PART X

COLLECTION AND IDENTIFICATION OF FISSION PRODUCTS OF FORBIDDEN 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 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 fallout 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 Bikini 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.

DECLARER

E.D. 1952, No. 21519955
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Restricted Data

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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
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 1948Pitzwilliam experiment
were almost all dismantled shortly after the Sandstone tests. The NRL,
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
16 September at a level corresponding to approximately 40 micro-curies 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 cor-
respondingly 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 Fitwilliam experiment and records of the
percentage increase in gamma response with fall-out after tests X, Y, and
Z are contained in NRL Report K-3396. At several stations within a range
of 1000 miles, the fall-out was comparable to that registered in the
recent event at Kodiak.

Water Collection 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. De-
tailed results and procedures are given in NRL reports CN 3378 and CN3524.
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 has been washed on 9 September. The rain was collected on 13 September and on chemical treatment yielded the fission products, Cerium, Titirium, 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 Geiger 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/s and 6000 c/s; Cerium 3000 c/s and 4000 c/s; Titirium 12,000 c/s and 25,000 c/s; Silver 700 c/s (counted in 20 percent geometry). These figures are approximate and uncorrected for chemical recovery.
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 fallout samples showed the presence of Cs$^{137}$ (0.6 MeV), Panama$^{244}$ (1.3 MeV), and Pu$^{239}$ (6.1 MeV). On the basis of the reported fission ratios, the measured sample could have originated on August 21 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 samples on 21 September gave a ratio of 3.1 of Ru$^{103}$ compared to Ru$^{106}$. The data 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 A for Test I, 20-40 for Test I and 4-15 for Test II were obtained from filter paper collections close to the source. The present ratio corresponds very closely to Test I 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. Radioactive fission fragments containing tens of thousands of counts per minute were separated chemically and identified by physical methods. The data of fission was computed from available fission yield curves.
### Table I

<table>
<thead>
<tr>
<th>Collection Dates</th>
<th>Ca</th>
<th>Y</th>
<th>Ra</th>
<th>Pu</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-31 March</td>
<td>13</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 April</td>
<td>6 total Ca + Y</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22 April</td>
<td>Ca + Y 9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 May</td>
<td>Ca + Y 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 May</td>
<td>Ca + Y 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 May</td>
<td>Ca + Y 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21-22 May</td>
<td>Ca + Y 6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-17-18 June</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-18 July</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 August</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>13-13-15 August</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28 August</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 September</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

- 16 June new aluminum roof used for collection
- not separated
- approximate
- T fraction contains In

The small counts in the rain collected from March to June were products deposited from the Sandstone test. See Report NRL CR134.

Ch. R. Chemical Recovery.
## Table II

**RESULT FROM KOMAX**

<table>
<thead>
<tr>
<th>Collection Dates</th>
<th>Ge</th>
<th>Y</th>
<th>Pu</th>
<th>Ra</th>
<th>Th</th>
</tr>
</thead>
<tbody>
<tr>
<td>April</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>16 May - 1 July</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>13 June - 13 June</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>10 July - 10 July</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6 September</td>
<td>7934</td>
<td>12,733</td>
<td>8,779</td>
<td>10,000</td>
<td>700</td>
</tr>
<tr>
<td>- 16 September</td>
<td>Ch.R. 84%</td>
<td>Ch.R. 60%</td>
<td>Ch.R. 30%</td>
<td>Ch.R. 10%</td>
<td>Ch.R. 7%</td>
</tr>
<tr>
<td>13 September</td>
<td>1641</td>
<td>25,400</td>
<td>5,794</td>
<td>11,000</td>
<td>60</td>
</tr>
<tr>
<td>- 16 September</td>
<td>Ch.R. 77%</td>
<td>Ch.R. 81%</td>
<td>Ch.R. 7%</td>
<td>Ch.R. 5%</td>
<td>Ch.R. 1%</td>
</tr>
</tbody>
</table>

* Note: Not separated.

Material collected in August not yet received.

Counts at approximately 20 percent geometry.

1 fraction contained in Ch.R. chemical recovery.
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 room scrubings from Kodiak and Washington and additional samples are being forwarded from outlying areas.