CERT I.

As shown in Figures 2 and 3, the same general grid design was used for the CERT II as was used for CERT I, the major difference being that the iodine generators were placed an additional 50 meters upwind to avoid heavy concentrations of radioiodine on the upwind edge of the pasture. The CERT IV and V grid design is shown in Figure 4.

Air sampling instruments used were Staplex High Volume air samplers equipped with MSA 2133 paper prefilters and a 5-cm-thick activated charcoal filter. Deposition collection media used were 25 x 25 cm plots of sticky paper, sticky paper covered with sand, and sticky paper covered with activated charcoal.

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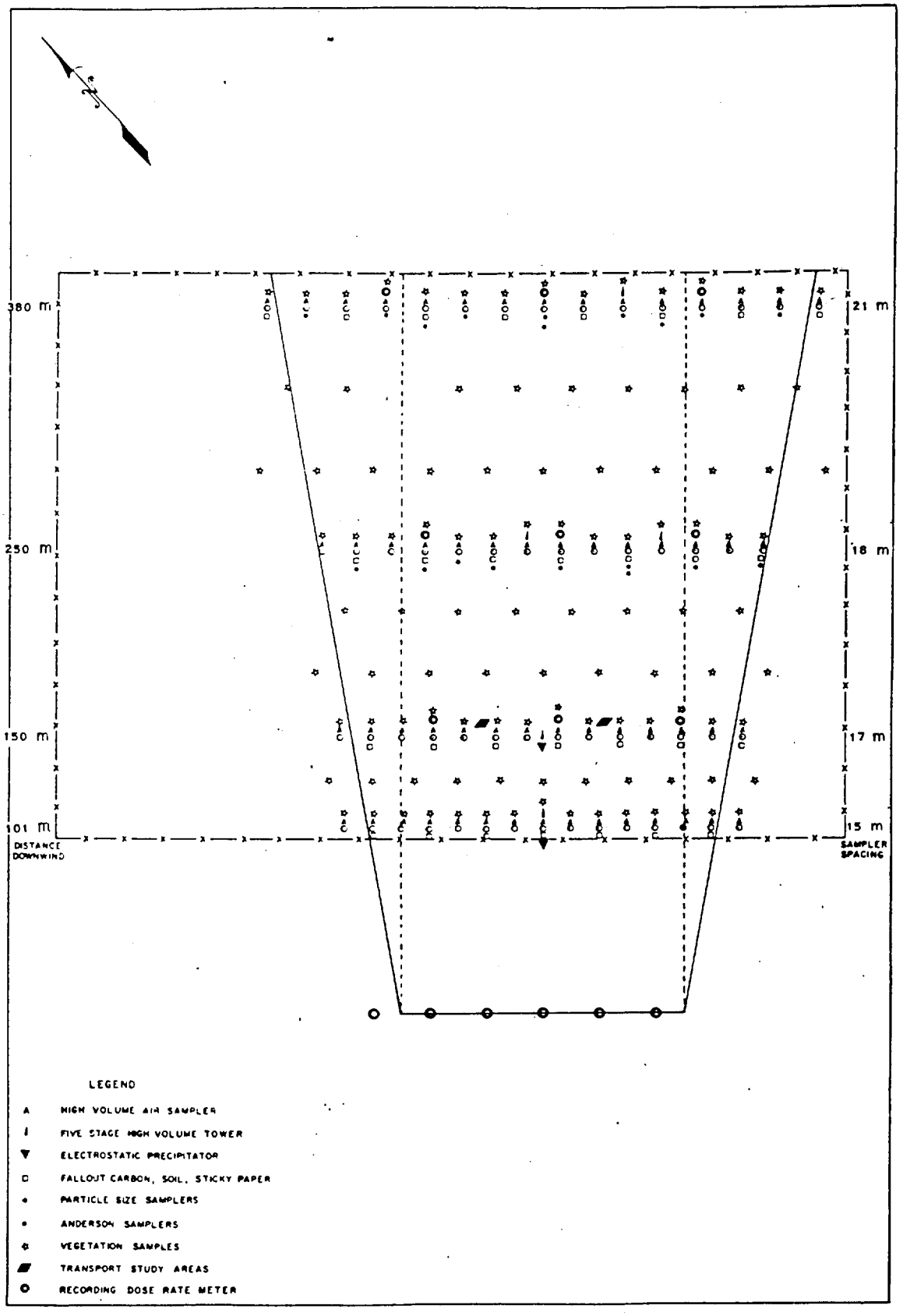

Fig. 2 Sampling grid -- pasture.

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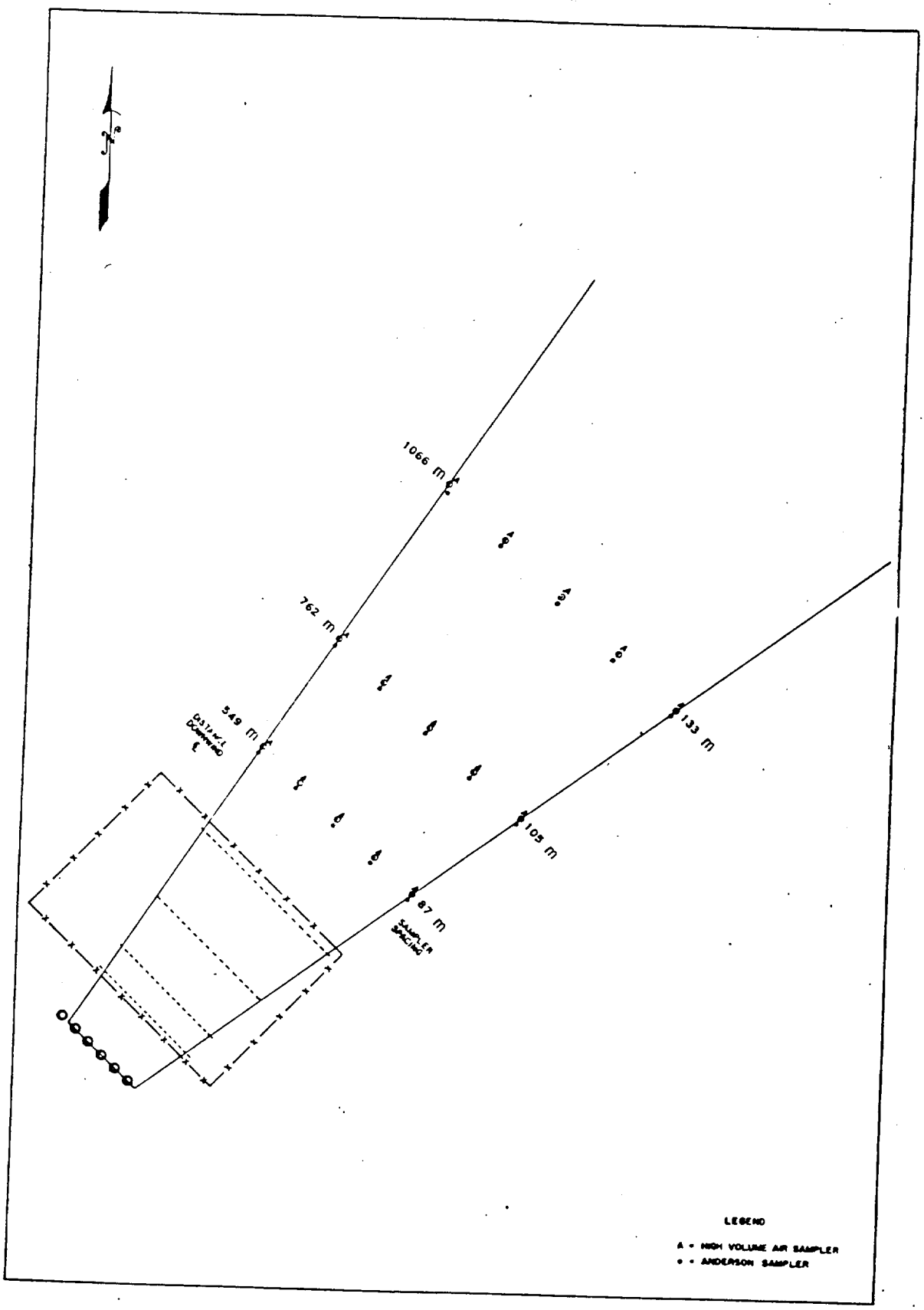

Fig. 3 Sampling grid -- long distance.

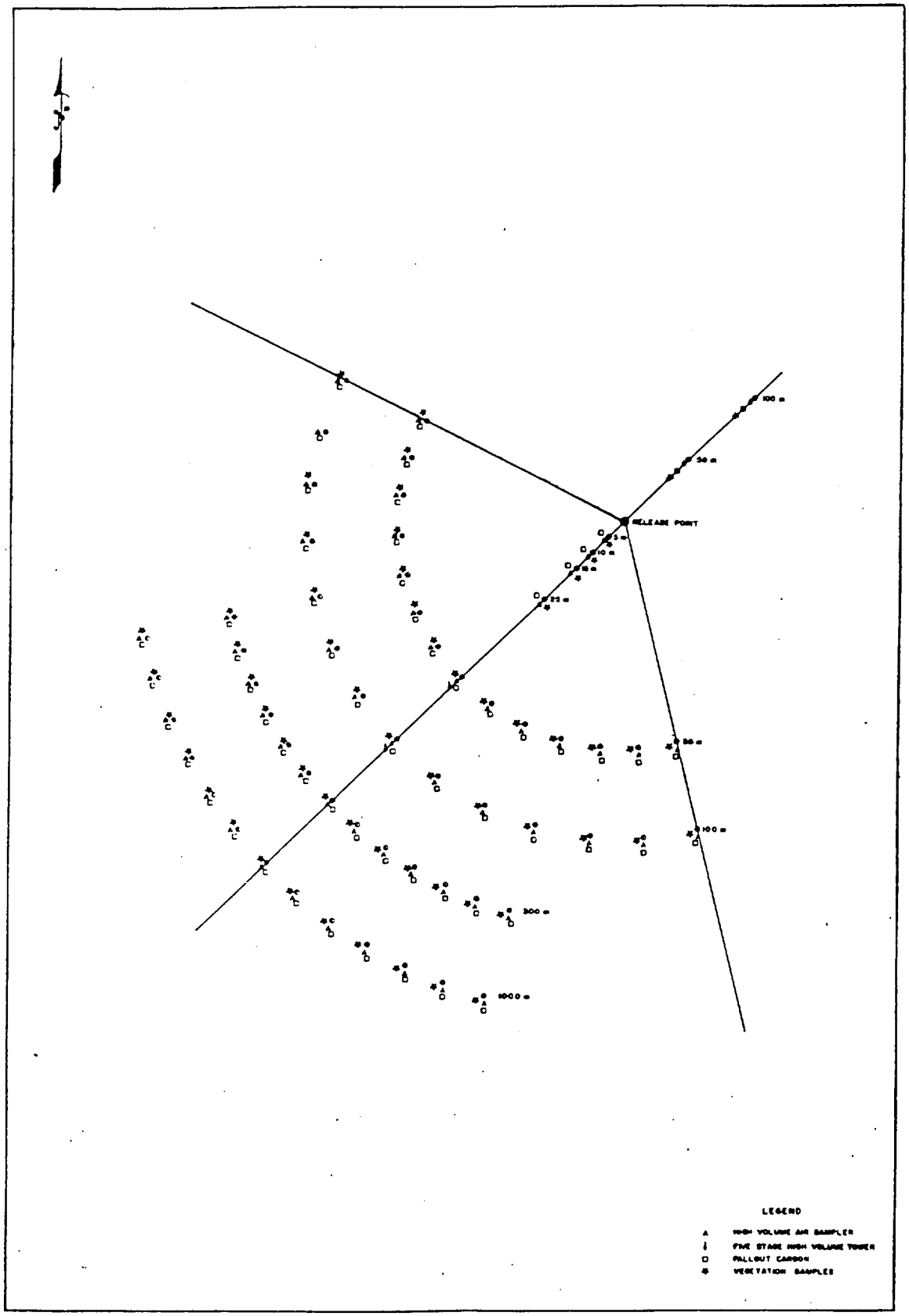

Fig. 4 Inversion test grid.

The sand was deleted during CERT II. Anderson particle size samplers were used at selected locations. A typical sampling station (excluding the Anderson sampler) is shown in Figure 5.

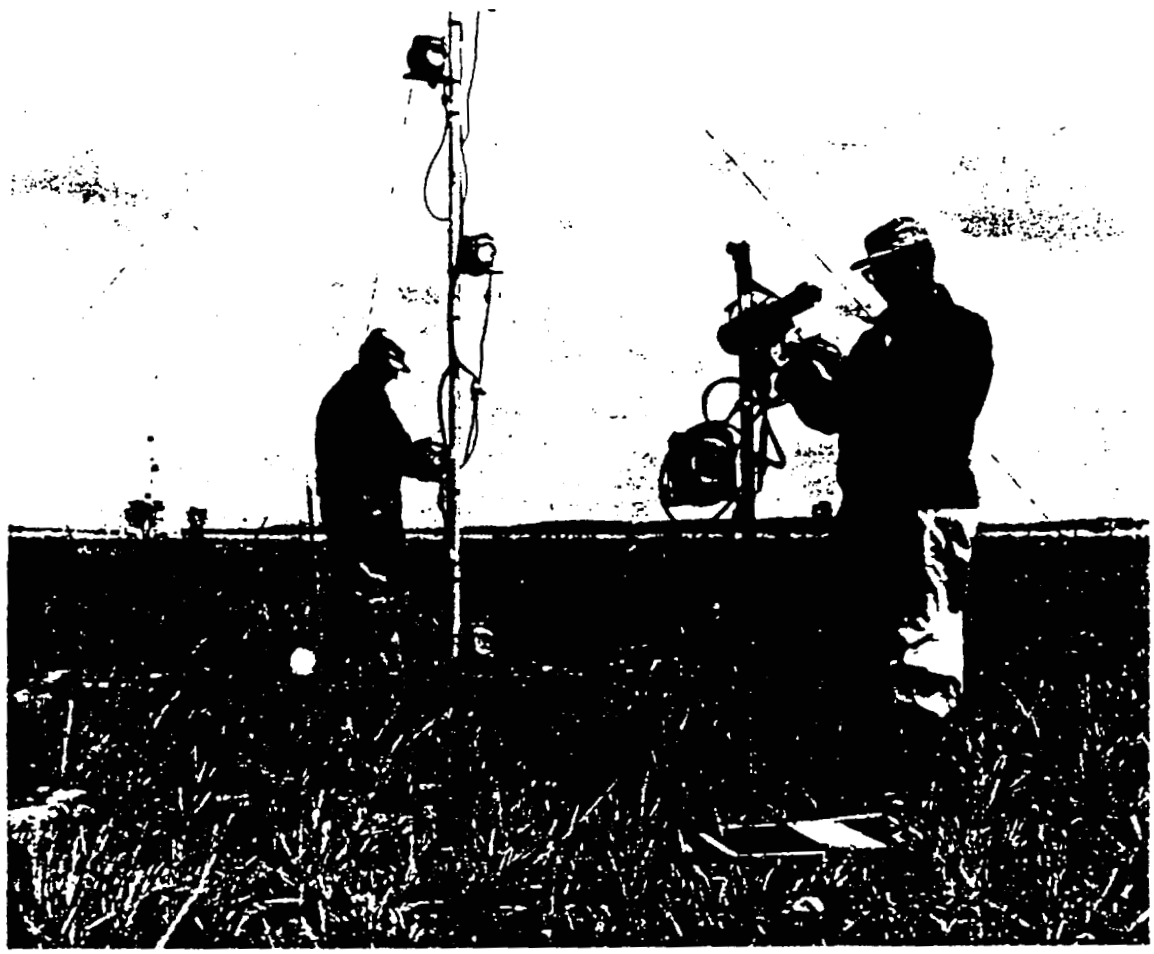

Fig. 5 Sampling equipment -- CERT II.

2. IODINE RELEASE MECHANISM

The same method of releasing the radioiodine was employed in four of the five tests reported herein. A detailed description of the method can be found in IDO-12035.

During CERT I, General Electric personnel from Hanford utilized the iodine release to check some experimental samplers. After returning to Hanford, they independently checked the release system employed and reported that "The generation technique was tested in the laboratory and found to produce elemental iodine gas which was not collected by membrane filters....." [3].

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3. METEOROLOGICAL ASPECTS

Measurements of wind speed and temperature profiles and vertical and horizontal turbulence statistics were made during each release from 1 to at least 16 meters above the surface. A summary of the temperature, wind, and stability for each release is given in Table II. The Richardson number, Ri, shows the wide variation of atmospheric stability encompassed by the releases.

TABLE II

METEOROLOGICAL CONDITIONS DURING CERT RELEASES

Meteorological Parameter	CERT I	CERT II	CERT III	CERT IV	CERT V
Temperature at 1m (°C)	22.3	16.8	-1.9	-1.8	9.9
Relative Humidity (percent)	21.0	32.0	71.0	99.0	74.0
Wind Speed at 4m(m/s)	7.1	9.3	6.0	3.1	3.7
R_i(4-16m) (Stability Parameter)	-0.13	-0.10	-0.04	+0.54	+0.10

The relative crosswind integrated concentrations, shown in Figure 6, also indicate the stability of the atmosphere. The crosswind integrated concentration at a given distance downwind is inversely related to stability. The first two releases were conducted during unstable conditions in the afternoon. CERT III was conducted in near neutral conditions with low cloudiness and snow cover. The last two CERT's were conducted during stable conditions at sunrise.

Table III summarizes the median deposition velocities on the various media for all of the releases. The deposition velocities were calculated by dividing the total activity deposited on the medium per unit area by the total integrated concentrations from the high volume air samplers at the 1-meter level. Median values were used to minimize the effect of skewed distributions. The grass deposition velocity during CERT IV was omitted because background problems existed. The deposition on grass was also calculated on a mass basis to minimize the effects of grass density changes on the deposition per unit area. An empirical study of the relationship between grass density and deposition velocity using data

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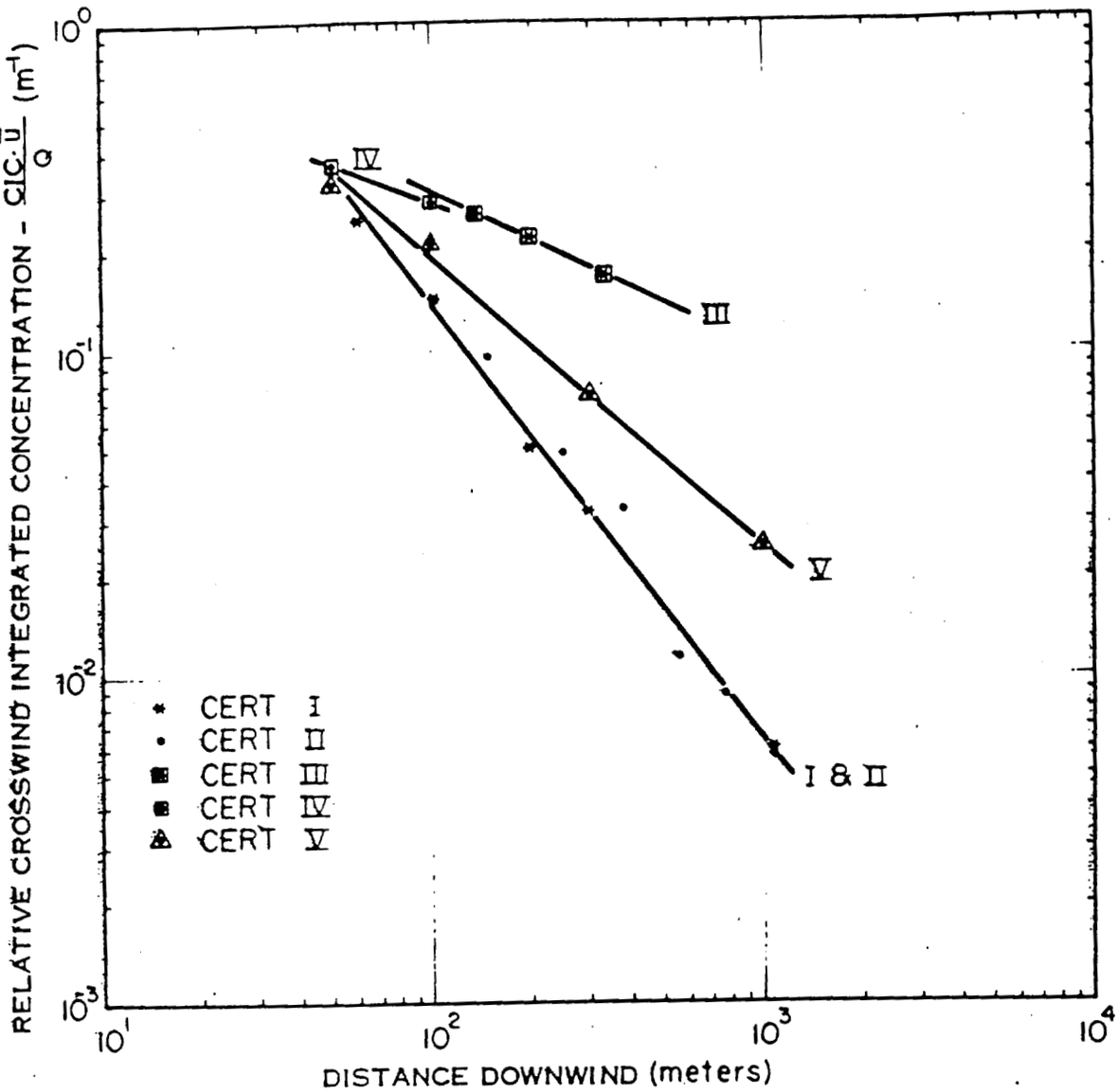

Fig. 6 Relative crosswind integrated concentration.

from the CERT II release, in which the grass density varied widely, showed that about half of the variability in deposition velocity on grass could be explained by density variations.

Figure 7 shows the variation of deposition velocities on carbon plates with distance downwind. From this figure there seem to be no systematic variations with distance. However, plots of grass deposition (pCi/g), which were measured at nine distances downwind in the first two tests, indicate a systematic departure from a power law relationship for CERT I and II. This implies a systematic change of deposition velocity with distance because the integrated concentrations seem to obey a power law relationship.

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TABLE III

MEDIAN DEPOSITION VELOCITIES (RATIOS)

Deposition Medium	CERT I	CERT II	CERT III	CERT IV	CERT V
Grass (cm/sec)	0.58	0.98	-	-	0.11
Grass + Soil (cm/sec)	1.38	1.33	-	-	-
Grass-mass Basis ($cm^3/g/sec$)	38.0	44.0	-	-	10.0
Snow (cm/sec)	-	-	0.22	-	-
Carbon Plates (cm/sec)	0.56	0.73	(0.83)	0.10	0.37
Sticky Paper (cm/sec)	0.14	0.41	0.50	-	-
Sand (cm/sec)	0.19	-	-	-	-

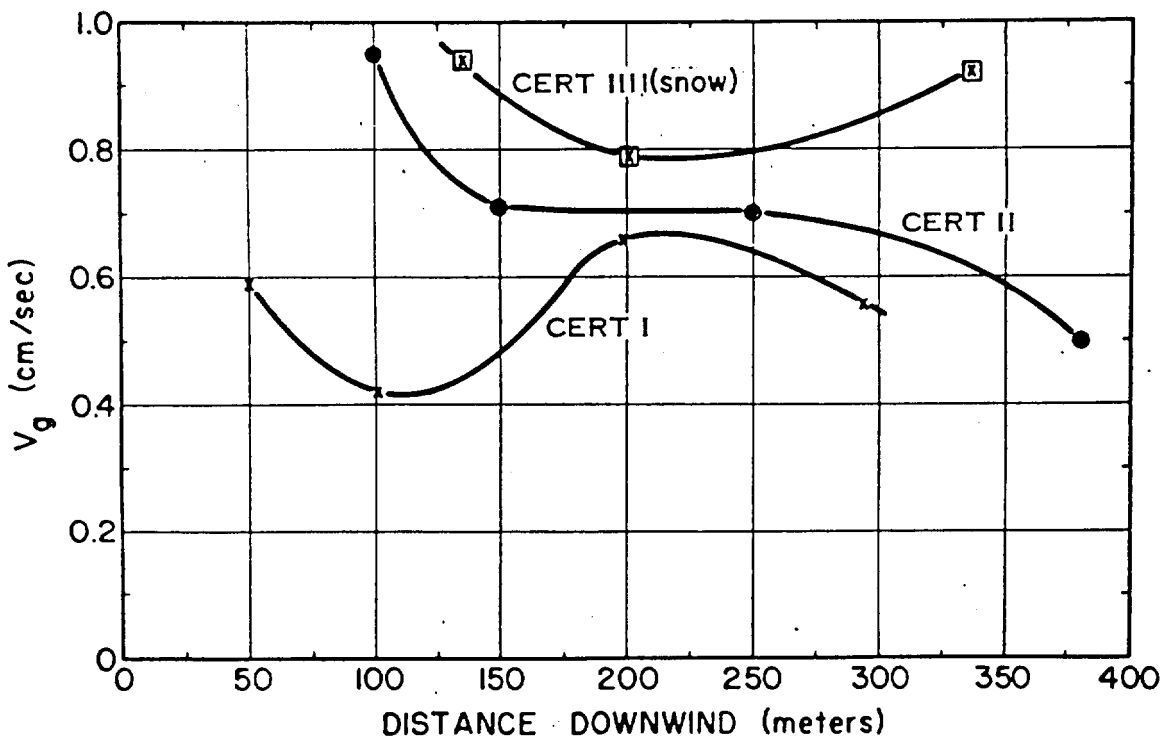

Fig. 7 Variation of carbon plate V_g with distance.

The median deposition velocities are proportional to the wind speed and are, therefore, in general accordance with theory. The only exceptions are the carbon and sticky paper deposition velocities for CERT III. During this test, some snow had been deposited on the plates and therefore the data are not considered to be reliable. The deposition velocity of 0.22 cm/sec on snow seems to be in agreement with the findings of other investigators.

4. MILK STUDIES

The general methods of collection, handling, and counting milk samples have not changed appreciably from those reported in IDO-12035. Table IV shows the average daily milk production and Table V shows the average daily iodine-131 concentration in milk for CERT II. All iodine-131 values are corrected for decay to time of milking. The cows were placed on the contaminated pasture at 1100 hrs on September 3, 1964.

Figure 8 illustrates several important points. It shows (a) the immediate rise in the iodine-131 content in the milk the day the cows went on contaminated pasture; (b) that the peak activity was reached on September 5 (on second full day of grazing); and (c) a decline of iodine-131 activity in milk for a period of 12 days, which was probably due to ever-decreasing ingested activity. The rise in iodine activity in milk on September 14 is a result of the cows accidentally leaving the controlled pasture and grazing for a time on more highly contaminated pasture. The graph also demonstrates the I-131 concentrations in milk after removal of cows from contaminated pasture. The three observations made on the effective half-life of I-131 in milk after the cows were removed from the contaminated pasture are in good agreement with values reported in IDO-12035 and with findings of Kahn [4] and Lengemann [5]. During the first two or three days, the observed half-life of iodine in milk was approximately one day with the half-life increasing to as much as three days on the fifth day (Figure 9).

A comparison of total ingested activity with the total activity accumulated in the milk (Table VI, Figure 10) shows that about 10 percent of the ingested iodine is recovered in the milk of the dairy cow (9.3 percent recovery during

TABLE IV

MILK PRODUCTION PER DAY, IN LITERS -- CERT II

	9/3/64	9/4/64	9/5/64	9/6/64	9/7/64	9/8/64	9/9/64	9/10/64
High	12.8	16.6	14.8	15.6	14.6	15.1	15.5	15.6
Average	11.6	13.4	12.9	13.2	12.9	12.8	12.9	13.2
Low	10.6	10.7	11.8	11.1	11.6	10.6	11.5	11.1

	9/11/64	9/12/64	9/13/64	9/14/64	9/15/64	9/16/64	9/17/64	9/18/64
High	14.0	14.6	15.6	14.4	15.4	14.0	14.2	13.5
Average	12.4	12.7	12.0	12.4	12.1	12.0	11.5	11.2
Low	9.9	9.8	8.4	8.5	8.5	8.8	7.5	8.9

	9/19/64	9/20/64	9/21/64	9/22/64	9/23/64	9/24/64	9/25/64	9/26/64
High	13.0	12.1	12.5	13.5	12.5	12.5	13.5	13.2
Average	10.9	10.7	11.2	10.9	10.7	10.6	10.8	11.0
Low	8.1	8.0	9.2	8.7	8.4	7.8	8.0	8.0

	9/27/64	9/28/64
High	13.6	12.2
Average	11.1	10.0
Low	8.1	7.2

TABLE V

μCi/l OF I-131 ACTIVITY IN MILK -- CERT II

	9/3/64 (p.m.)	9/4/64 (a.m.)	9/4/64 (p.m.)	9/5/64 (a.m.)	9/5/64 (p.m.)	9/6/64 (a.m.)	9/6/64 (p.m.)
High	0.068	0.104	0.130	0.138	0.131	0.104	0.146
Average	0.043	0.054	0.066	0.071	0.066	0.057	0.068
Low	0.021	0.021	0.034	0.024	0.024	0.022	0.023

Daily Average

	9/4/64	9/5/64	9/6/64
High	0.117	0.134	0.125
Average	0.060	0.068	0.063
Low	0.027	0.024	0.022

	9/7/64 (a.m.)	9/7/64 (p.m.)	9/8/64 (a.m.)	9/8/64 (p.m.)	9/9/64 (a.m.)	9/9/64 (p.m.)	9/10/64 (a.m.)	9/10/64 (p.m.)
High	0.117	0.125	0.107	0.114	0.083	0.091	0.091	0.094
Average	0.057	0.060	0.052	0.055	0.044	0.045	0.042	0.042
Low	0.015	0.019	0.018	0.019	0.014	0.014	0.013	0.013

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TABLE V (Cont.)

μCi/l OF I-131 ACTIVITY IN MILK -- CERT II

Daily Average

	9/7/64	9/8/64	9/9/64	9/10/64
High	0.121	0.110	0.087	0.092
Average	0.058	0.053	0.044	0.042
Low	0.017	0.018	0.014	0.013

	9/11/64 (a.m.)	9/11/64 (p.m.)	9/12/64 (a.m.)	9/12/64 (p.m.)	9/13/64 (a.m.)	9/13/64 (p.m.)	9/14/64 (a.m.)	9/14/64 (p.m.)
High	0.078	0.086	0.069	0.072	0.066	0.070	0.081	0.084
Average	0.035	0.037	0.033	0.034	0.031	0.032	0.039	0.037
Low	0.009	0.010	0.009	0.011	0.010	0.011	0.013	0.014

Daily Average

	9/11/64	9/12/64	9/13/64	9/14/64
High	0.082	0.070	0.068	0.082
Average	0.037	0.033	0.031	0.038
Low	0.011	0.010	0.010	0.013

	9/15/64 (a.m.)	9/15/64 (p.m.)	9/16/64 (a.m.)	9/16/64 (p.m.)	9/17/64 (a.m.)	9/17/64 (p.m.)	9/18/64 (a.m.)	9/18/64 (p.m.)
High	0.066	0.067	0.056	0.054	0.049	0.043	0.028	0.021
Average	0.031	0.034	0.028	0.027	0.028	0.026	0.015	0.011
Low	0.012	0.011	0.009	0.010	0.008	0.007	0.005	0.004

Daily Average

	9/15/64	9/16/64	9/17/64	9/18/64
High	0.066	0.055	0.046	0.024
Average	0.032	0.027	0.025	0.012
Low	0.011	0.009	0.007	0.004

	9/19/64 (a.m.)	9/19/64 (p.m.)	9/20/64 (a.m.)	9/20/64 (p.m.)	9/21/64 (a.m.)	9/21/64 (p.m.)
High	0.012	0.009	0.006	0.005	0.003	0.003
Average	0.006	0.005	0.003	0.003	0.002	0.002
Low	0.002	0.002	0.001	0.001	0.001	0.001

Daily Average

	9/19/64	9/20/64	9/21/64
High	0.010	0.005	0.003
Average	0.005	0.003	0.002
Low	0.002	0.001	0.001

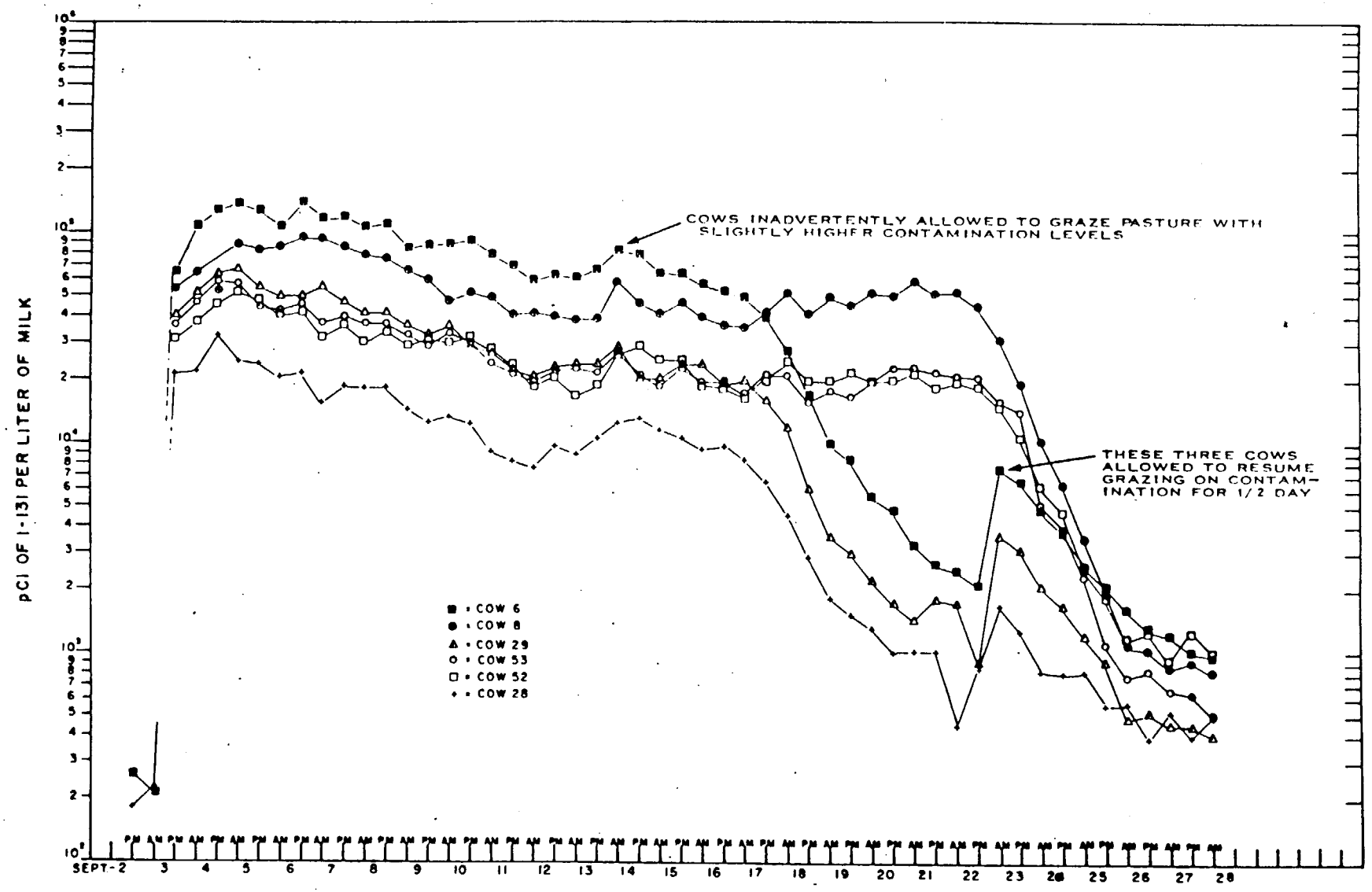

Fig. 8 Iodine-131 activity in cows' milk -- CERT II.

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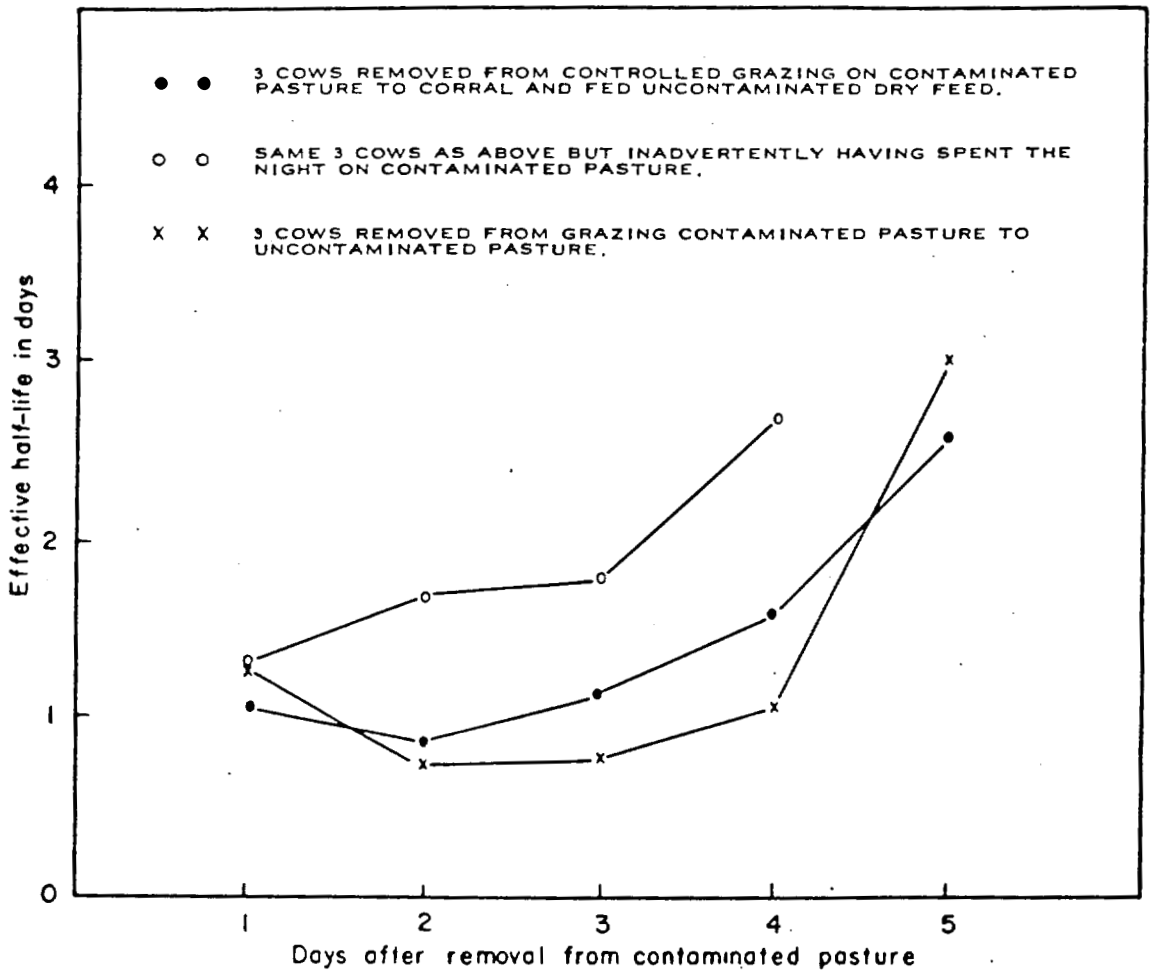

Fig. 9 Effective half-life in milk -- CERT II.

CERT I and 9.7 percent recovery during CERT II). This is a particularly interesting close comparison since it has been postulated by Lengemann et al [5] and Glascock [6] that iodine recovery in the milk may vary with stage of lactation, time of year, and level of milk production. In this instance, all three of these factors were quite different during CERT I and CERT II, and yet the results from these two tests were quite close. This was probably due to a "balancing out" of the involved factors.

The CERT II data, with respect to clean-out time of the milk, milk-grass ratios, and percent recovery of ingested activity, are in very good agreement with those found during CERT I.

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TABLE VI

TOTAL CONSUMPTION BY COWS

Wet Weight Basis -- CERT I

Date	pCi of I-131/g of Vegetation	kg of Vegetation Consumed/Cow/Day	pCi($x10^6$) of I-131 Consumed/Cow/Day	Total pCi($x10^6$) Consumed by All Cows
5/28/64	770	36	27.7	166.2
5/29/64	416	36	14.9	89.4
5/30/64	237 (est)	36	8.5	51.0
5/31/64	145	36	5.2	31.2
6/1/64	180	36	6.4	38.4
6/2/64	124	36	4.4	26.4
6/3/64	81	36	2.9	17.4
6/4/64	63	36	2.2	13.2
6/5/64	78	36	2.8	16.8
6/6/64	112	36	4.0	24.0
6/7/64	93	36	3.3	19.8
6/8/64	86	36	3.9	18.0
6/9/64	38	36	1.3	7.8
6/10/64	54	36	1.9	11.4
6/11/64	24	36	0.8	5.1

Dry Weight Basis -- CERT II

Date	pCi($x10^5$) kg of Vegetation	kg of Vegetation Consumed/Cow/Day	pCi($x10^6$) of I-131 Consumed/Cow/Day	Total pCi($x10^6$) Consumed by All Cows
9/3/64	14.5	7.4	10.73	64.38
9/4/64	16.8	6.8	11.42	68.52
9/5/64	11.6	8.3	9.62	57.72
9/6/64	9.0	9.2	8.2	49.20
9/7/64	6.6	8.5	5.61	33.66
9/8/64	4.7	9.9	4.65	27.90
9/10/64	4.8	9.5	4.56	27.36
9/11/64	4.5	9.0	4.05	24.30
9/12/64	3.5	9.2	3.42	20.52
9/13/64	3.9	8.7	3.39	20.34
9/14/64	3.7	8.6	3.18	19.08
9/15/64	3.5	8.5	2.97	17.82
9/16/64	3.1	8.5	2.63	15.78