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PART I

COLLECTION AND IDENTIFICATION OF FISSION PRODUCTS OF FOREIGN ORIGIN

Prepared by

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INTRODUCTION

Positive radioactive evidence of a recent explosion of an A-bomb has been accumulated by NRL fission product detection stations at Kodiak, Alaska, and in Washington, D.C. during the period from 9 September to 20 September. The date of fission, deduced from activity ratios of fission isotopes is probably not earlier than 24 August. Extremely hot samples extracted from the fall-out of fission products at Kodiak, have yielded tens of thousands of counts per minute of the major fission product isotopes. This report is a brief account of the methods of detection and the fission activity measurements completed to date. More detailed reports are now being written.

Filter Paper Detection at NRL

Several ground filter paper systems for the collection of atmospheric radioactivity have been in operation at NRL since the time of the Sandstone tests. For 15 months, up to the present time, continuous records were made of the apparent half life of the filtered radioactivity. In the absence of any fission product activities, the filter collections consisted mainly of RaB and ThB normally present in the air. The short lived RaB (30 min.) disappears within a few hours, leaving an apparent half life very close to the 10.6 hours of ThB.

When fission products from the Sandstone test fell out in the Washington area, the NRL filter unit detected their presence by indicating an apparent half life of 20 hours on the filter paper, rather than the normal 10.6 hrs. of ThB. From June of 1948 until 9 September 1949, all filter collections at NRL yielded apparent half lives less than 12 hours (apparent half life at 10 hours after removal from collector). Beginning on 9 September, the apparent half life of the filtered radioactivity rose rapidly to a peak of 50 hours on 16 September. The activity has fallen since then but has not yet returned to normal. The unprecedented rise on 9 September was immediately suspected to be the result of fission activity and this was soon verified by chemical extraction and physical identification of fission products such as Ruthenium, Barium and Iodine. Figure 1 illustrates the course of the filter paper activities before and during the fall-out period.

Gamma-Ray Detection at Kodiak

The gamma ray ground stations of the 1948 Fitswillian experiment were almost all disbanded shortly after the Sandstone tests. The N.R.L. considered it desirable, however, to continue the operation of a few scattered stations for background information. Stations have been operated continuously, since the Summer of 1948 at Kodiak, Manila, Honolulu, and Washington, D.C. On 9 September a deviation from normal activity was registered on the gamma ray detector at Kodiak. It reached a maximum on

APPARENT $T_{\frac{1}{2}}$ AT 10HRS. AFTER COLLECTION

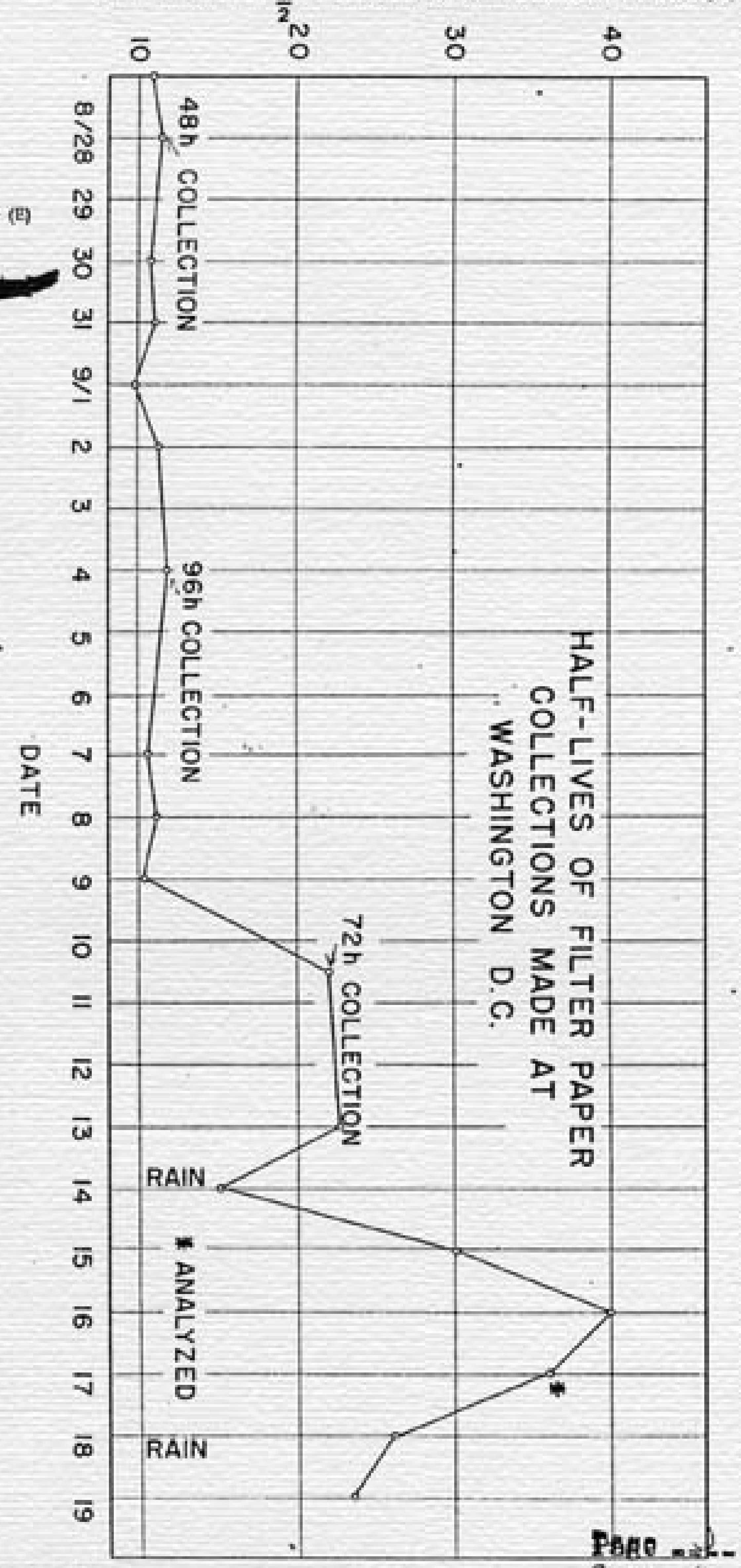

Fig. 1

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16 September at a level corresponding to approximately 50 micro-microcuries per square centimeter of fall-out activity. Figure 2 is a copy of the Kodiak record. Water collections made at Kodiak during the period of fall-out were received at NRL on 20 September and were found to contain a correspondingly high level of radioactivity.

The fall-out activity at Kodiak produced a maximum increase of about 20 percent in the response of the gamma ray ground counter. Similar ground counters were used in the Fitzwilliam experiment and records of the percentage increase in gamma response with fall-out after tests X, Y, and Z are contained in NRL Report M-3348. At several stations within a range of 1000 miles, the fall-out was comparable to that registered in the recent event at Kodiak.

Water Collections of Fission Activities

After the Sandstone Tests, A-bomb fission fragments scavenged from the atmosphere were extracted from rain water collections at several distant locations. These products were isolated chemically and identified by energy and half-life determinations. The great sensitivity of the rain barrel method of surveillance was thereby established experimentally and procedures were developed for operating field collection stations. Detailed results and procedures are given in NRL reports CN 3378 and CN3514.

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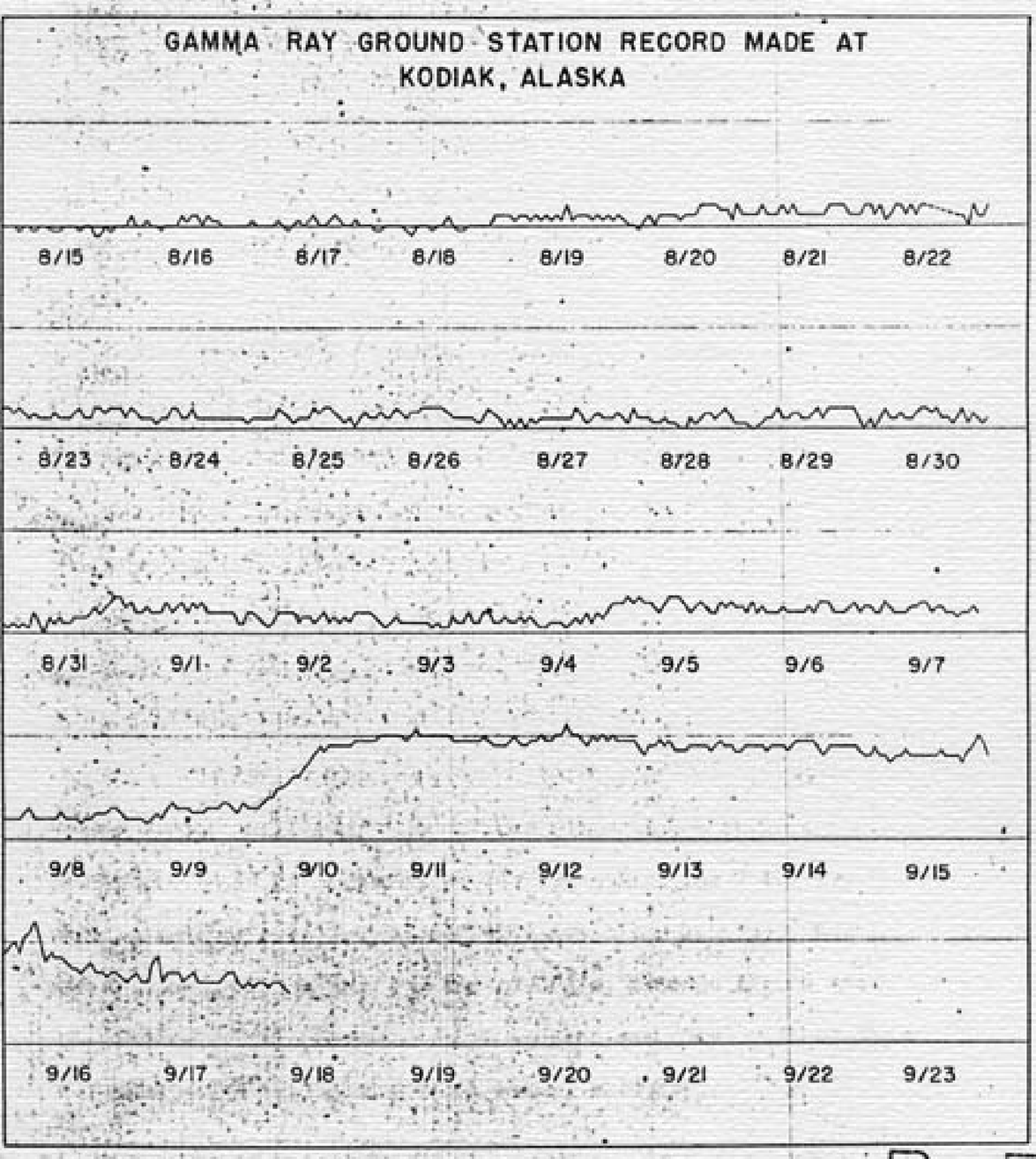
GAMMA RAY GROUND STATION RECORD MADE AT
KODIAK, ALASKA



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DECLASSIFIED
E.O. 11652, Sec. 3(E) and 5(D) or (E)

USF letter, April 12, 1954

Re: NRL

Five months ago rain water collection stations were established at the Naval Research Laboratory, Washington, D.C. and Kodiak, Alaska. Up to 9 September, no evidence of fission product activities was found at these locations. This background experience made it possible to positively prove the fall-out of fission activity which took place 9 September at these stations.

Alerted by the results obtained with the Washington, D.C. ground filter paper collections on 10 September, the NRL collected the next rain fall on a clean roof which had been washed on 9 September. The rain was collected on 13 September and on chemical treatment yielded the fission products, Cerium, Yttrium, Ruthenium, Zirconium and Barium. After these elements were isolated, the residue still contained much unidentified activity. The activities recovered were of sufficient strength to permit ratio determinations of relatively high accuracy.

The Kodiak station alerted by the abnormal response of the γ-ray ground counter, collected rain samples covering the periods 6 September to 12 September and 13 September to 16 September. The following fission product activities were separated from these water samples. Ruthenium 8000 c/m and 6000 c/m; Cerium 3000 c/m and 4000 c/m; Yttrium 12,000 c/m and 25,000 c/m; Silver 700 c/m (counted in 20 percent geometry). These figures are approximate and uncorrected for chemical recovery.

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Attached are Tables I and II giving the amounts of activities collected at the two stations over a period of several months.

An absorption analysis of the Cerium separation showed the presence of Ce^{141} (.6 Mev), Ce^{144} (.3 Mev), and Pr^{144} (3.1 Mev). On the basis of the reported fission ratios, the measured sample could have originated on August 24 from slow fission of Pu^{239}, on August 31 from fast fission of U^{235}, or September 6 from slow fission of U^{235}.

A similar analysis of the ruthenium separation on 21 September gave a ratio of 3.1 of Ru^{103} compared to Ru^{106}. The date of fission computed from available fission yield curves for U^{235} and Pu^{239} is much too early to fit in with other information as to the source. This difficulty is a repetition of the Sandstone experience, when ratios of 4 for Test X, 20-40 for Test Y and 4-18.5 for test Z were obtained from filter paper collections close to the source. The present ratio corresponds most closely to Test X of Sandstone.

Summary

A fall-out of fission products from the air was detected in Kodiak, Alaska, 9 September by a γ ray ground counter and in Washington, D.C. by filter paper on the same day. Radio active fission fragments containing tens of thousands of counts per minute were separated chemically and identified by physical methods. The date of fission was computed from available fission yield curves.

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TABLE I

RESULTS WASHINGTON, D.C.
C/M

Collection Dates	Ce	I	Ru	Pa
25-31 March	13	5	-	-
13 April	6 total Ce + I		-	-
22 April	Ce + I 9		-	-
2 May	Ce + I 3		-	-
11 May	Ce + I 2		-	-
15 May	Ce + I 5		-	-
21-22 May	Ce + I 6		-	-
16-17-18 June	0	0	-	-
15-18 July	0	0	-	-
3 August	0	0	0	-
12-13-15 August	0	0	-	-
28 August	0	0	-	-
13 September	56 Ch.R. 90%*	685 Ch.R. 93%*	176 Ch.R. 80%*	306 Ch.R. 20%*

16 June new aluminum roof used for collection
- not separated
* approximate
I fraction contains La
The small counts in the rain collected from March to June were products deposited from the Sandstone test. See Report NRL CR3514.
Ch. R. Chemical Recovery.

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TABLE II

RESULTS FROM KODIAK
C/M

Collection Dates	Ce	Y	Ru	Ba	Ag
April	0	0	0	-*	-
16 May - 31 May	0	0	0	-	-
3 June - 13 June	0	0	0	-	-
20 June - 10 July	0	0	0	-	-
6 September - 12 September	3934 Ch.R. 84°/o	12,733 Ch.R. 48°/o	8,739 Ch.R. 20°/o	10,000 Ch.R. 5°/o	700 Ch.R. 71°/o
13 September - 16 September	4614 Ch.R. 77°/o	25,400 Ch.R. 81°/o	5,794 Ch.R. 57°/o	13,000 Ch.R. 5-10°/o	40 Ch.R. 1°/o

* not seperated
Material collected in August not yet received.
Counts at approximately 20 percent geometry.
Y fraction contains La
Ch.R. chemical recovery.

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Subsequent parts of this report will contain detail results of chemical separations and physical measurements. Analysis are being performed on several active water collections and roof scrubbings from Kodiak and Washington and additional samples are being forwarded from outlying areas.

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