29. STELLAR SPECTRA (SPECTRES STELLAIRES)

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This report has been written with the cooperation of the vice-president, the members of the O. C. and of several other members.

Commission 29 has co-sponsored IAU Coll. 35 on Compilation, Critical Evaluation and Distribution of Stellar Data (Strasbourg, August 1976), IAU Symp. 80 on The HR Diagram (Washington, November 1977), and IAU Symp. 83 on Mass-loss and Evolution of O-type stars (Vancouver, June 1978). Other meetings of interest for the Commission: Conference on Novae and Related Stars (Paris, September 1976) 21st Liège Symp. on Laboratory and Astrophysical Spectroscopy of Small Molecular Species (Liège, June 1977); IAU Coll. 42 on The Interaction of Variable Stars with Their Environment (Bamberg, September 1977); 1st Latin-American Regional Meeting (Santiago, January 1978); 22nd Liège Symp. on Elements and their Isotopes in the Universe (Liège, June 1978); 4 th Trieste Coll. on High Resolution Spectrometry (Trieste, July 1978); IAU Coll. 47 on Spectral Classification of the Future (Vatican City, July 1978); 4 th European Regional Meeting (Uppsala, August 1978).

Commission 29 has supported the publication of the Atlas of Be stars by Drs. A. M. Hubert-Delplace and H. Hubert as a project of the Commission.

Because of the very limited space available for this report, it is impossible to include all the papers published since the last IAU meeting. Two research areas have received special attention:1) the physics of outer stellar layers:UV observations have revealed the existence of hot plasma and stellar winds in all early-type supergiants, in a few dwarfs and in many close binary envelopes, and have permitted detections of chromospheres and coronas of late-type stars. 2) the chemical composition gradients and the chemical evolution in our galaxy, and in nearly outer galaxies.

WR, O, Of, B, Be, early-type supergiants (written with the collaboration of Y. Andrillat, A. B. Underhill, H. G. Groth and T. P. Snow).

WR, O, Of Stars. It is not clear if all WR stars are binary systems; however, the majority of them are binaries. Computations of evolutionary sequences taking into account mass loss by stellar winds suggest that WN non-binary stars can be the result of the evolution of O-type stars of mass 80-120 M☉ (Loore et al. AA 67, 373); WC would be the result of the evolution of stars of 40-60 M☉. Relations between WR and Of are discussed by Conti (20th Liège Symp. p. 193). 13 WR stars have been studied individually: the binaries γ^2 Vel (a cloud of CS gas with radius 10^{15} cm, much larger than that of the binary orbit, has been revealed by radio and IR observations; mass loss of 3.9 10^{-5} M☉/y has been estimated by Morton, MN 182, 47P), θ Mus, HD 193793, V 444 Cyg (IR observations of this WN5 star show the presence of stellar wind escaping at constant velocity, Hartmann Ap J 223, 193), CV Ser, HD 90657, and the non-ascertained binaries HD 50896, HD 192163, HD 156385 (characterized by a very strong extinction at λ 2200, in spite of the fact that no nebulosity has been found around it, Willis et al. AA 59, 133), HD 93162 (Moffat, AA 68, 41), HD 151932 (Seggewiss, IAU Coll. 42, 633), HD 191765, HD 192103. Velocity gradients in the atmospheric regions where the absorption lines as well as where the emission lines originate were found by Niemela (IAU Symp. 83) in two Of stars and in 4 WN stars. The gradient appears to be spectral-type depen-

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dent. An atlas of WR stars for the region 3500-6700 A has been produced by Bappu and Scaria (Kodaikanal Obs. Bull. Ser. A, Vol. 2 No 2), who studied the violet absorption edges of CIV lines at 5807 A. Spectrophotometry of WR stars brighter than 8.5 mag is underway in the range 3400-11000 A.

The extended series of studies of O-type stars and O-type binaries by Conti and collaborators is continuing (Ap J 212, 728; 213, 438; 214, 759; 215, 561; 218, 431; 224, 558). Cassinelli, Olson and Stalio (Ap J 220, 573) studied the structure of the winds and coronae of O stars applying the Sobolev method to the Hα profile of ζ Ori, O9.7 Ib.

Bohannan and Garmany (Ap J 223, 908) have made a search for binaries and stellar winds among the O stars, in order to verify if the high mass-loss rate indicated by UV observations is found only in binary systems or is a general property of O stars. A velocity gradient in the Balmer lines is observed in most O supergiants and Of stars, and is certainly present in 3 of 6 late O-type giants and main-sequence stars. This gradient and the presence of photospheric mass motions complicates the problem of searching for spectroscopic binary systems. Walborn (Ap J 205, 419) has found that all of the O9.5-B0.7 supergiants in the Orion belt and in NGC 6231 are systematically nitrogen-deficient with comparison to the majority of the supergiants of the same spectral type. Bolton and Lars Rogers (Ap J 222, 234) have measured RV of OBN and OBC stars in order to determine binary frequency. At least 50% and possibly 100% of the OBN stars are members of short period binaries; none of the OBC is member of short period binaries. Masses and luminosities are normal for both groups; there is no evidence that the two groups are kinematically distinct. Walborn (Ap J 215, 53) has studied the brightest O, WR and B supergiants in the Magellanic Clouds. Further evidence for large metal deficiency in the SMC was found. Moreover the supergiant nature of Of stars has been confirmed in both Clouds.

The spectrum of the high galactic latitude O star HD 93521 has been studied (Hack and Yilmaz, ASS 48, 483) and several possibilities examined for explaining its distance from the galactic plane ($z > 750$ pc) and its slight He excess.

B stars. Several studies of the UV spectra of B stars have been published: three extensive lists giving identifications of the lines visible on Copernicus tracings of the UV spectra of B stars (Underhill and Adelman, Ap J Sup. 34, 409, Hill and Adelman, Ap J Sup. 37 No 2, Selvelli, Stalio and Crivellari AA Sup. 27,1) an Atlas of τ Sco (Rogerson and Upson, Ap J Sup. 35, 37) at Copernicus resolution 0.05 A and representation of the UV spectra of 17 O and 41 B stars (Snow and Jenkins Ap J Sup. 33, 269) at Copernicus resolution 0.2 A. Lamers and Snow (Ap J 219, 504) have interpreted the shapes and strengths of the resonance lines of Si IV, N V, and O VI in O and B stars and they suggest that the electron temperature in the coronal layer ranges from $7 \pm 3 \cdot 10^4$ (presence of Si IV) to $4 \pm 2 \cdot 10^5$ (presence of N V and O VI). Cassinelli and Olson (Wisconsin preprint No 71) have proposed that these ions originate from Auger ionization due to X-rays coming from a thin coronal zone at the base of a cool stellar wind. It is clear that absorption lines seen in the spectra of main sequence O and B stars as well as O and B supergiants indicate the presence of a plasma having a degree of ionization greater than can be maintained by the radiation field of the star. No ultimate source of the extra energy needed in O and B stars has yet been established.

Although asymmetric resonance lines of some high ions are seen in the UV spectra of a few main sequence stars (Snow and Morton, Ap J Sup. 32, 429; Lamers and Snow, Ap J 219, 504), rarely is material seen moving with a velocity great enough to permit it to escape unless the material is proved to be at more than 4 stellar radii. The same is true for Be stars. The available analyses suggest that the higly ionized, outward moving layers observed for some B and Be stars lie inside the cool shell. Thus these layers will not escape unless the material is given additional acceleration when it is in a state of ionization not observed. The broad emission wings of Hα in shell stars may be revealing this material. In normal B stars the outer cool shell is not seen; it is visible only when it is enhanced during the Be shell episodes.

Abundance analyses, using standard techniques, of γ Peg, B2 IV, and τ Her, B5 IV, by Peters (Ap J Sup. 30, 551) and Adelman (MN 181, 667) respectively, have given further confirmation that normal B stars have essentially solar composition. Line blocking factors in the UV spectra of 35 B6-A0 stars have been measured by Underhill and van der Hucht (AA 54, 393) using data from S 59 on TD 1. Rajamohan (Pramana 7, 160) has derived rotational velocities and H and He line intensities for 112 members of the Scorpio-Centaurus Association. For stars fainter than M_V = 0.0 the distribution of rotational velocity closely resembles that of field stars. Stars brighter than M_V = 0.0 which are found in the dense upper Scorpio region rotate faster than the field stars and the members of the Pleiades and α Persei clusters. Analyses of high resolution spectra of 5 members of the association give normal helium abundance.

Pulsating B stars. Line-profile observations at high resolution using an electronic detector have shown that several sharp-lined B stars have line-profile asymmetries which vary in a matter of hours and which are reminiscent of the line doubling observed in β Cephei stars (Smith, Ap J 215, 574; Smith and Karp, Ap J 219, 522; Smith and McNall, Ap J 223, 221). These variations can be interpreted in terms of travelling waves associated with nonradial pulsations. Smith and McNall (Ap J 221, 861) interpret the sharp components of γ Peg for 4567 Si III in terms of shell gas in a radial pulsating atmosphere. Line-profile variations in time scale of hours (Si IV, Fe III near λ 1120 A) and in time scale of days (C IV 1550 A) have been observed in β Cep (Hutchings and Hill Ap J 213, 111).

He-variable, He-strong stars. It is not clear if they are stars which have lost much of their hydrogen rich matter or if they are young stars. Spectral changes can be explained by the oblique rotator model (Bond and Levato, PASP 88, 905; Wolf and Wolf Ap J 203, 171; Pedersen AA 49, 217; Hardorp and Megessier AA 61, 411), but this does not explain particular cases like a Cen or σ Ori E. Lester (Ap J 210, 153) has made a differential abundance analysis of the He-rich star HR 3089 compared to the normal star λ Sco.

A spectroscopic search for B-stars with enhanced He^3 abundances has been made by Hartoog and A. P. Cowley (Lick Bull. No 814). 8 new stars of this class were found. They have helium abundances 5 to 20 times lower than normal B stars and He^3/He^4 ranging between 2.7 and 0.47. They occupy a narrow strip in the log g-log T_e plane between the He-strong and a group of He-weak stars, which present no He^3 enhancement. These results indicate a link between He-w and He-s stars and the possibility that the diffusion theory can explain both.

Be stars. The spectra of peculiar Be stars with IR excess have been studied by Allen and Swings (AA 47, 293) and three mechanisms of mass-loss which may explain the formation of the shells are discussed. UV observations (950-1450 A) of 6 Be stars with a range of v sin i obtained with Copernicus show radial velocity components up to a few hundred Km/s for stars with large v sin i. Stars with low v sin i do not show a similar behavior (Marlborough Ap J 216, 446). The region of Mg II lines of some Be and shell stars has been observed by Morgan et al. (Ap J 216, 457); evidence for expanding layers has been found.

The spectral variations of the shell star 48 Lib from 1965 to 1977 have been studied by Aydin and Faraggiana (AA Sup. 34, 51). The spectrum variations of Pleione from 1938 to 1975 have been studied by Gulliver (Ap J Sup. 35, 441). The same star has been studied by Hirata and Kogure (PASJ 28, 509; 29, 477 and 30 in press) and by Higurashi and Hirata (PASJ 30, in press). The mass of the shell is of the order of 10^{-10} $M_\odot$ and the mass loss 5 10^{11} $M_\odot$ /y. An atlas of high dispersion intensity tracings of Pleione is in press (Kodaikanal Obs. Bull. Series A, Vol. 2, No 3). Hirata and Asada (PASJ 28, 713 examined 15 suspected Be stars and Kogure, Hirata and Asada (PASJ 30, 385) studied the formation of the shell absorption lines in the Balmer series. Variations of γ Cas from 1965 to 1970 have been studied by Ivanova (Soobschenia Bjurakan Ap Obs 50). Significant variations of the equivalent widths of Hα with time scale of several minutes have been found for the Be stars φ Per, γ Cas, 28 Tau (Mamatkazina, Trudi Ap Inst Alma Ata, 31, 73); variations of Hα and Hβ during a period of 10 minutes have been found by Luud (AZ Lett, in press) in the spectra of γ Cas, γ Dra, 11 Cam and π Aqr.

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Early-type supergiants. Considerable UV data have been accumulated during the last three years, providing information on stellar parameters such as flux distributions temperatures, line identification, and especially on the winds from early supergiants. For the O4 If star ζ Pup a complete Copernicus high resolution spectrum has been published (Morton, Underhill Ap J Sup. 33, 83), the flux distribution analyzed by Holm and Cassinelli (OAO-2 data, Ap J 211, 432), the mass-loss rate studied by Morton (Ap J 203, 386) and later by Lamers and Morton (Ap J Sup. 32, 715). Another well-studied supergiant is β Ori, B8 Ia; an extensive line list was compiled by Selvelli et al. (AA Sup. 27, 1) and line-blocking factors were measured and new determination of the temperature made by Stalio et al. (AA 60, 109). For the A2 Ia supergiant α Cyg line identification based on Copernicus data was compiled by Underhill (Ap J 217, 488) and by Barbier et al. (AA Sup. 32, 69) and an investigation on mass-loss from α Cyg, β Ori and η Leo (AO Ib) was made by Lamers et al. (Ap J 223, 207) using data from BUSS VII and VIII. The two Ia supergiants present shifted components of the resonance lines of singly ionized metals while the Ib supergiant does not. Other data on mass-loss in early-type supergiants have been presented by Chentsov (Izv Spets Ap Obs 8, 128) using Orion 2 data; by Kondo et al. (Ap J 209, 489) using BUSS data, by Morton (IAU Symp. 83) using high resolution Copernicus scans of the O VI doublet at 1032, 1037 A. The physical conditions in stellar winds have been discussed by several authors in view of their importance as clues to the wind origins. The conclusion is that the high ionization observed in stellar winds precludes any possibility that pure radiative equilibrium exists and the nature of the non-radiative processes has been widely debated (Lamers and Morton, Ap J Sup. 32, 715; Lamers and Snow, Ap J 219, 504, Underhill, IUE data, private communication; Lamers and Cassinelli, PASP in press; Hearn, Lamers, Castor and Cassinelli, and Thomas in IAU Symp. 83). The mass-losing prototype P Cygni has been studied by Ambartsumian et al. (Ap J in press) using Copernicus data and found not to show evidence for non-radiative heating. Probably dynamic instabilities cause the outflow and it cannot be considered a prototype of mass-losing supergiants. UV indications of time-variability in stellar winds were found by: York et al. (Ap J Lett 213, L 61 for ζ Pup and δ Ori A in time scales of hours; Snow (Ap J 217, 760) for a number of stars over a three-year period; Lamers et al. (Ap J 223, 207) for β Ori and α Cyg. More detailed studies on time-scale variations in supergiant winds have been carried out by Snow and Hayes (Ap J in press) and by Wegner and Snow (Ap J Lett in press). New observations of α Cam, O9.5 Ia were carried out with IUE and ground based observations were obtained at the same time over a continuous period of 3 days.

Ground based observations of early-type supergiants also give important evidence of mass-loss rates. Hutchings (Ap J 203, 439) calculated mass-loss for 65 OB stars from RV measurements; Conti and Frost (Ap J 212, 728) calculated mass-loss from Hα for 20 O stars and compared measured intensities and profiles with those computed for non-LTE models. Groth (unpublished) derived a time-dependent Balmer progression including a reversal, and considerable variations of the Hα profile of HD 92207. Similar results were obtained by Wolf and Sterken (AA 53, 355) for HD 91619 and HD 96919. High resolution echellograms of α Cyg confirm the existence of asymmetric emission core in the K line that may be due to chromospheric emission or to scattering from a CS shell (McClintock and Henry, Ap J 218, 205).

An attempt to explain the variable line profiles of α Cyg during the period 1962-1974 is made by Inoue and Uesugi (PASJ 29, 149); a change of the microturbulence field cannot explain them, at least within the limits of plane parallel geometry and LTE assumptions. Luud et al. (A Z Lett in press) found that Fe II lines belonging to multiplet 42 in α Cyg spectrum sometimes have P Cygni profiles while at the same time Hα has normal pure absorption profile.

A-F-type stars, Ap and Am stars (written with the collaboration of C. R. Cowley and C. van't Veer Menneret).

Improved model atmospheres for early-type stars and availability of high resolution observations from the Lyman limit to the IR make it increasingly important to have accurate measurements of absolute energy distribution and attempts to detect chromospheric indicators. Energy distribution of A-type stars from 1100 to 8000 A was compared with thoretical predictions by Panek (Ap J 216, 747); Joshi and Rautela have determined the absolute energy distribution of 14 A-F stars lying in the δ Scuti region of the HR diagram (ASS 45, 199); absolute energy distribution of α Lyr and 109 Vir in the range 3295-9040 A is obtained by White and Lockwood (AA 61, 679) by comparison with black body sources. Line-blanketing was determined from high dispersion spectrograms for ten stars of type F5 by Climenhaga and Wright (PASP 88, 213). Line blanketing is considerably higher for the supergiants than for the dwarfs. A complete identification list of the UV spectrum of α Lyr (0.2 and 0.4 A resolution, Copernicus data) has been published by Faraggiana, Hack and Leckrone (Ap J Sup. 32, 501). Morton et al. (Ap J 212, 438) have presented UV spectra (2100-3200 A) of the normal stars α Aql, A7IV-V and α CMi, F5IV-V obtained with Copernicus and compared with the solar spectrum obtained with a rocket by Broadfoot.

High resolution studies of Sirius have been made by Millard et al. (AA 54, 869, v sin i measurements), Kurucz et al. (Ap J 217, 771; an overabundance of B_a by a factor of 50 was found). Freire et Al. (AA 61, 785) have measured high resolution profiles of the Ca II K line, with the spectrograph of the Meudon solar tower, for α CMa, A1 V, γ Gem, A0 IV and α Aql, A7 IV-V. A solar abundance for Ca has been found and no evidence for chromosphere. Asymmetries in the K line point to the existence of velocity fields in the photosphere. This result contrast with those of R.E.M. and R. F. Griffin (AA in press) who found it symmetrical and non variable. R.E.M. and R.F. Griffin are studying also α Lyr in the range 3100-6900. The emission lines observed by Johnson and Wisniewski (PASP 90, 139) were not confirmed by the Griffins' observations (PASP in press). Boyarchuk and Snow (Ap J 219, 515), using the Copernicus data, have found that α Lyr and α CMa have no excess of heavy elements such as Tc, Pt and Hg in comparison with the solar abundance. Castelli and Faraggiana using the Copernicus data and the Kurucz, Peytremann and Avrett models derived the atmospheric abundances for α Lyr. They found that if it is required that the abundances have the same value in the visual and UV range and that the ionization equilibria be respected, it is necessary to admit a depth-dependent microturbulence (4 th Trieste Coll. in press). The visual and photographic spectrum of ε Aur, F0 Ia was studied by Castelli (ASS 49, 179; AA 69, 23) who found spectrum variability in time-scale of 20 minutes, and depth-dependent microturbulence, increasing inward. IUE observations in the high resolution mode show the presence of chromospheric emissions in the two resonance lines of Mg II (Hack and Selvelli, Nature in press, AA in press).

Boesgaard (Ap J Dec. 15, 1978) has determined the abundance of boron from Copernicus scans of 1362.46 B II in 16 normal stars of spectral types A and B. A cosmic value $B/H \sim 2\ 10^{-10}$ is found, not dependent on the temperature. The cosmic values of Li, Be and B agree with the predictions of galactic-cosmic-ray spallation reactions for the origin of light elements.

Ap stars. Several abundance studies, especially of some particular atomic species, have been made, in order to check the diffusion theory. Of the possible suggestions for the origin of the Ap-abundance anomalies, the diffusion hypothesis is most compatible with established notions of stellar structure, stellar evolution, and nucleosynthesis (even if the stability required for the stellar atmosphere represents the greatest difficulty with the theory). The appeal of this theory lies here rather than in the results of detailed comparisons of theoretical predictions with observational results which are often of low accuracy. In its most recent formulation, diffusion theory provides the basis for an observational probe of numerous processes in stellar interiors from an examination of surface abundances. This positive aspect of the theory has yet to be exploited.

The proceedings of three conferences on Ap stars have appeared: the Shemaha conference (AZ 51, English abstracts), The IAU Coll. 32 and the Prague Conference (Publ Czech Ac Sci Astr Inst. No 54). Several papers by C. R. Cowley, M. S. Allen and coll. (Ap J 206, 196, Ap J 213, 121, Ap J Sup. 32, 631, PASP 89, 386, PDAO 15, 37) are devoted to the systematic study of very heavy elements in the spectra of Ap stars (Y, Ba, Lanthanides, Actinides, U and Th) and of Cr, Mn and Fe. Aikman and Cowley have a continuing program to make element identification in Ap stars using 2.4 A/mm plates (22nd Liège Symp.). Identification lists and occasional abundance determinations have been prepared for: γ Equ (Adelman et al. Preprint), HD 25354 (Pyper, Ap J Sup. 31, 249), HD 215038 (Rice, PASP 89, 770), ε UMa (Mallama and Molnar, Ap J Sup. 33, 1), α^2 CVn (Leckrone, private comm.) HD 161733 (Levato and Malaroda, PASP 89, 84), HD 34452 (Pavlova et al. Sov Astr 21, 554), α And (Aydin, Hack AA Sup. 33, 445). The Hg-Mn stars were studied by Kodaira and Takada (Ann Tokio Astr Obs 2nd Ser 17, 79) who discuss abundance work on 12 stars. Heacox (preprint) made abundance determinations for 21 elements in 21 stars. Properties of Hg-Mn stars were discussed by Aikman (PDAO 14, 379) and by S. Wolf and Preston (Ap J Sup July 1978) who derived the distribution of rotational velocities for a sample of 256 late B-type stars, and found that 16% of the non-magnetic late B-type stars are Hg-Mn stars and that these objects are not distinguished from normal ones by their age, duplicity, rotation, or any combination of these characteristics.

A summary of the properties of the hotter Ap stars (Bp-He-w) is given by Vilhu et al. (Report No 2 of Ap Lab Univ Helsinski). Hartoog and A. P. Cowley (Ap J in press) have studied the He^3 phenomenon in B stars. A. M. Boesgaard (PASP 88, 353) treats Li, Be, B abundances in Ap and other stars. C. Cowley and Etzler (PASP 89, 524) find the presence of weak CN bands in the cooler Ap stars. Several individual Ap stars have been studied for abundances by a large number of authors. Three papers have appeared dedicated to the very peculiar rare-earth star HD 101065 (Przybylski, IAU Symp. 72, 135; MN 178, 71 and 735). High resolution (0.086 A) polarization observations inside spectral lines of the magnetic star β Cr B have been made by Borra and Vaughan (Ap J 216, 462). The observations can be approximately explained by a decentered dipole model. Variability of spectrum and magnetic field have been investigated for several magnetic stars at the Zentralinstitut für Astrophysik in Potsdam (53 Cam, HD 9996, 52 Her, ε UMa, 73 Dra, β CrB) and the distribution in spots of the elements is studied by several Soviet astronomers (e. g. Astrophysics 12, 631). Babu has derived effective temperatures, radii and bolometric magnitudes of several Ap and Am stars (ASS 43, 57; Babu and Rautela, ASS in press). Raiamohan and Babu (MN 182, 773) have studied the correlation between rotational velocities and colors of magnetic variables, both singles and members of spectroscopic binaries.

Am stars. The main trend is (a) to improve spectral resolution for a more efficient comparison of the spectroscopic results with the prediction of the diffusion theory; (b) to study the interaction between the metallicity phenomenon and duplicity, rotation, evolutionary stage and other physical parameters affecting the stellar atmosphere. Disagreements appear between high and low dispersion spectroscopic results, as well as photometric work; recent UV observations give results in contrast with the observations in the visible range.

C. van't Veer and collaborators are continuing detailed analyses of Am stars; M. Kondo and Kitamura and collaborators (Ann TAO 2nd Ser 16; TAB 2nd Ser No 246) have made extensive studies of the eclipsing binary Am stars and found that the two components of RR Lyn have a different compositions while WW Aur and δ Cap may show a non-uniform distribution of metallicism on the surface components.

Kurtz (Ap J Sup. 132, 651) found that of seven δ Del stars analyzed, five showed similar abundances to evolved Am stars. Fracassini and Pasinetti (AA 66, 37) studied three suspected δ Sct variables (σ And, θ Peg and 2 Lyn) which are progressively far from the hot limit of the instability strip of the δ Sct variables. 2 Lyn may be an Am star.

Late-type stars (written with the collaboration of G. Cayrel De Strobel).

The role of late-type stars in astrophysics is of paramount importance, because in these objects evolution has not depleted the initial stellar content of the Galaxy and the full span of ages is still present. Hence these stars are used

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to study the chemical evolution of stellar populations, the abundance gradients across the galactic disc, the constraints on nucleosynthesis imposed by the chemical composition of extremely metal-deficient objects, and the connection between chemical, kinematical and dynamical evolution of the Galaxy.

High dispersion analysis of G and K standard stars. A critical survey of the solar abundances has been made by Holweger (22nd Liège Symp). Martin is carrying out a detailed non-LTE analysis of the sun; Hardorp (AA 63, 383) is comparing the energy distribution of the sun with solar-type stars by photoelectric scanning. Hardorp, Cayrel de Strobel and Perrin (IAU Symp 80) analyzed some of the stars belonging to the solar-type "boxes" of Golay (AA 60, 181). The found that, once analyzed in detail, stars belonging to the same "box" do not have identical atmospheric parameters. R. F. Griffin has reported on high resolution spectrometry of solar-type stars (4th Trieste Coll). Two new analyses of the iron spectrum of ε Vir (Hearnshaw et al. MN 185, in press and PASP 89, 797) and Cayrel de Strobel (AA 54, 797) are in good agreement with the former ones. β Gem, K0 III, is analyzed by Griffin (MN 175, 225) and by Holweger and Griffin on high resolution FTS spectra; β UMi, K4 III by Williams, α Tau, K5 III, by Tsuji (AA 62, 29) and by Foy and de Batz on FTS spectra. The problem of the gravity of Arcturus is debated: log g = 0.9$\pm$0.35 (Mackle et al. AA 38, 239) or log g = 1.6$\pm$0.20 (Ayres and Linsky, Ap J 200, 600; Ap J 201, 212; Blackwell and Willis MN 180, 169; Ayres and Johnson Ap J 214, 410; Martin, AA 31, 591). High resolution studies of the Ca II and Mg II lines in Arcturus have been made by Adams et al. (Ap J 211, 453) and by Kondo et al. (Ap J 207, 167) and van der Hucht et al. (AA in press). The region 2700-3400 of the Arcturus spectrum has been studied at 0.1 A resolution by Stencel and van der Hucht (Ap J Sup. Sept. 1978). CO bands in Arcturus give evidence of inhomogeneous chromosphere (Heasley et al. Ap J 219, 970).

G and K field stars. A series of studies on the abundances of Li, Be and B has been made by A. M. Boesgaard (Ap J 210, 466 and 475; PASP 88,353), by Luck (Ap J 218, 752) and by Kipper et al. (Publ. Tartu Obs. 44, 271). CNO abundances which are essential for understanding the different nucleosynthesis processes have been investigated by several authors: Bell and Branch (MN 175, 25), Clegg (MN 181, 7); Bell et al. (MN 181, 31),Lamber and Ries (Ap J 217, 508),Luck (Ap J 219, 148), Sneden and Peterson (Ap J 222, 585). The C^{12}/C^{13} ratio in 38 giants and supergiants has been determined by Tomkin et al. (Ap J 210, 694) and by Lambert and Sneden in the most metal-deficient star HD 122563. A solar C/Fe ratio has been found in 12 metal-poor dwarfs and subgiants (Peterson and Sneden, Ap J in press) and in the metal-rich K dwarf 14 Her (Peterson, Ap J 224, 595). On the other hand, a range of CNO/Fe abundance ratio in metal-poor field stars is suggested by Pilachowski (Ap J in press). Oxygen abundance has been studied by Eriksson and Toft (AA in press) and by Kjaergaard and Gustafsson (Stromgren Symp. p. 127). Kameswara Rao (MN 185, in press) has measured the strengths of the G band in 10 weak-G-band stars and found a correlation of the weakness of the G band to enhancement of NH-band strength. Kollatschny has analyzed the K5 V star ε Indi. Abundance anomalies very close to those of the Ba and CH stars have been found. This study confirms the trend of decreasing T_{min}/T_{eff} with decreasing T_{eff}. This value for ε Indi is 0.76. Hartmann and Anderson (Ap J 215, 188) have analyzed high resolution red spectra of three late-type dwarfs and two emission-line flare stars. The abundances are similar to the solar ones.

SMR stars. Contrasting results have been found. Peterson (Ap J Sup. 30, 61) has explained the SMR phenomenon as an effect of difference in surface temperature. Several analyses indicate that the SMR stars or some of them, have normal abundances (Kuroczkin and Wisniewski, Act Astr 27, 145; Hearnshaw AA 51, 85) while others found an overall metallic overabundances of 0.3 dex relative to the sun (Luck Ap J 212, 743). Weak metallic lines in the near IR are very sensitive to metallicity (Campbell and Garrison). Hearnshaw (AA 51, 71) in analyzing 8 high-velocity dwarfs found that the spectroscopic gravity is about a factor of 10 lower than the gravity derived from the trigonometric parallax. This effect was not confirmed by Cayrel de Strobel (AA 54, 797) in a new analysis of one of these stars, HD 103095.

Metal-poor stars. Foy (AA in press) shows that high-velocity stars are only moderately metal-deficient and that metal-deficiency and kinematic properties are weakly correlated. Wallerstein et al. (Ap J in press) have found a field red-horizontal branch star HD 175305. Spite and Spite (AA in press) have found two extreme metal-deficient objects (like the only one known up to now: HD 122563) with [Fe/H] = -2.6 : HD 84903 and HD 184711. From a sample of 11 very metal-deficient stars Spite and Spite (AA 67, 23) ascertain the following trends: i) no enhancement of the odd-even effect; ii) no overdeficiency of Eu (r-element); iii) when $F_e/H \lesssim -1.5$, Ba (s-element) is overdeficient, and to a lesser degree also Y (s-element). Pagel (22nd Liège Symp.) has carried out a survey of abundances in unevolved cool stars. There seems to be good evidence for variations in N, O and Ba abundance and for zero or very small variations in C and members of the iron group. The state of evolution of dwarfs and subgiants is discussed by several authors (e.g. see Cayrel de Strobel, Stromgren Symp. p 205). Greenstein has observed G and K stars of large proper motion with the multichannel spectrometer on the 5-meter telescope. The existence of a genuinely sub-luminous sequence with appreciable internal scatter is established for the high velocity stars. Some of these objects have no lines visible except Balmer lines, G-band and H and K, indicating a metal-defect by a factor of 1000 with respect to the sun. Some objects present retrograde motion with respect to the galactic center, a about 500 km/s with respect to the sun. These must be among the oldest metal-poor objects known.

G and K stars in galactic and nearby extragalactic systems. Owing to progress in instrumentation interesting results have been obtained for individual stars belonging to stellar systems. Significant differences in chemical composition have been found between members in the Arcturus group (Cayrel de Strobel, Martin, Pasinetti, AA 61, 591). Their result could raise doubts about the physical reality of old moving groups. Bonsack and Pilachowski (IAU Symp. 80) are conducting a low dispersion survey of stars in the clump and nearby regions of the giant branch of open clusters of intermediate age, in order to identify stars of peculiar composition and look for abundance variations within clusters and between clusters. A sensitive method of deriving metallicities of young G stars has been developed by Barry et al. (Ap J 212, 462; Ap J 219, 942; Ap J 222, 1032, PASP in press); they show that the metallicity difference between coeval clusters Hyades and Coma is greater than between old (Sun and M 67) and very young (NGC 2264) objects. The Hyades metal enrichment of 0.3 dex appears to be excluded (Tomkin and Lambert, Ap J 223, 937). Abundance determinations in globular clusters are being carried out by Bell et al.(Stromgren Symp. p. 249); Ap J Sup., submitted); Wallerstein and Pilachowski 22nd Liège Symp.); Zinn (Ap J 218, 96), Mallia, (AA 60, 195). Pagel et al. are obtaining spectra at 5 and 10 A/mm of globular cluster giants. Cohen et al. (Ap J 223, 487) have analyzed giants in M3, M13, M92 and M 67, Griffin in M 13 (MN in press), Kraft in M 15, M 13 and M 3. Kraft and Carlson (IAU Symp. 80) have found large N/Fe values and wide variation (1.30 dex) in these values among stars on the subgiant branch in M 92, suggesting that the CNO-cycle processing is initiated much earlier than had been thought until now.

Vilhu, Tuominen and collaborators (Report No 3, of Ap Lab Univ Helsinski) have studied high resolution spectrograms of several K giants in Wolf 630 moving group. μ Her, γ^2 Del and η Eri form a homogeneous sample, more metal-rich than the standard ε Cyg. Two peculiar stars of the group, 56 Peg (a barium star) and HD 148897 (a marginal CH star) have been studied. The latter is probably not a true member of the group because it is slightly metal-poor.

Metal abundance in the LMC cluster NGC 2209 is in reasonable agreement with that found for the LMC IS-medium (Gustaffson et al. Ap J Lett 216, L7); Foy is studying the chemical composition gradient in the SMC and Coehen (Ap J in press) has determined gradients of line strengths within M 31, M 81, NGC 4472 and NGC 3115.

Norris and collaborators have performed spectroscopic studies in M 13, M 92, NGC 6397, M 15, M 22, M 55, ω Cen, 47 Tuc, and discussed the spectroscopic similarities of dwarf spheroidal galaxies with ω Cen.

M, C, S stars. Maehara and Yamashita (PASJ, 28, 135) observed the energy distribution of M stars and found that it is an indicator of the TiO band intensity.

Yamashita and Maehara (PASJ 29, 319) and Yamashita et al. (PASJ 30, 219) observed the companion of Mira Ceti near light minimum, and estimated the mass-loss rate from Mira (PASJ 30, 409) to be about 2 10 ^{7} M⊙/y. F. and M. Querci (AA, submitted) have observed λ 10830 He I in R CrB in a pre-maximum phase. It appears with a P Cygni profile; the violet-displaced absorption gives an RV of 240 km/s. This line confirms the presence of He in R CrB and states the physical conditions in high temperature and high density prevailing in the CS cloud. F. and M. Querci (21th Liège Symp.) discuss the information that molecules in C star spectra can give on nucleosynthesis processes undergone by carbon stars and on their hydrodynamics. Fujita (JRASC 71, 115) examined the red spectrum of nine carbon stars for the presence of HCN, CH_2 and C_2H_2. Fujita and Tsuji (PJA 52, 296; PASJ 29, 711) determined the isotopic ratio C^{12}/C^{13} for nine carbon stars and found that this ratio is abnormal only in peculiar carbon stars (see also PJA 54, 207). The broad absorption band at 3 μ of 22 carbon stars was studied by Noguchi et al. (PASJ 29, 511). They found that the band depth correlates with the abundance ratio CN/C_2. The continuum between 1 and 4 mm from the carbon-Mira-Ceti star V Cyg is interpreted by M. Querci et al. (AA submitted) on the basis of the near IR flux. Shock waves and mass-loss should support the assumption of a flare-like event.

Kipper et al. (Publ Tartu Obs 44, 271) have determined the abundance of lithium in the atmospheres of 14 K and M giants. Dragunova et al. (AZ 52, 6) have investigated the blanketing effect of M0-M5 stars. In order to clarify the problem of the origin of lithium in the galaxy, de la Reza and F. Querci (AA 67, 7) are studying the importance of non-LTE effects in the Li abundance determination in Super-Li-Rich Carbon stars. de la Reza and Torres are also investigating the possibility of enrichment of Li by the mass-loss of the numerous flare stars. For this the Li abundance in the M dwarf Gl 182 is being calculated.

Mould and Wyckoff (MN 182, 63) found that the predicted properties of FeH do match the observed characteristics of the unidentified molecular band near 9900 A discovered in spectra of late M dwarfs by Wing and Ford in 1969.

Wyckoff and Clegg (MN 184, 127) have prepared an atlas of pure S stars near minimum light and a list of the positions of more than 200 molecular band heads. Model atmosphere analyses indicate that pure S stars have $0.98 \lesssim C/O \lesssim 1.02$.

Spectroscopic evidence of motion or variability in late-type photospheres and chromospheres. The main result is the detection of chromospheres and coronas in the UV. Separation of macroturbolence from rotation is being made on several K giants (Smith Ap J in press, Gray Ap J in press). A radial-tangential velocity distribution for macroturbolence fits the observations better than does a gaussian (Gray Ap J 202, 148; 211, 198; Smith et al. Ap J 207, 308), but supergiants may be an exception (Luck, Ap J 218, 752). SMR K-giants appear to show a different turbulence compared to normal K giants (Gray and Martin in preparation). Correlations between microturbolence, macroturbolence, chemical composition, and age are sought for (Smith, Ap J 224, 584; Foy AA 67, 311).

Wilson (Ap J Dec. 1 1978) and Vaughan et al. (PASP 90, 267) study the flux of Ca II emissions and find evidence for cycles similar to the solar one. Absolute fluxes of K chromospheric emission on the HR diagram have been evaluated by Blanco et al. (AA 48, 19) and the intensity effect in Wilson-Bappu relation was investigated on 248 G, K and M stars by Gleboki and Stawikowski (AA 68, 69).

The UV spectra of late-type stars have been studied with Orion 2 (Epremyan, Byurakan Obs Bull), Copernicus, BUSS. Observationally, new spectra obtained with IUE (Stencel, private communication) demonstrate that there exist two types of mid-UV emission line spectra for G and K stars: the early G bright giants, all G and K0-K1 giants and seemingly all G and K dwarfs present high excitation lines, including C II to N V; whereas the late G bright giants and the mid- and late-type K giants have only low excitation lines (Si II). This dichotomy appears to parallel the locus of evidence for strong mass-loss described by Reimers (AA 57, 395) and the Ca II V/R asymmetry changeover described by Stencel (Ap J 223, L37). The successful flight of BUSS X in May 1978 recorded the mid- UV spectrum of the active chromosphere star β Dra (G2 Ib-II). Mg II profiles present strong emission with possible multiple CS features superimposed.

Bappu and Mekkaden have studied K-emission in Canopus and find fluctuations in intensity. Bappu, Raveendran and Mekkaden have in progress a survey for the detection of the He I 5876 line of chromospheric origin. The absolute energy distribution in ρ Cas, F8 Iap (Joshi and Rautela, MN 183, 55) indicates that it is appreciably modified by the CS shell surrounding the star.

Spectral evidence of stellar chromospheres in late-type stars is being investigated at the Observatorio Nacional, Brazil: for carbon stars by studying the line formation of emission lines, by de la Reza; for M giants by means of the Ca II absorption lines in the infrared, by Batalha.

Binaries - (Written with the collaboration of M. Plavec and K. O. Wright).

Semi-detached systems of the Algol type: lines of the secondary component of Algol were finally seen by Tomkin and Lambert (Ap J 222, 119). Popper and Plavec discovered that some apparently normal Algol primaries show symptoms of a shell (weakness of Mg II, Si II); the phenomenon is quite pronounced in TT Hya.

Ultraviolet excesses in U Cep, U Sge, SX Cas and several RS CVn stars were found by Rhombs and Fix (Ap J 209, 821; 212, 446; 216, 503). These are probably due to free-free and bound-free emission associated with the hot components in Algols, but with the cool components in RS CVn stars. York, Flannery and Bahcall (Ap J 210, 143) found an H II region around V Pup. The RS CVn binaries became objects of great interest when it was discovered that they tend to be radio (and even X-ray) sources. Weiler (MN 182, 77) from a study of H, K, Hα emission suggest an exstensive chromospheric activity on the later-type component.

Perhaps significant for our understanding of He-rich stars is the suggestion that Sigma Ori E might be an interacting close binary (Hesser et al. Nature 262, 116; Groote and Hunger AA 56, 129).

Intensive observations of the far ultraviolet spectrum of β Lyr continued (Hack et al. Ap J Sup. 34, 565; Kondo et al. Ap J 208, 468) with both Copernicus and IUE. The peculiar emission spectrum is interpreted as arising in a supercorona; matter associated with the companion is detected through the absorption components of 1175 C III and a mass ratio $m_2/m_1 \simeq 3$ is derived. The He I line at 10830 in the spectrum of β Lyr was observed by Girnjak et al. (Iz Cr Ap Obs 58, 75) and shown to be formed in the gas stream and envelope. Leushun et al. (Iz Sp Ap Obs 9, 3) have estimated the He/H ratio in β Lyr to be equal to 1.55. The spectrum of β Lyr was believed to be unique until Plavec using IUE discovered a similar spectrum in W Ser, W Cru, and V 367 Cyg, and Koch in RX Cas and SX Cas (IBVS). υ Sgr was studied by Duvignau, Friedjung and Hack using Copernicus data (AA in press) and again by Hack with IUE. Evidence of an expanding hot plasma is found. N V, Si IV, C IV resonance lines present terminal velocity of about -700km/s. The photographic spectrum of V 367 Cyg was studied by Aydin et al. (ASS 53, 345) and a peculiar behavior of the lines at some phases detected. In the supergiant binary μ Sgr Plavec and Polidan found a hotter component (B1?) than the observed B8 Ia star, using Copernicus and IUE. Hack and Selvelli observed Epsilon Aur with IUE (IBVS 1439, Nature in press) and discovered a faint blue companion, V ~10, Sp. type ~ B8). R. F. Griffin and Radfoot (Obs 97, 169) and Griffin (MN in press) have shown that the G5Iab-Ib star HD 187299 has a B companion. Among the ζ Aur type stars, VV Cep (M2Ia+OB) was observed before and during atmospheric eclipse by Wright (IAU Circ 2811, JRASC 77, 152) and Faraggiana (AA 46, 317). IUE spectra in the region 1150-3200 A were obtained by Selvelli and are now being analyzed by Faraggiana. Saito and Kawabata (ASS 45, 63) observed the Ca I line at 6572 in spectra of ζ Aur and 31 Cyg; it is probably due to CS gas expanding from the systems.

T Tauri stars. (Written with the collaboration of W. K. Bonsack).

One of the main problems is the location of T Tau stars in the HR diagram: they probably represent the earliest evolutionary phase for which stellar spectra are observable. Many problems are posed by their envelope and photospheric spectra which present very complex and variable line profiles.

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A review of the relationship between the T Tauri stars and star formation is given by S. E. Strom in Star Formation (T. de Jong and A. Maeder eds., P. 179, Reidel Publ.). Rydgren, Strom and Strom (Ap J Sup. 30, 307) obtained spectra and photometry of 49 T Tau stars. The veiling superimposed on the stellar spectrum has the characteristics of H free-bound emission. The veiling, emission lines and IR excess can be accounted for by a CS envelope with T near 20000 K; is some cases a dust envelope must be added to account for silicate emission at 10 and 20 μ . Kuhi (Protostars and Planets conference, Tucson 1978) emphasizes the breadth of the absorption lines, implying v sin i up to 100 km/s. Kuhi noted that pre-main-sequence stars without H emission do not have unusually broad lines, suggesting the need for a rotational braking mechanism to act between T Tau phase and subsequent pre-main-sequence evolutionary phases. True P Cyg profiles are rare, and inverse P-Cygni profiles more so. Herbig (Ap J 214, 747) has made a radial velocity survey of T Tau stars and finds that the stars are essentially at rest with respect to the clouds with which they are associated. Frequency distribution of photospheres is peaked near MO. Schneeberger et al. (AA 62, 447) discuss the intensity ratio of He triplet lines to He singlet lines and point out the usefulness of this datum in discussing physical conditions in the CS cloud. Kuhi (Tucson conf.) pointed out that rapid variability of the emission lines (time scales of a few hours for the Na I lines, 24 hours for Fe II, weeks or months for Balmer lines and blue continuum, while forbidden lines are essentially constant) is common to many T Tau stars.

The subgroup YY Ori—type is characterized by the presence of inverse P Cyg profiles. S CrA, a bright member of this group, has been observed by Rydgren (PASP 89, 557 ; Appenzeller and Wolf AA 54, 713 and by Wolf et al. AA 58, 163).

FU Ori objects are characterized by an increase in brightness of four to six magnitudes in a time on the order of a year. The post-maximum spectrum is similar to an A or F supergiant. Three objects of this class are known: FU Ori, V 1057 Cyg and V 1515 Cyg. It has been suggested that the FU Ori phenomenon represents the clearing of the dust envelope of a protostar. A critical review by Herbig (Ap J 217, 693) points out that it is more likey that the FU Ori is an event which occurs several times during the lifetime of most T Tau stars.

An observational study of the Ae-Be Herbig stars, which are considered to be pre-main-sequence objects, has been made by Garrison and Anderson (Ap J 218, 438). The infall rotation model proposed by Ulrich (Ap J 210, 377) for T Tau stars, may be applicable to these variables.

Flare stars. (Written with the collaboration of R. E. Gershberg).

For understanding the mechanism of stellar flares it is very important to have simultaneous spectroscopic and photometric observations, like those performed by Moffet and Bopp (Ap J Sup. 31, 61). These data show that continuum emission dominates at the spike phase, while line emissions dominate during the phases of slow rise before maximum and of slow decay after maximum. Helium emissions are seen only symultaneously with strong flare continuum. High dispersion spectra of two faint flares of AD Leo have been studied by Schneeberger et al. (in press). Spectra of flare stars in quiet state have been studied by several authors. Bopp and Fekel (A J 82, 490) have analyzed the spectra of 13 BY -Dra -stars and found that 8 of them are SB2. one is SB1 and 4 are single stars. R. F. Griffin did not find close companions for 3 other flare stars (PASP 89, 65). It seems that the presence of a close companion is not necessary for spottedness to appear, and that the ultimate cause is relatively rapid rotation. Bopp and Shmitz (in press) have discussed the Hα variability in 15 dMe stars, and Worden and Peterson (Ap J 206, L145) have studied the profile of the Hα emission in 8 dMe stars and found that the central reversal is a common feature of Hα profiles of dMe stars, but that 5876 He I does not show such characteristics. Hartmann and Anderson (Ap J 213, L67) have found a short-lived absorption feature near Hα in the spectrum of EQ Vir which may be interpreted as large scale infalling gas with a velocity of 70 km/s. Zeeman, observations of 15 dM, dMe and BY Dra stars (Vogt BAAS 8, 535; 9, 593) show no evidence of magnetic fields.

A positive correlation between the variation of the emission of Hα and the star luminosity has been found for the star CC Eri (Busko, Quast and Torres, AA 60, L27). These authors are continuing the same kind of research for other variable stars of the type BY Dra.

Late stages of stellar evolution. (Written with the collaboration of Y.Andrillat and J. P. Swings).

Hot evolved stars. Five eruptive blue variables at a distance from the plane of 0.5 to 5 kpc have been observed by Greenstein et al. (PASP 89, 741) including the X-ray variable AM Her. High velocity stream motions in the lines are reported from high resolution spectrograms of AM Her. Several of the "ultraviolet objects" found with S2/68 on TD-1 are studied by groups in Liège and Strasbourg with an objective prism (Barber et al. Ap J Lett 66, L9). One halo star, F 86, which in the visible is very similar to the young Bp star 3 Cen A (Baschek and A. I. Sargent AA 53, 47) has been observed by Hack with IUE. The UV spectrum presents an energy distribution typical of an early B - type star. The same kind of peculiarity observed in the visual seems to be present also in the UV: strong P, Si and metallic ions, weak C and He. Two high galactic latitude stars, HZ 43 and F 24 have been observed with the Apollo Soyuz experiment in the far UV (100-900 A) (Margon et al. Ap J 209, 525; Liebert et al. Ap J 216, 18) and coude spectrograms of F 24 were studied by Thorstensen et al. Ap J 223, 260).

A survey of suspected white dwarfs has been made by Wickramasinghe, Bessel and coll. A magnetic field of 3.6 10^7 gauss was found for the DA star BPM 25114 (MN 183, 533). LOS 785 A has an H α absorption line, the first example in a DB, with the result that H/He = 10^4 to 10^5 by number (MN 178, 11P). LDS 687 B is an intermediate DA with no evidence of hydrogen absorption, so that H/He $< 10^{-4}$ by number (MN 182, 53 P).

Symbiotic stars and peculiar emission line stars. An interesting paper on the nature of symbiotic stars is that by Feast et al. (MN 179, 499). To define the nature of the objects-BQ] , symbiotics, proto-planetary nebula, planetary nebulae-is often quite difficult as Allen and Swings (AA 47, 293) remark in their survey of 65 peculiar emission-line stars with IR excess. Some of the results on peculiar emission line objects are to be found in the following publications: J. P. Swings (NASA TM-X73, 190), Y. Andrillat and J. P. Swings (Ap J 204, L123), J. P. Swings, Y. Andrillat (AA submitted), Johansson (MN 178, 17P), Thackeray (Mem RAS 83, 1). Future work would be desirable in the following direction: simultaneous spectroscopy and photometry of the variable objects (see e. g. Klutz et al. IAU Coll. 42, Bamberg, 126); extension of the observations towards the UV with the help of IUE (Hack and Selvelli have observed the symbiotic M6 III star CH Cyg in April and July 1978, during a period of activity and found evidence of a flat continuum in the range 1150-1900 and a strong 1302 O I emission indicative of an extended envelope of H II); use of the FTS in the near IR, e. g. to try to detect absorption bands and thus to confirm the presence of a late-type companion, which is just suspected in several cases, or to study Zeeman patterns or the velocity structure of lines formed in different layers of the atmosphere.

Nuclei of planetary nebulae. The study of the spectra of the nuclei of planetary nebulae is fundamental for understanding the evolution of the nebulae. Observations are difficult because stars are faint and nebular lines interfere with the stellar lines. However, the new technical developments have produced a quantity of new data. Several reviews on these nuclei have been given at the IAU Symp. 76 on Planetary nebulae. The main problems are: 1) to find the cause of the different spectral types of nuclei; 2) to discover what is their evolution; to look for possible correlations between the characteristics of nuclei and those of the nebulae. Ten planetary nebulae have a binary star as nucleus. This is a very important problem correlated to the evolution of nebulae, and it is strange that no systematic search for binariety among the nuclei of PN has been made.

Observations in the UV of 39 PN show that only 5 of them present variations on the order of 15% at maximum in the UV (Gilra et al. AA 63, 297; IAU Symp. 76 p. 210). Fast variations of low amplitude have been observed in several central stars of PN.

The spectrum of the unique object FG Sge has been observed by Chalonge et al. (Astroph 13, 437; Smolinski et al. PASP 88, 67; Kipper T. A. Sov Astr Lett 4, 280). The results of the observations of several central stars of PN (spectral type, population-membership, binariety, peculiarity) have been reviewed by Lutz (IAU Symp. 76, 185) and by Aller (20th Liège Symp. p. 271).

UV observations have permitted the derivation of the energy distribution and of the temperature of the central stars of PN and the comparison of them with those derived by the Zanstra method (Pottasch et al. AA 62, 95). The disagreement is strong in some cases; and the reasons for it are discussed by Heap (Ap J 215, 864).

Abbreviations.

AA =	Astronomy and Astrophysics
AA Sup =	Astronomy and Astrophysics Supplement
Act Astr =	Acta Astronomica
AJ =	Astronomical Journal
Ann TAO =	Annals of the Tokyo Astronomical Observatory
ApJ =	Astrophysical Journal
ApJ Sup =	Astrophysical Journal Supplement
ASS =	Astrophysics and Space Science
Astroph =	Astrophysics
AZ =	Astronomicheskij Zhurnal
IBVS =	Information Bulletin Variable Stars
IRASC =	Journal Royal Astronomical Society of Canada
MN =	Montly Notices of the Royal Astronomical Society
Mem RAS =	Memoirs of the Royal Astronomical Society
Obs =	Observatory
PASJ =	Publications of the Astronomical Society Japan
PASP =	Publications of the Astronomical Society Pacific
PDAO =	Publications of Dominion Astrophysical Observatory
PJA =	Proceedings Japan Academy
Sov Astr =	Soviet Astronomy
TAB =	Tokyo Astronomical Bulletin

M. HACK
President of the Commission

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