Light Emission by Germinating Plants.

L. Colli and U. Facchini

Istituto di Fisica del Politecnico - Milano
Laboratori CISE - Milano

(ricevuto il 29 Maggio 1954)

1. It is known that the use of the photomultipliers as counters of pulses given by individual photons permits the attainment of the highest sensitivity for the detection of weak light pulses.

Some workers conducted extensive studies on the characteristics of RCA 931 photomultipliers or an equivalent thereof, and have investigated their possibilities as counters of single photons (1).

Because of the small size of the photocathode, these photomultipliers are not very useful when it is desired to measure the light emitted by large surfaces as in the case of very weak emission per unit area.

In these cases photomultipliers EMI 6260 or RCA 5819 are more convenient, because of the large photocathode placed on the top of the tube, allowing a larger solid angle to be used in collecting light.

A paper on the behaviour of these photomultipliers as single photon counters has been previously published (2).

By means of this very sensitive apparatus we tried to detect a probable light emission from living vegetable tissues.

The research has been successful in

---


Fig 1. Scheme of the photomultiplier-thermostat setting. A similar setting is used, cooled with dry ice. 1) Photomultiplier, 2) diffusing light guide, whitened with magnesium oxide, 3) glass, 4) water cooler, 5) light tight box, 6) socket containing the voltage divider, 7) thermostat box, 8) electric heating element, 9) glass plate containing the plants under study, 10) thermocouple thermometer 11) lucite lid.
the case of germinating seedlings of some common plants. Some of our preliminary results are given in this paper.

2. – The experimental equipment is shown in Fig. 1. In order to ensure a steady temperature, water circulation is arranged around the phototube. In some cases the phototube was cooled with a ice-acetone freezing mixture, in order to reduce the thermoelectronic background.

The electronic equipment and the plate, 14 cm in diameter, in the counting apparatus of Fig. 1. The plants averaged, when fresh, 60 g in weight.

Table I shows some results obtained in this way. The statistical errors are less than 5%.

<table>
<thead>
<tr>
<th>Phototube</th>
<th>Kind of the plant used (6 days old)</th>
<th>Fresh weight</th>
<th>Temperature</th>
<th>Total pulses/min</th>
<th>Background pulses/min</th>
<th>Effect pulses/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>N. 143, cooled with H₂O</td>
<td>wheat</td>
<td>60 g</td>
<td>30°C</td>
<td>7936</td>
<td>4608</td>
<td>3328</td>
</tr>
<tr>
<td>N. 195, cooled with dry ice</td>
<td>lentils</td>
<td>60 g</td>
<td>22°C</td>
<td>7680</td>
<td>1024</td>
<td>6556</td>
</tr>
<tr>
<td>» »</td>
<td>corn</td>
<td>60 g</td>
<td>22°C</td>
<td>11520</td>
<td>1280</td>
<td>10240</td>
</tr>
<tr>
<td>» »</td>
<td>corn (grown in aseptic conditions)</td>
<td>60 g</td>
<td>22°C</td>
<td>8960</td>
<td>1280</td>
<td>7680</td>
</tr>
</tbody>
</table>

counting technique are the same as described in (3); pulses corresponding to single photoelectrons are recorded, above a given bias voltage and counted by a scaler scaling by 256.

We studied the seedlings of the following plants; wheat, corn, lentils, beans. The plants are grown in glass plates and are watered regularly. The growth of the seedlings took place in darkness, to avoid any excitation of phosphorescence. Under these conditions, practically no chlorophyll was formed and the well known red phosphorescence of the chlorophyll was not observed.

3. – In a first run of measurements about 300 seedlings were placed in a glass plate. In the case of corn, measurements were made also with plants grown in aseptic conditions.

Seeds were sterilized for 20 minutes with a 0.3 percent HgCl₂ solution. It was established that the seeds were free of bacteria, as shown by the fact that no bacteria colonies appear when the seeds are grown on glucose peptone agar. Results obtained with these plants are like the ones obtained with the non sterilized plants. This indicates that the luminescence observed does not seem to be due to luminescent bacteria.

Some preliminary tests using colored filters showed that the most of the light observed corresponds to a wave length between 4500 and 6500 Å.