

CORRESPONDENCE.

To the Editors of 'The Observatory.'

The General Shift of Fraunhofer Lines towards the Red.

GENTLEMEN,—

PROF. JULIUS has given an interesting account of his anomalous dispersion theory of the solar line shifts in the *Observatory* for June (page 252).

As I have not access to recent literature on the subject at the present time, I am unable to deal adequately with certain questions raised, but I may perhaps refer to one or two points which lead me to question seriously whether anomalous dispersion is really concerned at all in producing line shifts:—

(1) Referring to the general shift of the solar lines to the red both at the centre of the Sun's disk and at the limb, Prof. Julius states that the magnitude of the shifts depends on the intensity of the lines, and he gives a table showing how this is borne out by Adams's measures of the lines at the limb. This dependence

on intensity is, to quote his words, "exactly what our interpretation requires."

Now in the case of the iron lines this relation of shift to intensity holds only for the lines at the centre of the disk, the limb shifts unfortunately are not related to intensity. The shifts of the lines of other elements have not so far been determined, and Adams's measures refer to the displacements between lines at the limb and lines at the centre of the disk; these, therefore, give relative values only. When absolute limb shifts are measured, as when the limb spectrum is compared with the iron arc, a remarkable uniformity is found; many lines of widely differing intensity give the same shifts, and the mean shifts also show no relation to intensity. The requirements of the anomalous dispersion theory are, therefore, not fulfilled as regards intensity.

(2) The increase of shift with wave-length which Prof. Julius states may be explained from the point of view of the dispersion theory is also only an apparent increase observed when comparing relative shifts between limb and centre. In *Kodaikanal Observatory Bulletin*, No. 38, Dr. Royds and I have shown that the mean absolute limb shifts of the iron lines are practically constant over a very wide range of spectrum.

(3) The exact and beautiful correspondence between the bright lines of the chromosphere and the Fraunhofer lines, which may be observed during a large solar eclipse, is convincing to those who have seen it that the dark lines are true reversals of the emission lines, unaffected in any appreciable degree by anomalous dispersions. And the accurate measures by Hale without an eclipse confirm the impression of identity of wave-length between the bright lines and their dark equivalents.

The contention of Prof. Julius that the darkness of the lines is in the main due to anomalous dispersion is thus difficult or impossible to accept, yet this hypothesis appears essential to his theory.

(4) As regards the shifts of the lines in eccentrically placed sun-spots the word "distortion," used by Prof. Julius, aptly describes what we should expect to find if anomalous dispersion were the effective cause. What we actually do find is not distortion, but displacement; the edges of a spectrum line are not in any way altered in appearance in a sun-spot compared with the region outside, but there is a bodily shift. In fact, we cannot in any way distinguish a line shift in a sun-spot from a shift due to the rotation of the Sun; and the latter must certainly be due to motion in the line of sight.

The same also applies to the limb shifts. We cannot detect any asymmetry in the lines at the limb, and the general shift towards the red is indistinguishable from the rotation shift.

The motion theory of the shifts, which I have advocated, leads

inevitably to an earth effect in the case of the limb shifts, a repulsion of the solar gases by the Earth. This no doubt is "an extremely unsatisfactory idea," yet no other theory of the line shifts has as yet been proposed which is in better agreement with the facts of observation. I am, Gentlemen,

Kashmir, 1914, July 17.

Yours faithfully,

J. EVERSHED.