Catalogue describes the spectrum as "nearly continuous, except that $H\gamma$, $H\delta$, $H\varepsilon$, *and* $H\zeta$ are bright."

W. J. Luyten[1] suspected changes in the strength of the bright lines of HD 196982 on Harvard objective-prism plates, but found no change in brightness greater than half a magnitude. The spectrum of 20C 1250 showed bright lines[2] on plates taken at the Lick Observatory, but later none appeared on Harvard spectra. The Mount Wilson observations show no certain changes in the spectrum of any Me dwarf.

CARNEGIE INSTITUTION OF WASHINGTON
MOUNT WILSON OBSERVATORY
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OBSERVATIONS OF RW TAURI AT MINIMUM LIGHT

BY A. H. JOY

The well-known eclipsing binary RW Tauri is of especial interest to variable-star observers on account of its large change in brightness at the time of eclipse, when its visual magnitude drops from 8.0 to 11.5 in 3.25 hours. Its period is 2.77 days and the duration of totality 84 minutes. The spectral type of the principal star is B9 while that of the secondary, which is seen only during total eclipse, is K0. The lines of both components are well defined and show no abnormal rotation effect.

A. B. Wyse[3] photographed the spectrum at minimum on November 21, 1933, and reported the presence of emission lines of hydrogen and magnesium displaced toward shorter wave lengths. The brightness of the star was observed to increase toward the end of the exposure. This fact, together with the appearance of an A0 absorption spectrum, indicates that the exposure was extended beyond third contact. His later spectrograms failed to confirm the presence of emission.

The spectrum was photographed at the 100-inch telescope on October 9, 1940, when the variable was at minimum. The

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[1] *Harv. Bull.*, 835, 1926.

[2] Luyten, *Harv. Bull.*, 830, 1925.

[3] *Lick Obs. Bull.*, 17, 42, 1934, footnote 9.

exposure of 65 minutes' duration covered mid-eclipse and was wholly within the predicted totality according to the elements of Dugan and Wright.[1] The hydrogen lines $H\beta$, $H\gamma$, and $H\delta$ show strong double emission components displaced 350 km/sec toward the red and violet, respectively. They are about 3 A in width, fairly symmetrical and nearly equal in intensity, but the violet line is somewhat more diffuse. Other weaker emission lines (seen on this or later plates) are: λ 4481 *Mg* II; K *Ca* II; and λλ 4233, 4583, and 4629 *Fe* II. There is no evidence of absorption of the P Cygni type. The absorption spectrum is K0 and the star is probably a subgiant. See Plate IV.

Eleven spectrograms taken on September 9, October 29, and December 4, 1941, were timed so that the phases near second contact, mid-totality, and third contact were represented on separate plates. At second contact the red emission component appears alone, and at third contact the violet component, while at mid-eclipse no emission is seen.

The results indicate that the emission lines originate in an extended gaseous ring surrounding the equatorial region of the primary B9 star. As the larger K0 star passes in front at the time of second contact, one end of the edge-on ring is gradually occulted; then the whole ring is covered for more than 30 minutes; and finally, at third contact, the end of the ring which was covered at second contact is exposed to view. Observations are difficult on account of the faintness of the object, but it seems probable that, by properly timed exposures, the distribution of the constituent elements as well as the light-intensity in the ring may be determined.

This analysis is possible because of the large displacement of the emission lines as a result of rapid rotation of the ring. Until the spectrographic orbits of the stars can be determined, their actual size cannot be known with certainty. The photometric orbit indicates that the ratio of the diameter of the primary to the secondary is 0.56. The observations show that the diameter of the ring is somewhat less than that of the secondary K0 star. If the secondary is a subgiant, we may assume that the diameter of the ring is four times that of the sun. The period

[1] *Contr. Princeton Univ. Obs.*, No. 19, p. 29, 1939.

of rotation at the rate of 350 km/sec is then 14 hours. The dynamics of such a system require further study.

At the time of totality on September 9, 1941, a visual companion close to RW Tauri was observed with the 100-inch telescope. Its visual magnitude, distance, and position-angle were approximately 12.5, 1″, and 180°, respectively. The measured brightness at minimum must then be reduced 0.4 mag. to obtain the brightness of the eclipsing K0 star and this correction must be introduced in the photometric solution.

Carnegie Institution of Washington
Mount Wilson Observatory
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DETERMINING THE SPEED OF A CAMERA SHUTTER BY A THERMOELECTRIC METHOD

By Edison Pettit

The deflections given by a galvanometer as ordinarily used with a thermopile attain a maximum and remain constant. These deflections are then measures of the rate at which radiation falls on the thermopile.

If the same system is used ballistically the deflections are not quite proportional to the quantity of radiation and a special calibration is necessary. With a large resistance inserted into the circuit, the galvanometer swings to a maximum deflection and then oscillates several times before coming to rest. If the radiation is received for an interval that is short compared with the natural half-period of the galvanometer, the first maximum of deflection is proportional to the whole quantity of radiation received, and, if the rate of radiation is constant, it is also proportional to the effective exposure time. Although the large resistance greatly reduces the deflections, it was used in the measurements described here.

When a camera shutter is used for prominence photography by the motion-picture method[1] it is desirable to know the characteristics of its performance. The usual photographic methods of determining these characteristics are tedious to say the least.

[1] See page 41.