SHORT COMMUNICATIONS

THE 5577 Å OI EMISSION LINE OF THE AIRGLOW AT BRISBANE*

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During the four-month period from April to July 1960, a two-colour airglow photometer of the Huruhata type (Huruhata, Nakamura, and Tanabe 1957), recorded intensities of the night-sky emission at 5577 and 5300 Å at Brisbane (geographic latitude 27° 30′ S., longitude 153° 06′ E., and geomagnetic latitude 35° 06′ S.). A total of 156 hr of recording during 19 nights was obtained. A complete sky survey was made each 16 min. The corrections for van Rhijn variation and atmospheric extinction were applied in the analysis.

A 2–16 Mc/s ionosonde and a magnetometer measuring variations in the north-south horizontal component were operating on the same site.

Diurnal Variation

An analysis of individual diurnal variations revealed a wide range of behaviour. No systematic diurnal variation is indicated, in contrast with results obtained at Boulder by Roach (1955).

Intensity Distributions

The histogram of intensities of the green line showed the characteristic shape obtained at most other stations. This distribution is one with positive skewness. It has been pointed out by Roach, McCaulley, and Marovich (1959) that, if the Chapman reaction

$$\begin{aligned} &O+O+O\rightarrow O_2+O'\ (1S),\\ &O'\ (1S)\rightarrow 0'\ (1D)+h\nu\ (5577) \end{aligned}$$

is responsible for green line emission, then

$$I(5577)\propto N^3,$$

where $I(5577)$ is the green line intensity and N = number of oxygen atoms present. Thus

$$N\propto I^{\frac{1}{3}}.$$

If a normal distribution of oxygen atoms exists at this level one would expect a normal distribution in the values of $I^{\frac{1}{3}}$. The assumption of a normal distribution does not seem unreasonable if one keeps in mind De Moivre's theorem of large numbers, and the large number of oxygen atoms involved, as well as the large number of independent factors influencing its presence, e.g. solar ultraviolet, recombination effects, and possibly turbulence.

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This was tested with the available data and the normal curve of best fit was applied to the histogram obtained (Fig. 1). The goodness of fit was tested with the χ^2 test, which yielded a value for χ^2 of 13·3. Under the hypothesis that the $I^{\frac{1}{3}}$ values are normally distributed, 27% of similar observations would be expected to show a worse agreement than the current one.

Background Continuum

Although it is known that some of the 5300 Å background intensity must come from starlight, it is of interest to determine whether there is any correlation between the atmospheric component and the green line. Therefore a

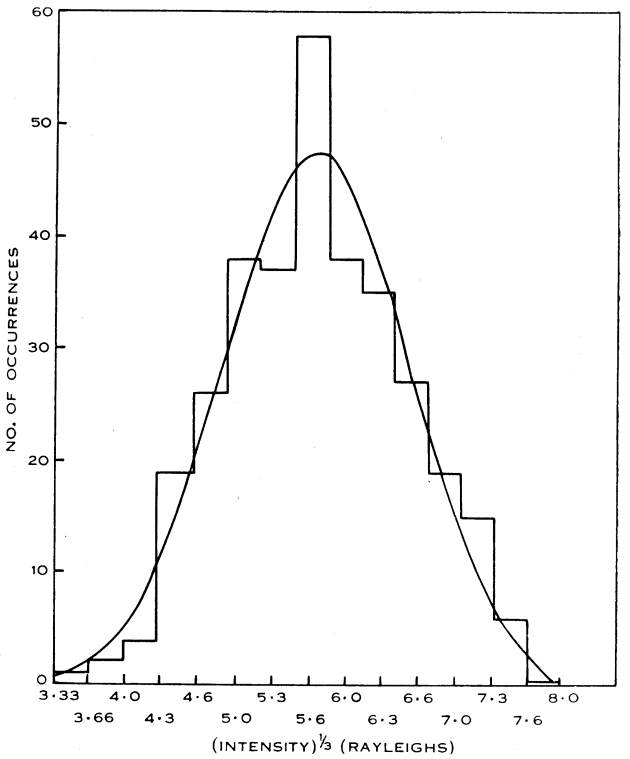

Fig. 1

comparison was made between the variations of the 5300 and 5577 Å intensities for some individual nights. The intensities in the direction of the Celestial South Pole were chosen, to avoid changes in the contribution from the Galaxy. Results showed that the two intensities were covariant.

Average values of 5300 Å intensity for all suitable nights were plotted against the corresponding average values of 5577 Å and a good linear relationship was obtained (Fig. 2). These results agree with those obtained by Barbier (1956) and Tohmatsu (1958). The van Rhijn variation of 5300 Å intensity is further evidence for its atmospheric origin and one can only conjecture with the available evidence that the covariancy of the two emissions is due to a linkage through

either the mechanism of excitation or the possibility that 5300 Å emission is part of a broad molecular emission of molecular oxygen which at times becomes the atomic oxygen responsible for 5577 Å emission.

Velocity of Drift

From the isophote diagrams drift patterns in the green line emission layer were determined. The frequency of scan, i.e. one every 16 min, was sufficient for unambiguous results to be obtained in many cases. The amount of data analysed was not great enough to be of statistical value but values of velocity of drift between 120 and 150 m/s were obtained.

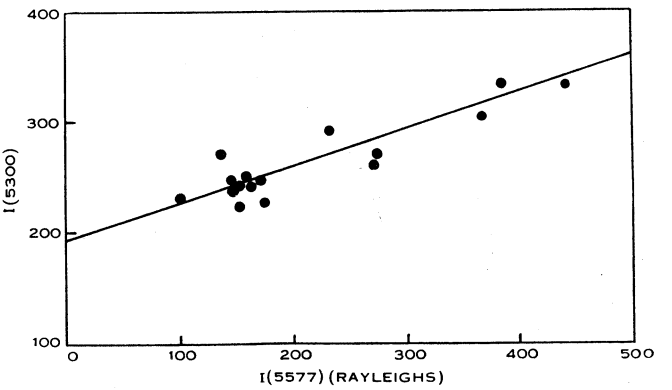

Fig. 2

Magnetic Control

No general correlation was found between the local K indices and green line intensity. However, a magnetic storm with K index 6, occurred on April 28, 1960, and in the same period the green line intensity exceeded 500 rayleighs as against the average green line intensity of approximately 250 rayleighs. It seems likely that the green line enhancement and the magnetic storm were associated. The more sensitive parameter ΔH, the variation in the Earth's horizontal field, was used to examine whether a magnetic control existed during magnetically quiet periods. The magnetometer did not measure the absolute field strength, so an arbitrary zero was set on the magnetometer records for the periods under investigation, the solar Sq variation being eliminated. ΔH was plotted against green line intensity for individual nights. The best straight-line fit was found and the slopes of the lines for the various nights compared. The results showed a general coherence, in so far as the slope was found to be always negative. Results were obtained for nine nights and slopes ranged between 0 and $-0\cdot2$/rayleigh with an average of $-0\cdot07$/rayleigh. This finding is consistent with that of McCaulley and Roach (1960).

Comments

The intensity distribution results still leave open the possibility of the Chapman reaction, which probably derives its energy from the solar ultraviolet.

The magnetic control results point to a magnetic influence and hence if this effect is analogous to auroral magnetic effects then the energy source would be the solar corpuscles either directly from the Sun or from the radiation belts surrounding the Earth. Evidence for the magnetic control seems to be increasing.

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