The Spectrum of R Cygni. By the Rev. T. E. Espin, M.A.

The star was examined on several occasions in August and September 1911. When first seen it was about 13.5 mag. It was observed with various powers and seemed quite sharp; no nebulosity was seen, and the faint spectrum was apparently continuous. During September it was obviously increasing in light, and the spectrum appeared to be deeply banded, and was thought to be probably of Type IV. The weather was very cloudy in October, and no observation was obtained till October 27. From this date the results may be quoted in detail:

Oct. 27, mag. 8.7, Type III.!! The bands well seen.

Oct. 28. The bands quite clear, large and deep, and Type is III.!!

Nov. 2, mag. 7.6. The star has brightened greatly; the bands do not seem so pronounced, and the star does not look so red. F was looked for, but not seen.

Nov. 6, mag. 7.5. The bands seem less distinct, and F is bright but not easy to see.

Nov. 10, mag. 7.3. The star is certainly III. Dunér's bands 2, 3, 4 are very strong; after that the bands are much fainter. F is now clearly seen.

Nov. 16, mag. 7.0. There is little alteration. The most prominent object is F. The bands are generally feeble, and ill seen, and the spectrum III. only and not more. There is a bright line in the yellow, and the bands at this end of the spectrum are the most pronounced. C is also bright.

Nov. 29, mag. 6.8. The type is III., but not conspicuously so. F is the most prominent feature in the spectrum, but is not so bright.

Dec. 3, mag. 6.8. Twilight and Moon and passing clouds. There are bands, and the spectrum may be III., but uncertain. F only glimpsed.

Dec. 9, mag. 6.8. Definition not good. The spectrum long and carefully observed. F is still bright, but difficult to see. Bands in the red are strong. Dunér's Nos. 1 and 2 well seen. A bright line near D. Nos. 3, 4, 5, 6, 7, 8 are faint; 9 and 10 seem one large band. The spectrum appears to be III., but ill-defined.

Dec. 14, mag. 7.1. The star is distinctly fainter. The bands in the yellow and red are quite obvious, and the spectrum appears to be III. F is only glimpsed at times, and there seems a bright line near D. The violet end is strongly absorbed, and the spectrum in the blue and violet looks like IV. The star is redder.
The analysis of the above observations shows: that
(1) The bands became less obvious as the star brightened.
(2) The visual maximum derived from the brightness of F took place on November 21.
(3) The actual maximum took place on December 5.
It may be well to collect here all the spectroscopic observations of this object.

It was observed by Dunér, 1879 March 16, 1880 May 25, 1882 October 6, and was noted as III. "The bands in the blue are very large and rather deep as far as band 9 inclusive." On 1888 August 13, I observed F as a very bright line, and the Third Type spectrum was not certainly seen. Dr. Copeland measured F, and believed the spectrum to be III. type. Mr. Maunder (M.N. xlix. p. 306), on September 21, found bright lines near D₂ and F, and on October 1 only F. He adds that the general spectrum of the star, apart from the bright line at F, appeared to be Secchi's Fourth Type. On 1889 September 16 I found the star mag. 7½ and Type III., and F was not certainly seen. On October 28 Dr. Becker found F very bright. Mrs. Fleming, 1890 November 19, found Hα Hγ bright on the Harvard photographs; but 1904 December 7 the star was Type IV., and there was no trace of the hydrogen lines. It is stated in Harvard Annals, lvi. No. 6, that "the spectrum is peculiar and shows changes in the various photographs," p. 211; and on p. 224, "On the best photograph this spectrum resembles class N."

It may be well to add that Mr. Grover has at times seen a small nebula in place of the star at minimum. During the earlier observations in 1911 the star was carefully examined with the 1½-inch and showed no sign of nebulosity as before stated. The spectroscope never showed a nebular spectrum. But Mr. Grover informs me that the nebula was seen by him in 1895, 1897, 1898, 1900, and adds, "During the last fourteen years this nebula has been many times observed when the star was invisible. I have always noticed that as soon as the faintest sign of the star showed itself the nebula at once vanished." There is so much that is obscure about the spectrum of this star that I asked Professor Wright of the Lick Observatory to photograph it, and he has very kindly done so. Unfortunately the maximum occurred earlier than we expected, and so the photographs were taken after it. The account of these plates and his measures are communicated (p. 548). One or two points deserve particular attention.

(1) Dunér's bands for Types III. and IV. were drawn to the scale of the enlarged photographs and compared directly with the plate. There is no apparent agreement with Type IV. With Type III. there is better agreement, although, as might be expected, the photographs show much additional detail. Band 1 begins at wave-length shorter than in Dunér's measures, and is not so extended. Band 2 is more extended in both directions; a very dark absorption band between 1 and 2 seems to coincide with Dunér's dark ray in a Orionis λ6337. Band 3 is well-defined. Band 4 is of vastly
greater extent and more complicated. If, however, Keefer’s band in α Orionis λ5669 to λ5682 is added, and the photograph of μ Geminorum (Publication of the Yerkes Observatory, vol. ii. No. 5, plate 10) is studied, it will be seen that the result is very similar in R Cygni, save that the commencement is slightly more refrangible. From this point to Hβ the spectrum becomes such a mixture of bright and dark bands that it is no longer possible to distinguish the Third Type spectrum with certainty.

(2) Of the bright lines other than hydrogen, the one at λ6289 is the most remarkable. The helium line λ5016 is apparently bright with a dark line on the more refrangible side. This is probably the case with λ4922.

(3) In the second enlargement, containing the region between Hβ and Hγ next to the brilliancy of these lines the most remarkable object is the dark band whose centre is λ4644. This has a striking similarity to the one in γ Cassiopeiae as given by Sidgreaves (M.N., lix. No. 8, plate 9). Indeed, the spectrum in this region appears to have a certain resemblance in other details to that of γ Cassiopeiae.

(4) The variation in the more refrangible hydrogen lines, mentioned by Professor Wright, finds its counterpart in the behaviour of Ha. It seems probable that when the maximum approaches the lines slowly brighten up in order of refrangibility, till at length the climax is reached with the brightening of Ha. By this time the more refrangible lines have faded down; then with the fading of Ha the lines of greater refrangibility brighten up again in order.

The Spectrum of R Cygni. By W. H. Wright, Astronomer at the Lick Observatory. (Plate 8.)

(Communicated by the Rev. T. E. Eyton.)

With the hope that they will not be too late to accompany your paper on the spectrum of R Cygni, I am enclosing my measurements of the three spectrograms it was found possible to secure. These plates were photographed with a single-prism spectrograph attached to the 36-inch refractor. I greatly regret the inability to get a more extensive series of photographs, but we have had bad luck with our weather this winter. There has been practically no observing.

You ask for my opinion of these plates; it is hard to form an opinion of a variable star that is worth much, on the basis of three observations; but, speaking generally, a very remarkable feature appears to be that the continuous spectrum fades out in the blue. With most stars the photographic maximum is in the neighbourhood of 4500 A, but that is the point where the continuous spectrum of R Cygni ended, at the time of these observations.

Connected with this is the comparative faintness or absence of