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REACTIONS OF $\text{U}^{238}$ WITH CYCLOTRON PRODUCED
NITROGEN IONS

By

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The acceleration of $\text{N}^{14}$ ions with the Berkeley Crocker Laboratory 60-inch cyclotron has made it possible to study nuclear reactions of these ions with $\text{U}^{238}$.

The following transmutation products have been observed:
$\text{O}^{16}$, $\text{F}^{19}$, $\text{Cl}^{24}$, $\text{Ar}^{36}$, $\text{K}^{47}$, $\text{Rb}^{85}$, $\text{Sr}^{90}$, $\text{Y}^{90}$, $\text{Zr}^{91}$, and other berkelium isotopes not yet identified. The identification of the elements was definitely established by their carrying on lanthanum fluoride precipitates and by their order of elution from a Dowex-50 ion exchange column.

The observed nuclear properties of these nuclides are summarized in Table 1.
Table I

Nuclides Produced by U$^{238}$ Plus N$^{14}$ Ions

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Half-life</th>
<th>Radiation</th>
<th>Alpha energy (Mev)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>$^{99}$Cf</td>
<td>~2.7 hr</td>
<td>EC, a, EC(?)</td>
<td>7.15</td>
<td></td>
</tr>
<tr>
<td>$^{99}$Cf</td>
<td>35.7 hr</td>
<td>a</td>
<td>6.75</td>
<td></td>
</tr>
<tr>
<td>$^{99}$U</td>
<td>~2.7 hr</td>
<td>EC</td>
<td>7.35</td>
<td>Observed only through growth of its 1.5-day Cf$^{246}$ daughter</td>
</tr>
<tr>
<td>$^{100}$Bk</td>
<td>225 day</td>
<td>a</td>
<td>6.26</td>
<td></td>
</tr>
<tr>
<td>$^{100}$Bk</td>
<td>4.6 hr</td>
<td>EC, a</td>
<td>6.72 (30%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6.55 (53%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6.20 (17%)</td>
<td></td>
</tr>
</tbody>
</table>

The nuclides Cf$^{244}$, Cf$^{246}$, Cf$^{248}$, Bk$^{243}$, and Bk$^{245}$ have previously been observed in this laboratory. 2, 9

The yields of the transcurium nuclides were low even though bombardment currents of 0.1 microampere of N$^{14}$ ions of energy greater than 100 Mev were available. In three separate experiments a total of 40 alpha-emitting atoms of the 7.3-minute isotope of element 99 were observed to decay in the ion exchange column fraction immediately preceding californium, namely the eka-holmium position. Thus, the element identification is certain though the mass number can only be inferred on the basis of nuclear systematics. By observation of the
abundant fission product activity it was found that almost all of the 
nuclear reactions of nitrogen ions with $^{238}\text{U}$ resulted in fission much 
as in the case of carbon ion bombardment of the same nucleus.

It is a pleasure to acknowledge the continued help and encourage-
ment of Professor Joseph G. Hamilton, Director of the Crocker Laboratory.
Our grateful thanks are extended to William B. Jones and the members 
of the 60-inch cyclotron operating crew for their cooperation in 
making the many bombardments necessary for this work. Special 
thanks are due to Dr. Gregory Choppin for his valuable assistance 
with some of the chemical separations. It is a privilege to acknowledge 
that this work was accomplished with the always helpful guidance of 
Professor Glenn T. Seaborg. The continued interest and encourage-
ment of Professor Ernest O. Lawrence is gratefully acknowledged.

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