THE EFFECT OF RADIOACTIVE RADIATIONS AND X-RAYS ON ENZYMES.

VI. THE INFLUENCE OF VARIATION OF TEMPERATURE UPON THE RATE OF RADIOCHEMICAL INACTIVATION OF SOLUTIONS OF Pepsin BY Beta RADIATION.

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We have observed that trypsin, pepsin, and invertase in dilute solutions are inactivated when irradiated by the radiations from the radioactive products in equilibrium with radium emanation. We have presented evidence which indicates that the inactivation is effected by the beta radiations from the radioactive source. This radiochemical inactivation of the enzymes named has been found to proceed as a monomolecular radiochemical reaction.

\[ \frac{dQ}{dt} = -kQP \]  

(1)

where \( Q \) is the concentration of active enzyme (in arbitrary units) at the time \( t \), expressed in hours, \( P \) is the power of the radioactive source at the same instant, and \( k \) is the speed coefficient of the reaction. The reader is referred to another paper in which this equation and its implications are discussed at length.

The irradiations referred to above were made at the temperature of melting ice. Recently we have observed the effect of the same radia-


315
EFFECT OF RADIOACTIVE RADIATIONS AND X-RAYS. VI

RADIATIONS ON PEPSIN IN DILUTE SOLUTION AT 10°C. It is the object of this paper to present these results (Table I) together with other observations made with the object of ascertaining what effect temperature variation has upon the value of the speed coefficient (Table II). The technical procedure was otherwise the same as that employed in the experiments reported in the paper immediately preceding this one.3

**TABLE I.**
Radiochemical Inactivation of Pepsin in Dilute Solution.

<table>
<thead>
<tr>
<th>Curie-power hours. ( (W) )</th>
<th>Units of active pepsin. ( (Q) )</th>
<th>( k = \frac{1}{W} \log_e \frac{Q_0}{Q} ) ( k \times 10^3 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.247</td>
<td>2.144</td>
<td>6.89</td>
</tr>
<tr>
<td>5.930</td>
<td>1.753</td>
<td>7.11</td>
</tr>
<tr>
<td>11.32</td>
<td>1.106</td>
<td>7.82</td>
</tr>
</tbody>
</table>

**TABLE II.**
Effect of Variation in Temperature on the Radiochemical Inactivation of Pepsin in Dilute Solution.

<table>
<thead>
<tr>
<th>Temperature ( ^\circ \text{C} )</th>
<th>Curie-power hours. ( (W) )</th>
<th>Units of active pepsin. ( (Q) )</th>
<th>( k = \frac{1}{W} \log_e \frac{Q_0}{Q} ) ( k \times 10^3 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>7.650</td>
<td>1.693</td>
<td>6.01</td>
</tr>
<tr>
<td>0</td>
<td>8.024</td>
<td>1.592</td>
<td>6.49</td>
</tr>
<tr>
<td>20</td>
<td>5.930</td>
<td>1.715</td>
<td>7.53</td>
</tr>
<tr>
<td>20</td>
<td>5.930</td>
<td>1.727</td>
<td>7.42</td>
</tr>
</tbody>
</table>

The data presented in Table I indicate that the course of radiochemical inactivation of pepsin solution at 10.0°C may be represented by a curve of the same form as that at 0.0°C.2 The data presented in Table II for 0.0°C and at 20.0°C, together with those in Table I for 10.0°C, indicate what influence temperature variation may be expected to have upon the speed of the reaction. However, no attempt is made, at the present time, to establish definite values for \( k \) and
its temperature coefficient which will hold precisely for any source of
radiation of the type described, inasmuch as definite standardization
of the thickness of the glass wall of the bulb containing the radium
emanation has not been possible up to the present time. Consequently, experiments made with different bulbs should not be expected
to yield precisely the same reaction speed coefficients as these have
been calculated with respect to the power of the radioactive source
and not with respect to what fraction of this is available to the radio-
sensitive system. In an attempt to compare the reaction speed
coefficients published by us in various communications this fact must
be borne in mind.

CONCLUSION.

Data are presented which indicate that variation in temperature is
associated with only slight variation in the speed of the radiochemical
inactivation of pepsin in dilute solution.