# LETTERS TO THE EDITORS

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## Night-Sky Emission and Region F Ionization

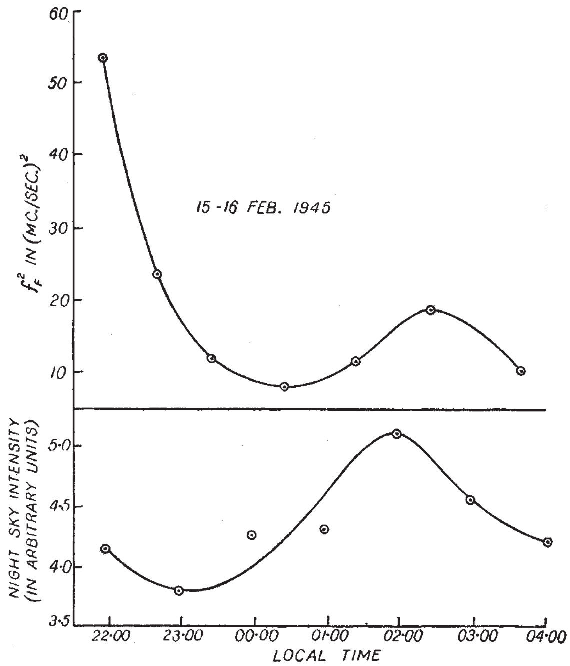
IN the theory of emission of the night-sky spectrum recently proposed by me, the Region $F$ of the ionosphere is identified as the luminescent layer[1]. The characteristic night-sky spectrum in the visible region consisting of the first-positive and the Vegard-Kaplan bands of $N_2$ and the auroral green and red lines of O are supposed to be emitted by the following reaction:

$$N_2^+ + O^- \rightarrow N_2 \text{ (excited)} + O \text{ (excited)}.$$

The energy released in the process of neutralization by electron transfer is given by the ionization potential of $N_2$ (15·58 eV.) less the electron affinity of O (2·2 eV.). This energy is taken up almost entirely as energy of excitation of $N_2$ to the $B^3\pi$ state ($v' = 9$; 9·1 eV.) and of O to the $^1S$ state (4·2 eV.). (There is some uncertainty about the value of the electron affinity of O. While Lozier[2] gives the value as 2·2 eV., recent experiments of Vier and Mayer[3] yield the value 3·0 eV. But even with the latter value there is sufficient energy available for raising $N_2$ to a high vibrational level of $B^3\pi$, if account is taken of the kinetic energy of the colliding particles.) According to the theory therefore one would expect a positive correlation between variation of the night-sky intensity and variation of the electron content of Region $F$. Prolonged observations on the intensity of night-sky emission and on the Region $F$ ionization density (square of penetration frequency $f_F$) do show unmistakable correlation in respect of long-period variations of the two, for example, seasonal variation and eleven-year solar cycle variation[4,5,6].

For the case of short-period nightly variations, however, one would not expect too close a correlation between the two. This is because the nightly variation of $f_F^2$ may not correspond to the variation of the total electron content of the region, on which latter, obviously, the intensity of night-sky emission depends. Thus the total number of electrons in a column of unit cross-section may remain constant or even decrease, but $f_F^2$ may show an increase due to contraction of the layer as a whole by cooling. Again, the decrease in $f_F^2$ due to recombination proceeds much faster than the decrease in the total electron content due to the same cause.

There are, however, 'disturbed' nights on which $f_F$, as also the intensity of the night sky, vary abnormally. On such nights the variation of $f_F^2$ follows the variation of the electron content of the region as a whole and, as such, one may expect a positive correlation between the two. This is precisely what has been found, and furnishes evidence in support of the theory. Taking advantage of the black-out condition in the city, Mr. S. N. Ghosh (Adair Dutt Research Scholar) has, for some time past, been keeping in my laboratory records of night-sky intensity variation on dark clear nights on which $f_F$ records were also being kept. It was found that on undisturbed nights on which the night-sky intensity shows a typical variation, $f_F^2$ also does the same, the two variations not necessarily following each other. On disturbed nights, however, on which $f_F^2$ exhibits abnormal variation, the night-sky intensity also varies abnormally, following the same trend. The accompanying figure depicts two such variation curves. It will be seen that they run approximately parallel to each other.




The night-sky intensity was measured photographically without any filter in the region 6° above the pole star. The photographic records were measured by a Moll microphotometer.

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[1] Mitra, S. K., *Science and Culture* (Calcutta), **9**, 46 (1943). See also Ghosh, S. N., *Proc. Nat. Inst. Sci. Ind.*, **9**, 301 (1943).
[2] Lozier, W. W., *Phys. Rev.*, **46**, 268 (1934).
[3] Vier, D. T., and Mayer, F. E., *J. Chem. Phys.*, **12**, 28 (1944).
[4] Rayleigh and Jones, H. S., *Proc. Roy. Soc.*, A, **151**, 22 (1935).
[5] Martyn, D. F., and Pulley, O. O., *Proc. Roy. Soc.*, A, **154**, 455 (1936).
[6] Smith, N., Gilliland, T. R., and Kirby, S. S., *J. Nat. Bur. Stand.*, **21**, 835 (1938).

## X-Ray Topographs

WHERE a sizable crystal is to be used for investigations of structure-sensitive properties, for example, X-ray intensity measurements, photo-electric effect, etc., it is advisable to test its homogeneity. This may be simply done in the following way.

The crystal is irradiated by a wide beam of appropriately filtered X-rays, diverging from a pinhole placed close to the anticathode. A small piece of flat photographic film is mounted in a holder on the axis about which the crystal oscillates. The film is arranged to be parallel to the face of the crystal which it is required to examine. The crystal is then placed in the position for a Bragg reflexion to occur for this face, and the crystal and film are then oscillated through an angle sufficient for every part of the crystal to reflect. We have found Kodak Process film very satisfactory for this purpose and better than Crystallex, because, though its sensitivity is less, it is much finer grained.