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THE OPTICAL SPECTRUM OF RS OPHIUCHI

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SUMMARY

We present the optical spectrophotometric observations obtained between 1985 February 27 and May 17, following the recent outburst of nova RS Ophiuchi. The photographic spectra cover the region 4300-8900 A, at dispersions ranging from 56 A mm^{-1} to 209 A mm^{-1}, whereas the photoelectric scans are restricted to 6300-7100 A, with a bandpass of 10 A. The present spectra are very much similar to those of previous outbursts. The lines were narrow at the time of the first observations and narrowed further with time.

INTRODUCTION

The recurrent nova RS Ophiuchi had its fifth recorded outburst in 1985 January (Morrison, 1985). RS Oph is one of the spectroscopically well-studied recurrent novae. The 1933 outburst was observed in detail by Adams and Joy (1933), and Wright and Neubauer (1933), and the 1958 outburst by Joy (1961) and Dufay et al. (1964). The nova was lost in Sun's glare following the discovery of the 1967 outburst; yet, some spectroscopic observations have been obtained by Barbon et al. (1967) and Mammano and Rosino (1968). We report here the optical spectrophotometric observations obtained between 1985 February 27 and May 17.

OBSERVATIONS

Spectrograms in the range 4300-8900 A were obtained with an

image-tube spectrograph at the Cassegrain focus of the 1-m Kavalur reflector, at dispersions ranging from 56 A mm^{-1} to 209 A mm^{-1}. All the spectra were calibrated using an auxiliary calibration spectrograph. The stars 57 Ser, ι Vir and BD+8^{o} 2015 were used as standard stars for the instrumental response corrections.

Photoelectric scans were obtained on 1985 March 3, 4 and April 5, with a bandpass of 10 A. These are noisy due to poor sky conditions. However, the region between 6300-7100 A is useful. The standard stars were 57 Ser and μVel.

REDUCTIONS

The spectrograms were digitized at 4 μm intervals using a Carl-Zeiss one-dimensional microdensitometer automated using the computer TDC 316 (Ananth, 1985). The digitized spectra were reduced using an interactive code developed with the Kavalur VAX 11/780 computer. The noise was filtered using an optimal filter in Fourier space. The wavelength scale was determined using the emission lines in the nova, absorption lines in the standard star, and the atmospheric absorption bands. The spectrum was then brought to a linear wavelength scale by cubic spline interpolation. The instrumental response curve was obtained using the standard star and applied to the nova spectrum.

The photoelectric scans were reduced in the conventional manner. The fluxes of the lines were derived by decomposing the blends by hand. The electron density and mass of ionized hydrogen in the shell were obtained from the total corrected flux in Hα, assuming a value of A_V = 2.4 and distance of 1800 pc following Duerbeck (1981).

DESCRIPTION OF THE SPECTRUM

The spectra during the outbursts in 1933, 1958 and 1967 were remarkably similar. We find this true of the 1985 outburst too (Figures 1 and 2). Seen clearly on February 27 are Hα, P_{11-15}, and He I 6678 and 7065. Coronal lines of [Fe X] 6374 A, [Fe XI] 7892 A are also fairly strong. Subsequently all the lines

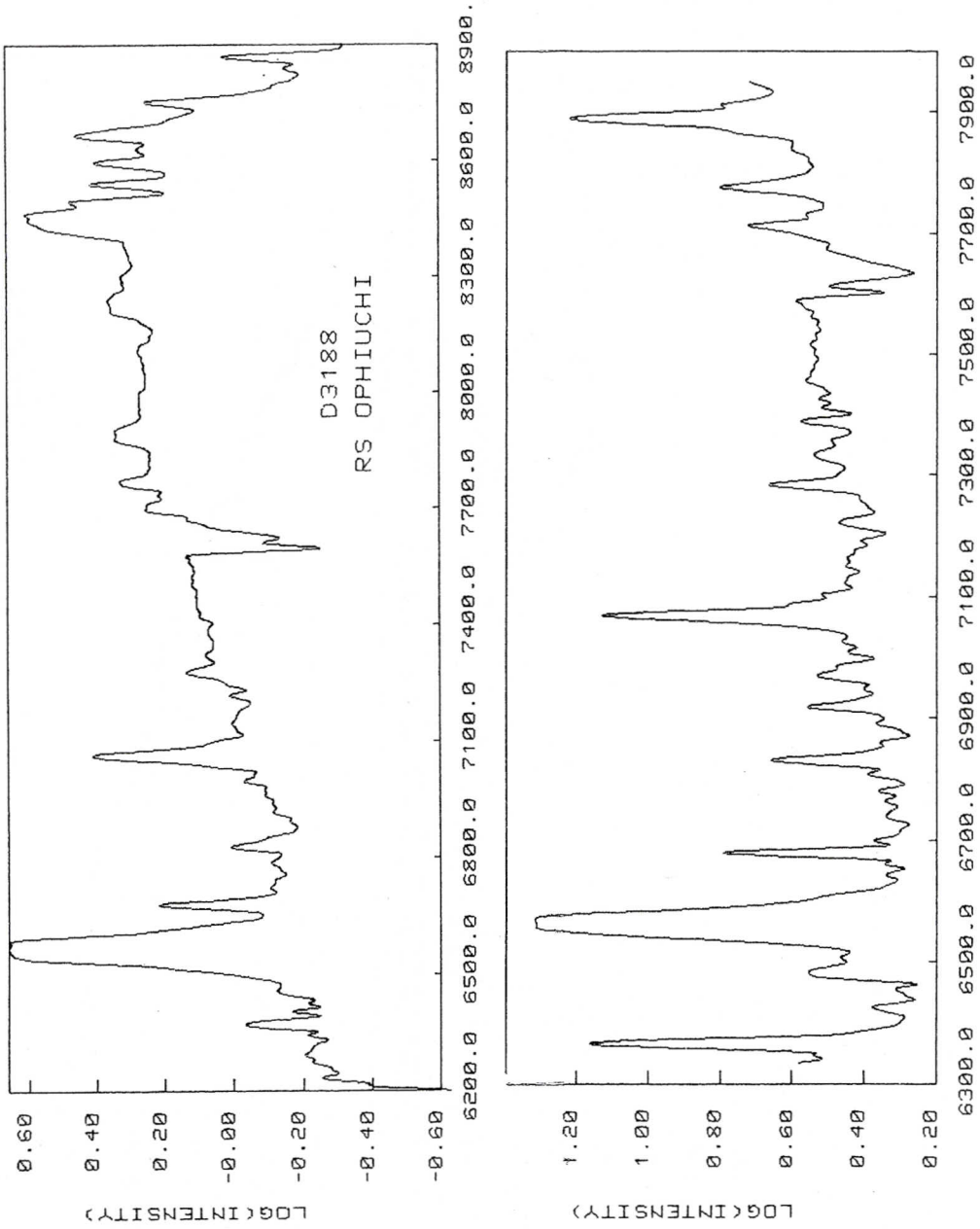

Figure 1. Sample spectra of RS Oph. Top: Feb 27. Bottom: Mar 28.

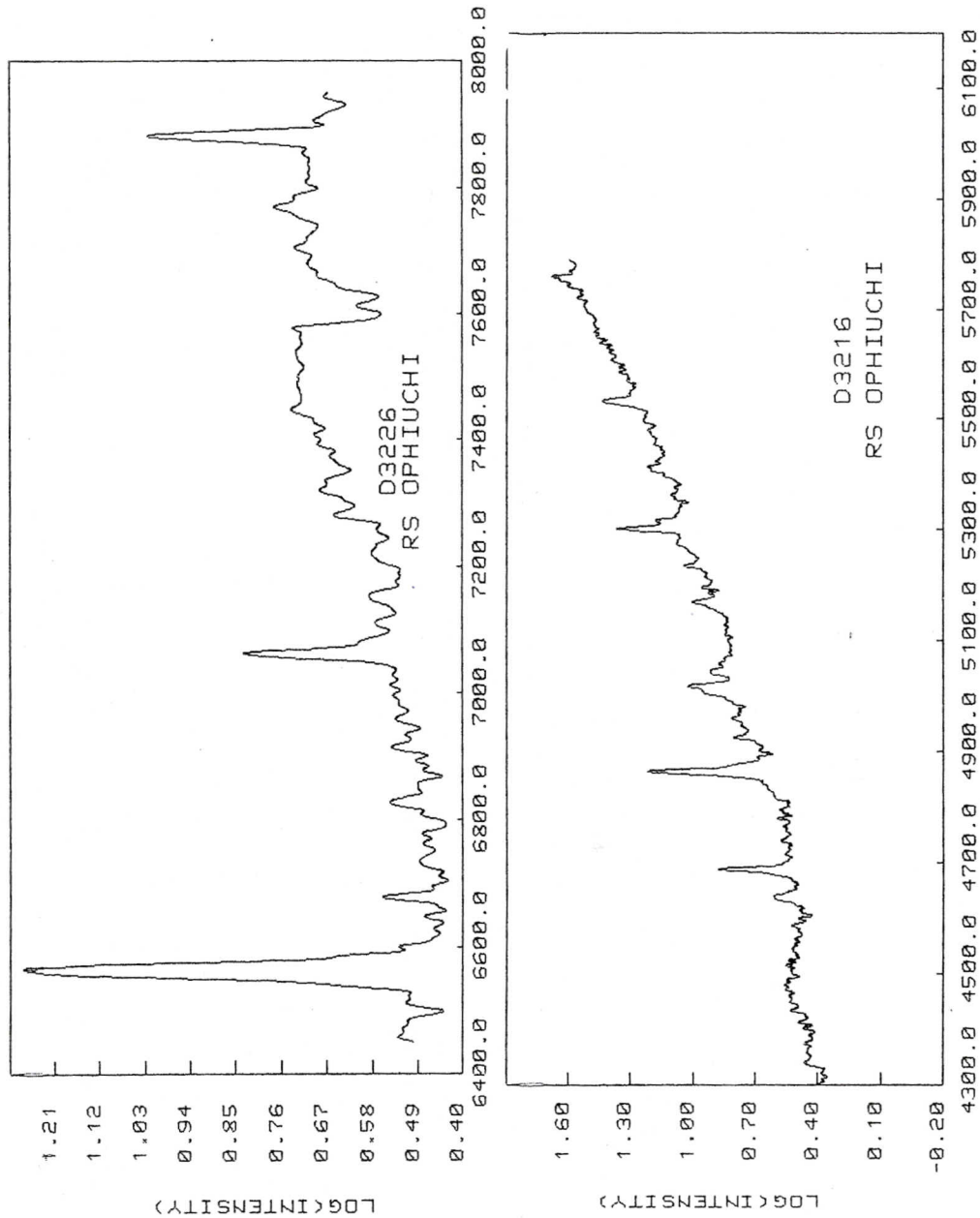

Figure 2. Sample spectra of RS Oph. Top: Apr 27. Bottom: Mar 29.

became narrower, and the coronal lines, particularly 7892, strengthened. [A XI] 6919 A was visible in March and April. Spectra in the blue and green region show Hβ, He I 5016, 5876, He II 4686, N III 4640, [Fe XIV] 5303, and [A X] 5535 in addition to several other fainter lines.

The unidentified feature around 6827 A was identified with [Kr III] 6826.9 by Joy and Swings (1945). Garstang (1963) suggests that the identification could be confirmed by the observation of [Kr III] 3504.0 A.

Photoelectric scans yield H_α fluxes of 26.56×10^{-10} and 18.67×10^{-10} erg cm^{-2} s^{-1}, on March 4 and April 5, respectively. The derived electron densities are 12.00×10^{8} and 3.32×10^{8} cm^{-3}, and the resultant masses of ionized hydrogen in the shell are 1.05×10^{-5} and $2.04 \times 10^{-5} M_\odot$. These values are in approximate agreement with the values derived at corresponding epochs for the 1958 outburst by Pottasch (1967).

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