Reviewer's Comment

The papers by Ruskol* and Moroz† contain some interesting but speculative suggestions concerning mechanisms which might lead to a dust belt or geocentric concentration of dust particles in the vicinity of the earth. Neither author favors the lunar impact hypothesis advanced by Whipple, but their arguments against this mechanism are weakened by a serious error (discussed below) in the analysis by Moroz of the rocket and satellite data. Some of the mechanisms proposed by the two authors are somewhat contradictory. For example, Ruskol suggests that particles may form in the vicinity of the earth from vapors formed in collisional interactions of dust particles accreted from interplanetary space, whereas Moroz suggests that high flux rates along with low accretion rates may result from fragmentation and subsequent evaporation of cometary debris in the upper atmosphere. Ruskol favors capture of dust particles into long-lived geocentric orbits, but Moroz finds that this mechanism is not a satisfactory explanation for the concentration.

The validity of the analysis by Moroz would be strengthened if it could be shown that the slope of the assumed mass distribution curve is unique or that the conclusions are relatively independent of a slight change in the slope. Attention is brought to these points, because the question of what mass distribution curve should be used in normalizing the data to a single value of particle mass before testing for an altitude dependence in the flux rates is a critical one in analyses of the direct measurements. Failure to realize this may lead one to purely spurious conclusions. More could be said on this subject, but instead, the interested reader may consult the references listed here. These papers include various results of an analysis of the available direct measurements based not on an assumed mass distribution but on a mass distribution measured with the satellite Explorer VIII.

The data from Explorer VI included in the analysis by Moroz have never been placed in the open literature by the experimenters; therefore, these results should not be propagated as a valid direct measurement.

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* Ruskol, E. L., "Origin of the interplanetary dust cloud around the earth," AIAA J. 1, 2209–2212 (1963).

† Moroz, V. I., "Earth's dust envelope," AIAA J. 1, 2212–2216 (1963).

[1] McCracken, C. W., Alexander, W. M., and Dubin, M., "Direct measurements of interplanetary dust particles in the vicinity of earth," Nature **192**, No. 4801, 441–442 (1961).

[2] McCracken, C. W. and Alexander, W. M., "The distribution of small interplanetary dust particles in the vicinity of earth" (to be published in Proc. Intern. Symp. Astronomy and Physics of Meteors; also in Smithsonian Contributions to Astrophysics; presently available as NASA TN D-1349).

[3] Dubin, M. and McCracken, C. W., "Measurements of distributions of interplanetary dust," Astron. J. **67**, No. 5, 248–256 (1962).

[4] Alexander, W. M., McCracken, C. W., Secretan, L., and Berg, O. E., "Review of direct measurements of interplanetary dust from satellites and probes" (to be published in Proc. Third Intern. Space Sciences Symp.; presently available as NASA TN D-1669).

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Direct Measurements of Airglow in the Region $\lambda = 8640$ Å

T. M. Tarasova

In this work the results of preliminary processing of experimental data obtained on September 23, 1960 are presented. The purpose of this experiment was to investigate the distribution in height of the night sky glow in the region of the spectrum $\lambda = 8640$ Å, in which the emission of molecular oxygen is concentrated. The investigated region was outlined with the aid of an interference light filter with half-width $\lambda = 280$ Å. The photometer was launched to altitudes of 200 km by means of a rocket. During measurements it performed complex motions which may be described approximately as follows: the axis of the photometer was directed toward the zenith in the range of altitudes from 65 to 75 km; at 75 km the device began a rotation, which was attended by increase in the intensity recorded by the device. In the 110–160 km range, the axis of the device is directed downward, and at 170–200 km the axis is directed again toward the zenith. In the descending branch of the trajectory from $h = 200$ to $h = 140$ km, the axis was directed at all times toward the earth.

The measurement results are presented in Fig. 1, in which the relative intensity recorded by the device in its measurement position is the abscissa, and the height of photometer is the ordinate. The position of the axis of the device is shown by arrows. It may be seen from Fig. 1 that the intensities measured at altitudes $h_B = 130$ km (ascent) and $h_H = 170$ km (descent) are equal (in both cases the axis of the photometer was directed vertically and downward). This indicates the absence of glow in the 130–170 km altitude range.

The portion of the curve corresponding to the altitudes $h =$ 64 to 74 km is characteristic; at these altitudes the intensity is constant and equal to the intensity measured from the ground ($h = 0$). This indicates the absence of glow in the atmospheric layer from 0 to 74 km altitude. At the same time, Fig. 1 indicates that the intensities registered at $h = 64$ km (axis directed toward the zenith) and $h = 130$ km (axis directed vertically downward) are equal. This fact and also the absence of glow at altitudes below 74 km permit the conclusion that, in the investigated region of the spectrum, all glow occurs in the layer 74 km $< h <$ 103 km. The sharp increase in intensity at 110, 165, and 180 km, caused by the rotation of the device, gives I ($h = 180$ km) $< I$ ($h = 110$ km). Such correlation must be observed at the disposition of the layer near 100 km.

In Fig. 2 we plotted the variation of relative radiation intensity with altitude over the 65–100 km and 170–190 km ranges. Curve I is plotted for the intensity without allowing for the orientation of the device, curve II for the intensity re-

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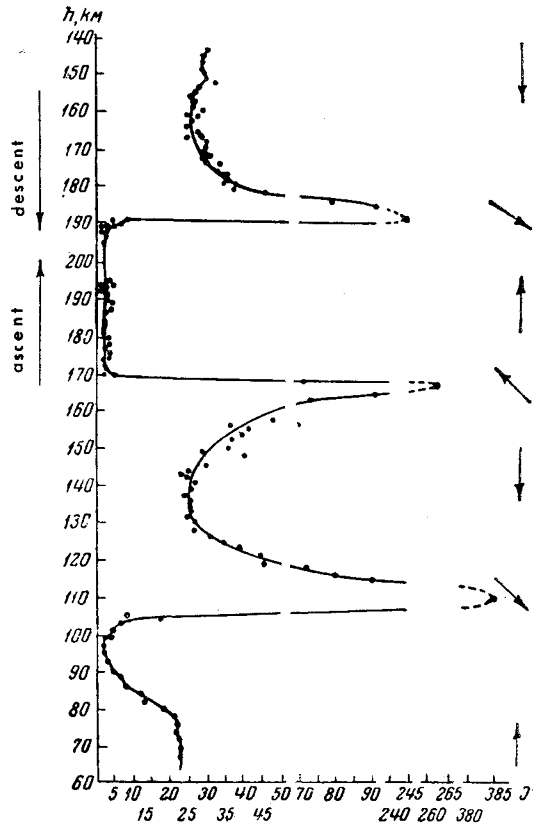
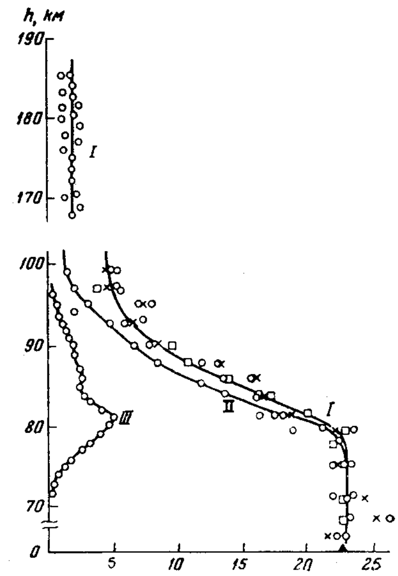


Fig. 1 Dependence on altitude of the relative intensity. The breaks in the curve correspond to breaks in the abscissa axis, made deliberately to reduce the size of the drawing.

duced to the zenith, and curve III for the emission in the unit of volume. The position of the maximum on curve III shows that the photometer indeed crosses the layer at altitude h = 80 km. The lower boundary of the layer is determined by the sharp decrease in intensity, caused by the reduction of volume brightness when the device enters the layer. This corresponds to h = 74 km. The upper boundary of the layer is at an altitude of 100 to 120 km, where the measured intensity is equal

Fig. 2 Dependence of glow intensity on altitude: I—without allowing for the orientation; II—at vertical sounding; III—relative intensity in the unit of volume.



to that of the stellar background, registered at 170–200 km altitudes. The center of gravity of the layer is at 81 ± 2 km.

The derived distribution of intensity with altitude describes the combined emissions of O_2 and OH, since the filter employed in the photometer transmits not only the radiation of molecular oxygen but also a band of hydroxyl OH.

According to a preliminary estimate, the emission of molecular oxygen constitutes about 50% of the combined emission passing through the filter. The glow of the hydroxyl, which we measured in the region λ = 8640 Å, was found to be localized in the layer, the center of gravity of which lies at 78 ± 2 km.

The detection of the glowing layer, emitting in the region λ = 8640 Å, at the same heights at which hydroxyl emits, and the establishment of the absence of emitting layers at other altitudes, indicate that the emission of molecular oxygen is concentrated in the layer from 74–120 km, with the center of gravity at 81 km.

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Reviewer's Comment

The determination of the height of a layer emitting a night airglow component is best accomplished by measuring the response from a photometer in the nose of a rocket that rapidly traverses the emitting region on both the upward and downward paths. The method has been used by American investigators for the radiations [OI] 5577, NaI 5893, OH, O_2, and the so-called continuum. The several airglow layers would not necessarily be expected to be at the same height.

Table 1

Molecule	Height, km	
	Packer	Tarasova
O_2	94	81
OH	85	81

Tarasova reports on a Soviet measurement with a filter which she estimates transmits about half O_2 and half OH, and it is of interest to compare the results with American measurements reported by Packer,* as shown in Table 1.

* Packer, D. M., Annales de Geophysique **17**, 67 (1961).

Packer used a filter for O_2 centered on the 0–0 atmospheric band near 7600 Å, which is not observable at all from the ground because it is strongly absorbed by the lower atmosphere. Tarasova, on the other hand, employed a filter centered on the 0–1 band at 8640 Å, which is not significantly absorbed by the lower atmosphere. In the case of Packer's O_2 height determination, the lower atmosphere thus acted as an absorption filter blacking out completely any initial photometric response. After a height of several tens of kilometers was attained, the readings increased, confirming the fact that the photometer was responding to the 0–0 band.

A difficulty in the interpretation of Tarasova's results is, as she brought out, the question of the relative contributions of O_2 and OH to the total emission, but no possible weighting of Packer's heights (85 km and 94 km) can yield an effective height of 81 km as reported by Tarasova. Therefore it is necessary to conclude that the two independent measurements are in moderate disagreement, which is not surprising, considering the difficulty of interpretation involved in the experiments.

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