On the Anisotropy of the Cosmic Radiation - II.

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Summary. — Recordings have been continued of penetrating cosmic-ray air showers which had previously been reported as giving indications of sidereal diurnal variations. It is found that showers due to primaries of about $10^{15}$ eV exhibit some variations which in themselves are not wholly significant but which must be considered jointly with those reported by other workers. It is thought that there is some cumulative evidence of anisotropy of $10^{15}$ eV primaries, but that this could be confirmed only by experiments singling out this energy region and yielding much better statistics.

In a previous paper by Kellermann and Islam (I (1)), the possibility of existence of an anisotropy of cosmic-ray air showers was discussed. Experiments had been carried out by means of an apparatus sensitive to penetrating air showers, and it was found that while the majority of showers recorded showed no anisotropy, it was possible to separate one type of shower whose rate showed some variation with sidereal time. The statistics on which this conclusion was based were, however, insufficient and the physical interpretation of the size of the effect, and of the nature of the shower was so difficult that the anisotropy could not be regarded as established.

It was felt that observations of the penetrating showers should be continued for some time, since other workers also employing relatively small-scale detecting arrays had reported sidereal effects similar in phase but of smaller amplitude (for a summary of these experiments see J. Delvaille,

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F. KendziorSKI and K. Greisen (2)). It was decided not just to extend the period of observations, but to add, to the detectors employed hitherto, additional apparatus which should facilitate recognition of the structure of the observed cosmic-ray showers. To the shielded detectors and G-M counters used previously (I, Fig. 1) there were added six unshielded circular scintillation counters of diameter 32 cm symmetrically grouped around the shielded counters as shown in Fig. 1. The addition of these counters had two major advantages: axes of showers of less than $5 \times 10^4$ particles could be located if these cores fell within 1 m of the centre of the array, and the apparatus was now sensitive to particle densities one-fifth lower than those observable by the unshielded Geiger counters alone.

A detailed account of the performance of all the detectors and the information obtained from them on the penetrating air showers falling on the array will be reported elsewhere. One result was that the events $P_\alpha (> 19, > 50 \text{ m}^{-2})$, abbreviated here to $P_{\alpha d}$ which have been described in I and which exhibited indications of anisotropy, could be identified as extensive air showers resulting from primaries of energy certainly larger than $10^{13}$ eV whose axes fell within few metres of the array centre. Furthermore, it was possible to identify events, named $T_\alpha$, recognisable by the discharge of more than 24 shielded counters, as extensive air showers originated by primaries of at least $10^{15}$ eV.

$P_{\alpha d}$-showers were observed for 13300 h additional to the 9800 h reported

<table>
<thead>
<tr>
<th>Type of shower events</th>
<th>No. of events</th>
<th>Straight line</th>
<th>$P_\alpha$ (%)</th>
<th>1st harmonic Amplitude</th>
<th>$P_{\alpha d}$ (%)</th>
<th>2nd harmonic Amplitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P_{\alpha d}$</td>
<td>498</td>
<td>yes</td>
<td>9.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$T_\alpha$</td>
<td>156</td>
<td>?</td>
<td>3</td>
<td>8.7 ± 1.5</td>
<td>02.1 ± 1.0</td>
<td>4.8 ± 0.9</td>
</tr>
</tbody>
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