CURRENT WORK ON CATACLYSMIC VARIABLES AT OXFORD AND CAMBRIDGE

G.T. Bath*, C.C. Brunt+, P.P. Eggleton+, A.C. Fabian+,
R. Harkness*, S.K. Mayo+, J. Papaloizou+, J.E. Pringle+,
M. Rayne+, G.S. Savonije+, J.A.J. Whelan+, C.A. Whyte+,
and D.T. Wickramasinghe+
*Department of Astrophysics, South Parks Road, Oxford
+Institute of Astronomy, Madingly Road, Cambridge

This talk summarizes recent work that has been done on cataclysmic variables at Oxford and Cambridge. Full details should be sought elsewhere, either from the authors concerned or from the references given below.

On the observational side, WZ Sge has been observed spectroscopically before and after the December 1978 outburst, in August 1978 and July 1979, using the Image Photon Counting System on the Anglo-Australian telescope. The data are being used (C.C.B. and J.A.J.W.) to study changes in emission lines and in the broad absorption line profiles.

Ultraviolet spectra were obtained with the I.U.E. satellite during the 1978 December outburst (Fabian et al. 1979). The data yield information on the evolution of the spectrum during the decline and on the short timescale spectral variability.

Three dwarf novae (VW Hyi, EX Hya and BV Cen) have been observed spectrophotometrically in the wavelength range 1250-7500 Å, using spectra obtained simultaneously with the I.U.E. satellite and the Anglo-Australian Telescope. The spectra of EX Hya, seen in quiescence, and of VW Hyi, seen on the decline from outburst can be fit to theoretical steady accretion disc spectra (Bath, Pringle and Whelan, 1979).

Time-resolution spectroscopy of Z Cha round the orbit in quiescence has been carried out. The data demonstrate that the centre of the disc rotates faster than the outside. The final analysis will yield information on the orbital parameters (Rayne and Whelan, 1979; Rayne, 1980).

On the theoretical side, a detailed investigation has been started on the spectrum to be expected from an optically thick outflowing wind (R.H. and G.T.B.).

An investigation of the conditions under which the boundary layer between an accretion disc and a white dwarf can emit X-rays has been

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carried out (Pringle and Savonije, 1979). For low accretion rates hard X-ray emission is possible. At high accretion rates the hard X-ray emission is suppressed and soft X-ray emission can be observed.

A study of the time-dependent behaviour of accretion discs during the outbursts of dwarf novae is being conducted (G.T.B. and J.E.P.). Adequate fits to the observed light curves can be obtained either by varying the mass-transfer rate or by varying the viscosity. The constraints on the types of variation which give rise to plausible light curves are being investigated.

Analytical and numerical computations of the oscillations of rapidly rotating white dwarfs are presented (Papaloizou and Pringle, 1978 and 1979a). The existence of the r-modes is confirmed, as is the confinement of the g-modes towards the equatorial regions. The results support the possibility that the coherent and the quasi-periodic variations seen in cataclysmic variables are caused by sets of low frequency oscillations excited in a rapidly rotating white dwarf envelope.

Theoretical continua ($3000 < \lambda(A^o) < 20,000$), UBV colours and Balmer absorption line profiles have been computed for the optically thick parts of steady-state accretion discs around white dwarfs. The results are compared with UBV colours taken from the literature and with new spectroscopic line profile data of several dwarf novae in outburst and a UX UMa type star, CoD -42^o14462. The overall agreement between theory and observation is good for UBV colours and reasonable for line profiles (Mayo 1979; Mayo _et al_. 1979).

A model is proposed to explain the super hump period seen in some cataclysmic variables during outburst (Papaloizou and Pringle 1979b). It is suggested that the orbits of these stars are slightly eccentric and that the superoutburst period, P_r, is the one on which the mass-transfer is modulated due to periodic variation of the stellar separation. Thus P_r is related to the orbital period P and the apsidal precession period U by $P_r - P = P^2/U$.

A simple model of binary star evolution has been produced and tested, including the effects of stellar mass loss and gain, of nuclear evolution and of loss of mass and angular momentum from the system (Whyte and Eggleton 1979). The program has been applied initially to the evolution of cataclysmic binaries. It is found that the 2 - 3 hour period gap and the concentration of systems at low binary period are due to evolution in systems with low mass white dwarfs.

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DISCUSSION FOLLOWING THE PAPER BY BATH *et al*. (GIVEN BY PRINGLE)

Mitrofanov: I would like to ask four questions about the model of dwarf novae:

(1) What is the cause of the sharp change in viscosity?

(2) How can you explain the existence of two types of outbursts?

(3) How can you explain the X-rays, in particular the anticorrelation with the optical curve during outburst, and the 8.9 s periodicity?

(4) How can you explain the sharp changes of the quasi-period of the optical luminosity?

Pringle: The nature of the viscosity itself is unknown, let alone any reason why it should or should not vary.

(2) I have seen no plausible explanation for this, but I would caution that the two types of dwarf novae may not be as distinct as has been thought.

(3) and (4) were more fully discussed in IAU Colloquium No. 53 which took place last week. I refer the reader to my contribution and to the references given at its end.

Mazeh: Did you observe the double peak emission in your UV spectra of WZ Sge? -- (After Pringle has answered positively):

Can you tell us about the separation between the components, in particular as compared with the separation between the outburst?

Friedjung: I can reply to the question concerning the emission peak separations of WZ Sge, as we have examined high-resolution IUE observations in Paris. On the 4th December 1978, the peaks of He II 1640 had a somewhat smaller separation than the pre-outburst Balmer separation, i.e. 800 - 1000 km/s. These results were presented in Rochester. Some observers who presented visual results there had found a separation of only 400 km/s for Hα, which they interpreted as due to an outer disk. Our discussions in Rochester showed that the interpretation may not be so clear-cut.

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Ritter: With regard to the S-wave component in the spectra of WZ Sge, what is its amplitude and its phase shift with respect to the eclipse phase?

Pringle: As I explained, Clarke Brunt is still in the process of analyzing this data. All I can say is that the values given originally by Krzeminski and Kraft were pretty good.

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