Figures 2, 3 and 4 illustrate the type of information we have at hand today on the chronology of various events, based on studies of lunar and meteorite samples. These figures are taken from a recent review "Time and the solar system" by T. Kirsten.

The outrageous simplicity of these figures are merely an indication of the enormous complexity in the early processes. Any models discussed today must be considered merely a reflection of our capability of deciphering the early history. We have yet to understand a great deal, but it is clear that direct studies of lunar samples have greatly speeded up the rate of acquisition of knowledge of early processes. New methods and new concepts in selenology, planetology and meteoritics are leading or trailing the other, and the net result is that our knowledge is quickly expanding, constituting a part of the quickly advancing new frontier.

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REPORT ON THE IAU COLLOQUIM NO. 42

IAU Colloquium No. 42, "The Interaction of Variable Stars with their Environment" was held at Bamberg, F.R.G. during September 6-9, 1977. About one hundred thirty astronomers from several countries participated in the colloquium. Deliberations on over 60 papers inlcuding about a dozen review papers, covering the young stellar objects, cataclysmic variables and evolved stars were carried out during the four days of tight schedule. In the following, we give a brief resume of the proceedings.

Herbig-Haro Objects

In the opening review talk on Herbing-Haro objects, Böhm described the current state of knowledge about these objects. These objects are small condensations ($\simeq$1000 AU) inhabitating the obscured regions near T Tauri stars. In some cases, they are connected with infrared sources and in one case to a H_2O maser. All these objects are variable on a time scale of 10-20 yr. The radial velocities are predominantly negative with respect to the surrounding by as much as 240 km/sec. The spectra show emission lines of Ca II, Cr II, Fe II, Fe III, O I 6300, O I 6364, besides a continuum. Simultaneous presence of H and K lines of Ca and the Ca infrared lines, makes the spectra similar to those of old supernova remnants. They have large ultraviolet excess. They suffer large amount of interstellar reddening, which could be determined with the help of S II lines. H-H1 and H-H2 have $E_{B-V} \backsim 0^m.6$ and $\backsim 0^m.25$—$0^m.35$ respectively. They have population I abundances.

T Tauri and YY Ori Stars

Contributory papers on T Tau and YY Ori stars then followed. The line profiles in DR Tau were shown to be variable, having a complex structure. The radial velocity variations are 1.5 km/sec. Short period luminosity variations are present.

From the photoelectric photometry of three low mass T Tau stars, Mauder went on to explain the variations in the light and colour of these stars in terms of small planetesimals eclipsing the star periodically. The statement about their low mass, as estimated from the evolutionary tracks in a luminosity-temperature diagram aroused discussions because of the uncertainties in the intrinsic B-V colours and the bolometric corrections of these stars.

Appenzeller pointed out that the frequcncy of YY Ori stars among the T Tau stars should be far greater than hitherto considered. Out of the 161 T Tauri stars known, only 65 have UBV data. Half the T Tau stars, when investigated, would show YY Ori characteristics.

YY Ori stars are T Tau-like stars with strong ultraviolet excess found in the nebulous clusters. They show inverse P Cygni line profiles, i.e., emission lines having red displaced absorption components. Walker has interpreted these objects as very young stars in which the matter is still raining down from the surrounding cloud on to the stellar core.

Bertout described briefly the results of calculations of the line profiles in YY Orionis type atmospheres, employing the photon escape probability method for treatment of the transfer of line radiation in a moving atmosphere.

Appenzellar reported the recent identification of S CrA as a YY Ori star, and suggested the study of BO Ori from this point of view. Mundt showed that the absorption components in the Balmer lines of CoD—35° 10525 are higly variable. Walker showed the profiles of Hβ, Hγ and Hδ lines in the spectrum of YY Ori obtained at a resolution of 0.5Å with the help of Wampler scanner. Swings reported about the image tube spectroscopic search for pecular Be stars having infrared excess in the 800-1100 nm region at a dispersion of 230 A/mm.

Flare Stars

Mirzoyan remarked that the expected number of flares in young cluster stars is larger than the observed number, and that flare stars are also radio stars in general. Swings reported flares in the peculair B_e star HD 45677—a B2 IV star. Thé showed that the variable shell star HR 6000 could be a binary star. He also remarked that the value of A_V increases as the star fades. Swings reported that the P Cygni star CD—52°9243 is a Be star with a shell. The underlying photospheric spectrum is late B or early A, having distance$\backsim$3kpc; k index$\backsim$4.2; h-k=1.2; and V=10. The Fe II lines have variable P Cygani profiles.

Proto-type Envelopes

Yorke dealt with the structure of envelopes around protostars and their subsequent evolution to stars. A condensation develops at the centre of a cloud which is bordered by an accretion shock-front. When the core contracts to stellar densities, thrmonuclear reactions in the core start. The luminous flux now coming out consists of the stellar luminosity and the luminosity of the shock-front. There forms a dust free zone inside the radius of grain melting. Further accretion takes place and luminosity of the star rises. When the intrinsic luminosity becomes high enough, the dust mixture beyond the radius of ice melting is accelerated outward by the radiation pressure, forming a thick shell of dust and gas beyond this radius. The inward flow of matter thereafter stops altogether.

He showed that a 10 $M_\odot$ cloud results in a star of 9.5 $M_\odot$.

Novae

Wolf discussed some results of the optical observations of recent novae in reference to Nova Cygni 1975. The prenova object in this case is a 9th magnitude object having a period of 3 hr, fluctuating by 5 minutes. After explosion, ejections of shells within intervals of the order of one day took place. The radial velocity of ejections obtained from Balmer lines came out to be ~1400 km/sec. O I 8446 line was very weak. Coronal lines in the infrared were present. From Balmer line absorptions, he derived $N_e = 10^{10}$, $r = 500\ R_*$, $T = 7000\ °K$, $\dot{M} = 10^{-5}\ M_\odot$ / year for the nova. The excess visible radiation over the infrared radiations E (V-IR) $\sim 5 \times 10^{44}$ ergs/sec during the first 11 days after the outburst points out to a mass loss rate of $10^{-3}\ M_\odot$ / year. He also subscribed to the binary hypothesis and surface nuclear reactions as the cause of the nova outbrust. Rosino reported a few observations of Nova Persei 1974 and Nova Scuti 1975, and pointed out that nova magnitudes can change by as much as one magnitude during a single night.

Image tube spectra of ten old novae were presented by Bianchini. Emission features at 4686 (He II) N III and C III blend were present. Large variations in He II emission lines were apparent. Ciatti et al. have derived a temperature of 3100°K for HM Sagittae, on the basis of infrared measurements at 10,20 and 30μ. Swings remarked that HM Sagittae could be a protoplanetary nebula because of the He I 10830 line.

Boyarchuck reported the curve of growth analysis of Nova Cygni 1975, carried out on 4 Å/mm blue and 6 Å / mm red spectra taken two days before its maximum. The spectra resembled those of supergiants without any emission lines.

He derived $T_{exc} = 20{,}000°K$, $\log P_e = +\ 0.85$, $\log V_t = 1.70$ and a high relative abundance of C, N, and O over metals for the nova.

Williams stated that the curve of growth method for the determination of chemical abundances in case of novae can be applied only if we have spectra at the maximum of the light curve. At this phase there is the least emission. Mustel and others have carried out such analyses. They also found high abundances of C, N, and O in the envelopes of novae. Caution has to be exercised for this type of analyses since microturbulent velocity in supergiants depends on the particular ion and the calibration of excitation temperature from the excitation potential is uncertain.

Thomas stated that the nuclear instability in the hydrogen shell burning white dwarf companion is the cause of nova outburst. The mass transfer from the red component to the white dwarf which is essentially a core helium star takes place. When a mass equal to $10^{-3}\ M_\odot$ is accreted on the envelope in the Kelvin-Helmholtz time scale of about 100 years, the temperature at the bottom of the envelope rises to 2×10^8 °K. This corresponds to thermal energy rate of 5×10^{17} ergs gm^{-1} sec^{-1}, and can impart velocity of 10^{10} cm sec^{-1} to the outside envelope.

In Nova Cygni 1975, Pringle reported two binary periods of $0\overset{d}{.}1400$ and $0\overset{d}{.}1384$ for the epochs September-October, 1975 and May-July, 1976 respectively.

Shaviv traced the evolution of a nova envelope starting from assumed parameters of mass, envelope mass, chemical composition, temperature and luminosity, and pointed out that a single theory is not adequate to explain both the dwarf and the classical novae.

Smak pointed out that in case of classical novae, sizable information about radial velocities, chemical composition and mass ejection is available. In case of recurrent novae, however, not much information is available. In the single determination in case of RS Oph, a secular mass loss rate of $10^{-7}\ M_\odot$ /year is obtained. This is larger by a factor 10 as compared to the rate in case of classical novae. Mass loss per outburst in recurrent novae is $10^{-9}\ M_\odot$. He described a mechanism for secular mass loss. The secondary filling its Roche-lobe looses mass, which may go to the primary. By transferring the rotational momentum to the disc of the primary, this material could proceed on to infinity or return back to the secondary. This is different from the case of classical novae, where the mass is accreted all the time on the white dwarf.

Binaries

Period changes and mass loss rates have been reported for three new eclipsing binaries, SV Cen, SZ Psc, and UW CMa, from Bamberg sky patrol plates. The emission line vriable V 1329 Cyg could be a binary. Van't Veer, on the basis of O-C diagrams for 15 W UMa stars, concluded that (1) all periods are variable, (ii) period changes take place in course of a few months and then remain constant for over 20 years, and (3) mean number of increases and decreases is the same and each amounts to to 10^{-5} day/day. Ruzyncki pointed out that the photometric determinations of the mass ratios of contact binaries are not very exact. For contact binaries, mass exchange takes place in short intervals. Kraft remarked that the spectroscopic mass ratios are also doubtful.

Ciatte et al. showed the photoelectric light curve and spectra of the massive eclipsing binary XY Sct. This star is believed to be in a very late stage of evolution. The spectrum is a rich absorption spectrum superposed by C II, C III, Si II, Si III and Si IV lines in emission.

RR Lyr Stars

Kraft pointed out that in the solar neighbourhood, 25 percent of RR Lyr stars are metal rich stars, which are not represented in any globular clusters. These stars constitute two groups. Group 1 has mean $< \frac{F_e}{H} > =$ $= -0.3$ and mean velocity component in the galactic plane $<V> = -40$ km/sec. Group 2 has mean $< \frac{F_e}{H} > =$ -0.2 and $<V> = -30$ km / sec.

The absolute magnitude of RR Lyr stars, based on a series of line blanketed model atmospheres, have been given to be $+0.58$ and $+0.55$ for Oosterhoff groups I and II respectively, and $+0.82$ for field RR Lyr stars. These values are brighter than the ones given by Christy's P_{tr}–L relation.

RR Lyr stars in NGC 6712 are quite different from the field RR Lyr in that the helium percentage Y in NGC 6712 is larger by 0.07 as compared to the solar vicinity RR Lyr stars, and they are fainter by 0.27 magnitudes.

The question remains as to why some clusters have RR Lyr variables and others with similar composition do not.

AM Her Type Stars

Krzeminski described the AM Her type stars as a new class of magnetic binaries. These stars are variable in the visible and in the infrared region. Their spectrum, radial velocity and polarisation also undergo variations. They are sources of both hard and soft X-rays. Three representative stars show the following characteristics: (i) The periods are short varying from $1^h 40^m$ to 3 hr, (ii) the light varies from 1-3 magnitudes, (iii) broad minima extending to half the orbital period, (iv) spectra of neutral H and He, and (v) little polarisation $\sim 1\%$.

Late-type Stars

Winnberg gave a review on molecular line formation in late-type stars. He pointed out that the maser lines of OH, SiO, CO, and H_2O have helped in understanding about the late-type stars. He quoted the results for U Ori as follows:

(i) Core diameter $\sim 0''.03$, (ii) halo diameter $\sim 0''.3$, (iii) distance 190 pc, (iv) diameter at $2\mu = 0''.0155$, (v) diameter $\sim 4 \times 10^{18}$ cm and (vi) envelope diameter 10^{10} cm.

SiO line was discovered in Orion Nebula, which shows intensity variation. Other SiO line sources have been found to be S CrB, W Hydrae, and R Leonis. There is no correlation between the intensity variation of SiO line and the optical light variation.

Reimers suggested that different optical methods may be employed to determine the mass loss rate in K, M and red giant stars. These methods could be (i) analysis of P Cyg profiles, (ii) shift of chromospheric lines, and (iii) Ca infrared triplet. He further suggested stellar wind velocities $V_{wind} \sim V^2_{escape}$ and in M and K giants,

$$\frac{E_{wind}}{E_{luminous}} = 2.5 \times 10^{-6}.$$

Weymann also proposed a theory of mass loss for late-type stars in terms of thermally driven stellar winds akin to solar wind.

Joshi and Rautela pointed out that the circumstellar envelope surrounding ρ Cas grew denser in 1974 as compared to in 1970, and that the Balmer continuum emission was variable.

Cepheids

Davis presented a theoretical model for a ten day cepheid. In case of cepheids, the masses computed from evolutionary theory and from pulsation theory do not agree. The pulsation theory gives smaller masses. The various factors that need be checked are : (i) distance to Hyades, (ii) opacities, (iii) composition, and (iv) mass loss.

Kraft further remarked that more accurate values for interstellar reddening and better θ_e, (B-V) relations have been derived for cepheids now, hence more reliance should be placed on these values.

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NATO ADVANCED STUDY INSTITUTE ON ENERGY SOURCES AND EMISSION MECHANISMS OF QUASARS

Over 80 astronomers and astrophysicists gathered in the Institute of Astronomy, Cambridge between 25 July-4 August, 1977 to take part in the NATO Advanced Study Institute on Energy Sources and Emission Mechanisms of Quasars. Though no substantially new results were reported, the meeting was successful in bringing together and assessing the diverse developments in both theory and observations of the Seyfert and radio galaxies, BL Lac objects, quasars etc.

Osterbrock summarised the recent resluts on the emission line spectra of Seyfert and radio galaxies. He brought out the similarities in the optical spectra of Seyfert galaxies of Type I, broad line radio galaxies (BLRG) and the quasars. Seyfert galaxies of Type II and narrow line radio galaxies (NLRG) have indistinguishable optical spectra. The limits on electron densities in quasars can be obtained from the absence of forbidden lines in their spectra and the presence of C III. These turn out to be $10^8 < N_e < 10^{10}$ cm^{-3}.

The input mechanism causing the emission lines is not very certain. The photoionization with a power law spectrum for the radiation field seems to represent the NLRG and Seyfert galaxies of Type II. But in the case of BLRG and quasars, the mechanism may be resonance-fluorescence especially at every large optical depths. Other processes like collisional excitation may also play an important role.

Several models to explain the optical spectra of emission line regions were presented by Colin Souffrin,