NOTES FROM OBSERVATORIES

THE SPECTRUM OF ε AURIGAE IN OCTOBER AND NOVEMBER, 1956*

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The spectrographic observations of ε Aurigae described in a previous paper[1] have been continued during the total phase of the present eclipse and during the early stages of the emergence of the F-type star. Plates I and II show the appearance of the spectrum on October 26, 1956 and November 22, 1956. For comparison the spectrum of ε Aurigae on December 29, 1955 is also shown. This spectrogram was taken at the very beginning of totality, whereas the plate on October 26 was taken at the very end of totality.

The absorption lines in October and November show a remarkable amount of structure not previously observed in this star. The stronger lines of Fe II are triple. The lines of Sr II, Sc II, Ca I, Fe I, and several other elements are double. The lines of Ti II at first sight also look double, but the strongest of these lines have a weak violet-displaced component in addition to the two strong components visible in Ti II λ 4468, etc.

The three components of the stronger lines of Fe II give radial velocities of approximately +10, —23, and —53 km/sec. The Ti II lines give radial velocities of +12 and —33 km/sec. Evidently the red components of Fe II and of Ti II arise in the same mass of gas. The violet component of Ti II is probably a blend of a relatively strong component corresponding to the —23 km/sec component of Fe II and a weak component corresponding to the —53 km/sec component.

An examination of the entire spectrum in October and November, 1956, shows the following:

1. The strong lines of Fe I are double, the two components

* The spectrograms used in this work were obtained by O. Struve and J. Sahade as guest investigators at the Mount Wilson Observatory.

probably corresponding to the +10 and the —23 km/sec components of Fe II. The violet component of Fe I is slightly stronger. There is no indication of the —53 km/sec component. The Fe I line, λ 4260, which is known to be influenced by the dilution of radiation, is also double but the red component is stronger than the violet component. We are not certain that this is a true dilution effect because most of the weak lines of all elements are single, and their radial velocities resemble those of the red components of the multiple lines.

2. The Ca I λ 4227 line is double, with the violet component (corresponding to the intermediate component of Fe II) decidedly stronger than the red component.

3. The lines Sr II λ 4078 and λ 4216 are double with the red component stronger than the violet component.

4. The lines of Cr I are double, with the violet component (corresponding to the intermediate component of Fe II) much stronger than the red component.

5. The strongest lines of Cr II show the same triple pattern as do the lines of Fe II. The weaker lines of Cr II show only the red component.

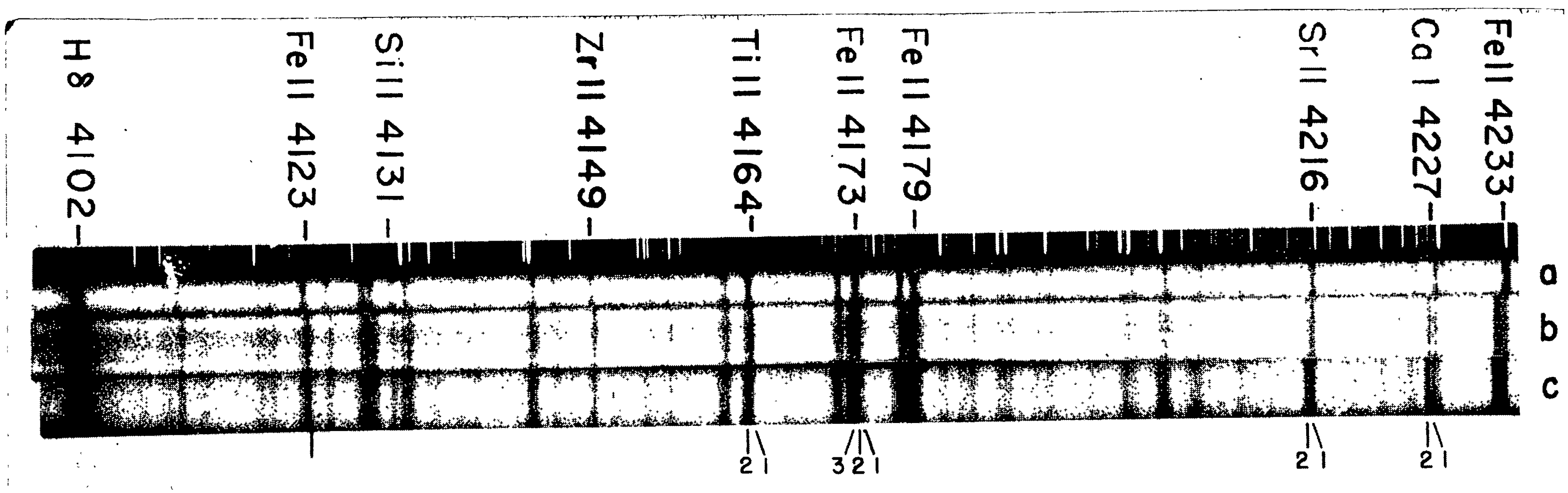
6. For any one atom or ion the relative intensities of the absorption components are strongly correlated with the laboratory intensity of the line: for example, in the case of very strong lines of Fe II, the intermediate and violet components are stronger than the red component, while the weaker lines of Fe II are strongest in the red component. This effect may be due to differences in the turbulent velocities corresponding to the three components.

7. It is reasonable to assume that the three components arise in three different sources having appreciably different ionizations and excitations. The Mg II line, λ 4481, does not show structure and is greatly affected by the dilution of the radiation in the gaseous medium surrounding many eclipsing stars. Its radial velocities are as follows:

October 26, 1956	+8.8 km/sec
November 21, 1956	—2.9 km/sec
November 22, 1956	—1.3 km/sec

These velocities probably refer to the gases surrounding the bright F-type star. From earlier observations we know that even out-

PLATE I



a) 1955, Dec. 29 b) 1956, Oct. 26 c) 1956, Nov. 22

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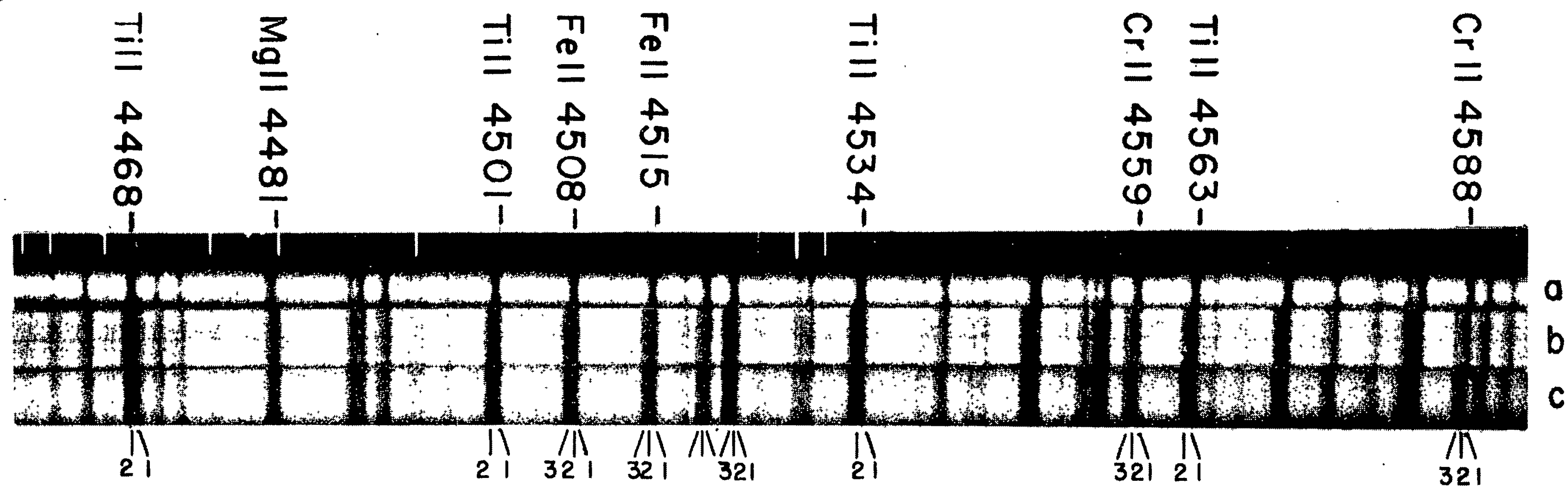
PLATE II



a) 1955, Dec. 29   b) 1956, Oct. 26   c) 1956, Nov. 22

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side of eclipse Mg II λ4481 shows marked irregular changes in radial velocity. We cannot entirely attribute this line to absorption in a quiescent reversing layer. It is probable that this line is at least partly produced in clouds that belong to the F star and move around it within the appropriate lobe of the critical zero-velocity surface shown in Figure 4 on page 35 of Volume 68 of these *Publications*.

8. The intermediate and the violet-displaced components of the Fe II absorption lines presumably originate within the volume previously assigned to the so-called I star. The volume contained in the lobe of the critical zero-velocity surface that surrounds the unknown star, which is in front of the F star at the present time, must contain at least two distinct clouds in the line of sight whose diameters are between that of the F star and that of the lobe. Both clouds have large negative velocities and the cloud at −53 km/sec has the higher ionization.

9. The intensities of the intermediate and the violet components were slightly stronger in November than in October.

The phenomena observed in October and November differ strikingly from those observed during the ingress and early stages of totality. In September and October, 1955 (ingress), the profiles of the absorption lines can best be explained as the result of a superposition of lines produced in the lobe of the F star with lines produced in a single cloud in the lobe of the eclipsing star. The radial velocity of this latter cloud was about +26 km/sec. There was no indication of another cloud at a still higher radial velocity.

During the eclipse of 1928–30 Adams and Sanford observed two components on November 15, 1929, at approximately the same phase as that of our observation on November 22, 1956.[2] The radial velocities of these components were about −35 km/sec and +5 km/sec. The former was undoubtedly produced in a cloud belonging to the eclipsing star while the latter may represent a blend of components from the F star and the eclipsing star. The plates of 1929 and 1930 give no indication of a component at −53 km/sec.

It is reasonable to suggest that the number of clouds in the line of sight and their radial velocities are distributed in an irregular manner but that the predominant motion of the clouds in each lobe is in the direction of the orbital motion. It is of course probable that the two lobes contain other clouds in the line of sight than those that can be distinguished by their radial velocities. It is, however, unlikely that the large volumes of the two lobes are filled with a gas of uniform density.

[1] O. Struve, *Pub. A.S.P.*, **68**, 27, 1956. In the caption for Plate II of this paper, the words (*top*) and (*bottom*) should be interchanged.

[2] W. S. Adams and R. F. Sanford, *Pub. A.S.P.*, **42**, 203, 1930.

THE ABSOLUTE MAGNITUDE OF U SAGITTARII AND ITS MEMBERSHIP IN M 25

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Irwin has recently re-emphasized the possibility that the classical cepheid variable U Sagittarii[1] is a member of the galactic cluster M 25.[2] This cepheid was assumed to be a cluster member by Doig many years ago,[3] but the first definite evidence for its association with M 25 came from the radial-velocity measurements published by Miss Hayford in 1932.[4] In order to test whether or not it is a member, spectrograms of 16 other stars in the vicinity of the cluster have been obtained with the new Cassegrain spectrograph of the 60-inch telescope on Mount Wilson. The spectra, of dispersion 80 Å/mm, were widened to 0.4 mm to improve the accuracy of the radial velocities and of the spectral classifications. The resulting observational data are summarized in Table I. The columns give, respectively, the HD and CPD numbers of the stars, the spectral type, radial velocity, probable error of the velocity, weight of the velocity for the B-type stars, and remarks.

The radial velocities were measured in the usual way; wavelengths for stars of all spectral types are on the Victoria system. Laboratory wavelengths were used for the four additional ultra-