

Pressure in the Reversing Layer.

GENTLEMEN,—

Considering the sole purpose in scientific controversy to be the elucidation of obscure points, I trust that another letter on the above subject will not be considered superfluous.

Prof. Whittaker, in his recent letters, has suggested that the absence of pressure-shifts in the spectrum of the Sun may be accounted for in other ways than the obvious one, viz. that pressures exceeding one atmosphere do not exist in the reversing layer.

While fully recognizing the possibility that pressure-shifts, as determined in the laboratory, may not be strictly applicable, in a quantitative sense, under solar conditions, I must take exception to the statement that "pressure is well known to produce different effects on spectra according to the methods by which they are produced in the laboratory, *e. g.* the effect on arc-spectra is not the same as the effect on spark-spectra." This does not appear to represent the views taken by those who have worked at the subject. In his classical researches on pressure-shifts, Humphreys compares the shifts measured by Anderson in the iron spark with his own results in the arc, and he calls attention to the general agreement between the two, "showing that presumably neither the nature of the surrounding gas, nor the mode of rendering the atoms luminous, changes very greatly the magnitude of the shift" *.

It is true that the investigations of Hale and Kent on the spark under pressure indicate discordances in some cases; but Humphreys, after referring to these, says: "The possible difference of pressure-shift of arc and spark lines is still an open question." This appears to be the last word on the subject, so far as I know. If any newer results are known to Prof. Whittaker, a reference to them might have been made.

The whole trend of Humphreys's admirable researches goes to show that pressure-shifts are dependent upon the fundamental proportion of atoms. Most interesting relations are found between the shifts and the atomic weights, as well as the physical properties of the elements. This being so, it would seem *a priori* improbable that different modes of exciting luminosity produce different pressure-shifts. That temperature differences are ineffective has also been shown by Humphreys; but I take it that Prof. Whittaker has abandoned his position in this respect.

As to forces acting in opposition to gravity, I do not think that Prof. Whittaker has fairly represented my views when he says that they amount to saying "that the conditions in the chromosphere are unknowable." I consider that a force, other than light-pressure, acting on matter exterior to the photosphere has

* *Astrophysical Journal*, xxvi. p. 33.

been demonstrated by the accelerating movements of prominences and of comets' tails *, and I believe that a numerical determination of this force is quite within the range of possibility.

But there are some independent considerations which point to a very much lower pressure and smaller pressure *gradient* in the reversing layer than is demanded by the gravitation theory alone. To mention only one: it seems inconceivable that any gas at the base of the reversing layer, under a pressure of "many thousands of atmospheres," or even hundreds, could emit a discontinuous spectrum consisting of fine lines.

Finally, it may not be out of place to mention here that indications of pressure-shift are not entirely absent in the Sun. As a result of a large number of measures of lines in the spectrum of sun-spots, a small relative shift of those lines most affected by pressure with respect to the lines least affected has been detected here recently; and, contrary to preconceived ideas, the most affected lines in almost all cases are found to be shifted towards the violet, indicating a pressure in the umbrae of about one-third of an atmosphere less than that in the surrounding regions, assuming that the pressure-shifts observed by Humphreys can be applied quantitatively. Full details of these measures will be published shortly.

Yours faithfully,

J. EVERSHEED.

Kodaikanal Observatory,
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