SWRHL-42r

^{131}I DAIRY COW STUDIES USING A DRY AEROSOL (PROJECT ALFALFA)

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Bioenvironmental Research
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Department of Health, Education, and Welfare
Public Health Service
Bureau of Radiological Health
Consumer Protection and Environmental Health Service

August, 1969

This study performed under a Memorandum of
Understanding (No. SF 54 373)
for the
U. S. ATOMIC ENERGY COMMISSION

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CONSUMER PROTECTION AND ENVIRONMENTAL HEALTH SERVICE

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The following corrections should be made in SWRHL-42r, "^{131}I Dairy Cow Studies Using a Dry Aerosol (Project Alfalfa)."

Page 30, Figure 8. The symbols □ and Δ are reversed in the legend for the figure.

Δ should represent Group I (Air Uptake)

□ should represent Group IV (Fresh Green Chop)

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ABSTRACT

This report covers the second controlled release conducted by the Bioenvironmental Research Program to define the mechanisms associated with the transfer of radioiodine from the environment to cow's milk.

Growing alfalfa-oats, hay, and spread green chop were contaminated with a diatomaceous earth aerosol labelled with ^{131}I. Three groups of dairy cows were fed the three types of contaminated forage. One other group of dairy cows was exposed directly to the aerosol for an air uptake study.

The smaller particle size of the aerosol used in this study (2 μm) resulted in higher milk-to-forage ratios than were observed in the first study where the particle size was 23 μm. These ratios of peak average milk to peak average forage activities were 0.061 for the hay, 0.036 for the green chop, and 0.032 for the growing alfalfa-oats.

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I. INTRODUCTION

This report covers the second controlled release conducted by the Bioenvironmental Research Program (BER) in a continuing program to define the mechanisms associated with the transfer of radioiodine from the environment to cow's milk.

This experiment, code named Alfalfa, was conducted on June 21, 1966, at the U. S. Public Health Service's Experimental Dairy Farm, Area 15, Nevada Test Site (NTS). The three primary objectives for this study were:

1. To interrelate the amounts of ^{131}I deposited per kilogram upon spread alfalfa hay, spread alfalfa-oats green chop, and a growing mixed forage crop of alfalfa and oats as a result of the dissemination of ^{131}I in the form of a dry aerosol.
2. To determine the levels of ^{131}I in the milk of groups of dairy cows fed the three different types of contaminated forage.
3. To determine the air uptake of ^{131}I in the milk of dairy cows exposed during aerosol cloud passage but not allowed to ingest contaminated food or water.

Essentially, this experiment was a repeat, with certain modifications, of the first controlled release, Project Hayseed.(1) Hayseed was conducted on October 4, 1965, at the same farm at Nevada Test Site and also employed a dry aerosol of ^{131}I labelled diatomaceous earth particles as the contaminant. However, since certain aspects of the Hayseed study introduced questionable variables, it was decided to repeat the experiment making the following changes:

1. Substitute alfalfa-oats forage, a more commonly employed dairy forage in Southern Nevada and Southern Utah, the area of our primary interest, for the Sudan grass used in Hayseed.

2. Endeavor to obtain a more homogeneous distribution of the deposited radioactivity and also to decrease the particle size of the contaminant from 23μm to 2.5μm count median diameter (CMD).
3. Eliminate green chop from the diet of the cows being fed contaminated hay to more closely simulate a realistic situation.

The results from our past studies, those conducted in conjunction with the nuclear testing activities at Nevada Test Site and our one controlled release, indicate not only a direct relationship between peak activity measured in the milk and the peak activity in the forage,

$$\frac{\text{pCi/liter of milk}}{\text{pCi/kg of forage}}$$

but also suggests a possible inverse relationship between the CMD of the contaminant aerosol and this observed milk-to-forage ratio. If the data from future experiments confirm this relationship over a range of particle sizes, it becomes a relatively simple mathematical calculation, after determining the particle size and measuring the peak forage concentration, to predict the levels that will probably occur in the milk.

This relationship, if real, would permit advising appropriate authorities of the possible need to institute countermeasures at an early time to reduce levels of ^{131}I in fresh milk following contamination of feed by fresh fission products. Analysis of data collected after an inadvertent release of radioactivity from the Pin Stripe event[2] in April, 1966, indicates that a change to uncontaminated feed during the first three days following contamination is a highly effective countermeasure.

II. PROCEDURE

A. EXPERIMENTAL DESIGN

Eighteen lactating Holstein cows were divided into five groups. In addition to the control group consisting of two cows and designated as Group V in this experiment, there were four experimental groups of four cows each. Group I cows were exposed directly to the aerosol for air uptake measurements. This group was maintained on uncontaminated hay and uncontaminated fresh green chop following exposure. The remaining three experimental groups and the control group were not exposed to the aerosol during its passage.

Group II cows were fed only contaminated hay following the release. The contents of 15 bales of hay were separated and stacked as loose hay on a plastic sheet. The stack or pile of hay was 8 meters long, 6 meters wide, and 24 centimeters deep. Following the passage of the aerosol over the area, the spread hay was collected by placing 7.5 kg amounts in individual plastic bags. This amount is sufficient to feed one cow for one feeding. The bags were sealed and stored for use as needed during the remainder of the study.

Group III cows were maintained on contaminated spread green chop supplemented with uncontaminated hay. The spread green chop was contaminated in a manner similar to that previously described for the hay. However, the stack dimensions were different, being only 5 meters by 5 meters by 24 centimeters. Following the release, the first feeding of contaminated spread green chop for each of the four cows allotted to this group was collected in individual feeding containers and fed. The remainder was taken into the barn and stored for feeding later as needed. The spread green chop could not be prepackaged as was the hay, since the subsequent heating produced by the compaction could adversely affect the palatability.

Group IV cows were given contaminated fresh green chop supplemented with uncontaminated hay. Following the release, the growing mixed forage of alfalfa-oats contaminated by the aerosol was cut daily and taken directly to the four cows in this group for consumption.

Group V animals received uncontaminated hay and uncontaminated fresh green chop. The diet of all animals in the five groups was supplemented with uncontaminated grain given at the time of milking.

Table 1 summarizes the experimental grouping, the source of contamination, and amount of forage fed.

B. ANIMAL HUSBANDRY

Assignment of the cows to the various experimental groups was based on milk-production and stage of lactation. Individual records and group averages are shown in Tables A-1 and A-2 of the Appendix.

All cows consuming contaminated feed (Groups II, III, and IV), and the cows exposed directly to the aerosol (Group I), were maintained in individual pens, measuring 9 feet by 9 feet by 5 feet, separated to the extent that no physical contact between cows was possible. Group V cows were separated from the other groups and maintained in the corral.

Details of animal care, feeding and milking procedures, and sample collections have been published in a previous report.[1]

C. RELEASE MECHANICS

1. Study Area

The study area for this controlled release was located at the Public Health Service Experimental Farm, Area 15, NTS. A schematic of the farm showing the location of the study area is shown in Figure 1. A detailed diagram of the study area showing the location of all the associated physical equipment, various forage types, the four cows for air uptake, and the area occupied by ancillary studies (the results of which will be reported elsewhere) is presented in Figure 2.

TABLE 1. EXPERIMENTAL DESIGN.

Group	Number of Animals	Animal Identification	Source of ^{131}I	Type Feed Amount Fed Each Animal	Daily	Remarks
I	4	21,28, 43,45	Air uptake only	Hay Fresh Green Chop	7.5 kg 15.0 kg	Air Uptake group placed in position 0330,removed 0530 Jun 21
II	4	5, 26, 29,47	Contaminated Hay	Hay*	15.0 kg	Fed contaminated for 8 days.
III	4	2, 16, 44, 13	Contaminated Spread Green Chop	Green Chop* Hay	15.0 kg 7.5 kg	Fed contaminated green chop for 3 days (spread)
IV	4	12, 15 17,18	Contaminated Fresh Green Chop	Fresh Green Chop* Hay	15.0 kg 7.5 kg	Fed contaminated green chop for 9 days (fresh).
V	2	19, 24	None	Hay Fresh Green Chop	7.5 kg 15.0 kg	

*Denotes contaminated feed.

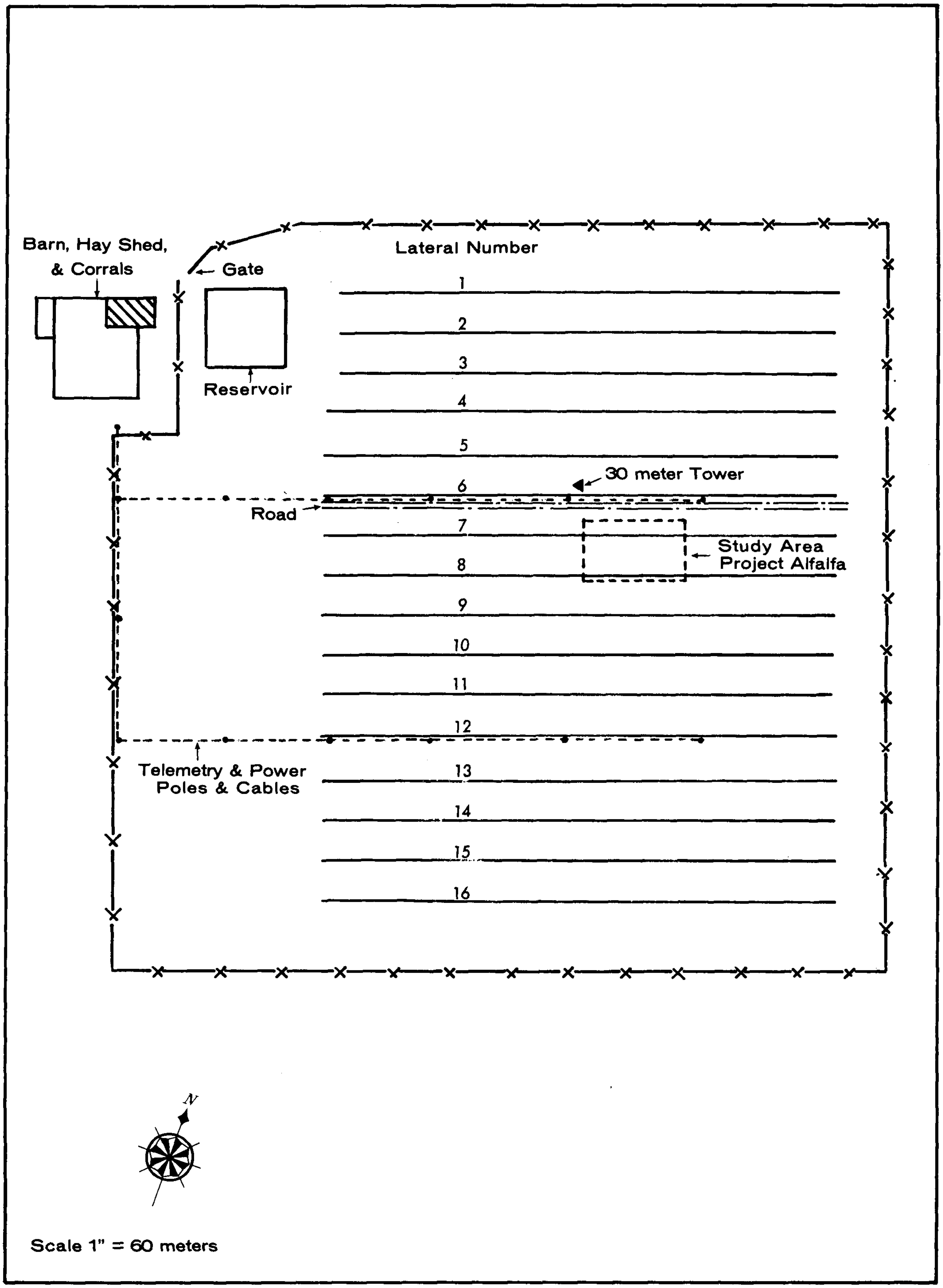


Figure 1. Public Health Service Farm and Study Area.

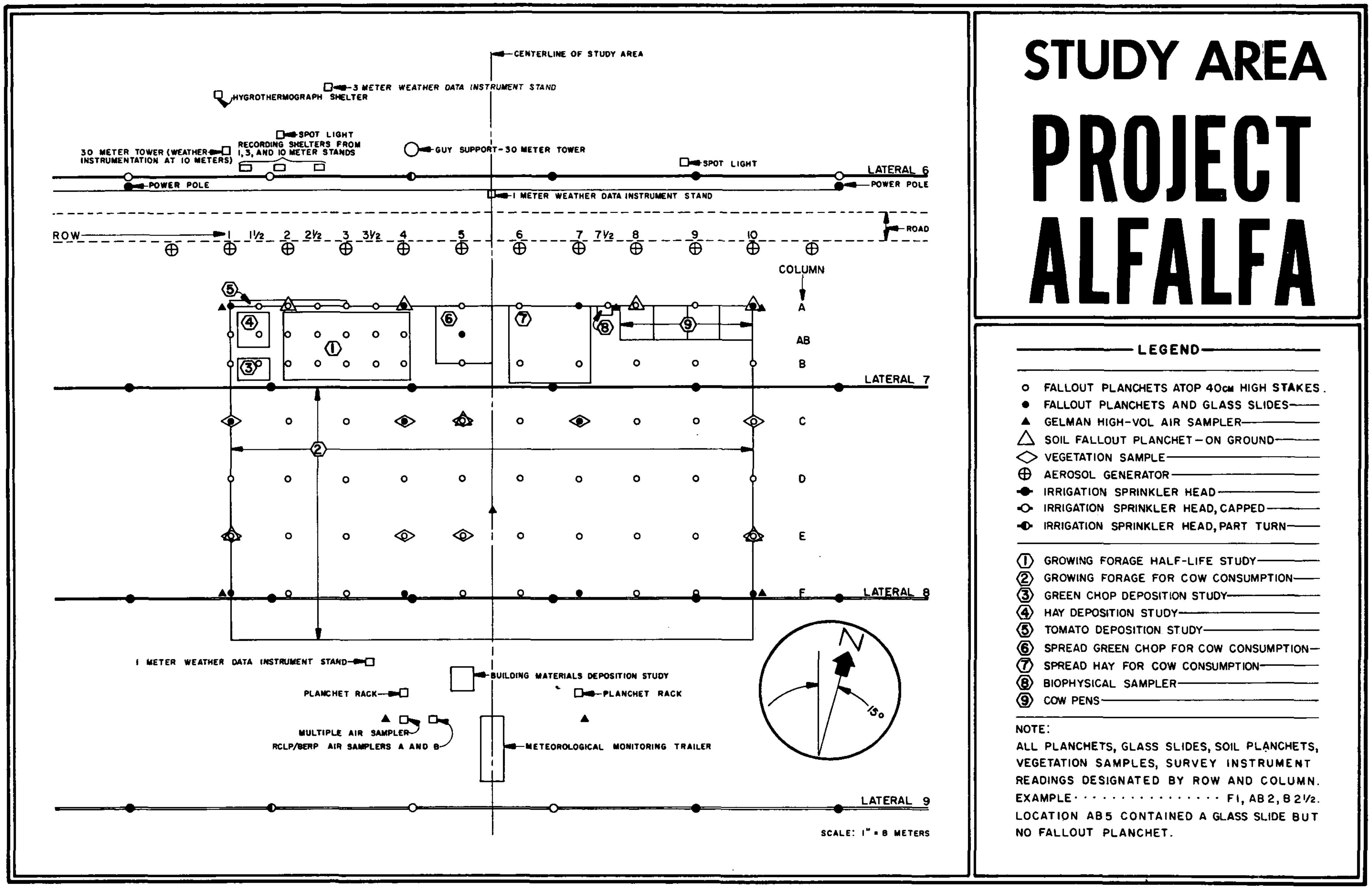


Figure 2. Detail of study area.

2. Meteorology

Since cloud transport and deposition characteristics are of interest to the overall research program, data such as wind speed, direction, temperature, and relative humidity, which have a bearing on these two parameters, are recorded on all field exercises. In addition, for the controlled release it is the accumulation and analysis of the local meteorological data which enables the weather bureau project officer to make his forecasts. It was felt that in order to maximize the deposition on the forage the wind speed should be in the range of 2-10 miles per hour and the surface wind direction in the arc 315°- 015° grid azimuth.

Meteorological instrumentation was installed and located as shown on Figure 2. Wind speed and direction sensors were established at three different levels--one, three, and ten meters. In addition, temperature and relative humidity were recorded. Each of these parameters was monitored continuously by off-grid recorders prior to the release to allow for an optimum prediction capability.

It was determined that the optimum time for the aerosol release would be during the early morning hours prior to sunrise. It is at this time that the drainage winds are generally from a northerly direction at about three to five miles per hour with an inversion layer existing at the low levels.

3. Aerosol Preparation and Generation

A series of feasibility studies was conducted prior to Project Alfalfa to consider other possible carrier materials and to determine the count median diameter that would be expected on the full field operation. Two basic carrier materials were examined, one being the diatomaceous earth (DE) previously used on Project Hayseed and the other, native sand. It was found that the constituents of the sand varied considerably from sample to sample; whereas the DE had a relatively fixed chemistry. A number of tests were also conducted with rats to determine the absorption of ^{131}I from labelled soil and DE particles mixed in with their food. It was found, as a result of these tests, that there were no significant differences in different experimental groups in the amount of ^{131}I that was found in the thyroid, whole body, feces, and urine of the rats. Therefore, DE was selected as the carrier material for the project, since its chemistry was less variable than that observed for sand. Aerosolization tests, using unlabelled DE previously sieved through a standard Tyler Sieve Shaker having a final stage of 400 mesh (37 μm), were conducted at the farm. The deposited material yielded a count median diameter of slightly less than 3 μm, thus satisfying the primary physical criterion for this study for particles of approximately 2.5 μm.

One hundred fifty grams of diatomaceous earth containing particles previously sieved to the proper size were placed in each of 12 casseroles. To each casserole were added 400 ml of ethyl alcohol and 10 ml of 0.1N NaOH. The contents were then stirred to form a slurry. Approximately 4 mCi of carrier-free ^{131}I were added to each of the 12 dishes. The contents were stirred for 10 minutes, allowed to air dry for 24 hours, and then stirred again. The labelled DE was transferred to sieves containing several steel balls and shaken on a mechanical shaker for 60 minutes. The sieved portion was placed in a 2-liter, two-necked, generating flask which was sealed, weighed, and counted. This was done for each of the 12 flasks.

Prior to the release, a 25- by 45-meter sampling grid was prepared at the farm. Stainless steel 4½-inch planchets coated with a non-setting alkyd resin were spaced at 5-meter intervals over the plot to determine the deposition concentration. Additional resin coated planchets were used in the special study areas and adjacent to each air sampler. Gelman Tempest air samplers were placed throughout the plot and adjacent to the cow pens to measure airborne concentration. These concentration data would also be used as input to calculations of deposition velocity. Glass microscope slides (1- by 3-inch) were spaced evenly over the field and used to determine the size distribution of the aerosol. Two planchet racks having stations at ground, one-, and two-meter levels, and at orientations normal and 45° to the field were placed downwind of the plot. Two other air samplers were used which made use of special sampling trains employing graded filtration techniques. A line of 12 aerosol generators was formed parallel with and 5 meters upwind from the leading edge of the test field. These generators were of the same design and were used in approximately the same fashion, except for two minor modifications, as described in the report on Project Hayseed. The modifications were the use of dry nitrogen as the carrier gas to minimize the possibility of moisture being introduced into the flasks and the use of 5-mm glass beads in the flasks to keep the powdered material fluidized. The generators were spaced at 5-meter intervals and the line extended one generator beyond each end of the field. Each of the generators was fixed so that the outlet stem was 18 inches above ground. At 0410 hours PDT, 21 June 1966, the nitrogen was introduced into the flasks at the rate of 85 lmp which started aerosol generation. Throughout the period of generation, the flasks were agitated by hand to assure uniformity of unloading. The generating period lasted for approximately 25 minutes at which time the flow of nitrogen was stopped. The generators were gamma counted following the release to allow for a determination of generation efficiency and to quantitate the release of ^{131}I.

D. SAMPLING TECHNIQUES

All forage, regardless of type, was sampled in an identical manner. The prescribed amount of forage to be fed was placed in the individual feed containers of each cow. The sample taken consisted of one handful from each of five specific locations within the container, each surface corner and the bottom center. This procedure produced a sample of approximately 200 grams which was placed into a plastic bag, sealed, and submitted for gamma analysis. Prior to analysis, the entire sample was compressed into a 400-ml plastic container to obtain a standard geometry for the counting system. Frequency of sampling corresponded with feeding frequency of the forage.

Grain used to supplement the diet of all animals was stored in a common storage bin within the milking barn. One 400-ml container full of grain was collected daily directly from the storage bin for gamma analysis.

One-gallon composite samples of water were collected on a daily basis from each group. The group samples consisted of equal amounts collected directly from each cow's individual waterer. The samples were submitted in four-liter plastic cubitainers for analysis.

A one-gallon sample of milk was collected from each cow at each milking. Ten cubic centimeters of 37 percent formaldehyde was added as a preservative to each milk sample.

After collection and before submission for analysis, all samples were taken to a central location, logged, and numbered in chronological order. Table 2 summarizes the sample collection.

E. ANALYTICAL PROCEDURES

Gamma spectrometry was performed on the milk and contaminated vegetation samples using a system consisting of two opposed 4- by 9-inch thallium-activated sodium iodide crystals. This system has been described in detail in previous reports.[1, 2, 3]

TABLE 2. SUMMARY OF DAILY SAMPLE COLLECTION.
(Number, Type, and Frequency)

Group	Time	Contaminated Feed	Uncontaminated Feed	Milk, Formalin-Treated	Water	Grain
I	a.m.	0	4[1]	4	1	1
	p.m.	0	4[2]	4		
II	a.m.	4[2]	0	4	1	
	p.m.	4[2]	0	4		
III	a.m.	4[3]	0	4	1	
	p.m.	0	4[2]	4		
IV	a.m.	4[4]	0	4	1	
	p.m.	0	4[2]	4		
V*	a.m.	0	2[1]	2	1	
	p.m.	0	2[2]	2		

[1] Green chop
[2] Hay
[3] Spread green chop
[4] Fresh green chop
*This group consisted of two cows; the other group had four cows each.

Water, grain, and uncontaminated vegetation were analyzed by this station's Technical Services Group using a 4- by 4-inch thallium-activated sodium iodide crystal coupled to a gamma pulse height analyzer calibrated for energies of 0-2 MeV. The minimum detectable limits for the two geometries analyzed are as follows:

3.5-liter container (water) 20 ± 10 pCi/liter

400-milliliter container (vegetation and grain) 20 ± 10 pCi/sample

Effective half-lives* were calculated using a least squares fit computer program on an IBM 1620 computer.

*Effective half-life: For the purpose of this report and with reference to forage, this term will be used to denote the time required for ^{131}I fixed in or attached to the forage to be reduced by 50 percent. The reduction will likely result from the combined action of physical dislodgment of attached particles in addition to radioactive decay and biological elimination.

III. RESULTS

A. AEROSOL DEPOSITION

The release commenced at 0410 hours PDT on 21 June 1966 and continued for 25 minutes. The meteorological conditions at the time of the release were highly favorable and did, in fact, allow for suitable deposition of the aerosol over the study area. The mean wind direction was from 302° at a speed of three miles per hour. During the release the wind direction shifted across an arc of approximately 25°, thus enhancing the uniformity of deposition. The wind direction one meter above the ground integrated over one-minute periods is shown in Figure 3. Detailed meteorological data, including wind speed and direction at all three levels, temperature, and relative humidity measurements are presented in Table A-3 of the Appendix.

The activity collected on the fallout planchets was extrapolated to measure the deposition on the entire field. Each planchet, which represents 0.01 m^2, was extended and reported in terms of $\mu Ci/m^2$ and the activity isophleths, as shown in Figure 4, were constructed. These planchets were placed at approximately forage height, i.e., 18 inches, and represent segments of an infinite collection plane at that height.

By scaling the data at each point to represent the deposition on a proportional amount of surrounding area, it was estimated that 5.24 mCi or 12.65 percent of 41.5 mCi disseminated was deposited on the 1125-square-meter plot.

The sampling train of the Gelman Tempest air samplers consisted of a Whatman 541 prefilter and an activated charcoal cartridge (Mine Safety Appliances Company No. 46727). The activity collected on each component, the filter/charcoal ratios, and the deposition velocities are shown in Table 3. Samplers 5 and 7 (southwest corner and south by west of the study plot, respectively) experienced an edge effect in that they were missed by the major portion of the release and are not included in the averages presented.

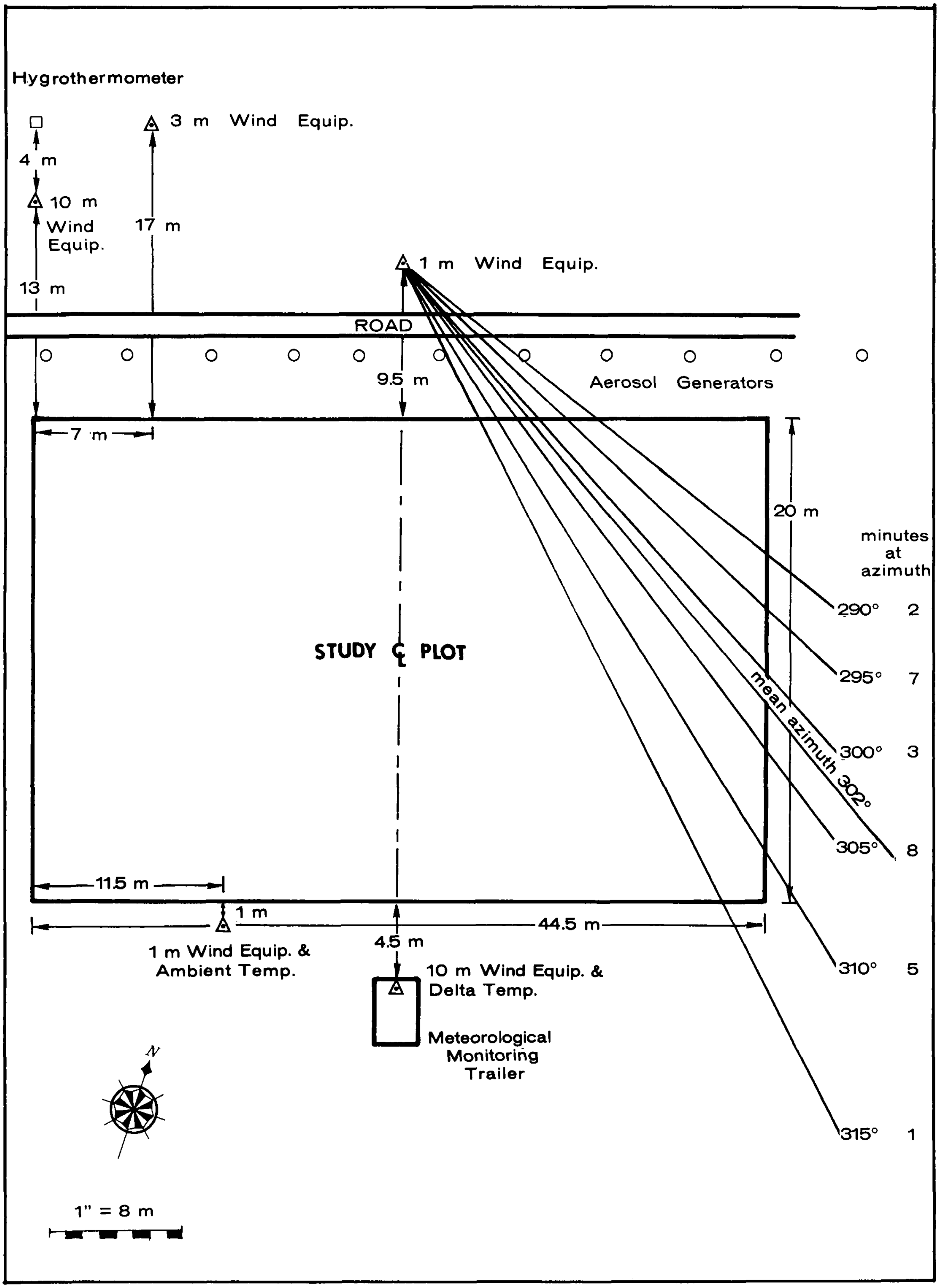


Figure 3. One-meter wind direction during the release.

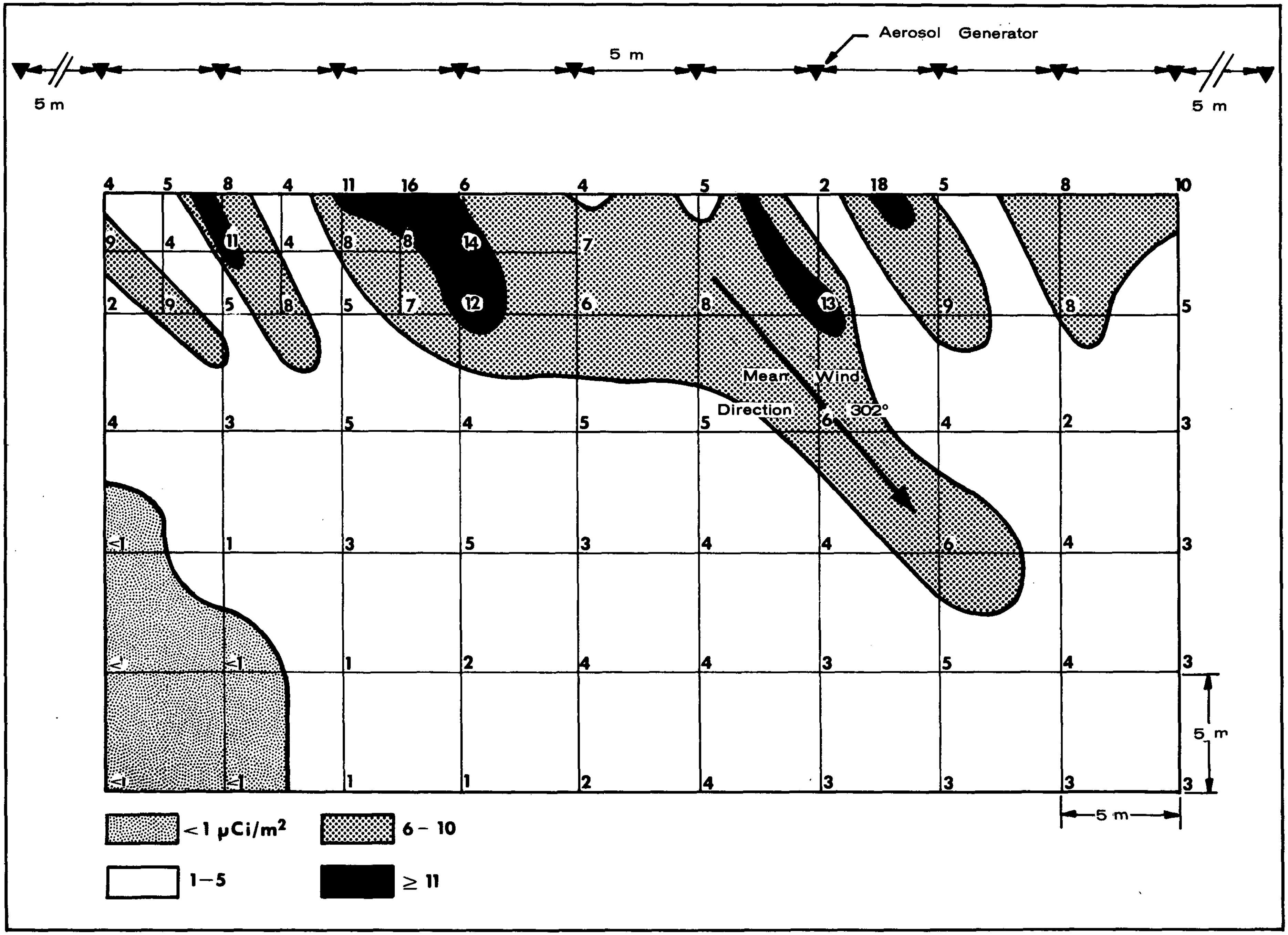


Figure 4. Activity isopleths ($\mu Ci/m^2$).

TABLE 3. AIR SAMPLER DATA.

Sampler	^{131}I Activity (μCi) Charcoal	Filter	Total	Filter/Charcoal Ratio	$\frac{\mu Ci\text{-}sec}{m^3}$	V_d (Cm/sec)
1	0.623	3.423	4.046	5.49	708.58	0.62
2	0.970	1.733	2.703	1.79	458.13	3.86
3	0.269	1.020	1.289	3.79	218.10	4.77
4	0.394	1.080	1.474	2.74	260.42	1.50
5	0.001	0.016	0.017	16.00	2.92	3.08
6	0.199	0.911	1.110	4.58	196.11	1.46
7	0.011	0.029	0.040	2.64	6.77	
8	0.236	0.672	0.908	2.85	155.21	
Average*	0.45	1.47	1.92	3.54	332.76	2.44

*Samplers 5 and 7 are excluded from the averaging as they were not in the path of the cloud.

Twelve glass slides that had been exposed to the aerosol cloud were examined with a light microscope. An average of 440 particles was sized from each slide using the Feret diameter measurement. The cumulative size distribution data is shown in Table 4 and is plotted as a histogram on Figure 5. The count median diameter of all the material collected was approximately 2 μm.

The planchet rack on the western side of the field was not in the path of the more concentrated portion of the cloud, but demonstrates that the activity at its location was quite uniform through the first 2 meters of elevation. The planchet rack on the eastern side of the field, however, was subjected to the main part of the cloud and the arm with planchets oriented normal to approximately 297° collected more activity (Table 5) than did the other two, as expected. Again, this rack demonstrated the uniformity of the cloud through the first two meters.

B. CONTAMINATED FORAGE ACTIVITY LEVELS

The mean values for all three types of contaminated forage-- fresh green chop, spread green chop, and spread hay--are summarized in Table 6. Peak activity levels were found on the initial samples of both the fresh green chop and spread hay. A definite peak was not observed in the spread green chop during the limited course of this portion of the study. The Group III animals were fed spread green chop for only three days. Heating of the uncured forage adversely affected the palatability and the cows would no longer accept the material after this period of time.

The highest ^{131}I activity was found in the fresh cut green chop fed the Group IV animals. The peak mean activity of the four individually collected samples was 3.4×10^6 pCi/kg. The activity decreased daily to 1.9×10^5 pCi/kg on the last day of the nine-day feeding period with a calculated effective half-life (T_{eff}) of 2.1 ± 0.21* days. Throughout the period, the daily variation in activity among samples was relatively small. A graphic illustration of the daily mean values

*± 1 standard deviation

TABLE 4. PARTICLE SIZE DISTRIBUTION.

Size (μm)	Count	Cumulative Count*	Cumulative Percent*	Size (μm)	Count	Cumulative Count*	Cumulative Percent*
1	1152	1152	21.9	25	32	4759	90.4
2	1439	2591	49.2	26	13	4772	90.7
3	926	3517	66.8	27	21	4793	91.1
4	408	3925	74.6	28	28	4821	91.6
5	199	4124	78.4	29	32	4853	92.2
6	81	4205	79.9	30	24	4877	92.7
7	65	4270	81.1	31	30	4907	93.2
8	46	4316	82.0	32	18	4925	93.6
9	45	4361	82.9	33	17	4942	93.9
10	39	4400	83.6	34	21	4963	94.3
11	28	4428	84.1	35	19	4982	94.7
12	20	4448	84.5	36	11	4993	94.9
13	28	4476	85.0	37	19	5012	95.2
14	18	4494	85.4	38	12	5024	95.5
15	27	4521	85.9	39	14	5038	95.7
16	24	4545	86.4	40	13	5051	96.0
17	24	4569	86.8	41	15	5066	96.3
18	24	4593	87.3	42	10	5076	96.4
19	22	4615	87.7	43	15	5091	96.7
20	18	4633	88.0	44	9	5100	96.9
21	23	4656	88.5	45	5	5105	97.0
22	19	4675	88.8	46	12	5117	97.2
23	24	4699	89.3	>46	162	5279	100.3
24	28	4727	89.8				

*Refers to amount ≤ stated size.

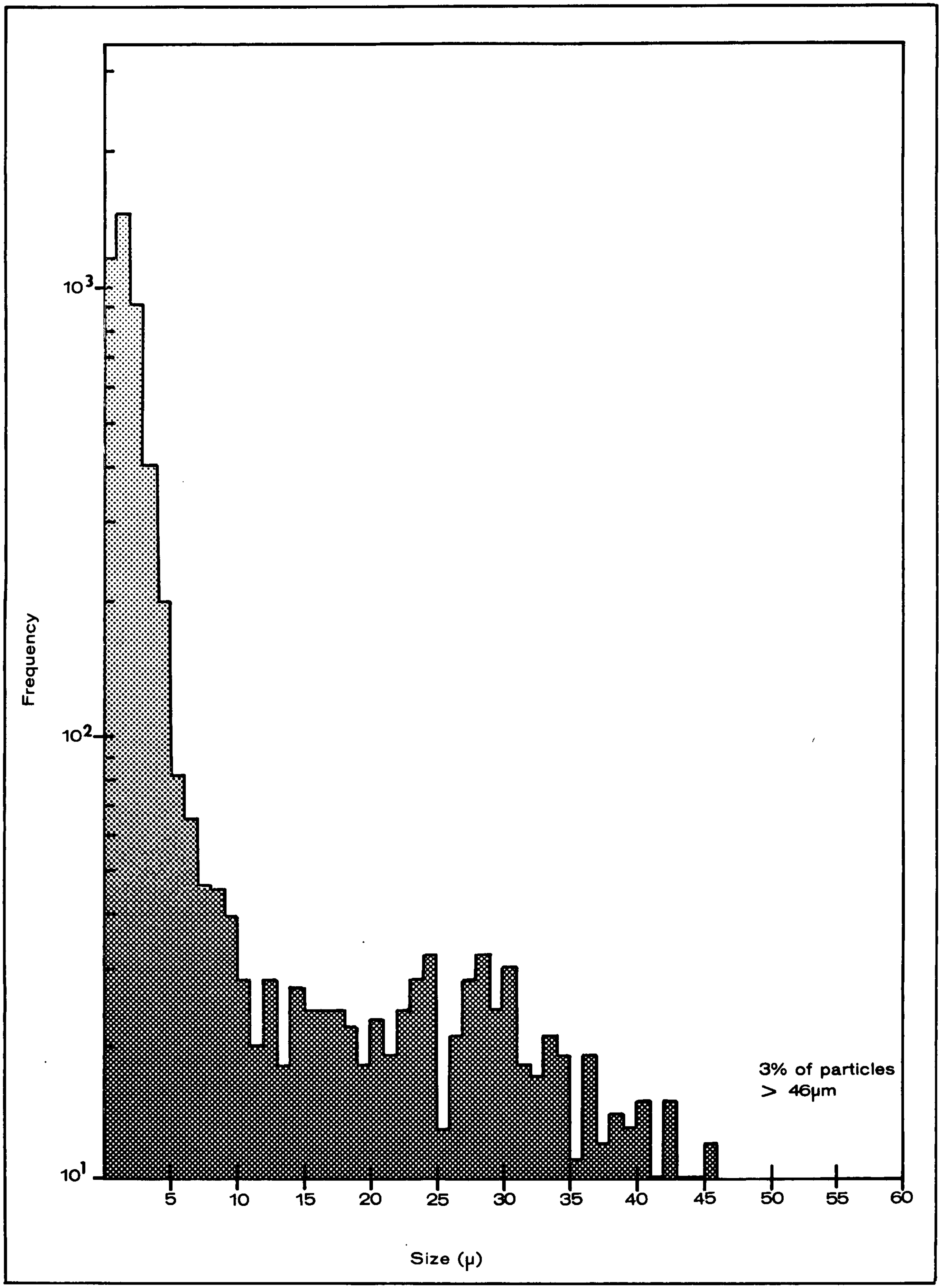
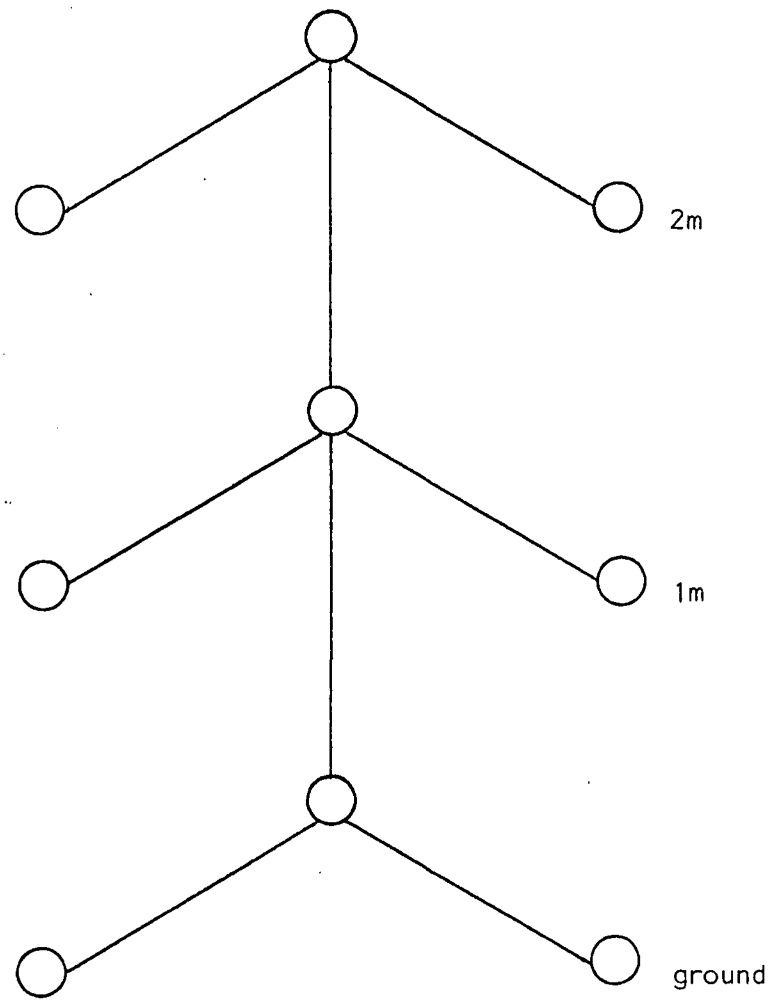


Figure 5. Particle size distribution histogram.

TABLE 5. PLANCHET RACK DATA (μCi/m of ^{131}I).



Height		West Side Rack		Average
2m	0.09	0.12	0.11	0.11
1m	0.12	0.16	0.11	0.13
ground	0.10	0.15	0.12	0.12
Average	0.10	0.14	0.11	

Height		East Side Rack		Average
2m	1.20	1.13	0.85	1.06
1m	0.97	1.10	1.06	1.04
ground	1.47	0.56	1.00	1.01
Average	1.21	0.93	0.97	

TABLE 6. SUMMARY OF AVERAGE ^{131}I CONCENTRATIONS IN FORAGE

(pCi/kg)

Collection Date	Time	Fresh Green Chop	Spread Hay	Spread Green Chop
6/21	a.m.	$3.4 \pm 0.6 \times 10^6$*	$6.4 \pm 3 \times 10^5$	$2.2 \pm 1.6 \times 10^5$
6/21	p.m.		$4.9 \pm 4.5 \times 10^5$	
6/22	a.m.	$1.2 \pm 0.1 \times 10^6$	$1.8 \pm 1.4 \times 10^5$	$2.3 \pm 1.3 \times 10^5$
6/22	p.m.		$3.5 \pm 2.8 \times 10^5$	
6/23	a.m.	$1.0 \pm 0.2 \times 10^6$	$3.5 \pm 3.1 \times 10^5$	$2.6 \pm 1.1 \times 10^5$
6/23	p.m.		$2.6 \pm 1.8 \times 10^5$	
6/24	a.m.	$9.7 \pm 2.2 \times 10^5$	$1.9 \pm 0.6 \times 10^5$	
6/24	p.m.		$3.1 \pm 3.9 \times 10^5$	
6/25	a.m.	$6.0 \pm 0.6 \times 10^5$	$3.3 \pm 2.2 \times 10^5$	
6/25	p.m.		$3.0 \pm 1.7 \times 10^5$	
6/26	a.m.	$5.4 \pm 0.3 \times 10^5$	$3.6 \pm 0.5 \times 10^5$	
6/26	p.m.		$2.8 \pm 1.9 \times 10^5$	
6/27	a.m.	$2.5 \pm 0.7 \times 10^5$	$1.9 \pm 1.2 \times 10^5$	
6/27	p.m.		$2.4 \pm 1.3 \times 10^5$	
6/28	a.m.	$2.6 \pm 1.2 \times 10^5$	$1.9 \pm 0.9 \times 10^5$	
6/28	p.m.		$1.4 \pm 0.2 \times 10^5$	
6/29	a.m.	$1.9 \pm 0.4 \times 10^5$		

*Mean ± 1 standard deviation

and the best fit regression line is shown in Figure 6. Individual sample values for the nine days are shown in Table A-4 of the Appendix.

The contaminated spread hay fed to the Group II animals had an initial peak ^{131}I activity of 6.4×10^5 pCi/kg which decreased to 1.4×10^5 pCi/kg on the final day of the eight-day feeding period. A best fit regression line produced a T_{eff} of 6.50 ± 2.10* days (Figure 7). Individual sample values are given in Table A-5 of the Appendix.

The spread green chop was fed to Group III cows for only three days and the recorded average activity values were 2.2, 2.3, and 2.6×10^5 pCi/kg, respectively. These values are not significantly different. Obviously, a T_{eff} could not be calculated from these data. Table A-6 of the Appendix shows the individual samples activity for the three days.

C. "UNCONTAMINATED" FEED ACTIVITY LEVELS

1. Forage

Peak values of 1.9×10^4 pCi/kg of fresh green chop on 24 June and 5.5×10^3 pCi/kg of hay on 23 June were observed in the intended uncontaminated forage. With the exception of the Group I and Group V animals, these amounts of contamination were of relatively little consequence since the contaminated forage levels were higher by a factor of 100. However, there is little doubt that a measurable influence was exerted on the milk values of the Group I and Group V animals. The possible sources of this unwanted contamination will be discussed in a following section. The gamma scan results of the uncontaminated forage are shown in Table 7 and in Tables A-7 and A-8 of the Appendix.

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* ± 1 standard deviation

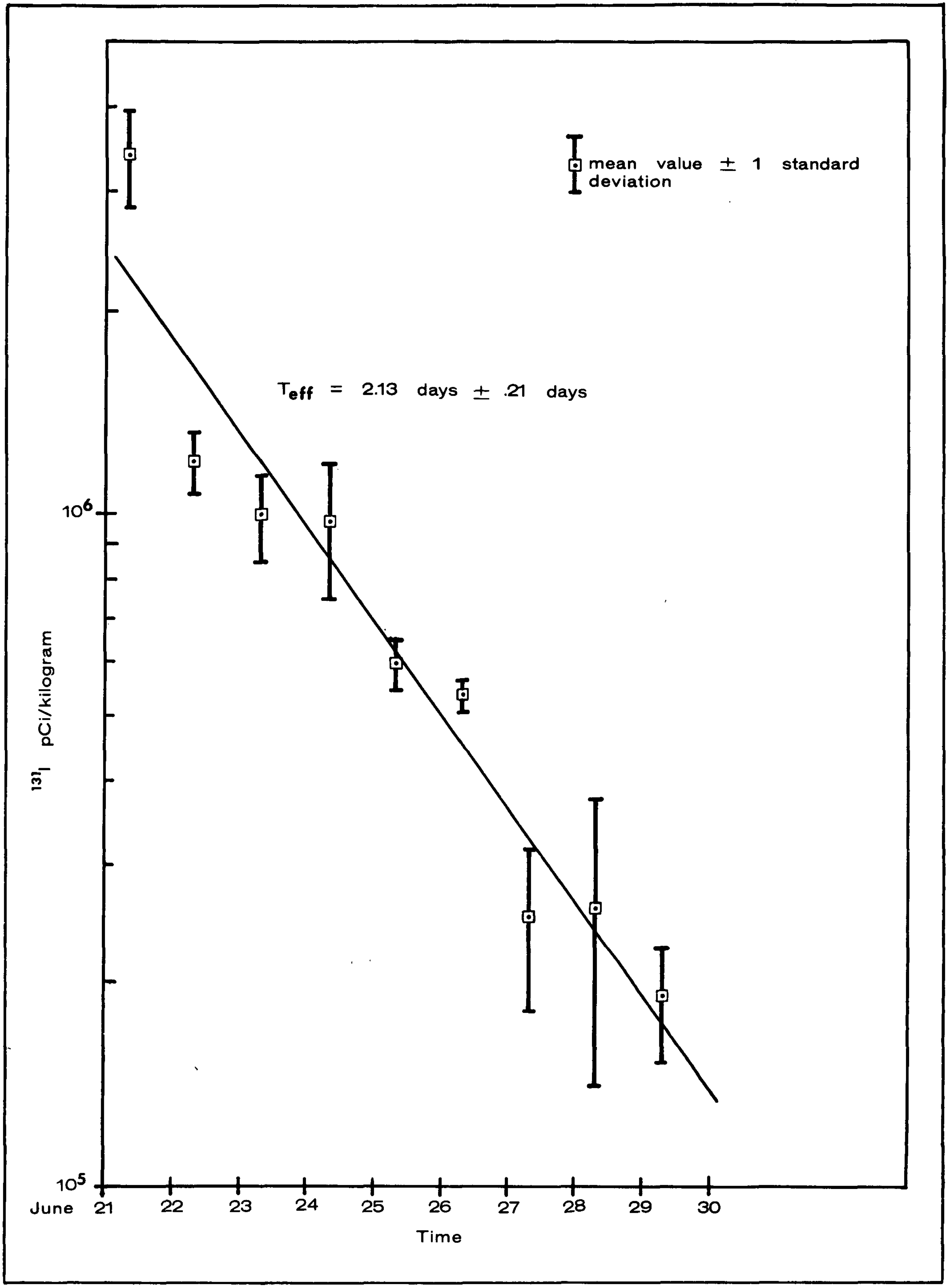

Figure 6. Average ^{131}I concentration in fresh green chop.

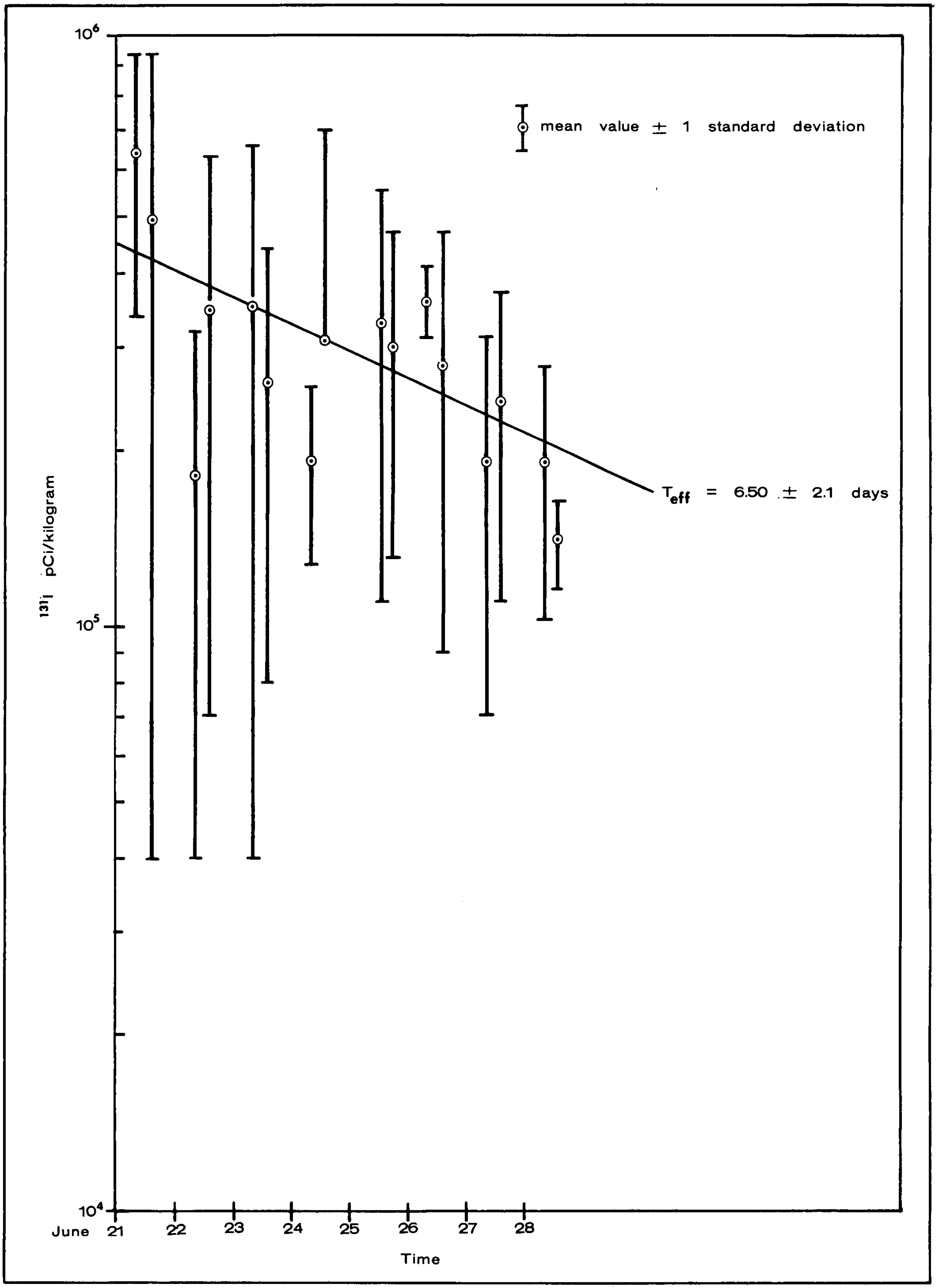

Figure 7. Average ^{131}I concentration in spread hay.

TABLE 7. DAILY MEAN ^{131}I VALUES OF "UNCONTAMINATED" INGESTA

Collection Date	Hay pCi/kg	Fresh Green Chop pCi/kg	Grain pCi/kg	Water pCi/liter
6/18	ND	ND	ND	NC
6/20	ND	ND	ND	NC
6/21	2,100	2,500	ND	380
6/22	690	12,000	ND	310
6/23	5,500	720	ND	60
6/24	ND	19,000	ND	20
6/25	240	6,300	ND	40
6/26	100	8,000	140	50
6/27	160	6,900	ND	30
6/28	110	7,400	ND	20
6/29	ND	5,000	460	ND
6/30	ND	3,200	NC	ND
7/1	350	NC	NC	NC
7/2	520	NC	360	40
7/3	380	NC	240	40
7/4	930	NC	300	ND
7/5	290	5,100	150	ND
7/6	2,600	NC	460	ND

ND = Nondetectable
NC = Not collected

2. Grain and water

Contamination was also detected in the grain and water, but to a much lower level than that recorded for the forage. Peak activities of 4.6×10^2 pCi/kg in grain on 29 June and 6 July and 3.8×10^2 pCi/l in water on 21 June were observed. Daily activity levels in grain and water are presented in Appendix Tables A-9 and A-10. Table 7 summarizes the daily mean ^{131}I values.

D. MILK ACTIVITY

The individual morning and evening milk activity results for all five groups are shown in Tables A-11 through A-15 of the Appendix. Daily morning and evening mean values on pCi/l basis for the groups are presented in Table 8.

A mean peak level of 1.09×10^5 pCi/l was observed 32 hours after feeding of contaminated fresh green chop began in Group IV. The effective half-life of the ^{131}I in the milk during the feeding was 2.5 ± 0.2* days. When feeding of the contaminated forage was stopped at the end of the nine-day period, the resulting T_{eff} in the milk was 0.9 ± 0.2 days.

A mean peak level of 3.95×10^4 pCi/l was reached in Group II 23 hours following the initial ingestion of contaminated hay. The T_{eff} in milk during the feeding period was 8.2 ± 1.3 days. At the end of the eight-day feeding period the uncontaminated hay was substituted for the contaminated. The T_{eff} then changed to 0.9 ± 0.1 day.

Due to rapidly decreasing palatability following exposure of the spread green chop, the Group III animals were fed contaminated feed for only three days. Mean peak milk values of 9.4×10^3 pCi/l occurred 32 hours following the initial ingestion of the forage.

* ± 1 standard deviation

TABLE 8. ^{131}I MEAN MILK VALUES FOR THE COWS (pCi/liter).

Collection Date	Time	Group IV	II	III	I	V
6/21	a.m.	ND	ND	ND	$4.91\pm1.29 \times 10^2$	ND
	p.m.	$1.01\pm.32 \times 10^5$	$2.75\pm0.98 \times 10^4$	$7.80\pm4.85 \times 10^3$	$2.16\pm1.21 \times 10^3$	$6.0\pm0.35 \times 10^1$
6/22	a.m.	$9.30\pm3.10 \times 10^4$	$3.95\pm1.91 \times 10^4$	$7.87\pm3.05 \times 10^3$	$2.22\pm0.56 \times 10^3$	$3.0\pm0.00 \times 10^1$
	p.m.	$1.09\pm0.34 \times 10^5$	$3.87\pm1.75 \times 10^4$	$9.42\pm4.73 \times 10^3$	$1.29\pm0.57 \times 10^3$	$1.62\pm1.24 \times 10^2$
6/23	a.m.	$7.90\pm2.54 \times 10^4$	$3.80\pm1.63 \times 10^4$	$6.77\pm2.87 \times 10^3$	$0.95\pm0.42 \times 10^3$	$1.85\pm0.78 \times 10^2$
	p.m.	$1.05\pm.45 \times 10^4$	$3.85\pm1.64 \times 10^4$	$8.37\pm2.83 \times 10^3$	$1.13\pm0.49 \times 10^3$	$2.85\pm1.63 \times 10^2$
6/24	a.m.	$6.97\pm2.77 \times 10^4$	$3.10\pm1.11 \times 10^4$	$5.62\pm1.83 \times 10^3$	$8.3\pm3.56 \times 10^2$	$1.30\pm0.14 \times 10^2$
	p.m.	$8.75\pm5.59 \times 10^4$	$2.90\pm1.07 \times 10^4$	$5.50\pm2.15 \times 10^3$	$1.04\pm0.40 \times 10^3$	$3.75\pm2.33 \times 10^2$
6/25	a.m.	$8.05\pm4.78 \times 10^4$	$2.37\pm0.94 \times 10^4$	$3.15\pm1.13 \times 10^3$	$7.42\pm3.10 \times 10^2$	$6.15\pm1.77 \times 10^2$
	p.m.	$7.35\pm3.28 \times 10^4$	$2.82\pm1.17 \times 10^4$	$3.42\pm1.57 \times 10^3$	$8.10\pm3.01 \times 10^2$	$4.50\pm0.99 \times 10^2$
6/26	a.m.	$5.75\pm2.60 \times 10^4$	$2.50\pm0.86 \times 10^4$	$2.00\pm0.9 \times 10^3$	$6.67\pm2.23 \times 10^2$	$3.45\pm0.92 \times 10^2$
	p.m.	$5.05\pm2.08 \times 10^4$	$2.67\pm1.13 \times 10^4$	$1.60\pm0.67 \times 10^3$	$6.55\pm2.65 \times 10^2$	$3.50\pm1.27 \times 10^2$
6/27	a.m.	$3.57\pm1.18 \times 10^4$	$2.41\pm1.16 \times 10^4$	$0.95\pm0.31 \times 10^3$	$5.52\pm2.26 \times 10^2$	$2.2\pm0.00 \times 10^2$
	p.m.	$3.95\pm1.97 \times 10^4$	$2.65\pm1.28 \times 10^4$	$1.06\pm0.40 \times 10^3$	$5.92\pm2.08 \times 10^2$	$3.05\pm1.20 \times 10^2$
6/28	a.m.	$2.82\pm1.25 \times 10^4$	$2.24\pm0.91 \times 10^4$	$6.72\pm1.77 \times 10^2$	$5.17\pm1.51 \times 10^2$	$2.60\pm0.57 \times 10^2$
	p.m.	$3.05\pm1.30 \times 10^4$	$2.48\pm1.04 \times 10^4$	$7.22\pm2.35 \times 10^2$	$4.37\pm0.67 \times 10^2$	$3.10\pm0.57 \times 10^2$
6/29	a.m.	$2.05\pm1.05 \times 10^4$	$2.00\pm0.88 \times 10^4$	$4.85\pm1.24 \times 10^2$	$4.00\pm1.27 \times 10^2$	$1.90\pm0.14 \times 10^2$
	p.m.	$1.75\pm0.73 \times 10^4$	$1.47\pm0.54 \times 10^4$	$4.02\pm1.20 \times 10^2$	$3.77\pm1.42 \times 10^2$	$1.25\pm0.21 \times 10^2$
6/30	a.m.	$1.12\pm0.54 \times 10^4$	$7.42\pm2.8 \times 10^3$	$3.30\pm0.86 \times 10^2$	$3.22\pm1.00 \times 10^2$	
	p.m.	$8.77\pm2.61 \times 10^3$	$6.00\pm2.25 \times 10^3$			
7/1	a.m.		$2.80\pm1.04 \times 10^3$			
	p.m.		$1.90\pm0.45 \times 10^3$			
T_{eff}[1]		2.5 ± 0.2	8.2 ± 1.3	[2]		

[1] T_{eff} during feeding (days).
[2] T_{eff} could not be calculated from limited data

Group IV Contaminated Fresh Green Chop
Group II Contaminated Spread Hay
Group III Contaminated Spread Green Chop
Group I Air Uptake
Group V Control

*Mean± 1 standard deviation

ND = Nondetectable

A T_{eff} during feeding was not calculated because of the limited data; however, after the feeding of contaminated forage ceased, a T_{eff} of 1.5 ± 0.1* days was calculated for this group during the remainder of the study.

The air uptake group exhibited mean peak milk activities of 2.2×10^3 pCi/liter 25 hours following exposure with a T_{eff} of approximately 1 day. Later this changed to a much longer T_{eff} of 3.1 ± 0.2 days.

Finally, note the activity levels in the milk of the control animals. By experimental design these animals were to receive uncontaminated forage, both fresh green chop and hay. However, significant contamination was detected in both of these forage types, reaching mean peak levels of 1.9×10^4 pCi/kg in the green chop and 5.5×10^3 pCi/kg in the hay. The milk from this group exhibited a mean peak level of 6.15×10^2 pCi/liter 36 hours after the forage peaked. The T_{eff} in the milk was 2.5 ± 0.2 days.

A graph of the comparative milk activity values and the calculated T_{eff} for the five groups of cows is shown in Figure 8. Figures A-1 through A-4 in the Appendix graphically summarize the milk and forage data for all groups. The maximum and minimum ^{131}I concentration values for individual cows within each group are presented in Table A-16 of the Appendix.

* ± 1 standard deviation

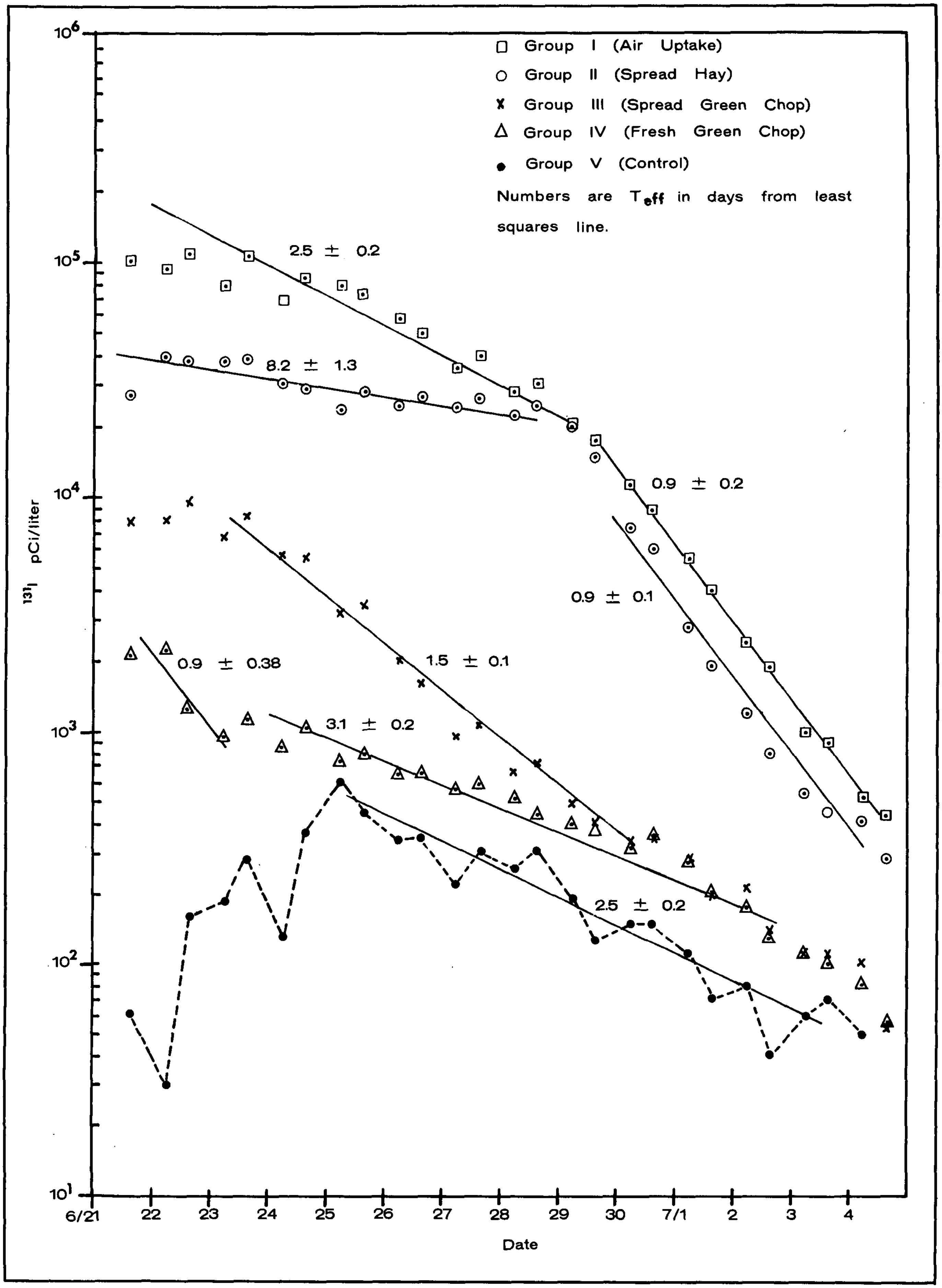

Figure 8. ^{131}I concentrations in milk for the five groups.

IV. DISCUSSION

The primary purpose of this study was to repeat Project Hayseed using a contaminant of smaller particle size in order to obtain additional milk to forage relationships and to gain a further insight into the various mechanisms involved in the overall transfer of radioiodine from air to forage to milk of dairy cows.

A. AEROSOL DEPOSITION

The field arrangement allowed for a wind direction ± 10° of normal whereas the actual mean wind direction was 40° from being normal to the plot. The isopleths suggest that the generators should be set back further from the leading edge of the field to allow for additional lateral diffusion and mixing of the individual aerosol plumes.

A deposition figure of 4.66 $\mu Ci/m^2$ compares favorably to Project Hayseed for which the similarly calculated deposition was 3.13 $\mu Ci/m^2$. The count median diameter of the particulate distribution was approximately 2 μm and was consistent over the grid.

B. "UNCONTAMINATED" FEED

The radioactivity detected in the "uncontaminated" feed represents an aspect of the study which needs explanation. While it did not appear to influence significantly the results of the two groups exhibiting the higher activities in the milk, a definite effect was exerted on the remaining three experimental groups. A portion of the activity detected in the milk of the air uptake, spread green chop, and control groups can be attributed to an external source of contamination. The major portion of the unexpected contamination appeared on the second day following the release. This resulted in a much longer T_{eff} in these groups than expected. The results from past studies as well as those in the former two groups indicate that a one-day half-life is usually obtained after ingestion and/or air uptake has stopped.

Three separate incidents occurred during this study which were suspected of contributing to the contamination. The effluent from the testing of an NRX reactor at another area of the Nevada Test Site during the late morning of 23 June was one contributor. Radioactive particulates containing radionuclides that could definitely be traced to this testing activity were collected on the farm. Also, air samplers operating both inside and outside the barn area during the study recorded increased activities between 0900 and 1430 hours on the 23rd. The radioactive cloud passed over the farm about 1200 on this date. The second possibility was the occurrence of high winds during the afternoon following the release. Southerly winds with speeds up to 30 miles per hour were recorded from 1200 to 2300 hours. While the study area was east of the barn area and winds from this direction would not appear to present a problem to the animals or feed in the immediate area of the barn, this mild storm was accompanied by "dust devils" or miniature whirlwinds. Greatly increased activities were detected on the air samplers for this period and tend to confirm that this was the source of feed contamination occurring prior to the reactor test. The third possibility was one of methodology.

As previously described, the spread green chop was stored inside the barn to take advantage of the cooler environment. The handling of this material during the preparation of the individual rations for the Group III cows may have caused re-suspension of the deposited material, possibly contaminating the grain supply stored in close proximity. All three incidents acting in concert contributed to the contamination encountered; but, fortunately, they exerted limited influence on the overall study. Air sampler results from samplers placed outside and inside the barn for the entire study period are shown in Table 9. Notethat ^{131}I was detected after the controlled release, probably due to re-suspension, and that ^{133}I was detected on 23 June. The detection of ^{133}I indicates that debris from the NRX reactor did reach the farm. Iodine-133 was also detected in the

TABLE 9. AIR SAMPLER RESULTS FOLLOWING PROJECT ALFALFA RELEASE.

Date	Time On	Time Off	Location	pCi-sec m^{-3} ^{131}I	pCi-sec m^{-3} ^{133}I
6/20-6/21	0745	0745	1	8.3×10^4	ND[2]
6/21-6/22	0750	0755	1	6.8×10^5	ND
6/22-6/23	0755	0625	1	2.5×10^4	ND
6/23	0900	1430	1	6.1×10^5	5.3×10^6
	0945	1415	3	7.5×10^5	4.0×10^7
	1630	1100	4	9.1×10^6	ND
	1110	1430	4	7.0×10^6	ND
6/23-6/24	1430	0935	1	1.1×10^4	ND
	1435	0942	4	4.8×10^5	ND
6/24-6/25	0940	0710	1	2.7×10^3	ND
	0945	0705	4	8.9×10^3	ND
6/25-6/27			5	ND	ND

[1]Outside barn.
[2]Nondetectable.
[3]Study area.
[4]Inside barn.
[5]Outside and inside barn.

the milk of the control cows indicating deposition of the NRX reactor debris on the "uncontaminated" forage.

C. CONTAMINATED FORAGE

Under the conditions of this study, the results indicate contaminated fresh green chop to be the major source of radioiodine in the dairy cow's diet.

The measured activity on a per kilogram basis was almost a factor of ten higher for the fresh green chop than it was for the next most contaminated forage, spread hay. The observed small variability between individual samples suggests that the deposited radioactivity was distributed homogeneously in the fresh green chop. Since the variation among samples was small, the T_{eff} of 2.1 ± 0.2 days for ^{131}I labelled DE on growing alfalfa-oats forage is reliable. Levels of activity as well as distribution homogeneity appear to be directly related to the surface area presented by the forage.

While discussing half-lives and the relative contributory importance of various types of forage, note the estimated T_{eff} of 6.5 ± 2.1 days for the spread hay. If this half-life was a valid measurement, the relative importance of contaminated hay as a source of subsequent milk activity levels would be increased. However, this estimate may be an artifact resulting from sampling techniques.

It is extremely difficult, if not impossible, to obtain a representative 200-gram sample from a 7.5-kg individual ration by the sampling technique described. It has been demonstrated that over 80 percent of the deposited activity is retained in the top 10 cm of stacked hay.[5] Thus one would expect a wide variation not only between samples but within samples where the samples consist of five separate aliquots taken from various locations in the feed box. Recall from the procedures that all the hay was bagged immediately after the release and stored for future consumption by the cows. None of the factors working in the growing forage to remove the initially deposited material or the dilution factor resulting from continued plant growth had an opportunity to affect the deposited material on the hay. Again, from ancillary studies, we have indications that radioactivity deposited on hay as a dry aerosol is less firmly attached than on growing forage or spread green chop and is more susceptible to physical dislodgment. If we had simulated in detail the conditions existing in most dairy operations where hay is stored unprotected, results different than the ones obtained might be expected.

With one exception, all discussions relevant to the hay data also apply to the spread green chop. Green chop is more dense and traps up to 95 percent of the contamination in the upper 10 cm of the surface layer.[5] The deposited material is apparently more firmly attached than on the hay and therefore less affected by environmental factors. The increased trapping and holding abilities seem to be related to the comparative textures of the two forages; one loose and dry, the other wet and compact.

The fresh green chop results appear to be the most reliable and indicate that green chop is the major source of radioiodine contamination for the cow. The results from the spread hay and spread green chop require further investigation. Results from ancillary studies suggest two practical countermeasures for the latter two types of forage which would further minimize their significance as a source of contamination for the cow. One is to simply discard the upper 10 cm of the stack after the fallout cloud has passed. Another equally effective method is to protect the stacked forage during cloud passage with a plastic sheet or some other type covering.

D. MILK ACTIVITY

Peak values were obtained in the milk from all groups 23 to 32 hours following initial exposure, times which are similar to those recorded for Hayseed. However, since these times are shorter than those reported in the literature,[4] they may be peculiar to the experimental design used in our two controlled releases and thus require further testing under other conditions.

The respective ratios of peak average milk to peak average forage values of 0.061 for the hay, 0.036 for the spread green chop, and 0.032 for the fresh green chop indicate the contaminant in the hay was less firmly bound and more available biologically.

These ratios are in rather close agreement with those obtained in actual field studies conducted following Pike[3] and Pin Stripe,[2] underground nuclear tests producing inadvertent releases of fission products to the atmosphere. In the Pike study, the milk-to-forage ratios for hay ranged from 0.046 to 0.054 and ranged from 0.038 to 0.080 in fresh cut forage. The ratio for the hay group from the present study of 0.061 is close, as is the 0.032 for the fresh green chop. The ratios from the Pin Stripe study, where the only forage type was fresh green chop, were 0.081 and 0.065. Two ratios for the same forage type were obtained in the Pin Stripe study since separate studies were conducted concurrently at two farms five miles apart. The difference in the milk-to-forage ratios obtained for the same forage type may be a reflection of the different particulate to gaseous ratios for the respective contaminants found at the two farms. However, these milk-to-forage ratios agree closely with the Pike ratio of 0.08. Hence, the only presently discernible variation of milk-to-forage ratios between the controlled release and the true fallout situation is in the fresh green chop where differing contaminate and forage characteristics appear to affect the results. It would appear to make little difference in the hay as to the physical or chemical nature of the contaminant, as the hay does not engage actively in the contamination process as does the growing forage.

A comparison of the data from the two controlled releases (Hayseed and Alfalfa) shown in Table 10 indicates that particle size of the contaminant may play a definite role in any prediction capability for milk based on forage activity. Attention is directed primarily to the fresh green chop data since the activity measurements of this forage type were the most reliable. Peak forage activity levels, effective half-lives, and time of peak in milk obtained from the two studies were in close agreement; yet peak milk activities differed by a factor of five, being

TABLE 10. COMPARATIVE RESULTS FROM THE TWO CONTROLLED RELEASES

Item	HAYSEED	ALFALFA(Current Study)
Particle Size of ^{131}I Labelled DE (CMD)	23μm	2μm
Average Peak ^{131}I Concentrations in Forage (pCi/kg)		
Fresh Green Chop	2.7×10^6	3.4×10^6
Hay	4.1×10^5	6.4×10^5
Spread Green Chop	1.4×10^6	2.6×10^5
Average Peak ^{131}I Concentrations in Milk (pCi/l)		
Cows on Fresh Green Chop	2.2×10^4	1.09×10^5
Cows on Hay	1.2×10^4	3.95×10^4
Cows on Spread Green Chop	1.4×10^4	9.42×10^3
Air Uptake	5.85×10^2	2.20×10^3
T_{eff} in Milk During Feeding (days)		
Cows on Fresh Green Chop	3.0	2.5
Cows on Hay	2.7	8.2
Cows on Spread Green Chop	2.3	†
Time to Peak in Milk (hr)		
Cows on Fresh Green Chop	33	32
Cows on Hay	33	23
Cows on Spread Green Chop	33	32
Milk-to-Forage Ratio*		
Cows on Fresh Green Chop	.008	.032
Cows on Hay	.029	.061
Cows on Spread Green Chop	.010	.036

†Not calculated due to limited data

$$*\frac{\text{Avg. peak concentration in milk (pCi/l)}}{\text{Avg. peak concentration in forage (pCi/kg)}}$$

higher in the study where the particle size of the contaminant was smaller. While the difference in particle size seems to be the principal variation between the studies, one cannot discount completely the effect produced by the different types of forages used as fresh green chop; Sudan grass green chop was used in Hayseed and an alfalfa-oat mixture in Alfalfa. Even though the data tend to support the former interpretation, further investigations are required to substantiate the validity of this observation.

The contribution to milk radioactivity resulting from air uptake appears to be minimal. From the Hayseed study, air uptake was calculated to be responsible for only 1.2 percent of the predicted peak average milk level resulting from eating both contaminated green chop and contaminated hay combined with air uptake. A gross comparison of the results from this study, comparing peak milk activity from air uptake with the peak average milk value from the fresh green chop data, indicates the air uptake contribution to be not greater than 2.1 percent.

The percent ^{131}I secreted in the milk (Table 11) among Groups II, III, and IV is the same indicating no obvious metabolic differences among groups of cows. The protein bound iodine (PBI), thyroid binding index (TBI), and blood counts for Groups I-V (Table A-2, in the Appendix) substantiate the above. A similar value for Group I cows is not presented because the exact amount of ^{131}I intake could not be determined to any degree of accuracy. The low percent secretion of ^{131}I in Group V cows may be related to the form of radioiodine in the reactor debris.

Maximum-minimum ^{131}I milk values for individual cows within Groups I, II, III, and IV are presented in Table A-16 of the Appendix. It is interesting to note that the average maximum-to-minimum ratio is approximately 3 for all groups.

TABLE 11. PERCENT ^{131}I SECRETED IN MILK.

Group	Cow No.	Total pCi Ingested	Total pCi Secreted	Percent Secreted	Mean ± 1 Standard Deviation
II	5	2.39×10^7	4.8×10^6	20.08	
	26	3.86×10^7	7.2×10^6	18.65	15.18 ± 6.19 %
	29	2.06×10^7	1.3×10^6	6.31	
	47	5.23×10^7	8.2×10^6	15.68	
III	2	2.27×10^6	5.4×10^5	23.79	
	13	7.16×10^6	5.6×10^5	7.82	14.75 ± 6.78 %
	16	6.49×10^6	1.0×10^6	15.41	
	44	1.00×10^7	1.2×10^6	12.00	
IV	12	7.51×10^7	1.8×10^7	23.97	
	15	1.15×10^8	1.2×10^7	10.43	12.51 ± 7.83 %
	17	9.03×10^7	5.7×10^6	6.31	
	18	1.07×10^8	1.0×10^7	9.34	
V	19	1.22×10^6	4.4×10^4	3.59	2.57 ± 1.44 %*
	24	1.22×10^6	1.9×10^4	1.55	

*Calculated for the same period of time as for the three experimental groups. Over an extended time interval the percentage would probably have approached the other three since the area remaining under the regression curve, at the time the study was terminated, was substantial by comparison to the observed peak activity for this group.

V. CONCLUSIONS

Under the conditions of this study, general conclusions on the transfer of ^{131}I to cow's milk based on specific results listed in Table 10, are given below:

A. When radioiodine contamination of an area occurs, the major portion of radioiodine which subsequently appears in cow's milk is usually due to ingestion of contaminated forage. When exposure is limited to air uptake, the expected peak milk activity would be almost two orders of magnitude less than the peak activity resulting from the ingestion of contaminated fresh green chop.

B. When different forage types, such as the three employed in this study, are exposed to an ^{131}I aerosol under simulated fallout conditions, the greatest amount of activity per kilogram will be deposited on the type presenting the most surface area. Hence, the greatest amount of activity per kilogram will usually be deposited on the growing forage, since this will represent the largest plant surface area in most exposure configurations.

C. Following ingestion of contaminated forage, peak concentrations of radioactivity (pCi/l) occur in the milk within two days and are at least one order of magnitude lower than the peak activity (pCi/kg) of the ingested material.

D. When intake of ^{131}I ceases, the effective half-life of this nuclide in the milk is approximately one day.

E. From a comparison of the data from the two controlled releases (Hayseed and Alfalfa) there appears to be an inverse relationship between the particle size of the contaminant and the milk to forage ratio.

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2. Dairy Farm Radioiodine Studies Following the Pin Stripe Event (SWRHL-41r)

3. Dairy Farm Radioiodine Study Following the Pike Event (SWRHL-14r)

4. Soldat, J. K. 1963. The relationship between ^{131}I Concentrations in various environmental samples. Health Physics. 9:11-67-1171

5. Unpublished data.

APPENDIX

LIST OF TABLES

TABLE A-1 - MILK PRODUCTION RECORD AND STAGE OF LACTATION FOR ALL GROUPS OF COWS.

Group	Cow No.	Avg. Milk per day (liters) 1 Jun - 21 Jun 66	Avg. Milk per day (liters) 22 Jun - 5 Jul 66	% Butterfat 1 Jun 66 Herd Avg= 2.71%	% Butterfat 1 Jul 66 Herd Avg= 2.91%	Days in Production as of 21 Jun 66	Days Carried Calf as of 21 Jun 66
	21	29.77	30.96	3.4	4.0	8[1]	Not Preg.
	28	26.45	23.18	2.0	2.3	106	47
I	43	28.77	25.51	3.7	3.6	126	Not Preg.
	45	26.95	23.59	2.8	2.5	129	36
	Avg.	27.98	25.81	2.98	3.10	92.3	
	5	21.87	19.50	2.0	2.3	142	Not Preg.
	26	30.99	28.73	3.0	2.8	118	Not Preg.
II	29	13.36	11.86	2.5	3.0	295	Not Preg.
	47	30.36	25.82	2.5	2.7	80	Not Preg.
	Avg.	24.15	21.48	2.5	2.70	158.8	
	2	22.60	21.52	2.2	2.5	203	40
	16	30.56	28.05	3.1	3.0	131	Not Preg.
III	44	33.81	28.83	3.0	2.8	79	Not Preg.
	13	28.39	33.99	——	3.1	20	Not Preg.
	Avg.	28.84	28.10	2.77	2.85	108.3	

[1]No. 21 -- Fresh 15 June 66

TABLE A-1 - (Continued)

Group	Cow No.	Avg. Milk per day (liters) 1 Jun - 21 Jun 66	Avg. Milk per day (liters) 22 Jun - 5 Jul 66	% Butterfat 1 Jun 66 Herd Avg= 2.71%	% Butterfat 1 Jul 66 Herd Avg= 2.91%	Days in Production as of 21 Jun 66	Days Carried Calf as of 21 Jun 66
	12	29.10	25.00	3.3	3.0	118	40
	15	31.92	28.99	2.7	2.5	71	Not Preg
IV	17	19.11	17.63	2.7	3.1	214	185
	18	26.40	22.89	2.0	2.3	146	82
	Avg.	26.63	23.63	2.68	2.73	137.3	
	19	20.96	24.87		3.6	8	Not Preg.
V	24	11.17	7.83	2.6	2.5	294[2]	200

[2]No. 24 -- Dry 30 June 66

TABLE A-2 - BLOOD DATA FOR INDIVIDUAL COWS

Group	Cow No.	Date	% HCT	1x10^6 Rbc	W.B.C.	gm/100ml[1] T.P.	µgm[2] P.B.I.	TBI[3]
	21	6/16/66	38	4.6	12,300	6.4	1.45	.92
		7/19/66	37	4.7	11,000	7.3	1.40	.91
	28	6/16/66	35	4.7	6,850	7.7	2.05	.93
		7/19/66	36	4.7	8,800	7.9	2.15	.94
I	43	6/16/66	37	4.7	10,900	7.4	2.85	1.00
		7/19/66	38	4.8	7,800	7.9	3.25	1.03
	45	6/16/66	39	4.7	8,100	7.8	3.25	1.05
		7/19/66	39	4.8	8,000	7.6	3.15	1.06
	Group I	6/16/66	37.25	4.68	9,537.5	7.33	2.40	.98
	Average	7/19/66	37.50	4.75	8,900.0	7.68	2.49	.99
	5	6/16/66	34	4.2	7,650	7.5	2.90	.93
		7/19/66	38	4.7	9,400	8.4	2.00	.90
	26	6/16/66	39	4.8	6,750	7.0	3.35	.92
		7/19/66	38	4.8	6,800	8.6	2.35	.87
II	29	6/16/66	38	4.8	6,700	7.5	2.50	.96
		7/19/66	39	4.8	7,000	7.9	2.75	.92
	47	6/16/66	37	4.6	7,700	7.5	3.25	1.00
		7/19/66	35	4.6	6,200	7.2	2.70	1.01
	Group II	6/16/66	37.00	4.60	7,200.0	7.38	3.00	.95
	Average	7/19/66	37.50	4.73	7,350.0	8.03	2.45	.93

[1]Total Protein
[2]Protein Bound Iodine
[3]Thyro Binding Index

TABLE A-2 - (Continued)

Group	Cow No.	Date	% HCT	1x10^6 Rbc	W.B.C.	gm/100ml[1] T.P.	μgm[2] P.B.I.	TBI[3]
III	2	6/16/66	38	4.3	6,050	6.9	2.70	.95
		7/19/66	39	4.8	8,000	6.6	2.45	.98
	13	6/16/66	33	4.5	7,100	7.2	2.30	.84
		7/19/66	36	4.7	8,200	7.7	2.50	.89
	16	6/16/66	38	4.7	8,250	7.6	2.40	.97
		7/19/66	41	4.8	8,550	8.1	2.75	.98
	44	6/16/66	38	4.6	9,450	7.5	2.10	.87
		7/19/66	37	4.7	7,300	7.5	2.00	.89
	Group III Average	6/16/66	36.75	4.53	7,712.5	7.30	2.38	.91
		7/19/66	38.25	4.75	8,012.5	7.48	2.43	.94
IV[4]	12	6/16/66	35	4.6	6,700	7.7	1.85	.82
		7/19/66	39	4.8	6,950	8.1	2.40	.93
	15	6/16/66	36	4.8	6,650	8.1	1.85	.91
		7/19/66	40	4.8	7,750	8.9	2.10	.93
	18	6/16/66	35	4.6	8,850	8.3	2.10	.88
		7/19/66	41	4.9	8,100	8.7	2.45	.94
	Group IV Average	6/16/66	35.33	4.67	7,400.0	8.03	1.93	.87
		7/19/66	40.00	4.83	7,600.0	8.57	2.32	.93

[1]Total Protein
[2]Protein Bound Iodine
[3]Thyro Binding Index
[4]No blood data available for Cow No. 17

TABLE A-2 - (Continued)

Group	Cow No.	Date	% HCT	1x10^6 Rbc	W.B.C.	gm/100ml[1] T.P.	µgm[2] P.B.I.	TBI[3]
	19	6/16/66	39	4.8	5,750	7.3	2.45	.84
		7/19/66	39	4.7	10,800	8.3	1.70	.84
V	24	6/16/66	36	4.7	13,450	7.2	2.55	.93
		7/19/66	40	4.9	11,800	7.7	2.75	.93
	Group V Average	6/16/66	37.50	4.75	9,600.0	7.25	2.50	.89
		7/19/66	39.50	4.80	11,300.0	8.00	2.23	.89
	Herd Average	6/16/66	36.76	4.63	8,188.2	7.45	2.46	.92
		7/19/66	38.35	4.76	8,379.4	7.91	2.40	.94

[1]Total Protein
[2]Protein Bound Iodine
[3]Thyro Binding Index

TABLE A-3 - METEOROLOGICAL DATA DURING AEROSOL RELEASES.

Date/Time	1 Meter		3 Meter		10 Meter		Temperature	Relative Humidity
PDT	Dir[1]	Sp[2]	Dir	Sp	Dir	Sp	°F.	%
21/0415	310	03	310	06	280	05	58	40
0416	305	03	310	06	270	05	58	40
0417	310	03	310	06	285	06	58	40
0418	315	03	310	06	285	06	58	40
0419	310	03	315	06	285	06	58	40
0420	310	03	310	06	285	06	58	40
0421	310	03	310	06	285	08	58	40
0422	305	03	310	06	285	08	58	40
0423	305	03	310	05	285	08	58	40
0424	305	03	305	06	280	08	58	40
0425	300	03	305	06	280	08	58	40
0426	305	03	300	06	280	07	58	40
0427	295	03	300	06	285	07	58	40
0428	295	03	300	05	280	07	58	40
0429	290	03	300	06	275	07	58	40
0430	295	03	295	05	275	07	59	40
0431	300	03	295	06	275	07	59	40
0432	295	03	300	06	265	07	59	40
0433	300	03	305	05	260	05	59	40
0434	305	03	295	05	270	05	59	40
0435	305	03	300	06	265	05	59	40
0436	295	03	305	05	270	05	58	40
0437	290	03	300	05	270	05	58	40
0438	295	03	300	05	265	05	58	40
0439	295	03	300	05	260	04	58	40
0440	305	03	300	05	270	04	58	40

[1]Direction given in degrees
[2]Speed given in miles per hour

TABLE A-4. ^{131}I LEVELS IN INDIVIDUAL SAMPLES OF FRESH GREEN CHOP FED GROUP IV COWS (pCi/kg).

		Cow Number			
Date	Time	12	15	17	18
6/21	0700	3.1×10^6	4.2×10^6	2.9×10^6	3.3×10^6
6/22	0800	1.2×10^6	1.3×10^6	1.2×10^6	9.8×10^5
6/23	0800	8.0×10^5	8.9×10^5	1.1×10^6	1.1×10^6
6/24	0900	8.5×10^5	9.2×10^5	1.3×10^6	8.3×10^5
6/25	1300	5.8×10^5	6.6×10^5	6.2×10^5	5.3×10^5
6/26	0800	5.1×10^5	5.7×10^5	5.1×10^5	5.6×10^5
6/27	0800	1.8×10^5	2.2×10^5	2.5×10^5	3.4×10^5
6/28	0800	4.1×10^5	2.0×10^5	3.1×10^5	1.4×10^5
6/29	0800	2.1×10^5	2.1×10^5	1.3×10^5	2.0×10^5

TABLE A-5. ^{131}I LEVELS IN INDIVIDUAL SAMPLES OF SPREAD HAY FED GROUP II COWS (pCi/kg).

Date	Time	Cow Number 5	26	29	47
6/21	0700	3.1×10^5	8.4×10^5	4.8×10^5	9.5×10^5
	1400	2.6×10^5	7.5×10^4	5.3×10^5	1.1×10^6
6/22	0800	8.7×10^4	1.6×10^5	8.6×10^4	3.8×10^5
	1400	1.5×10^5	5.3×10^5	7.9×10^4	6.6×10^5
6/23	0800	3.1×10^4	6.7×10^5	1.3×10^5	5.6×10^5
	1400	3.2×10^5	4.9×10^5	8.5×10^4	1.6×10^5
6/24	0900	2.0×10^5	1.7×10^5	1.3×10^5	2.8×10^5
	1400	4.3×10^4	1.1×10^5	2.0×10^5	8.9×10^5
6/25	1300	3.4×10^5	3.9×10^5	5.7×10^5	3.4×10^4
	1800	5.2×10^5	2.3×10^5	1.2×10^5	3.3×10^5
6/26	0800	4.1×10^5	3.9×10^5	2.9×10^5	3.4×10^5
	1400	1.8×10^5	3.9×10^5	8.2×10^4	4.9×10^5
6/27	0800	6.6×10^4	2.9×10^5	1.0×10^5	3.0×10^5
	1400	6.4×10^4	3.5×10^5	2.4×10^5	3.2×10^5
6/28	0800	2.8×10^5	1.1×10^5	2.6×10^5	1.3×10^5
	1400	1.2×10^5	1.2×10^5	1.4×10^5	1.7×10^5

TABLE A-6 ^{131}I LEVELS IN INDIVIDUAL SAMPLES OF SPREAD GREEN CHOP FED GROUP III COWS (pCi/kg).

		Cow Number			
Date	Time	2	13	16	44
6/21	0700	1.1×10^5	1.7×10^5	1.5×10^5	4.6×10^5
6/22	0800	9.2×10^4	3.5×10^5	3.4×10^5	1.5×10^5
6/23	0800	1.9×10^5	3.0×10^5	4.0×10^5	1.7×10^5

TABLE A-7. ^{131}I LEVELS "UNCONTAMINATED" FRESH GREEN CHOP FED TO GROUP I, III, AND V COWS (pci/kg).

		Group			
Date	Time	I	III	IV	V
6/18*	0900	ND			
6/20*	0900	ND			
6/21	0700	2.1×10^3			3.0×10^3
6/22	0800	1.0×10^4			1.4×10^4
6/23	0700	6.5×10^3			8.0×10^3
6/24	0900	1.8×10^4	1.9×10^4		1.9×10^4
6/25	1300	6.3×10^3	6.6×10^3		6.1×10^3
6/26	0800	6.8×10^3	6.3×10^3		1.1×10^4
6/27	0800	6.5×10^3	7.1×10^3		7.2×10^3
6/28	0800	3.9×10^3	5.2×10^3		1.3×10^4
6/29	0800	3.9×10^3	3.8×10^3		7.4×10^3
6/30	0800	3.3×10^3**		2.9×10^3	
7/5*	0800	5.1×10^3			

*One composite sample was collected representing all groups.
**One composite sample was collected representing Groups I, III, and V.
ND Nondetectable

TABLE A-8. ^{131}I LEVELS IN "UNCONTAMINATED" HAY FED TO ALL GROUPS (pCi/kg).

Date	Time	Group I	II	III	IV	V
6/18*	0900	ND				
6/20*	0900	ND				
6/21	1400	1.9×10^3		2.6×10^3	1.8×10^3	2.1×10^3
6/22	0800					ND
	1300	6.8×10^2		6.7×10^2	7.3×10^2	
6/23	1400	9.2×10^3		8.7×10^2	1.1×10^3	1.1×10^4
6/24	1400	ND		ND	ND	ND
6/25	1400	ND		ND	2.0×10^2	7.5×10^2
6/26	1400	ND		4.1×10^2	ND	ND
6/27	0800					6.5×10^2
	1400	ND		ND	ND	
6/28	1400	2.3×10^2		2.1×10^2	ND	ND
6/29	0800		ND			
	1400	ND	ND	ND		ND
6/30	0800		ND			
7/1	1400	3.1×10^2**	4.9×10^2			
7/2	0800	4.0×10^2**	1.0×10^3			
7/3*	0800	1.6×10^2				
	1500	6.1×10^2				
7/4*	0800	1.3×10^3				
	1500	5.7×10^2				
7/5*	0800					
	1400	2.9×10^2				
7/6*	0800	2.6×10^3				

*One hay composite sample was collected representing all groups.
**One hay composite sample was collected representing Groups I, III, IV, & V.
ND Nondetectable

TABLE A-9. ^{131}I LEVELS IN GRAIN FED TO ALL GROUPS(pCi/kg).

Date	Time	pCi/kg
6/18	0900	ND
6/20	0900	ND
6/21	1400	ND
6/22	0800	ND
6/23	0600	ND
6/24	0900	ND
6/25	0700	ND
6/26	0800	1.4×10^2
6/27	0800	ND
6/28	0900	ND
6/29	0800	4.6×10^2
7/2	0800	3.6×10^2
7/3	0800	2.4×10^2
7/4	0600	3.0×10^2
7/5	0600	1.5×10^2
7/6	0800	4.6×10^2

TABLE A-10. ^{131}I LEVELS IN WATER FOR ALL GROUPS (pCi/liter).

Date	Time	Group I	II	III	IV	V
6/21	1400	9.9×10^2	3.2×10^2		2.1×10^2	ND
6/22	0800	5.0×10^2	2.2×10^2	4.0×10^1	7.7×10^2	ND
6/23	0700	6.0×10^1*				
6/24	0900	ND	7.0×10^1	3.0×10^1	ND	ND
6/25	1300	5.0×10^1	4.0×10^1	3.0×10^1	6.0×10^1	3.0×10^1
6/26	0800	5.0×10^1	4.0×10^1	4.0×10^1	6.0×10^1	4.0×10^1
6/27	0800	2.0×10^1	5.0×10^1	2.0×10^1	5.0×10^1	2.0×10^1
6/28	0800	3.0×10^1	2.0×10^1			1.0×10^1
6/29	0800	ND	2.0×10^1	ND	ND	ND
6/30	0900	ND	1.0×10^1	ND		ND
7/2**	0800	3.7×10^1				
7/3	0800	3.9×10^1				
7/4	0600	ND				
7/5	0800	1.0×10^1				
7/6	0800	ND				

*Average of five collections; $6.0 \times 10^1 \pm 8$ pCi/liter.
**Collected one water sample for all groups from this date on.
ND Nondetectable

TABLE A-11. ^{131}I LEVELS IN MILK FOR GROUP I COWS.

		Cow 21			Cow 28		
Date	Time	pCi/liter	Liters	Total pCi	pCi/liter	Liters	Total pCi
6/21	0600	6.7×10^2	16.8	1.12×10^4	3.7×10^2	13.4	4.95×10^3
	1500	7.5×10^2	14.7	1.10×10^4	2.2×10^3	9.5	2.09×10^4
6/22	0600	1.4×10^3	16.8	2.35×10^4	2.4×10^3	12.5	2.35×10^4
	1500	4.6×10^2	12.5	5.76×10^3	1.6×10^3	8.2	1.31×10^4
6/23	0600	3.7×10^2	19.4	7.19×10^3	1.2×10^3	14.7	1.76×10^4
	1500	4.2×10^2	10.4	4.35×10^3	1.2×10^3	7.8	9.33×10^3
6/24	0600	3.5×10^2	19.4	6.22×10^3	1.1×10^3	15.1	1.66×10^4
	1500	4.8×10^2	8.2	3.93×10^3	1.1×10^3	6.0	6.65×10^3
6/25	0600	2.8×10^2	17.7	4.95×10^3	8.9×10^2	13.4	1.19×10^4
	1500	3.6×10^2	12.1	4.35×10^3	9.4×10^2	9.1	8.52×10^3
6/26	0600	3.5×10^2	17.3	6.04×10^3	7.9×10^2	13.0	1.02×10^4
	1500	2.8×10^2	10.4	2.90×10^3	7.5×10^2	9.1	6.80×10^3
6/27	0600	2.6×10^2	17.3	4.49×10^3	6.3×10^2	13.8	8.70×10^3
	1500	3.1×10^2	13.0	4.01×10^3	7.1×10^2	8.2	5.82×10^3
6/28	0600	3.1×10^2	17.3	5.35×10^3	6.3×10^2	13.0	8.16×10^3
	1500	3.4×10^2	11.2	3.81×10^3	4.5×10^2	9.5	4.27×10^3

TABLE A-11. (Continued)

Date	Time	Cow 21			Cow 28		
		pCi/liter	Liters	Total pCi	pCi/liter	Liters	Total pCi
6/29	0600	2.2×10^2	17.7	3.89×10^3	4.8×10^2	14.7	7.05×10^3
	1500	1.9×10^2	9.9	1.88×10^3	4.6×10^2	7.8	3.57×10^3
6/30*	0600	1.8×10^2	17.7	3.18×10^3	3.9×10^2	13.0	5.05×10^3
	1500	3.6×10^2					
7/1	0600	2.7×10^2					
	1500	2.1×10^2					
7/2	0600	1.8×10^2					
	1500	1.3×10^2					
7/3	0600	1.1×10^2					
	1500	1.0×10^2					
7/4	0600	8.4×10^1					
	1500	5.6×10^1					
7/5	0600	1.0×10^2					
	1500	7.6×10^1					
7/6	0600	6.6×10^1					

*A group composite milk sample collected after this date

TABLE A-11. (Continued)

		Cow 43			Cow 45		
Date	Time	pCi/liter	Liters	Total pCi	pCi/liter	Liters	Total pCi
6/21	0600	4.3×10^2	13.0	5.57×10^3	5.0×10^2	13.0	6.48×10^3
	1500	2.0×10^3	13.0	2.59×10^4	3.7×10^3	8.6	3.19×10^4
6/22	0600	2.6×10^3	14.7	3.81×10^4	2.5×10^3	13.0	3.24×10^4
	1500	1.7×10^3	9.5	1.61×10^4	1.4×10^3	7.8	1.08×10^4
6/23	0600	1.3×10^3	17.7	2.30×10^4	9.3×10^2	16.0	1.48×10^4
	1500	1.5×10^3	7.8	1.16×10^4	1.4×10^3	7.8	1.08×10^4
6/24	0600	7.7×10^2	16.8	1.29×10^4	1.1×10^3	16.4	1.80×10^4
	1500	1.4×10^3	6.9	9.67×10^3	1.2×10^3	6.0	7.25×10^3
6/25	0600	9.3×10^2	13.8	1.28×10^4	8.7×10^2	16.0	1.39×10^4
	1500	1.0×10^3	9.5	9.50×10^3	9.4×10^2	8.6	8.12×10^3
6/26	0600	8.5×10^2	13.0	1.10×10^4	6.8×10^2	13.0	8.81×10^3
	1500	9.0×10^2	9.1	8.16×10^3	6.9×10^2	8.6	5.96×10^3
6/27	0600	8.0×10^2	16.0	1.27×10^4	5.2×10^2	16.0	8.31×10^3
	1500	7.8×10^2	8.2	6.40×10^3	5.7×10^2	7.3	4.18×10^3
6/28	0600	6.3×10^2	15.1	9.52×10^3	5.0×10^2	14.7	7.34×10^3
	1500	4.9×10^2	8.2	4.02×10^3	4.7×10^2	8.2	3.85×10^3
6/29	0600	5.0×10^2	15.6	7.77×10^3	4.0×10^2	14.3	5.70×10^3
	1500	5.1×10^2	8.6	4.40×10^3	3.5×10^2	6.0	2.11×10^3
6/30*	0600	3.9×10^2	15.6	6.06×10^3	3.3×10^2	15.1	4.98×10^3

*A group composite milk sample collected after this date(see data on p. 57).

TABLE A-12. ^{131}I LEVELS IN MILK FOR GROUP II COWS.

		Cow 5			Cow 26		
Date	Time	pCi/liter	Liters	Total pCi	pCi/liter	Liters	Total pCi
6/21	0600						
	1500	1.9×10^4	8.6	1.64×10^5	3.5×10^4	15.6	5.4×10^5
6/22	0600	3.5×10^4	13.0	4.53×10^5	4.9×10^4	16.8	8.25×10^5
	1500	4.2×10^4	5.6	2.35×10^5	1.4×10^4	9.1	1.27×10^5
6/23	0600	4.5×10^4	11.2	5.05×10^5	3.3×10^4	19.0	6.27×10^5
	1500	4.1×10^4	7.8	3.18×10^5	4.5×10^4	9.5	4.27×10^5
6/24	0600	2.9×10^4	13.0	3.75×10^5	4.0×10^4	19.0	7.60×10^5
	1500	3.0×10^4	4.3	1.29×10^5	3.3×10^4	8.2	2.70×10^5
6/25	0600	3.3×10^4	10.8	3.56×10^5	2.8×10^4	17.3	4.83×10^5
	1500	3.0×10^4	6.9	2.07×10^5	3.1×10^4	9.5	2.94×10^5
6/26	0600	2.9×10^4	11.2	3.25×10^5	2.5×10^4	16.8	4.21×10^5
	1500	3.5×10^4	6.0	2.11×10^5	2.6×10^4	9.9	2.58×10^5
6/27	0600	3.0×10^4	13.8	4.14×10^5	2.3×10^4	17.7	4.07×10^5
	1500	3.5×10^4	6.5	2.26×10^5	2.5×10^4	11.2	2.80×10^5

TABLE A-12. (Continued)

		Cow 5			Cow 26		
Date	Time	pCi/liter	Liters	Total pCi	pCi/liter	Liters	Total pCi
6/28	0600	2.4×10^4	11.2	2.69×10^5	2.5×10^4	16.8	4.21×10^5
	1500	3.2×10^4	6.5	2.07×10^5	2.8×10^4	11.2	3.14×10^5
6/29	0600	2.5×10^4	10.8	2.70×10^5	2.2×10^4	18.1	3.99×10^5
	1500	1.8×10^4	6.5	1.16×10^5	1.6×10^4	8.6	1.38×10^5
6/30	0600	8.6×10^3	11.2	9.65×10^4	8.3×10^3	18.1	1.50×10^5
	1500	7.5×10^3	6.9	5.18×10^4	6.4×10^3	10.8	6.91×10^4
7/1	0600	3.0×10^3	10.8	3.24×10^4	3.2×10^3	16.4	5.25×10^4
	1500	1.9×10^3	6.5	1.23×10^4	2.0×10^3	11.2	2.24×10^4
7/2*	0600	1.2×10^3					
	1500	8.1×10^2					
7/3	0600	5.4×10^2					
	1500	4.5×10^2					
7/4	0600	4.1×10^2					
	1500	2.8×10^2					
7/5	0600	2.8×10^2					
	1500	2.5×10^2					
7/6	0600	2.2×10^2					

*A group composite milk sample collected after this date.

TABLE A-12- (Continued)

		Cow 29			Cow 47		
Date	Time	pCi/liter	Liters	Total pCi	pCi/liter	Liters	Total pCi
6/21	1500	1.9×10^4	4.8	9.02×10^4	3.7×10^4	13.0	4.79×10^5
6/22	0600	1.5×10^4	5.2	7.77×10^4	5.9×10^4	13.0	7.64×10^5
	1500	4.4×10^4	5.2	2.28×10^5	5.5×10^4	10.8	5.94×10^5
6/23	0600	1.8×10^4	8.2	1.47×10^5	5.6×10^4	13.8	7.74×10^5
	1500	1.5×10^4	3.9	5.83×10^4	5.3×10^4	11.7	6.18×10^5
6/24	0600	1.6×10^4	8.6	1.38×10^5	3.9×10^4	16.0	6.23×10^5
	1500	1.4×10^4	2.6	3.62×10^4	3.9×10^4	9.1	3.53×10^5
6/25	0600	1.1×10^4	7.3	8.07×10^4	2.3×10^4	15.6	3.57×10^5
	1500	1.2×10^4	4.8	5.70×10^4	4.0×10^4	9.1	3.62×10^5
6/26	0600	1.3×10^4	6.9	8.98×10^4	3.3×10^4	12.5	4.13×10^5
	1500	1.1×10^4	4.3	4.75×10^4	3.5×10^4	11.7	4.08×10^5
6/27	0600	8.3×10^3	7.8	6.45×10^4	3.5×10^4	14.7	5.14×10^5
	1500	8.9×10^3	5.2	4.61×10^4	3.7×10^4	8.6	3.19×10^5
6/28	0600	9.5×10^3	7.3	6.97×10^4	3.1×10^4	15.1	4.68×10^5
	1500	9.4×10^3	3.5	3.24×10^4	3.0×10^4	11.2	3.36×10^5
6/29	0600	7.1×10^3	7.8	5.52×10^4	2.6×10^4	15.6	4.04×10^5
	1500	6.7×10^3	3.5	2.31×10^4	1.8×10^4	8.6	1.55×10^5
6/30	0600	3.3×10^3	6.9	2.28×10^4	9.5×10^3	13.0	1.23×10^5
	1500	2.7×10^3	4.3	1.16×10^4	7.4×10^3	9.1	6.71×10^4
7/1*	0600	1.3×10^3	6.9	8.98×10^3	3.7×10^3	14.3	5.27×10^4
	1500	1.3×10^3	3.9	5.05×10^3	2.4×10^3	9.9	2.38×10^4

*A group composite milk sample collected after this date (see data on p. 60)

TABLE A-13. ^{131}I LEVELS IN MILK FOR GROUP III COWS.

		Cow 2			Cow 16		
Date	Time	pCi/liter	Liters	Total pCi	pCi/liter	Liters	Total pCi
6/21	1500	8.0×10^3	10.8	8.64×10^4	7.0×10^3	15.6	1.08×10^5
6/22	0600	8.1×10^3	12.1	9.79×10^4	8.7×10^3	15.6	1.35×10^5
	1500	8.5×10^3	6.0	5.14×10^4	1.2×10^4	8.6	1.03×10^5
6/23	0600	5.8×10^3	14.7	8.51×10^4	8.5×10^3	16.4	1.39×10^5
	1500	7.9×10^3	4.3	3.41×10^4	1.1×10^4	7.8	8.55×10^4
6/24	0600	4.5×10^3	15.1	6.80×10^4	7.6×10^3	17.7	1.34×10^5
	1500	4.0×10^3	4.3	1.72×10^4	8.1×10^3	5.6	4.54×10^4
6/25	0600	2.3×10^3	13.8	3.17×10^4	4.6×10^3	14.7	6.75×10^4
	1500	2.1×10^3	8.2	1.72×10^4	5.2×10^3	9.9	5.16×10^4
6/26	0600	1.1×10^3	12.1	1.33×10^4	3.0×10^3	14.7	4.40×10^4
	1500	1.0×10^3	6.9	6.91×10^3	2.4×10^3	10.8	2.59×10^4
6/27	0600	5.9×10^2	14.3	8.41×10^3	1.1×10^3	16.8	1.85×10^4
	1500	6.4×10^2	7.8	4.97×10^3	1.3×10^3	10.4	1.34×10^4
6/28	0600	4.5×10^2	12.1	5.44×10^3	7.1×10^2	17.3	1.22×10^4
	1500	4.7×10^2	6.9	3.24×10^3	8.2×10^2	9.5	7.79×10^3

TABLE A-13. (Continued)

		Cow 2			Cow 16		
Date	Time	pCi/liter	Liters	Total pCi	pCi/liter	Liters	Total pCi
6/29	0600	3.7×10^2	13.0	4.79×10^3	4.4×10^2	17.7	7.79×10^3
	1500	2.9×10^2	7.3	2.12×10^3	4.0×10^2	9.1	3.62×10^3
6/30*	0600	2.2×10^2	13.0	2.85×10^3	4.2×10^2	10.4	4.35×10^3
	1500	3.4×10^2					
7/1	0600	2.8×10^2					
	1500	2.0×10^2					
7/2	0600	2.1×10^2					
	1500	1.4×10^2					
7/3	0600	1.1×10^2					
	1500	1.1×10^2					
7/4	0600	1.0×10^2					
	1500	5.2×10^1					
7/5	0600	9.9×10^1					
	1500	8.2×10^1					
7/6	0600	9.7×10^1					

*A group composite milk sample collected after this date.

TABLE A-13. (Continued)

		Cow 44			Cow 13		
Date	Time	pCi/liter	Liters	Total pCi	pCi/liter	Liters	Total pCi
6/21	1500	1.4×10^4	13.4	1.87×10^5	2.2×10^3	17.7	3.89×10^4
6/22	0600	1.1×10^4	16.8	1.85×10^5	3.7×10^3	16.4	6.07×10^4
	1500	1.4×10^4	10.8	1.51×10^5	3.2×10^3	13.0	4.14×10^4
6/23	0600	9.6×10^3	16.8	1.61×10^5	3.2×10^3	21.2	6.77×10^4
	1500	1.0×10^4	9.5	9.50×10^4	4.6×10^3	11.2	5.16×10^4
6/24	0600	6.7×10^3	18.1	1.21×10^5	3.7×10^3	21.6	7.99×10^4
	1500	6.4×10^3	6.9	4.42×10^4	3.5×10^3	9.1	3.17×10^4
6/25	0600	3.5×10^3	19.0	6.65×10^4	2.2×10^3	18.6	4.08×10^4
	1500	4.3×10^3	12.1	5.20×10^4	2.1×10^3	13.8	2.90×10^4
6/26	0600	2.5×10^3	16.4	4.10×10^4	1.4×10^3	16.8	2.35×10^4
	1500	1.9×10^3	10.8	2.05×10^4	1.1×10^3	12.1	1.33×10^4
6/27	0600	1.3×10^3	18.1	2.35×10^4	8.3×10^2	21.2	1.75×10^4
	1500	1.5×10^3	9.5	3.99×10^4	8.2×10^2	12.5	3.00×10^4
6/28	0600	8.8×10^2	16.0	1.40×10^4	6.5×10^2	13.8	8.98×10^3
	1500	1.0×10^3	9.5	9.50×10^3	6.0×10^2	12.5	7.51×10^3
6/29	0600	6.6×10^2	16.8	1.11×10^4	4.7×10^2	21.6	1.01×10^4
	1500	5.7×10^2	9.5	5.41×10^3	3.5×10^2	11.7	4.08×10^3
6/30*	0600	3.7×10^2	13.4	4.95×10^3	3.1×10^2	17.3	5.35×10^3

*A group composite milk sample collected after this date (see data on p.63)

TABLE A-14. ^{131}I LEVELS IN MILK FOR GROUP IV COWS.

		Cow 12			Cow 15		
Date	Time	pCi/liter	Liters	Total pCi	pCi/liter	Liters	Total pCi
6/21	1500	1.4×10^5	11.7	1.63×10^6	9.0×10^4	15.6	1.39×10^6
6/22	0600	1.3×10^5	11.2	1.46×10^6	9.4×10^4	17.3	1.62×10^6
	1500	1.5×10^5	8.6	1.29×10^6	1.1×10^5	9.1	9.97×10^5
6/23	0600	1.1×10^5	15.6	1.71×10^6	8.7×10^4	16.8	1.46×10^6
	1500	1.7×10^5	7.3	1.31×10^6	9.3×10^4	7.8	7.23×10^5
6/24	0600	1.1×10^5	18.1	1.99×10^6	6.3×10^4	19.4	1.22×10^6
	1500	1.7×10^5	5.2	8.81×10^5	6.5×10^4	7.3	4.77×10^5
6/25	0600	1.5×10^5	15.6	2.33×10^6	5.4×10^4	15.6	8.39×10^5
	1500	1.2×10^5	12.1	1.45×10^6	5.8×10^4	13.0	7.51×10^5
6/26	0600	9.5×10^4	13.0	1.23×10^6	4.9×10^4	12.5	6.13×10^5
	1500	8.0×10^4	8.6	6.91×10^5	4.4×10^4	10.8	4.75×10^5
6/27	0600	5.2×10^4	15.1	7.86×10^5	3.2×10^4	19.4	6.22×10^5
	1500	6.9×10^4	8.2	5.66×10^5	3.2×10^4	9.5	3.04×10^5
6/28	0600	4.7×10^4	13.8	6.49×10^5	2.3×10^4	14.7	3.37×10^5
	1500	5.0×10^4	9.1	4.53×10^5	2.5×10^4	10.8	2.70×10^5

TABLE A-14. (Continued)

		Cow 12			Cow 15		
Date	Time	pCi/liter	Liters	Total pCi	pCi/liters	Liters	Total pCi
6/29	0600	3.6×10^4	15.1	5.44×10^5	1.8×10^4	14.7	2.64×10^5
	1500	2.8×10^4	7.3	2.05×10^5	1.7×10^4	10.4	1.76×10^5
6/30	0600	1.9×10^4	14.3	2.70×10^5	1.1×10^4	17.3	1.90×10^5
	1500	1.2×10^4	9.5	1.14×10^5	9.8×10^3	9.9	9.73×10^4
7/1*	0600	5.5×10^3					
	1500	4.1×10^3					
7/2	0600	2.4×10^3					
	1500	1.9×10^3					
7/3	0600	1.0×10^3					
	1500	9.1×10^2					
7/4	0600	5.3×10^2					
	1500	4.3×10^2					
7/5	0600	4.7×10^2					
	1500	4.2×10^2					
7/6	0600	3.5×10^2					

*A group composite milk sample collected after this date.

TABLE A-14. (Continued)

		Cow 17			Cow 18		
Date	Time	pCi/liter	Liters	Total pCi	pCi/liter	Liters	Total pCi
6/21	1500	6.5×10^4	7.3	4.77×10^5	1.1×10^5	10.8	1.18×10^6
6/22	0600	5.4×10^4	9.5	5.13×10^5	9.4×10^4	13.8	1.29×10^6
	1500	6.7×10^4	7.3	4.92×10^5	1.1×10^5	6.5	7.12×10^5
6/23	0600	5.1×10^4	10.8	5.50×10^5	6.8×10^4	15.6	1.05×10^6
	1500	6.9×10^4	5.6	3.87×10^5	8.7×10^4	5.6	4.88×10^5
6/24	0600	4.7×10^4	10.8	5.07×10^5	5.9×10^4	16.4	9.68×10^5
	1500	4.6×10^4	5.2	2.38×10^5	6.9×10^4	5.2	3.57×10^5
6/25	0600	4.5×10^4	10.4	4.66×10^5	7.3×10^4	13.0	9.46×10^5
	1500	4.5×10^4	6.0	2.72×10^5	7.1×10^4	7.8	5.52×10^5
6/26	0600	3.5×10^4	10.8	3.78×10^5	5.1×10^4	13.0	6.60×10^5
	1500	3.1×10^4	6.0	1.87×10^5	4.7×10^4	7.3	3.45×10^5
6/27	0600	2.4×10^4	12.1	2.90×10^5	3.5×10^4	14.3	4.98×10^5
	1500	2.8×10^4	5.6	1.57×10^5	2.9×10^4	8.2	2.38×10^5
6/28	0600	2.1×10^4	10.4	2.17×10^5	2.2×10^4	14.3	3.13×10^5
	1500	2.4×10^4	9.1	2.17×10^5	2.3×10^4	6.0	1.39×10^5
6/29	0600	1.4×10^4	9.9	1.39×10^5	1.4×10^4	13.8	1.93×10^5
	1500	1.3×10^4	6.5	8.42×10^4	1.2×10^4	7.8	9.33×10^4
6/30*	0600	7.3×10^3	10.4	7.56×10^4	7.7×10^3	13.4	1.03×10^5
	1500	6.8×10^3	7.3	4.99×10^4	6.5×10^3	9.5	6.17×10^4

*A group composite milk sample collected after this date (see data on p. 66)

TABLE A-15. ^{131}I LEVELS IN MILK FOR GROUP V COWS

		Cow 19			Cow 24		
Date	Time	pCi/liter	Liters	Total pCi	pCi/liter	Liters	Total pCi
6/21	0600	N	12.1			4.3	
	1500	6.0×10^1	10.8	6.48×10^2	5.5×10^1	4.8	2.61×10^2
6/22	0600	3.0×10^1	13.0	3.49×10^2	ND	3.9	
	1500	7.0×10^1	7.8	5.75×10^2	2.5×10^2	3.5	8.64×10^2
6/23	0600	1.3×10^2	15.1	1.96×10^3	2.4×10^2	5.6	1.34×10^3
	1500	1.7×10^2	8.2	1.39×10^3	4.0×10^2	3.0	1.20×10^3
6/24	0600	1.4×10^2	14.7	2.05×10^3	1.2×10^2	5.2	6.22×10^2
	1500	2.1×10^2	7.8	1.63×10^3	5.4×10^2	3.5	1.86×10^3
6/25	0600	4.9×10^2	14.3	6.98×10^3	7.4×10^2	4.3	3.19×10^3
	1500	5.2×10^2	9.5	4.94×10^3	3.8×10^2	2.6	9.84×10^2
6/26	0600	4.1×10^2	13.4	5.49×10^3	2.8×10^2	3.5	9.67×10^2
	1500	2.6×10^2	8.6	2.24×10^3	4.4×10^2	3.0	1.33×10^3
6/27	0600	2.2×10^2	14.3	3.13×10^3	3.7×10^2	3.9	1.43×10^3
	1500	2.2×10^2	9.5	2.09×10^3	3.9×10^2	3.9	1.51×10^3
6/28	0600	2.2×10^2	14.3	3.13×10^3	3.0×10^2	4.3	1.29×10^3
	1500	2.7×10^2	8.6	2.33×10^3	3.5×10^2	3.0	1.05×10^3

TABLE A-15. (Continued)

		Cow 19			Cow 24		
Date	Time	pCi/liter	Liters	Total pCi	pCi/liter	Liters	Total pCi
6/29	0600	1.8×10^2	14.7	2.64×10^3	2.0×10^2	4.3	8.64×10^2
	1500	1.1×10^2	9.1	9.97×10^2	1.4×10^2	2.6	3.62×10^2
6/30*	0600	1.4×10^2	14.7	2.05×10^3	1.6×10^2	4.3	6.91×10^2
	1500	1.5×10^2					
7/1	0600	1.1×10^2					
	1500	7.0×10^1					
7/2	0600	8.0×10^1					
	1500	4.0×10^1					
7/3	0600	6.0×10^1					
	1500	7.0×10^1					
7/4	0600	5.0×10^1					
	1500	9.0×10^1					
7/5	0600	8.0×10^1					
	1500	6.0×10^1					
7/6	0600	6.0×10^1					

*A group composite milk sample collected after this date.

TABLE A-16. MAXIMUM AND MINIMUM ^{131}I VALUES FOR INDIVIDUAL COWS WITHIN EACH GROUP.

		Group I				Group I				
Date	Time	Maximum (pCi/l)	Cow	Milk Liters	PBI % (μg)	Minimum (pCi/l)	Cow	Milk Liters	PBI % (μg)	Max/Min Ratio
6/21	a.m.	6.7×10^2	21	16.8	1.45	3.7×10^2	28	13.4	2.05	1.8
	p.m.	3.7×10^3	45	8.6	3.25	7.5×10^2	21	14.7	1.45	4.9
6/22	a.m.	2.6×10^3	43	14.7	2.85	1.4×10^2	21	16.8	1.45	1.9
	p.m.	1.7×10^3	43	9.5	2.85	4.6×10^2	21	12.5	1.45	3.7
6/23	a.m.	1.3×10^3	43	17.7	2.85	3.7×10^2	21	19.4	1.45	3.5
	p.m.	1.5×10^3	43	7.8	2.85	4.2×10^2	21	10.4	1.45	3.6
6/24	a.m.	1.1×10^3	{28 45	15.1 16.4	2.05 3.25}	3.5×10^2	21	19.4	1.45	3.1
	p.m.	1.4×10^3	43	6.9	2.85	4.8×10^2	21	8.2	1.45	2.9
6/25	a.m.	9.3×10^2	43	13.8	2.85	2.8×10^2	21	17.7	1.45	3.3
	p.m.	1.0×10^3	43	9.5	2.85	2.6×10^2	21	12.1	1.45	3.8
6/26	a.m.	8.5×10^2	43	13.0	2.85	3.5×10^2	21	17.3	1.45	2.4
	p.m.	9.0×10^2	43	9.1	2.85	2.8×10^2	21	10.4	1.45	3.2
6/27	a.m.	8.0×10^2	43	16.0	2.85	2.6×10^2	21	17.3	1.45	3.1
	p.m.	7.8×10^2	43	8.2	2.85	3.1×10^2	21	13.0	1.45	2.5
6/28	a.m.	6.3×10^2	{43 28	15.1 13.0	2.85 2.05}	3.1×10^2	21	17.3	1.45	2.0
	p.m.	4.9×10^2	43	8.2	2.85	3.4×10^2	21	11.2	1.3	1.4

TABLE A-16. (Continued)

Date	Time	Maximum (pCi/l)	Cow	Milk Liters	PBI % (μg)	Minimum (pCi/l)	Cow	Milk Liters	PBI % (μg)	Max/Min Ratio
		Group I				Group I				
6/29	a.m.	5.0×10^2	43	15.6	2.85	2.2×10^2	21	17.7	1.45	2.3
	p.m.	5.1×10^2	{43 43	8.6 15.6	2.85 2.85}	1.9×10^2	21	9.9	1.45	2.7
6/30	a.m.	3.9×10^2	28	13.0	2.05	1.8×10^2	21	17.7	1.45	2.2
										Average 2.9 ± 0.9
		Group II				Group II				
6/21	p.m.	3.7×10^4	47	13.0	3.25	1.9×10^4	{5 29	8.6 4.8	2.90 2.50}	1.9
6/22	a.m.	5.9×10^4	47	13.0	3.25	1.5×10^4	29	5.2	2.50	3.9
	p.m.	5.5×10^4	47	10.8	3.25	1.4×10^4	26	9.1	3.35	3.9
6/23	a.m.	5.6×10^4	47	13.8	3.25	1.8×10^4	29	8.2	2.50	3.1
	p.m.	5.3×10^4	47	11.7	3.25	1.5×10^4	29	3.9	2.50	3.5
6/24	a.m.	4.0×10^4	26	19.0	3.35	1.6×10^4	29	8.6	2.50	2.5
	p.m.	3.9×10^4	47	9.1	3.25	1.4×10^4	29	2.6	2.50	2.8

TABLE A-16. (Continued)

		Group II				Group II				
Date	Time	Maximum (pCi/l)	Cow	Milk Liters	PBI % (μg)	Minimum (pCi/l)	Cow	Milk Liters	PBI % (μg)	Max/Min Ratio
6/25	a.m.	3.3×10^4	5	10.8	2.90	1.1×10^4	29	7.3	2.50	3.0
	p.m.	4.0×10^4	47	9.1	3.25	1.2×10^4	29	4.8	2.50	3.3
6/26	a.m.	3.3×10^4	47	12.5	3.25	1.3×10^4	29	6.9	2.50	2.5
	p.m.	3.5×10^4	{5 47	6.0 11.7	2.90 3.25}	1.1×10^4	29	4.3	2.50	3.2
6/27	a.m.	3.5×10^4	47	14.7	3.25	8.3×10^3	29	7.8	2.50	4.2
	p.m.	3.7×10^4	47	8.6	3.25	8.9×10^3	29	5.2	2.50	4.2
6/28	a.m.	3.1×10^4	47	15.1	3.25	9.5×10^3	29	7.3	2.50	3.3
	p.m.	3.2×10^4	5	6.5	2.90	9.4×10^3	29	3.5	2.50	3.4
6/29	a.m.	2.6×10^4	47	15.6	3.25	7.1×10^3	29	7.8	2.50	3.7
	p.m.	1.8×10^4	{47 5	8.6 6.5	3.25 2.90}	6.7×10^3	29	3.5	2.50	2.7
6/30	a.m.	9.5×10^3	47	13.0	3.25	3.3×10^3	29	6.9	2.50	2.9
	p.m.	7.5×10^3	5	6.9	2.90	2.7×10^3	29	4.3	2.50	2.8
7/1	a.m.	3.7×10^3	47	14.3	3.25	1.3×10^3	29	6.9	2.50	2.8
	p.m.	2.4×10^3	47	9.9	3.25	1.3×10^3	29	3.9	2.50	1.8
										Average 3.1 ± 0.7

TABLE A-16. (Continued)

Date	Time	Group III Maximum (pCi/l)	Cow	Milk Liters	PBI % (μg)	Group III Minimum (pCi/l)	Cow	Milk Liters	PBI % (μg)	Max/Min Ratio
6/21	p.m.	1.4×10^4	44	13.4	2.10	2.2×10^3	13	17.7	2.30	6.4
6/22	a.m.	1.1×10^4	44	16.8	2.10	3.7×10^3	13	16.4	2.30	3.0
	p.m.	1.4×10^4	44	10.8	2.10	3.2×10^3	13	13.0	2.30	4.4
6/23	a.m.	9.6×10^3	44	16.8	2.10	3.2×10^3	13	21.2	2.30	3.0
	p.m.	1.1×10^4	16	7.8	2.40	4.6×10^3	13	11.2	2.30	2.4
6/24	a.m.	7.6×10^3	16	17.7	2.40	3.7×10^3	13	21.6	2.30	2.0
	p.m.	8.1×10^3	16	5.6	2.40	3.5×10^3	13	9.1	2.30	2.3
6/25	a.m.	4.6×10^3	16	14.7	2.40	2.2×10^3	13	18.6	2.30	2.1
	p.m.	5.2×10^3	16	9.9	2.40	2.1×10^3	{2 13	8.2 13.8	2.70 2.30}	2.5
6/26	a.m.	3.0×10^3	16	14.7	2.40	1.1×10^3	2	12.1	2.70	2.7
	p.m.	2.4×10^3	16	10.8	2.40	1.0×10^3	2	6.9	2.70	2.4
6/27	a.m.	1.3×10^3	44	18.1	2.10	5.9×10^2	2	14.3	2.70	2.2
	p.m.	1.5×10^3	44	9.5	2.10	6.4×10^2	2	7.8	2.70	2.3
6/28	a.m.	8.8×10^2	44	16.0	2.10	4.5×10^2	2	12.1	2.70	2.0
	p.m.	1.0×10^3	44	9.5	2.10	4.7×10^2	2	6.9	2.70	2.1

TABLE A-16. (Continued)

Date	Time	Maximum (pCi/l)	Cow	Milk Liters	PBI % (µg)	Minimum (pCi/l)	Cow	Milk Liters	PBI % (µg)	Max/Min Ratio
		Group III				Group III				
6/29	a.m.	6.6×10^2	44	16.8	2.10	3.7×10^2	2	13.0	2.70	1.8
	p.m.	5.7×10^2	44	9.5	2.10	2.9×10^2	2	7.3	2.70	2.0
6/30	a.m.	4.2×10^2	16	10.4	2.40	2.2×10^2	2	13.0	2.70	1.9
									Average	2.6 ± 1.1
		Group IV				Group IV				
6/21	p.m.	1.4×10^5	12	11.7	1.85	6.5×10^4	17	7.3	[1]	2.2
6/22	a.m.	1.3×10^5	12	11.2	1.85	5.4×10^4	17	9.5		2.4
	p.m.	1.5×10^5	12	8.6	1.85	6.7×10^4	17	7.3		2.2
6/23	a.m.	1.1×10^5	12	15.6	1.85	5.1×10^4	17	10.8		2.2
	p.m.	1.7×10^5	12	7.3	1.85	6.9×10^4	17	5.6		2.5
6/24	a.m.	1.1×10^5	12	18.1	1.85	4.7×10^4	17	10.8		2.3
	p.m.	1.7×10^5	12	5.2	1.85	4.6×10^4	17	5.2		3.7
6/25	a.m.	1.5×10^5	12	15.6	1.85	4.5×10^4	17	10.4		3.3
	p.m.	1.2×10^5	12	12.1	1.85	4.5×10^4	17	6.0		2.7

[1]No blood data available for Cow 17

TABLE A-16. (Continued)

		Group IV				Group IV				
Date	Time	Maximum (pCi/l)	Cow	Milk Liters	PBI % (µg)	Minimum (pCi/l)	Cow	Milk Liters	PBI % (µg)	Max/Min Ratio
6/26	a.m.	9.5×10^4	12	13.0	1.85	3.5×10^4	17	10.8	[1]	2.7
	p.m.	8.0×10^4	12	8.6	1.85	3.1×10^4	17	6.0		2.6
6/27	a.m.	5.2×10^4	12	15.1	1.85	2.4×10^4	17	12.1		2.2
	p.m.	6.9×10^4	12	8.2	1.85	2.8×10^4	17	5.6		2.5
6/28	a.m.	4.7×10^4	12	13.8	1.85	2.1×10^4	17	10.4		2.2
	p.m.	5.0×10^4	12	9.1	1.85	2.3×10^4	18	6.0	2.10	2.2
6/29	a.m.	3.6×10^4	12	15.1	1.85	1.4×10^4	{17 18	9.9 13.8	2.10}	2.6
	p.m.	2.8×10^4	12	7.3	1.85	1.2×10^4	18	7.8	2.10	2.3
6/30	a.m.	1.9×10^4	12	14.3	1.85	7.3×10^3	17	10.4		2.6
	p.m.	1.2×10^4	12	9.5	1.85	6.5×10^3	18	9.5	2.10	1.8
									Average	2.5 ± 0.4

[1]No blood data available for Cow 17

*{} denote two cows with the same activity concentrations (pCi/l).

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