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MEMBRES: MM. F. S. Hogg†, McLaughlin, J. A. Pearce, G. A. Shajn, Struve, R. E. Wilson.

Since the last General Assembly the extensive radial velocity programmes of the Lick and Mount Wilson Observatories have been completed, and a *New General Catalogue* of 15,115 stars, representing the line-of-sight observations of twenty observatories through the past sixty years, has been compiled by Dr R. E. Wilson. This constitutes the greatest contribution to the work of this Commission within the past two decades.

A second notable event has been the long-awaited inauguration of radial velocity work at Pretoria. It is also encouraging to report that work has been resumed at the European Observatories of Simeis and Heidelberg.

The Commission has lost three valued members: Joseph H. Moore, Director Emeritus of the Lick Observatory, who died 15 March 1949, Frank S. Hogg, Director of the David Dunlap Observatory, suddenly stricken on 1 January 1951, and V. A. Albitzky of the Simeis Observatory who died on 15 June 1952.

Observations have been energetically carried out at all observatories, and gratifying reports of progress have been received.

'NEW GENERAL CATALOGUE OF RADIAL VELOCITIES'

The *New General Catalogue of Radial Velocities*, completed by Dr R. E. Wilson (in the Press) will be welcomed by all students of stellar motions. The members of the Union are deeply indebted to Dr Wilson for the meticulous attention he devoted to the edition of this great catalogue. The volume will constitute a memorial commemorating the industry of those astronomers, especially at Mount Hamilton and Mount Wilson, who devoted their lives to the determination of accurate radial velocities and the problems of stellar motions.

The rapid accumulation of data during the past two decades is evident from the fact that whereas the 1932 catalogue contained the velocities of 6739 stars, the 1951 catalogue lists 15,115 velocities; 99% of them come from ten observatories, and 75% from the three Pacific Coast observatories. The sources of the velocities and the spectral distributions of the stars are given in the following tables.

TABLE I
Sources of Radial Velocities

Observatory	Stars	Observatory	Stars
Mount Wilson	7434	Simeis	841
Lick	4797	Cape	519
Victoria	3272	Bonn	253
Dunlap	1791	Ottawa	174
Yerkes-McDonald	1448	Michigan	108

(In the years 1900–20, the following observatories produced approximately 200 velocities of the bright stars, observed in common with one or more of the active observatories: Allegheny, Cambridge, Columbus, Heidelberg, Lowell, Meudon, Poulkovo, Potsdam, Vienna.)

TABLE II
Spectral Distribution

Spectral type	1932 Catalogue	1951 Catalogue
O–B	1142	2052
A	1376	2811
F	548	1772
G	870	2193
K	1997	3644
M	727	2099
NRS	62	306
Peculiar	17	238
	<hr/> 6739	<hr/> 15115

The catalogue gives for each star a single velocity, representing the weighted mean of all observations reduced to the Lick system. For stars observed at more than one observatory, the published velocities are given in the notes following the catalogue. The *New General Catalogue* lists the velocities of the gaseous nebulae and globular clusters with the stars in their order of right ascension and thus contains the line-of-sight velocities of all objects within our own galaxy. It is understood that Dr Milton Humason will shortly publish a catalogue of the radial velocities of the extragalactic objects.

On the occasion of Dr R. E. Wilson's retirement from the Mount Wilson Observatory a symposium⁽¹⁾ on stellar radial-velocity programmes of the Pacific Coast observatories was held in Pasadena in his honour. The radial velocity achievements of Mount Wilson, Lick and Victoria were discussed by W. S. Adams, G. H. Herbig, and R. M. Petrie, respectively, while R. E. Wilson described his catalogue which summarizes the accomplishments of twenty observatories, in the field of radial velocities, during the past sixty years.

BRIEF SURVEY OF RADIAL VELOCITY WORK

Mount Wilson

At the symposium⁽¹⁾ held in honour of R. E. Wilson, Dr W. S. Adams described the various stellar radial velocity programmes undertaken during the past forty years. References to the extensive lists of velocities resulting from these programmes are given by Wilson⁽²⁾. The last great programme of nearly 2500 faint solar-type stars under observation by Wilson and Joy since 1942 has been completed and the velocities, proper motions and spectral types published in two lists (a) 2111 stars⁽³⁾, and (b) 360 stars⁽⁴⁾. For the present no new programmes of faint stars will be initiated.

Spectral types and radial velocities of ninety stars, for most of which parallaxes and proper motions had been obtained at the Leander McCormick Observatory, have been determined by Joy and Mitchell⁽⁵⁾. A dispersion of 120 A./mm. at H γ was employed, as the majority of these dwarf M-type stars have apparent magnitudes between 10 and 12.

A comprehensive list of 445 stars, of which the spectra have bright H and K lines of calcium, is given by Joy and Wilson⁽⁶⁾, together with the first published references to their discovery. The majority are faint dG–dM stars, and nearly one-quarter of them are situated in the Taurus region⁽⁷⁾.

Coudé radial velocities of the four cepheids TU Cas, PT Cyg, U Vul and FF Aql are given by Sanford⁽⁸⁾. He has also observed the eight N-type long-period variables R Lep, UV Aur, T. Cam, V Hyd, V CrB, RR Her, V Oph, and U Cyg with the Coudé spectrograph in the region $\lambda\lambda 6100\text{--}6700$. His radial velocities of 283 R- and N-type stars were published in 1944⁽⁹⁾.

A detailed study of the recurrent nova T CrB was made by Sanford⁽¹⁰⁾ from Coudé plates taken from March 1946 to May 1948, when the star was in general fainter than the ninth magnitude. The radial velocities from the gM₃ absorption lines are represented by a sine curve of 21 km./sec. amplitude in a period of 230.5 days.

An extensive survey of the internal motions in twenty-six bright planetary nebulae has been made by O. C. Wilson⁽¹¹⁾ with the Coudé spectrograph of the 100-inch reflector. O. C. Wilson is continuing his studies of WR binary systems and has derived orbits for H.D. 190918⁽¹²⁾ and for the Of-type star BD +40° 4220⁽¹³⁾.

The determination of the radial velocities of thirty-five variables of high luminosity in fourteen globular clusters by Joy⁽³³⁾ is a remarkable achievement, as these 12–15 magnitude cluster stars are probably the faintest stars whose radial velocities have been accurately determined. For some of the fainter stars in the more remote clusters, a dispersion of 220 A./mm. was necessary (51 plates), but the majority of the observations (120 plates) were secured with a dispersion of 110 A./mm. The velocities of the clusters obtained by Mayall at the Lick Observatory, from the integrated light observed with a spectrograph of 420 A./mm. dispersion, are in excellent agreement with those of Joy. The magnitudes of the stars and the great majority of the periods of the variables were determined by Mrs Helen Sawyer Hogg. The programme comprises nearly all the variables in globular clusters observable at Mount Wilson.

Mount Hamilton

An excellent survey of the Lick Observatory radial velocity programmes from the pioneer work of Keeler in 1890–1950 is given by G. H. Herbig⁽¹⁴⁾. The last great programme of 820 stars, F- to M-type, of photographic magnitude 8.5, and distributed fairly uniformly over the sky north of declination -30° , has been completed. The publication of the results was delayed by the lamented death of Moore in 1949, but they have now been published with a brief discussion by Mayall⁽¹⁵⁾. Luminosity classes on the Yerkes system were assigned and solutions for solar motion and galactic rotation carried out, with results in harmony with the results of Nordstrom's researches.

Herbig has taken over the late Dr Moore's programme of thirty binaries with the Mills three-prism spectrograph, most of these stars have long periods (up to 40 years). He is also currently observing the faint variables RW And, T Ori, BF Ori, SU Tau, UV Boo, R CrB, WW Vul, and RY Sgr with the two-prism, 75 A./mm. dispersion spectrograph.

Neubauer completed his programme of 127 B-type stars of magnitude 7.5–9.0 in the Zone 0° to $+20^\circ$ and the results await publication.

Weaver has completed about one-third of the observations on his important galactic pole programme, mentioned in the last report. It is hoped that he will resume his observations in the near future.

McDonald

Popper⁽¹⁶⁾ has made a valuable contribution to our knowledge of the faint O-B6 stars. The photographic magnitudes, spectral types, colours, and colour excesses of 253 stars of magnitudes between 8 and 12 were obtained, together with 151 stellar and 135 interstellar radial velocities. It is very desirable that such radial velocity surveys of the fainter stars be continued to supplement the data on the brighter O and B stars under observation at Victoria, Mount Hamilton, and Pretoria.

David Dunlap

Dr Heard reports that over 3800 plates have been obtained on the programme of 1042 G-M stars, brighter than the ninth magnitude, selected from the Yale zone catalogue, $\delta + 25^\circ$ to $+30^\circ$. The velocities of 233 of these stars have been completed and incorporated in Wilson's *New General Catalogue*. Some 800 plates remain to be taken on this programme, which is expected to be completed in 1953.

About 200 plates have been secured on a new programme of 369 stars, of photographic magnitude 7.5-8.0, spectral types A-M, in the Kapteyn areas, $\delta + 15^\circ$. Progress is reported on the programmes of 105 stars brighter than magnitude 7.6 in northern Kapteyn areas between R.A. 9^h and 18^h .

Dr Heard has also published velocity measures of eight stars formerly classified as β Cephei variables⁽¹⁷⁾ and the radial velocities of twenty-one Be stars⁽¹⁸⁾.

Simeis

Dr G. A. Shajn reports that astrophysical investigations interrupted in 1941 when the observatory was evacuated and destroyed were resumed late in 1950. The 40-inch reflector, when returned from Potsdam, was found to be damaged beyond repair, and 70% of the spectrograms were lost. A new 50-inch reflector has been installed on the new site of the Crimean Astrophysical Observatory, some 35 km. north of Simeis. The new spectrograph is equipped with a prism of glass 0-118, giving good definition over the range $\lambda\lambda$ 3900-6500 Å., with cameras having dispersions of 23, 34, and 70 Å./mm. The present programme consists mainly in observing spectrographic binaries discovered at Simeis.

Dr V. A. Albitzky has communicated the following summary of the spectrographic results accomplished with the 40-inch reflector, the observations being secured during the years 1938-41.

Radial Velocities Determined at the Simeis Observatory

No. stars	Type	Magnitude	Average no. plates	P.E. (km./sec.)	L.O.-S.O. (km./sec.)	No. stars	Disp. (Å./mm.)	Ref.
107	B8-A0	6.8-7.3	5.3	± 3.6	$+0.13 \pm 0.71$	23	75	(19)
131	B8-A0	6.8-7.3	6.4	± 2.5	$+0.6$	10	75	(20)
114	F5-G0	6.6-7.2	3.0	± 2.4	$+0.64 \pm 0.60$	17	75	(21)
53	G0-K5	6.6-7.2	3.0	± 1.7	$+1.33 \pm 0.67$	18	75	(22)
73	A0-F2	6.5	36	(23)

Haute Provence

The determination of radial velocities by means of objective-prism observations have been continued at the Observatoire de Haute Provence. Dr C. Fehrenbach reports as follows:

L'appareil original a été transformé par l'adjonction d'une lentille de Smyth pour étendre son champ de netteté, mais cette solution n'est pas très satisfaisante et nous nous proposons de remplacer la lentille à deux verres par une lentille à trois verres. Nous avons pris plus de quatre cents clichés mais le programme de mesure est en retard. Une extension du programme de dépouillement est envisagée avec la collaboration de l'observatoire de Paris (Service de la Carte du Ciel) et de l'Observatoire de Marseille. Nous espérons publier une liste de vitesses radiales d'un champ situé dans la constellation d'Orion en 1951, mais un matériel important ne sera publié que d'ici quelques années.

Radcliffe

When the Lick Observatory sold its station and equipment on Cerro San Cristobal, Santiago, to the University of Chile in 1929, spectrographic investigations of stars in the southern hemisphere ceased. After a lapse of twenty-one years, observations were resumed at the Radcliffe Observatory, Pretoria. Pending the receipt of the Cassegrainian spectrograph, Dr A. D. Thackeray constructed a low-dispersion instrument, 240 A./mm. at $H\gamma$, for the Newtonian focus, and investigated a number of emission-line objects including Proxima Centauri and long-period variables in the globular cluster 47 Tucanae⁽²⁴⁾.

The two-prism Cassegrainian-focus spectrograph constructed by C. F. Casella and Co., with optical parts by Adam Hilger Ltd., was received in January 1951. Dr J. Jackson published a description of it in *Nature*⁽²⁵⁾, 3 February 1951. It is equipped with four cameras whose focal lengths vary from 4"8 ($f/2$) to 24"0 ($f/8$), having dispersions corresponding very closely to those obtained with the four cameras employed with the single-prism spectrograph at Victoria.

Observations have commenced on the programme of first priority, namely, 150 O- and B-type stars, brighter than 7.5 magnitude, south of $\delta - 35^\circ$, with unknown radial velocities. This programme will be complementary to the work of the Lick and Dominion Astrophysical Observatories. At the completion of this programme, the observations will be continued on the O-B stars of magnitude 7.5 to 9.0, south of the equator (possibly in collaboration with Canberra).

Dr Thackeray reports that the programmes contemplated include:

- (a) Southern cepheids—continuation of Joy's work.
- (b) RR Lyrae variables accessible with their equipment.
- (c) Nearby stars with well-determined parallaxes and proper motions.
- (d) Long-period variables.
- (e) Brighter stars in selected areas. If this programme is tackled, it will be done with the co-operation of the Cape Observatory.

Dr Thackeray states: 'Apart from stellar radial velocities, I am expecting that a few of the brighter globular clusters will be accessible with the Cassegrainian equipment for checking radial velocities obtained with the small Newtonian spectrograph.'

Dominion Astrophysical

Observations in the extensive programme of O and B stars are nearing completion, except for the winter stars in the 2^h–7^h region. In recent years a considerable amount of observation has been devoted to the necessary and important auxiliary programmes of parallax stars for the determination of absolute magnitude, and to the observation of moving-cluster and Aitken double stars for the determination of wave-lengths. These projects have been completed. The absorption of $H\gamma$ has been measured in the spectra of 110 standard stars from which the calibration of the absolute magnitudes is obtained⁽²⁶⁾. The revision of radial velocity standards for the B–K stars is summarized in the accompanying report of the Sub-commission. For the B-type stars, it is shown that laboratory wave-lengths may be safely used with the exception of the helium lines $\lambda 4471$ and $\lambda 4026$. Revised radial velocities of 79 B-type stars have been published by Pearce and Petrie⁽²⁷⁾. Wright⁽²⁸⁾ completed the radial velocity measures of 137 plates of 101 bright F–M stars, which had originally been obtained on the parallax programme of Young and Harper.

A detailed investigation of the Ursa Major cluster has been made by Petrie⁽²⁹⁾. One hundred and forty-four high-dispersion, 11 A./mm. at $H\gamma$, spectra of the thirteen nucleus stars have been measured. The space motion of the nucleus stars was determined solely from their proper motion and the parallax data. It was found that the usual methods of Charlier and Bohlin led to indeterminate results, and a new method of finding the convergent of a moving cluster was derived⁽³⁰⁾. The space motion of 15.8 km./sec. in the

direction of $\alpha 300^\circ$ and $\delta - 32\frac{1}{2}^\circ$ predicts exactly the observed radial velocities of the nucleus stars, proving that they alone constitute the moving cluster.

Spectroscopic studies of the two cepheid variables δ Cephei⁽³¹⁾ and η Aquilae⁽³²⁾ have been completed by T. S. Jacobsen.

A considerable number of spectroscopic binaries are being investigated.

INTERSTELLAR CALCIUM VELOCITIES

Dr W. S. Adams has published his remarkable investigation of multiple interstellar lines in the spectra of 300 O- and B-type stars, confirming and amplifying his earlier observations of the multiple structure in fifty stars⁽³⁴⁾. Four-fifths of the spectra were photographed with a dispersion of 2.9 A./mm. and the remainder with a dispersion of 10 A./mm. While the stars are bright and relatively near, about one star in two shows multiple H and K lines, over 100 double lines, seventeen stars triple lines, quadruple and even five components for P Cygni and HD 199478. The most complex lines appear in stars of very low galactic latitude. The considerable spread in the observed radial velocities indicates the presence of small thin interstellar clouds moving rapidly in the line of sight with respect to the general interstellar cloud whose peculiar velocity is low.

A valuable contribution was made by R. F. Sanford⁽³⁵⁾ who determined the velocities of interstellar calcium lines in 128 stars in thirty-one galactic clusters (stars of spectral types O5-B5). Dispersions of 10 A./mm. and 25 A./mm. were employed for approximately one-half of the stars brighter than magnitude 8.5, and a dispersion of 50 A./mm. for the remainder to magnitude 10.5. The distances of the clusters were derived from the equivalent widths of the interstellar lines, and also by means of the stellar and interstellar velocities, in accordance with differential galactic rotation. While the correlation of these two methods is not especially good, either method provides a useful means of obtaining the distances of galactic clusters.

GALACTIC STAR CLUSTERS

The extensive programme of radial-velocity measures in galactic star clusters undertaken by Dr R. J. Trumpler in 1924 is now practically completed. The programme consists of 820 stars to the limiting photographic magnitude of 12.5 in seventy-four clusters distributed in galactic longitude $311-214^\circ$. The three nearest clusters have been thoroughly investigated. Pleiades 80 stars, Praesepe 54 stars, and Coma Berenices 53 stars; for the remaining 71 clusters an average of 9 stars was observed.

Approximately 3300 spectra of the cluster stars were secured with two spectrographs attached to the 36-inch refractor of the Lick Observatory: (a) a one-prism instrument with a 12-inch camera, and (b) a two-prism spectrograph with a 6-inch camera, both giving dispersions of 70 A./mm. at $H\gamma$. Throughout the whole observing period, approximately 300 observations of bright stars with known radial velocities were obtained for standardizing the system. The observations have been completed and the velocities are being reduced to a homogeneous system.

A number of spectrographic binaries among the cluster stars was discovered, and sufficient observations were secured to derive preliminary orbits for eight double-line and fifteen single-line binaries.

This carefully executed survey will unquestionably make important contributions to our knowledge of the system of galactic star clusters, the gravitational shift of spectral lines in the atmospheres of massive stars, and the problem of galactic rotation. Obviously a similar survey of the radial velocities of the southern hemisphere, in longitudes $215-315^\circ$, is urgently needed to supplement Trumpler's survey.

RR LYRAE VARIABLES

A series of forty-two high-dispersion coude spectrograms of RR Lyrae is discussed by R. F. Sanford⁽³⁶⁾, who observed the lines H and K and H γ to be doubled for 1.4 hours of each period, following median increasing magnitude. The radial velocities of fifteen RR Lyrae variables observed by Struve and Miss Iwanowska at the McDonald Observatory are given by Colacevich⁽³⁷⁾. In most of the plates only the K line and the hydrogen lines were measured, as a dispersion of 170 A./mm. at H γ was employed.

Completing his programme of the RR Lyrae stars, Joy has⁽³⁸⁾ published the velocities of sixty-two variables. For most of the stars of medium photographic magnitude 11.4, only one spectrogram of 110 A./mm. dispersion was obtained, and the measured velocity was reduced to the normal velocity of the star by means of a standard curve of 68 km./sec. range. There is now a total of 131 radial velocities of these short-period variables, due principally to Joy. Forty of the stars have velocities exceeding 100 km./sec., and the mean peculiar velocity of the group is approximately 85 km./sec.

The observation of RR Lyrae variables in southern galactic latitudes near the longitude of the galactic centre, though a difficult observational problem, is highly desirable. The results would make possible a reliable determination of the distance of the galactic centre and the distribution of mass in the galactic system (Oort).

KAPTEYN SELECTED AREAS

In 1934 the Mount Wilson Observatory undertook the determination of the radial velocities of some 450 stars in Kapteyn's selected areas. This work has been completed by Dr R. E. Wilson, the results being published in the 1952 Report of Commission 32, Selected Areas. The table contains the 1950 positions, magnitudes, spectral types, and velocities for 464 stars. In general, four plates per star were obtained, and with twelve exceptions the probable errors are less than ± 2.5 km./sec.

As noted under the heading of 'Current Investigations', stars in the Kapteyn selected areas are being observed at the David Dunlap Observatory.

WORK OF SUB-COMMISSION ON SPECTROSCOPIC BINARY SYSTEMS

The perfections of the photo-electric photometer, and its application to the study of eclipsing variables, have greatly increased our knowledge of these fascinating systems. A great number of new photo-electric light curves of stars brighter than the tenth magnitude have been published during the past four years, as recorded in the report of Commission 42. Many systems, well observed photometrically, are in urgent need of spectroscopic observation for, as in the past, the spectroscopic work lags behind.

Endeavouring to supply this information, and greatly stimulated by Struve's admirable monograph on Stellar Evolution, spectroscopists at all observatories have devoted an ever-increasing amount of observing to these systems, with profitable results. The following table lists more than ninety new spectroscopic orbits published since the last General Assembly. The list is doubtless incomplete, as a hurried survey of the literature was made. The very numerous investigations of Struve and his associates at the Yerkes-McDonald Observatories is an obvious testimony to the great contribution he has made to this subject. The virgin field of the southern skies is being energetically exploited by Sahade and his assistants at Cordoba, and it is gratifying to record the resumption of spectroscopic work at the Simeis and Heidelberg Observatories.

RECENT SPECTROSCOPIC ORBITS

HD 85217	Shajn and Popper	<i>P.C.A.O.</i> 2 , 44, 1948
102713	Shajn	<i>Ibid.</i> 4 , 148, 1949
121648	Shajn	<i>Ibid.</i> 5 , 105, 1950
211433	Albitzky	<i>Ibid.</i> 4 , 144, 1949
218154	Albitzky	<i>Ibid.</i> 4 , 78, 1949
HD 2019	Heard and Miss Northcott	<i>D.D.O.</i> 1 , no. 22, 1949
10588	Heard and Miss Northcott	<i>Ibid.</i> 1 , no. 22, 1949
14688	Heard and Miss Northcott	<i>Ibid.</i> 1 , no. 22, 1949
3264	Norris, Sharp and Tanner	<i>Ibid.</i> 1 , no. 23, 1949
158013	Norris, Sharp and Tanner	<i>Ibid.</i> 1 , no. 23, 1949
170829	Norris, Sharp and Tanner	<i>Ibid.</i> 1 , no. 23, 1949
201032	Norris, Sharp and Tanner	<i>Ibid.</i> 1 , no. 23, 1949
π^5 Ori	Miczaika	<i>Z. Ap.</i> 27 , 247, 1950
ϕ Per	Miczaika	<i>Ibid.</i> 28 , 43, 1950
κ Dra	Miczaika	<i>Ibid.</i> 28 , 203, 1951
η Ori	Miczaika	<i>Ibid.</i> 29 , 105, 1951
ι Peg	Miczaika	<i>Ibid.</i> 29 , 108, 1951
ι Ori	Miczaika	<i>Ibid.</i> 29 , 305, 1951
δ Ori	Miczaika	<i>Ibid.</i> 30 , 299, 1952
AH Vir	Chang	<i>Ap. J.</i> 107 , 96, 1948
HD 47129	Struve	<i>Ibid.</i> 107 , 327, 1948
Anon.	Hiltner	<i>P.A.S.P.</i> 58 , 215, 1946; <i>Ap. J.</i> 108 ,
UX UMa	Struve	<i>Ibid.</i> 108 , 153, 1948 [56, 1948]
VW Cep	Popper	<i>Ibid.</i> 108 , 490, 1948
TX Cnc	Popper	<i>Ibid.</i> 108 , 490, 1948
RZ Com	Struve and Gratton	<i>Ibid.</i> 108 , 497, 1948
V 502 Oph	Struve and Gratton	<i>Ibid.</i> 108 , 497, 1948
RV Crv	Struve and Gratton	<i>Ibid.</i> 108 , 497, 1948
BF Vir	Struve and Gratton	<i>Ibid.</i> 108 , 497, 1948
β Aur	Smith	<i>Ap. J.</i> 108 , 504, 1948
HD 190918	Wilson	<i>Ibid.</i> 109 , 76, 1949
TW And	Hiltner, Smith and Struve	<i>Ibid.</i> 109 , 94, 1949
μ Ori	Popper	<i>Ibid.</i> 109 , 101, 1949
ζ Sex	Popper	<i>Ibid.</i> 109 , 103, 1949
V 380 Cyg	Popper	<i>Ibid.</i> 109 , 104, 1949
V 505 Sgr	Popper	<i>Ibid.</i> 109 , 106, 1949
RS Sgr	Sahade	<i>Ibid.</i> 109 , 116, 1949
β Cep	Rudkjøbing	<i>Ibid.</i> 109 , 331, 1949
SW Lac	Struve	<i>Ibid.</i> 109 , 436, 1949
XZ Sgr	Sahade	<i>Ibid.</i> 109 , 439, 1949
TW Dra	Smith	<i>Ibid.</i> 110 , 63, 1950
V \dot{V} Ori	Struve and Luyten	<i>Ibid.</i> 110 , 160, 1950
RW Tau	Hiltner and Hardie	<i>Ibid.</i> 110 , 438, 1950
AO Cas	Struve and Horak	<i>Ibid.</i> 110 , 447, 1950
V 377 Cen	Sahade	<i>Ibid.</i> 110 , 463, 1950
R CMa	Struve and Smith	<i>Ibid.</i> 111 , 27, 1950
CPD - 61° 669	Sahade and Dessy	<i>Ibid.</i> 111 , 191, 1950
UX Mon	Sahade	<i>Ibid.</i> 111 , 194, 1950
HD 25267	Sahade	<i>Ibid.</i> 111 , 438, 1950
δ Ori	Pismis, Haro and Struve	<i>Ibid.</i> 111 , 509, 1950
FO Ori	Struve, Horak, Cavanaggia, Kourganoff and Colacevich	<i>Ibid.</i> 111 , 658, 1950
DI Her		
Y Cam		
FL Lyr		
RZ Tau		
U Peg		
AB And		
TW Cet		

W UMa	Struve and Horak	<i>Ap. J.</i> 112 , 178, 1950
TW Cas	Struve	<i>Ibid.</i> 112 , 184, 1950
TY Pup	Struve	<i>Ibid.</i> 112 , 184, 1950
VV UMa	Struve	<i>Ibid.</i> 112 , 184, 1950
YY Gem	Struve, Herbig and Horak	<i>Ibid.</i> 112 , 216, 1950
HD 193576	Münch	<i>Ibid.</i> 112 , 266, 1950
U Cep	Hardie	<i>Ibid.</i> 112 , 542, 1950
AR Lac	Sanford	<i>Ibid.</i> 113 , 299, 1951
HD 228766	Hiltner	<i>Ibid.</i> 113 , 317, 1951
12 Lac	Struve	<i>Ibid.</i> 113 , 589, 1951
HD 374	Jose	<i>Ibid.</i> 114 , 370, 1951
BD + 40° 4220	Wilson and Abt	<i>Ibid.</i> 114 , 477, 1951
U Sag	McNamara	<i>Ibid.</i> 114 , 513, 1951
Boss 4496	Sahade and Dessy	<i>Ibid.</i> 115 , 53, 1952
RZ Cas	Horak	<i>Ibid.</i> 115 , 61, 1952
X Car	Sahade	<i>Ibid.</i> 115 , 134, 1952
κ Dra	Struve	<i>Ibid.</i> 115 , 138, 1952
HD 193611	Miss McDonald	<i>P. Dom. Ap. O.</i> 8 , 135, 1949
ι Peg	Petrie and Phibbs	<i>Ibid.</i> 8 , 225, 1950
25 Ser	Petrie and Phibbs	<i>Ibid.</i> 8 , 228, 1950
DI Her	McKellar	<i>Ibid.</i> 8 , 235, 1950
RY Gem	McKellar	<i>Ibid.</i> 8 , 244, 1950
ϵ UMi	Climenaga, McKellar and Petrie	<i>Ibid.</i> 8 , 401, 1950
ϵ Aur	Wright and Miss van Dien	<i>J.R.A.S.C.</i> 43 , 15, 1949
HD 27483	Miss Northcott and Wright	<i>Ibid.</i> 46 , 11, 1952
γ Per	McLaughlin	<i>A.J.</i> 53 , 200, 1947
HD 215835	Pearce	<i>Ibid.</i> 54 , 135, 1948
HD 44701	Pearce	<i>Ibid.</i> 56 , 137, 1951
32 Cyg	Wright	<i>Ibid.</i> 56 , 146, 1951
HD 190786	Pearce	<i>Ibid.</i> 57 , 22, 1952
HD 100018	Petrie and Miss Laidler	<i>Ibid.</i> 57 (in the Press)
HD 228854	Pearce	<i>P.A.S.P.</i> 64 (in the Press)
HD 23642	Pearce	Unpublished
HD 37756	Pearce	Unpublished
μ Sgr	Miss L. Lowen	<i>P.A.S.P.</i> 62 , 61, 1950
HD 187399	Merrill	<i>Ap. J.</i> 110 , 59, 1949
HD 198784	Jacobsen and Kraft	<i>P. Dom. Ap. O.</i> 8 , 129, 1949
32 Cyg	Wright, K. O.	<i>Ibid.</i> 9 (in the Press)

SUB-COMMISSION ON THE OBSERVATION OF SPECTROSCOPIC BINARIES

This Sub-commission was not reorganized following the death of its chairman, the late Dr J. H. Moore. It is considered unnecessary to publish again in this report the extensive table of stars under observation at the various observatories (see *Trans. I.A.U.* **7**, 313, 1950). Of this list of 252 stars, only seven were being observed at more than one observatory, and in these cases the investigations were different in character.

NEED FOR A NEW CATALOGUE OF SPECTROSCOPIC BINARIES

With the completion of the long-term observing programmes at the Lick and Mount Wilson Observatories, the resumption of spectroscopic work at European observatories, and especially the investigations of the southern stars by the observers at the Cordoba and Pretoria Observatories, there is every reason to expect that binary star investigations will increase during the next decade. The rapid accumulation of information since 1 January 1947, the epoch of Moore and Neubauer's *Fifth Catalogue*, fully justifies the

issuing of a *Sixth Catalogue* of the orbital elements of eclipsing variables and spectroscopic binaries to include all results published prior to 1 January 1954. Subsequently, the annual distribution of addenda to this *Catalogue* would be of value to workers in this field.

JOSEPH A. PEARCE

Dominion Astrophysical Observatory, Victoria, B.C.
August 1952.

REPORT OF SUB-COMMISSION ON STANDARD VELOCITY STARS

There are no revisions of the bright standard velocity stars, Table I, recommended in these *Transactions*, 7, 311, 1950. The stars designated are well distributed over the entire sky and are suitable standards for observers in both hemispheres.

The fainter standard stars, Table II, are not uniformly distributed, as only four are south of the equator. Conforming to a request of Dr A. D. Thackeray, this table is revised by the addition of ten equatorial and southern stars. It is suggested that additional observations of these stars be secured and this table subsequently revised to include suitable standards of fainter magnitude.

TABLE II
Standard Velocity Stars Fainter than Magnitude 5.0
(1950)

HD	Mag.	Type	(1950)				V (km./sec.)	No. obs
			hr.	min.	°			
693	5.0	F4	0	08.7	-15	45	+ 14.7 ± 0.4	13
3765	7.5	K5	0	38.1	+39	55	- 62.7 ± 0.4	7
8779	6.5	K0	1	23.9	- 0	39	- 5.9 ± 0.7	6
9138	5.1	K4	1	27.6	+ 5	53	+ 35.1 ± 0.5	16
22484	4.4	F9	3	34.3	+ 0	15	+ 27.7 ± 0.2	15
26162	5.7	K1	4	06.2	+19	29	+ 23.8 ± 0.6	18
29587	7.3	G2	4	38.1	+42	02	+112.1 ± 0.3	7
35410	5.2	K0	5	21.9	- 0	56	+ 20.6 ± 0.4	12
44131	5.2	M1	6	17.5	- 2	55	+ 46.7 ± 0.2	16
51250	5.2	M0	6	53.8	-13	59	+ 20.0 ± 0.3	12
65583	6.9	G7	7	57.4	+29	22	+ 13.0 ± 0.4	7
66141	4.5	K3	7	59.7	+ 2	28	+ 70.7 ± 0.3	14
80170	5.4	K5	9	15.0	-39	11	0.0 ± 0.2	6
89449	5.0	F5	10	17.0	+19	44	+ 5.9 ± 0.4	10
92588	6.4	K1	10	38.9	- 1	29	+ 43.5 ± 0.4	10
103095	6.5	G5	11	50.1	+38	05	- 98.8 ± 0.4	15
107328	5.1	K1	12	17.8	+ 3	35	+ 35.5 ± 0.1	11
114762	7.7	F7	13	09.9	+17	47	+ 50.2 ± 0.5	6
119971	5.5	K5	13	44.5	-50	04	+ 30.4 ± 0.5	5
123782	5.4	M2	14	06.4	+49	42	- 13.0 ± 0.4	16
136202	5.2	G0	15	16.8	+ 1	57	+ 53.5 ± 0.2	14
144579	6.8	G8	16	03.2	+39	17	- 52.9 ± 0.4	9
145001	5.3	G4	16	05.8	+17	11	- 9.5 ± 0.3	6
157457	5.2	K1	17	22.1	-50	35	+ 17.6 ± 0.3	6
171391	5.2	G6	18	32.3	-11	01	+ 6.6 ± 0.2	8
184467	6.7	K5	19	30.3	+58	29	+ 12.8 ± 0.5	7
187691	5.2	F8	19	48.6	+10	17	- 0.4 ± 0.5	13
203638	5.5	K3	21	21.3	-21	04	+ 22.0 ± 0.1	7
212943	4.9	K0	22	25.3	+ 4	27	+ 53.9 ± 0.3	13
213014	7.5	G8	22	25.8	+17	00	- 39.7 ± 0.6	8
223647	5.1	G7	23	49.2	-82	18	+ 14.5 ± 0.6	3

R. F. SANFORD, J. A. PEARCE

DRAFT REPORT OF THE SUB-COMMISSION ON WAVE-LENGTHS

Since the last report was submitted, work has continued at Victoria on the determination of effective wave-lengths. The spectral range A 0 to F 2 has been studied with single-prism dispersions, at H γ , of 30 A./mm. and 51 A./mm.* Spectral types F 4 to K 8 have been investigated with single-prism dispersion of 51 A./mm.† There remain the tasks of extending the system to spectral classes O, B, and M. The B stars are now under study at Victoria and it is possible to report substantial progress in measuring spectrograms of suitable control objects. Considerable practical difficulties attend this work in the selection of appropriate stars but a number of visual binaries and some galactic clusters have been found to satisfy the requirements. It is hoped to complete this programme in 1952.

The revised wave-lengths for high-dispersion spectra of A stars, previously reported, have been applied in a study of the bright stars of the Ursa Major stream.‡ A comparison based upon eleven stars observed in common confirmed the absence of any systematic difference between the new radial velocities and those determined earlier with high dispersion at the Lick Observatory. The convergent and space motion of the Ursa Major cluster, calculated from proper motions and trigonometric parallaxes, predict radial velocities in good agreement with the observed values. This independent check is a very satisfactory verification of the procedures for determining wave-length standards recommended in the last report.

The Sub-commission has discussed the feasibility of recommending values of the space motions of the Taurus and Ursa Major clusters in order to supply fundamental controls for spectral types A 0 to F 2. Pertinent developments since the last report include:

(a) An extensive study of the Taurus cluster has been completed by R. E. Wilson§ in which 141 cluster members have been recognized. Wilson has derived the vertex (1950 co-ordinates), $\alpha = 94^{\circ}.0 \pm 0.5$, $\delta = +7^{\circ}.6 \pm 0.3$, from the proper motions and a stream motion, relative to the Sun, of 44.3 ± 0.2 km./sec.

(b) Recent studies of the Ursa Major stream have demonstrated that the 'nucleus' stars form a moving cluster. The proper motions and parallaxes are relatively large. There is, however, some difficulty in ascertaining the convergent point because of the distribution of the proper motions. Three recent determinations are (1900 co-ordinates):

	α	δ	Space motion
Roman	306°	−37°	...
Petrie ‡	298°	−32°	15.8 km./sec.
Brown ¶	303°	−32°	...

It may be noted that an uncertainty of 5° in the position of the convergent point produces an uncertainty of about 1 km./sec. in the predicted radial velocities.

Opinion was divided among the members and it seemed advisable, therefore, not to recommend definitive values at present for the space motions of these clusters. At the same time it is urged that radial-velocity workers verify their wave-length systems, for spectral types other than F 5 to K 8, by reference to moving clusters and visual binaries as outlined in the previous report.

W S. Adams points out the advantages of using solar wave-lengths for stellar velocity measurements in that (a) wave-lengths are determined with the same scale of accuracy for all elements, and (b) the degree of precision is a few thousandths of an angstrom. Studies at Victoria with moderate dispersion confirm Adams's belief that enough unblended solar features may be found, in spectral types A 0 to M 0, to serve as a basis for the stellar wave-length system. For the B-type stars, however, it is necessary to use other sources of wave-lengths, because the lines of high excitation are absent from the solar spectrum.

* *J. Roy. A.S. Can.* **42**, 213, 1948; *Contr. Dom. Ap. O.* no. 11, 1948.

† *J. Roy. A.S. Can.* **42**, 220, 1948; *Contr. Dom. Ap. O.* no. 12, 1948.

‡ *P. Dom. Ap. O.* **8**, 117, 1949.

§ *Ap. J.* **107**, 119, 1948.

|| *Ap. J.* **110**, 205, 1949.

¶ *Ap. J.* **112**, 225, 1950.

Addendum to Draft Report

The determination of wave-length standards for radial-velocity measurements of B-type stars, with single-prism dispersion, is now completed. The work has been done with linear dispersion, at $H\gamma$, of 30 A./mm. and 51 A./mm., employing slit widths of 0.05 mm. and 0.075 mm., respectively. The spectral-type range is from B0 to B9.

A total of seventeen primary standards has been observed and measured; seven stars are members of star clusters and ten are components of visual binaries. The control velocities for the clusters and binary systems are adopted from radial-velocity measures of stars of spectral types later than B8, employing the wave-length standards found previously for the ranges A0 to F2 and F4 to K8. The procedure, as before, is to study the behaviour of each B-type line with respect to the adopted control velocity. An additional eighteen stars were employed as secondary standards in order to strengthen the results for certain wave-lengths.

The final list contains nineteen spectral lines in the region between K and $H\beta$ but some of the wave-lengths are available only over part of the spectral range. The principal features of the tabulation are.

(i) A large part of the original list of B-type wave-lengths has been eliminated as being of inferior accuracy and reliability.

(ii) It has been demonstrated that, generally speaking, the laboratory wave-lengths may be used.

(iii) Important exceptions to the use of laboratory wave-lengths are 4026.143 He I for main-sequence stars, and 4471.352 He I, with the lower dispersion and purity.

Radial velocity comparisons with the new wave-length system are satisfactory. The velocity residuals in the sense B star *minus* control velocity are:

Cluster members	+0.8 km./sec.	± 0.5 (p.e.)
Visual binaries	-0.1	± 0.3
All stars	+0.2	± 0.5

The detailed discussion of this work will be published in the near future.

R. M. PETRIE

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Report of meeting. 8 September 1952

ACTING PRESIDENT: Dr R. M. PETRIE.

SECRETARY: Dr A. D. THACKERAY.

1. Dr Petrie expressed Dr Pearce's regrets at being unable to be present in person.

2. A portion of Dr R. E. Wilson's *New General Catalogue of Radial Velocities* was circulated for inspection by members of the Commission. The Chairman expressed profound appreciation of Dr Wilson's labours in completing this *Catalogue* and the Secretary was instructed to write to Dr Wilson to express the gratitude of the Commission.

3. The President announced with sorrow that in addition to Drs J. H. Moore and F. S. Hogg the Commission had lost another member in M. V. A. Albitzky who died in 1952.

4. Reports by the following observatories on work achieved or planned since the Draft Report was prepared, were presented:

Royal Observatory, Cape. The list of stars being observed by the Cape with the 74-inch Radcliffe reflector contains all stars south of -26° and brighter than 9.0 for which either:

- (1) the parallax has been determined at the Cape and found to exceed $0''.060$;
- or (2) the annual proper motion is known to exceed $1''.0$;
- or (3) the G.C. annual proper motion exceeds $0''.1$ and the star lies within an area of $6 \times 6^{\circ}$ surrounding each of the Kapteyn Selected Areas 140-206.

In addition a few double stars suggested by Dr van den Bos are included.

The list contains 400 stars south of -26° , and 12 north of this limit which are to be regarded as 'standard stars'. About 50 of the stars in the list are brighter than 5.5 and have previously determined radial velocities either by Lick, Mount Wilson or the Cape. These should provide a sufficient tie with the generally accepted system of radial velocities. The greater number of stars in the list are of spectral type F, G or K and have visual magnitudes between 6.5 and 8.5.

Observatoire de Haute Provence. The report presented by M. Ch. Fehrenbach was also read in the combined meeting of Commissions 32 and 33. M. Fehrenbach's statement is given in the report of this combined meeting on p. 497 of these *Transactions*.

In discussion of this report, Dr Fehrenbach stated that it was essential to have at least one standard star with known velocity per field. The Commission noted the importance of developing this type of observation and was encouraged to provide Dr Fehrenbach with velocities from slit spectrograms to tie in with the slitless velocities. Dr Fehrenbach was asked to circulate immediately lists of his fields to observatories interested in radial velocity work. In reply to a question about overlapping of the spectra of adjacent stars, Dr Fehrenbach stated that with 4 m. focal length and 2 hr. exposure, the loss in measurable velocities amounted to about 15-25% according to the richness of the field.

Cordoba Observatory. Dr L. Gratton reported that radial velocity work was being begun with the 60-inch reflector. Following on preliminary tests on stars with known velocities, velocities of cepheids and some long-period variables were being measured. It was also planned to observe the velocities of all stars in the preliminary *General Catalogue* with unknown velocities, and to include a number of cepheids and B stars.

Goethe Link Observatory. Dr F. K. Edmondson reported that velocities of 681 K stars between 11th and 12th magnitude (photographic) had been obtained mostly from single observations with a probable error of ± 5 km./sec. Unmeasured spectra of about 500 A stars (two plates per star) ($m = 10-11.5$) had been obtained. Most of the material was obtained at the McDonald Observatory. Systematic errors were checked by taking at least two standard velocity stars per night.

Observatoire de Toulouse. Dr Bouigue reported that one-prism spectra of 8th magnitude A stars were being obtained with the 80 cm. reflector for measures of velocity with an accuracy of ± 5 km./sec. The technique of photo-electric measurement of the centres of the wide hydrogen lines in these stars was being developed. In reply to a question, Dr Bouigue stated that 30-40 minutes sufficed for the measurement of one plate by the method.

David Dunlap Observatory. Prof. J. F. Heard reported that a somewhat similar technique to that of the Toulouse Observatory was being used at Toronto on the measurement of spectrograms.

Simeis Observatory. A report on fifty new spectroscopic binaries and seventeen probable binaries discovered at the Simeis Observatory was presented. A paper on radial velocities of seventy-three stars was presented. It was understood that apart from spectroscopic binaries no definite plan had been made for continuing radial velocity work.

Lick Observatory. It was reported (by Dr Struve) that radial velocity work at Mount Hamilton was now being mainly carried out by Dr Herbig, who was working on stars of individual interest, e.g. spectroscopic binaries.

Radcliffe Observatory. Dr Thackeray reported that since submitting a report early in 1951 the two-prism Cassegrain spectrograph attached to the 74-inch reflector had been in regular operation for the observation of radial velocities. Good progress had been made with the measurements of 150 O-B5 southern stars with unknown velocities. Fifty-two cepheids had been observed with good coverage of all phases of the light-curves. It was also planned to observe Me-, R- and N-type stars for velocity.

It was probable that the Cape Observatory would at some stage begin an extension of Trumpler's work on galactic clusters to the southern hemisphere.

The Draft Report was adopted with minor corrections and emendations.

5. *Sub-commission on spectroscopic binaries.* After discussion of the question of publishing a *Sixth Catalogue* of spectroscopic binaries, it was agreed that such a *Catalogue* should be published by the Observatory at Victoria. The desire to see estimates of difference of magnitude in double-line binaries was expressed. It was also desirable that a list of stars known to be spectroscopic binaries but with unknown orbits should be included.

It was agreed that it was no longer necessary to publish lists of spectroscopic binaries being observed, as duplication was rare, and in some cases desirable.

6. *Sub-commission on standard velocity stars.* The new recommendations for faint standard stars suitable for observation in the southern hemisphere were noted. It was pointed out that it was desirable to secure ten plates with the highest possible dispersion to test the quality of the new standard stars.

Copies of the new list would be sent to the Eva Peron and Cordoba Observatories.

Dr Struve proposed a re-examination of the velocities of the bright standard stars in view of some unexplained discrepancies between the adopted velocities and those from coudé spectra of high internal accuracy (e.g. α Bootis). It was desirable to tie-in these velocities from high-dispersion spectra with the general system which must be considered as generally correct.

7. The Report of the Sub-commission on wave-lengths was adopted.
 8. Dr Struve drew attention to the possibility of detecting planet-like objects by means of radial velocities of moderately wide visual binaries with sharp lines. Such bodies might reveal themselves through radial velocity variations in periods of the order of a day and amplitudes of about ± 1 km./sec.
 9. Dr Gratton described briefly a new optical device by Dr Platzeck (Cordoba Observatory) by which the speed of the Cordoba Cassegrain Spectrograph had been increased by a factor about 3.
 10. Dr Thackeray presented preliminary results of galactic rotation in the southern hemisphere as determined from seventy-eight stars of type O-B5 at the Radcliffe Observatory. These stars formed a sufficiently homogeneous group to show the normal curve in the longitudes 220° – 320° , and it was clear that they lay beyond the disturbing influence of the Scorpio-Centaurus group, which had been rejected in earlier solutions.
- Another problem of interest which had been tackled (by Dr Wesselink) was the determination of the parallax of α Centauri from radial velocity observations combined with the elements of the visual orbit. The result was in good agreement with the trigonometrical parallax.