Opening the panel on 3U0900-40 (HD77481, Vela X-1), N. V. Vidal mentioned that besides the 8.95 days period, 283 sec modulation has been found by the SAS group. One may be able to determine apsidal motion and $\dot{\omega}$ from X-ray, which are more accurate than derived from visual observations. The mass of the optical component is $\sim 20M_{\odot}$ and its luminosity high for the mass. He 4686 line has been an enigma in X-ray binaries but it has not been observed in this except for a small feature as reported by Hutchings. Its distance has been estimated about 2 kpc and may go down to 1·2 kpc. In infrared, it is not different to other hot stars. Kamp et al. have found a varying circular polarization in the wings of Hβ and have deduced a magnetic field about 10,000 gauss but others have not concurred with this result. 1.8 $M_{\odot}$ and 20 $M_{\odot}$ are the most likely masses, though the former appears a little high for a neutron star. C. T. Bolton estimated the distance, from reddening measurements, between 1-2 kpc, and C. C. Wu found E (B-V)=0.73 assuming B0Ib star. K. Pounds found a big dip around 0.3 phase and around 0.6 phase in the X-ray data; a flare of duration of a day was also observed around MJD 42634 and may be due to temporary blow up of Roche lobe. J. E. McClintock et al. gave for HD 77581, $M \gg 20M_{\odot}$, $R \sim 32 R_{\odot}$ and for Vela X-1, $M \gg 1.7M_{\odot}$, whereas van Paradijs et al. gave $M_x = 1.61 \pm 0.22M_{\odot}$, and $M_{opt} = 21.2 \pm 2.4M_{\odot}$.

In the last but one session devoted to "Other Possible X-ray Binaries", H. Gursky reviewed the galactic sources which do not follow the "normal" pattern of the X-ray sources. He discussed the low luminosity sources (luminosity lower by one or two orders compared to "normal"), like X-Per globular cluster sources, which may be related to a black hole in the center of the cluster and transient sources in which the X-ray emission increases suddenly at least 2 or 3 orders of magnitude and declines gradually over weeks or months. A. P. Cowley et al. have found that Sco X-1 is a single lined binary with a period of $0^d.787$ with $M_x \backsim 1.4M_{\odot}$ and $M_{sec} \backsim 1M_{\odot}$. A. F. Davidsen, R. Malina and S. Bowyer have found that the optical candidate for GX1+4 (3U 1728-29) is a strong infrared object and is an M giant star at a distance of abour 10 kpc if $M_v \simeq 0.5$. S. I lovarsky reported simultaneous X-ray and optical observations of Cyg X-2; the results indicate a period of 13.6 days and it was found that the optical intensity decreased in 1975 relative to 1974, whereas in X-ray it was the reverse.

The workshop ended with a session on the present plans and future prospects. Emphasis was laid on simultaneous observations in X-ray, optical, IR and radio regions.

The symposium, though crowded, was a very useful contribution to this fast developing field.

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REPORT ON THE COLLOQUIUM ON THE PHYSICS OF Ap STARS

This IAU Colloquium No. 32 was held at the University of Vienna between September 8-11, 1975. The meeting was organized according to themes of current research interest, each theme being extensively reviewed by invited papers with new results being reported in short contributed papers. In addition, three "open discussions" were held on "hot" topics, viz., diffusion versus magnetic accretion theories, the Hg-Mn star problem and blanketing-backwarming effects.

The Ap stars are among the most complex and problematical objects in stellar astrophysics. Constituting about 20 per cent of the main-sequence stars with effective temperatures in the range 8000-16000°K, they may be divided into two broad groups-those with appreciable surface magnetic fields and those without. Each group exhibits a remarkable variety of chemical peculiarities. The non-magnetic Ap stars include those which are helium rich, helium deficient, enhanced in Hg and Mn or generally enhanced in metallic spectral line strengths. The magnetic Ap stars exhibit enhanced spectral lines of Si, Sr, Cr, He, C etc. The magnetic Ap stars are typically variable in field strength, in brightness and in the strengths and radial velocities of certain spectral lines. These variations are described most successfully by oblique-rotator models, wherein the stellar magnetic and rotational axes are inclined with respect to each other and with respect to our line of sight. In addition, the sources of line and continuous absorption are distributed in a patchy manner over the surface of the oblique rotator, although whether this reflects real chemical inhomogenity or local variations in physical conditions of excitation, line broadening, etc., is still debated. The non-magnetic metallic-line A stars (Am Stars) and Hg-Mn stars are usually members of binary systems and are intrinsically slow rotators. The magnetic Ap stars also are usualy sharp-lined but their spectroscopic binary frequency is lower than normal. There are a number of major issues in Ap star research and discussion at the colloquium quickly focused on these and upon new observations which provide leverage for the resolution of major questions. This discussion is summarized below.

The Origin of Magnetic Fields:

Two competing hypotheses were discussed by L. Mestel (U. K.): (1) relic or primeval magnetic fields "frozen" into the stellar envelope and photosphere with a mixture of poloidal and toroidal components producing dynamical stability, and (2) fields being maintained by stellar rotational dynamo. The primeval fields, advocated by Mestel, could either arise in the interstellar medium from which the star formed or in a dynamo generated as the star went through its Hayashi phase pre-main-sequence contraction (models for which were discussed by M. Schessler, G.F.R.). The dynamo models are advocated primarily by physicists from the U.S.S.R. The major difficulty with the dynamo is the lack of observed correlations between rotational period and field strength and the absence of significant (> 1000 gauss) fields in the most rapidly rotating Ap stars, as discussed by J. Landstreet (Canada). An important test for the relic field theory will be an observational confirmation of the segregation of field obliquity (angle between magnetic and rotation axes) into two families, as tentatively found by Preston : small obliquity (toroidal component dominate) and large obliquity (poloidal component dominate). A. Dolginov (U.S.S.R.) outlined another hypothetical mechanism for magnetic field generation, namely battery effects wherein the chemical abundance anomalies patchily distributed over the photosphere give rise to significant electrical currents and magnetic fields.

Observations of Magnetic Fields :

S. Wolff (U.S.A.) reviewed systematic long term studies of stellar magnetic fields at the University of Hawaii. During this survey, the important discovery was made that the helium variabe star HR 7129 has a strong and variable field (+7000 to —5000 gauss). This star is very similar to *a Centauri*, for which a strong surface field has not been detected, but for which a strong sub-surface toriodal field has been suggested. Thus HR 7129 is the hottest (20,000°) known magnetic, chemically peculiar "main-sequence" star.

J. Landstreet (Canada) discussed an extremely, important new technique for detecting magnetic fields in the nonsharp-lined Ap stars. This involves comparing circular polarization between the red and blue wings of the hydrogen Balmer lines—a technique originating in solar magnetography. The method is accurate to $\sim$ 500 gauss and reproduces well the field measurements carried out by classical Zeeman spectroscopy on known magnetic stars. Landstreet has investigated 16 Ap stars with $34 \leqslant V \sin i \leqslant 135$ km/sec and finds that fields exceeding 1000 gauss are much less common for these more rapidly rotating Ap stars than in Ap stars with low V sin i.

Origin of Chemical Peculiarities:

The current major debate is between diffusive segregation of atoms and ions in zones of great stability at or near the surfaces of B and A stars (the stability perhaps enhanced by magnetic fields) advocated by G. Michaud (Canada), and magnetic accretion produced by Ap star magnetosphers, selectively sweeping ions out of the interstellar medium advocated by O. Havnes (Norway). Older hypotheses concerning surface nuclear processing or accretion of material ejected in nearby supernovae explosions are no longer viable for a variety of reasons. The Michaud model seeks to explain both Ap and Am stars in a 3-zone model-two convectively mixed layers separated by a very stable radiative layer, the latter a reservoir for diffusion. In Ap stars, the top convective layer does not occur and one directly observes the stable reservoir. In Am stars, the top hydrogen convective zone brings to the visible surface the chemical peculiarities generated diffusively in the stable zone below. Diffusion model calculations are still at a relatively primitive stage, although advances made in this regard were reported by S. Shore (Canada) and H. Gail (G.F.R.). The principal difficulty with the diffusion idea is that it cannot as yet explain the full range of observed peculiarities, expecially the simultaneous existence in the same effective temperature range of Hg-Mn stars showing no Si—Sr—Cr or rare earth anomalies, and a star like, α^2 CVn which exhibits all of these varieties of chemical anomaly. The magnetic accretion model also has difficulties reproducing the observed trends of chemical peculiarities. In sweeping material out of the interstellar medium a magnetosphere of 1.5 A.U. would have a typical capture efficiency for ions $\sim$ 0.5 percent and on a time scale $\sim 10^7$ years should produce significant over-abundances in certain ions. It is difficult to produce overabundances > 100x in this way. One cannot explain the observed He deficiency by accretion. The elements P and Ga should be among the most overabundant elements but are not observed to be. Molnar (U.S.A.) has suggested that some of these problems would be ameliorated if one considered selective magnetic accretion within the pre-stellar nebula from which the star formed rather than from the general interstellar medium. It is also possible that diffusion and magnetic accretion might act simultaneously.

Ap Star Variability :

H. Wood (U.S.A.) reviewed the history of the dispute as to whether Ap stars such as 73 Draconis vary photometrically or spectroscopically on a time scale of hours. Other related issues are the suggestions that there are long-term variations in Ap stars with regard to their amplitudes or periods of variation with regard to the strengths of their chemical anomalies. The observational evidence does not favour such long-term variations, but little systematic work has been done in this area. Astronomers from the U.S.S.R. presented the most interesting new observations of short time scale variability. N. Polosukhina reported the appearance of emission lines in the spectrum of HD 215441 (the most magnetic of the Ap stars) which arise and disappear in the vicinity of $H\alpha$, $H\beta$, and $H\gamma$ on a time scale of a few minutes (measured with a time resolution of 1 minute). The observations appear carefully done and if confirmed would be the first evidence of such a phenomenon. No explanatory mechanism was proposed but certainly stellar activity, extended atmospheric geometry or other unusual physical effects will be exciting possibilities to pursue.

Ap Star Flux Distributions :

In addition to the ultraviolet flux deficiency of Ap stars, compared to normal stars, an interesting abnormality in the visible has now been confirmed by several workers (S. Adelman, U.S.A., H. Maitzen, G.F.R., J. Hardorp, G.F.R.). That is the appearance of broad, shallow absorption features near $\lambda\lambda$4200, 5300 and 6300Å. High resolution spectra apparently rule out blended lines as the source of these features and S. Adelman and S. Shore are investigating rare-earth continuua and Si I auto-ionization features as possible sources. N. Yogt (G.F.R.) reported on a program of narrow band photometry of these features in many stars to allow statistically significant trends to be established.

Ap Star Models :

Extensive empirical modeling of Ap stars, based on the patchy distribution of chemical anomalies over the surface of an oblique rotator, has been carried out by astronomers in the USSR (reviewed by V. Khokhlova) and their collaborators (C. Megessier, France). K. Rakosch (Austria), K. Stepien (Poland) and others are investigating an alternative concept that variations in spectral line strengths over the surface of an oblique rotator result from localized variations in effect surface gravity or from some other spatial variation in physical conditions rather than from the actual concentration of different elements in different "spots" on the star. M. Molnar (U.S.A.) noted a trend that seems to be developing in oblique rotator analyses—namely the appearance of iron rich zones in a belt around the magnetic equator. F. Krause (G.D.R.) is attempting to develop equator—symmetric dynamo magnetic star models-i.e. he rejects entirely the oblique rotator concept. Nevertheless, it appears to this author that the evidence for the oblique rotator concept is overwhelming.

The Evolution of Ap Stars:

S. Wolff (U.S.A.) offered rather convincing evidence that the SrCrEu magnetic Ap stars undergo magnetic breaking on a timescale comparable to their main-sequence lifetimes. This is reflected in an observed correlation between period and radius (R sin i), in the occurrence of very-long-period Ap stars of this class and in the absence of such very-long-period variables among the more massive Si stars. Rare-earth anomalies appear stronger in the longer period stars and photometric amplitudes appear larger. Landstreet's observations of small surface fields in the shortest period Ap stars probably implies that subsurface circulation traps the field within the star when it is newly arrived on the main-sequence. However, as magnetic braking by interaction of the small surface fields with the interstellar medium, for example, progresses, the circulation will be suppressed, allowing the observed magnetic field to increase in strength. As the star evolves near the main sequence, it diminishes in rotational velocity by magnetic braking, the diffusive segregation of elements becomes more fully developed, the rare earths grow stronger as an ultraviolet opacity source and the photometric amplitudes in the visible increase. Thus, Wolff argues that the progression from broad-lines to sharp-lined magnetic stars corresponds to an evolutionary sequence away from the zero age main-sequence.

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(*Continued from page* 80)

The proceedings on the whole contain a review of many of the important subjects pertaining to infrared and millimeter astronomy.

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ERRATUM

In the report on IAU Symposium on Fast Transients in X-and Gamma Rays by S. V. Damle (*Bull. Astr. Soc. India*, **3**, 58, 1975), under the heading Transient X-ray sources, the 10th line should have been " Some 19 new X-ray sources..., instead of some 91 new X-ray sources... "