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October 26, 1959

C-127

Mr. J. Z. Holland, Chief
Fallout Studies Branch
Atomic Energy Commission
Division of Biology and Medicine
Washington 25, D. C.

Subject: Report No. ARF 3127-9 (Letter Report)
Contract No. AT(11-1)4626

Dear Mr. Holland:

I. INTRODUCTION

This is the ninth letter report on ARF Project C 127, entitled "Preliminary Studies of Scavenging Systems Related to Radioactive Fallout." This report covers the period from August 1 to October 1, 1959.

II. PHASE I - AIR SAMPLING

During this report period one test with the Andersen sampler and three with the cyclone separator were completed. The Andersen sampler covers the period from May 28 to September 8, 1959; approximately 103,000 cu ft of air was sampled in this time. A new test started September 10, 1959, has sampled about 29,000 cu ft to date. The cyclone separator samples cover the periods from July 28 to August 17, August 20 to September 8, and September 11 to September 30, 1959. The volumes of air sampled during these periods were 98,176, 100,590, and 109,503 cu ft, respectively. The dust retained in each separator and on the millipore filter was weighed before it was sent to the New York Operations Office for analysis.

The strontium-90 and total beta activities of the samples analyzed to date are presented in Tables 1 and 2. Data on precipitation in the Chicago area during the sampling periods are given in Table 3, Table 4, and Fig. 1.

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The Anderson sampler data (Table 1) show a general increase in radioactivity since July 1958. The total beta activity of Test 2 is 52% higher than that of Test 1. Similarly, the strontium-90 activity is 38% higher. The strontium-90 activity of Test 3 is 144% higher than that of Test 2 and 236% higher than that of Test 1. Most of the 236% increase is due to the high activity of the submicron particles which bypassed the samplers and were collected on the filters.

Table 1

RADIOACTIVITY ASSOCIATED WITH DRY ATMOSPHERIC PARTICLES
CLASSIFIED BY THE ANDERSEN SAMPLER

Test	Date	Particle Size Range	Radioactivity, <u>$\mu\text{mc}/100,000 \text{ cu ft}$</u>	
			Total Beta	Strontium-90
1	7/15/58-10/20/58	5.5-7+ microns	83	0.7
		1.0-5.5 microns	593	8.3
		<1 micron	76	3.8
		Millipore filter	563	16.0
			<u>1,315</u>	<u>28.8</u>
2	11/18/58-2/13/59	>7 microns	75	1.1
		5.5-10.0 microns	78	4.5
		3.5-5.5 microns	243	3.1
		2.0-3.5 microns	272	3.6
		1.0-2.0 microns	601	11.0
		<1 micron	210	5.7
		Millipore filter	520	10.6
			<u>1,999</u>	<u>39.6</u>
3	2/23/59-5/26/59	>7 microns	No	2.5
		5.5-10.0 microns	counts	1.5
		3.5-5.5 microns	taken	1.9
		2.0-3.5 microns		13.4
		1.0-2.0 microns		15.6
		<1 micron		19.5
		Millipore filter		42.3
				<u>96.7</u>

The radioactivity associated with the particles classified by the single cyclone-filter system during five sampling periods covering the past winter is shown in Table 2. The total beta activity of the dust retained in the cyclone separator, i.e., activity due to larger particles, varies from 16 to 33% and averages 27% of the beta activity for all the dust collected. The strontium-90 activity of the portion retained by the cyclone varies from 14-26% and averages 20% of the activity for the whole system. The radioactivity seems to vary randomly during the five periods sampled.

Table 2

RADIOACTIVITY ASSOCIATED WITH DRY ATMOSPHERIC PARTICLES
CLASSIFIED BY THE CYCLONE SEPARATOR

Test	Date	Particle Size Range	Radioactivity, <i>μ</i> c/100,000 cu ft	
			Total Beta	Strontium-90
A	11/24/58-12/3/58	Retained by separator	1,730	6.7
		Passed by separator	3,840	26.2
			<u>5,570</u>	<u>32.9</u>
B	12/3/58-12/12/58	Retained by separator	1,380	5.8
		Passed by separator	2,900	16.5
			<u>4,280</u>	<u>22.3</u>
C	12/15/58-12/22/58	Retained by separator	1,385	3.9
		Passed by separator	4,050	24.4
			<u>5,435</u>	<u>28.3</u>
D	12/22/58-12/29-58	Retained by separator	1,483	7.3
		Passed by separator	7,490	33.0
			<u>8,973</u>	<u>40.3</u>
E	1/22/59-1/30/59	Retained by separator	635	10.3
		Passed by separator	1,940	38.7
			<u>2,575</u>	<u>49.0</u>

Some evidence of a correlation between beta activity and snowfall is apparent from an examination of Table 4, where the beta activity and the amounts of snowfall and total precipitation are listed. Note that by placing the tests in an increasing order of beta activity, the series EBACD is obtained. By arranging the amounts of snowfall in decreasing order, the series BEACD results. Thus, an inverse relationship is evident. A decreasing series based on the total precipitation is AEBDC.

Table 3

PRECIPITATION AT MIDWAY AIRPORT IN CHICAGO DURING SAMPLING
BY THE ANDERSEN SAMPLER

Year	Month	Precipitation, in. of water	Snow- fall, in.	Departure from Norm, in.	Greatest Fall in 24 Hr, in.	Number of Days of Precipitation			
						.01-.1 in.	.1-.5 in.	.5-1 in.	>1 in.
1958	July	4.74		+2.01	1.69	13	7	4	1
	Aug	2.51		-0.68	1.18	9	7	2	0
	Sept	1.86		-1.37	1.03	9	4	1	1
	Oct	2.12		-0.44	0.81	5	4	2	0
	Nov	1.58	0.7	-0.75	0.61	10	7	1	0
	Dec	0.57	13.2	-1.38	0.28	8	2	0	0
1959	Jan	2.13	18.4	+0.29	0.78	9	8	2	0
	Feb	2.39	4.0	+0.98	0.94	10	8	1	0
	March	3.91	4.6	+1.06	1.48	14	6	2	1
	April	4.00	0.1	+1.18	2.15	14	6	2	1
	May	3.87		+0.21	1.09	16	8	2	1
	June	5.94		+1.79	4.58	7	4	2	1
	July	4.77		+2.04	1.32	13	8	4	0
	Aug	1.63		-1.56	1.14	7	3	1	1

Table 4

PRECIPITATION AT MIDWAY AIRPORT IN CHICAGO DURING SAMPLING
BY THE CYCLONE SEPARATOR

Test	Date	Total Precipitation, in. of water	Snowfall, in.	Beta Activity, μmc/100,000 cu ft
A	11/24/58-12/3/58	0.47	0.7	5,570
B	12/3/58-12/12/58	0.37	11.0	4,280
C	12/15/58-12/22/58	0.01	0.2	5,435
D	12/22/58-12/29/58	0.02	Trace	8,973
E	1/22/59-1/30/59	0.46	2.8	2,575

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Fig. 1. DAILY PRECIPITATION AT MIDWAY AIRPORT IN CHICAGO
DURING SAMPLING BY THE ANDERSEN SAMPLER

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III. PHASE II - LABORATORY STUDY OF SCAVENGING SYSTEMS

To determine the minute quantities of material captured by a water droplet, analysis by radioactivity was undertaken. According to the radioisotope catalog of the Atomic Energy Commission, the rare earth element dysprosium can be detected at concentrations of 10^{-11} g through neutron activation. Therefore dysprosium nitrate was purchased, and three standard water samples containing 1.2×10^{-5} , 1.2×10^{-8} , and 1.2×10^{-11} grams/cc were prepared. Aliquots of these standards were transferred to cork-stoppered Vycor vials. These vials were wrapped in paper tissue and placed into a polyethylene bottle. The bottle was placed in port B of the Armour Research Foundation reactor and irradiated for 2 hr. After activation the contents of each vial were rinsed into stainless steel planchettes. After evaporation the 655-kev peak of dysprosium was counted by using a 3 x 3-in. sodium iodide crystal and a 256 channel analyzer. No correlation between count rate and dysprosium concentration was obtained. The samples containing 1.2×10^{-8} and 1.2×10^{-11} g/cc were too low to count.

In a second experiment two vials containing 1.2×10^{-5} g of dysprosium were irradiated, and count rates were made on duplicate 10- λ aliquots from each vial. The 93-kev peak of dysprosium-165 was used for counting during this experiment. Good agreement was obtained on the count rate of the duplicate aliquots from each vial, but the count rate between the two vials was unsatisfactory. This indicates that relative position of the vials in the reactor is a factor which must be controlled.

IV. FUTURE WORK

Air sampling during rainless periods will continue. Special tubes are being fabricated so that the position of samples in the nuclear reactor can be duplicated. Once this is achieved, it is believed that dysprosium concentrations as low as 10^{-11} g/cc can be determined by activation analysis techniques. Future work on optical methods is also being planned.

V. RECORDS AND PERSONNEL

The data reported here are recorded in ARF Logbooks C 9230 and C 9032. Personnel who contributed to the project are S. Bernsen and Dr. C. E. Miller.

Respectfully submitted,

ARMOUR RESEARCH FOUNDATION
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