

Sun-spot Radiation.

GENTLEMEN,—

In connection with Mr. Wilson's interesting letter on the recent sun-spot printed in your last number, I would like again to call attention to the very marked difference which appears to exist between the relative blackness of a sun-spot when measured by thermal methods and the blackness as observed visually.

I am not aware that any accurate measures of spot darkness have been made photometrically, but some years ago I attempted some rough estimates by means of rotating sectors placed in front of the slit of a spectroscope, producing in this way an artificial dark band in the spectrum of the photosphere which I compared directly with the dark band given by a spot.

I found that it was necessary to reduce the photospheric light at least twenty times to produce a band in the spectrum as dark as that of a well-defined spot-nucleus; and a reduction of about four times was required to match the penumbra. That was in the green and yellow region of the spectrum. Towards the violet the spot-band seemed darker still.

Now the thermal measures obtained by Mr. Wilson in the case of the recent large spot give one-fifth (.209) as the smallest value of the ratio $\frac{\text{umbra}}{\text{photosphere}}$, whilst the mean of the values obtained on the three dates given by him is about one-fourth. That is to say, to the radio-micrometer the umbra of this spot was about as dark as the *penumbra* usually appears to the eye, if my estimates are correct.

Why is the spot so much less dark thermally than visually? The rays which have the greatest heating effect in sunlight are also those to which the eye is most sensitive, consequently one would expect the two methods of measuring the relative darkness to be in substantial agreement.

The fact that they are not so seems to me to be of especial importance. It implies that in some invisible region of the spot-spectrum the radiation is much more intense than it is in the visible region. Possibly in the infra-red the dark spot band may even be *reversed*, and could we see the spot by these radiations alone it might appear *brighter* than the photosphere.

It would be of great interest to determine where in the spot-spectrum the radiation is greatest or the relative darkness least. It seems probable that it is in the infra-red, because in the visible

Nov. 1898.]

Correspondence.

405

spectrum the spot-band is darker towards the more refrangible end.

Yours faithfully,

Kenley, Surrey, 1898, Oct. 7.

J. EVERSHED.