The Active Region on the West Solar Limb during the Eclipse of 1952, 25 February

GENTLEMEN,—

The High Altitude Observatory of Harvard University and the University of Colorado obtained about 20 satisfactory spectrograms in each of three spectral regions from \( \lambda 3400 \)—\( \lambda 8500 \) of the flash spectrum at the Khartoum eclipse. Our most complete observations were for the east limb, and until recently all our attention was directed to these spectrograms. Results of analysis of the hydrogen spectrum therefrom will be published shortly. However, there were several spectrograms of the west limb regions that were of excellent quality, and we now have examined them in detail.

The active region on the west limb centred at 260° heliographic position angle, previously reported, shows some very interesting characteristics as compared with the east limb region, which seems to represent average conditions of the “undisturbed” chromosphere. The principal properties of interest revealed on our spectra of this narrow active region were:

1. The intensities of all of the chromospheric lines so far studied were stronger at the west limb region. The maximum increase was shown by \( \text{He}^+ \), \( \lambda 4686 \), and amounted to a factor of 10.

2. The plots of intensity vs. height of the Moon’s limb for hydrogen are exponential on both limbs, but the rate of exponential decrease is three times as great on the east limb as it is on the west limb.

3. The ratio of \( \text{He}^+ (\lambda 4686)/\text{He} (\lambda 4713) \) is increased by a factor of two on the west limb.

4. The continuum intensity at \( \lambda 4700 \) is increased by a factor of 1.8 on the west limb.

5. The Balmer decrements in the west limb region are larger than in the east limb region. The observed decrements from \( H_9 \) to \( H_{28} \) exceed the thermodynamic equilibrium decrements at all levels observed on the west limb. They do this only at high levels on the east limb.

6. All of the observable coronal lines have a maximum at the west limb region, and some lines show only in this region. The yellow coronal line, \( \lambda 5654 \), has been identified in this region on 10 spectrograms. It does not show at any other position. We have not seen previous reports of this line at eclipse.

One other item of interest in relation to this region is the prominence at 270°. The structure of this prominence on the spectrograms is considerably different from the structure shown by the Climax prominence survey and the drawings from the McMath-Hulbert spectroheliograms although the structure shown by these latter two are very similar. Both of these show nearly vertical structure and average brightness. The eclipse spectrograms however show a bright shaft inclined about 45° to the radial direction as the only pronounced feature of the prominence. This suggests that the prominence at eclipse time was a short-lived surge of the type usually associated with solar flares.

The intensification of the chromosphere and coronal lines, the occurrence of the yellow coronal line, and the possibility of a surge-type prominence
tempt us to suggest that the observations are of a moderate limb-flare in some stage of its development. This suggestion is made more plausible by the fact that this region showed considerable flare activity during disk passage and on eclipse day. One flare was reported on 13 February, one on 16 February, two on 24 February, and two on 25 February\(^1\),\(^2\).

Observations by Minnis\(^3\) during the eclipse at Khartoum showed that 28 per cent of the total Sun's E-region ionizing radiation came from a small region very near the west limb having but 0.4 per cent of the area of the Sun's disk. A flare at the west limb would explain this observation.

Our tentative interpretation of these results is as follows:

1. The increase in the continuum intensity results from an increase in the electron density.
2. The increase in the ratio of $He^+\!/He$ results from an increase in the electron temperature.
3. The increase in the Balmer decrements and the fact that they exceed the thermodynamic equilibrium decrements results from an over-population of the lower atomic levels. This direction of departure from thermodynamic equilibrium suggests a high temperature model in the regions.\(^5\)

We are initiating a more complete analysis of the region, including measurements of more spectral lines and a more complete interpretation of the data. These results will be published when the work is completed.

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We are, Gentlemen,

Yours faithfully,

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References


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The Aim of Double Star Measures

GENTLEMEN,—

There was a time when the prime object of double star observation was to verify if the stars obeyed gravitation and if the force acting was then identical with that found in the solar system.

Measures made a hundred years ago have shown that it was so and it