6. PHOTO-ELECTRIC OBSERVATIONS OF AE AQUARII

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Dr A. H. Joy has shown that the star AE Aquarii is a spectroscopic binary. Seventy hours of photo-electric observations have revealed light variations accompanied by frequent explosions.

The light curve of AE Aquarii shows a roughly sinusoidal variation of 0·8 photographic magnitude in amplitude and with a period of about one day. It will be recalled that the spectroscopic period is not more than 0·71 day.

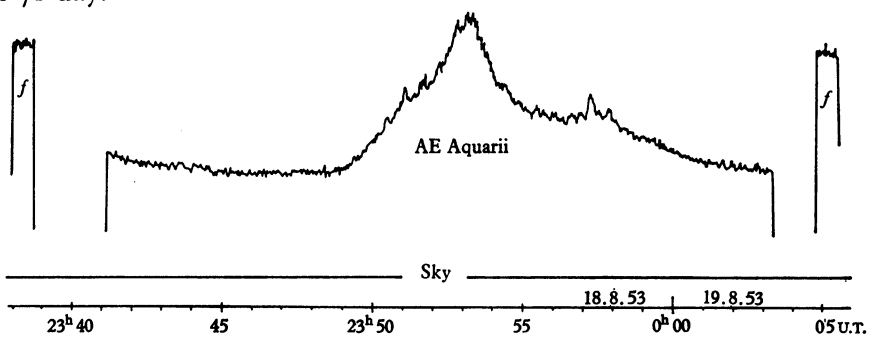

Fig. 1. Photo-electric recording of an explosion of AE Aquarii, observed through a blue filter. The deflexions at beginning and end marked *f* are of a comparison star.

An explosion is shown in Fig. 1. Three general characteristics can be distinguished in the eighty explosions observed thus far. They are as follows.

(1) The amplitude of the explosions is not constant. The strongest explosion had a photographic amplitude of 1·2 magnitude.

(2) The total duration of an explosion is about 15 minutes, this length varying little with the amplitude of the explosions. The phenomenon is thus very transient.

(3) The tracings of all the explosions show a sharp peak at maximum despite the rapid motion of the recording paper. The increasing and

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decreasing phases of the strong explosions always show small bursts which stand out from the natural fluctuations of the anode current of the cell.

The time constant of the combined cell and recorder plays an important part in the faithful reproduction of the light curve and in the recording of the small bursts mentioned above.

In Fig. 2 is illustrated a rough regularity in the occurrence of the explosions. These generally appear when AE Aquarii has a high mean brightness. However, it is not possible to predict either the time of occurrence or the amplitude of the explosions, which often overlap one another.

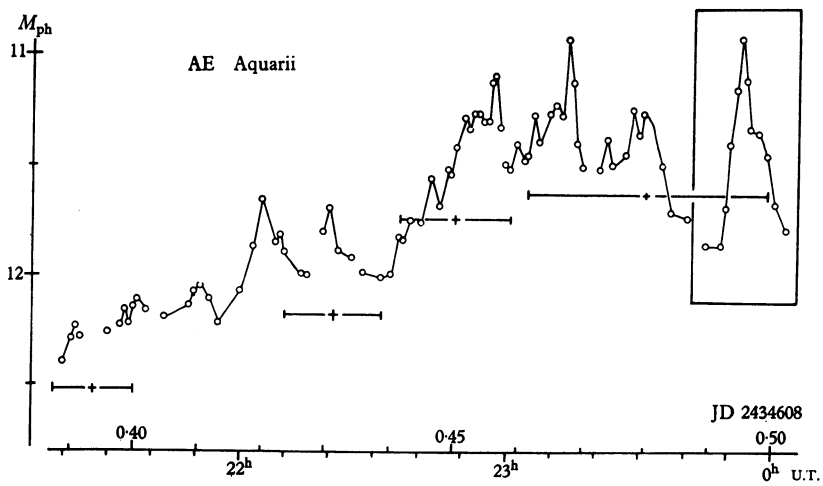

Fig. 2. The light curve of AE Aquarii, as observed photo-electrically in blue light on JD 2434608. The horizontal lines indicate the intervals of exposure of photographs taken in Hα light; their positions with respect to the ordinate axis represent the magnitude in Hα light. The rectangle encloses the explosion that is shown in the form of the original record in Fig. 1.

A deeper understanding of the explosion phenomenon requires successive observations in several colours. Such a study is difficult, and the chance of obtaining successful results is not large in the case of such an erratic phenomenon. All of our measures show, however, that the amplitude of an explosion increases from the yellow to the ultra-violet.

Dr Joy has established the presence of strong bright lines of hydrogen. Their influence may be estimated by means of the two following photometric methods.

(1) Two telescopes of the Observatory of Haute Provence follow AE Aquarii simultaneously. At the 120 cm. telescope, the photo-electric photometer records AE Aquarii continuously. The second (80 cm.) telescope photographs AE Aquarii and the neighbouring stars with a

pseudo-monochromatic combination which is centred on Hα (by the use of 103*a*-E plates and an Ilford 608 filter). The photographic exposures are made on the basis of the appearance of the photo-electric record. We have succeeded in centering the exposure times of different plates sometimes upon calm phases, and sometimes upon the explosions. Examination of the plates indicates a strengthening of the Hα emission line at each explosion. This result may be criticized because this photographic observation covers too large a spectral interval, and the length of the exposure blurs the phenomenon.

(2) Mr Ring has obtained for us an interference filter which transmits a band 70 angstroms in width. At each explosion, measures are made alternately upon a bright line and upon the neighbouring continuous spectrum. The result is the same as before: the bright lines of hydrogen contribute two-thirds of the amplitude of the explosion, the variation of the continuous spectrum contributing the remaining one-third.

AE Aquarii is a faint star, and the quality of the results is limited by the small number of photons received per second in a limited spectral region. An increase in the sensitivity would be detrimental to the rapidity of response. But an explosion is a rapid phenomenon that is difficult to record correctly as well as alternatively in two limited spectral intervals. The diversity of the amplitudes of successive explosions makes it impossible to compare the observation of an explosion, observed in an emission line with that of a second explosion observed in the adjacent spectral region. Therefore, the erratic character of the rapid explosions is the principal experimental difficulty preventing a more detailed photometric study.