J. Andersen (ed.), Reports on Astronomy, Vol. XXIVA, 338–345.

COMMISSION 30: RADIAL VELOCITIES

(VITESSES RADIALES)

PRESIDENT: J.B. Hearnshaw
VICE-PRESIDENT: A.A. Tokovinin
ORGANIZING COMMITTEE: W.D. Cochran, F.C. Fekel, T. Mazeh, N. Morrell, B. Nordström, H. Quintana, R.P. Stefanik & S. Udry

1. INTRODUCTION

Commission 30 has 120 members in 28 countries who are active in the area of radial velocities. During the past triennium 11 new members have joined the commission. The work of the commission covers a wide range of topics all of which concern the application of the Doppler effect to astronomical objects, including galaxies and the interstellar medium as well as stars, and in all wavelength ranges of the electromagnetic spectrum. Although the commission focuses mainly on stellar and galaxy radial velocities, it is noted that stellar rotation, spectroscopic binaries, extrasolar planet searches, pulsating variable stars, asteroseismology and turbulence in stellar atmospheres are also included.

2. SCIENTIFIC HIGHLIGHTS 1997–1999

2.1. Radial velocities of galaxies (H. Quintana)

The new generation of very large redshift surveys are just starting to give their first results. Primary among them is the Sloan Digital Sky Survey, which is operating only in imaging mode. The 2dF instrument at the AAT had been delayed but is now getting up to full speed. A similar delay occurred at the Hobby-Eberly Telescope.

The major breakthrough has come with the redshift measurements on the first 8–10-m class telescopes of galaxies at very large distances (Steidel et al. 1999 ApJ 519, 1). Most important in this period are the results of Keck, with galaxy velocities reported up to $z > 5$. In fact, a whole class of galaxy populations at $z = 3 - 4$ has been identified, with velocities measured for a sample of about 700 galaxies (Steidel et al. 1998, ApJ 492, 428). Also, velocities are being measured for the sample of deep submillimetre sources, with many objects found in the range $2 < z < 3$ (Lilly et al. 1999, ApJ 518, 641; Barger et al. 1999, AJ 117, 2656).

A large amount of work has been done by the previous generation of instruments, completing or continuing velocity surveys at various z (e.g. ESO Slice Project: Vettolani et al. 1998, A&AS 130, 323; Southern Sky Redshift Survey: Da Costa et al. 1998, AJ 116, 1; Caltech Faint Redshift Survey: Cohen et al. 1999, ApJS 120, 171; Durham/UKST Survey: Ratcliffe et al. 1998, MNRAS 300, 417; and others). The reconstruction of the density field from the velocity surveys turned out to be a harder problem than expected (Giovanelli et al. 1998 AJ 116, 2632). The study of clusters has continued, producing large numbers of redshifts for galaxies in some of the best studied systems (Coma, Virgo, Centaurus: Stein et al. 1997, A&A 327, 952; A85: Durret et al. 1998, A&AS 129, 281; A3266, Quintana et al. 1996, AJ 112, 36; and others). Many clusters now have 200 or more measured velocities for members (Hill & Oegerle 1998, AJ 116, 1529; Abraham et al. 1996, ApJ 471, 694), with particular relevant work by the CNOC survey (Ellington et al. 1998, ApJS 116, 247). Several nearby superclusters have also been extensively surveyed, such as Hercules (Barmby

& Huchra 1998, AJ 115, 6), Corona Borealis (Small et al. 1998, ApJ 492, 45), Shapley (Quintana et al. 1997, A&AS125, 247), Perseus-Piscis (Hudson et al. 1997, MNRAS291, 488) and ABCG 85/86/87 (Durret et al. 1998, A&A 335, 41), with up to several thousand velocities measured in each. From these surveys a complex picture of their structures is now appearing. Moreover, the local convergence depth or extension of the Great Attractor region has remained controversial, with conflicting results. Many velocities in clusters and structures at fairly high redshifts, $0.5 < z < 1.0$ (Deltorn et al. 1997 ApJ 483,21; Oke et al. 1998 AJ116,549) are now being measured. The aim is to evaluate cluster evolution to check cosmological models. X-ray surveys have provided a large number of target clusters at those distance ranges, leading to identification of complete samples. The launching of Chandra and XMM will push this research to even higher redshifts. On the near side of the distance scale, the identification of galaxies and clusters has continued in the obscuration zone of the Milky Way (Roman et al. 1998, PASJ 50, 47; Visvanathan & Yamada 1996, ApJS 107, 521), finding likely major contributors to the Great Attractor gravitational pull. As was remarked in the previous report, it can be said that a large number of velocities continue to remain unpublished, a problem that has worsened.

2.2. The Milky Way (F. C. Fekel)

This triennium saw the publication of the Hipparcos Catalogue, which included parallaxes and proper motions for over one hundred thousand stars. This extensive long-term project engendered a variety of complementary programs including the acquisition of radial velocities for use in computing space velocities of various groups of stars. Velocities for 1879 early-type stars were determined by Fehrenbach et al. (68.002.012). Grenier et al. (1999, A&A 135, 503) measured velocities of 581 southern B8–F2 type stars, while Grenier et al. (1999, A&AS 137, 451) reported velocities for nearly 3000 northern stars of similar early-type.

At the "ESA Symposium: Hipparcos – Venice '97" preliminary results from a number of projects were presented. Udry et al. (69.111.021) summarized the status of two large radial-velocity surveys, one in the north and one in the south, which included about 40 000 stars of the Hipparcos mission with spectral types later than F4. Meillon et al. (69.155.172) estimated the escape velocity from the solar neighbourhood using the space velocities of several thousand late-type stars determined from Hipparcos parallaxes and proper motions plus velocities from Coravel. Gomez et al. (69.155.177) determined the velocity ellipsoid as a function of age for disk stars in the solar neighborhood.

At a different meeting, Nordström et al. (67.155.303) discussed a study of the kinematics and chemical evolution of the Galaxy using a sample of about 5700 F, G, and K dwarfs for which Coravel velocities, Hipparcos data, and ground-based Strömgren photometry had been obtained. Levato et al. (66.111.001) determined radial velocities for 186 chemically peculiar early-type stars to determine their space velocities. De Medeiros & Mayor (68.002.017) reported Coravel radial velocities of nearly 2000 evolved stars, while Fekel & Watson (1998, AJ 116, 2466) determined radial velocities of a sample of 40 infrared excess giants.

Yoss & Griffin (69.155.232) measured radial velocities of about 900 late-type stars within 15° of the north galactic pole. They found trends of chemical abundance with velocity dispersion in the W and V space velocity components and to a lesser extent in U. In a direction toward the Galactic centre, Tiede & Tendrup (67.155.023) surveyed the kinematics of 189 stars. They found a rotational velocity for the bulge of 97 ± 9 km s^{-1}.

2.3. Star clusters (N. Morrell)

Open clusters Many radial-velocity determinations for stars in open clusters were published during this triennium, most of them dealing with red giant stars measured through different cross-correlation techniques.

Several works showed evidence of mass segregation of binaries in open clusters. For example, this effect was found by Gim et al. (1998, PASP110, 1172) in NGC 7789 and by Raboud & Mermilliod (69.153.001; 69.153.042) in the Pleiades, NGC 6231 and Praesepe clusters.

Radial velocities for dwarfs in 9 open clusters in the solar neighbourhood were discussed by Mermilliod (69.153.063). More than 1000 stars were observed in a long-term survey to study membership and discover spectroscopic binaries.

Nordström and collaborators, obtained radial velocities for stars in the field of NGC 3680 (66.153.004, 67.153.038). The authors identify members, non-members and spectroscopic binaries to study the cluster's dynamical evolution. Torres et al. (1997, ApJ 474, 256; 67.153.044; 68.153.040) presented new radial velocities for binaries in the Hyades cluster. Combined with astrometric information, those data allowed the derivation of astrometric-spectroscopic orbits leading to new determinations of the distance to the cluster (47.6 ± 1.8 pc) and discussion of the mass-luminosity relation.

Another investigation of the Hyades cluster (distance, structure and dynamics) was conducted by Brown et al. (69.153.050) based on trigonometric parallaxes and proper motions from Hipparcos and ground-based radial velocities.

Several studies reported radial velocities for OB stars in open clusters. Raboud (66.153.027) studied a sample of B stars in NGC 6231, while radial velocities of O-type stars were presented by García et al. (69.153.003) for Tr 14 and Bosch et al. (1999, RevMexAA 35, 85) for NGC 6611.

High precision ($\pm 0.3 - 0.4 \,\mathrm{km\,s^{-1}}$) astrometric radial velocities were obtained through Hipparcos observations for stars in the Hyades, Ursa Major and Coma Berenices open clusters by Dravins et al. (69.153.053).

References on individual open clusters are provided by the bibliographic service of the database for stars in open clusters (http://obswww.unige.ch/webda/) maintained by J.-C. Mermilliod. Most published data can be obtained from the database.

Globular clusters Côté and collaborators reported results of searches for binaries in M4 (66.154.021) and M22 (66.154.022) finding fractions of binaries (x_b) of 0.2 for M4 and 0.02–0.05 for M22. Similar searches were conducted by Yan & Cohen (66.154.032) for NGC 5053 (who obtained 236 radial velocities for 77 giant and subgiant cluster members) and Barden et al. for M 71 (66.154.119) who investigated the frequency of binaries near the cluster turn-off.

The stellar dynamics of ω Cen was investigated by Merritt et al. (68.154.013) based on Coravel data by Mayor et al. (68.154.014) who found a peak rotational velocity of 7.9 $\mathrm{km\,s^{-1}}$ at $\sim$11 pc from the cluster centre and a mass distribution, as inferred from the kinematics, slightly more extended than that derived from the luminosity function.

A large number of interesting radial-velocity studies concerning both open and globular clusters, are summarized in the proceedings of the symposium on "The origins, evolution and destinies of binary stars in clusters", ed. E.F. Milone & J.-C. Mermilliod (66.012.065), and IAU Symposium 174: "Dynamical evolution of star clusters: confrontation of theory and observations", ed. P. Hut & J. Makino (66.012.093).

2.4. Spectroscopic binaries (T. Mazeh)

A few large radial-velocity surveys are being carried out for detecting spectroscopic binaries in the period covered by this report. Delfosse et al. (1998, A&A 331, 581; 1999, A&A 341, 63; 1999, A&A 344, 897) are studying nearby M stars. The Geneva and the CfA teams (together with Tel Aviv research group) are monitoring a large sample of > 3000 nearby G stars (Udry et al. 1998, ASP Conf. Ser. 154, 2148). The Geneva group has completed the study of the nearby K stars (e.g., Mayor et al., 1997, IAU Coll. 161, 313). The CfA group has completed the survey of high-proper-motion stars (Latham et al. 1998, ASP Conf. Ser. 134, 178). The Geneva group is monitoring a sample of cool Am and Ap stars (North et al. 1998, A&AS 130, 223). Corporon and Lagrange (1999, A&AS 136, 429) have monitored a sample of 42 Herbig Ae/Be stars. All these surveys will increase dramatically our knowledge of the characteristics of the binary population (see Heacox 1998, AJ 115, 325 for a statistical discussion), and the secondary mass distribution in particular (Halbwachs et al. 1998, ASP Conf. Ser. 134, 308; Mazeh et al. 1998, ASP Conf. Ser. 134, 188). The study of the characteristics of multiple systems as a population has benefited substantially from the catalogue of multiple systems (Tokovinin et al. 1997, A&AS 124, 75; see also Fekel et al. 1997, AJ 113, 1095; Liu et al. 1997, ApJ 485, 350).

Finally, radial-velocity work together with accurate astrometry or interferometry is a promising field (Torres, 1999, PASP 111, 169) for accurate mass determination, which can be used to test stellar structure and evolution. Recent works include those of Mason et al. (1997, AJ 114, 1607), Gies et al. (1997, ApJ 475, L49), Koresko (1998, ApJ 509, L45), Hummel (1998, AJ 116, 253), Boden (1999, ApJ 515, 356) and Pourbaix (1999, A&A 348, 127). This area of research is becoming more important as the era of the next generation astrometric satellites is approaching.

2.5. Pulsating stars (A. A. Tokovinin)

Many works on the radial velocities (RV) of pulsating stars were devoted to Cepheids. Gorynya et al. (70.122.178) published 2444 observations of 108 northern Cepheids and first RV curves for 12 of them. A continuing effort at the Mt. John Observatory is being made for southern objects (Petterson et al., 70.122.178). These and other data were used for the classical Baade-Wesselink analysis of light and RV curves. Sachkov et al. (70.122.106) studied 62 Cepheids and stated that the current uncertainties do not permit to use the distances derived from RV curves for cosmic distance scale calibration. On the other hand, Taylor et al. (68.122.042, 70.122.045) who studied in detail the RV curves of l Car and β Dor claimed that the current level of the systematic distance errors is within 3%. Gorynya (1998, IBVS 4636) studied the progression of Cepheid RV-curve shapes with period, similar to Hertzsprung sequence well known for light curves. From the RV curves of 117 classical Cepheids, Moskalik & Krzyt (70.122.074) checked the theoretical mass-luminosity relation. RV curves of the Cepheids pulsating in the second overtone were obtained and analysed by Kienzle et al. (1999, A&A341, 818). Antipin et al. (1999, IBVS 4718) used RVs to separate modes of the double-mode Cepheid BD$-10°$ 4669.

Complex atmospheric motions in Cepheids mean that their RVs depend on the excitation and ionization state of the lines being measured (Kiss, 70.122.096; Vinkó et al., 69.122.104, 70.122.099). Models of these effects seem to be essential for correct interpretation of precise Doppler measurements (e.g. Butler et al., 1996, ApJ 461, 362).

Several Cepheids in new spectroscopic binaries were discovered. A review by Szabados (66.120.001) counted 22 SBs among 250 Cepheids. Sugars & Evans (66.122.045) studied Z Lac, a binary Cepheid with the shortest known period of 1 yr and a circularized orbit, as well as V350 Sgr (67.122.023). Orbits of 8 classical Cepheids were published by Szabados & Pont (70.122.053), and another 4 orbits by Petterson et al. (70.122.178).

The GHRS spectrograph on the HST has been used to measure the velocities of hot secondary components of binary Cepheids to determine for the first time the mass ratios. Evans et al. reviewed their results on 5 objects (S Mus, V350 Cyg, Y Cas, U Aql, SU Cyg) in (69.122.018), adding later V636 Sco (70.122.065). Cepheid masses are found to be in agreement with the recent evolutionary tracks with modern overshooting theory.

Among the other types of pulsating stars most attention was paid to δ Sct and related variables. It was definitely established that a large number (hundreds) of non-radial modes are excited in these objects. The starspot hypothesis was found to be invalid in the case of γ Dor by Balona et al. (66.122.027) and Hatzes (70.122.057). Precise radial velocities provide an important complement to the multi-colour photometry for mode identification (e.g. Mathias & Aerts, 66.122.021; Viksum et al., 70.122.015). Multi-site spectroscopic campaigns were organized to obtain better time coverage (Mathias et al., 68.122.077; Huilai et al., 70.122.124). Often the pulsation signal was disentangled from the orbital motions in binary systems (Paunzen et al., 69.120.001; Preston & Landolt, 69.120.026; DeMey et al., 70.120.002). It must be noted that RVs and photometry of rapid pulsators give information on the lowest-degree modes ($l = 0..3$), while higher-order modes ($l > 3$) are better manifested by variable line shapes. So, in studies of nonradial oscillations, RVs were often supplemented by line-shape analysis (Montegazza, 68.122.017; Huilai et al., 70.122.124). A technique of line-profile analysis called Fourier-Doppler imaging provides pulsation amplitude maps in the azimuth-frequency plane which are well suited for mode identification (Kennelly et al., 66.122.034; 69.122.088).

Hot pulsating variables of β Cep type were studied by Telling et al. (67.122.047, 70.122.043, 70.122.092, 70.122.093) who identified several non-radial modes from line profile variations. Aerts et al. (69.122.001) reported 13 yr of RV data on β Cru, showing it to be a β Cep pulsator as well as a 5-yr spectroscopic binary. Non-radial oscillations in 2 O-type stars were detected by de Jong et al. (1999, A&A 342, 172).

Modern studies of stellar pulsations gave rise to a new research field, asteroseismology. From the frequency of the fundamental radial mode one can derive stellar mass and radius (Bossi et al., 70.122.018). Fundamental parameters of V2109 Cyg (an RR Lyr type star) were given by Kiss et al. (1999, A&A 345, 149). Pulsational modes with frequency spacing of 1.2 μHz were identified in Arcturus by Merline (70.122.127). Various groups using precise RV techniques try to detect the non-radial pulsations in solar-type stars. Current sensitivity approaches the required levels, and a characteristic 53 μHz periodic structure seems to emerge in the pulsational spectrum of Procyon derived from the FTS velocities by Mosser et al. (70.122.063). The confident detection of the acoustic modes in solar-type stars is to be expected very soon.

RVs of pulsating stars of other types were also studied. Lawson & Cottrell (67.122.069) investigated the relation between RV and light variations in a number of R CrB-type and hydrogen-deficient carbon stars. RV curves of 4 Mira variables, 9 long-period variables and 5 semi-regular variables in the infrared were obtained by Hinkle et al. (68.122.051).

2.6. Extrasolar planets (W. D. Cochran)

The most successful method for detection of planetary-mass companions to stars has been the precise measurement of stellar radial-velocity variations resulting from the stellar reflex orbit around the system barycentre. The most common technique for achieving high RV precision is the use of an I_2 gas absorption cell (Butler et al. 1996, PASP108, 500), but numerical cross-correlation techniques using Th-Ar reference spectra (Baranne et al. 1996, A&AS 119, 373) are also used. With a "state of the art" RV precision around $3\,\mathrm{m\,s^{-1}}$, objects well below the mass of Jupiter in orbits with semimajor axes of several AU can be detected. Several groups are using this method to pursue major new surveys (Marcy et al. 1999, ASP Conf. Ser. 185, 121; Nisenson et al. 1999, ASP Conf. Ser. 185, 143; Kürster et al. 1999, ASP Conf. Ser. 185, 154; Cochran & Hatzes 1999, ASP Conf. Ser. 185, 113).

Since the last report, planetary mass companions have been reported around 16 Cygni B (Cochran et al. 1997, ApJ 483, 457), 55 Cnc, τ Boo, υ And (Butler et al 1997, ApJ 474, L115), ρ CrB (Noyes et al. 1997, ApJ 483, L111), HD 195019, HD 217107 (Fischer et al. 1998, PASP 111, 50), HD 210277, HD 168443 (Marcy et al. 1998, ApJ 520, 239), Gl 876 (Marcy et al. 1998, ApJ 505, L147; Delfosse et al. 1998, A&A 338, L67), 14 Her (Mayor et al. 1998, Geneva Observ. press release), Gl 86 (Queloz et al., 1998, ESO Press Release 18/98) HD 187123 (Butler et al. 1998, PASP110, 1389), HD 75289 (Mayor et al. 1999, Geneva Observatory press release), ι Hor (Kürster et al. 1999, ESO Press Release 12/99), and HD 130322 (Udry et al. 1999, Geneva Observatory press release). Follow-up observations of the υ And system by the AFOE and SFSU groups have led to the discovery of two additional planets in eccentric orbits (Korzennik et al. 1999, BAAS 31, 847; Marcy et al. BAAS 31, 847). This represents the first system of multiple planets found by high precision RV observations. Preliminary dynamical studies indicate that this triple planet system is on the edge of long-term dynamical stability.

There are now a sufficient number of extrasolar planet candidates to examine the properties of their masses and orbital elements. The most striking aspect is the mass distribution, which peaks near $1M_{\rm Jup}$. When this is corrected for the mass sensitivity of radial-velocity techniques, this implies a mass function that is rising sharply at masses below $1M_{\rm Jup}$. High precision RV surveys have found no companions above $10M_{\rm Jup}$. When combined with results from lower precision RV data, these results clearly show a bimodal mass function. The common interpretation is that these Jupiter-mass companions are formed by a different physical process than that for stellar and brown-dwarf companions.

The distribution of orbital elements of these objects may also provide important clues to their origin and dynamical evolution. Objects are found at a large range of semimajor axes, distributed from 2.4 AU to 0.04 AU. Objects in long period orbits show a very wide range of eccentricities, with values ranging up to 0.68 for 16 Cygni B. The period-eccentricity distribution found for these Jupiter-mass objects is quite similar to that for brown-dwarf and stellar companions. There are several objects with very small semimajor axes of 0.04 to 0.15 AU. This would be expected from theories of tidal migration, in which the object is formed at several AU from the star, and then is moved to a very small semimajor axis through tidal interaction with the circumstellar disk. The objects found in very short period orbits (3–4 days) all show very low eccentricities as would be expected to result from subsequent tidal circularization of the orbit by the primary star. However, there are a large number of objects at semimajor axes between 0.15 and 2.5 AU. The origin of these objects is difficult to understand from standard tidal migration theories, perhaps implying the importance of early dynamical evolution of extrasolar planetary systems.

3. WORKING GROUPS

3.1. Standard radial-velocity stars (R. P. Stefanik & S. Udry)

Late-type standards The "official" list of IAU Radial Velocity Standard Stars consist of 81 stars of various spectral types and luminosity classes, with velocities drawn from several observatories, using different techniques and dispersions, and covering various time spans and numbers of observations (Pearce 1957, Trans. IAU 9, 441; Evans 1968, Trans. IAU, 13B 170; Bouigue, 1973, Trans. IAU 15A, 407) Almost immediately after these stars were proposed as standards many were found to be variable. Commission 30 set as an objective the establishment of a new set of late-type standard stars with individual mean velocities and an absolute zero point of the entire system good to 100 m/s. To achieve this goal an observational campaign has been under way for more than 20 years to monitor the IAU standard stars as well as additional candidates, principally with the Dominion Astrophysical Observatory (Victoria) spectrometer, the Coravels and the CfA Digital Speedometers. For a review of these efforts see Stefanik et al. (1999, ASP Conf. Ser. 185, 354) and references therein. The Working Group on velocity standards is close to achieving this goal and it is anticipated that a new standard list will be presented for adoption at the next IAU General Assembly. This progress follows from recent efforts at CfA and Geneva and reported at IAU Colloquium 170, Precise Stellar Radial Velocities, by Stefanik et al. (1999, *op. cit.*) and Udry et al. (1999, ASP Conf. Ser. 185, 367). Key features reported are: 1. Among the IAU standard stars and candidates, practically all velocity variables above the 100 m/s level have been identified from observations covering a time span of about 20 years. Among the remaining "constant" velocity stars very low amplitude velocity variation almost certainly will be discovered due to unseen low mass companions, very long period low amplitude binaries, very eccentric binaries or intrinsic processes in stellar atmospheres. In particular, probably all the giant standards will be found to vary at some level. 2. For a long time it has been recognized that there is a colour dependence in the comparison of velocities from several observatories. A major step towards understanding this problem has been addressed by the Geneva team who have re-observed the standard stars with Elodie for comparison with the Coravel results (Udry et al. 1999, *op. cit.*). They also proposed a new set of very low variation standard stars based on high-precision Elodie measurements. 3. To establish an absolute velocity zero point the CfA has been monitoring minor planets for more than 13 years and have accumulated 1245 exposures of 35 different minor planets. The observed velocities are compared to velocities predicted by the IAU Minor Planet Center and the JPL Horizons On-Line Ephemeris System. No drift in the CfA velocity zero point has been found and the native CfA zero point is too positive by about 100 m/s. (Stefanik et al. 1999, *op. cit.*).

Until a new IAU standard list is adopted, the reports by Stefanik et al. and Udry et al. are the current best source of standard star velocities for medium precision work and for documentation on the variables among the IAU standard stars.

Early-type standards Because of the low density of spectral lines, high rotational velocity and line blending it has been difficult to establish velocity standards for early spectral type stars. In the report of Commission 30 to the 1990 General Assembly a list of 39 early spectral type stars, drawn from several sources, were proposed for consideration as standards (Latham & Stefanik 1991, Trans. IAU, 21B, 269). Fekel has been monitoring 27 of these standard candidates for some time and recently summarized this effort (Fekel 1999, ASP Conf. Ser. 185, 378). A number of the stars have been found to be variable and should no longer be considered as standard candidates.

3.2. Bibliography of stellar radial velocities (H. Levato)

Levato reports that a group for compiling the bibliography of stellar radial velocities has been organized and is currently working systematically at the Complejo Astronómico El Leoncito in San Juan, Argentina. The catalogue, which covers the period 1991–94 has been completed and the data for the period 1995–98 is well underway. The publication through the Web will permit a continuous update. The title with each update will reflect the new period involved and new data will be merged with the previous ones, so that users always find in the Web the complete compilation since 1991. The plan is to update the bibliography every 6 months. At present the catalogue may be downloaded from the Web page at www.casleo.secyt.gov.ar. It will soon also be possible to download it from the CDS database. The compilation for 1991–94 includes almost 14 000 entries selected from the twenty most important journals. In addition to the bibliographic reference the catalogue provides J2000.0 coordinates, visual magnitudes and spectral types. These data and the identification of the objects were retrieved from SIMBAD. The primary identifications of SIMBAD were used when no BD, CD, CPD or HD numbers were available. Also included is information about the number of radial-velocity measurements in each reference, the average radial velocity given by the authors and the barycentric velocity in the case of a spectroscopic binary, the spectral resolution, resolving power or dispersion, comments about the type of object and the kind of method used for the RV measurement (Coravel, relative velocity, objective prism, etc).

4. MAJOR CONFERENCE

Because of the wide-ranging nature of the commission members' interests, many conferences have been held which are relevant to these interests, and a number of these are referenced in section 2 on scientific highlights.

During the triennium Commission 30 organized one major conference devoted solely to stellar radial velocities. This was IAU Coll. 170 *Precise stellar radial velocities* (Hearnshaw & Scarfe, (eds.) 1999, ASP Conf. Ser. 185), which was held in Victoria, B.C., Canada in June 1998. It was the first conference dedicated to stellar radial velocities since 1984.

5. SOURCES OF FURTHER INFORMATION

Further information on radial velocities can be obtained from the commission's Web page at:
http://www.phys.canterbury.ac.nz/ phys012/iau30/iau30.html.
In addition, the commission's working group on RV bibliography maintains a Web page at:
http://www.casleo.secyt.gov.ar (see section 3.2).
In 1999 the latest data on RV standard stars is in IAU Coll. 170 (ASP Conf. Ser. 185 (*op. cit.*). Useful Web pages on extrasolar planets are:
http://www.obspm.fr/planets and
http://cannon.sfsu.edu/ gmarcy/planetsearch/planetsearch.html.

J. B. Hearnshaw
President of the Commission