same star is $\lambda 3244$. My spectrogram can be well measured between $\lambda\lambda 3650$ and 4400. It serves, therefore, to check a considerable portion of Struve's measures and also to supply wavelengths for a part of the gap between his measures and those of Adams and Dunham.

The part in common with Struve confirms the lines which he found, except those at $\lambda\lambda 4039.24, 4064.89, 4129.02, 4130.88, 4202.89, 4273.35$, and 4342.90. Several $O\ II$ lines were added to those listed by Struve. Moreover, there seems to be some gain in resolution, for the line observed by Struve at $\lambda 4069.81$ has four components agreeing well with four of the six lines which he assigns to this blend; $\lambda 4120.81$, $He\ I$, and $\lambda 4121.48$, $O\ II$, are clearly resolved; $\lambda 4253.51$, $S\ III$, and $\lambda 4253.98$, $O\ II$, are well separated; and two lines are present in each of the blends, $\lambda\lambda 4277.55$ and 4283.04.

For the newly measured region, $\lambda 3650$ to $\lambda 4026$, all the lines found are those to be expected from the previous work in other spectral regions.

The K line of $Ca\ II$ is weak but sharp and gives a radial velocity of $-6$ km/sec. $D_2$ agrees very closely with $D_1$ and together they yield a radial velocity of $-8.5$ km/sec. The stellar velocity from $O\ II$ lines is $+0.5$ km/sec. The agreement between K and $D_2$ and $D_1$ is all that can be desired. Both show a significantly greater negative velocity than that of the star. The sharpness of these lines, the spectral type of the star, and the magnitude of the velocity they yield when freed from the solar motion point to an interstellar origin.

Carnegie Institution of Washington
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He Emission in the Spectrum of Arcturus

By O. C. Wilson

The H and K lines of $Ca\ II$ in the spectrum of Arcturus (K0, $M_{sp} = 0.2$) have fairly strong double emission components at their centers, a feature which is not uncommon for
stars of this type.\(^1\) Recent coudé spectrograms showed what appeared to be an additional emission line within the H line to the red of its center, for which there was no counterpart within the K line. Microphotometer tracings, of which examples are reproduced in Figure 1, have clarified the situation. In the figure, the background on the violet side of the H line has been reflected to the red side as shown by the solid curve. This procedure shows clearly the presence of a rather broad emission line superimposed upon the red wing of H. The K absorption, on the other hand, is obviously symmetrical about its central emission components. The wave length of the broad emission line agrees with that of H\(\varepsilon\) as closely as could be expected from its diffuse character.

The appearance of the H\(\varepsilon\) emission is in striking contrast to the behavior of the iron lines lying within H and K, three of which are indicated on the tracing. Evidently both \(\lambda 3927\) and \(\lambda 3930\) have the same central absorption (referred to the continuous background near K), but the total absorption of \(\lambda 3930\) is considerably less than that of \(\lambda 3927\). Similarly, the Fe line \(\lambda 3969\), which occurs at the deepest part of H, still shows a slight residual absorption rather than emission. These qualitative statements are in complete agreement with Thackeray’s

results on the solar spectrum\textsuperscript{1} and may be fully accounted for by an application of Eddington's formulae for the formation of absorption lines. The same theoretical considerations do not, however, seem capable of explaining the appearance of H\varepsilon in emission. Recalling that in stellar spectroscopy the integrated spectrum of the entire star is necessarily observed, we conclude that the most probable explanation is that the atoms producing the broad H absorption and those producing the bright H\varepsilon are at different relative heights above the photosphere. If the star is surrounded by an extensive hydrogen chromosphere, then the weaker general background within H will favor the appearance of the chromospheric H\varepsilon emission, while at the same time the H\varepsilon absorption, due to the hydrogen atoms in the reversing layer, will be greatly weakened by reason of its position well down in the H absorption line. Thus the observations described here may be considered tentatively as indicating that Arcturus possesses an extensive chromosphere of hydrogen.

There are few good high-dispersion spectrograms of late-type stars in the H and K region available at present. A plate of $\alpha$ Orionis, however, shows clearly that H\varepsilon occurs as absorption rather than as emission. Hence it is not unlikely that further study of H\varepsilon in stars of various types and absolute magnitudes may yield interesting information as to the relative distributions of hydrogen and ionized calcium in the outer regions of their atmospheres.

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The Violet CN Bands in Cometary Spectra

By Arthur Adel

In two short notes which appeared recently in the Publications of the Astronomical Society of the Pacific it was shown not only that a typical CN violet band in a comet spectrum possesses the expected cluster of rotation lines at the band

\textsuperscript{1} Mt. W. Contr., No. 555; Ap. J., 84, 405, 1936.