CORRESPONDENCE

To the Editors of the 'Observatory

The Central Intensities of the Fraunhofer Lines.

GENTLEMEN,—

Referring to Mr. Thackeray's article in your issue for July (**56**. 228), the difficulty of accounting for the high value of the central intensities of the Fraunhofer lines surely implies the same difficulty in accounting for the brightness of these lines when the background of photospheric light is cut off by the Moon in an eclipse, for it is this luminosity that produces the central intensity, and if its value were measured it would probably be found to be identical with the central intensities of the lines which appear dark by contrast.

So far as I understand the matter, the difficulty arises mainly from the exceedingly low pressure prevailing in the reversing layer, whereby the mean free path of the atoms and electrons is so great that collisions are comparatively rare. Also the energy re-emitted after absorption of photospheric radiation would be scattered in all directions, and so this would not account for the high value observed.

The difficulty must also apply to the prominences and chromosphere, which, according to theory, ought not to be luminous, as the density must be less even than obtains in the reversing layer. Apart from slight local variations frequently noted, the central intensity of the Hα line, so far as eye estimates can tell, is exactly the same on the Sun's disc and outside it in the chromosphere and prominences, where it has no luminous background, as can easily be observed or photographed at any time.

Local variations of intensity, not perhaps perceptible at a time of sunspot minimum, may become conspicuous in active sunspot regions, so that the central intensity of Hα may equal or exceed the intensity of the adjacent continuous spectrum. Exactly the same thing sometimes

happens with the other Fraunhofer lines, which for short periods of time may reverse and become brighter than the continuous spectrum. This phenomenon is generally admitted to be due to the uprush of highly luminous gases from lower levels, and this seems to me to give the clue to the explanation of the high central intensities of the lines when no obvious eruptions are in progress, for the chromosphere, including the reversing layer, is not a statical atmosphere, but consists of innumerable jets of gas or minute prominences familiar to all observers with the spectroscope from the time of Secchi. These jets radiate temporarily but are continually renewed from below, just as in a big eruption the prominence radiates brilliantly while it is fed from the photosphere, but fades very rapidly as soon as the supply of luminous gas ceases. It cannot maintain its luminosity by re-emitting the radiant energy absorbed by the atoms.

In the ordinary quiescent prominences, which maintain their luminosity for periods which may last for one or more solar rotations, the explanation is the same, for the detailed structure of these apparently stable masses indicates that they are continually being renewed by streams of gas issuing from the photosphere.

A general rising movement of the gases of the reversing layer is indicated by my measures of the line-shifts at the centre of the Sun's disc and at different points between centre and limb. When these are freed from the Einstein effect and the components of rotation the residual shifts give strong support to St. John's conclusion that in the lowest region "where 99 per cent. of the solar lines originate, upward currents exist in the Sun's atmosphere which increase in strength with nearness to the photosphere" (*Ap. J.* **67.** 195, 1928).

I am Gentlemen,

Yours faithfully,

1933, August 7. J. EVERSHED.