The paper presents the results of measuring the brightness temperature of cosmic radio emission in the 20.0 to 38.0 MHz range by means of antennas having a wide radiation pattern which are oriented toward the zenith ($\delta = 90^\circ$). A comparison of the data of our work with values of the brightness temperature of the cosmic background obtained earlier [6] using analogous antennas reveals a discrepancy in the results that considerably exceeds the indicated errors. The possible causes of this are discussed.

At present many projects are being carried out which are devoted to measuring the intensity of cosmic radio emission. Notwithstanding this, difficulties arise in using the data obtained due to discrepancies in the results that are often considerably in excess of the indicated confidence intervals. For measurements performed by means of radio telescopes having a large angular resolution such a discrepancy can be explained chiefly by the difference in radiation patterns of the antennas, the effect of side lobes, and the difficulty of an accurate consideration of the efficiency. But there are grounds for assuming the presence of a substantial error caused by other factors, as is revealed in a comparison of results obtained by means of weakly directional instruments. In this connection it would seem useful to carry out measurements using antennas having a small angular resolution. A comparison of the results of such measurements allows the correctness of the procedure to be evaluated, and possibly allows the observed differences to be reduced.

The present paper reports the results of measurements of the intensity of cosmic radio emission and makes a comparison with the data obtained by other authors. The measurements of the intensity of the background using antennas having a small angular resolution, besides determining the null point in the cosmic radiation level, also allow certain conclusions to be drawn regarding the large-scale structure of the Galaxy.

The Antenna and the Receiving Equipment. The measurements of the brightness temperature of the cosmic radio emission were performed during 1969 at frequencies of 20.0, 25.0, 31.0, and 38.0 MHz using thin half-wave dipoles aligned in the east--west direction at an altitude of 0.23$\lambda$ above a metallic shield. The shield was constructed in the form of a wire grid having the dimensions 60 × 60 cm$^2$ with a square cell 10 × 10 cm$^2$. The SWR at the input of the dipole did not exceed 1.08 in the worst case. A modulation radiometer with a synchronous detector was used as the receiver. The gain stability was ensured by an AGC system [1]. The calibration of the radiometer was accomplished by replacing the antenna by a standard noise generator (SNG) at intervals no longer than every six hours. For coincidence of the calibrations with an accuracy of worse than 6% the recordings were not processed, and the equipment was assumed to be faulty. Since the spectral density of the noise of the SNG was known with an accuracy of 7%, it was calibrated by means of a thermal load* in order to reduce this error. The load was fabricated from constantan wire, was matched, and was placed in liquid nitrogen.

It is well known that in measuring a noise temperature comparable with room temperature the accuracy with which the impedances are matched is of great significance. The coefficient of reflection from the

*The calibration of the SNG was carried out in the 10 to 38 MHz range jointly with L. L. Bazelyan and B. P. Ryabov.
TABLE 1. The Brightness Temperature of the Sky (Units of 1000°K)

<table>
<thead>
<tr>
<th>MHz</th>
<th>20.0</th>
<th>25.0</th>
<th>31.0</th>
<th>38.0</th>
<th>( \beta \pm 0.12 )</th>
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<td>21.3</td>
<td>12.30</td>
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<td>62.5</td>
<td>35.9</td>
<td>21.0</td>
<td>12.05</td>
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<td>5</td>
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<td>35.5</td>
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<td>60.2</td>
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<td>20.1</td>
<td>11.60</td>
<td>2.56</td>
</tr>
<tr>
<td>7</td>
<td>59.4</td>
<td>33.2</td>
<td>19.1</td>
<td>11.06</td>
<td>2.54</td>
</tr>
<tr>
<td>8</td>
<td>58.1</td>
<td>30.7</td>
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<td>27.3</td>
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<td>8.70</td>
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</tr>
<tr>
<td>12</td>
<td>51.2</td>
<td>28.5</td>
<td>16.1</td>
<td>9.15</td>
<td>2.68</td>
</tr>
<tr>
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<tr>
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<td>18.8</td>
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<tr>
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<tr>
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<tr>
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<tr>
<td>21</td>
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<td>45.9</td>
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<td>15.85</td>
<td>2.50</td>
</tr>
<tr>
<td>22</td>
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<td>42.6</td>
<td>25.0</td>
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<tr>
<td>23</td>
<td>70.0</td>
<td>39.5</td>
<td>23.4</td>
<td>13.55</td>
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</table>

Load did not exceed 0.01 in the 20.0 to 38.0 MHz range. The difference in the coefficients of reflection from a load situated at room temperature and cooled in nitrogen was no more than 0.005. Besides this, the SNG was calibrated according to a second noise standard. The average value of the spectral density of the noise obtained in measuring 20 2D28 diodes taken from various batches was used as the secondary standard. The maximum scatter of the measured quantity was 2%. The spectral density found was compared with the arithmetic mean of the spectral noise density obtained from ten diodes of the 2D38 type. The difference in the means did not exceed 1%. The calibrations of the SNG using the primary and secondary noise standards coincided at four frequencies in the 20 to 38 MHz range with an accuracy of 2%.

The Losses in the Earth and the Absorption in the Ionosphere. Above it is indicated that the brightness temperature of the background was determined using dipoles mounted above a metallic shield. The penetration and losses in the shield did not exceed 0.5%. A portion of the measurements was carried out on antennas situated above the ground. In this case, the losses in the earth were measured, and the appropriate corrections were introduced with allowance for the distortion of the radiation pattern due to the finite conductivity of the earth [1].

Measurements at 20.0, 25.0, and 31.0 MHz were carried out at night, while measurements at 38.0 MHz were carried out around the clock. In accordance with [2] the absorption at night at 18.5 MHz did not exceed 0.1 dB. Taking into account that the twentieth cycle of solar activity was more moderate than the previous one [3], it may be assumed that the estimate of the absorption magnitude given was the maximal estimate. Under these conditions the absorption at 20.0, 25.0, and 31.0 MHz will not exceed 2.5, 1.5, and 1%, respectively. The measurements at 38.0 MHz were carried out during February, July, and October. The first cycle of measurements, as it has now turned out, coincided with the maximum of the solar activity. It differed in its high noise level, and the absorption during the day reached 1 dB. Comparing the data obtained in July and in October, one can find the absorption in the ionosphere for this period at a frequency of 38.0 MHz. At 12 hours local time it reached 3.5%.

The Antenna Temperature. The brightness temperature of the sky \( T_B \) is defined as the antenna temperature of a radiator pointing in the direction \( \delta = 50^\circ \). The values of temperature are found for each hour of direct ascension (ah) and are displayed in Table 1 with a random error equal to 1%. The systematic error does not exceed 4%. It included the uncertainty in the value of the spectral density of the SNG noise (2.5%), the error in the attenuators (2.5%), as well as the errors accompanying the measurement of attenuation in the symmetrizing transitional devices and in the cables, the uncertainty in the magnitude of the absorption in the ionosphere, and the errors due to mismatch, penetration through the grid, and losses in the dipole.

A small random error of the measurements causes a small random error in the spectral index of cosmic radio emission and allows a qualitative analysis of this parameter to be performed. The spectral