30. COMMISSION DES VITESSES RADIALES STELLAIRES

Président: M. W. S. Adams, *Director of the Mount Wilson Observatory, Pasadena, California, U.S.A.*

Membres: MM. Bok, Guthnick, Harper, Joy, Knox-Shaw, McLaughlin, Merrill, J. M. Mohr, J. H. Moore, Neubauer, Pearce, J. S. Plaskett, Sanford, G. Shajn, Shapley, Struve, R. K. Young.

During the past three years the measurement of stellar radial velocities has formed an important part of the spectroscopic programme of most observatories possessing large telescopes. As observations are carried to fainter and fainter stars and the number of observable objects increases rapidly, a natural development has been the selection of special groups and types of stars, the radial velocities of which will aid in the solution of certain specific problems. Illustrations are the studies of the O, B and A type stars made at the Dominion Astrophysical, the Lick, and the Simeis Observatories, of the members of the galactic clusters at the Lick Observatory, and of the fainter Cepheid variables and early-type stars with strong interstellar lines at the Mount Wilson Observatory. All of these investigations have an important bearing on problems of galactic rotation. Observations of stars of spectral types F to M have been continued at nearly all observatories, in the case of stars of especial interest the measures having been carried to objects as faint as the 12th photographic magnitude. The radial velocities of about 2500 stars have been determined during the past 3-year period and the results have either been published or are ready for publication.

In the appended report of the Sub-Committee on Co-operation in Radial Velocity Work is given a detailed list of spectroscopic binaries and other stars of variable radial velocity under observation at numerous observatories. Studies of different types of variable stars and the redetermination of the orbits of spectroscopic binaries with a view to possible changes of period or other elements are important features of this field of investigation. The Dominion Astrophysical and the Yerkes Observatories have been devoting much of their observing programme to work of this character.

Some very important instrumental advances have been made during the past few years which have added greatly to the possibilities both of radial velocity observations and of stellar spectroscopy in general. Among these may be mentioned the development of more transparent types of optical glass for prisms and lenses, the application of the evaporation process for depositing aluminium surfaces upon telescope mirrors, thus bringing the far ultra-violet region of the spectrum within the range of observation, the remarkable success attained by R. W. Wood and others in ruling diffraction gratings with great concentration of light in the first or second order, and the adaptation of the Schmidt design of a correcting plate with concave mirror to the construction of spectrographic cameras. Schmidt cameras with aperture ratios ranging from f/1 to f/16 are in regular use at the Mount Wilson Observatory, and several cameras of this type planned for the McDonald Observatory have been built and tested with excellent results. A series of similar instruments is being designed for the Radcliffe Observatory at Pretoria and all three institutions will soon have available high-dispersion spectrographs for the investigation of the spectra of bright stars on a linear scale approximating 3 A./mm. At the Berlin-Babelsberg Observatory new Zeiss camera objectives with aperture ratios of f/1 and f/0·56 have been used successfully on the three-prism spectrograph. The combination of all these advances in instruments with improvements in the sensitiveness of photographic emulsions has resulted in a great increase in the range of spectrum available for radial velocity measurements and physical investigations of spectral lines.

A large part of the radial velocity programme at the Berlin-Babelsberg Observatory has consisted in observations of a number of selected stars, many of which show variations of velocity. Among these are α and ζ Aurigae, α Andromedae, α Lyrae, π^2 Cygni, α Draconis, β Aurigae, η Ursae Majoris, γ Cassiopeiae and Boss 5442. New orbital elements have been derived for α Aurigae and α Andromedae, and α Aurigae and α Lyrae are under systematic investigation both for small rapid variations in radial velocity and for simultaneous changes in brightness which are being measured with a photoelectric photometer.

An extensive study has been made at Berlin-Babelsberg of the wave-lengths, intensities, and identifications of a large number of lines in the spectra of early B-type stars, the results now being ready for publication.

At the Dominion Astrophysical Observatory the list of stars under observation includes 100 spectroscopic binaries, a large number of A-type stars, and about 800 stars of types O to B5 north of the equator and fainter than visual magnitude 7·5. The spectroscopic binaries include 33 stars for which the orbital elements are being redetermined with a view to possible changes, 30 newly discovered binaries, and 37 stars of somewhat doubtful variability of velocity which are being investigated further. Of the 100 binaries 26 are eclipsing variables.

Measurements of the radial velocities of 917 stars, mainly of type A, have been completed in the course of the 15-year investigation at the Dominion Astrophysical Observatory and the results are now in press. Some of these stars have been observed elsewhere, but 415 have no published velocities. A statistical study of the motions of A stars emphasizes the need in certain cases of additional observations to bring the probable error of the mean result for these diffuse-line stars to reasonable proportions, such as ± 5 km./sec., for example. There may be as many as 80 or 90 such stars in a total of 1600 under observation. Several hundred spectrograms of stars on the O- and B-type programme are now available and this investigation will be carried on more actively as soon as the study of the eclipsing variables has been completed.

A form of spectrograph recently used with success at Victoria utilizes a plane diffraction grating with a prism for relatively high-dispersion observations in the yellow and red regions of the spectrum. A new type of projection measuring machine designed by Petrie has been found to give results comparable in accuracy with those obtained from micrometric measures and obviates much eye-strain and fatigue. A simple comparator is adapted optically to project the negative and scale upon a screen on which the readings are made directly.

At the David Dunlap Observatory a programme of observations on a list of about 500 stars brighter than photographic magnitude 7·59 in and near the Kapteyn Selected Areas has been under way during the past three years. The spectra have been photographed with dispersions of 30 A. and 60 A. per mm. at $H\gamma$, and the plan of taking four plates on each star has been followed regularly. The observations are practically complete and it is expected that the results will be published in 1938. With the completion of this programme more time will be devoted to observations of spectroscopic binaries.

A development of interest to the progress of radial velocity observations is the successful application by Bok and his collaborators at the Harvard College Observatory of the method of using neodymium absorption screens for producing reference lines in the spectra of stars photographed with an objective prism. Using a dispersion of about 100 A./mm. at Hγ and the narrow absorption band-head at λ 4272·8, the observers derived radial velocities of B- and A-type stars with probable errors of about ± 20 km./sec. from measurements of a single plate. The average of results from five or six spectrograms gives values sufficiently accurate for statistical investigations. Numerous difficulties have been overcome in the course of this work, among them the very serious one of the corrections to be applied in different portions of the field.

At present the method is limited to spectral types earlier than Go because of difficulties with blended lines in more advanced spectra. The spectrograms are reduced with the aid of multiple-image plates of standard stars of known radial velocity which are obtained each night, numerous images of the standard spectra being impressed upon the plates in a geometrical pattern. Corrections derived from the standard stars are then applied to the field stars. The suggestion is offered that observations with slit-spectrographs of the radial velocities of a few stars of intermediate magnitude in each field would be of great value in guarding against possible systematic error.

The method has been tested successfully in the case of stars of the Taurus group and results have also been published for a field of stars in Cygnus. The observational programme under way includes 12 low-latitude fields distributed roughly 30° apart along the Milky Way, together with several fields in the Southern Hemisphere where the 13-inch Boyden telescope at Bloemfontein with a 6° prism is providing spectra comparable with those obtained at Cambridge. The limit with the present equipment is about photographic magnitude 10, and the probable error of the final velocities is between about ± 6 km./sec. and ± 10 km./sec.

Stellar radial velocity observations at the Lick Observatory during the past three years have been devoted largely to the continuation of the three programmes noted in the last report. The first of these, relating to the determination of the radial velocities of members of the galactic clusters, is now nearing completion, and it is hoped that the necessary observations may be obtained within the next few years. The second programme of 413 stars of classes Oe5 to B5, between declinations 0° and $-23°$, and of visual magnitudes 7·0 to 10·5, is about three-fourths completed, the remaining stars being situated for the most part in the 18-hour region. The observations and reductions on the third programme consisting of about 800 stars of spectral classes F to M are practically finished, with the exception of a few stars which have been found to have variable velocities. In addition to the above a programme of brighter stars is under observation with the 3-prism Mills spectrograph. These stars are principally long-period spectroscopic binaries, components of visual binaries, and certain stars which appear to have small variations in velocity of very short period. As the observations of the fainter stars are completed, more time will be devoted to the 3-prism programme. A selected list of about 25 eclipsing variables is also being observed, special attention being given to those in which both spectra are visible.

Observations of the spectra of stars with peculiar, variable, and other interesting characteristics with a view to the study of their physical conditions have formed the major part of the programme of the Observatory of the University of Michigan. Many of these stars have variable radial velocities. Practically all Be stars brighter than magnitude 5·5 and north of $-20°$ are now under observation, and the observing list also contains a few semi-regular variables, some stars with composite spectra and a few bright c-stars of early type. The variables R Scuti and W Cygni and the interesting binaries Zeta Aurigae and VV Cephei have been studied extensively.

The observing programme at the Mount Wilson Observatory during the past three years has been based mainly upon four lists of stars: (1) a selected list of about 1800 stars, mainly of types F to M and visual magnitudes 6 to 9, which includes stars of Boss's *Preliminary General Catalogue* not previously observed, stars in the Selected Areas, many of the fainter stars thought to belong to the Taurus group, numerous visual binaries, and faint stars of large proper motion; (2) faint Cepheid variables; (3) stars of types O, B and cA with interstellar calcium and sodium lines; (4) relatively bright stars observed with high dispersion or photographed in the infra-red or far ultra-violet regions of the spectrum. Observations upon the stars of list (1), made chiefly with the 60-inch telescope, are well advanced, and the radial velocities of 600 stars are ready for publication.

The investigation by Joy of the fainter Cepheid variables (to visual magnitude about 12) has been practically completed. Velocities have been measured for 190 stars and velocity curves derived for 106 stars. Observations of the early-type stars in list (3) have been made primarily for a study of the intensities and contours of the interstellar lines and of their displacements as bearing on problems of galactic rotation, but the radial velocities of numerous stars with known velocities have been redetermined in the course of the investigation, and about 70 additional stars have been measured. Many of the brighter stars of list (4) have been observed with the large spectrograph at the coudé focus of the 100-inch telescope, and the spectrograms, with a linear scale of about 3 A./mm., yield highly accurate radial velocities as well as differential displacements for certain lines. A 32-inch Schmidt camera used in the second order of a plane grating has been found most useful for observations in the far ultra-violet. Numerous O- and B-type stars which show but few lines in the usual photographic region have spectra comparatively rich in lines in the ultra-violet.

At the Central Astronomical Observatory at Simeis a programme of 237 B8 to A0 stars with magnitudes 6·8 to 7·4 has been essentially completed and the results are being prepared for publication. Several stars of constant velocity have been observed regularly to provide a check upon the measured velocities and especial attention has been given to the determination of the wave-lengths of the lines used in the reduction of the spectrograms. Several spectroscopic binaries have been under investigation and the study of stars in the Coma Berenices cluster has been completed. The linear dispersions of the spectrographs used in these investigations have been 36 A./mm. and 74 A./mm.

The plan for future observations at Simeis will include measurements of radial velocities of stars of types A to G, and magnitude 6·5 or fainter, an investigation of differential displacements of lines in the spectra of some supergiant stars, tests of the method of deriving radial velocities from objective prism spectra, and spectrophotometric observations of spectroscopic binaries in which the spectra of the two components are not fully resolved.

At the Yerkes Observatory most of the recent radial velocity work has consisted in the determination of the orbits of spectroscopic binaries. Among the stars investigated are several with orbits determined many years ago for which new orbits have been derived for the purpose of studying possible changes in the longitude of periastron. This work has been carried on in collaboration with Luyten of the University of Minnesota.

A programme for observations of the radial velocities of faint stars has been prepared at the Yerkes Observatory in co-operation with Vyssotsky of the McCormick Observatory in anticipation of the completion of the McDonald telescope. It will include the stars of types A and K between photovisual magnitudes 10·3 and 11·0 contained in the McCormick Observatory catalogue of proper motions. These stars are distributed fairly uniformly over the sky as far as declination $-20°$ and $-30°$. The total number of A stars will be 275 and of K stars 450. The radial velocities of these stars combined with the proper motions will provide the solution of several problems of stellar motions.

The following recommendations and suggestions are offered by the commission:

1. That observers engaged in radial velocity determinations use consistent values of wave-lengths over as long intervals as possible, defining these wave-lengths for the benefit of those interested in analysing the material.

2. That the brighter stars of uncertain velocity be reobserved to such an extent that fairly reliable mean velocities can be derived, and that they then be removed from or included in a list of definite spectroscopic binaries. Each observatory should so far as possible clear its own slate in this respect.

3. That observation of the fainter stars in the Selected Areas be especially recommended to observatories having adequate facilities.

4. That attention be called to simplified methods and tables for deriving and checking reductions to the Sun. An illustration is the method developed by Herrick and described in *Lick Bulletin*, No. 470, subject to certain corrections of sign.

As in previous years the Commission is glad to offer its assistance in the preparation and co-ordination of any of the observational programmes.

REPORTS OF SUB-COMMITTEES

Report of Sub-Committee on Standard Velocity Stars

Three lists of standard velocity stars recommended for co-operative investigation have been published in reports of the Commission des Vitesses Radiales Stellaires. The first of these (*Transactions of the International Astronomical Union*, **3**, 171, 1928) contained stars of spectral types A to M, the second (*Transactions*, **4**, 181, 1932) stars of types O and B, and the third (*Transactions*, **5**, 191, 1935) stars of types F to M. The third list was intended to extend and supplement with some fainter stars the list of very bright F to M stars given in the first list.

These lists have in general proved satisfactory for comparison purposes and measurements of radial velocity have been continued at several observatories. Dr Harper and Dr Guthnick, however, call attention to a probable rapid variation of small amplitude in the velocity of α Lyrae, and Dr Harper finds a variation in the velocity of Iota Herculis, a star which, according to Edwards, also has a variable spectrum. Both of these stars appear in the lists of standard velocity stars of early types.

Especial attention has been given by Sanford to the redetermination of the velocities of the fainter stars of types F to M, and the development of more powerful spectrographs at several observatories may result in slight modifications of the velocities of the brighter stars as adopted at present. Any such modifications will be presented for consideration at a future meeting of the Union.

The members of this committee recommend the continued use of the adopted lists of standard velocity stars subject to the few comments already noted.

W. S. ADAMS
W. E. HARPER
J. H. MOORE

REPORT OF SUB-COMMITTEE ON CO-OPERATION IN RADIAL VELOCITY WORK

In order to provide a basis for closer co-operation in the observation of the radial velocities of spectroscopic binaries and variable stars, the sub-committee prepared a list of these stars under observation on January 1, 1935, at the seven observatories then engaged in the determination of stellar radial velocities. As this list was tentative in character and had for its chief purpose the prevention of needless duplication of effort, copies were distributed only to the seven observatories and to a few other observers who were especially interested in it.

Experience with this method of co-operation, during the past three years, appears to justify its continuance, and your committee has therefore undertaken a careful revision of this list in order that it may better serve the needs of observers in this particular field. Accordingly a letter was addressed to the ten observatories now engaged in radial velocity work requesting information concerning the spectroscopic binaries and variable stars included in their programmes. Replies were received from nine of the observatories and on the basis of the data furnished by them, the accompanying table has been compiled. It lists the spectroscopic binaries, variables and special stars under observation on January 1, 1938. The observatory at which the star is being studied is noted in the final column, the following abbreviations being used:

B = Berlin-Babelsberg	L = Lick	W = Mount Wilson
C = Cook	M = Michigan	V = Victoria
D = David Dunlap	S = Simeis	Y = Yerkes

The table contains 289 stars, of which 93 are eclipsing variables. Eighteen on the list are under observation at two observatories, two appear on three programmes, two are being observed at four institutions, and one is on the programme of five observatories. The duplication in these few cases, however, represents for the most part stars that are being studied by several observers by somewhat different methods or with different objectives in view.

Most of the stars listed in the table are being observed for the purpose of determining their orbital elements. Several objects, however, have been included in the list that are probably not real spectroscopic binaries, whose spectra are under observation for studies other than that of their radial velocities. Your committee realises that it would have added to the value of the list if it could have been arranged in a form so as to indicate the purpose for which the star was being studied. Unfortunately the data supplied did not permit of this procedure. Where a star is under observation at several institutions, or in case one wishes to study an object being observed elsewhere, proper care should be taken to prevent unnecessary duplication of effort.

J. H. MOORE
A. H. JOY
W. E. HARPER

Variable Velocity Stars under Observation

January 1, 1938

Star	1900 α	1900 δ	Mag.	Sp.	Observatory
	h m	° ′			
α And	0 03·2	+28 32	2·1	A0p	Y
SX Cas	05·5	+54 20	Ecl	A7	W
35 Psc	09·8	+ 8 16	5·9	F0	S
HD 1083	10·0	+26 43	6·1	A0	V
AO Cas	12·5	+50 53	Ecl	B0	V
HD 1383	12·9	+61 10	7·9	B0	V
TV Cas	13·9	+58 35	Ecl	B9	V
κ Cas	27·3	+62 23	4·2	B0	M
13 Cet	30·1	− 4 09	5·2	G0	Y
π And	31·5	+33 10	4·4	B3	Y
RT Scl	31·5	−26 13	Ecl	A5	W
YZ Cas	39·1	+74 26	Ecl	A3	V
64 Psc	43·7	+16 24	5·2	F5	L
ν And	44·3	+40 32	4·4	B3	V
BM Cas	48·6	+63 33	Ecl	—	D
γ Cas	50·7	+60 11	2·2	B0nne	M, B
η And	51·9	+22 53	4·6	G5	L
U Cep	53·4	+81 20	Ecl	A0	W
WZ And	56·2	+37 33	Ecl	A5	W
47 And	1 17·9	+37 12	5·5	A0	Y
α UMi	22·6	+88 46	2·1	F8	L
XX Cas	23·0	+60 27	Ecl	B	V
φ Per	37·4	+50 11	4·2	B0ne	M
ζ Cet	46·5	−10 50	3·9	K0	L
ξ Psc	48·4	+ 2 42	4·8	K0	L
β Ari	49·1	+20 19	2·7	A5	Y
HD 12447	56·9	+ 2 17	4·3	A2p	V
β Tri	2 03·6	+34 31	3·1	A5	V
HR 634	05·6	+31 03	6·2	A0	S
b And	06·9	+43 46	5·1	K0	L
HD 14214	12·8	+ 1 17	5·8	F8	V
o Cet	14·3	− 3 26	Var	Mde	M
B 552	21·2	+50 07	6·3	F0	W
IC 1805; 5	24·4	+61 10	(9·0)	O8	L
HR 741	27·5	+14 36	6·1	F5	S
HR 760	31·1	+39 27	6·4	B8	S
TW Cas	37·6	+65 19	Ecl	B	V
RY Per	39·0	+47 43	Ecl	B9	V
RS Ari	40·4	+27 27	Ecl	F9	V
IC 1848	43·4	+60 01	7·1	O7	L
TX Cas	44·3	+62 22	Ecl	B8	V
τ Per	47·2	+52 21	4·1	G0, A5	M
HD 18296	51·2	+31 32	5·2	A0p	V
RX Cas	58·8	+67 11	Ecl	G2p	W
HD 20336	3 11·2	+65 17	4·8	B3ek	M
HD 20340	11·2	−17 12	7·8	B3e	L
ξ Tau	21·7	+ 9 23	3·8	B8	V
B 786	21·9	+58 32	4·8	A0p	V, M
AB Per	31·1	+40 26	Ecl	A8	V
HR 1118	34·8	+25 00	6·2	A0	S
HR 1137	38·6	+20 37	6·0	B9	S
HD 23277	38·8	+70 34	5·4	A2	V
X Per	49·1	+30 45	Var	B0nne	M
HD 24546	49·2	+50 24	5·5	F5p	V

Star	1900 α	1900 δ	Mag.	Sp.	Observatory
	h m	° ′			
RU Eri	3 50·1	−15 14	Ecl	F8	L, W
λ Tau	55·1	+12 12	Ecl	B3	M, V
HD 25638	59·1	+62 04	7·0	B0nk	L, D
HD 25639	59·1	+62 04	7·0	B0nk	L, D
HD 25940	4 01·4	+47 27	4·0	B3e	M
b′ Per	10·7	+50 03	Var	A2	Y, L, V
HD 27483	15·2	+13 38	6·1	F2	W, D, V
B 1074	29·7	+41 04	4·5	K0	W, M
B 1113 brt	38·8	− 8 59	6·7	F5	W
π^5 Ori	49·0	+ 2 17	3·9	B3	V
HD 31293	49·4	+30 24	7·5	A0	W
ε Aur	54·8	+43 40	Ecl	F5p	M
ζ Aur	55·5	+40 56	Ecl	K5+B1	W, L, V, M, B
HD 32196	56·3	+85 50	6·5	F0	V
HD 32343	57·4	+58 50	5·3	B3e	M
HD 32991	5 02·0	+21 34	6·0	B3nek	M
SX Aur	04·6	+42 02	Ecl	A3	V
ER Ori	06·5	− 8 41	Ecl	—	L
α Aur	09·3	+45 54	0·2	G1	B
B 1250	09·7	− 8 19	0·3	B8p	M
B 1250 BC	09·7	− 8 19	7·0	B8	W
HD 34762	14·7	+27 51	6·3	B9	D
HD 35439	19·6	+ 1 45	4·7	B3ne	M
HD 35715	21·6	+ 3 00	4·7	B2	V
χ Aur	26·2	+32 07	4·9	B1	M
EY Ori	26·4	− 5 47	Ecl	F8	L
δ Ori	26·9	− 0 23	Ecl	B0	Y
HD 36576	27·6	+18 29	5·5	B3ek	M
HD 36954	30·1	− 0 48	8·1	B3	L
BM Ori	30·4	− 5 27	Ecl	B2	V
θ^1 Ori C	30·4	− 5 27	5·4	Oe5	M
HD 37043	30·5	− 5 59	2·9	Oe5	V
ζ Tau	31·7	+21 05	3·0	B3e	M
ω Ori	33·9	+ 4 04	4·5	B3ek	M
HD 37756	35·8	− 1 11	5·0	B3	V
χ^2 Ori	58·0	+20 08	4·7	B2p	M
HD 41335	59·4	− 6 42	5·1	B2e	M
17 Lep	6 00·5	−16 29	5·0	A0	Y
HD 41753	01·9	+14 47	4·4	B2	V
B 1541	05·3	−24 14	8·5	A0	W
WW Gem	07·0	+23 32	Ecl	B5	L
η Gem	08·8	+22 32	Var	M3	M
HD 44458	16·8	−11 44	5·5	B2ne	M
SV Cam	19·8	+82 21	Ecl	G	V
ν Gem	23·0	+20 17	4·1	B5ne	M
β^1 Mon	24·0	− 6 58	4·7	B3ne	M
RW Mon	29·3	+ 8 54	Ecl	A5	D
γ Gem	31·9	+16 29	1·9	A0	L
HD 47129	32·0	+ 6 13	6·1	O8ek	V
NGC 2264	35·1	+ 9 53	8·1	B6	L
RX Gem	43·7	+33 21	Ecl	A2	V, D
UY Mon	53·3	+ 9 45	Ecl	—	L
o^2 CMa	58·8	−23 41	3·1	B5p	M
27 CMa	7 10·2	−26 11	4·7	B5p	Y, L
29 CMa	14·5	−24 23	Ecl	Oe	Y
τ CMa	14·5	−24 46	4·4	O9	L
AR Mon	15·9	− 5 05	Ecl	K0	L

Star	1900 α	1900 δ	Mag.	Sp.	Observatory
	h m	° ′			
β CMi	7 21·7	+ 8 29	3·1	B8	M
RY Gem	21·7	+15 51	Ecl	A2	L, V
α^1 Gem	28·2	+32 06	2·9	A0	L
α^2 Gem	28·2	+32 06	2·0	A0	L
B 1985	29·2	−14 18	5·1	K5, B	M
UZ Pup	37·1	−13 09	Ecl	—	L
l_3 Pup	39·8	−28 43	4·1	A2p	L
HD 63630	44·8	+46 12	6·5	A3	D
TU Mon	48·3	− 2 47	Ecl	B8	D
UX Mon	54·4	− 7 14	Ecl	A5	D
HD 65626	54·5	+57 33	6·5	G0	V
HD 73731	8 34·7	+19 54	6·4	A2	V
RX Hya	9 00·8	− 7 52	Ecl	A2	W
HD 82523	27·4	+28 49	6·4	A2	V
S Ant	27·9	−28 11	Ecl	F0	W
o Leo	35·8	+10 21	3·8	F5, A3	V
W UMa	36·7	+56 25	Ecl	G0	V
HR 3893	45·3	+ 4 49	6·2	F5	S
HD 87243	58·6	+52 50	6·2	A2	V
HR 4006	10 08·2	+27 39	6·1	G5	S
HD 88815	09·6	+73 35	6·5	F0	V
TX Leo	28·9	+ 9 10	Ecl	—	D
UV Leo	30·6	+15 01	Ecl	—	D
HD 92941	38·8	+20 17	6·1	A3	V
ω UMa	48·2	+43 43	4·8	A0	V
α UMa	57·6	+62 17	2·0	K0	L
HD 96528	11 02·3	+23 52	6·4	A2	D
HD 97302	06·9	+55 26	6·5	A2	V
HD 98353	13·7	+38 44	4·8	A2	V
HD 98664	16·0	+ 6 35	4·1	A0	V
HD 98673	16·1	+57 37	6·3	A2	V
HR 4410	20·7	+ 4 25	6·3	F0	S
HD 100018	25·4	+41 50	7·0	F2	V
HD 100740	30·5	+11 28	6·4	A2	V
HR 4536	44·5	+35 29	5·8	F5	S
HD 104321	55·7	+ 7 10	4·6	A3	V
HD 105805	12 05·7	+27 50	5·8	A2	V
AH Vir	09·2	+12 23	Ecl	K0	L
12 Com	17·5	+26 24	4·8	F5	L
HR 4746	22·8	− 4 04	6·0	F2	S
κ Dra	29·2	+70 20	3·9	B5e	M
B 3303	36·1	−12 28	6·1	F5	W
B 3304	36·1	−12 28	6·0	F5	W
HD 110533	38·2	+84 12	7·2	F2	V
UY Vir	56·6	−19 15	Ecl	A3	L
HD 115227	13 10·7	+73 20	6·4	A0	V
α Vir	19·9	−10 38	Ecl	B2	Y
HD 118216	30·3	+37 42	5·0	F5	V
η Boo	49·9	+18 54	2·8	G0	V
λ Vir	14 13·7	−12 55	4·6	A2	L
UW Boo	17·4	+47 33	Ecl	—	D
HD 129132	35·8	+22 24	6·2	F1	V
HD 129988	40·6	+27 30	5·1	A0	V
i Boo	15 00·5	+48 03	Ecl	G2p	V
HD 135384	09·7	+68 10	6·2	A0	V
β CrB	23·7	+29 27	3·7	F0p	L
HD 139891–2	35·6	+36 58	6·0, 5·1	B8	V

Star	1900 α	1900 δ	Mag.	Sp.	Observatory
	h m	° ′			
HD 142926	15 52·2	+42 51	5·6	B8	D
HD 142983	52·6	−13 59	4·7	B3p	W
HD 143807	57·4	+30 07	4·9	A0	V
β Sco	59·6	−19 32	2·9	B1	Y
HD 145674	16 07·1	+58 12	6·3	A0	V
χ Oph	21·2	−18 14	4·8	B3e	M
WW Dra	37·7	+60 55	Ecl	G5	W
HD 153653	55·6	+ 6 44	6·4	A5	V
U Oph	17 11·4	+ 1 19	Ecl	B5nk	V
μ Her	13·6	+33 12	Ecl	B3	V, Y
HD 157482	18·4	+40 05	5·7	F8	D
B 4437	26·3	+ 2 48	5·6	G0p	D
HD 159176	28·1	−32 31	5·7	O5	L
ι Her	36·6	+46 04	3·8	B3	M
HD 162936	48·5	+32 02	7·0	A0	D
WY Sgr	54·9	−23 01	Ecl	B9	W
HD 164898	58·3	+45 21	7·4	B9	D
HD 165645	18 01·9	+41 56	6·4	F0	D
o Her	03·6	+28 45	Ecl	A0	D
W Ser	04·1	−15 34	Ecl	G4e	W
HD 166228	04·6	+49 42	6·3	A0	V
μ Sgr	07·8	−21 05	4·0	B8p	M
HD 169028	17·6	+51 18	6·2	K2	D
ζ Sct	18·2	− 8 59	4·8	G5	L
W Sct	18·9	−13 42	Ecl	F2	L
RZ Sct	21·1	− 9 16	Ecl	B2	D
AW Her	21·3	+18 14	Ecl	K2, G4	V
V 451 Oph	24·5	+10 49	Ecl	A0	D
HD 170474	24·5	− 2 03	5·4	K0	D
HD 171487	30·0	+20 23	6·4	A2	V
HD 171623	30·8	+18 07	5·7	A2	V
α Lyr	33·6	+38 41	0·1	A1s	B
HD 172187	33·7	+43 08	6·2	A5	D
YY Sgr	38·7	−19 29	Ecl	A0	W
V 356 Sgr	41·9	−20 23	Ecl	B9	L
HD 174512	45·7	− 6 23	8·0	B8	W
HD 175426	50·2	+36 51	5·5	B3	V
B 4797	50·5	+22 31	4·6	G0, A3	M
FF Aql	53·8	+17 14	Var	F5	W
HD 176853	57·1	−10 52	6·7	B5	W
KP Aql	58·0	+15 39	Ecl	—	L
V 337 Aql	58·9	− 2 10	Ecl	B3	D
RS Vul	19 13·4	+22 16	Ecl	B8	V
υ Sgr	16·0	−16 08	4·6	B8p	M
Z Vul	17·5	+25 23	Ecl	B3n	V
RR Lyr	22·3	+42 36	Var	B9, F2	W
TT Lyr	24·3	+41 30	Ecl	A	D
HD 183534	25·0	+52 07	5·7	A0	V
HD 183794	26·1	− 2 19	Ecl	B8	D
UZ Dra	26·2	+68 34	Ecl	A2	L
β^1 Cyg	26·7	+27 45	3·2	Kp	M
σ Aql	34·3	+ 5 10	Ecl	B8	Y, V
φ Cyg	35·4	+29 55	4·8	K0	L
QS Aql	36·5	+13 35	Ecl	B3	D
BR Cyg	37·9	+46 33	Ecl	—	D
δ Sge	42·9	+18 17	3·8	Ma, A0	M
OO Aql	43·4	+ 9 04	Ecl	G5	L

Star	1900 α	1900 δ	Mag.	Sp.	Observatory
	h m	° ′			
V 505 Sgr	19 47·5	−14 51	Ecl	A2	D
SW Cyg	20 03·8	+46 01	Ecl	A2	D
HD 191610	05·7	+36 33	4·8	B3nne	M
θ Aql	06·1	− 1 07	3·4	A0	Y
HD 192044	07·8	+26 11	5·9	B8	M
31 Cyg	10·5	+46 26	4·0	K0	L, M.
32 Cyg	12·3	+47 24	4·2	K0, A3	V, M
HD 193007	12·8	+37 20	8·0	B0	L
IC 4996 : 37	12·8	+37 20	9·3	B2	L
35 Cyg	14·8	+34 40	5·2	F5p	L
β Cap	15·4	−15 06	3·2	G0, A0	M, W
MY Cyg	16·2	+33 38	Ecl	A	D
HD 194495	20·8	+21 10	7·1	B9	S
BE Vul	21·6	+27 02	Ecl	—	D
HD 195986	29·4	+42 51	6·4	B6	V
GO Cyg	33·5	+35 05	Ecl	B9	V
VW Cep	36·6	+75 14	Ecl	G5	D
V 367 Cyg	44·2	+38 55	Ecl	F2ev	W
57 Cyg	49·7	+44 00	4·7	B3k	Y
HD 200120	56·4	+47 08	4·9	B3ne	M
HD 200753	21 00·3	+46 29	6·3	A5	V
ξ Cyg	01·3	+43 32	3·9	K5	L
B 5442	04·4	+29 48	5·6	A0	B
HD 203467	17·3	+64 27	5·2	B3nek	M
HD 204862	26·3	+11 43	5·9	A0	V
HD 206155	35·1	+ 8 44	Ecl	A0	D
AI Cep	43·1	+56 28	Ecl	—	D
π^2 Cyg	43·1	+48 51	4·3	B3	L
14 Peg	45·4	+29 43	5·0	A0	L, V
HD 207826	46·8	+66 20	6·8	F2	V
AW Peg	47·7	+23 32	Ecl	A2	L
VV Cep	53·8	+63 09	Var	M2ep	W, M, V, D
UZ Cyg	55·2	+43 53	Ecl	A3k, K1	W
HD 209481	58·7	+57 31	5·5	B0	V
HD 210129	22 03·1	+21 13	5·7	B8	M
AR Lac	04·6	+45 15	Ecl	G5	V, D
HD 212076	16·6	+11 42	4·9	B3e	M
2 Lac	16·9	+46 02	4·7	B5	Y
π Aqr	20·2	+ 0 52	4·6	B1nnek	M
WX Cep	27·8	+63 00	Ecl	A0	V
XZ Cep	29·3	+66 38	Ecl	—	V
HD 214168	31·4	+39 07	5·8	B3nek	M
ZZ Cep	41·7	+67 36	Ecl	A2	L
AH Cep	44·2	+64 32	Ecl	B0nk	V
HD 217050	52·7	+48 09	5·2	B3nek	M
o And	57·3	+41 47	3·6	B3	M
β Psc	58·8	+ 3 17	4·6	B5e	M
RT And	23 06·7	+52 29	Ecl	A?	L
AB And	06·8	+36 21	Ecl	—	L
SZ Psc	08·3	+ 2 08	Ecl	G5	D
HD 219634	12·2	+61 25	6·5	B8	D
94 Aqr	13·9	−14 00	5·3	G5	L
TY Peg	24·9	+12 59	Ecl	A	W
AR Cas	25·4	+58 00	Ecl	B3	Y, V
Y Psc	29·3	+ 7 22	Ecl	A2	D
XX Cep	33·6	+63 47	Ecl	A	V

Observations of the following stars have been completed:

Star	1900 α	1900 δ	Mag.	Sp.	Observatory
	h m	° ′			
ο Per	3 38·0	+31 58	3·9	B1	V
θ^2 Tau	4 22·9	+15 39	3·6	F0	V
π^4 Ori	4 45·9	+ 5 26	3·8	B3	V
25 Ser	15 40·9	− 1 30	5·4	B8	V
σ Cyg	21 13·5	+38 59	4·3	A0	V
δ Cap	21 41·5	−16 35	3·0	A5	V
ι Peg	22 02·4	+24 51	4·0	F5	V

In addition to the stars included in the above list, Mount Wilson is observing:

(1) Cepheid variables in globular clusters;
(2) RR Lyrae variables with periods 0·2 to 1·2 days;
(3) Intermediate and irregular variables with periods 50 to 150 days.

The Cook Observatory is obtaining spectrophotometric plates of all Be stars brighter than magnitude 5·0, which will also be measured for radial velocity.

Report of Sub-Committee on Wave Lengths

The Sub-Committee on Wave-Lengths calls attention to the publication by W. E. Harper of an article entitled "The Victoria System of Radial Velocity Determinations". This paper contains tables of wave-lengths now in use at Victoria and it describes the various changes in the wave-length system adopted at Victoria since 1918.

Dr Moore reports that at the Lick Observatory the Hartmann spectrocomparator is being used for the measurement of 1-prism spectrograms of the faint star programme. The spectrocomparator is also being used for the measurement of 3-prism plates of spectroscopic binaries of the late spectral classes. For spectra of classes A and B, taken with 3-prism dispersion, the Lick observers use the wave-lengths given in the report of Commission 30 of the I.A.U. The wave-lengths of the lines in the region λ4395 to λ4600 have been determined on 3-prism spectrograms of α Lyrae, and are given in *Lick Observatory Bulletin*, No. 473, p. 110. With few exceptions, these values agree closely with those recommended by the I.A.U.

For high-dispersion work with the coudé spectrograph at Mount Wilson, solar wave-lengths are used for spectra of type A or later. For O and B stars, the wave-lengths of Miss Moore's *Table of Lines of Astrophysical Interest* are used. For low-dispersion work, the Mount Wilson Observatory uses the wave-lengths listed in Vol. 5 of the *Transactions of the I.A.U.*

It is not yet possible to recommend the adoption of a single system of wave-lengths based upon laboratory measurements. The Committee therefore wishes to emphasize the importance of specifying the wave-length system used in radial velocity determinations. It is especially important in high-dispersion work to state clearly whether the system is directly or indirectly (by means of observations of planets) dependent upon the solar or laboratory measurements.

An important practical question is that of the wave-lengths of blended lines for the determination of which there is at present no adequate method. Recent theoretical work, principally by Thackeray, should make it possible to determine accurate wave-lengths of lines whose wings overlap. For example, in the case of helium triplets, the wings of the components overlap to a considerable extent. This overlapping must be different in stars having different surface gravity because of the Stark effect, and the question arises whether the theory of blended lines could provide simple rules for the determination of the centre of gravity of a blended line contour. In this connection, Dr Thackeray reports:

"It is reasonable to assume that in wave-length measurements the eye tends to neglect parts of the wings beyond 20 per cent. absorption, even when the central intensity is only 40 per cent. I have computed Eddington contours of the blended helium triplet λ4471 with assumed separations 0·20 and 0·02 A. and intensity ratios 1 : 3 : 5, and a total equivalent width of about 1 A. I find that the locus of centres of chords moves from 0·035 A. from the strongest component at 30 per cent. absorption to 0·066 A. at 70 per cent. I have not yet tried the effects of finite resolving power and rotational broadening, but presumably the mean shift must be of the order of 0·04 A. Weighting according to intensity gives a shift of 0·029 A. so that the blending effect is small, and I doubt whether it could exceed 0·02 A. in any case for this triplet. The blending of the two strongest components has practically no effect as they are so close, and for all practical purposes the triplet may be treated as a doublet with one component 8 times as strong as the other."

W. S. Adams
J. H. Moore
J. S. Plaskett
O. Struve, *Chairman*

W. S. Adams
President of the Commission