

NOTE ON THE ZEEMAN EFFECT IN SUNSPOT SPECTRA.

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Photographs of sunspot spectra obtained with the liquid prism spectrograph have clearly shown the Zeeman widening of several lines in the region near $H\beta$ and $H\gamma$, where a dispersion of 1.5 to 2 mm./Å. has been obtained with four transmissions through the prism.

Recently it has been possible to obtain very high dispersion in the less refrangible regions after perfecting the optical performance of the prism. In the region between λ 5200 and 5300 the spot spectrum has been photographed many times with ten transmissions through the liquid prism, the scale here being 2 mm./Å.

With this dispersion a very striking example of a Zeeman doublet is revealed in the Fe line λ 5250.218. This line, in all large spots examined, is split into two at the edges of the penumbra, and the separation increases to about 0.25 Å. over the umbra when the spot is not very far from the centre of the disc. This amount of separation of the components is much greater than in any other Zeeman doublet that I have observed. In some cases a central component appears on the umbra, even when the spot is near the centre of the disc; but there is some doubt whether this is due to superposed light from the photosphere scattered in a hazy sky and showing the unaffected line.

The neighbouring lines are also greatly widened and show signs of doubling in some spot spectra. These are 5247.060 due to iron and 5247.576 due to chromium. There is also an iron line at 5250.576, but this is only very slightly widened.

I cannot find any reference to the line 5250.218 in Hale's work on the magnetic field in sunspots, although it appears to be one of the most conspicuous cases of the magnetic effect to be found in the spot spectrum, and it would apparently serve better than any of the lines that had been chosen in attempts to measure the general magnetic field in the Sun. The only references to it that I can find are in a list of lines affected in sunspots by W. M. Mitchell.* Also in a spot observed on 1909 May 11 the line is described by Mitchell as a wide doublet in one position in the spot group and a wide triplet in another. The line is unaccountably omitted in Adams's comprehensive list of lines doubled in spots.†

As regards the Zeeman effect observed in the laboratory, King has measured the magnetic separation of this line, and some of the neighbouring iron lines, in furnace spectra.‡ His results are as follows, observed along the lines of force, and with a field strength of 6400 gauss:—

* *Ap. J.*, 24, 86, 1906. † *Ap. J.*, 30, 120, 1909. ‡ *Ap. J.*, 51, 115, 1920.

λ	$\Delta\lambda$
5232.954	0.20
5247.060	0.34
5250.218	0.51
5254.955	0.40
5270.390	0.12

Here also the line 5250.2 shows a wider separation of the two components than any of the nearby lines, and the relative separations in these five iron lines agree well with those shown in my spot spectra. The line 5250.656 was not measured, presumably because so little affected.

In Hale's work on the general magnetic field of the Sun it is curious to note that the chromium line at 5247.576 and the iron line at 5250.656 were both measured, whilst 5250.218 was not measured although so conspicuously affected in spots. This may possibly be due to the fact that the magnetic effect of the line had not then been observed in the laboratory: King's measures of it in the furnace spectrum were made much later. The separation of the components is notably greater than that of the chromium line in my spectra, and at least three times greater than that of its near neighbour 5250.656. It is a relatively narrow line in the Sun's spectrum, and should be easy to measure with precision. The region of spectrum including the line occurs on some of the original negatives of the solar magnetic field taken at Mt. Wilson in the year 1913, which Dr. Hale left with me in 1933. I hope to undertake some new measures of these plates and compare the shifts of 5250.2 with its near neighbours.

Summary.—The liquid prism spectrograph has revealed the Zeeman effect in many lines in the $H\beta$ and $H\gamma$ regions of the sunspot spectrum with four transmissions through the prism.

In the less refrangible regions and with ten transmissions a dispersion of 2 mm./Å. reveals a striking example of a Zeeman doublet in the iron line at 5250.218. This line does not appear to have been observed by Hale in his work on the magnetic field in sunspots, nor was it included in the lines used by him in investigating the general magnetic field of the Sun, although its close neighbours showing far less effect in spots were used and gave evidence of the general field.

The Zeeman effect of the line in the furnace was shown by King to give a wider separation than any of the nearby lines.

It is suggested that this line would be very suitable for obtaining new evidence of the general magnetic field of the Sun.