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THE EFFECT OF PACIFIC WEAPONS TESTING ON BACKGROUND ACTIVITIES IN THE STATE OF CALIFORNIA

by

L. Baurmash, J. W. Neel, R. F. Butts

91560 - 50054

Submitted by: Stafford L. Warren, M.D.
Director

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ABSTRACT

Air and fall-out sampling stations were established at Redding, Davis, Fresno, Los Angeles, and San Diego, California during the month of April, 1956 and operated through August 31, 1956. Daily air radioactivity concentrations and fall-out levels, measured approximately three days after each sample was completed, are presented in tabular and graphic form. Three major increases in air concentrations were noted in California during the following time periods: June 8 - 13, July 4 - 12, and July 22 - 30. The maximum daily concentrations detected at each station ranged from 4.15 $\mu\mu c/M^3$ at San Diego to 11.63 $\mu\mu c/M^3$ at Redding. Daily fall-out levels at individual stations were highly variable; the maxima ranged from 457.27 $\mu\mu c/ft^2$ at San Diego to 1,033.17 $\mu\mu c/ft^2$ at Los Angeles.

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THE EFFECT OF PACIFIC WEAPONS TESTING ON BACKGROUND ACTIVITIES IN THE STATE OF CALIFORNIA

In order to determine the effect of fall-out from weapons tests in the Pacific area during 1956, a nationwide network was established at the request of the Division of Biology and Medicine, Atomic Energy Commission. Various government agencies and AEC contractors cooperated in this worldwide monitoring program. As an adjunct to this program, the Atomic Energy Project at UCLA was requested to sample the fall-out at Los Angeles. Since data collected from more than the one station would lend itself to a better evaluation, a program of sampling was instituted at five stations located on a line approximately north to south through the State of California. The sampling stations were started one to three weeks prior to the beginning of the recent Test Series at the Pacific Proving Grounds in order to obtain an estimate of the background radiation and its variation at that time.

METHODS

Sampling stations were set up at Redding, Davis, Fresno, Los Angeles, and San Diego, California; the relative locations of these stations and the predominant surface air movement during the summer months are described in Fig. 1. Each station was maintained by two persons who were instructed in the operation of the equipment at that station. The persons who were selected had previous scientific training and/or experience, and some were connected with California State and Regional Civil Defense groups. All stations were in operation at least one week

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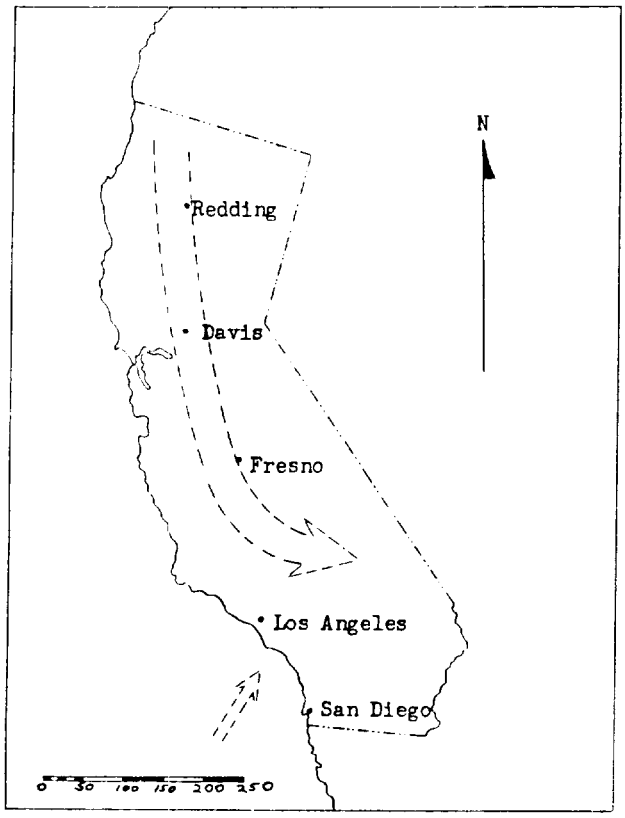

Fig. 1. Locations of UCLA-AEP Sampling Stations in California and the Predominant Surface Air Movement During Summer Months.*

* Personal communication, Trans-World Airlines Meteorology Section, International Airport, Los Angeles, California.

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prior to the initial shot in the Series. With the exception of a small number of samples, sample continuity was maintained for the duration of the collection period.

The equipment at each station consisted of a modified Parsons air sampler, gummed paper fall-out collector, rain collector and a background radiation recorder. Each station was located at least 100 feet from any building to minimize the influence of turbulence set up by vertical walls. The stations at Los Angeles and San Diego were located in the most ideal areas, i.e., in relatively open areas on knolls or hills.

The air sampler consisted of a pump capable of sampling 0.5 cubic meters of air per minute through an M.S.A. #1106 B glass fiber filter, four inches in diameter. Each sample was collected for a period of approximately 24 hours. The volume of air sampled was determined by averaging the initial and final flow-rates (determined by Bacharach "Florite" velocity meter calibrated against a Fischer and Porter "Flowrator") and multiplying this average by the duration of sample collection. The fall-out collector consisted of duplicate one half square foot gummed papers taped on horizontal metal plates mounted approximately three feet above the ground surface. The gummed papers were also exposed for 24 hours. The radiation recorder, consisting of a metal G-M tube (Nuclear Chicago Model 90 NB) mounted 18 inches above the ground surface, a rate-meter (Nuclear Chicago Model 1619), and an Esterline Angus tape recorder, was set up at each station to obtain a continuous 24-hour record of the radiation intensity in counts per

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minute. A polyethylene plastic rain collector, 7.5 inch diameter, was set up at each station to obtain 24-hour rainfall samples whenever rain occurred.

After each 24-hour sampling period, the air sample was sealed in a cellophane bag, and individual gummed papers were folded to enclose the sticky surface and likewise placed in a cellophane bag. The two types of samples, plus the Esterline Angus recorder tape and data sheet, describing weather conditions and air sample information, were mailed to the Atomic Energy Project at UCLA for analysis.

Air samples (enclosed in cellophane bag) and gummed papers were counted approximately 72 hours after sample termination in gas flow proportional counters as developed for this laboratory by Los Alamos Scientific Laboratory. The detector has an aluminized "mylar" window equivalent to 0.8 mgm/cm^2 and a sensitive area of 3.5" x 8". Radium D+E standards were used to correct the sample data for geometry.

Rain water samples were first filtered through a membrane filter (Millipore Type HA) in order to separate the insoluble active fraction from the soluble active fraction. The soluble fraction was evaporated to dryness. The two fractions were then counted in Halogen-filled G-M systems. A strontium90-yttrium90 standard was used to correct the sample data for geometry.

In addition, certain samples which indicated significant amounts of fall-out were radioautographed in order to determine the distribution of the radioactive particulate matter. Optical microscopic measurements of radioactive particles thus located were made on selected samples.

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DATA AND RESULTS

The daily levels of airborne and fall-out radioactivity detected at the five stations throughout the sampling period are tabulated in Appendix A for purposes of reference.

Background Radioactivity Levels: A study was made of the decay characteristics of air samples collected prior to the Test Series. For purposes of illustration, decay curves of pre-series air samples collected at the Los Angeles station are presented in Fig. 2. Samples collected at the remaining stations demonstrated similar fluctuation with respect to level of natural radioactivity and decay curve shape. The latter suggests variations in the relative contribution of short- and long-lived emitters.

The comparison of background decay curves of air samples collected at the several stations (Fig. 3) is based upon the average of from 10 to 20 individual curves of samples collected between April 9 and April 30, 1956 at each station. While the curves appear to be of the same family, the lower values at Los Angeles and San Diego suggest the influence of predominant "marine air" movement, with lower radon-thoron decay product concentration, contrasted to "continental air" at the northern, interior stations.

To avoid fluctuations in the contribution of the shorter-lived emitters, all subsequent gummed paper and air samples were routinely radioassayed at least 72 hours (and generally not more than 96 hours) after termination of sampling. TABLE I summarizes the background radioactivities of air and fall-out samples assayed three days after termination of sampling at the five stations.

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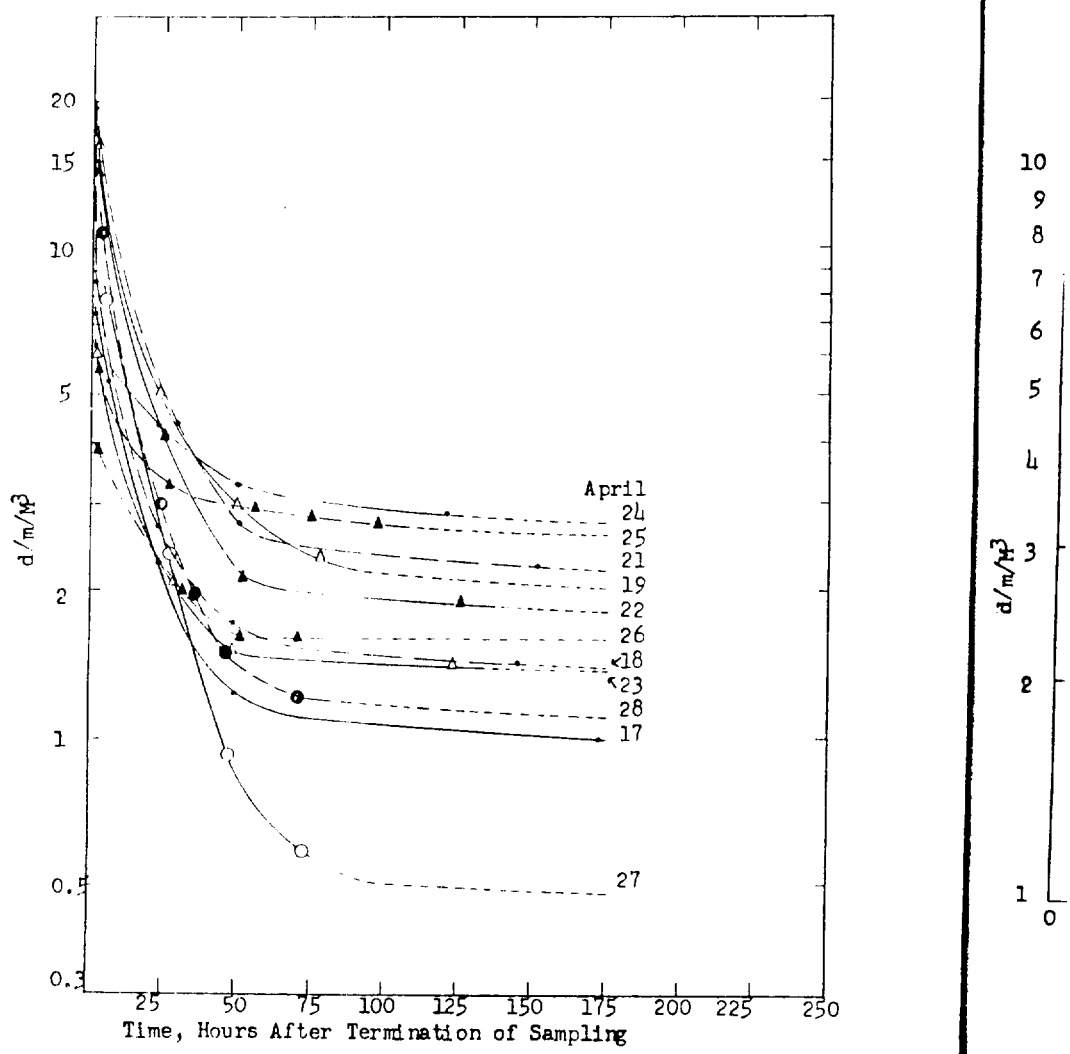

Fig. 2. Decay Curves of Pre-Series Air Samples Collected at Los Angeles Sampling Station During the Month of April, 1956.

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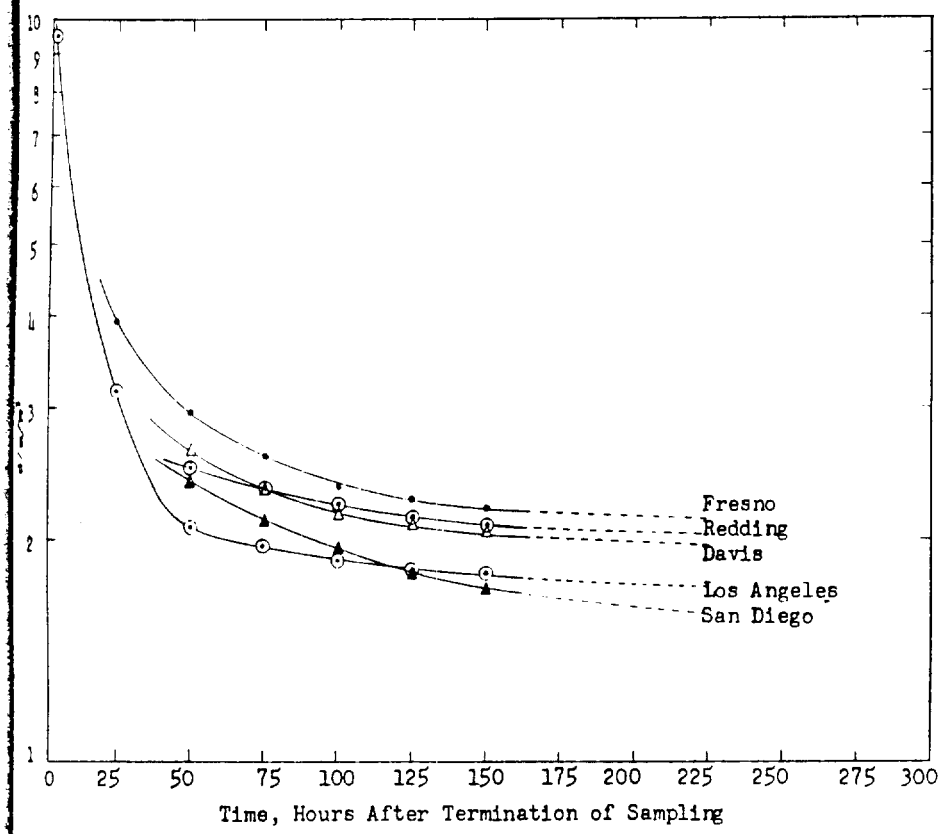

Fig. 3. Average Decay Curves of Pre-Series Air Samples.

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TABLE I

Background Air and Fall-out Concentrations at California Sampling Locations, April 1956
(24-hour Samples, Radioassayed Three Days after Termination)

Sample Location	Collection Dates	Air Samples			Gummed Papers		
		No. Samples	Range, $\mu\mu c/M^3$	Mean, $\mu\mu c/M^3$	No. Samples	Range, $\mu\mu c/ft^2$	Mean, $\mu\mu c/ft^2$
Redding	4/16-4/30	13	0.40-1.93	1.09	15	0-132.70	24.12
Davis	4/9 -4/30	21	0.34-2.45	0.96	22	0-100.45	25.56
Fresno	4/9 -4/30	20	0.30-2.50	1.16	21	0-141.36	31.17
Los Angeles	4/17-4/30	13	0.25-1.32	0.81	14	0-115.91	35.94
San Diego	4/9 -4/30	22	0.24-2.25	0.83	22	0-145.45	31.41

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During the five month sampling period there were a large number of zero fall-out values (31.9 per cent of the samples collected at Redding, 34.2 per cent at Davis, 37.1 per cent at Fresno, 41.9 per cent at Los Angeles, and 35.8 per cent at San Diego). These results suggest that gummed paper contamination, when detected, originates from fall-out from the stratospheric reservoir of fission product residues as cited by other investigators*, rather than from locally-occurring radon-thoron decay products. The average daily fall-out at the five California stations during the month of April, 1956 was approximately 30 $\mu\mu c/ft^2$.

Air Radioactivity Concentrations: The daily airborne activity detected at each station during the sampling period are plotted in Fig.4. Three major peaks in activity occurred during the following time periods: June 8 - 13, July 4 - 12, and July 22 - 30. The arrival times tended to increase by one to several days from north to south, as is consistent with the predominant air movement (Fig. 1). The activity levels were generally lower at the Los Angeles and San Diego stations, presumably reflecting the eastward flow of air at the southern end of the San Joaquin Valley located to the north. The maximum air concentrations detected at each station are as follows: Redding, 12:03; Davis, 6.40; Fresno, 11.63; Los Angeles, 7.90; and San Diego, 4.15 $\mu\mu c/M^3$.

The biological significance of the radioactivity levels detected three days after termination of sampling depends upon actual fission product concentrations during the sampling period. Estimates of the average fission product concentration during the day of June 8, 1956 at

* Libby, W. F., Radioactive Strontium Fallout. Proceedings of the National Academy of Sciences, V 42:6, pp.365-390, June,1956.

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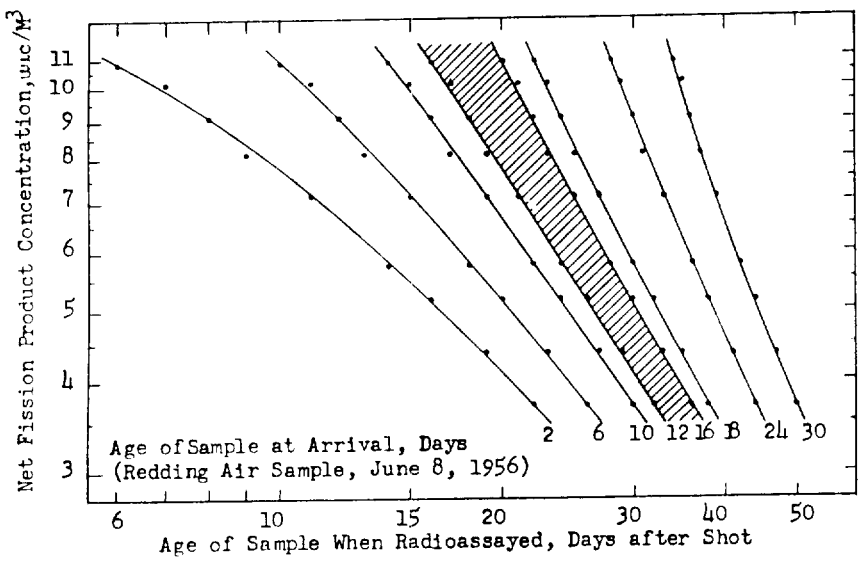

Fig. 5. Estimation of Sample Age on the Basis of Decay Slope.

TABLE II

Comparison of Total Airborne Concentrations Detected Approximately 3 Days After Termination of Sampling and Estimated Fission Product Concentrations on Day of Sample Collection (June 8, 1956 Air Samples)

Station	Radioassay Date, Days after Sample Termination	Total Conc. μμc/M³	Est. Fission Product Conc. Day of Sample μμc/M³
Redding	3	12.03	16.3
Davis	4	5.94	8.5
Fresno	3	11.63	14.9

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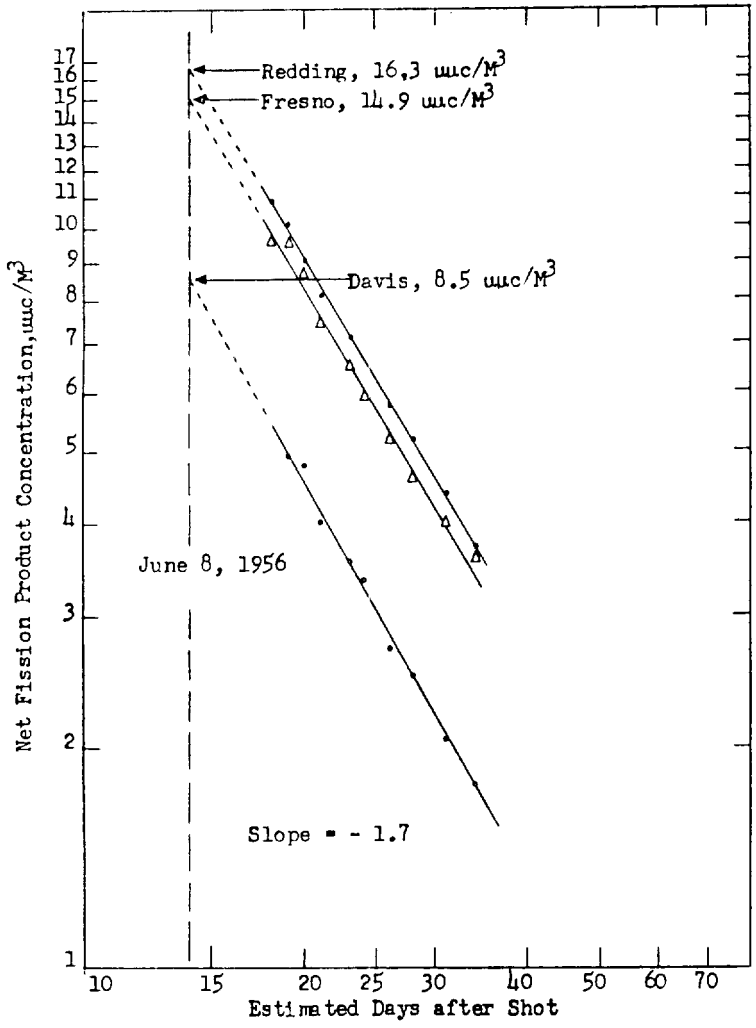

Fig. 6. Decay Curves of June 8, 1956, Air Samples Collected at Redding, Davis, and Fresno based upon Estimated Age of 14 Days at Day of Arrival.

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Fall-out Concentrations: The radioactivities of the daily gummed paper samples demonstrated wide variability, ranging from 0 to 860.25 at Redding, 0 to 472.72 at Davis, from 0 to 589.08 at Fresno, from 0 to 1,033.17 at Los Angeles, and from 0 to 457.27 $\mu\mu c/ft^2$ at San Diego, approximately three days after termination of sampling.

The increase in fall-out contamination from May to August, 1956 at the several California locations due to the 1956 Pacific testing operations may be estimated if the average fall-out values determined during the month of April before testing was initiated are considered valid for the succeeding four months. TABLE III indicates that increases ranging from 28 per cent in San Diego to 168 per cent in Redding occurred for the four month period.

TABLE III

Estimated Increase in Fall-out at Five California Locations from May 1 to August 31, 1956

Station	No. Days Sampled, 5/1/56 - 8/31/56	Total Fall-out $\mu\mu c/ft^2$	Bkg Fall-out for Similar Period* $\mu\mu c/ft^2$	Increase in Fall-out Contamination $\mu\mu c/ft^2$	%
Redding	123	7,944	2,967	4,977	168
Davis	122	5,500	3,118	2,382	76
Fresno	122	7,019	3,803	3,216	85
Los Angeles	122	7,526	4,385	3,141	72
San Diego	123	4,935	3,863	1,072	28

* Calculations based upon pre-series, April, 1956, average fall-out levels (See TABLE I).

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In an effort to correlate fall-out and airborne radioactivity levels, values of each type of sample which were equal to or greater than twice the maximum activity observed during the background period are tabulated in TABLE IV. It is to be noted that of 51 cases where either air concentrations or fall-out activities were twice the background maximum, there are only six cases where both types of sample were correspondingly high. The data emphasize the relatively independent movement and occurrence of the two types of contamination which may be attributed primarily to differences in particle size.

Nature of Airborne and Fall-out Contamination: A number of rain water samples were collected, and the activity in each sample was separated into soluble and particulate fractions (TABLE V). Twenty to 35 per cent of the activity was soluble in rain water. It can be noted from the Redding data in TABLE V that increased amounts of activity were present in rain samples collected after the Test Series had started.

Selected air and gummed paper samples were radioautographed to determine the distribution of activity on the sample collector. The active material was determined to be particulate in nature and randomly distributed on both types of samples (Fig. 7). The variability of particle size and/or activity per particle of fall-out is demonstrated by TABLE VI which presents the numbers of contributing particles on several gummed papers as determined by radioautogrphic methods. Single particles as large as 100 microns in size were detected which contained all the activity on that paper, while other gummed papers had as many as 177 active particles of smaller size. Particles as small as 0.5 micron in diameter were observed. The particles were black, fragile spheres.

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TABLE IV

Air and Fall-out Radioactivity Concentrations Equal to or Greater than Twice Maximum Values Detected during Pre-Series Sampling Period (Indicated by *)

Date	Redding		Davis		Fresno		Los Angeles		San Diego	
	μμc/M³	μμc/ft²	μμc/M³	μμc/ft²	μμc/M³	μμc/ft²	μμc/M³	μμc/ft²	μμc/M³	μμc/ft²
5/8	- [a]	-	-	-	-	-	0.39	261.85*	-	-
5/17	-	-	-	-	-	-	2.80*	0	-	-
5/18	-	-	-	-	-	-	2.62*	0	-	-
5/29	0.34	306.29*	-	-	-	-	-	-	-	-
6/8	12.03*	206.77	5.94*	149.09	11.63*	452.72*	-	-	-	-
6/9	-	-	6.40*	323.18*	8.03*	331.81*	-	-	-	-
6/11	-	-	-	-	-	-	3.02*	121.92	-	-
6/12	-	-	-	-	-	-	3.39*	68.18	2.82*	63.18
6/18	1.08	392.64*	-	-	-	-	-	-	-	-
7/6	-	-	-	-	9.38*	238.18	-	-	-	-
7/7	-	-	-	-	5.60*	80.00	-	-	-	-
7/8	4.31*	0	-	-	6.06*	0	-	-	-	-
7/9	-	-	-	-	3.35	392.72*	-	-	-	-
7/10	4.84*	159.51	5.51*	36.36	7.30*	195.91	7.90*	770.00*	-	-
7/11	2.39	269.49*	-	-	4.09	494.54*	-	-	1.75	457.27*
7/12	2.34	409.45*	0.66	418.63*	3.80	589.08*	2.64*	263.63*	-	-

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TABLE IV (Continued)

Date	Redding		Davis		Fresno		Los Angeles		San Diego	
	μμc/M³	μμc/ft²	μμc/M³	μμc/ft²	μμc/M³	μμc/ft²	μμc/M³	μμc/ft²	μμc/M³	μμc/ft²
7/13	-	-	0.18	227.27*	-	-	-	-	-	-
7/14	-	-	-	-	-	-	1.21	1,033.17*	1.33	439.09*
7/21	-	-	1.85	200.45*	-	-	-	-	-	-
7/24	-	-	-	-	-	-	3.18*	85.91	-	-
7/25	3.94*	860.25*	-	-	-	-	-	-	-	-
7/26	3.05	366.28*	1.56	261.82*	-	-	-	-	-	-
7/27	4.14	11.36	-	-	-	-	3.43*	36.36	-	-
7/28	5.30*	16.36	-	-	-	-	-	-	-	-
7/29	3.92*	86.80	-	-	6.34*	57.27	-	-	-	-
7/31	-	-	-	-	-	-	2.71*	0	-	-
8/7	-	-	-	-	-	-	3.51*	116.36	-	-
8/8	-	-	-	-	-	-	0.70	248.18*	-	-
8/15	-	-	-	-	-	-	-	243.18*	-	-
8/18	-	-	0.58	472.72*	-	-	1.17	921.81*	-	-
8/19	-	-	-	-	-	-	0.74	428.63*	-	-
8/28	-	-	0.34	281.81*	-	-	-	-	-	-
8/30	-	-	-	-	0.94	294.54*				
8/31	-	-	-	-	-	-	-	-	0.13	397.27*

a. Values indicated by dash are less than twice maximum value observed during pre-series sampling period.

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TABLE V

Summary of Rain Water Activities

Station	Date 1956	Volume Rain, ml	Total Activity	% Soluble Activity	Calc. $\mu\mu c/ft^2$ Dep. in Rain
San Diego	5/22	20	4.0	-	5.9
Davis	4/11	501	20.0	19.9	29.4
	4/26	275	27.5	27.9	40.4
Fresno	4/14	121	19.4	24.2	28.5
Los Angeles	4/25	191	19.1	29.0	28.0
	5/9	560	50.4	32.1	74.0
Redding	4/25	160	30.4	24.7	44.6
	5/29	135	283.5	35.8	416.0
	6/14	284	340.8	26.3	500.0
	6/19	226	542.4	21.8	796.0
	7/1	33.5	93.8	20.7	137.6

TABLE VI

Number of Particles Contributing to Measured Radioactivity of Fall-out Samples from Several Locations

Station	Date 1956	Fall-out Activity $\mu\mu c/ft^2$	Number Particles	Average $\mu\mu c$/ Particle
Redding	6/18	392.64	1*	392.64
	7/25	860.25	42	20.49
	7/26	366.28	14	26.17
	7/28	16.36	10	1.64
Fresno	6/9	331.81	177	1.87
	7/6	238.18	6	39.7
	7/9	392.72	2	196.36
	7/11	494.54	2	247.27
Los Angeles	7/10	770.0	19	40.52
	7/14	1,033.17	4	258.29
	8/18	921.81	8	115.01

* Single 100 μ diameter particle.

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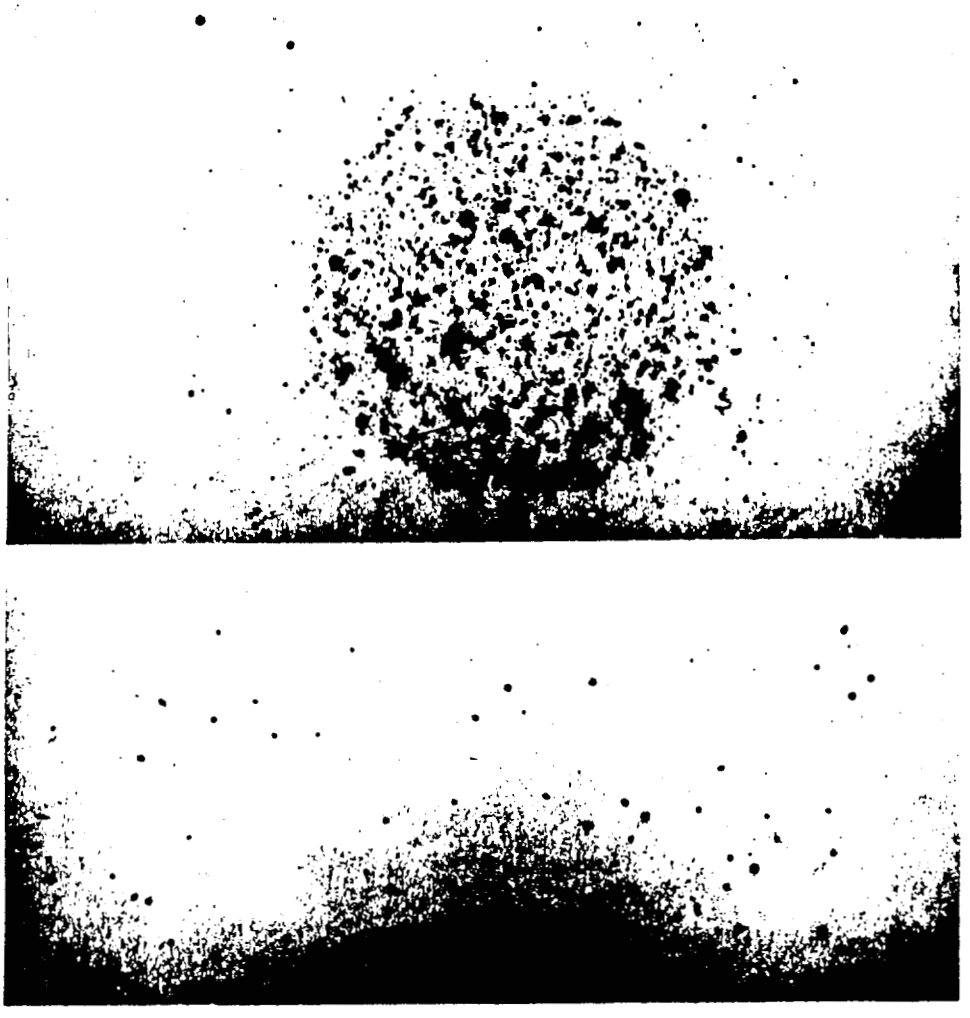

Fig. 7. Radioautographs of Fresno, June 9, 1956, Air Filter and Gummed Paper.

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APPENDIX A

Daily Total Radioactivity Levels of Air and Fall-out at Five California Sampling Stations
(Radioactivity Measurements Performed Approximately Three Days after Termination of Each Sampling)

Date Collected	San Diego		Los Angeles		Fresno		Davis		Redding	
	Air $\mu\mu c/M^3$	Fall-out $\mu\mu c/ft^2$	Air $\mu\mu c/M^3$	Fall-out $\mu\mu c/ft^2$	Air $\mu\mu c/M^3$	Fall-out $\mu\mu c/ft^2$	Air $\mu\mu c/M^3$	Fall-out $\mu\mu c/ft^2$	Air $\mu\mu c/M^3$	Fall-out $\mu\mu c/ft^2$
4/8/56	-	-			-	-	-	-		
4/9	0.85	0			1.17	3.64	1.45	43.64		
4/10	1.04	0			0.64	8.18*	0.45	37.73*		
4/11	0.72	0 *			-	18.64*	0.57	14.09*		
4/12	0.55	126.36			1.14	93.18*	-	76.82*		
4/13	0.58	77.73*			1.36	68.64*	1.11	37.73*		
4/14	0.60	48.64*			0.37	0 *	0.37	58.64*		
4/15	0.35	0 *	-	-	0.51	0 *	0.45	0	-	-
4/16	0.76	51.82	-	-	0.80	0 *	1.11	0	-	0
4/17	0.65	62.73	0.50	0	-	7.27	2.45	8.18	-	42.26
4/18	0.99	0	0.75	115.91	2.50	19.09	1.43	0	1.05	0
4/19	0.70	0	1.08	62.73	1.64	-	1.05	10.00	1.02	7.73
4/20	1.09	145.45	-	111.36	1.43	0	1.15	20.45	1.15	0
4/21	0.72	18.18	1.17	0	1.59	55.91	1.54	100.45	1.21	20.45
4/22	0.77	24.09	0.87	41.36	1.66	39.09	1.14	34.09	1.09	46.81
4/23	0.74	0	0.65	0	0.81	33.18	0.34	10.00	0.67	0
4/24	2.01	0	1.32	45.91	2.13	0	0.96	12.27	0.69	5.91*
4/25	2.25	7.73	1.31	46.82*	0.81	141.36*	0.54	35.91*	0.75	132.70*
4/26	0.62	83.18	0.73	4.09*	0.30	0 *	0.45	26.82*	0.40	0 *
4/27	0.24	0 *	0.25	8.18	0.54	0 *	0.75	0 *	1.30	11.36*
4/28	0.73	0 *	0.55	55.00	0.95	115.45*	0.90	0	1.36	0

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APPENDIX A (Continued)

Date Col-lected	San Diego Air uuc/M^3	San Diego Fall-out uuc/ft^2	Los Angeles Air uuc/M^3	Los Angeles Fall-out uuc/ft^2	Fresno Air uuc/M^3	Fresno Fall-out uuc/ft^2	Davis Air uuc/M^3	Davis Fall-out uuc/ft^2	Redding Air uuc/M^3	Redding Fall-out uuc/ft^2
4/29	0.28	22.27	0.77	11.82	1.32	50.91	1.05	0	1.93	22.27
4/30	0.99	22.73	0.60	0	1.60	0	0.89	35.45	1.53	72.26
5/1	0.87	0	1.41	10.00	1.38	0	1.17	4.09	1.38	0
5/2	0.97	0	0.89	0	-	0	1.65	0	1.61	48.62*
5/3	1.29	46.82	1.38	31.36*	0.68	30.00*	0.51	20.45	-	39.08*
5/4	0.28	21.36	0.32	0	0.34	69.09*	0.47	0 *	0.25	0 *
5/5	0.34	0	0.40	0	0.33	0 *	0.22	21.36*	0.26	41.35
5/6	0.34	0	0.35	74.09	0.46	0 *	0.47	0 *	0.48	108.61*
5/7	0.49	0	0.46	7.73	-	0 *	0.64	0 *	0.34	127.70
5/8	0.42	10.45*	0.39	261.85	0.45	138.18*	0.58	192.72	0.43	0
5/9	0.60	14.09*	0.53	35.45*	1.53	4.09*	0.87	12.73*	0.63	34.08*
5/10	0.58	0	0.45	1.82*	0.57	23.64*	0.32	18.64*	0.19	29.99*
5/11	0.48	91.82	0.52	78.64	0.45	123.63*	0.55	78.18	0.68	141.79*
5/12	0.55	31.82	0.72	58.18	0.67	21.82	0.63	52.73	0.48	9.09
5/13	0.94	61.82	1.05	0	0.69	0	0.79	0	0.90	0
5/14	1.07	18.18	1.15	0	1.17	2.27	1.28	0	1.35	0
5/15	1.30	14.55	1.62	0	1.28	0	1.23	0	2.88	4.09
5/16	1.44	23.18	2.20	0	1.65	20.91	1.65	0	2.84	109.97
5/17	1.29	132.73	2.80	0	1.81	122.73*	1.81	77.73	1.87	0
5/18	1.18	0	2.62	0	1.43	0 *	0.90	0	1.46	18.63
5/19	1.30	0	1.66	0	1.52	0	1.02	0	1.28	4.08
5/20	1.57	0	1.41	0	-	19.55	0.49	11.36	1.65	0
5/21	0.90	0	1.14	14.09	1.10	0	0.54	0	1.24	0
5/22	0.82	2.27	0.70	0	0.96	0	0.44	5.91	1.03	0
5/23	1.61	0	0.72	5.91*	0.95	4.09	0.98	4.09	1.13	15.00
5/24	1.08	28.64	1.08	7.73*	1.06	0	0.94	11.82	1.08	18.18
5/25	0.40	8.64	1.52	70.45	1.13	129.09	0.69	33.64	1.29	0
5/26	0.63	38.64	0.78	0	0.67	12.73	0.52	0	0.70	1.82

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APPENDIX A (Continued)

Date Collected	San Diego Air μμc/M³	San Diego Fall-out μμc/ft²	Los Angeles Air μμc/M³	Los Angeles Fall-out μμc/ft²	Fresno Air μμc/M³	Fresno Fall-out μμc/ft²	Davis Air μμc/M³	Davis Fall-out μμc/ft²	Redding Air μμc/M³	Redding Fall-out μμc/ft²
7/22	1.42	0	2.01	93.18	3.13	48.18	1.04	97.73	3.30	64.98
7/23	2.58	26.36	2.26	40.00	2.46	11.82	-2.10	42.73	2.75	62.71
7/24	1.87	175.91	3.18	85.91	3.66	44.09	2.25	56.36	3.13	70.89
7/25	1.72	0	1.98	85.45	3.68	31.36	1.70	17.73	3.94	860.25
7/26	1.54	53.64	1.91	72.73	4.22	0	1.56	261.82	3.05	366.28
7/27	1.28	78.64	3.43	36.36	3.75	17.27	1.79	120.91	4.14	11.36
7/28	1.51	140.91	1.73	0	3.54	38.18	1.58	35.00	5.30	16.36
7/29	1.28	21.36	2.34	19.09	6.34	57.27	3.53	0	3.92	86.80
7/30	2.11	0	1.86	33.65	2.33	0	-	-	2.90	0
7/31	1.26	12.27	2.71	0	2.40	0	0.89	0	1.71	0
8/1	1.67	0	1.10	0	1.96	24.09	0.54	11.36	0.39	145.42
8/2	2.05	33.18	1.29	30.00	0.61	72.73	0.41	0	0.35	52.26
8/3	0.43	34.55	1.05	0	0.57	101.36	0.18	0	0.43	0
8/4	0.61	24.55	0.72	0	0.50	70.45	0.17	27.27	0.53	0
8/5	0.35	40.00	0.58	19.55	0.58	0	0.43	0	0.85	13.63
8/6	0.55	27.27	0.68	0	0.90	69.54	0.70	0	1.12	82.25
8/7	0.48	0	3.51	116.36	0.90	89.54	0.41	114.09	0.89	0
8/8	0.50	4.09	0.70	248.18	0.92	46.36	0.33	43.18	0.92	22.72
8/9	0.39	108.18	0.84	116.36	0.54	23.64	0.73	89.99	0.89	23.18
8/10	0.19	73.64	0.60	26.36	1.09	0	0.46	99.54	0.78	0
8/11	0.57	0	0.61	0	0.73	8.64	0.25	19.09	0.54	12.27
8/12	0.78	15.91	0.91	35.45	0.55	89.09	0.16	58.64	0.75	67.71
8/13	1.57	75.00	0.97	70.91	0.71	85.91	0.65	37.73	0.65	93.61
8/14	0.50	0	1.21	29.55	0.85	44.54	0.41	0	0.76	15.00
8/15	0.58	37.27	0	243.18	1.02	155.00	0.43	80.00	1.03	28.63
8/16	0.58	154.54	0.76	101.36	0.92	210.91	0.32	0	0.76	250.85
8/17	0.76	114.54	0.73	105.45	0.98	11.36	0.46	47.27	1.23	0
8/18	0.89	21.36	1.17	921.81	0.97	46.36	0.58	472.72	1.95	250.40

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APPENDIX A (Continued)

Date Collected	San Diego Air uuc/M³	San Diego Fall-out uuc/ft²	Los Angeles Air uuc/M³	Los Angeles Fall-out uuc/ft²	Fresno Air uuc/M³	Fresno Fall-out uuc/ft²	Davis Air uuc/M³	Davis Fall-out uuc/ft²	Redding Air uuc/M³	Redding Fall-out uuc/ft²
8/19	1.03	19.09	0.74	423.63	1.14	47.73	0.34	0	1.31	257.21
8/20	0.67	0	0.69	90.91	0.60	0	0.18	0	0.84	127.70
8/21	0.33	0	-	0	0.73	0	0.41	46.82	1.04	5.45
8/22	0.53	1[illegible].36	1.08	50.91	1.02	4.09	#	#	1.05	146.33
8/23	0.43	120.91	1.38	75.91	1.30	61.82	0.64	57.27	1.70	91.80
8/24	0.39	5.91	0.71	15.91	1.07	77.27	0.67	17.73	1.19	50.90
8/25	1.12	53.13	1.53	150.91	1.25	72.73	1.33	31.82	1.54	75.39
8/26	0.11	5.91	1.93	32.27	1.53	65.45	0.79	17.73	0.87	0
8/27	0.76	67.73	0.39	0	0.99	0	0.52	67.27	0.85	3.19
8/28	0.79	35.91	0.78	53.64	0.81	39.09	0.34	281.81	0.53	69.53
8/29	0.85	155.00	0.69	49.09	1.32	264.54	0.40	8.18	0.87	78.16
8/30	0.92	115.45	0.63	228.63	0.94	294.54	0.40	0	1.45	66.35
8/31	0.13	397.27	0.62	78.18			0.63	22.73	1.12	83.16

* Rain
\# 48-hour sample.

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