CROSS REFERENCE

FILE: STRÖMGREN, PROFESSOR BENGT-----ONR CONTRACT (current 1967)

RE: funds for salary for Mr. Richard Henry as Research Associate to come out of current ONR contract

LETTER DATED: April, June and December, 1966

SEE: Professor Strömgren/s master file

Princeton University

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Princeton, New Jersey

Final Report to

The Office of Naval Research

on

Investigations of Problems of Star Formation

Contract Nonr 1858 (33)

November 12, 1965

Prepared by: Bengt Strömgren
Principal Investigator

The research work supported by the Office of Naval Research through Contract Nonr 1858 (33) and reported on herewith aimed at the determination, for F and G stars, of color and and absolute magnitude, distance from the galactic plane, space velocity, age, and an index of atmospheric metal content. The ultimate goal of the investigation was to contribute to the solution of problems of star formation pertaining to the older populations of our galaxy.

1. Publications. The following papers presenting work supported by the ONR Contract Nonr 1858 (33) have been published, or are in press:

B. Strömgren, "Past Distribution of Interstellar Gas," Conference on Interstellar Matter, Edited by L. Woltjer, 1962

B. Strömgren, "Problems of Internal Constitution and Kinematics of Main-Sequence Stars," Quarterly Journal of the Royal Astr. Soc. 4, 8, 1963

B. Strömgren, "Comparison of Observed and Theoretically Calculated Intensities in the Continuous Spectra of Main-Sequence B Stars," Rev. Mod. Phys. 36, 532, 1964

B. Strömgren, "On the Chemical Composition and Kinematics of Disc High-velocity Stars of the Main Sequence," Astrophys. Norvegica 9, 333, 1964, and Contr. Kitt Peak National Obs. No. 59

B. Strömgren, "Age Determination for Main-Sequence B, A, and F stars," to appear in Symposium Volume on Stellar Evolution, Goddard Institute for Space Studies, Edition by A. Cameron and R. Stein, 1965

T. Kelsall and B. Strömgren, "Calibration of the Hertzsprung-Russell diagram in terms of age and mass for main-sequence B and A stars," to appear in Vistas of Astronomy, Vol. 6, 1965

D. L. Crawford and B. Strömgren, "Comparison of the Hyades, Coma, and Pleiades Clusters based on photoelectric uvby and Hβ photometry," to appear in Vistas of Astronomy, Vol. 6, 1965

G. Contopoulos and B. Strömgren, "Tables of Plane Galactic Orbits," Publ. Goddard Institute for Space Studies, 1965

Work on the following publications has been completed, and the papers presenting the work will be submitted for publication during 1965 and the first half of 1966:

B. Strömgren and C. Perry, "Photoelectric uvby Photometry for 1217 Stars brighter than V = $6^{m}.5$, mostly of spectral classes A, F and G." This paper will be submitted to the Astronomical Journal and will also appear as a Kitt Peak National Observatory Publication. The catalogue contained in the paper is included in this report as Appendix 1.

B. Strömgren, "Spectral Classification through Photoelectric Photometry." The Henry Norris Russell Lecture 1965. The paper will be submitted to the Astronomical Journal and will also appear as a Kitt Peak National Observatory Publication.

C. Perry, "Photoelectric uvby Photometry for 850 F and G stars with V between $6^{m}.5$ and $7^{m}.3$." The paper will be submitted to the Astronomical Journal and will also appear as a Kitt Peak National Observatory Publication.

D. L. Crawford, B. Faure, J. V. Mander and C. Perry, "Photoelectric Hβ Photometry for 1217 Stars brighter than V = $6^{m}.5$." This paper will be submitted to the Astronomical Journal and will also appear as a Kitt Peak National Observatory Publication. The work is a joint undertaking of the Kitt Peak National Observatory and the present project, directed by D. L. Crawford of KPNO. The collaboration of C. Perry was made possible through Contract Nonr 1858 (33). The catalogue contained in the paper is included in this report as Appendix 2.

A considerable amount of further observational and computational material has been obtained and should become ready for publication in 1966.

2. <u>Instrumentation. The method of photoelectric uvby photometry.</u> The instrumentation used for the photoelectric photometry carried out as part of this research project consisted of photoelectric photometer boxes, interference filters and glass filters, Weitbrecht-type integrators for measuring the photomultiplier currents, and equipment for digitizing the voltage output. The instruments were designed for use with the following reflectors that were available for making the photoelectric observations: The 20-inch reflector of Mount Palomar Observatory, the 36-inch reflector of the Kitt Peak National Observatory, and the 16-inch reflectors of KPNO.

The instrumentation for photoelectric photometry is now used at KPNO exclusively and has become an integral part of the auxiliary equipment used with the KPNO 36-inch and 16-inch reflectors. It is available to and has been used extensively by other investigators at KPNO.

Our investigation has led to the development of a method of intermediate-band photometry (half-widths about 200 Å) in four colors

u	3500 Å
v	4110
b	4670
y	5470

which has been found to be very effective for F and G star work. From the magnitudes u, v, b and y the following indices are derived: a. A color index b - y that is relatively insensitive to chemical-composition effects. b. A metal-content index $m_1 = (v - b) - (b - y)$. c. A Balmer discontinuity index $c_1 = (u - v) - (v - b)$. The combination of b - y and c_1 yields the absolute magnitude M_v. Calibration of the c_1 - (b - y) diagram in terms of M_v is carried out on the basis of M_v - values for stars with well-determined trigonometric or cluster parallaxes. The influence of variations in chemical composition can be eliminated through a correction to c_1 according to the value of m_1.

The metal-content index m_1 has been calibrated in terms of the atmospheric metal-hydrogen ratio on the basis of the results of high-dispersion abundance analysis carried out by J. L. Greenstein, G. Wallerstein and their collaborators. The calibration residuals indicate that the accuracy of the metal-hydrogen ratios derived from m_1 is quite satisfactory, being about as good as the accuracy obtained in the high-dispersion work.

For the F and G stars in question the calibration of m_1 in terms of the metal-hydrogen ratio depends on b - y and c_1, but the dependence is not pronounced and it can be allowed for.

The method of photoelectric uvby photometry is limited to unreddened stars. In most of the applications of the method in the present project this limitation is of no consequence because the stars studied are within 100 parsec and not affected by interstellar reddening. However, an alternative method was developed for the F stars which is insensitive to interstellar reddening.

The method in question utilizes photoelectric uvby, and Hβ photometry that yields an index β measuring the strength of the Hβ absorption lines. Intrinsic colors $(b - y)_o$ are derived from the indices c_1 and β. The color excess E(b - y) is found as the difference between observed b - y and $(b - y)_o$. Small reddening corrections are applied to the values of c_1 and m_1 according to the value of E(b - y), and the combination of the corrected c_1 and $(b - y)_o$ yields the absolute magnitude M_v, as before.

It is of particular importance that this method has been found applicable to F stars of intermediate population II (compare section 6 of this report), since this will make it possible to push investigations of the distribution of interstellar grains to large distances from the galactic plane.

3. Results of photoelectric photometry. The program of photoelectric observations was a consolidated one, consisting of A2 - F2 stars to be observed for an investigation supported by the NSF and F3 - G2 stars, the observation of which was part of the present project supported by the ONR.

The photoelectric photometry was carried out with the 20-inch reflector of Mount Palomar Observatory, the 36-inch reflector of Kitt Peak National Observatory, and the 16-inch reflectors of KPNO. The uvby observations were obtained on 80 nights in 1960-62. Supplementary observations needed to assure that every program star had been observed on at least 2 nights were obtained on parts of 10 nights in 1963-65. A uvby photometric system was established through about 2000 observations of a network of 175 standard stars. The rest of the program stars were observed relative to the standard stars. Altogether somewhat more than 5000 observations were made (each observation consisted of two sets of measures of uvby-intensities). The observers were C. Perry and the Principal Investigator.

The accuracy obtained is shown in the following table of internal probable errors:

$\pm\, 0^m.004$ for a catalogue value of b - y (2 observations)
$\pm\, 0.005$ for a catalogue value of m_1 (2 observations)
$\pm\, 0.006$ for a catalogue value of c_1 (2 observations)

An analysis of closing errors in the network of standard stars indicates that the photometric system is maintained around the sky within a few thousandths of a magnitude in b - y and m_1 and probably within $0^m.01$ in c_1 (the index which is dependent on the ultraviolet intensity). The accuracy has proved to be fully sufficient for the various purposes of the discussion ~~band~~ based on the uvby observations.

The final catalogue is given in Appendix 1. It will be published in the Astronomical Journal and in Contributions from the Kitt Peak National Observatory.

Using the same network of standard stars C. Perry has carried out photoelectric uvby photometry for 850 F and G stars with apparent visual magnitude V between $6^m.5$ and $7^m.3$. At least 2 observations were obtained for every star on this program. The observations and the reductions have been completed and the final catalogue is expected to be ready before the end of 1965. About 2500 observations were made on this program.

The Hβ photometry of the 1217 stars of the uvby catalogue of stars brighter than V = $6^m.5$ was carried out at Kitt Peak National Observatory under the direction of D. L. Crawford. The observers were D. L. Crawford, B. Faure, J. V. Mander and C. Perry. The support through Contract Nonr 1858 (33) made possible the participation of C. Perry in this work.

The Hβ observations are on the photometric system described by D. L. Crawford (Ap. J. 132, 66, 1960). For the great majority of the stars 4, or more, observations were obtained. The probable error of a catalogue value (4 observations) of the index β is $\pm\, 0^m.004$. The total number of observations is about 5000.

The final Hβ catalogue is given in Appendix 2. It will be published in the Astronomical Journal and in Contributions from the Kitt Peak National Observatory.

The total number of photoelectric intensity measures made on the three photoelectric programs described in this section is approximately 200,000.

4. Colors and absolute magnitudes. The metal-index m_1. The photoelectric uvby and Hβ photometry of 1217 A, F and G stars brighter than $V = 6^m.5$ described in section 3 of this report has been utilized for the determination of intrinsic colors and visual absolute magnitudes according to the principles outlined in section 2. Metal-hydrogen ratios for the F and G stars have been derived from m_1. A discussion of the results is contained in two of the papers listed in section 1 (Quarterly Journal R. A. S. 4, 8, 1963, and the Henry Norris Russell Lecture).

5. Space velocities and their correlation with location in the Hertzsprung-Russell diagram and with the metal-content index m_1. Galactic orbits. The absolute visual magnitudes M_v derived from the photoelectric photometry have been utilized for the determination of distances and space velocities. It would appear that these space velocities are more accurate than any previously derived for large numbers of field stars.

In two unpublished investigations by the Principal Investigator and by Mr. T. Dennis (Princeton University Observatory) the correlation of average velocity $\overline{W}$ at right angles to the galactic plane with location in the Hertzsprung-Russell diagram has been studied. In particular $\overline{W}$ was determined as a function of b - y for stars in the upper half of the main-sequence band from B5 to G2. For stars in this portion of the Hertzsprung-Russell diagram the color index b - y is a very good indicator of stellar age. It was found that $\overline{W}$ remains very nearly constant for all values of b - y up to about $+ 0^m.32$ while $\overline{W}$ is conspicuously larger for stars with $b - y > + 0^m.34$. These results will be discussed in a forthcoming paper by Mr. T. Dennis.

The stellar age for which this increase in $\overline{W}$ occurs can be evaluated when a more accurate calibration of the H-R diagram in the region of the middle and late F stars becomes available (see section 7).

When analogous results based on C. Perry's catalogue of uvby photometry of F and G stars with V between $6^m.5$ and $7^m.3$ have been derived it will be possible to make a more detailed analysis of the relatively sharp transition in $\overline{W}$ that occurs for stars in the upper half of the H-R diagram near $b - y = + 0^m.33$, since this material will yield a considerably large sample of stars.

A discussion of certain aspects of the correlation of space velocity with metal-index m_1 has been carried out on the basis of results of photoelectric uvby photometry by the Principal Investigator. A special series of photoelectric observations of high-velocity stars brighter than $V = 8^m.5$ was made for this purpose (see KPNO Contribution No. 59, listed in section 1).

The preliminary discussion emphasized the importance of a component of stars of solar chemical composition among the high-velocity stars. The discussion also suggested that detailed study of the properties of a well-defined group of stars of intermediate metal deficiency (Δm_1 between $0^m.045$ and $0^m.080$) would yield results of considerable importance in the study of problems of formation of old stars. I refer to this group of stars as Intermediate Population II.

It is already clear that the photoelectric uvby photometry of F and G stars with V between $6^m.5$ and $7^m.3$ (C. Perry's catalogue) will provide the basis for establishing, for the first time, an unbiased and rather large list of stars of Intermediate Population II.

G. Contopoulos and the Principal Investigator have published tables of plane galactic orbits that facilitate galactic-dynamics studies on the basis of the material of space velocities, metal-hydrogen ratios and ages collected with the aid of photoelectric uvby and Hβ photometry. In KPNO Contribution 59 an application to the problems of the category of high-velocity stars of solar composition is discussed.

6. Intermediate Population II. A study based on the photoelectric uvby photometry of 1217 stars brighter than $V = 6^m.5$ showed that every main-sequence B, A, F or G star in this sample with a velocity component W (perpendicular to the galactic plane) numerically larger than 40 km/sec has a Δm_1 - value larger than $0^m.044$. According to the calibration of the m_1 - index this means that the metal-hydrogen ratio is down from the Hyades Cluster value by a factor of 4 or larger. Furthermore, it follows from a discussion of this material and the special survey of high-velocity stars referred to in the previous section that less than 20 per cent of the stars with a $\Delta m_1 > 0^m.044$ have Δm_1 - values larger than $0^m.080$. It is therefore natural to segregate for further detailed study the main-sequence F and early G stars with Δm_1 between $0^m.044$ and $0^m.080$. The average value of the metal-hydrogen ratio for this group is smaller than the Hyades Cluster value by a factor of approximately 5. I shall refer to this group as stars belonging to Intermediate Population II.

Stars of Extreme Population II have Δm_1 - values well over $0^m.1$, and as is well known their metal-hydrogen ratios are typically down from the Hyades Cluster value by factors of 100 or more. It is important to note that the stars of Intermediate Population II are much more numerous than those of Extreme Population II; the number of stars per unit volume is at least 50 times higher for the former category.

The results of a preliminary study of the kinematics of stars of Intermediate Population II is reported in Kitt Peak Contribution 59. For the sample of high-velocity stars brighter than $8^m.5$ with Δm_1 between $0^m.044$ and $0^m.080$ $\overline{W}$ is found to be 43 km/sec. It is pointed out that this is a biased sample and that the value of $\overline{W}$ found from the stars brighter than $6^m.5$ characterizes the group more reliably. In the photometric catalogue of 1217 stars there are 25 main-sequence F and G stars with Δm_1 between $0^m.044$ and $0^m.080$, and for these stars $\overline{W} = 26$ km/sec. This is almost twice the value found for main-sequence late F and early G stars of approximately solar composition ($\Delta m_1 < 0^m.025$). The result, although based on a small sample of stars, shows that Intermediate Population II stars (defined as I have done it here through the Δm_1 - value) are distributed in a galactic disc that is considerably thicker than that of solar-composition stars. On the other hand the $\overline{W}$ - value and the average distance from the galactic plane are considerably smaller than for Extreme Population II.

A preliminary analysis of the results of the photoelectric uvby photometry of the F and G stars between $V = 6^m.5$ and $V = 7^m.3$ (C. Perry's catalogue of 850 stars) shows that the consolidated photometric material of stars brighter than $V = 7^m.3$ contains about 80 main-sequence F and G stars with Δm_1 between $0\overset{m}{.}044$ and $0\overset{m}{.}080$. This is a valuable sample of stars of Intermediate Population II, obtained without any bias. It should serve the purpose of further studies of kinematics and space distribution for stars of Intermediate Population II. And since the distribution of these stars in the Hertzsprung-Russell diagram can be determined, a good basis for age determination of stars of Intermediate Population II can be obtained.

The distribution in the Hertzsprung-Russell diagram of the Intermediate Population II stars for which uvby photometry is already available indicates the presence of a well-defined sequence of practically unevolved stars for $b - y > 0\overset{m}{.}32$ and a distribution about a giant branch, separated from the zero-age sequence by somewhat over 1^m in the color range $0\overset{m}{.}32 - 0\overset{m}{.}39$. Analysis of the larger sample of Intermediate Population II stars just referred to should contribute to the further clarification of this question.

7. Age determinations. In recent years the problem of the calibration of the Hertzsprung-Russell diagram in terms of mass and age has been considered in theoretical investigations by a number of astrophysicists. For main-sequence B, A and early F stars the situation is now quite satisfactory (see e.g. the paper by T. Kelsall and the Principal Investigator listed in section 1). For late F and G stars of the main-sequence, however, it appears that considerably more work has to be done before reliable age calibration will become available for the whole relevant range of initial chemical compositions.

In collaboration with N. Baker, A. Reiz and S. Temesvary who have worked at The Institute for Advanced Study, and A. Arking, J. Herring and T. Kelsall who are connected with the Theoretical Division of the Goddard Space Flight Center, I have tried to further the investigation of problems of computing evolutionary tracks for main-sequence F and G stars. In the early phase of this work an effort was made to improve the accuracy of the theoretical calculations of opacities of stellar interior matter (see A. Arking and J. Herring, Pub. Astr. Soc. Pacific 75, 226, 1964). This effort was aided by Contract Nonr 1858 (33), the support making it possible to obtain important consultant advice from Dr. H. R. Griem.

Theoretical work on evolutionary tracks for main-sequence F and G stars is in progress, and if successful it will form the basis of further discussions of the observational results described in the previous sections.

8. Photographic photometry to visual magnitude 15^m in high galactic latitudes. The aim of the program of photographic photometry to visual magnitude 15^m in high galactic latitudes was a survey of main-sequence F and G stars with high ultraviolet excess, i.e. of Intermediate and Extreme Population II.

As a first step in this program I took plates with the 48-inch Schmidt telescope of Mount Palomar Observatory with image pairs (separation 0.8 mm) obtained through one ultraviolet-filter exposure (30 minutes) and one yellow-filter exposure (3 minutes), a total of 90 plates covering 60 areas of $4^\circ \times 4^\circ$ (30 areas were covered twice). The evaluation of the plates was begun in 1964 through a program of cooperation with Dr. L. Mavridis, Research and Computing Center, Academy of Sciences of Athens. Photographic color indices ultraviolet-yellow will be determined for stars to $V = 15^m$ in areas

$2^{\circ} \times 2^{\circ}$ in the center of 25 of the plates (a total of about 20 000 stars). In collaboration with D. L. Crawford, KPNO, I will carry out the observations of photoelectric standards necessary in this connection. Experience obtained in two areas through photoelectric UBV photometry, following the photographic photometry, has shown that photoelectric UBV photometry of the 2 per cent-fraction of the stars with the largest negative ultraviolet-yellow color index (photographically determined) will quite effectively turn up Intermediate and Extreme Population II stars.

A Scanner has been constructed with the support of Contract Nonr 1858 (33) which is to be used for automatic search for ultraviolet-excess stars on the material of the 48-inch Schmidt plates just described. This Scanner is being operated at KPNO, and it is expected that it will be extensively used when the measuring program carried out in collaboration with Dr. L. Mavridis has been completed. The 25 measured areas of $2^{\circ} \times 2^{\circ}$ will provide an excellent basis for testing the automatic search procedure.

Work on a planned program of photographic photometry to the limit $V = 12^{m}$ in high galactic latitudes, to be carried out for a larger area in the sky, has been postponed until the time when the instrument that was to serve the purpose (20-inch Schmidt telescope, Copenhagen Observatory) has been put into operation.

9. Future work. The early work by Oort, Lindblad, Baade, Hoyle and Lyttleton, and Schwarzschild and Spitzer, on the evolution of our galaxy, in particular on star formation in the galaxy, has been followed by a large number of investigations due to many investigators. The following picture is gradually emerging: 1. If we go back in time, we find that secular changes in stellar kinematics and stellar chemical composition are small through 2 - 3 billion years. 2. The phase corresponding to stellar ages 3 - 10 billion years is at the present epoch represented by stars with higher average velocities and formed with chemical compositions that do not differ very much from those characterizing young stars. 3. This phase was preceded by a phase of shorter duration during which an appreciable fraction of all stars in the galaxy were formed, namely, Intermediate Population II. These stars form a flat-disc system, but the thickness is more than twice that of the Population I disc. The initial metal-hydrogen ratio of these stars is 4 - 10 times smaller than for Population I. 4. Extreme Population II stars were probably formed before Intermediate Population II stars, but the relative difference in age may not be very large. The initial metal-hydrogen ratio is much smaller for this population than for any other. The number of stars of Extreme Population II appears to be much smaller than that of Intermediate Population II.

The research results reported in the previous section have contributed in some measure to the clarification of parts of this picture. A continuation of the work is planned, with emphasis on two areas: The extension of the photoelectric uvby photometry, now done to $V = 6\overset{m}{.}5$ and $V = 7\overset{m}{.}3$, respectively, to $V \sim 8\overset{m}{.}5$, and a general extension of the work on Intermediate Population II to much fainter stars in selected small areas in high and intermediate galactic latitudes.

In future photoelectric uvby photometry work the spectrograph-photometer constructed with support from Contract 1858 (33), and now forming an integral part of the KPNO equipment, should prove of great value.

APPENDIX 1

Photoelectric uvby Photometry for 1217 Stars Brighter than $V = 6^m.5$, mostly of spectral classes A, F and G

By

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Second Version
October, 1965

The catalogue is based on photoelectric photometry obtained with the 20-inch reflector of Mount Palomar Observatory and the 36-inch and 16-inch reflectors of Kitt Peak National Observatory.

Magnitudes u, v, b and y were determined in the following bands:

	Central wave length	Half width
u	3500 Å	300 Å
v	4110	190
b	4670	180
y	5470	230

From the magnitudes the following classification indices were derived:

b -y a color index that is relatively insensitive to chemical-composition effects.

c_1 = (u-v) - (v-b) a color difference that is a measure of the Balmer discontinuity

m_1 = (v-b) - (b-y) a color difference that is a measure of the total intensity of the metal lines in the v band.

$\pm 0^{\mathrm{m}}.004$ p.e. of catalogue value of b -y (2 observations)

$\pm 0^{\mathrm{m}}.005$ p.e. of catalogue value of m_1 (2 observations)

$\pm$ 0.006 p.e. of catalogue value of c_1 (2 observations)

For unreddened A2 - G2 stars of luminosity classes III, IV and V the indices have been calibrated to give the visual absolute magnitude M_v. The accuracy of the M_v - values is $\pm 0^{\mathrm{m}}.1$-$0^{\mathrm{m}}.2$ (p.e.). For late F and early G stars the indices m_1 and b -y give the relative metal content.

The investigation was supported by The National Science Foundation (grant NSF-G10285) and The Office of Naval Research (contract Nonr 1858(33)).

No.	Name	HR	α(1950.0)		δ(1950.0)		V	b-y	m_1	c_1	n
1	21 α And	15	0^h	$5^m.8$	+28°	49'	$2^m.0$	$-0^m.046$	$0^m.120$	$0^m.520$	10
2		17	0	6.1	+36	21	6.0	0.332	0.147	0.386	2
3	11 β Cas	21	0	6.5	+58	52	2.2	0.216	0.177	0.785	19
4	22 And	27	0	7.7	+45	48	5.0	0.273	0.121	1.082	17
5	88 Peg	39	0	10.7	+14	54	2.8	-0.106	0.092	0.116	2
6	23 And	41	0	10.9	+40	46	5.6	0.222	0.156	0.613	2
7	24 And	63	0	14.5	+38	24	4.6	0.028	0.177	1.050	23
8	25 And	68	0	15.7	+36	30	4.5	0.026	0.187	1.040	6
9		72	0	16.1	- 8	20	6.4	0.412	0.256	0.342	2
10	27 And	82	0	18.5	+37	42	5.1	0.288	0.162	0.566	2
11		107	0	25.7	+ 9	55	6.0	0.298	0.141	0.438	2
12	28 And	114	0	27.5	+29	29	5.2	0.169	0.165	0.869	11
13	14 Cet	143	0	33.0	- 0	47	5.9	0.306	0.132	0.493	2
14		145	0	33.3	+12	46	6.4	0.335	0.150	0.401	3
15		146	0	33.6	+60	3	5.8	0.224	0.050	1.534	2
16	54 Psc	166	0	36.8	+20	59	5.8	0.508	0.370	0.334	3
17		178	0	38.9	+24	21	5.9	0.137	0.257	0.931	3
18	20 Cas	184	0	40.7	+46	45	5.0	0.087	0.221	0.902	16
19		204	0	43.4	+55	2	6.5	0.106	0.164	1.111	2
20	59 Psc	214	0	44.6	+19	18	6.0	0.165	0.178	0.929	3
21	24 Cas	219	0	46.1	+57	33	3.4	0.372	0.185	0.275	3
22	65 Psc	230-31	0	47.2	+27	26	6.3:6.3	0.240	0.168	0.719	2
23		233	0	47.7	+63	59	5.4	0.355	0.127	0.696	11
24		238	0	48.1	+51	14	6.4	0.166	0.216	0.780	2
25		244	0	50.1	+60	51	4.9	0.346	0.193	0.412	2
26	21 Cet	255	0	51.8	- 9	1	6.2	0.571	0.286	0.403	2
27	67 Psc	262	0	53.3	+26	56	6.0	0.071	0.190	1.000	3
28	37 And	269	0	54.0	+38	14	3.9	0.067	0.195	1.054	26
29	39 And	290	1	0.1	+41	5	6.0	0.086	0.218	0.950	2
30		297	1	1.2	+61	19	5.8	0.356	0.183	0.475	2
31		303	1	1.7	+29	24	6.0	0.294	0.154	0.471	2
32	72 Psc	308	1	2.4	+14	41	5.6	0.276	0.149	0.508	2
33		309	1	3.2	+62	30	6.4	0.114	0.198	0.842	2
34	41 And	324	1	5.1	+43	41	5.0	0.028	0.226	1.046	2
35	78 Psc	327	1	5.2	+31	45	6.2	0.268	0.160	0.522	2
36	79 Psc	328	1	5.3	+20	28	5.6	0.064	0.188	0.949	2
37	80 Psc	330	1	5.8	+ 5	23	5.5	0.218	0.154	0.629	2
38	44 And	340	1	7.5	+41	49	5.7	0.390	0.168	0.410	2
39	33 Cas	343	1	8.0	+54	53	4.3	0.087	0.213	0.997	16
40	37 Cet	366	1	11.9	- 8	11	5.0	0.290	0.144	0.441	3
41	38 Cet	368	1	12.3	- 1	14	5.7	0.283	0.154	0.488	2
42	39 Cet	373	1	14.1	- 2	46	5.5	0.567	0.291	0.328	13
43	89 Psc	378	1	15.2	+ 3	21	5.2	0.028	0.182	1.104	2
44	34 Cas	382	1	16.9	+57	58	5.0	0.492	0.008	1.473	2
45	90 Psc	383	1	16.7	+27	0	4.6	0.022	0.161	1.189	3
46	44 Cet	401	1	21.5	- 8	16	6.2	0.124	0.205	0.829	2
47		407	1	22.9	+23	15	6.0	0.289	0.152	0.547	2
48		409	1	23.4	+43	12	6.0	0.326	0.156	0.421	2
49		410	1	23.3	+34	19	6.2	0.314	0.164	0.449	2
50	93 Psc	413	1	23.6	+18	55	5.3	0.256	0.148	0.485	19

No.	Name	HR	α(1950.0)	δ(1950.0)	V	b-y	m_1	c_1	n
51		415	1^h $24^m.3$	$+34^\circ$ 7'	$6^m.2$	$0^m.296$	$0^m.178$	$0^m.461$	2
52	48 And	417	1 24.7	+45 9	4.9	0.288	0.148	0.477	2
53		418	1 24.5	+40 50	6.4	0.187	0.196	0.684	2
54	97 Psc	432	1 27.2	+18 6	5.9	0.090	0.166	1.093	2
55	99 Psc	437	1 28.8	+15 5	3.6	0.605	0.374	0.393	2
56		448	1 31.2	- 7 17	5.8	0.395	0.214	0.389	2
57		457	1 33.2	+17 11	5.8	0.145	0.193	0.847	4
58	50 And	458	1 33.9	+41 9	4.1	0.346	0.177	0.410	25
59	102 Psc	463	1 34.4	+11 53	5.6	0.236	0.142	0.615	2
60		476	1 37.7	+43 3	5.4	0.116	0.201	0.978	2
61		483	1 38.7	+42 22	4.9	0.389	0.203	0.338	4
62		484	1 38.5	+25 30	6.2	0.306	0.154	0.463	2
63		515	1 43.9	+17 10	6.4	0.158	0.173	0.979	2
64		518	1 44.7	+45 59	6.2	0.296	0.146	0.511	2
65		523	1 45.8	+32 26	5.7	0.369	0.160	0.364	2
66		529	1 47.7	+51 41	5.8	0.264	0.181	0.505	3
67		534	1 48.2	+10 48	5.9	0.203	0.148	0.642	2
68		540	1 50.5	+55 21	6.5	0.084	0.244	0.886	2
69	2 α Tri	544	1 50.2	+29 20	3.5	0.316	0.156	0.501	3
70	6 β Ari	553	1 51.9	+20 34	2.6	0.064	0.211	0.983	7
71	9 Ari	569	1 55.1	+23 21	4.8	0.175	0.179	0.817	3
72		578	1 56.7	+12 3	6.0	0.108	0.196	0.915	2
73	112 Psc	582	1 57.5	+ 2 52	5.9	0.388	0.208	0.411	2
74	52 Cas	586	1 59.1	+64 40	5.9	0.006	0.157	1.018	3
75	3 Tri	599	2 0.0	+33 3	5.5	0.006	0.169	1.098	2
76	60 Cet	607	2 0.6	- 0 7	5.6	0.080	0.188	1.064	2
77		618	2 5.2	+58 11	5.7	0.488	-0.068	0.648	2
78	58 And	620	2 5.5	+37 37	4.8	0.055	0.195	1.063	3
79	4 β Tri	622	2 6.6	+34 45	3.0	0.071	0.191	1.065	6
80	14 Ari	623	2 6.6	+25 42	5.0	0.211	0.184	0.874	20
81		624	2 6.6	+16 59	6.4	0.296	0.147	0.403	2
82	64 Cet	635	2 8.7	+ 8 20	5.6	0.366	0.170	0.462	2
83		638	2 8.9	-10 17	6.1	0.263	0.154	0.525	3
84	17 Ari	646	2 10.0	+20 59	5.2	0.308	0.132	0.466	2
85	20 Ari	656	2 12.9	+25 33	5.8	0.288	0.171	0.498	2
86	21 Ari	657	2 12.9	+24 49	5.6	0.339	0.140	0.452	2
87	8 Tri	660	2 14.0	+34 0	4.9	0.386	0.191	0.254	22
88		671	2 16.0	+46 15	6.0	0.100	0.156	1.085	3
89		672	2 15.4	+ 1 31	5.6	0.373	0.192	0.385	2
90		673	2 16.1	+48 43	6.4	0.283	0.150	0.490	2
91	10 Tri	675	2 16.0	+28 25	5.2	0.011	0.161	1.145	21
92		684	2 17.2	- 4 34	6.5	0.035	0.177	1.068	2
93	9 Per	685	2 18.9	+55 37	5.2	0.321	-0.038	0.753	16
94		687	2 19.7	+41 10	5.8	0.186	0.158	0.768	2
95		690	2 20.4	+55 8	5.4	0.542	0.171	0.884	2
96	70 Cet	691	2 19.7	- 1 7	5.6	0.194	0.176	0.862	2
97	66 And	709	2 24.5	+50 21	6.1	0.278	0.147	0.476	2
98	12 Tri	717	2 25.2	+29 27	5.3	0.178	0.211	0.780	17
99	13 Tri	720	2 25.9	+29 42	5.8	0.381	0.174	0.353	3
100		723	2 26.4	+23 15	6.0	0.076	0.236	0.935	2

No.	Name	HR	α(1950.0)		δ(1950.0)		V	b-y	m_1	c_1	n
101		728	2^h	$27^m.7$	$+25^\circ$	$1'$	$5^m.8$	$0^m.269$	$0^m.158$	$0^m.559$	4
102	26 Ari	729	2	27.8	+19	38	6.1	0.155	0.185	0.839	4
103		732	2	28.2	+ 0	2	6.0	0.090	0.190	0.988	2
104	29 Ari	741	2	30.2	+14	49	6.0	0.354	0.196	0.349	2
105		756	2	33.8	+38	31	5.9	0.320	0.160	0.463	2
106		761	2	34.1	+32	40	6.2	0.321	0.151	0.438	2
107	31 Ari	763	2	33.9	+12	14	5.6	0.336	0.146	0.380	2
108		765	2	34.1	+24	26	6.6	0.267	0.161	0.485	3
109		768	2	35.2	+37	31	6.2	0.306	0.170	0.529	2
110		770	2	35.4	+ 7	29	6.4	0.281	0.150	0.510	2
111	32 Ari	773	2	36.0	+21	45	5.3	0.092	0.182	1.095	24
112		783	2	37.6	+ 5	54	6.2	0.268	0.154	0.466	2
113		784	2	37.8	- 9	40	5.9	0.319	0.174	0.348	2
114	12 Per	788	2	39.1	+39	59	4.9	0.368	0.198	0.400	2
115	13 Per	799	2	40.8	+49	1	4.1	0.326	0.165	0.373	2
116		803	2	40.9	+25	26	6.3	0.045	0.169	1.055	2
117	38 Ari	812	2	42.2	+12	14	5.1	0.136	0.185	0.841	20
118	87 Cet	813	2	42.2	+ 9	54	4.2	0.189	0.187	0.762	17
119		816	2	42.7	+ 4	30	6.0	0.191	0.193	0.722	3
120		825	2	45.8	+56	53	6.3	0.682	-0.119	1.413	3
121		831	2	46.3	+37	7	6.4	0.269	0.176	0.678	2
122	16 Per	840	2	47.4	+38	7	4.2	0.220	0.174	0.761	2
123		856	2	50.4	+16	17	6.3	0.296	0.154	0.693	2
124		859	2	50.4	- 9	39	6.3	0.104	0.186	0.983	2
125		860	2	52.0	+61	19	5.6	0.287	0.133	0.442	2
126	46 Ari	869	2	53.6	+17	49	5.5	0.308	0.153	0.452	2
127		870	2	53.6	+ 8	11	6.0	0.315	0.164	0.499	2
128		875	2	54.1	- 3	55	5.2	0.048	0.166	1.060	2
129	47 Ari	878	2	55.2	+20	28	5.8	0.277	0.166	0.483	4
130	22 Per	879	2	55.6	+39	28	4.6	0.050	0.134	1.181	2
131		892	2	56.2	- 2	59	5.2	0.002	0.161	1.145	2
132		895	2	56.4	- 9	59	6.1	0.118	0.220	0.842	2
133	49 Ari	905	2	59.0	+26	16	5.9	0.070	0.221	0.968	3
134		913	2	59.7	- 6	41	6.2	0.371	0.199	0.387	2
135	23 Per	915	3	1.2	+53	19	2.9	0.442	0.214	0.694	2
136		916	3	0.5	+28	4	6.3	0.193	0.158	0.702	2
137	10 Eri	925	3	1.8	- 7	48	5.3	0.114	0.189	0.899	3
138		937	3	5.4	+49	25	4.0	0.376	0.201	0.376	23
139	94 Cet	962	3	10.2	- 1	23	5.1	0.362	0.192	0.400	2
140		975	3	12.7	+32	40	6.3	0.248	0.134	0.566	3
141		976	3	12.9	+34	30	6.2	0.156	0.216	0.781	2
142	13 Eri	984	3	13.4	- 9	0	4.8	0.137	0.188	0.847	3
143	14 Eri	988	3	14.2	- 9	20	6.1	0.257	0.162	0.466	2
144		1001	3	18.3	+48	54	6.1	0.293	0.167	0.495	2
145	32 Per	1002	3	18.1	+43	9	5.0	0.022	0.190	1.026	2
146	33 α Per	1017	3	20.7	+49	41	1.8	0.304	0.194	1.076	4
147		1020	3	22.1	+53	45	6.3	0.189	0.159	0.777	3
148		1024	3	20.9	- 7	58	6.2	0.436	0.121	0.268	2
149		1036	3	24.2	+18	35	6.4	0.106	0.158	0.982	2
150		1046	3	26.2	+55	17	5.1	0.019	0.168	1.062	2

No.	Name	HR	α(1950.0)		δ(1950.0)		V	b-y	m_1	c_1	n
151		1068	3^h	$29^m.5$	$+58^o$	36'	$6^m.2$	$0^m.063$	$0^m.214$	$0^m.985$	3
152	36 Per	1069	3	29.0	+45	53	5.3	0.267	0.142	0.540	5
153		1071	3	29.7	+57	42	6.3	0.342	0.152	0.418	2
154		1073	3	29.8	+54	48	5.8	0.072	0.163	1.030	2
155	7 Tau	1086	3	31.5	+24	18	6.6:6.7	0.073	0.162	1.124	2
156		1089	3	32.2	+ 6	15	6.4	0.404	0.180	0.474	2
157		1102	3	35.0	+15	16	6.6	0.089	0.212	0.910	2
158		1129	3	41.6	+63	11	4.8	0.554	0.110	0.450	3
159		1130	3	41.2	+45	57	6.0	0.181	0.158	1.049	3
160	38 Per	1131	3	41.2	+32	8	3.8	0.094	0.014	0.073	3
161		1133	3	41.3	+36	18	5.5	0.032	0.179	1.090	2
162	41 Per	1135	3	41.8	+42	25	3.8	0.267	0.185	0.972	3
163		1138	3	44.0	+70	43	5.4	0.038	0.214	1.074	2
164	16 Tau	1140	3	41.8	+24	8	5.4	-0.001	0.105	0.647	6
165	17 Tau	1142	3	41.9	+23	57	3.7	-0.038	0.094	0.640	2
166	18 Tau	1144	3	42.2	+24	41	5.6	-0.025	0.109	0.639	6
167	19 Tau	1145	3	42.2	+24	19	4.3	-0.039	0.098	0.553	2
168	20 Tau	1149	3	42.8	+24	13	3.9	-0.014	0.090	0.626	2
169	21 Tau	1151	3	42.9	+24	24	5.8	-0.003	0.114	0.768	2
170	22 Tau	1152	3	43.1	+24	22	6.4	-0.004	0.132	0.860	2
171	23 Tau	1156	3	43.4	+23	48	4.2	-0.001	0.082	0.612	2
172		1158	3	45.2	+63	9	5.9	0.114	0.182	0.891	2
173		1164	3	44.7	+32	3	6.2	0.322	0.134	0.424	2
174	25 Tau	1165	3	44.5	+23	57	2.9	-0.019	0.074	0.744	2
175		1170	3	45.7	+43	49	5.8	0.179	0.154	0.826	3
176		1172	3	45.4	+23	16	5.4	-0.024	0.111	0.714	2
177		1176	3	46.6	+44	49	5.7	0.485	0.256	0.443	2
178	42 Per	1177	3	46.4	+32	56	5.1	0.019	0.176	1.158:	2
179	27 Tau	1178	3	46.2	+23	54	3.6	-0.023	0.095	0.710	4
180	28 Tau	1180	3	46.2	+23	59	5.1	-0.024	0.100	0.549	2
181		1183	3	46.8	+23	34	6.2	-0.014	0.120	0.896	2
182		1197	3	48.9	+31	1	6.2	0.114	0.194	0.952	2
183		1201	3	50.3	+17	11	6.0	0.221	0.166	0.610	21
184	43 Per	1210	3	52.9	+50	33	5.3	0.279	0.159	0.490	2
185	32 Tau	1218	3	53.9	+22	20	5.7	0.225	0.152	0.660	2
186		1223	3	54.8	+34	40	6.4	0.124	0.190	0.818	2
187		1233	3	56.9	+10	11	6.4	0.271	0.173	0.477	3
188		1238	3	57.9	+18	3	5.9	0.207	0.169	0.706	2
189		1242	4	0.3	+59	1	5.0	0.347	0.112	1.487	2
190		1248	4	1.9	+65	23	6.0	0.076	0.222	1.078	2
191	38 Tau	1251	4	0.5	+ 5	51	3.9	0.015	0.170	1.092	2
192	36 Tau	1252	4	1.4	+23	58	5.6	0.627	0.060	0.486	2
193		1254	4	1.2	+ 8	4	5.5	0.250	0.146	0.558	2
194	42 Tau	1269	4	3.9	+28	52	5.3	0.226	0.159	0.588	15
195		1276	4	5.4	+54	42	6.2	0.282	0.166	0.470	2
196	50 Per	1278	4	5.3	+37	55	5.5	0.334	0.180	0.373	2
197	44 Tau	1287	4	7.8	+26	21	5.4	0.215	0.175	0.752	4
198	45 Tau	1292	4	8.7	+ 5	24	5.7	0.231	0.163	0.592	17
199		1296	4	10.9	+57	20	6.1	0.483	-0.002	1.620	4
200	38 Eri	1298	4	9.4	- 6	58	4.0	0.197	0.192	0.789	3

No.	Name	HR	α(1950.0)	δ(1950.0)	V	b-y	m_1	c_1	n
201	51 Per	1303	$4^h\ 11^m.2$	$+48^\circ\ 17'$	$4^m.1$	$0^m.614$	$0^m.268$	$0^m.551$	10
202		1308	4 10.8	+ 8 46	6.4	0.060	0.242	0.938	2
203	48 Tau	1319	4 12.9	+15 17	6.3	0.261	0.172	0.525	4
204		1321	4 12.8	+ 6 5	7.2	0.410	0.260	0.287	2
205		1322	4 12.8	+ 6 4	6.5	0.367	0.190	0.318	2
206		1324	4 14.5	+50 10	4.5	0.029	0.151	1.110	2
207		1327	4 15.9	+65 1	5.3	0.508	0.290	0.403	10
208	50 Tau	1329	4 14.3	+20 27	4.8	0.146	0.235	0.745	12
209		1330	4 15.5	+49 56	5.4	0.138	0.182	0.963	2
210	51 Tau	1331	4 15.4	+21 28	5.6	0.175	0.185	0.787	8
211		1334	4 15.7	+ 9 22	6.5	0.092	0.170	1.161	2
212	56 Tau	1341	4 16.6	+21 39	5.2	-0.100	0.201	0.550	2
213		1342	4 17.8	+56 23	5.9	0.058	0.188	1.030	2
214	57 Tau	1351	4 17.1	+13 55	5.6	0.172	0.197	0.770	2
215		1354	4 17.5	+18 37	6.1	0.243	0.166	0.596	2
216	58 Tau	1356	4 17.8	+14 59	5.3	0.126	0.206	0.866	2
217		1358	4 18.1	+13 45	6.2	0.292	0.177	0.437	4
218	60 Tau	1368	4 19.2	+13 58	5.7	0.204	0.194	0.727	2
219	63 Tau	1376	4 20.5	+16 40	5.6	0.180	0.237	0.738	10
220	64 Tau	1380	4 21.2	+17 20	4.8	0.081	0.210	0.981	8
221	66 Tau	1381	4 21.1	+ 9 21	5.1	0.038	0.172	1.156	2
222		1385	4 22.0	+18 56	6.0	0.248	0.166	0.610	2
223	65 Tau	1387	4 22.4	+22 11	4.2	0.070	0.200	1.054	11
224	67 Tau	1388	4 22.4	+22 5	5.3	0.149	0.193	0.840	13
225	68 Tau	1389	4 22.6	+17 49	4.3	0.020	0.193	1.046	6
226	70 Tau	1391	4 22.8	+15 50	6.5	0.315	0.181	0.390	3
227	69 Tau	1392	4 23.3	+22 42	4.3	0.168	0.172	0.947	2
228	71 Tau	1394	4 23.5	+15 30	4.5	0.150	0.188	0.934	11
229		1403	4 25.0	+21 31	5.7	0.165	0.213	0.772	3
230		1406	4 25.7	+30 15	6.4	0.344	0.172	0.494	2
231	76 Tau	1408	4 25.6	+14 38	5.9	0.206	0.170	0.700	3
232	78 Tau	1412	4 25.8	+15 46	3.4	0.102	0.199	1.014	8
233	79 Tau	1414	4 26.0	+12 56	5.0	0.114	0.225	0.912	11
234		1427	4 27.7	+16 5	4.8	0.088	0.217	0.965	3
235	81 Tau	1428	4 27.8	+15 35	5.5	0.140	0.240	0.796	2
236	83 Tau	1430	4 27.8	+13 37	5.4	0.154	0.201	0.814	11
237	85 Tau	1432	4 29.0	+15 45	6.0	0.215	0.175	0.658	5
238	57 Per	1434	4 29.9	+42 58	6.0	0.272	0.139	0.596	2
239		1436	4 29.4	+ 5 18	6.4	0.271	0.177	0.483	4
240	86 Tau	1444	4 31.0	+14 44	4.7	0.144	0.205	0.823	8
241		1455	4 32.8	+19 47	6.5	0.456	0.272	0.495	2
242	88 Tau	1458	4 32.9	+10 4	4.3	0.095	0.194	0.949	3
243		1459	4 33.5	+23 14	6.0	0.240	0.182	0.576	2
244		1470	4 35.4	+26 51	7.2:7.2	0.225	0.162	0.548	2
245	89 Tau	1472	4 35.3	+15 56	5.8	0.191	0.188	0.740	3
246	90 Tau	1473	4 35.4	+12 25	4.3	0.070	0.194	1.052	2
247		1477	4 36.3	+25 7	6.2	0.105	0.168	1.060	2
248	91 Tau	1478	4 36.3	+15 42	5.1	0.058	0.224	0.992	2
249	92 Tau	1479	4 36.4	+15 49	4.7	0.090	0.192	1.010	2
250		1480	4 36.4	+ 7 46	5.4	0.150	0.223	0.828	2

No.	Name		HR	α (1950.0)		δ (1950.0)		V	b-y	m_1	c_1	n
251			1486	4^h	$39^m.0$	+59°	26'	$7^m.2$:7.2	$0^m.130$	$0^m.196$	$0^m.910$	2
252			1489	4	38.4	+38	11	5.8	0.372	0.200	0.397	2
253	95	Tau	1499	4	40.2	+24	0	6.1	0.345	0.181	0.442	2
254			1501	4	40.6	+32	46	6.4	0.190	0.166	0.701	2
255			1507	4	41.7	+11	3	5.4	0.151	0.193	0.816	3
256	4	Cam	1511	4	43.8	+56	40	5.3	0.135	0.230	0.877	2
257			1515	4	44.0	+55	31	6.2	0.199	0.177	0.660	2
258			1528	4	46.1	+32	30	5.9	0.147	0.225	0.874	2
259	1	Ori	1543	4	47.1	+ 6	53	3.2	0.299	0.162	0.413	17
260			1546	4	49.2	+52	46	6.3	0.035	0.170	1.100	2
261	97	Tau	1547	4	48.4	+18	45	5.1	0.132	0.195	0.900	2
262			1554	4	49.7	+27	49	5.8	0.227	0.184	0.844	2
263			1561	4	52.1	+52	47	5.6	0.052	0.170	1.126	2
264			1566	4	52.0	+19	24	6.4	0.178	0.190	0.739	3
265	6	Ori	1569	4	52.0	+11	21	5.1	0.078	0.168	1.079	2
266			1575	4	53.2	+24	31	6.1	0.233	0.150	0.561	2
267			1593	4	57.1	+61	0	6.0	0.273	0.179	0.468	2
268	5	Aur	1599	4	56.9	+39	19	5.9	0.280	0.157	0.484	2
269	7	Aur	1605	4	58.4	+43	45	3.0	0.426	0.021	1.286	2
270	102	Tau	1620	5	0.1	+21	31	4.6	0.080	0.203	1.031	21
271			1627	5	1.4	+32	15	6.4	0.171	0.210	0.819	2
272			1632	5	1.5	+27	38	6.5	0.134	0.200	0.868	2
273	9	Aur	1637	5	2.8	+51	32	4.9	0.217	0.152	0.642	2
274			1639	5	2.7	+35	52	6.3	0.094	0.202	0.908	2
275	10	Aur	1641	5	3.0	+41	10	3.2	-0.086	0.108	0.315	5
276			1644	5	3.3	+43	7	6.2	0.294	0.149	1.070	2
277			1647	5	4.9	+64	52	6.3	0.281	0.165	0.440	2
276	104	Tau	1656	5	4.5	+18	35	5.7:5.7	0.415	0.197	0.332	9
279	106	Tau	1658	5	4.8	+20	21	5.2	0.044	0.204	1.030	2
280	13	Ori	1662	5	4.9	+ 9	25	6.2	0.396	0.185	0.347	2
281	67	Eri	1666	5	5.4	- 5	9	2.8	0.069	0.184	1.091	3
282			1668	5	7.0	+46	54	5.5	0.300	0.130	0.576	2
283			1670	5	6.6	+27	58	6.0	0.149	0.245	0.803	3
284	16	Ori	1672	5	6.6	+ 9	46	5.4	0.138	0.245	0.840	13
285	68	Eri	1673	5	6.2	- 4	31	5.1	0.300	0.151	0.443	3
286	15	Ori	1676	5	6.8	+15	32	4.8	0.194	0.182	0.944	2
287	14	Cam	1678	5	8.9	+62	38	6.4	0.125	0.172	0.935	2
288			1687	5	8.8	- 2	33	5.9	0.298	0.184	0.468	2
289	11	Aur	1689	5	10.0	+38	26	4.7	0.101	0.226	0.854	2
290	14	Aur	1706	5	12.1	+32	38	5.1	0.130	0.180	0.998	2
291	13	Aur	1708	5	13.0	+45	57	0.1	0.513	0.278	0.425	2
292			1717	5	12.8	- 1	28	6.1	0.260	0.152	0.532	2
293	15	Aur	1729	5	15.6	+40	3	4.7	0.389	0.206	0.363	12
294	18	Aur	1734	5	16.1	+33	56	6.5	0.144	0.195	0.810	3
295			1736	5	16.9	+46	55	6.4	0.394	0.145	0.891	2
296			1738	5	16.7	+41	2	5.4	0.076	0.160	1.042	2
297	19	Aur	1740	5	16.7	+33	54	5.0	0.226	0.060	1.599	2
298	21	Ori	1746	5	16.6	+ 2	33	5.3	0.268	0.177	0.682	2
299			1760	5	19.3	+40	59	5.5	0.084	0.163	1.101	2
300	110	Tau	1774	5	20.7	+16	39	6.0	0.078	0.166	1.072	2

No.	Name	HR	α (1950.0)		δ (1950.0)		V	b-y	m_1	c_1	n
301	111 Tau	1780	5^h	$21^m.5$	$+17^o$	20	$5^m.0$	$0^m.348$	$0^m.169$	$0^m.352$	2
302	112 β Tau	1791	5	23.1	+28	34	1.6	-0.055	0.101	0.562	3
303		1809	5	24.4	+15	13	6.0	0.046	0.155	1.166	2
304		1819	5	25.7	+13	38	6.2	0.092	0.177	1.026	2
305		1822	5	26.5	+29	9	6.2	0.308	0.150	0.532	2
306	18 Cam	1828	5	28.3	+57	11	6.4	0.376	0.179	0.417	2
307	9 β Lep	1829	5	26.1	-20	48	2.8	0.510	0.260	0.446	2
308		1832	5	27.6	+15	19	5.7	0.060	0.168	1.093	2
309		1854	5	30.3	+34	42	6.0	0.103	0.168	1.040	2
310		1869	5	32.5	+47	41	6.0	0.158	0.208	0.901	2
311	38 Ori	1872	5	31.6	+ 3	44	5.4	0.028	0.168	1.081	2
312		1889	5	33.4	+25	55	6.2	0.288	0.161	0.557	2
313	45 Ori	1901	5	33.2	- 4	53	5.3	0.150	0.185	0.998	2
314	122 Tau	1905	5	34.2	+17	1	5.5	0.133	0.203	0.850	12
315		1929	5	36.4	+21	44	6.3	0.056	0.144	1.080	2
316		1940	5	37.0	- 3	35	6.0	0.187	0.164	0.662	2
317		1955	5	38.5	+ 0	19	5.9	0.194	0.167	0.718	2
318	26 Cam	1969	5	42.3	+56	6	6.0	0.098	0.173	0.956	2
319		1974	5	42.3	+40	29	6.4	0.160	0.175	0.764	2
320		1978	5	42.4	+ 3	59	6.1	0.202	0.180	0.704	2
321	131 Tau	1989	5	44.4	+14	28	5.6	0.042	0.168	1.114	2
322	130 Tau	1990	5	44.5	+17	43	5.4	0.196	0.148	1.176	2
323	29 Cam	1992	5	46.3	+56	54	6.4	0.070	0.176	1.100	2
324	14 Lep	1998	5	44.7	-14	50	3.6	0.052	0.199	0.988	2
325	52 Ori	1999	5	45.3	+ 6	26	6.0:6.0	0.132	0.198	0.996	2
326		2001	5	45.1	-10	33	6.0	0.072	0.190	1.082	2
327		2025	5	49.2	+39	34	6.4	0.078	0.129	1.220	2
328	30 Aur	2029	5	50.7	+55	42	4.9	0.025	0.169	1.127	2
329	136 Tau	2034	5	50.2	+27	36	4.5	0.000	0.136	1.153	9
330		2045	5	52.3	+51	48	6.4	0.112	0.148	1.173	2
331		2046	5	51.7	+31	42	5.8	0.082	0.189	1.030	2
332	54 Ori	2047	5	51.4	+20	16	4.4	0.380	0.193	0.307	20
333		2066	5	53.4	+28	56	6.4	0.266	0.013	1.472	2
334		2079	5	55.6	+55	19	6.4	0.194	0.218	0.759	2
335	16 Lep	2085	5	54.1	-14	11	3.7	0.218	0.163	0.625	3
336	59 Ori	2100	5	55.8	+ 1	50	6.0	0.116	0.218	0.952	2
337	1 Mon	2107	5	56.6	- 9	23	6.3	0.153	0.197	0.888	2
338	2 Mon	2108	5	56.7	- 9	34	5.0	0.083	0.242	0.994	2
339		2122	5	59.6	+32	38	6.2	0.290	0.158	0.487	2
340		2123	6	0.5	+51	35	6.3	0.100	0.190	0.985	2
341		2137	6	1.6	+37	58	6.3	0.523	0.274	0.548	2
342		2141	6	2.8	+35	24	6.0	0.374	0.182	0.334	2
343	40 Aur	2143	6	3.1	+38	29	5.3	0.139	0.222	0.923	15
344		2150	6	3.1	-10	14	5.9	0.219	0.180	0.621	3
345		2172	6	7.7	+52	40	6.2	0.066	0.223	0.937	2
346		2179	6	7.1	- 5	42	6.2	0.222	0.153	0.674	3
347		2191	6	8.6	+13	39	5.9	0.026	0.128	1.126	2
348		2214	6	11.6	+17	55	6.5:6.5	0.146	0.208	0.920	2
349	71 Ori	2220	6	11.9	+19	11	5.2	0.293	0.163	0.448	8
350	42 Aur	2228	6	13.9	+46	27	6.5	0.157	0.192	0.804	2

No.	Name		HR	α(1950.0)		δ(1950.0)		V	b-y	m_1	c_1	n
351			2233	6^h	$13^m.0$	-0°	30'	$5^m.6$	$0^m.314$	$0^m.172$	$0^m.434$	2
352			2234	6	13.0	- 4	54	6.0	0.028	0.216	0.978	2
353			2236	6	13.3	+ 1	11	6.3	0.310	0.135	0.475	3
354	2	Lyn	2238	6	15.2	+59	2	4.4	0.004	0.180	1.066	2
355	74	Ori	2241	6	13.6	+12	17	5.0	0.284	0.153	0.438	8
356	75	Ori	2247	6	14.4	+ 9	58	5.4	0.050	0.200	0.985	2
357			2251	6	14.6	+ 5	7	5.7	0.382	0.200	0.331	2
358	45	Aur	2264	6	17.7	+53	29	5.4	0.284	0.171	0.632	12
359			2287	6	19.8	+12	36	5.9	0.192	0.174	0.770	2
360	8	Mon	2298	6	21.1	+ 4	37	4.5	0.115	0.183	0.974	3
361			2313	6	22.7	- 0	55	5.9	0.366	0.166	0.395	2
362			2321	6	23.6	- 7	52	6.4	0.081	0.174	1.058	2
363			2339	6	25.8	+27	0	6.4	0.342	0.169	0.389	2
364			2351	6	26.2	+11	3	6.4	0.182	0.183	0.707	2
365	19	Gem	2371	6	28.7	+15	56	6.4	0.164	0.169	0.944	2
366			2375	6	29.0	+11	35	5.1	0.101	0.172	0.999	9
367			2386	6	29.9	- 5	50	5.6	0.158	0.177	0.812	2
368	8	Lyn	2394	6	33.1	+61	32	5.9	0.546	0.300	0.375	2
369			2417	6	34.4	+24	38	6.4	0.057	0.150	1.088	2
370	24	Gem	2421	6	34.8	+16	27	1.9	0.004	0.148	1.187	6
371			2439	6	36.5	+24	39	6.4	0.340	0.176	0.308	2
372			2449	6	37.0	+13	2	5.8	0.022	0.197	1.050	2
373			2452	6	38.3	+35	59	6.2	0.334	0.155	0.376	2
374	56	Aur	2483	6	43.1	+43	38	5.2	0.357	0.185	0.371	14
375	31	Gem	2484	6	42.5	+12	57	3.4	0.288	0.167	0.552	18
376			2485-86	6	44.0	+55	46	6.3:6.3	0.314	0.167	0.432	2
377	32	Gem	2489	6	43.1	+12	45	6.4	0.239	0.116	1.414	2
378	9α	C Ma	2491	6	42.9	-16	39	-1.5	-0.008	0.169	0.976	2
379			2514	6	45.8	- 1	16	5.7	0.178	0.180	0.714	2
380			2530	6	48.3	- 0	29	5.8	0.272	0.123	0.465	3
381			2532	6	49.5	+44	54	6.0	0.136	0.174	0.964	2
382	59	Aur	2539	6	49.6	+38	56	6.0	0.240	0.186	0.764	2
383	34	Gem	2540	6	49.5	+34	1	3.6	0.060	0.178	1.163	2
384	61	Aur	2547	6	50.5	+38	34	6.2	-0.016	0.125	0.895	2
385			2551	6	50.1	+ 8	27	5.8	0.156	0.183	0.874	2
386			2557	6	51.6	+43	58	6.0	0.221	0.142	1.023	2
387	37	Gem	2569	6	52.2	+25	26	5.7	0.376	0.184	0.306	2
388			2572	6	51.9	- 1	4	5.4	0.098	0.172	1.128	2
389	16	Lyn	2585	6	54.0	+45	10	4.9	0.011	0.163	1.101	13
390			2586	6	53.7	+33	45	5.9	0.541	0.332	0.346	2
391			2597	6	54.6	+11	58	6.1	0.245	0.118	1.338	2
392			2599	6	54.6	- 8	7	6.4	0.415	0.162	0.684	2
393	39	Gem	2601	6	55.7	+26	9	6.0	0.348	0.134	0.390	2
394			2606	6	55.9	+ 7	41	6.3	0.057	0.188	1.013	2
395			2620	6	58.0	+32	29	6.4	0.174	0.182	0.890	2
396			2622	6	57.8	- 5	18	6.4	0.364	0.185	0.405	2
397			2643	7	0.3	+29	25	5.8	0.374	0.198	0.301	2
398			2644	7	1.7	+52	50	6.9:7.0	0.037	0.200	0.970	2
399			2647	7	0.6	+ 9	13	6.0	0.072	0.193	0.983	2
400	47	Gem	2700	7	8.3	+26	56	5.6	0.066	0.183	1.095	2

No.	Name	HR	α(1950.0)		δ(1950.0)		V	b-y	m_1	c_1	n
401	48 Gem	2706	7^h	$9^m.4$	$+24^\circ$	$13'$	$5^m.7$	$0^m.246$	$0^m.170$	$0^m.786$	2
402	21 Mon	2707	7	8.8	- 0	13	5.4	0.184	0.187	0.878	27
403		2711	7	9.7	+27	19	7.1:7.1	0.330	0.174	0.380	2
404		2721	7	12.1	+47	20	5.6	0.370	0.173	0.294	5
405		2751	7	14.7	+49	33	4.8	0.060	0.138	1.206	2
406	64 Aur	2753	7	14.6	+40	58	5.7	0.102	0.177	1.016	2
407	54 Gem	2763	7	15.2	+16	38	3.6	0.048	0.198	1.055	22
408		2776	7	17.7	+45	19	5.6	0.216	0.168	0.612	2
409	55 Gem	2777	7	17.1	+22	5	3.5	0.221	0.156	0.696	16
410		2779	7	17.1	+ 7	14	5.9	0.340	0.169	0.462	3
411		2798	7	18.9	- 8	47	6.5	0.346	0.169	0.379	2
412		2807	7	19.8	- 2	53	6.3	0.427	0.221	0.590	3
413		2811	7	20.0	- 5	53	5.8	0.209	0.190	0.941	3
414	59 Gem	2816	7	21.4	+27	44	5.6	0.228	0.171	0.744	2
415	1 C Mi	2820	7	22.2	+11	46	5.3	0.061	0.184	1.109	2
416		2833	7	23.4	- 5	40	6.0	0.565	0.350	0.463	3
417		2835	7	23.9	+21	38	6.4	0.324	0.123	0.356	2
418	61 Gem	2837	7	24.0	+20	22	5.8	0.205	0.167	0.843	2
419	3 β C Mi	2845	7	24.4	+ 8	23	2.8	-0.038	0.113	0.801	6
420	63 Gem	2846	7	24.8	+21	33	5.2	0.286	0.166	0.466	2
421	22 Lyn	2849	7	26.1	+49	47	5.4	0.308	0.142	0.390	4
422	5 C Mi	2851	7	25.3	+ 7	3	5.3	0.136	0.191	1.001	3
423	62 Gem	2852	7	25.9	+31	53	4.2	0.217	0.152	0.606	8
424	64 Gem	2857	7	26.2	+28	13	5.0	0.062	0.202	1.013	12
425		2866	7	27.0	- 7	27	5.9	0.313	0.150	0.393	3
426	7 C Mi	2880	7	29.5	+ 2	1	5.2	0.131	0.173	1.203	13
427		2883	7	29.7	- 8	46	5.9	0.350	0.122	0.344	3
428	68 Gem	2886	7	30.8	+15	56	5.1	0.036	0.149	1.178	10
429	8 C Mi	2887	7	30.6	+ 3	24	5.6	0.188	0.206	0.723	3
430		2904	7	32.2	+ 2	50	6.4	0.135	0.198	0.971	3
431		2914	7	34.2	+48	53	5.8	0.118	0.250	0.904	2
432		2918	7	33.9	+ 5	58	5.9	0.372	0.190	0.393	3
433		2926	7	35.2	+24	28	6.2	0.216	0.156	0.608	2
434	25 Mon	2927	7	34.8	- 4	0	5.1	0.289	0.169	0.653	7
435	71 Gem	2930	7	35.9	+34	42	4.9	0.266	0.176	0.660	7
436		2936	7	36.7	+32	8	6.1	0.222	0.194	0.769	2
437	10 C Mi	2943	7	36.7	+ 5	21	0.3	0.272	0.167	0.532	2
438	24 Lyn	2946	7	38.8	+58	50	5.0	0.053	0.155	1.132	4
439		2958	7	38.2	- 8	4	6.0	0.085	0.174	1.003	2
440		2962	7	39.5	+34	7	6.0	0.310	0.153	0.486	2
441	49 Cam	2977	7	41.9	+62	57	6.3	0.143	0.265	0.735	3
442		2989	7	41.5	+ 2	32	6.3	0.112	0.202	1.006	3
443	82 Gem	3021	7	45.6	+23	16	6.1	0.377	0.159	0.706	2
444		3028	7	47.2	+54	15	6.0	0.317	0.156	0.416	2
445		3033	7	46.3	+ 4	28	6.4	0.489	0.274	0.382	2
446	83 Gem	3067	7	50.4	+26	54	5.0	0.052	0.190	1.068	2
447		3072	7	50.3	- 5	18	5.8	0.259	0.167	0.499	3
448		3087	7	52.8	+ 9	0	5.8	0.233	0.172	0.560	2
449		3106	7	57.2	+59	11	5.7	0.264	0.168	0.499	2
450	53 Cam	3109	7	57.5	+60	28	6.0	0.057	0.254	0.754	2

No.	Name		HR	α(1950.0)		δ(1950.0)		V	b-y	m_1	c_1	n
451			3112	7^h	$58^m.0$	+63°	14	$6^m.0$	$0^m.430$	$0^m.230$	$0^m.594$	2
452			3119	7	58.5	+57	25	6.4	0.405	0.198	0.394	2
453			3144	7	59.1	+ 9	3	6.0	0.357	0.200	0.473	2
454			3150	8	0.0	- 6	12	6.3	0.377	0.225	0.417	2
455	27	Lyn	3173	8	4.7	+51	39	4.8	0.021	0.150	1.099	17
456	10	Cnc	3176	8	4.8	+21	44	5.4	0.408	0.206	0.402	4
457	12	Cnc	3184	8	5.9	+13	47	6.2	0.313	0.152	0.514	2
458	29	Mon	3188	8	6.1	- 2	50	4.4	0.597	0.361	0.445	3
459			3193	8	8.1	+38	53	6.4	0.368	0.194	0.390	2
460			3214	8	9.6	+14	9	6.3	0.081	0.197	1.130	2
461			3224	8	10.7	+23	17	6.4	0.069	0.177	1.046	2
462			3228	8	11.3	+17	50	6.4	0.174	0.221	0.813	2
463	29	Lyn	3235	8	13.7	+59	44	5.5	0.090	0.193	1.034	2
464			3245	8	15.0	+62	40	5.7	0.552	0.341	0.384	2
465	30	Lyn	3254	8	16.4	+57	54	5.9	0.266	0.154	0.470	2
466			3258	8	16.7	+53	44	6.3	0.174	0.205	0.704	2
467	18	Cnc	3262	8	17.0	+27	23	5.1	0.314	0.146	0.384	12
468			3265	8	16.9	-10	1	6.3	0.196	0.230	0.786	2
469			3271	8	17.7	- 0	45	6.2	0.384	0.204	0.400	2
470			3277	8	20.0	+53	23	5.5	0.048	0.214	0.967	2
471	20	Cnc	3284	8	20.5	+18	30	5.8	0.091	0.217	1.026	2
472			3285	8	20.0	- 6	1	6.2	0.132	0.217	0.844	2
473			3295	8	22.1	- 4	33	6.0	0.302	0.163	0.508	2
474	1	Hya	3297	8	22.1	- 3	35	5.6	0.315	0.140	0.394	2
475	25	Cnc	3299	8	23.0	+17	13	6.1	0.286	0.146	0.489	2
476			3309	8	24.1	+45	49	6.3	0.394	0.214	0.317	2
477	23	Cnc	3310-11	8	23.8	+27	6	6.3:6.3	0.112	0.171	0.988	2
478			3314	8	23.2	- 3	45	3.9	-0.007	0.157	1.027	5
479	2	Hya	3321	8	24.0	- 3	49	5.4	0.128	0.194	0.833	3
480	1	U Ma	3323	8	26.1	+60	53	3.4	0.522	0.308	0.422	2
481			3325	8	24.8	- 6	15	6.6	0.338	0.163	0.518	2
482	28	Cnc	3329	8	25.7	+24	19	6.0	0.140	0.195	0.944	2
483	29	Cnc	3333	8	25.8	+14	23	5.9	0.120	0.176	1.021	2
484			3342	8	26.4	- 9	35	6.0	0.268	0.188	0.938	2
485	30	Cnc	3355	8	28.6	+24	15	5.6	0.194	0.172	0.800	2
486	32	Lyn	3365	8	30.2	+36	36	6.1	0.272	0.136	0.458	2
487	33	Lyn	3377	8	31.5	+36	36	5.7	0.034	0.145	1.065	2
488			3380	8	31.5	+ 8	37	5.9	0.213	0.162	0.735	2
489	35	Cnc	3387	8	32.5	+19	46	6.5	0.442	0.200	0.459	2
490	3	U Ma	3391	8	34.8	+65	12	5.6	0.390	0.206	0.282	2
491			3394	8	33.3	+15	29	6.2	0.211	0.186	0.732	2
492			3395	8	33.2	+ 6	48	6.0	0.329	0.181	0.395	4
493			3396	8	33.2	+ 6	48	7.2	0.428	0.271	0.305	3
494	3	Hya	3398	8	33.0	- 7	49	5.7	-0.041	0.212	1.021	2
495			3416	8	35.9	- 6	29	6.5	0.287	0.145	0.821	2
496			3423	8	37.2	+32	7	6.0	0.258	0.164	0.614	2
497			3451	8	41.0	+37	6	6.3	0.290	0.164	0.473	2
498			3459	8	41.2	- 7	3	4.6	0.519	0.289	0.476	10
499	10	Hya	3469	8	42.4	+ 5	52	6.1	0.109	0.200	0.872	2
500	48	Cnc	3474	8	43.6	+28	57	6.6	0.020	0.185	1.014	2

No.	Name		HR	α (1950.0)		δ (1950.0)		V	b-y	m_1	c_1	n
501	48	Cnc	3475	8^h	$43^m.7$	$+28^\circ$	$57'$	$4^m.2$	$0^m.606$	$0^m.406$	$0^m.414$	2
502			3499	8	47.4	+33	28	6.1	0.336	0.184	0.362	2
503	5	U Ma	3505	8	49.3	+62	9	5.7	0.188	0.166	0.869	2
504			3506	8	49.2	+59	15	6.2	0.263	0.166	0.562	2
505	54	Cnc	3510	8	48.2	+15	32	6.2	0.420	0.206	0.386	2
506	51	Cnc	3519	8	49.5	+32	40	5.8	0.118	0.216	0.822	2
507			3526	8	49.8	+ 5	32	6.4:9.6	0.067	0.185	1.163	2
508			3528	8	50.8	+35	44	6.0	0.036	0.155	1.200	2
509			3538	8	51.8	- 5	15	6.0	0.411	0.237	0.341	2
510			3546	8	53.3	+40	24	5.8	0.232	0.179	0.710	2
511	59	Cnc	3555	8	53.9	+33	6	5.4	0.084	0.205	0.968	22
512	62	Cnc	3561	8	54.5	+15	31	5.1	0.069	0.230	0.965	2
513	61	Cnc	3563	8	54.9	+30	26	6.1	0.303	0.135	0.504	2
514	63	Cnc	3565	8	54.8	+15	46	5.6	0.120	0.209	0.858	3
515	9	U Ma	3569	8	55.8	+48	14	3.1	0.104	0.216	0.856	3
516	65 α	Cnc	3572	8	55.8	+12	3	4.2	0.070	0.222	1.060	2
517			3579	8	57.4	+41	59	4.1:6.1	0.286	0.173	0.499	3
518			3586	8	58.5	+39	55	6.2	0.190	0.185	0.736	2
519	67	Cnc	3589	8	58.8	+28	6	6.0	0.128	0.204	0.830	2
520			3592	9	0.4	+54	29	5.6	0.012	0.160	1.120	2
521			3603	9	2.0	+48	44	5.4	0.300	0.188	0.724	2
522			3606	9	1.9	+32	35	6.4	0.136	0.201	0.853	2
523	15	U Ma	3619	9	5.4	+51	48	4.5	0.169	0.233	0.776	11
524			3620	9	5.0	+32	45	6.3	0.242	0.156	0.626	2
525	14	U Ma	3624	9	6.8	+63	43	4.6	0.217	0.238	0.723	12
526			3625	9	5.8	+34	5	5.9	0.377	0.198	0.311	2
527			3635	9	7.1	+11	46	6.4	0.232	0.136	0.506	2
528	16	U Ma	3648	9	10.4	+61	38	5.2	0.386	0.182	0.375	2
529			3649	9	9.3	+ 5	40	6.3	0.204	0.171	0.630	2
530	21	Hya	3655	9	10.0	- 6	54	6.0	0.120	0.234	0.836	2
531	18	U Ma	3662	9	12.6	+54	14	4.8	0.113	0.196	0.892	11
532			3664	9	12.2	+34	50	6.0	0.528	0.236	0.412	2
533	38	Lyn	3690	9	15.7	+37	1	3.9:6.6	0.049	0.156	1.042	2
534			3701	9	17.9	+38	24	6.5:6.7	0.280	0.138	0.452	2
535			3702	9	17.1	-11	6	6.6	0.046	0.179	1.124	2
536			3724	9	20.4	- 9	37	7.3:7.3	0.092	0.262	0.801	2
537			3727	9	21.3	+36	48	6.4	0.127	0.180	0.923	2
538			3747	9	26.2	+55	58	6.4	0.248	0.156	0.506	2
539			3750	9	25.3	- 5	51	5.4	0.418	0.182	0.366	2
540	23	U Ma	3757	9	27.6	+63	17	3.6	0.211	0.180	0.752	11
541			3758	9	26.5	- 1	2	6.3	0.173	0.176	0.869	2
542	31	Hya	3759	9	26.6	- 2	32	4.6	0.296	0.164	0.448	17
543			3760	9	26.9	- 1	59	6.1	0.130	0.182	1.030	2
544	24	U Ma	3771	9	30.1	+70	3	4.6	0.488	0.254	0.347	6
545	25	U Ma	3775	9	29.5	+51	54	3.2	0.314	0.153	0.463	11
546			3778	9	29.8	+49	40	6.5	0.051	0.203	0.986	2
547			3785	9	29.2	-10	20	6.1	0.154	0.187	0.816	2
548	32	Hya	3787	9	29.4	- 0	58	4.6	0.072	0.144	1.186	2
549			3792	9	30.4	+28	35	6.3	0.072	0.182	1.006	2
550			3794	9	30.1	+ 2	5	6.1	0.386	0.214	0.587	2

No.	Name		HR	α (1950.0)		δ (1950.0)		V	b-y	m_1	c_1	n
551			3797	9^h	$31^m.1$	$+47^\circ$	$8'$	$6^m.4$	$0^m.132$	$0^m.189$	$0^m.882$	2
552			3811	9	32.3	+40	11	6.6	0.233	0.142	0.575	2
553	42	Lyn	3829	9	35.2	+40	28	5.2	0.121	0.218	0.829	3
554			3848	9	37.9	-10	33	6.2	0.042	0.168	1.206	2
555	38	Hya	3849	9	37.9	-14	6	5.1	-0.072	0.108	0.410	6
556	14	Leo	3852	9	38.5	+10	7	3.5	0.306	0.234	0.615	14
557			3855	9	39.7	+54	36	6.3	0.056	0.210	1.004	2
558	13	L Mi	3857	9	39.7	+35	19	6.0	0.244	0.162	0.594	2
559			3859	9	40.7	+65	13	6.1	0.262	0.161	0.631	2
560	15	Leo	3861	9	40.6	+30	12	5.6	0.047	0.217	0.927	2
561	28	U Ma	3865	9	42.1	+63	53	6.4	0.228	0.168	0.643	2
562	17	Leo	3873	9	43.0	+24	0	3.0	0.510	0.274	0.457	4
563			3879	9	43.8	+ 2	1	5.6	0.215	0.178	0.800	2
564	19	Leo	3880	9	44.7	+11	48	6.3	0.152	0.192	0.773	2
565			3881	9	45.4	+46	15	5.1	0.390	0.203	0.382	10
566			3885	9	46.5	+65	50	6.2	0.173	0.181	0.871	2
567	29	U Ma	3888	9	47.5	+59	17	3.8	0.196	0.162	0.830	6
568	20	Leo	3889	9	47.0	+21	25	6.5:6.9	0.147	0.214	0.918	2
569	4	Sex	3893	9	47.9	+ 4	35	6.2	0.309	0.159	0.416	2
570	6	Sex	3899	9	48.7	- 4	0	6.0	0.084	0.212	0.937	2
571	22	Leo	3900	9	49.0	+24	38	5.2	0.139	0.200	0.809	4
572			3901	9	48.9	- 5	57	6.5	0.368	0.186	0.403	2
573	31	U Ma	3917	9	52.5	+50	3	5.3	0.032	0.181	1.062	2
574	19	L Mi	3928	9	54.6	+41	18	5.1	0.300	0.165	0.457	10
575			3936	9	55.6	+28	0	6.4	0.226	0.168	0.590	2
576	12	Sex	3945	9	57.1	+ 3	37	6.6	0.174	0.174	0.821	2
577	20	L Mi	3951	9	58.1	+32	10	5.4	0.415	0.235	0.385	11
578			3954	10	1.3	+54	8	5.7	0.318	0.169	0.478	2
579			3958	10	1.9	+52	37	6.1	0.062	0.186	1.058	2
580			3969	10	3.0	+16	0	6.2	0.238	0.175	0.764	2
581	21	L Mi	3974	10	4.5	+35	29	4.5	0.110	0.196	0.870	15
582			3979	10	5.4	+31	51	6.1	0.286	0.165	0.490	2
583	32α	Leo	3982	10	5.7	+12	13	1.4	-0.044	0.104	0.713	4
584			4012	10	11.7	+21	25	6.1	0.361	0.184	0.440	2
585	32	U Ma	4026	10	14.4	+65	22	5.7	0.085	0.181	1.029	2
586	24	L Mi	4027	10	13.6	+28	56	6.4	0.396	0.208	0.368	2
587	35	Leo	4030	10	13.8	+23	45	5.9	0.410	0.220	0.374	4
588	36	Leo	4031	10	13.9	+23	40	3.4	0.201	0.158	0.997	4
589	33	U Ma	4033	10	14.1	+43	10	3.4	0.020	0.158	1.140	2
590	39	Leo	4039	10	14.5	+23	21	5.8	0.336	0.140	0.352	2
591	22	Sex	4042	10	15.1	- 7	49	5.2	0.189	0.201	0.815	2
592			4051	10	17.0	+54	2	6.4	0.366	0.185	0.368	2
593	40	Leo	4054	10	17.0	+19	44	4.8	0.297	0.171	0.459	15
594			4060	10	17.5	- 8	48	6.3	0.223	0.151	0.685	2
595			4067	10	19.2	+41	29	5.8	0.336	0.186	0.450	2
596			4072	10	20.6	+65	49	4.9	-0.020	0.141	0.955	2
597	27	L Mi	4075	10	20.2	+34	10	5.7	0.076	0.188	1.010	2
598			4079	10	20.6	+ 5	57	6.4	0.302	0.136	0.454	2
599			4084	10	25.2	+82	49	5.2	0.265	0.143	0.456	2
600	30	L Mi	4090	10	23.1	+34	3	4.7	0.151	0.195	0.956	13

No.	Name	HR	α(1950.0)		δ(1950.0)		V	b-y	m_1	c_1	n
601		4096	10^h	$24^m.5$	$+41^\circ$	$51'$	$5^m.9$	$0^m.084$	$0^m.188$	$0^m.950$	2
602		4098	10	25.0	+49	3	6.4	0.395	0.182	0.272	3
603		4108	10	27.0	+64	31	6.0	0.094	0.197	0.985	2
604	36 U Ma	4112	10	27.4	+56	14	4.8	0.341	0.172	0.331	9
605	32 L Mi	4113	10	27.2	+39	11	5.9	0.052	0.152	1.239	2
606		4132	10	30.3	+40	41	4.8	0.121	0.208	0.850	2
607	34 L Mi	4137	10	30.7	+35	15	5.5	0.022	0.141	1.178	2
608	37 U Ma	4141	10	32.0	+57	20	5.2	0.228	0.159	0.574	9
609	35 L Mi	4150	10	33.5	+36	35	6.2	0.289	0.136	0.476	2
610		4155	10	33.8	-10	19	6.6	0.164	0.208	0.732	2
611	37 L Mi	4166	10	35.9	+32	14	4.7	0.510	0.298	0.475	12
612	40 L Mi	4189	10	40.3	+26	35	5.4	0.104	0.186	0.898	2
613		4191	10	40.6	+46	28	5.2	0.212	0.154	0.682	2
614	41 L Mi	4192	10	40.7	+23	27	5.0	0.028	0.157	1.095	2
615		4197	10	41.6	+20	1	6.0	0.107	0.196	0.872	2
616	44 L Mi	4230	10	47.2	+28	14	6.0	0.264	0.132	0.580	2
617	41 Sex	4237	10	47.8	- 8	38	5.8	0.081	0.219	1.011	2
618		4244	10	49.7	+ 1	17	6.2	0.050	0.166	1.162	2
619	48 L Mi	4254	10	52.0	+25	45	6.1	0.184	0.188	0.888	2
620	47 U Ma	4277	10	56.7	+40	42	5.1	0.392	0.203	0.337	14
621		4281	10	57.1	+11	58	6.4	0.288	0.155	0.436	3
622		4285	10	57.5	+43	11	6.0	0.378	0.170	0.376	2
623	49 U Ma	4288	10	58.0	+39	29	5.1	0.145	0.194	1.007	8
624	59 Leo	4294	10	58.2	+ 6	22	5.6	0.087	0.198	0.969	2
625	48 β U Ma	4295	10	58.8	+56	39	2.4	-0.004	0.148	1.099	2
626		4303	11	0.7	- 0	29	6.1	0.162	0.184	0.771	2
627	51 U Ma	4309	11	1.7	+38	31	6.0	0.094	0.186	0.974	2
628	63 Leo	4310	11	2.4	+ 7	36	4.6	0.208	0.187	0.710	5
629		4315	11	3.1	-10	49	6.1	0.187	0.163	0.775	2
630	64 Leo	4322	11	5.0	+23	36	6.3	0.094	0.214	0.909	2
631	67 Leo	4332	11	6.1	+24	56	5.6	0.040	0.166	1.152	2
632		4341	11	9.1	+14	40	6.2	0.116	0.201	0.840	2
633		4344	11	9.8	+55	10	6.6	0.052	0.181	1.016	2
634		4345	11	9.8	+36	5	6.2	0.392	0.210	0.311	2
635	68 Leo	4357	11	11.5	+20	48	2.6	0.073	0.183	1.042	2
636	70 Leo	4359	11	11.6	+15	42	3.3	0.002	0.150	1.161	2
637		4363	11	13.2	+53	3	6.2	0.311	0.126	0.410	2
638		4366	11	13.4	+13	7	6.5	0.188	0.164	0.750	2
639	74 Leo	4368	11	14.1	- 3	23	4.5	0.128	0.174	1.037	2
640		4369	11	14.4	- 6	52	6.1	0.107	0.254	0.829	2
641	55 U Ma	4380	11	16.4	+38	28	4.8	0.056	0.197	0.930	2
642		4388	11	19.0	+57	21	6.3	0.103	0.169	0.979	2
643	78 Leo	4399	11	21.3	+10	48	4.0:7.2	0.267	0.172	0.606	4
644	81 Leo	4408	11	23.0	+16	44	5.6	0.254	0.142	0.604	2
645	80 Leo	4410	11	23.3	+ 4	8	6.3	0.216	0.175	0.679	2
646		4412	11	23.8	+33	44	6.2	0.302	0.151	0.501	2
647		4421	11	26.2	+62	3	5.8	0.268	0.124	0.494	2
648		4424	11	26.9	+57	1	6.2	0.092	0.195	0.936	2
649	58 U Ma	4431	11	27.8	+43	27	5.8	0.340	0.148	0.429	2
650	88 Leo	4437	11	29.2	+14	39	6.0	0.367	0.188	0.332	2

No.	Name	HR	α (1950.0)		δ (1950.0)		V	b-y	m_1	c_1	n
651		4454	11^h	$31^m.6$	$+11^\circ$	18'	$6^m.4$	$0^m.112$	$0^m.197$	$0^m.872$	2
652	89 Leo	4455	11	31.8	+ 3	20	5.7	0.302	0.169	0.419	2
653		4464	11	33.1	+11	11	6.5	0.082	0.174	1.035	2
654	59 U Ma	4477	11	35.7	+43	54	5.5	0.226	0.167	0.598	2
655	60 U Ma	4480	11	35.9	+47	7	6.2	0.237	0.186	0.761	2
656	62 U Ma	4501	11	39.0	+32	1	5.7	0.310	0.125	0.400	2
657		4505	11	39.5	+22	29	6.5	0.243	0.149	0.532	2
658	2 Vir	4515	11	42.7	+ 8	32	5.1	0.091	0.198	0.919	7
659	93 Leo	4527	11	45.4	+20	30	4.6	0.352	0.186	0.725	15
660		4529	11	45.8	-10	2	6.2	0.369	0.204	0.420	2
661		4531	11	46.1	+14	34	5.9	0.171	0.194	0.738	2
662		4533	11	46.5	- 0	2	6.1	0.325	0.186	0.431	2
663	94 Leo	4534	11	46.5	+14	51	2.1	0.042	0.212	0.971	9
664		4535	11	46.7	+16	31	6.0	0.158	0.226	0.794	2
665		4536	11	47.1	+35	13	5.7	0.310	0.159	0.500	2
666	5 Vir	4540	11	48.1	+ 2	3	3.6	0.354	0.190	0.412	27
667		4543	11	48.4	+12	33	6.3	0.160	0.214	0.734	2
668	64 U Ma	4554	11	51.2	+53	58	2.4	0.006	0.152	1.116	2
669		4555	11	51.3	+ 0	50	6.4	0.114	0.201	0.991	2
670	95 Leo	4564	11	53.1	+15	55	5.5	0.067	0.168	1.108	2
671		4572	11	54.7	+40	37	6.5	0.326	0.136	0.427	2
672		4574	11	55.6	+32	33	6.2	0.221	0.147	0.610	2
673		4584	11	57.4	+34	19	6.2	0.142	0.193	0.921	2
674	7 Vir	4585	11	57.4	+ 3	56	5.2	-0.002	0.163	1.062	2
675	8 Vir	4589	11	58.3	+ 6	54	4.6	0.064	0.186	1.129	2
676	67 U Ma	4594	11	59.6	+43	19	5.0	0.170	0.190	0.758	2
677	11 Vir	4629	12	7.5	+ 6	5	5.7	0.198	0.254	0.696	2
678		4633	12	8.2	+27	34	6.0	0.077	0.175	1.012	2
679		4642	12	9.5	+28	49	6.3	0.269	0.156	0.599	3
680	12 Vir	4650	12	10.9	+10	32	5.8	0.151	0.226	0.785	2
681		4657	12	12.6	-10	1	6.1	0.317	0.118	0.333	3
682	69 U Ma	4660	12	13.0	+57	19	3.3	0.040	0.183	1.053	3
683	6 Com	4663	12	13.5	+15	11	5.1	0.028	0.180	1.060	2
684		4680	12	16.0	+30	32	6.1	0.208	0.150	0.734	2
685	13 Vir	4681	12	16.1	- 0	31	5.9	0.099	0.178	1.072	2
686		4684	12	16.5	+26	17	6.5	0.103	0.196	0.938	2
687	8 Com	4685	12	16.8	+23	19	6.3	0.076	0.262	0.927	2
688	9 Com	4688	12	17.0	+28	26	6.2	0.336	0.192	0.451	2
689		4694	12	17.8	+26	17	6.1	0.193	0.176	0.762	2
690		4698	12	18.2	+27	20	7.0:7.1	0.249	0.164	0.580	2
691	12 Com	4707	12	20.0	+26	7	4.8	0.322	0.175	0.779	12
692	17 Vir	4708	12	20.0	+ 5	35	6.4	0.352	0.190	0.370	2
693	4 C Vn	4715	12	21.3	+42	49	5.9	0.226	0.178	0.833	2
694	13 Com	4717	12	21.8	+26	23	5.2	0.043	0.185	1.106	2
695	14 Com	4733	12	23.9	+27	33	5.0	0.175	0.160	1.064	2
696	16 Com	4738	12	24.5	+27	6	5.0	0.058	0.176	1.129	2
697		4746	12	25.3	- 4	20	6.0	0.276	0.176	0.648	2
698		4750	12	26.1	+26	30	6.5	0.099	0.226	0.896	2
699	18 Com	4753	12	27.0	+24	23	5.5	0.289	0.172	0.611	7
700	20 Com	4756	12	27.2	+21	10	5.7	0.049	0.177	1.076	2

No.	Name	HR	α (1950.0)		δ (1950.0)		V	b-y	m_1	c_1	n
701	74 U Ma	4760	12^h	$27^m.6$	$+58^o$	41'	$5^m.4$	$0^m.118$	$0^m.211$	$0^m.996$	2
702	7 C Vn	4761	12	27.7	+51	49	6.1	0.345	0.168	0.415	2
703	21 Com	4766	12	28.5	+24	51	5.5	0.021	0.203	1.091	2
704		4767	12	28.5	+53	21	6.2	0.360	0.181	0.330	2
705	22 Com	4780	12	31.1	+24	34	6.3	0.053	0.214	0.990	2
706	8 C Vn	4785	12	31.4	+41	38	4.3	0.385	0.182	0.296	6
707	9 C Vn	4811	12	36.4	+41	9	6.4	0.117	0.191	0.883	2
708	27 Vir	4824	12	39.1	+10	42	6.3	0.120	0.182	0.890	2
709	29 Vir	4825-26	12	39.1	- 1	11	3.6:3.7	0.245	0.147	0.528	3
710		4837	12	41.1	- 1	18	5.9	0.532	0.298	0.330	2
711		4843	12	42.1	+44	23	6.2	0.413	0.183	0.643	2
712	10 C Vn	4845	12	42.6	+39	33	6.0	0.375	0.150	0.280	2
713	32 Vir	4847	12	43.1	+ 7	57	5.2	0.191	0.226	0.777	2
714	34 Vir	4855	12	44.7	+12	14	6.0	0.067	0.202	0.962	2
715		4856	12	45.0	- 6	2	6.3	0.350	0.164	0.482	2
716		4859	12	45.2	+63	3	5.8	0.117	0.204	0.896	2
717	11 C Vn	4866	12	46.4	+48	44	6.3	0.095	0.230	1.032	2
718		4867	12	46.5	+60	36	5.8	0.319	0.158	0.367	2
719		4875	12	47.8	+37	47	5.9	0.109	0.152	1.025	2
720	31 Com	4883	12	49.3	+27	49	5.0	0.437	0.195	0.407	6
721		4886	12	50.0	+16	24	6.2	0.094	0.192	1.000	2
722	38 Vir	4891	12	50.6	- 3	17	6.2	0.320	0.165	0.434	2
723	41 Vir	4900	12	51.3	+12	41	6.2	0.178	0.171	0.748	2
724		4904	12	51.8	+33	48	6.3	0.121	0.194	0.880	2
725	12 C Vn	4915	12	53.7	+38	35	2.9	-0.055	0.187	0.620	2
726	8 Dra	4916	12	53.5	+65	43	5.2	0.194	0.174	0.652	5
727		4926	12	58.2	+18	38	6.0	0.288	0.178	0.446	2
728	78 U Ma	4931	12	58.6	+56	38	4.9	0.246	0.172	0.576	7
729		4934	12	59.8	+63	53	6.0	0.275	0.167	0.479	2
730	48 Vir	4937	13	1.3	- 3	24	7.1:7.4	0.180	0.188	0.812	2
731	39 Com	4946	13	3.9	+21	25	5.9	0.269	0.153	0.514	2
732		4948	13	3.8	+29	18	6.4	0.032	0.216	0.998	2
733	42 Com	4968-69	13	7.6	+17	48	5.2:5.2	0.304	0.152	0.386	2
734	17 C Vn	4971	13	7.8	+38	46	6.0	0.200	0.174	0.658	3
735	43 Com	4983	13	9.5	+28	8	4.3	0.372	0.193	0.336	9
736	19 C Vn	5004	13	13.3	+41	7	5.6	0.109	0.209	0.944	3
737		5005	13	13.9	- 1	8	6.5	0.200	0.166	0.824	2
738		5010	13	14.1	+20	3	6.2	0.173	0.172	0.856	2
739	59 Vir	5011	13	14.3	+ 9	41	5.2	0.376	0.191	0.383	6
740		5014	13	14.9	- 0	25	6.3	0.164	0.170	0.779	2
741	20 C Vn	5017	13	15.3	+40	50	4.7	0.180	0.231	0.913	7
742		5025	13	16.8	+35	23	5.9	0.169	0.184	0.794	3
743		5045	13	19.9	+44	10	6.3	0.159	0.175	0.875	3
744	66 Vir	5050	13	21.9	- 4	54	5.8	0.276	0.150	0.465	2
745		5057	13	22.7	+24	7	5.6	0.040	0.191	1.075	2
746		5059	13	23.6	- 0	56	6.0	0.096	0.214	0.972	2
747	80 U Ma	5062	13	23.2	+55	15	4.0	0.105	0.195	0.923	2
748	70 Vir	5072	13	26.0	+14	3	5.0	0.452	0.233	0.348	4
749		5076	13	26.0	+53	0	6.1	0.153	0.186	0.894	3
750		5079	13	26.1	+50	51	6.7	0.171	0.177	0.858	3

No.	Name		HR	α (1950.0)		δ (1950.0)		V	b-y	m_1	c_1	n
751			5083	13^h	$26^m.7$	$+50^\circ$	59'	$6^m.2$	$0^m.259$	$0^m.157$	$0^m.642$	3
752	78	Vir	5105	13	31.6	+ 3	55	4.9	-0.007	0.226	0.935	2
753	79	Vir	5107	13	32.1	- 0	20	3.4	0.068	0.176	1.016	2
754			5108	13	32.2	+39	3	6.1	0.122	0.221	0.844	2
755	24	C Vn	5112	13	32.4	+49	16	4.6	0.075	0.193	1.044	3
756			5116	13	33.1	+44	27	6.6	0.105	0.227	0.940	3
757			5129	13	35.7	+14	33	6.3	0.150	0.214	0.794	2
758	82	U Ma	5142	13	37.6	+53	10	5.4	0.065	0.178	1.002	3
759			5148	13	38.4	+50	46	6.3	0.346	0.166	0.334	3
760			5156	13	39.7	+ 8	38	5.9	0.278	0.146	0.464	2
761			5177	13	43.4	+56	8	6.3	0.316	0.154	0.387	3
762			5179	13	44.1	+41	20	5.7	0.127	0.193	0.859	2
763	3	Boo	5182	13	44.4	+25	57	5.8	0.337	0.172	0.555	2
764			5183	13	44.5	+ 6	36	6.3	0.404	0.192	0.388	2
765	4	Boo	5185	13	44.9	+17	42	4.5	0.319	0.179	0.439	5
766			5204	13	47.6	+36	53	6.3	0.152	0.196	0.800	2
767			5214	13	48.9	+35	1	6.6	0.068	0.186	0.988	2
768			5220	13	49.9	+12	25	6.0	0.022	0.180	1.062	2
769			5229	13	50.9	+28	54	5.8	0.109	0.211	0.932	2
770	8	Boo	5235	13	52.3	+18	39	2.7	0.378	0.206	0.474	3
771			5243	13	53.4	+14	18	6.1	0.335	0.154	0.330	2
772	92	Vir	5244	13	53.9	+ 1	18	5.9	0.119	0.194	0.970	2
773			5245	13	54.0	+32	17	6.2	0.260	0.169	0.596	2
774			5258	13	57.2	- 3	18	6.3	0.317	0.182	0.484	2
775			5262	13	58.9	+ 9	8	5.8	0.043	0.192	1.038	2
776	11	Boo	5263	13	58.9	+27	38	6.1	0.107	0.200	0.990	2
777	93	Vir	5264	13	59.1	+ 1	47	4.3	0.062	0.164	1.177	2
778			5270	14	0.1	+ 9	56	6.2	0.637	0.091	0.557	2
779			5275	14	1.4	+ 5	8	6.2	0.265	0.154	0.508	2
780	12	Boo	5304	14	8.1	+25	20	4.8	0.348	0.175	0.441	8
781			5307	14	9.0	+ 1	36	6.2	0.312	0.175	0.456	2
782			5317	14	11.1	- 0	37	5.9	0.315	0.164	0.500	2
783	14	Boo	5323	14	11.7	+13	12	5.5	0.343	0.196	0.440	2
784			5333	14	12.4	+22	6	6.4	0.111	0.214	0.844	2
785	99	Vir	5338	14	13.4	- 5	46	4.1	0.341	0.163	0.448	3
786			5343	14	13.7	+19	9	6.0	0.163	0.199	0.755	3
787			5345	14	13.5	+52	46	6.4	0.044	0.188	1.009	3
788			5347	14	14.4	+39	59	6.2	0.255	0.144	0.522	2
789	21	Boo	5350	14	14.4	+51	36	4.8	0.128	0.198	0.834	3
790			5363	14	16.0	+48	14	6.2	0.310	0.157	0.533	2
791	18	Boo	5365	14	16.8	+13	14	5.4	0.267	0.162	0.484	3
792			5368	14	17.1	+ 0	37	6.1	0.106	0.206	0.887	2
793			5372	14	17.3	+55	6	6.5	0.102	0.187	0.886	3
794			5373	14	17.7	+39	1	6.3	0.039	0.164	1.084	2
795			5384	14	20.7	+ 1	28	6.3	0.402	0.200	0.269	2
796			5387	14	20.9	+25	34	6.1	0.261	0.161	0.488	2
797			5392	14	21.7	+ 6	3	5.1	0.064	0.200	0.996	2
798	23	Boo	5404	14	23.5	+52	5	4.1	0.334	0.156	0.418	3
799	22	Boo	5405	14	24.1	+19	27	5.3	0.128	0.233	0.984	2
800			5411	14	25.5	+41	15	6.4	0.247	0.156	0.551	2

No.	Name		HR	α (1950.0)		δ (1950.0)		V	b-y	m_1	c_1	n
801			5418	14^h	$27^m.3$	$+ 1^\circ$	$3'$	$5^m.8$	$0^m.088$	$0^m.201$	$0^m.984$	2
802	24	Boo	5420	14	26.9	+50	4	5.5	0.544	0.256	0.422	5
803			5423	14	27.6	+42	1	6.4	0.439	0.250	0.383	2
804	26	Boo	5434	14	30.3	+22	29	5.9	0.237	0.174	0.646	3
805	27	Boo	5435	14	30.1	+38	32	3.0	0.116	0.191	1.008	6
806			5436	14	29.6	+63	24	6.0	0.285	0.148	0.428	3
807			5437	14	30.4	+60	27	6.2	0.150	0.180	0.956	3
808			5441	14	31.3	+37	11	6.4	0.340	0.170	0.486	2
809			5445	14	32.1	+32	45	6.2	0.300	0.131	0.476	2
810	28	Boo	5447	14	32.5	+29	58	4.4	0.254	0.135	0.490	6
811			5451	14	32.8	+57	17	6.3	0.340	0.162	0.348	3
812			5473	14	38.3	+13	45	5.9	0.132	0.208	0.810	3
813	107	Vir	5487	14	40.4	- 5	27	3.9	0.254	0.167	0.530	2
814			5529	14	47.1	+38	1	5.9	0.258	0.139	0.518	2
815			5532	14	47.8	+28	49	5.5	0.043	0.166	1.124	2
816	38	Boo	5533	14	47.5	+46	19	5.7	0.313	0.169	0.491	2
817			5537	14	47.9	+51	35	6.4	0.259	0.163	0.518	3
818	16	Lib	5570	14	54.6	- 4	9	4.5	0.206	0.176	0.708	2
819			5581	14	54.7	+49	50	5.6	0.338	0.174	0.410	2
820			5583	14	56.3	- 4	47	6.1	0.336	0.170	0.428	2
821	40	Boo	5588	14	57.7	+39	28	5.5	0.217	0.160	0.718	2
822			5599	15	0.1	- 2	50	6.5	0.118	0.200	1.014	2
823			5608	15	0.3	+60	24	5.8	0.064	0.175	1.101	3
824			5612	15	1.3	+44	50	6.4	0.305	0.161	0.506	2
825			5630	15	4.6	+36	39	6.2	0.353	0.165	0.391	3
826	45	Boo	5634	15	5.1	+25	4	4.9	0.285	0.165	0.449	10
827	4	Ser	5679	15	13.3	+ 0	33	5.7	0.096	0.205	0.894	2
828			5691	15	14.1	+67	32	5.1	0.350	0.177	0.422	3
829	5	Ser	5694	15	16.8	+ 1	57	5.1	0.352	0.176	0.425	4
830			5702	15	17.5	+32	42	6.1	0.136	0.219	0.840	3
831			5715	15	18.6	+52	8	5.6	0.069	0.187	1.017	2
832			5716	15	19.0	+44	37	5.8	0.245	0.166	0.643	2
833	8	Ser	5721	15	21.1	- 0	51	6.1	0.155	0.194	0.800	2
834	51	Boo	5733	15	22.6	+37	33	4.3	0.203	0.178	0.740	3
835			5740	15	23.6	+19	39	6.2	0.397	0.214	0.441	2
836	10	Ser	5746	15	26.1	+ 2	1	5.1	0.144	0.186	0.852	2
837	3	Cr B	5747	15	25.8	+29	17	3.7	0.140	0.255	0.740	3
838			5748	15	25.2	+54	12	6.1	0.042	0.177	1.087	2
839			5758	15	28.5	+ 8	45	6.4	0.236	0.164	0.514	2
840			5759	15	27.7	+55	22	6.2	0.043	0.210	1.004	2
841			5769	15	29.5	+36	47	6.2	0.348	0.164	0.448	3
842			5783	15	31.6	+17	18	6.4	0.197	0.187	0.719	2
843			5791	15	32.5	+ 1	50	6.6	0.180	0.167	0.732	2
844	14	Ser	5799	15	34.0	- 0	24	6.5	0.466	0.234	0.657	2
845	18	Ser	5804	15	34.2	+16	17	5.8	0.222	0.160	0.681	2
846			5817	15	34.7	+52	14	6.5	0.207	0.169	0.666	3
847	21	Ser	5842	15	39.3	+19	50	5.3:5.3	0.034	0.174	1.053	2
848	22	Ser	5845	15	39.7	+18	37	5.7	0.116	0.227	0.868	2
849	28	Ser	5867	15	43.9	+15	35	3.7	0.038	0.171	1.134	2
850	27	Ser	5868	15	44.0	+ 7	31	4.4	0.385	0.199	0.354	7

No.	Name	HR	α (1950.0)		δ (1950.0)		V	b-y	m_1	c_1	n
851		5886	15^h	$45^m.9$	$+62^\circ$	$45'$	$5^m.2$	$0^m.037$	$0^m.171$	$1^m.067$	3
852		5887	15	46.4	+55	32	5.7	0.139	0.245	0.873	2
853	39 Ser	5911	15	50.9	+13	21	6.1	0.385	0.190	0.254	3
854		5913	15	51.3	+16	13	6.0	0.279	0.152	0.648	2
855	1 Her	5914	15	50.9	+42	35	4.6	0.381	0.151	0.323	4
856	41 Ser	5933	15	54.1	+15	49	3.8	0.320	0.153	0.403	7
857	12 Cr B	5936	15	54.0	+38	5	5.4	0.233	0.161	0.662	7
858		5960	15	56.6	+54	53	5.0	0.178	0.188	0.776	3
859		5964	15	57.7	+50	1	5.9	0.188	0.173	0.731	3
860	15 Cr B	5968	15	59.1	+33	27	5.4	0.394	0.183	0.322	9
861	44 Ser	5972	16	0.1	+22	57	4.8	0.038	0.184	1.053	2
862		5983	16	1.5	+36	46	5.8	0.384	0.179	0.750	3
863	13 Dra	5986	16	0.9	+58	42	4.0	0.354	0.174	0.460	6
864		6091	16	18.2	+39	50	5.4	0.268	0.168	0.467	2
865	50 Ser	6093	16	19.5	+ 1	9	4.8	0.220	0.177	0.649	4
866	20 Her	6095	16	19.7	+19	16	3.7	0.168	0.192	1.008	7
867		6110	16	21.0	+32	27	6.1	0.053	0.160	1.149	3
868	25 Her	6123	16	23.6	+37	30	5.5	0.121	0.154	1.014	3
869		6127	16	23.3	+55	19	5.7	0.004	0.157	1.088	3
870		6181	16	35.5	+13	47	6.2	0.276	0.173	0.540	2
871		6201	16	38.6	- 0	54	6.3	0.185	0.194	0.726	2
872		6203	16	38.5	+12	29	5.9	0.022	0.178	1.056	2
873	14 Oph	6205	16	39.2	+ 1	17	5.8	0.206	0.175	0.747	2
874	40 Her	6212	16	39.4	+31	42	2.9:6.4	0.415	0.207	0.408	7
875		6222	16	42.0	+34	8	5.8	0.193	0.183	0.736	3
876		6226	16	41.9	+55	47	6.2	0.032	0.220	1.059	3
877	19 Oph	6232	16	44.6	+ 2	9	6.0	0.092	0.144	1.228	2
878		6248	16	47.8	- 2	34	6.3	0.278	0.137	0.506	2
879		6277	16	51.6	- 1	32	6.2	0.169	0.190	0.840	2
880		6290	16	53.0	+13	42	6.1	0.208	0.190	0.723	2
881		6317	16	58.0	+ 6	39	6.4	0.143	0.192	0.820	2
882		6328	16	59.2	+27	16	6.3	0.274	0.154	0.457	2
883	59 Her	6332	16	59.8	+33	38	5.2	0.002	0.180	1.094	8
884		6349	17	2.7	+ 0	46	5.8	0.374	0.174	0.329	2
885		6351	17	2.1	+34	52	6.0	0.125	0.200	0.857	2
886	60 Her	6355	17	3.1	+12	48	4.9	0.071	0.206	0.989	24
887	21 Dra	6369-70	17	4.3	+54	32	5.8:5.8	0.318	0.164	0.457	2
888		6376	17	6.1	+40	35	6.2	0.018	0.161	1.120	2
889		6377	17	6.3	+36	0	6.0:6.0	0.189	0.206	0.720	2
890	63 Her	6391	17	9.0	+24	18	6.2	0.122	0.200	0.901	3
891		6394	17	10.3	+ 0	25	6.4	0.330	0.156	0.479	2
892	65 Her	6410	17	13.0	+24	54	3.1	0.040	0.184	1.057	2
893		6421	17	12.1	+62	56	5.5	0.103	0.220	0.846	2
894		6434	17	16.4	+ 6	8	6.4	0.246	0.167	0.895	2
895	69 Her	6436	17	15.9	+37	21	4.8	0.017	0.174	1.071	3
896		6455	17	18.1	+25	35	5.3	0.030	0.163	1.183	2
897	72 Her	6458	17	18.8	+32	32	5.4	0.409	0.182	0.309	24
898		6467	17	19.2	+48	14	6.2	0.294	0.118	0.469	2
899		6469	17	20.1	+40	1	5.6	0.442	0.205	0.460	2
900	73 Her	6480	17	22.0	+23	0	5.7	0.136	0.188	0.809	2

No.	Name	HR	α(1950.0)		δ(1950.0)		V	b-y	m_1	c_1	n
901		6481	17^h	$22^m.3$	$+16^o$	21'	$5^m.6$	$0^m.052$	$0^m.168$	$1^m.157$	2
902		6489	17	23.4	- 1	37	6.3	0.294	0.154	0.498	2
903		6493	17	24.0	- 5	3	4.5	0.257	0.150	0.566	2
904		6499	17	24.0	+26	55	6.3	0.070	0.188	1.145	2
905		6507	17	26.3	+ 0	22	5.1	0.156	0.192	0.925	2
906	77 Her	6509	17	25.4	+48	18	5.8	0.072	0.180	1.127	2
907		6511	17	25.0	+60	5	5.8	0.012	0.142	1.090	2
908		6514	17	25.3	+58	42	6.5	0.070	0.183	1.009	2
909		6524	17	28.8	+ 2	46	6.3:6.3	0.529	0.295	0.532	2
910		6531	17	29.0	+38	55	6.4	0.327	0.192	0.773	2
911	23 β Dra	6536	17	29.3	+52	20	2.9	0.610	0.323	0.423	17
912		6541	17	31.2	+19	17	5.5	0.328	0.148	0.471	2
913	53 Oph	6548	17	32.2	+ 9	37	5.6	0.018	0.151	1.089	2
914		6551	17	32.2	+16	32	6.3	0.152	0.154	1.061	2
915	24 Dra	6554	17	31.2	+55	13	4.9	0.165	0.183	0.779	3
916	25 Dra	6555	17	31.3	+55	12	4.8	0.176	0.219	0.741	3
917	55 α Oph	6556	17	32.6	+12	36	2.1	0.093	0.168	1.039	2
918		6560	17	32.7	+57	35	6.1	0.373	0.220	0.805	2
919		6570	17	34.7	+30	49	5.7	0.086	0.217	0.967	2
920		6577	17	36.7	+13	21	6.2	0.382	0.151	0.573	3
921		6594	17	39.7	+15	58	5.5	0.258	0.155	0.541	2
922		6604	17	41.1	+14	19	6.1	0.273	0.168	0.798	2
923	84 Her	6608	17	41.3	+24	21	5.5	0.420	0.223	0.449	2
924		6611	17	42.0	+14	26	6.1	0.110	0.232	1.026	2
925		6655	17	48.7	+22	20	5.9	0.154	0.172	0.957	2
926	30 Dra	6656	17	47.9	+50	48	5.1	0.010	0.184	1.019	3
927		6669	17	49.6	+40	5	6.4	0.352	0.188	0.371	2
928		6670	17	50.8	+ 6	7	5.7	0.278	0.172	0.458	2
929		6676	17	51.9	+11	8	6.2	0.291	0.172	0.543	2
930	89 Her	6685	17	53.4	+26	3	5.5	0.230	0.130	1.361	2
931		6697	17	55.2	+24	0	6.3	0.406	0.220	0.357	2
932		6699	17	54.5	+55	59	6.0	0.193	0.187	0.764	2
933	94 Her	6707	17	56.6	+30	12	4.5	0.254	0.141	0.901	2
934		6709	17	57.7	+ 0	38	6.3	0.088	0.176	1.098	2
935	57 Ser	6710	17	57.8	- 3	41	4.6	0.254	0.154	0.564	2
936	68 Oph	6723	17	59.2	+ 1	18	4.5	0.033	0.136	1.094	14
937		6754	18	2.6	+23	56	6.2	0.202	0.158	0.724	2
938		6764	18	3.1	+40	5	6.4	0.323	0.163	0.475	2
939		6767	18	3.5	+41	56	6.4	0.184	0.170	0.750	2
940	72 Oph	6771	18	5.0	+ 9	33	3.7	0.058	0.214	0.993	2
941	99 Her	6775	18	5.1	+30	33	5.0	0.361	0.143	0.326	4
942	100 Her	6782	18	5.8	+26	6	5.9	0.075	0.204	0.949	3
943		6784	18	6.3	+14	17	6.3	0.092	0.226	1.077	3
944	101 Her	6794	18	6.7	+20	2	5.2	0.091	0.182	1.150	2
945		6797	18	7.4	+ 3	7	5.7	0.305	0.164	0.452	2
946		6813	18	10.5	- 4	2	6.6	0.155	0.234	0.867	2
947		6831	18	12.8	+29	12	6.4	0.376	0.156	0.357	2
948		6844	18	14.5	+ 0	59	6.5	0.200	0.160	0.692	2
949		6847	18	14.1	+45	12	6.2	0.410	0.206	0.340	3
950		6849	18	13.8	+56	34	6.4	0.230	0.150	0.684	2

No.	Name	HR	α (1950.0)	δ (1950.0)	V	b-y	m_1	c_1	n
			h m	° '	m	m	m	m	
951	36 Dra	6850	18 13.6	+64 23	4.8	0.281	0.143	0.472	2
952	108 Her	6876	18 19.0	+29 50	5.5	0.141	0.204	0.768	2
953	107 Her	6877	18 19.1	+28 51	5.0	0.133	0.169	1.087	2
954	2 Lyr	6903	18 22.6	+39 29	5.0	0.028	0.152	1.200	2
955		6911	18 22.7	+53 16	6.2	0.088	0.226	1.017	2
956		6917	18 24.0	+29 48	5.8	0.045	0.164	1.140	2
957	61 Ser	6957	18 29.4	- 1 2	5.8	0.109	0.148	1.272	2
958		6975	18 32.2	+20 26	6.4	0.093	0.130	1.125	2
959	45 Dra	6978	18 31.7	+57 0	4.8	0.369	0.265	0.866	2
960		6985	18 34.1	+ 9 5	5.3	0.262	0.150	0.524	2
961		6987	18 34.2	+ 6 38	5.3	0.256	0.144	0.564	2
962		7003	18 35.2	+43 11	6.2	0.156	0.170	0.904	2
963		7008	18 37.2	+ 5 13	6.2	0.524	0.203	0.724	2
964		7019	18 38.5	+38 19	6.4	0.126	0.218	0.955	2
965		7044	18 42.0	+31 53	5.5	0.242	0.154	0.693	2
966	6 Lyr	7056	18 43.0	+37 33	4.4	0.101	0.230	0.996	2
967	7 Lyr	7057	18 43.1	+37 32	5.7	0.184	0.180	0.780	2
968		7060	18 42.4	+53 49	6.1	0.040	0.158	1.274	2
969	110 Her	7061	18 43.5	+20 30	4.2	0.314	0.150	0.484	3
970	Sct	7063	18 44.5	- 4 48	4.2	0.707	0.354	0.425	2
971	111 Her	7069	18 44.8	+18 7	4.3	0.059	0.221	0.943	19
972		7096	18 46.9	+48 43	6.0	0.129	0.193	0.868	3
973	8 Aql	7101	18 48.7	- 3 23	6.0	0.178	0.178	0.834	2
974	9 Lyr	7102	18 48.0	+32 30	5.1	0.057	0.173	1.101	2
975		7110	18 50.3	- 9 38	6.3	0.112	0.193	0.942	2
976		7154	18 53.5	+48 48	5.8	0.286	0.162	0.557	2
977		7163	18 56.0	+ 6 10	6.3	0.307	0.166	0.479	2
978	10 Aql	7167	18 56.5	+13 50	5.9	0.154	0.206	0.830	2
979	11 Aql	7172	18 56.8	+13 33	5.2	0.350	0.174	0.455	2
980		7207	18 59.7	+22 11	6.3	0.067	0.182	1.081	2
981		7214	19 1.0	+ 1 45	5.7	0.094	0.204	0.904	2
982	16 Lyr	7215	19 0.0	+46 52	5.0	0.106	0.200	0.901	3
983		7219	19 1.7	+ 3 15	6.5	0.067	0.208	1.088	2
984		7222	19 1.6	+21 12	6.5	0.206	0.168	0.892	2
985		7231	19 2.7	- 1 35	6.4	0.238	0.148	0.531	2
986		7250	19 4.6	+24 10	5.7	0.053	0.194	1.083	2
987		7253	19 4.6	+28 33	5.4	0.176	0.190	0.752	15
988	17 Lyr	7261	19 5.5	+32 25	5.0	0.253	0.144	0.708	2
989		7263	19 5.9	+21 37	6.1	0.288	0.138	0.538	2
990	19 Aql	7266	19 6.5	+ 6 0	5.3	0.230	0.165	0.655	2
991		7267	19 6.4	+16 46	6.4	0.307	0.166	0.463	2
992		7280	19 9.5	+26 39	6.2	0.285	0.160	0.468	2
993		7288	19 11.3	+ 5 26	6.3	0.074	0.140	1.141	2
994	1 Sge	7301	19 13.1	+21 9	5.6	0.068	0.184	1.072	2
995	22 Aql	7303	19 14.0	+ 4 45	5.4	0.062	0.158	1.234	2
996		7308	19 14.0	+27 50	5.9	0.398	0.208	0.759	2
997	25 Aql	7315	19 15.5	+11 30	5.1	0.120	0.167	1.128	2
998		7322	19 15.4	+46 54	6.0	0.320	0.147	0.435	2
999	28 Aql	7331	19 17.3	+12 17	5.3	0.164	0.184	0.990	2
1000	29 Aql	7332	19 17.5	+11 26	6.0	0.044	0.196	1.055	2

No.	Name	HR	α (1950.0)		δ (1950.0)		V	b-y	m_1	c_1	n
1001		7354	19^h	$20^m.4$	$+9^\circ$	49'	$6^m.2$	$0^m.320$	$0^m.125$	$0^m.425$	2
1002		7357	19	20.9	+14	49	6.5	0.159	0.194	0.823	2
1003		7366	19	22.4	- 4	59	6.5	0.210	0.184	0.772	2
1004	30 Aql	7377	19	23.0	+ 3	1	3.4	0.210	0.165	0.713	10
1005		7386	19	23.4	+24	49	6.2	0.339	0.168	0.352	2
1006	32 Aql	7387	19	24.0	+ 0	14	4.6	0.416	0.079	1.452	2
1007		7389	19	24.1	+12	55	5.7	0.302	0.169	0.541	2
1008	10 Cyg	7420	19	28.4	+51	37	3.9	0.080	0.177	1.055	2
1009		7438	19	32.9	+ 2	48	6.3	0.280	0.144	0.480	2
1010	9 Cyg	7441	19	32.9	+29	21	5.3	0.382	0.163	0.794	2
1011		7444	19	33.1	+42	18	5.2	0.140	0.152	1.197	2
1012		7445	19	33.8	+11	2	6.5	0.049	0.158	1.085	2
1013		7451	19	33.0	+51	8	5.7	0.320	0.146	0.421	2
1014	42 Aql	7460	19	35.1	- 4	46	5.5	0.268	0.176	0.524	2
1015	13 Cyg	7469	19	35.1	+50	6	4.5	0.261	0.158	0.506	21
1016	5 Sge	7479	19	37.9	+17	54	4.3	0.497	0.260	0.466	10
1017		7481	19	37.9	+33	52	6.1	0.069	0.163	1.152	2
1018		7484	19	37.6	+54	51	5.8	0.294	0.165	0.451	2
1019		7495	19	39.3	+45	24	5.0	0.265	0.202	0.720	2
1020		7501	19	40.8	+29	13	6.4	0.222	0.187	0.768	2
1021		7502	19	40.8	+32	18	5.8	0.086	0.130	1.454	2
1022	16 Cyg	7503	19	40.5	+50	24	6.0	0.410	0.214	0.375	9
1023		7504	19	40.5	+50	24	6.2	0.416	0.226	0.354	8
1024	49 Aql	7519	19	43.2	+ 7	29	5.9	0.106	0.187	0.894	2
1025		7522	19	42.3	+57	54	6.2	0.381	0.182	0.427	2
1026		7533	19	44.6	+25	1	6.5	0.192	0.152	0.744	2
1027	17 Cyg	7534	19	44.5	+33	37	5.0	0.316	0.155	0.435	12
1028		7542	19	46.1	+10	34	6.3	0.633	0.210	0.698	2
1029	53 Aql	7557	19	48.3	+ 8	44	0.8	0.137	0.178	0.880	10
1030	54 Aql	7560	19	48.6	+10	17	5.1	0.356	0.188	0.404	14
1031		7569	19	49.7	+11	30	6.1	0.424	0.190	0.333	2
1032		7577	19	49.8	+47	15	6.2	0.249	0.166	0.563	2
1033	61 Aql	7610	19	53.9	+11	17	5.2	0.002	0.174	1.020	6
1034		7634	19	55.2	+56	33	6.1	0.050	0.170	1.054	2
1035	14 Vul	7641	19	57.0	+22	58	5.6	0.231	0.148	0.695	2
1036		7646	19	57.8	+45	38	5.8	0.095	0.184	1.058	2
1037	15 Vul	7653	19	59.0	+27	37	4.7	0.096	0.202	1.066	2
1038		7661	20	1.3	- 7	37	6.5	0.222	0.171	0.677	2
1039	15 Sge	7672	20	1.9	+16	56	5.8	0.389	0.197	0.321	2
1040		7677	20	2.8	+23	4	6.4	0.100	0.184	0.944	2
1041		7692	20	4.2	+56	12	6.1	0.278	0.155	0.535	2
1042		7697	20	4.9	+53	1	5.7	0.280	0.156	0.507	2
1043		7702	20	5.8	+50	5	6.5	0.094	0.139	1.168	2
1044	18 Vul	7711	20	8.5	+26	45	5.5	0.048	0.167	1.149	2
1045	68 Dra	7727	20	10.8	+61	56	5.7	0.334	0.186	0.464	2
1046	30 Cyg	7730	20	11.7	+46	40	4.9	0.068	0.150	1.310	2
1047	21 Vul	7731	20	12.2	+28	33	5.1	0.110	0.152	1.154	2
1048		7734	20	12.2	+36	27	6.4	0.010	0.122	1.142	2
1049	33 Cyg	7740	20	12.2	+56	25	4.3	0.056	0.178	1.093	2
1050		7756	20	14.4	+45	26	5.7	0.281	0.164	0.481	3

No.	Name	HR	(1950.0)		(1950.0)		V	b-y	m_1	c_1	n
			h	m	°	'	m	m	m	m	
1051	35 Cyg	7770	20	16.7	+34	50	5.2	0.438	0.170	1.032	2
1052		7774	20	17.7	+13	23	5.9	0.196	0.206	0.775	2
1053		7793	20	20.5	+14	23	6.1	0.338	0.162	0.342	2
1054	37 Cyg	7796	20	20.4	+40	6	2.2	0.401	0.295	0.878	7
1055		7823	20	25.2	+34	10	6.4	0.357	0.108	1.337	2
1056		7833	20	27.1	+19	55	6.3	0.010	0.160	1.042	2
1057	41 Cyg	7834	20	27.4	+30	12	4.0	0.264	0.184	1.066	2
1058		7839	20	28.7	+20	26	6.0	0.072	0.216	1.000	2
1059	44 Cyg	7847	20	29.1	+36	46	6.2	0.711	0.081	1.106	2
1060	2 Cep	7850	20	28.7	+62	50	4.2	0.106	0.220	0.998	2
1061	3 Del	7858	20	31.6	+12	51	5.2	0.038	0.196	0.975	6
1062	4 Del	7871	20	33.0	+14	30	4.6	0.066	0.176	1.107	9
1063	26 Vul	7874	20	34.0	+25	42	6.2	0.074	0.206	1.097	2
1064		7876	20	33.4	+51	41	6.2	0.236	0.091	1.481	2
1065	5 Del	7883	20	35.4	+11	12	5.4	0.024	0.184	1.014	5
1066	9 Del	7906	20	37.3	+15	44	3.8	-0.021	0.124	0.897	2
1067		7907	20	37.5	+11	4	6.3	0.364	0.158	0.407	2
1068		7916	20	37.7	+55	50	6.4	0.223	0.186	0.806	2
1069	50 Cyg	7924	20	39.7	+45	6	1.3	0.105	0.044	0.917	2
1070		7925	20	39.2	+60	19	5.9	0.302	0.140	0.459	2
1071	11 Del	7928	20	41.1	+14	54	4.5	0.190	0.163	0.854	2
1072		7955	20	44.1	+57	24	4.6	0.353	0.186	0.430	3
1073	15 Del	7973	20	47.2	+12	21	5.9	0.302	0.136	0.419	2
1074	56 Cyg	7984	20	48.3	+43	52	5.1	0.108	0.209	0.897	12
1075	6 Aqr	7990	20	50.0	- 9	10	4.7	0.186	0.225	0.716	2
1076		7998	20	51.3	- 7	5	6.5	0.237	0.154	0.621	2
1077		8006	20	52.6	- 1	34	6.6	0.171	0.184	0.810	2
1078	16 Del	8012	20	53.3	+12	23	5.5	0.056	0.198	1.015	2
1079		8025	20	54.8	+50	32	5.7	0.224	0.167	0.708	2
1080		8037	20	57.5	+16	38	6.5	0.246	0.155	0.508	3
1081	11 Aqr	8041	20	57.9	- 4	55	6.3	0.406	0.209	0.397	2
1082		8071	21	2.0	+41	26	6.3	0.247	0.179	0.761	2
1083	4 Equ	8077	21	3.0	+ 5	46	5.9	0.350	0.170	0.421	2
1084		8095	21	7.4	+ 2	44	6.4	0.248	0.160	0.675	2
1085	5 Equ	8097	21	7.9	+ 9	56	4.6	0.147	0.242	0.755	2
1086	6 Equ	8098	21	8.1	+ 9	51	6.0	0.015	0.164	1.100	2
1087		8120	21	11.4	+36	26	6.0	0.154	0.122	1.409	2
1088	8 Equ	8131	21	13.3	+ 5	2	3.9	0.321	0.220	0.725	2
1089		8155	21	17.0	+40	50	6.2	0.184	0.108	1.309	2
1090		8157	21	17.4	+38	2	6.5:6.5	0.332	0.151	0.742	3
1091	5 Cep	8162	21	17.4	+62	22	2.4	0.125	0.190	0.936	10
1092		8170	21	19.1	+40	8	6.4	0.349	0.181	0.319	2
1093		8189	21	21.4	+37	11	6.4	0.335	0.159	0.584	2
1094		8190	21	21.7	+24	4	5.7	0.206	0.178	0.738	2
1095		8191	21	22.0	+ 9	57	6.3	0.307	0.172	0.617	2
1096	20 Aqr	8192	21	22.3	- 3	37	6.4	0.206	0.211	0.701	2
1097	19 Aqr	8195	21	22.5	- 9	58	5.8	0.100	0.226	0.925	2
1098		8198	21	22.3	+25	58	5.7	0.208	0.158	0.795	2
1099		8205	21	23.9	+ 0	53	6.1	0.306	0.157	0.475	2
1100		8208	21	23.5	+46	30	5.5	0.220	0.162	0.622	2

No.	Name	HR	α(1950.0)		δ(1950.0)		V	b-y	m_1	c_1	n
1101		8210	21^h	$24^m.1$	$+19^{\circ}$	$9'$	$6^m.0$	$0^m.143$	$0^m.198$	$0^m.785$	2
1102		8216	21	25.1	+48	37	5.3	0.056	0.174	1.203	2
1103		8220	21	26.0	+32	0	5.7	0.200	0.198	0.648	2
1104	22 β Aqr	8232	21	28.9	- 5	48	2.9	0.513	0.326	0.554	2
1105		8250	21	32.3	+22	32	6.3	0.330	0.170	0.462	3
1106		8257	21	33.1	+27	58	6.3	0.244	0.132	0.627	2
1107		8263	21	35.0	- 0	37	6.2	0.020	0.180	1.090	2
1108	23 Aqr	8264	21	35.1	- 8	5	4.7	0.090	0.196	1.015	2
1109	74 Cyg	8266	21	34.9	+40	11	5.0	0.122	0.172	0.970	2
1110	5 Peg	8267	21	35.4	+19	6	5.4	0.203	0.170	0.892	10
1111	4 Peg	8270	21	36.0	+ 5	33	5.7	0.150	0.182	0.853	2
1112		8272	21	35.5	+44	28	6.0	0.122	0.174	1.125	2
1113		8276	21	36.7	+20	2	5.7	0.201	0.166	0.696	2
1114		8314	21	42.1	+14	33	6.0	0.379	0.190	0.305	2
1115		8330	21	44.7	+16	58	6.2	0.226	0.164	0.632	2
1116		8332	21	45.0	- 6	9	6.2	0.127	0.202	0.779	2
1117	10 Cep	8334	21	44.0	+60	53	4.3	0.430	-0.059	1.016	2
1118	13 Peg	8344	21	47.8	+17	3	5.2	0.263	0.156	0.545	11
1119	15 Peg	8354	21	50.3	+28	34	5.5	0.309	0.108	0.439	2
1120		8359	21	51.5	+ 6	38	6.5	0.518	0.188	0.409	2
1121	17 Peg	8373	21	54.5	+11	50	5.6	0.036	0.148	1.126	2
1122		8376	21	55.6	- 5	40	6.2	0.248	0.159	0.523	2
1123		8391	21	58.2	+32	46	6.4	0.298	0.136	0.562	2
1124	20 Peg	8392	21	58.7	+12	53	5.6	0.238	0.152	0.739	2
1125	32 Aqr	8410	22	2.2	- 1	9	5.3	0.124	0.237	0.918	2
1126	34 α Aqr	8414	22	3.2	- 0	34	2.9	0.598	0.380	0.437	3
1127		8429	22	4.2	+45	0	6.0	0.054	0.167	1.065	2
1128	24 Peg	8430	22	4.7	+25	6	3.8	0.296	0.159	0.446	9
1129		8435	22	5.1	+19	14	5.7	0.213	0.155	0.768	2
1130		8441	22	6.0	+25	18	5.9	0.191	0.182	0.850	2
1131		8443	22	5.6	+53	4	6.1	0.337	0.001	1.339	2
1132	26 Peg	8450	22	7.7	+ 5	57	3.5	0.051	0.153	1.093	2
1133	29 Peg	8454	22	7.8	+32	56	4.3	0.304	0.177	0.778	10
1134		8455	22	7.9	+19	22	5.0	0.462	0.199	0.334	2
1135	28 Peg	8459	22	8.1	+20	44	6.4	0.050	0.166	1.189	2
1136		8460	22	8.6	+30	18	6.3	0.124	0.180	1.025	2
1137		8463	22	9.2	+50	35	5.4	0.076	0.200	0.967	2
1138		8467	22	10.1	- 4	58	6.4	0.312	0.178	0.487	2
1139		8472	22	10.0	+56	35	5.2	0.338	0.174	0.488	2
1140	23 Cep	8494	22	13.2	+56	48	4.2	0.167	0.194	0.790	6
1141		8495	22	14.0	- 1	51	6.1	0.116	0.172	0.952	2
1142		8507	22	15.5	- 0	29	6.4	0.278	0.172	0.462	2
1143		8514	22	18.4	+ 7	56	6.1	0.302	0.148	0.409	2
1144		8536	22	21.7	+38	19	6.1	0.314	0.154	0.486	2
1145	34 Peg	8548	22	24.1	+ 4	8	5.8	0.330	0.188	0.417	2
1146		8581	22	28.7	- 6	49	6.2	0.360	0.188	0.328	2
1147		8584	22	29.2	+29	17	6.3	0.118	0.193	0.959	2
1148		8588	22	30.2	+39	31	5.8	0.102	0.163	1.176	2
1149		8607	22	33.9	+55	49	6.2	0.052	0.174	1.073	2
1150	9 Lac	8613	22	35.3	+51	17	4.8	0.142	0.174	0.948	9

No.	Name	HR	α (1950.0)		δ (1950.0)		V	b-y	m_1	c_1	n
1151		8617	22^h	$36^m.1$	$+44^o$	$55'$	$6^m.4$	$0^m.494$	$0^m.238$	$0^m.515$	2
1152	30 Cep	8627	22	36.9	+63	19	5.2	0.040	0.163	1.164	2
1153	44 Peg	8650	22	40.7	+29	58	3.0	0.535	0.296	0.499	9
1154		8653	22	41.2	+10	41	6.3	0.318	0.155	0.432	3
1155	46 Peg	8665	22	44.2	+11	55	4.2	0.330	0.147	0.407	16
1156		8666	22	43.9	+44	17	5.8	0.222	0.178	0.731	2
1157		8681	22	47.0	+10	13	6.4	0.181	0.171	0.758	2
1158	49 Peg	8697	22	49.9	+ 9	34	5.2	0.321	0.149	0.433	4
1159	76 Aqr	8709	22	52.0	-16	5	3.3	0.032	0.165	1.188	3
1160	1 Psc	8715	22	52.4	+ 0	48	6.0	0.097	0.202	1.043	2
1161		8718	22	52.7	+36	49	5.9	0.273	0.138	0.530	3
1162	24 Ps A	8728	22	54.9	-29	53	1.2	0.037	0.204	1.016	3
1163	51 Peg	8729	22	55.0	+20	30	5.5	0.416	0.232	0.364	8
1164		8735	22	55.8	- 1	41	6.4	0.236	0.138	0.702	2
1165		8752	22	58.0	+56	41	5.0	0.548	0.340	0.484	4
1166		8755	22	58.3	+45	6	6.4	0.220	0.082	1.448	2
1167		8765	23	0.2	+31	31	6.4	0.206	0.190	0.789	2
1168		8776	23	1.5	+ 6	21	6.2	0.276	0.138	0.625	2
1169	54 α Peg	8781	23	2.3	+14	56	2.5	-0.008	0.120	1.137	5
1170	83 Aqr	8782	23	2.6	- 7	58	5.4	0.186	0.176	0.749	2
1171		8788	23	3.8	+18	15	6.1	0.287	0.188	0.478	2
1172		8792	23	4.0	+19	38	6.3	0.353	0.182	0.364	2
1173		8799	23	5.0	+20	52	5.9	0.184	0.136	0.687	2
1174	5 And	8805	23	5.5	+49	1	5.7	0.286	0.152	0.495	2
1175	2 Cas	8822	23	7.6	+59	4	5.8	0.236	0.074	1.580	2
1176	6 And	8825	23	8.1	+43	17	6.0	0.302	0.145	0.442	2
1177	59 Peg	8826	23	9.2	+ 8	27	5.1	0.075	0.165	1.090	11
1178	7 And	8830	23	10.3	+49	8	4.5	0.181	0.172	0.723	15
1179		8838	23	11.9	+29	30	6.4	0.309	0.134	0.549	2
1180		8840	23	13.0	- 3	46	5.5	0.018	0.179	1.060	2
1181		8845	23	13.5	+24	30	6.4	0.276	0.146	0.468	2
1182		8853	23	14.4	+52	57	5.6	0.352	0.171	0.396	2
1183	96 Aqr	8868	23	16.8	- 5	24	5.6	0.254	0.172	0.521	2
1184		8870	23	16.7	+44	52	6.4	0.094	0.184	1.051	2
1185	62 Peg	8880	23	18.2	+23	28	4.6	0.104	0.166	1.013	10
1186		8884	23	18.4	+43	51	6.1	0.078	0.193	0.980	4
1187	12 And	8885	23	18.5	+37	55	5.7	0.296	0.170	0.489	2
1188		8899	23	21.3	+32	15	6.4	0.327	0.120	0.405	2
1189	68 Peg	8905	23	22.9	+23	8	4.5	0.390	0.186	0.461	6
1190	8 Psc	8911	23	24.4	+ 0	59	5.0	-0.006	0.218	0.875	5
1191		8931	23	28.9	- 4	22	6.5	0.350	0.162	0.309	2
1192	14 Psc	8944	23	31.6	- 1	31	6.0	0.166	0.256	0.785	2
1193	16 Psc	8954	23	33.8	+ 1	49	5.6	0.304	0.121	0.389	2
1194		8955	23	34.0	+32	38	6.2	0.303	0.171	0.511	2
1195	17 Psc	8969	23	37.4	+ 5	21	4.1	0.336	0.152	0.399	12
1196		8970	23	37.4	+ 9	24	6.0	0.119	0.218	0.870	2
1197		8973	23	37.6	+37	23	6.2	0.228	0.178	0.736	2
1198		8977	23	38.2	+36	27	6.2	0.272	0.154	0.514	2
1199		8981	23	39.0	+49	14	6.3	0.094	0.176	1.164	2
1200	18 Psc	8984	23	39.5	+ 1	30	4.5	0.098	0.208	0.888	4

No.	Name		HR	α (1950.0)		δ (1950.0)		V	b-y	m_1	c_1	n
1201			9015	23^h	$46^m.3$	+ 1^o	$56'$	$6^m.4$	$0^m.308$	$0^m.128$	$0^m.478$	2
1202			9020	23	46.7	+58	41	6.4	0.277	0.140	0.546	2
1203	21	Psc	9022	23	46.9	+ 0	48	5.7	0.091	0.190	1.031	2
1204	79	Peg	9025	23	47.1	+28	34	5.9	0.097	0.230	0.950	2
1205			9028	23	47.9	+51	21	6.5	0.258	0.148	0.472	2
1206	82	Peg	9039	23	50.1	+10	40	5.3	0.099	0.181	0.967	6
1207			9057	23	54.5	+42	23	6.0	0.474	0.164	0.588	2
1208			9059	23	54.6	+55	26	5.6	0.309	0.161	0.516	3
1209	28	Psc	9072	23	56.7	+ 6	35	4.0	0.266	0.150	0.630	11
1210			9074-75	23	56.9	+33	27	6.6:6.6	0.347	0.176	0.348	2
1211			9078	23	57.8	+26	38	6.3	0.340	0.162	0.448	2
1212			9085	23	59.1	+60	57	5.6	0.289	0.084	1.510	2
1213	85	Peg	9088	23	59.6	+26	49	5.8	0.431	0.190	0.203	13
1214	31	Psc	9092	23	59.8	+ 8	41	6.3	0.099	0.198	1.016	2
1215	32	Psc	9093	23	59.9	+ 8	12	5.6	0.212	0.152	0.640	2
1216			9105	0	2.0	+41	49	6.0	0.091	0.150	1.164	2
1217			9107	0	2.3	+34	23	6.1	0.412	0.170	0.317	2

APPENDIX 2

Photoelectric Hβ Photometry for 1217 Stars Brighter than $V = 6\overset{m}{.}5$

By

D. L. Crawford, B. Faure, J. V. Mander

and C. Perry

This work was carried out at the Kitt Peak National Observatory under the direction of D. L. Crawford. The participation of Dr. C. Perry was made possible by support through Contract Nonr 1858 (33).

The catalogue gives the value of the index β on the photometric Hβ system described by D. L. Crawford (Ap. J., 132, 66, 1960, see also "Standard Stars for Photoelectric Hβ Photometry" by D. L. Crawford and Jeannette Mander, to appear in the Astrophysical Journal and in the Contributions from the Kitt Peak National Observatory).

The probable error of a catalogue value of β derived from 4 observations is ± $0^{m}.004$.

No.	HR	β	n
1	15	2742	11
2	17	2615	4
3	21	2709	5
4	27	2666	STD
5	39	2629	STD
6	41	2717	5
7	63	2879	STD
8	68	2893	8
9	72	2598	4
10	82	2656	5
11	107	2641	4
12	114	2755	6
13	143	2632	4
14	145	2615	5
15	146	2746	5
16	166	2559	5
17	178	2812	5
18	184	2857	6
19	204	2831	3
20	214	2773	5
21	219	2588	5
22	230-31	2695	5
23	233	2663	6
24	238	2770	4
25	244	2613	4
26	255	2537	4
27	262	2876	3
28	269	2863	STD
29	290	2844	5
30	297	2615	5
31	303	2651	5
32	308	2665	4
33	309	2822	4
34	324	2865	5
35	327	2677	6
36	328	2883	5
37	330	2712	5
38	340	2598	5
39	343	2845	6
40	366	2647	4
41	368	2660	5
42	373	2562	3
43	378	2897	3
44	382	2664	4
45	383	2872	6
46	401	2786	4
47	407	2654	4
48	409	2615	4
49	410	2651	3
50	413	2680	5
51	415	2656	3
52	417	2672	4
53	418	2748	4
54	432	2817	3
55	437	2575	4
56	448	2585	3
57	457	2777	5
58	458	2629	STD
59	463	2700	4
60	476	2811	5
61	483	2604	4
62	484	2650	5
63	515	2777	3
64	518	2644	4
65	523	2619	3
66	529	2669	4
67	534	2718	4
68	540	2856	4
69	544	2637	5
70	553	2879	8
71	569	2762	4
72	578	2830	5
73	582	2624	3
74	586	2884	4
75	599	2877	5
76	607	2834	6
77	618	2531	3
78	620	2869	4
79	622	2848	6
80	623	2723	STD
81	624	2637	3
82	635	2627	3
83	638	2669	5
84	646	2647	3
85	656	2655	3
86	657	2639	3
87	660	2585	4
88	671	2832	5
89	672	2621	5
90	673	2643	3

No.	HR	β	n
91	675	2880	5
92	684	2897	3
93	685	2568	4
94	687	2764	5
95	690	2645	3
96	691	2726	5
97	709	2640	4
98	717	2762	7
99	720	2589	3
100	723	2880	4
101	728	2679	4
102	729	2777	4
103	732	2847	4
104	741	2614	3
105	756	2641	4
106	761	2621	4
107	763	2615	3
108	765	2679	3
109	768	2645	4
110	770	2655	4
111	773	2829	10
112	783	2654	4
113	784	2620	3
114	788	2633	3
115	799	2625	4
116	803	2874	5
117	812	2804	STD
118	813	2743	4
119	816	2740	4
120	825	2608	3
121	831	2679	4
122	840	2701	4
123	856	2656	4
124	859	2813	4
125	860	2645	3
126	869	2648	3
127	870	2656	3
128	875	2844	5
129	878	2676	4
130	879	2845	5
131	892	2872	4
132	895	2830	4
133	905	2886	4
134	913	2707	3
135	915	2646	5

No.	HR	β	n
136	916	2742	4
137	925	2822	4
138	937	2605	5
139	962	2626	3
140	975	2678	4
141	976	2814	4
142	984	2694	3
143	988	2660	4
144	1001	2653	4
145	1002	2903	5
146	1017	2677	STD
147	1020	2736	4
148	1024	2564	3
149	1036	2815	4
150	1046	2875	4
151	1068	2872	4
152	1069	2675	5
153	1071	2628	4
154	1073	2873	4
155	1086	2880	4
156	1089	2619	4
157	1102	2852	4
158	1129	2637	4
159	1130	2796	5
160	1131	2597	6
161	1133	2878	4
162	1135	2693	4
163	1138	2882	5
164	1140	2750	15
165	1142	2691	13
166	1144	2749	STD
167	1145	2702	11
168	1149	2692	7
169	1151	2793	13
170	1152	2823	10
171	1156	2642	7
172	1158	2808	4
173	1164	2636	4
174	1165	2653	17
175	1170	2743	4
176	1172	2737	12
177	1176	2592	4
178	1177	2886	4
179	1178	2697	STD
180	1180	2579	9

No.	HR	β	n
181	1183	2794	12
182	1197	2834	4
183	1201	2712	16
184	1210	2680	4
185	1218	2703	5
186	1223	2801	4
187	1233	2670	7
188	1238	2724	4
189	1242	2738	4
190	1248	2851	4
191	1251	2900	6
192	1252	2632	4
193	1254	2683	4
194	1269	2720	5
195	1276	2664	4
196	1278	2641	3
197	1287	2708	5
198	1292	2694	6
199	1296	2780	3
200	1298	2730	4
201	1303	2610	5
202	1308	2872	5
203	1319	2690	6
204	1321	2560	4
205	1322	2604	3
206	1324	2854	4
207	1327	2574	6
208	1329	2796	4
209	1330	2788	4
210	1331	2767	8
211	1334	2884	4
212	1341	2769	STD
213	1342	2862	4
214	1351	2767	7
215	1354	2693	7
216	1356	2812	7
217	1358	2655	3
218	1368	2757	7
219	1376	2783	10
220	1380	2857	7
221	1381	2877	4
222	1385	2705	8
223	1387	2864	10
224	1388	2784	9
225	1389	2889	8
226	1391	2644	4
227	1392	2753	9
228	1394	2767	4
229	1403	2775	8
230	1406	2624	3
231	1408	2747	7
232	1412	2830	STD
233	1414	2831	7
234	1427	2856	8
235	1428	2809	11
236	1430	2797	6
237	1432	2725	6
238	1434	2689	3
239	1436	2670	7
240	1444	2797	12
241	1455	2611	2
242	1458	2834	4
243	1459	2709	7
244	1470	2737	5
245	1472	2754	9
246	1473	2870	8
247	1477	2817	4
248	1478	2887	4
249	1479	2852	8
250	1480	2811	8
251	1486	2808	4
252	1489	2611	4
253	1499	2616	3
254	1501	2736	5
255	1507	2791	6
256	1511	2819	4
257	1515	2740	4
258	1528	2787	3
259	1543	2654	STD
260	1546	2906	4
261	1547	2813	10
262	1554	2702	3
263	1561	2872	4
264	1566	2739	7
265	1569	2868	4
266	1575	2706	4
267	1593	2664	3
268	1599	2654	4
269	1605	2594	4
270	1620	2847	11

No.	HR	β	n	No.	HR	β	n
271	1627	2770	4	316	1940	2733	5
272	1632	2800	5	317	1955	2741	4
273	1637	2723	4	318	1969	2822	4
274	1639	2838	4	319	1974	2746	4
275	1641	2684	STD	320	1978	2746	5
276	1644	2736	2	321	1989	2852	4
277	1647	2660	4	322	1990	2731	4
278	1656	2579	6	323	1992	2862	4
279	1658	2891	5	324	1998	2873	4
280	1662	2585	3	325	1999	2799	5
281	1666	2846	5	326	2001	2850	5
282	1668	2673	3	327	2025	2821	4
283	1670	2796	8	328	2029	2890	4
284	1672	2820	7	329	2034	2854	9
285	1673	2637	3	330	2045	2804	3
286	1676	2743	5	331	2046	2855	4
287	1678	2799	5	332	2047	2599	STD
288	1687	2662	3	333	2066	2696	4
289	1689	2846	5	334	2079	2751	4
290	1706	2799	6	335	2085	2726	4
291	1708	2590	4	336	2100	2789	5
292	1717	2657	4	337	2107	2738	5
293	1729	2598	10	338	2108	2832	5
294	1734	2783	5	339	2122	2650	3
295	1736	2701	3	340	2123	2823	4
296	1738	2839	5	341	2137	2613	3
297	1740	2724	5	342	2141	2588	3
298	1746	2685	7	343	2143	2798	5
299	1760	2851	5	344	2150	2711	5
300	1774	2885	5	345	2172	2884	7
301	1780	2618	3	346	2179	2693	5
302	1791	2703	8	347	2191	2820	4
303	1809	2867	5	348	2214	2799	4
304	1819	2844	5	349	2220	2661	3
305	1822	2620	2	350	2228	2747	3
306	1828	2601	4	351	2233	2646	4
307	1829	2574	3	352	2234	2902	4
308	1832	2856	4	353	2236	2641	4
309	1854	2832	3	354	2238	2914	4
310	1869	2776	4	355	2241	2666	2
311	1872	2864	4	356	2247	2883	4
312	1889	2650	3	357	2251	2593	3
313	1901	2770	5	358	2264	2689	3
314	1905	2800	4	359	2287	2734	4
315	1929	2835	4	360	2298	2824	5

No.	HR	β	n
361	2313	2608	3
362	2321	2840	5
363	2339	2608	2
364	2351	2737	5
365	2371	2755	5
366	2375	2822	3
367	2386	2772	5
368	2394	2550	2
369	2417	2836	3
370	2421	2869	STD
371	2439	2580	1
372	2449	2906	4
373	2452	2607	1
374	2483	2640	3
375	2484	2664	6
376	2485-86	2640	4
377	2489	2760	4
378	2491	2910	4
379	2514	2768	5
380	2530	2671	5
381	2532	2778	4
382	2539	2702	3
383	2540	2848	6
384	2547	2782	3
385	2551	2773	5
386	2557	2741	4
387	2569	2593	4
388	2572	2835	5
389	2585	2879	8
390	2586	2566	4
391	2597	2717	3
392	2599	2648	4
393	2601	2602	4
394	2606	2892	3
395	2620	2758	2
396	2622	2609	3
397	2643	2600	4
398	2644	2889	3
399	2647	2884	3
400	2700	2838	3
401	2706	2699	4
402	2707	2740	4
403	2711	2639	3
404	2721	2599	3
405	2751	2815	5
406	2753	2833	5
407	2763	2875	9
408	2776	2713	4
409	2777	2712	10
410	2779	2621	5
411	2798	2640	3
412	2807	2629	3
413	2811	2724	3
414	2816	2708	2
415	2820	2858	2
416	2833	2590	3
417	2835	2610	3
418	2837	2744	2
419	2845	2733	STD
420	2846	2659	3
421	2849	2648	3
422	2851	2811	3
423	2852	2713	STD
424	2857	2871	7
425	2866	2638	2
426	2880	2800	2
427	2883	2602	2
428	2886	2842	2
429	2887	2750	6
430	2904	2796	3
431	2914	2840	4
432	2918	2600	3
433	2926	2723	2
434	2927	2657	3
435	2930	2683	6
436	2936	2725	2
437	2943	2671	5
438	2946	2831	5
439	2958	2862	3
440	2962	2667	4
441	2977	2859	5
442	2989	2814	3
443	3021	2661	4
444	3028	2640	3
445	3033	2555	3
446	3067	2856	5
447	3072	2691	3
448	3087	2706	2
449	3106	2674	4
450	3109	2860	4

No.	HR	β	n	No.	HR	β	n
451	3112	2624	2	496	3423	2680	4
452	3119	2585	2	497	3451	2649	3
453	3144	2628	6	498	3459	2612	6
454	3150	2606	3	499	3469	2837	4
455	3173	2875	7	500	3474	2916	4
456	3176	2617	2	501	3475	2580	2
457	3184	2635	3	502	3499	2626	3
458	3188	2596	6	503	3505	2737	3
459	3193	2608	4	504	3506	2677	3
460	3214	2848	3	505	3510	2598	2
461	3224	2856	2	506	3519	2825	4
462	3228	2775	3	507	3526	2871	3
463	3235	2852	2	508	3528	2874	3
464	3245	2574	4	509	3538	2585	2
465	3254	2680	2	510	3546	2699	3
466	3258	2742	2	511	3555	2848	2
467	3262	2636	3	512	3561	2882	3
468	3265	2753	3	513	3563	2636	3
469	3271	2611	4	514	3565	2838	3
470	3277	2886	2	515	3569	2843	5
471	3284	2837	4	516	3572	2865	7
472	3285	2820	4	517	3579	2670	5
473	3295	2665	4	518	3586	2742	4
474	3297	2623	4	519	3589	2814	2
475	3299	2660	5	520	3592	2898	3
476	3309	2583	4	521	3603	2673	2
477	3310-11	2810	4	522	3606	2806	2
478	3314	2897	STD	523	3619	2796	6
479	3321	2832	4	524	3620	2687	2
480	3323	2579	4	525	3624	2764	5
481	3325	2627	4	526	3625	2606	4
482	3329	2788	4	527	3635	2690	3
483	3333	2815	4	528	3648	2607	3
484	3342	2688	4	529	3649	2733	3
485	3355	2731	4	530	3655	2832	3
486	3365	2663	4	531	3662	2833	4
487	3377	2848	4	532	3664	2550	4
488	3380	2719	4	533	3690	2866	4
489	3387	2612	5	534	3701	2667	4
490	3391	2596	4	535	3702	2877	3
491	3394	2720	4	536	3724	2852	3
492	3395	2632	4	537	3727	2790	2
493	3396	2606	3	538	3747	2682	4
494	3398	2867	4	539	3750	2594	2
495	3416	2693	4	540	3757	2733	4

No.	HR	β	n
541	3758	2763	3
542	3759	2657	4
543	3760	2809	3
544	3771	2567	4
545	3775	2646	4
546	3778	2882	2
547	3785	2783	3
548	3787	2808	8
549	3792	2848	4
550	3794	2634	2
551	3797	2793	3
552	3811	2711	3
553	3829	2830	3
554	3848	2869	3
555	3849	2700	STD
556	3852	2689	5
557	3855	2879	2
558	3857	2695	2
559	3859	2669	2
560	3861	2904	2
561	3865	2705	3
562	3873	2598	4
563	3879	2738	3
564	3880	2784	3
565	3881	2607	3
566	3885	2742	2
567	3888	2738	5
568	3889	2788	4
569	3893	2637	2
570	3899	2868	3
571	3900	2788	3
572	3901	2626	2
573	3917	2924	3
574	3928	2640	2
575	3936	2701	4
576	3945	2761	3
577	3951	2599	14
578	3954	2651	3
579	3958	2874	3
580	3969	2724	3
581	3974	2836	STD
582	3979	2668	2
583	3982	2723	STD
584	4012	2647	3
585	4026	2866	2
586	4027	2589	4
587	4030	2596	3
588	4031	2722	STD
589	4033	2873	5
590	4039	2616	3
591	4042	2765	3
592	4051	2608	2
593	4054	2654	6
594	4060	2734	3
595	4067	2646	2
596	4072	2827	7
597	4075	2860	3
598	4079	2628	2
599	4084	2680	3
600	4090	2774	7
601	4096	2885	4
602	4098	2577	3
603	4108	2855	3
604	4112	2618	6
605	4113	2856	4
606	4132	2821	5
607	4137	2844	4
608	4141	2716	4
609	4150	2639	3
610	4155	2746	3
611	4166	2594	STD
612	4189	2836	2
613	4191	2720	3
614	4192	2871	5
615	4197	2824	5
616	4230	2670	4
617	4237	2849	3
618	4244	2864	3
619	4254	2750	4
620	4277	2606	3
621	4281	2655	3
622	4285	2598	3
623	4288	2793	3
624	4294	2862	3
625	4295	2880	9
626	4303	2775	4
627	4309	2853	4
628	4310	2727	6
629	4315	2758	4
630	4322	2870	5

No.	HR	β	n
631	4332	2862	4
632	4341	2825	5
633	4344	2900	4
634	4345	2604	4
635	4357	2869	4
636	4359	2874	6
637	4363	2634	3
638	4366	2743	5
639	4368	2777	6
640	4369	2852	4
641	4380	2869	4
642	4388	2846	4
643	4399	2686	6
644	4408	2679	5
645	4410	2720	4
646	4412	2647	4
647	4421	2655	3
648	4424	2849	3
649	4431	2628	3
650	4437	2599	5
651	4454	2834	8
652	4455	2661	5
653	4464	2822	7
654	4477	2722	4
655	4480	2704	4
656	4501	2623	3
657	4505	2694	4
658	4515	2854	5
659	4527	2673	6
660	4529	2618	4
661	4531	2775	6
662	4533	2636	4
663	4534	2900	STD
664	4535	2796	5
665	4536	2648	3
666	4540	2628	STD
667	4543	2774	6
668	4554	2885	STD
669	4555	2817	6
670	4564	2870	6
671	4572	2626	5
672	4574	2730	4
673	4584	2803	4
674	4585	2891	6
675	4589	2842	4
676	4594	2770	3
677	4629	2758	3
678	4633	2851	10
679	4642	2687	4
680	4650	2793	4
681	4657	2622	4
682	4660	2883	6
683	4663	2879	5
684	4680	2717	4
685	4681	2819	3
686	4684	2835	10
687	4685	2866	8
688	4688	2640	3
689	4694	2738	4
690	4698	2696	3
691	4707	2701	31
692	4708	2603	3
693	4715	2707	4
694	4717	2882	10
695	4733	2742	10
696	4738	2867	24
697	4746	2673	3
698	4750	2842	8
699	4753	2668	6
700	4756	2881	4
701	4760	2830	4
702	4761	2615	4
703	4766	2905	9
704	4767	2604	4
705	4780	2881	8
706	4785	2600	5
707	4811	2797	4
708	4824	2806	4
709	4825-26	2694	4
710	4837	2556	5
711	4843	2651	3
712	4845	2574	3
713	4847	2755	5
714	4855	2863	5
715	4856	2618	4
716	4859	2828	4
717	4866	2842	4
718	4867	2641	3
719	4875	2797	4
720	4883	2594	STD

No.	HR	β	n
721	4886	2808	5
722	4891	2646	4
723	4900	2750	5
724	4904	2825	3
725	4915	2777	7
726	4916	2744	5
727	4926	2659	5
728	4931	2708	STD
729	4934	2676	4
730	4937	2756	4
731	4946	2678	4
732	4948	2903	5
733	4968-69	2646	3
734	4971	2731	3
735	4983	2609	STD
736	5004	2876	2
737	5005	2720	5
738	5010	2753	3
739	5011	2599	3
740	5014	2755	5
741	5017	2778	4
742	5025	2757	3
743	5045	2770	4
744	5050	2663	4
745	5057	2905	5
746	5059	2845	5
747	5062	2847	STD
748	5072	2576	3
749	5076	2787	3
750	5079	2771	4
751	5083	2695	4
752	5105	2880	5
753	5107	2875	5
754	5108	2850	4
755	5112	2852	4
756	5116	2852	4
757	5129	2778	5
758	5142	2874	4
759	5148	2618	3
760	5156	2663	5
761	5177	2643	3
762	5179	2819	4
763	5182	2630	4
764	5183	2604	4
765	5185	2656	7
766	5204	2794	5
767	5214	2890	4
768	5220	2901	5
769	5229	2838	5
770	5235	2627	STD
771	5243	2610	4
772	5244	2812	4
773	5245	2682	5
774	5258	2639	3
775	5262	2889	4
776	5263	2824	4
777	5264	2843	4
778	5270	2540	STD
779	5275	2681	4
780	5304	2631	7
781	5307	2658	3
782	5317	2654	3
783	5323	2631	5
784	5333	2825	4
785	5338	2622	4
786	5343	2771	5
787	5345	2910	4
788	5347	2679	4
789	5350	2817	7
790	5363	2651	4
791	5365	2676	5
792	5368	2835	5
793	5372	2832	3
794	5373	2996	4
795	5384	2589	3
796	5387	2685	5
797	5392	2869	4
798	5404	2644	4
799	5405	2817	3
800	5411	2688	4
801	5418	2844	4
802	5420	2566	6
803	5423	2593	3
804	5434	2699	4
805	5435	2815	7
806	5436	2671	3
807	5437	2790	4
808	5441	2643	3
809	5445	2657	3
810	5447	2681	STD

No.	NR	β	n
811	5451	2628	3
812	5473	2816	3
813	5487	2687	5
814	5529	2678	4
815	5532	2823	4
816	5533	2660	3
817	5537	2689	4
818	5570	2726	5
819	5581	2646	3
820	5583	2646	4
821	5588	2713	3
822	5599	2884	4
823	5608	2868	4
824	5612	2668	3
825	5630	2633	3
826	5634	2664	7
827	5679	2847	4
828	5691	2629	3
829	5694	2617	6
830	5702	2816	4
831	5715	2872	4
832	5716	2706	4
833	5721	2788	4
834	5733	2745	5
835	5740	2617	3
836	5746	2799	4
837	5747	2842	5
838	5748	2888	3
839	5758	2694	5
840	5759	2891	4
841	5769	2631	4
842	5783	2736	4
843	5791	2756	4
844	5799	2655	3
845	5804	2724	3
846	5817	2739	4
847	5842	2900	4
848	5845	2860	4
849	5867	2866	4
850	5868	2608	7
851	5886	2901	5
852	5887	2823	5
853	5911	2576	3
854	5913	2663	3
855	5914	2601	6

No.	HR	β	n
856	5933	2633	STD
857	5936	2714	9
858	5960	2761	4
859	5964	2757	4
860	5968	2588	7
861	5972	2900	4
862	5983	2678	3
863	5986	2639	8
864	6091	2679	4
865	6093	2726	6
866	6095	2776	5
867	6110	2854	4
868	6123	2806	4
869	6127	2865	4
870	6181	2664	5
871	6201	2743	4
872	6203	2893	4
873	6205	2723	4
874	6212	2613	6
875	6222	2744	4
876	6226	2908	4
877	6232	2834	4
878	6248	2628	4
879	6277	2764	4
880	6290	2709	4
881	6317	2802	4
882	6328	2672	3
883	6332	2886	8
884	6349	2589	3
885	6351	2834	4
886	6355	2878	STD
887	6369-70	2660	4
888	6376	2875	5
889	6377	2848	5
890	6391	2798	5
891	6394	2610	3
892	6410	2857	5
893	6421	2831	4
894	6434	2722	4
895	6436	2888	4
896	6455	2860	4
897	6458	2587	3
898	6467	2656	3
899	6469	2613	3
900	6480	2814	4

No.	HR	β	n	No.	HR	β	n
901	6481	2876	4	946	6813	2801	4
902	6489	2644	4	947	6831	2606	3
903	6493	2678	4	948	6844	2740	4
904	6499	2869	3	949	6847	2597	5
905	6507	2784	4	950	6849	2712	4
906	6509	2849	4	951	6850	2653	3
907	6511	2846	4	952	6876	2800	4
908	6514	2887	5	953	6877	2808	4
909	6524	2613	3	954	6903	2846	4
910	6531	2669	3	955	6911	2876	4
911	6536	2595	3	956	6917	2878	4
912	6541	2631	3	957	6957	2853	4
913	6548	2888	4	958	6975	2862	4
914	6551	2792	5	959	6978	2641	3
915	6554	2778	4	960	6985	2687	4
916	6555	2772	4	961	6987	2682	4
917	6556	2832	8	962	7003	2793	4
918	6560	2695	4	963	7008	2634	3
919	6570	2858	4	964	7019	2814	5
920	6577	2626	3	965	7044	2706	5
921	6594	2680	4	966	7056	2849	4
922	6604	2701	3	967	7057	2748	5
923	6608	2611	4	968	7060	2842	4
924	6611	2871	4	969	7061	2648	5
925	6655	2773	5	970	7063	2597	3
926	6656	2899	4	971	7069	2903	STD
927	6669	2629	4	972	7096	2837	5
928	6670	2662	4	973	7101	2747	4
929	6676	2644	4	974	7102	2879	5
930	6685	2645	6	975	7110	2818	4
931	6697	2613	4	976	7154	2646	3
932	6699	2757	5	977	7163	2628	4
933	6707	2673	7	978	7167	2809	5
934	6709	2905	4	979	7172	2616	3
935	6710	2688	5	980	7207	2874	4
936	6723	2837	3	981	7214	2852	5
937	6754	2728	4	982	7215	2845	4
938	6764	2641	4	983	7219	2856	4
939	6767	2758	3	984	7222	2749	7
940	6771	2878	6	985	7231	2710	3
941	6775	2616	5	986	7250	2889	4
942	6781	2892	4	987	7253	2754	4
943	6784	2864	4	988	7261	2702	3
944	6794	2844	4	989	7263	2688	3
945	6797	2638	4	990	7266	2729	4

No.	HR	β	n	No.	HR	β	n
991	7267	2596	4	1036	7646	2832	4
992	7280	2669	3	1037	7653	2840	4
993	7288	2846	4	1038	7661	2724	4
994	7301	2878	4	1039	7672	2615	4
995	7303	2859	4	1040	7677	2827	4
996	7308	2641	3	1041	7692	2671	3
997	7315	2828	4	1042	7697	2679	5
998	7322	2640	3	1043	7702	2822	4
999	7331	2796	4	1044	7711	2896	3
1000	7332	2907	3	1045	7727	2633	3
1001	7354	2646	3	1046	7730	2807	4
1002	7357	2776	4	1047	7731	2791	4
1003	7366	2743	6	1048	7734	2766	4
1004	7377	2739	STD	1049	7740	2834	4
1005	7386	2614	3	1050	7756	2671	3
1006	7387	2724	3	1051	7770	2665	3
1007	7389	2659	3	1052	7774	2764	4
1008	7420	2833	4	1053	7793	2626	3
1009	7438	2667	3	1054	7796	2641	STD
1010	7441	2676	3	1055	7823	2727	3
1011	7444	2873	4	1056	7833	2837	4
1012	7445	2892	4	1057	7834	2700	4
1013	7451	2642	5	1058	7839	2890	4
1014	7460	2687	4	1059	7847	2680	4
1015	7469	2686	4	1060	7850	2834	4
1016	7479	2596	4	1061	7858	2921	4
1017	7481	2876	3	1062	7871	2872	3
1018	7484	2663	3	1063	7874	2859	4
1019	7495	2712	4	1064	7876	2753	5
1020	7501	2729	5	1065	7883	2917	4
1021	7502	2812	4	1066	7906	2802	STD
1022	7503	2595	3	1067	7907	2649	3
1023	7504	2598	3	1068	7916	2704	4
1024	7519	2863	4	1069	7924	2567	3
1025	7522	2621	3	1070	7925	2667	3
1026	7533	2744	4	1071	7928	2738	4
1027	7534	2641	3	1072	7955	2635	4
1028	7542	2612	3	1073	7973	2652	3
1029	7557	2828	4	1074	7984	2846	4
1030	7560	2620	4	1075	7990	2752	4
1031	7569	2590	4	1076	7998	2687	4
1032	7577	2706	4	1077	8006	2760	4
1033	7610	2905	4	1078	8012	2889	4
1034	7634	2875	4	1079	8025	2728	4
1035	7641	2714	4	1080	8037	2684	4

No.	HR	β	n	No.	HR	β	n
1081	8041	2620	3	1126	8414	2605	4
1082	8071	2714	3	1127	8429	2894	4
1083	8077	2625	3	1128	8430	2668	4
1084	8095	2701	5	1129	8435	2714	4
1085	8097	2825	4	1130	8441	2754	4
1086	8098	2882	4	1131	8443	2671	3
1087	8120	2774	4	1132	8450	2886	4
1088	8131	2707	3	1133	8454	2670	4
1089	8155	2752	4	1134	8455	2545	3
1090	8157	2665	4	1135	8459	2865	4
1091	8162	2809	4	1136	8460	2801	3
1092	8170	2619	3	1137	8463	2869	4
1093	8189	2646	4	1138	8467	2629	3
1094	8190	2753	5	1139	8472	2635	3
1095	8191	2661	3	1140	8494	2757	STD
1096	8192	2752	4	1141	8495	2801	3
1097	8195	2835	4	1142	8507	2653	3
1098	8198	2716	4	1143	8514	2620	3
1099	8205	2676	3	1144	8536	2628	3
1100	8208	2721	4	1145	8548	2622	3
1101	8210	2806	4	1146	8581	2619	3
1102	8216	2894	4	1147	8584	2821	4
1103	8220	2745	4	1148	8588	2830	4
1104	8232	2624	4	1149	8607	2864	4
1105	8250	2638	3	1150	8613	2779	4
1106	8257	2698	4	1151	8617	2609	4
1107	8263	2882	4	1152	8627	2858	4
1108	8264	2836	4	1153	8650	2592	4
1109	8266	2819	5	1154	8653	2642	5
1110	8267	2728	4	1155	8665	2626	6
1111	8270	2770	4	1156	8666	2718	4
1112	8272	2826	4	1157	8681	2740	4
1113	8276	2740	7	1158	8697	2631	4
1114	8314	2594	5	1159	8709	2866	5
1115	8330	2705	4	1160	8715	2836	4
1116	8332	2800	4	1161	8718	2674	4
1117	8334	2593	3	1162	8728	2896	4
1118	8344	2690	4	1163	8729	2603	3
1119	8354	2640	3	1164	8735	2672	5
1120	8359	2553	3	1165	8752	2638	6
1121	8373	2841	4	1166	8755	2807	4
1122	8376	2678	4	1167	8765	2731	4
1123	8391	2656	3	1168	8776	2666	4
1124	8392	2704	4	1169	8781	2841	STD
1125	8410	2817	4	1170	8782	2738	4

No.	HR	β	n
1171	8788	2660	4
1172	8792	2612	5
1173	8799	2746	4
1174	8805	2672	3
1175	8822	2777	4
1176	8825	2640	3
1177	8826	2814	7
1178	8830	2742	9
1179	8838	2632	3
1180	8840	2894	3
1181	8845	2678	3
1182	8853	2624	3
1183	8868	2678	4
1184	8870	2834	4
1185	8880	2808	5
1186	8884	2842	4
1187	8885	2663	3
1188	8899	2640	3
1189	8905	2614	5
1190	8911	2879	4
1191	8931	2600	3
1192	8944	2775	4
1193	8954	2641	4
1194	8955	2631	4
1195	8969	2622	STD
1196	8970	2849	3
1197	8973	2714	4
1198	8977	2683	3
1199	8981	2832	4
1200	8984	2818	5
1201	9015	2635	4
1202	9020	2666	3
1203	9022	2854	4
1204	9025	2840	4
1205	9028	2679	4
1206	9039	2823	4
1207	9057	2594	4
1208	9059	2641	3
1209	9072	2670	5
1210	9074-75	2630	4
1211	9078	2640	3
1212	9085	2784	4
1213	9088	2563	STD
1214	9092	2815	4
1215	9093	2714	4

No.	HR	β	n
1216	9105	2838	4
1217	9107	2592	4

Stromgren ONR

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
WASHINGTON, D. C. 20360

IN REPLY REFER TO
ONR:414:JRS:mm
Astronomy Proposal
27 May 1966

Dr. Bengt Stromgren
Institute for Advanced Study
Princeton, New Jersey 08540

Dear Bengt:

I am happy to write you that your proposal entitled "Investigations of Problems of Star Formation" received one of the highest ratings and was recommended for support by ONR.

We will not be able to negotiate a contract by July as you have requested. It is more realistic to expect a starting date in October. I hope this will not greatly inconvenience you. If it is important for you to begin earlier we can back-date the contract but the contractor would have to assume the risk for all funds spent prior to final execution of the contract.

It must be about time for your annual (at least) trip to Denmark. I hope you have a pleasant visit.

Sincerely yours,

Jean

JEAN R. STREETER
Geography Branch

Copy to:
ResRep Princeton

for Strömgren ONR

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
WASHINGTON, D. C. 20360

IN REPLY REFER TO
ONR:410:LOQ:rjs
5 April 1966

AIR MAIL

Dr. Bengt Stromgren
Princeton University
Institute for Advanced Study
Princeton, New Jersey 08540

Dear Dr. Stromgren:

Your proposal entitled "Investigations of Problems of Star Formation" has been received by the Geography Branch of this Division. You will be notified by the Branch of the action contemplated in connection with your proposal.

We wish to thank you for your interest in the program of the Office of Naval Research.

Sincerely yours,

LOUIS O. QUAM
Director
Earth Sciences Division
By direction of
Chief of Naval Research

Copy to:
ONR/New York
→ R. Oppenheimer/Princeton Univ.

Stromgren ONR

Institute for Advanced Study
Princeton, New Jersey

Proposal to

The Office of Naval Research

for a contract in support of

Investigations of problems of star formation

Funds requested: $9,800 Period: July 1966 - June 1967

Bengt Strömgren

Principal Investigator: Bengt Stromgren

Approved: Robert Oppenheimer
Director, Institute for
Advanced Study

Herewith a proposal is submitted to The Office of Naval Research for a one-year contract in support of "Investigations of problems of star formation."

Results obtained through research work supported by Contract Nonr 1858 (33) (Investigations of problems of star formation) have been summarized in the Final Report to ONR on this contract and described in a number of publications listed in the Final Report [see references (1) - (7)] . This research work has led to the formulation of new research programs on problems of star formation. Support from the ONR for work on two of these programs is herewith requested:

1. A study based on photoelectric uvby photometry of F and G stars north of declination - 10° and to the magnitude limit $V = 7^{m}.3$ has made it possible to draw up a list of intermediate population II stars (Δm_1 between $0^{m}.044$ and $0^{m}.080$, average metal-hydrogen ratio equal to 0.2 times the Hyades cluster value) without any observational bias, see sections 5 and 6 of the Final Report. It is very desirable to increase the accuracy of the uvby data for these stars (a total of 80) by adding 3 observations to the 2 observations already available. This will give accurate information on the distribution of the stars in the Hertzsprung-Russell diagram; comparison of this information with theoretical calculations of evolutionary sequences should yield important results regarding the initial helium-hydrogen ratio and the age of the stars in question.

It is also desirable to obtain 2 additional observations for all stars which according to the previous photoelectric uvby photometry have Δm_1 values in the range $0^{m}.025$ - $0^{m}.044$ (about 100 stars). This should make the list of stars with Δm_1 between $0^{m}.044$ and $0^{m}.080$ practically complete, since the probable error of an m_1 - value determined from 4 observations is $\pm\ 0^{m}.003$.

2. Methods have been developed for the determination of ages of main-sequence B and A stars on the basis of photoelectric uvby and Hβ photometry [see references (4) and (5)]. These methods have been applied to B and A stars brighter than V = $6^{m}_{\cdot}5$, and the determined ages and space velocities have been combined, using tables of plane galactic motions [reference (6)], to give places of formation for the stars. The results already obtained [reference (7)] suggest that main-sequence B and A stars in the solar neighborhood (within 150 pc) can be segregated into two groups, one containing stars formed in our spiral arm, the other stars originating in the outer (Perseus) spiral arm. However, it is necessary to pursue the question further by increasing the samples of stars through extension of the photometric work. It is particularly desirable to obtain photoelectric uvby and Hβ photometry for A0 stars with V between $6^{m}_{\cdot}0$ and $7^{m}_{\cdot}0$, and A1 - A2 stars with V $6^{m}_{\cdot}5$ - $7^{m}_{\cdot}0$ (north of declination -10°, total number of stars about 800).

The auxiliary equipment necessary for carrying out these two programs is available as it is the same that was used in the research work supported by Contract Nonr 1858 (33). I have been informed that observing time with the Kitt Peak National Observatory 36-inch and 16-inch reflectors would be available.

Financial support is herewith requested for the salary of a Research Associate who would collaborate with the Principal Investigator in obtaining the photoelectric observations, and for travel between Princeton and Kitt Peak National Observatory.

The proposed budget is as follows:

Research Associate, 1 year	$7,500
Overhead, 20 per cent of salary	1,500
Travel and miscellaneous expenses	800
	$9,800

References

(1) B. Strömgren, "Problems of Internal Constitution and Kinematics of Main-Sequence Stars," Quarterly Journal of the Royal Astr. Soc. 4, 8, 1963

(2) B. Strömgren, "Comparison of Observed and Theoretically Calculated Intensities in the Continuous Spectra of Main-Sequence B Stars," Rev. Mod. Phys. 36, 532, 1964

(3) B. Strömgren, "On the Chemical Composition and Kinematics of Disc High-velocity Stars of the Main Sequence," Astrophys. Norvegica 9, 333, 1964, and Contr. Kitt Peak National Obs. No. 59

(4) B. Strömgren, "Age Determination for Main-Sequence B, A, and F stars," to appear in Symposium Volume on Stellar Evolution, Goddard Institute for Space Studies, Edited by A. Cameron and R. Stein, 1966

(5) T. Kelsall and B. Strömgren, "Calibration of the Hertzsprung-Russell diagram in terms of age and mass for main-sequence B and A stars," to appear in Vistas of Astronomy, Vol. 8, Edited by A. Beer and K. Strand, 1966

(6) G. Contopoulos and B. Strömgren, "Tables of Plane Galactic Orbits," Publ. Goddard Institute for Space Studies, 1965

(7) B. Strömgren, The Henry Norris Russell Lecture 1965, to be published in the Astronomical Journal

Fac Strömgren ONR contract

Princeton University

Department of Astronomy
Princeton, New Jersey

Semi-Annual Status Report to

The Office of Naval Research

on

Investigations of Problems of Star Formation
Contract Nonr 1858 (33)

November 10, 1960

Prepared by: Bengt Strömgren
Principal Investigator

1. Equipment. The digitizer and print-out equipment ordered from the Datex Corporation, Monrovia, California, was received and first assembled at the Kitt Peak National Observatory where it was tested in May and June, 1960, by Dr. David Crawford. The results of the tests were very satisfactory. In July, 1960, the equipment was transported to Mount Palomar Observatory and re-assembled there for use with the photoelectric photometer on the 20-inch reflector during the observing period July 25, 1960-September 24, 1960.

The digitizer and print-out equipment was used through the entire observing period without any malfunctioning whatsoever. Over 25,000 deflections were recorded in printed form during this period.

A photoelectric photometer that could be attached to the Mount Palomar Observatory 20-inch reflector for uvby and Hβ-photometry was constructed by Jacobson Tool and Die Company, Darien, Wisconsin. A filter slide for use of the four interference filters for uvby-photometry with the standard Mount Palomar Observatory photoelectric photometer was constructed in the Mount Wilson and Palomar Observatory shop in Pasadena. Both photometers were used; however, the combination of the standard Mount Palomar Observatory photometer and the new filter slide proved to be the most suitable.

The Jacobson photometer is now being adapted for use with the Kitt Peak National Observatory 36-inch and 16-inch reflectors. It is expected that it will be ready for use during an observing period in January, 1961.

A set of four filters for the photoelectric uvby photometry was acquired from Jenaer Glaswerk Schott (W. Germany). The peak transmission wave-length and half-widths are given below.

	Filter	λ Max.	Max. transm.	Half-width	Diameter	Thickness
u.	Ultraviolet (glass)	3450A	30 per cent	400 A	25.4 mm	9.0 mm
v.	Violet (interference)	4110	44	200	27.8	3.8
b.	Blue (interference)	4680	45	180	27.8	7.7
y.	Yellow (interference)	5480	52	230	27.8	4.8

The peak-transmission wave-lengths and half-widths are nearly the same for the photometer response curve (allowing for atmospheric transparencies, telescope transparencies, and photomultiplier sensitivity), except that λ_{max} is somewhat larger and the half-width considerably reduced for the u combination.

A set of Hβ and comparison filters has been acquired from Spectrolab, Inc., North Hollywood, California. The half-width of the Hβ filter is 25A. These filters have a high degree of constancy of the peak-transmission wave length.

In collaboration with Mr. L. C. Eichner the Scanner design has been worked out. Mr. Eichner has completed the mechanical parts of the scanner. A plate 5 x 5 inches is scanned in 3 hours. The motion in the Y-coordinate between consecutive scans in the X-coordinate is 0.05mm. It is expected that the Scanner will be ready for tests within 4 months.

2. Photoelectric observations. The 20-inch reflector of the Mount Palomar Observatory was used for a program of photoelectric uvby-photometry with the filter set just described. The program consists of all stars brighter than $6.^m5$ and north of declination -10° in the spectral range A2-Go (Harvard classification). This program is a consolidated one, the spectral range A2-F2 being of interest in connection with a project supported by the NSF, while the stars in the spectral range F5-Go form part of the photometric program outlined under the heading

1 a, p. 5, in the proposal to the ONR for "Investigations of problems of star formation".

During the observing period July 25-September 24, 1960, the 20-inch reflector was available for 45 nights. Out of these, 38 nights were partly or completely clear (more than 70 per cent of the nights were completely clear). Altogether about 2100 star observations were obtained, a star observation consisting of 2 deflections on star and 1 deflection on sky for each of the four filters (on nights when seeing conditions were poor 4 deflections instead of 2 were obtained). Altogether about 26,000 deflections were recorded.

The observations covered the right ascensions 17^h to 4^h. A network of 60 standard stars was set up, and uvby-photometry of the standard stars was carried out on 10 nights. On these nights the determination of extinction was emphasized. The program stars were then observed relative to these standard stars in zones of 10^o width in declination.

The program was practically completed between 17^h and 3^h right ascension, with at least 2 observations on separate nights for each star. A number of Pleiades and Hyades stars fainter than the $6.^m5$ limit were observed in addition to the program stars. Altogether about 600 stars were observed.

In the 20-inch photometric work I was effectively assisted by Mr. Charles Perry and Mr. Robert Cameron (on 18 nights the observers were Strömgren - Perry, on 10 nights Strömgren - Cameron, on 10 nights Perry).

The reduction of the observations has been practically completed. A large part of the reduction was carried out with the Royal McBee electronic computer of the Kitt National Observatory by Mr. Charles Perry. The code for the reduction of the photometric observations has been worked out by Dr. D. L. Crawford with Dr. D. Schulte of the National Observatory staff.

Preliminary tests have shown that the photometric accuracy obtained is satisfactory, about the same as that of photometric observations of the same type which I have carried out previously at McDonald Observatory and Lick Observatory.

I expect to submit a Technical Report summarizing the results of the observations within two months. However, it is already clear from a preliminary investigation that the observations will yield the expected indices for F5-Go stars, namely (1) an index of effective temperature which is relatively insensitive to differences in chemical composition, (2) an absolute magnitude index, and (3) a metal-content index.

3. Planned continuation of the photoelectric observations. It is planned to continue the observations on the program of A2-Go stars brighter than $6^{m}.5$ and north of declination -10° in January, 1960. The 36-inch reflector of the Kitt Peak National Observatory has been made available for a one-month period. I will be assisted during this period by Mr. Charles Perry. It is expected that the program can then be completed up to 13^{h} right ascension. It is further hoped that the remaining gap, 13^{h} - 17^{h}, can be filled in (with the 36-inch Kitt Peak Observatory reflector) during May, 1961.

When the photometric program has been completed to visual magnitude $6^{m}.5$ it will be possible to carry out the planned observations to $8^{m}.25$ with the help of the spectrograph - photometer for simultaneous measures in the four wave-length bands. It is, of course, of importance that the observations with the spectrograph-photometer can be made relative to a network of about 1200 stars already observed.

4. Photographic observations. Photographic observations on the program described under the heading 2b, p. 8 of the proposal for "Investigations of problems of star formation" were obtained with the 48-inch Schmidt telescope of Mount Palomar Observatory. During my stay there July 25-September 24, 1960, this telescope was available for the program in question on 10 nights. I could observe on 8 of these nights. Mr. C. Kearns, night assistant at Mount Palomar Observatory, cooperated most effectively in obtaining the photographic material.

With the 48-inch Schmidt telescope 50 plates 10 x 10, were obtained. Of these 39 were program plates, the others were test and control plates to determine focus and exposure times. Altogether 26 program areas in high south galactic latitude were covered, 13 of these with two plates.

Each plate has one ultraviolet-filter exposure (28 minutes exposure time) and one yellow filter exposure (3 minutes exposure time). The two images of each star are separated by about 0.8 mm. The image strengths are about matched for main-sequence F5-stars. The limiting magnitude is 17^m, so that the faintest program stars, $15^m.5$, have well exposed images.

Plates of Eichfeld 92 have already been examined, and it was verified that the halo Population II stars already known from my previous investigations in this area can indeed be picked out with the help of the 48-inch program plates.

The evaluation of the plates will be carried out when the Scanner is completed. For this work each 10 x 10 plate will be cut into four 5 x 5 inches plates.

5. Continuation of the photographic observations. It is hoped that the 48-inch Schmidt telescope work can be continued in the spring or early summer of 1961 and that plates in northern high galactic latitudes can then be obtained.

Final Report

to

The Office of Naval Research

On Contract Nonr 2331(00)

Photoelectric Line Intensity Photometry

By

Bengt Strömgren *
Principal Investigator

Sponsoring Institution: University of Chicago

* Now at the Institute for Advanced Study, Princeton, New Jersey

The work carried out under the ONR contract Nonr 2331(00) and reported on herewith aimed at the construction of a photoelectric line intensity photometer. A 2-beam photoelectric line photometer was constructed and tested. It has been used extensively on the McDonald Observatory 36-inch reflector, and also on the 36-inch refractor of the Lick Observatory. It is now being used on the Kitt Peak National Observatory 36-inch reflector.

The instrument is described below. A summary of the results of the tests is given. Appendix I includes the results of measures with the photoelectric line photometer of the Hβ-index l, made at Lick Observatory by B. Strömgren and C. Perry. Appendix II contains the results of Hβ-line photometry made with the photometer by D. L. Crawford at McDonald Observatory.

The principle according to which the 2-beam photoelectric line photometer was constructed has been described by B. Strömgren (references [1] and [2]) and by D. L. Crawford (reference [3]). Fig. 1 of this report shows the design of the photometer schematically, while Fig. 2 is a reproduction of a photograph of the instrument.

From Fig. 1 it is seen how the light from the star to be observed is split into two beams which are channeled into two photomultipliers through suitably chosen interference filters. An interference filter with a half-width in the range 15 - 35 A and a peak transmission wave length coinciding with that of the line to be measured is utilized in the main beam. The filter box allows switching between this filter and a comparison filter which is 5 - 10 times as wide and also centered on the line. The intensity ratio narrow filter - comparison filter is an index of the strength of the absorption line in question. In the secondary beam a comparison filter identical with the comparison filter in the main beam is used for every measure, simultaneous measures being made in the main beam and the secondary beam. In this way the influence of any changes in the transparency of the terrestrial atmosphere is eliminated. It is also clear that the measured index of the strength of the absorption line is independent of the ratio of the sensitivities of the two photomultipliers.

The reliability and accuracy of the photometer was tested through repeated measures of standard stars. The repetitions of measures of standard stars on one and the same night indicated that any existing hour angle effect or time dependence of the measured indices is quite small, at most a few thousandth of a magnitude. The actual scatter corresponds to a p. e. of on the average about $\pm$ 0.^{m} 003 on the l-scale (cf. Appendix I).

Measures made on different nights of the same observing period are reduced to a common system through night corrections, assumed constant for each night and determined through the observation of standard stars. The variations of the night correction from night to night are of the order of a few hundredth of a magnitude. These variations are presumably caused by a number of effects which include small variations in the condition of the filters and variations in the seeing. The elimination of the effect of such variations through the observation of a sufficient number of standard stars on every night is essential.

Comparisons of measures of standard stars made with the same interference filters in different observing periods sometimes indicated differences caused by shifts of the peak transmission wave-length of the order of 5 - 10 A. Accurate reduction of the measures to a common system with the help of the observations of standard stars presented no difficulty. As expected haze, and even clouds, had no effect on the measured line absorption indices.

Since the photoelectric line photometer does not have rotational symmetry it is important to make sure that the measured line absorption indices are nevertheless independent of the polarization of the incident star light. The tests were made as follows. A pair of stars at an angular distance of a few degrees was selected in such a way that the stars had similar spectra, and polarizations of $0.^m00$ and about $0.^m10$, respectively. The position angle of the photometer was varied in steps of 30°, and the Hβ-index was measured as a function of position angle for both stars. It turned out that the measured difference between Hβ-indices of the two stars remained practically constant, independent of the position angle.

The limiting magnitude depends on the particular filters used, the integration time during which the photoelectrons are accumulated, and the required accuracy. With the 36-inch reflector of the McDonald Observatory it was found the limiting magnitude for 1 minute integration time and a p. e. of the Hβ-index on the 1-scale of $\pm 0.^m005$ was $10^m - 11^m$.

With a convenient telescope such as the 36-inch reflector of the McDonald Observatory observing programs consisting of Hβ measures for stars brighter than $9^m - 10^m$ have been carried out with quite satisfactory speed, it being possible to observe 15 stars, or more, per hour. The insensitivity of the results to haze and thin clouds has proved to be a great advantage. As an example it may be mentioned that D. L. Crawford, working with the 36-inch reflector of the McDonald Observatory, during an observing period of two months of the summer of 1958, found that the photoelectric line photometer could be used on 45 nights, while only 4 nights were photometric.

July, 1960 Bengt Strömgren

References:

(1) B. Strömgren 1958 a, Le Problème des Populations Stellaires, p. 385-409.

(2) B. Strömgren 1958 b, Observatory, Vol. 78, p. 137-148.

(3) D. L. Crawford 1958, Ap. J. 128, 185-206.

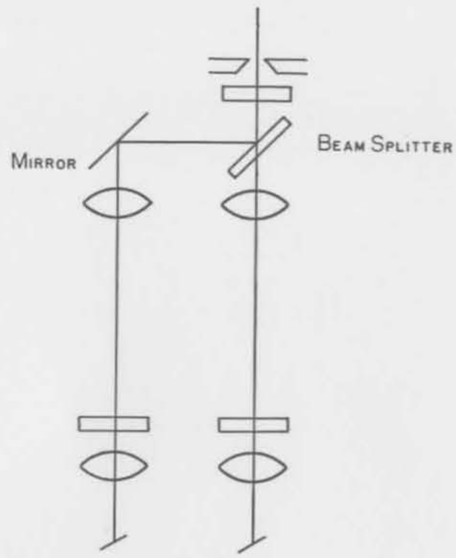

Fig. 1. The schematic drawing shows the design of the 2-beam photoelectric line photometer. The star image is centered in the deaphragm indicated at the top. The light passes a glass filter and is divided into two beams by the beam splitter (70 per cent transmission, 30 per cent reflection). Two field lenses (one in each beam) image the telescope objective on the narrow-band filters. The filter in the transmitted beam has a half-width in the range of 15-35 A and is centered on the line to be measured. The filter box allows switching between this filter and a comparison filter which is about ten times as wide and also centered on the line. Another comparison filter, identical with the one just mentioned, is located in the reflected beam. Two further field lenses image the filters in the two beams on the photocathodes of two photomultipliers.

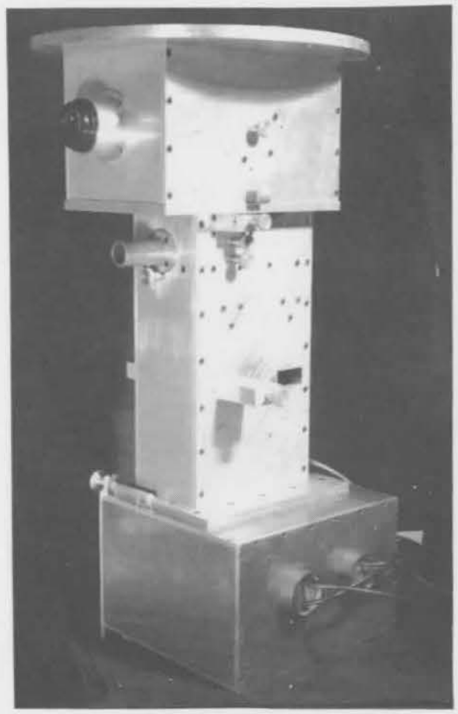

Fig. 2. The 2-beam photoelectric line photometer is shown with the circular plate by which it is attached to the telescope at the top. The upper box contains a sliding prism and a large-field eyepiece for checking the star field. The photometer diaphragm and a sliding prism and microscope for checking the centering in the diaphragm are at the upper end of the middle box. This box contains the beam splitter, mirror field lenses, and filters shown in the schematic drawing, Figure 1. The lower box is a dry-ice refrigeration box which contains the two photomultipliers.

APPENDIX I.

Photoelectric Narrow-band Photometry of B, A and F Stars Brighter than $5^m.5$ Observed by B. Strömgren at McDonald Observatory and by B. Strömgren and C. Perry at Lick Observatory

Photoelectric Narrow-band Photometry of B, A and F Stars Brighter than $5^m.5$ observed at McDonald Observatory and Lick Observatory

Notation

Filter	Peak Wavelength	Half-width
a	5000 Å	90 Å
b	4861	35 and 15 Å, respectively
c	4700	100
d	4500	80
e	4030	90
f	3600	350

Hβ Index $l = \text{constant} + 2.5\,[\tfrac{1}{2}\log I(a) + \tfrac{1}{2}\log I(c) - \log I(b)]$

Balmer Discontinuity Index $c = \text{constant} + 2.5\,[2\log I(e) - \log I(d) - \log I(f)]$

Color Index $e\text{-}a = \text{constant} + 2.5\,[\log I(a) - \log I(e)]$

Metal Index $m = \text{constant} + 2.5\,[2\log I(d) - \log I(a) - \log I(e)]$

Accuracy, Probable Errors

	McDonald Observatory		Lick Observatory	
	1 Observation	Catalogue Value	1 Observation	Catalogue Value
	m	m	m	m
l	± 0.004	± 0.003	± 0.003	± 0.002
c	± 0.007	± 0.005	± 0.008	± 0.005
e-a	± 0.006	± 0.004	± 0.005	± 0.004
m	± 0.009	± 0.006 Series A ± 0.004 Series A & B	± 0.005	± 0.004

Total Number of Observations, Bright B, A and F Stars

McDonald Observatory, 82-inch	649	214 Stars
Lick Observatory, 36-inch Refractor	188	92 Stars
Lick Observatory, 36-inch Crossley Reflector	263	92 Stars

Comparison of McDonald Observatory and Lick Observatory Results

	Actual p.e. 1 Difference	p.e. 1 Difference Computed from Values Given Above
	m	m
l	± 0.005	± 0.004
c	± 0.005	± 0.007
e-a	± 0.005	± 0.005
m	± 0.007 (Series A)	± 0.007

February, 1960 Bengt Strömgren

		McDonald Observatory							Lick Observatory						
HR		Sp	l	c	e-a	m	Number of Obs.	m Series B	l	c	e-a	m	Number of Obs.	MK Type	Remarks
21	β Cas	F5	145	755	390	126	3		132	761	379	133	2,2	F2 IV	
27	22 And	F0	104	906	413	085	8		107	900	423	085	2,2	F2 II	
39	γ Peg	B2	088	386	-237	021	3							B2 IV	Beta C Ma st.
63	24 And	A2	230	1075	065	115	2		247	1080	070	108	2,1	A2 V	
68	25 And	A2	250	1078	075	133	2		259	1081	079	135	2,1	A2 V	
114	28 And	F0	163	869	287	113	6		156	858	286	119	3,2	F0 IV	Met.l.st.
130	15 Cas	B0	032	208	085	-081	2							Bl Ia	
184	20 Cas	A5	237	933	210	154	1		233	934	218	156	2,2		SB
196		A0	225	1140	010	100	2								
233		Comp	082	747	525	087	1								
269	37 And	A2	237	1052	155	131	2		238	1052	148	145	1,2		
324	41 And	A2	250	1052	140	142	3		248	1050	153	153	1,2		
343	33 Cas	A5	235	988	215	135	2		218	982	212	158	1,2	A7 V	
349	82 Psc	A5	170	1030	270	130	2		173	1034	262	114	1,1		
378	89 Psc	A2	243	1115	085	115	2		251	1112	081	111	1,3		
403	δ Cas	A5	225	1086	157	115	14							A5 V	
413	93 Psc	F0	112	525	420	130	2		113	534	418	127	1,6		
458	50 And	G0	070	405	605	195	3		079	409	609	193	1,3	F8 V	
542	ε Cas	B3	100	615	-150	010	2							B2 p	
544	α Tri	F5	090	490	550	146	2		093	511	523	154	2,3	F6 IV	SB
553	β Ari	A5	245	1002	170	150	3		243	995	169	154	1,6	A5 V	SB
569	9 Ari	A5	160	815	313	151	2							F0 IV	
589	53 Cas	B5p	050	542	304	-054	2							B8 Ib	
599	ε Tri	A2	225	1137	035	101	1								
613	12 Ari	A0	240	998	160	138	1							Met.l.st.SB 2-sp	
620	58 And	A2	228	1080	135	115	2							A5V	
622	β Tri	A5	228	1054	157	121	2							A5 III SB	
623	14 Ari	F0	140	823	373	141	10							F2 III	
655	7 Tri	A0	200	1070	-020	056	2								
664	γ Tri	A0	245	1102	020	090	2							A0 V	

HR		McDonald Observatory Sp	l	c	e-a	m	Number of Obs.	m Series B	Lick Observatory l	c	e-a	m	Number of Obs.	MK Type	Remarks
670	62 And	A0	243	1107	003	073	1								
675	10 Tri	A2	230	1165	020	080	2								
685	9 Per	A2p	055	705	280	-050	2							A2 Ia	
707	υ Cas	A5p	210	950	153	147	1							Sp.Var.	VB 2.3^{m}
717	12 Tri	F0	168	780	340	170	2								
773	32 Ari	A2	202	1075	163	123	1								
782	33 Ari	A2	227	1133	075	095	1								
812	38 Ari	A3	203	882	235	137	1								
813	87 Cet	F0	162	775	350	130	2							F0 IV	
840	16 Per	F0	128	750	395	115	2							F2 III	
879	22 Per	A2	207	1157	057	073	1							A2 V	
972	58 Ari	A0	215	1135	-015	075	1							A0 IV-V	
1017	α Per	F5	097	841	552	142	4							F5 Ib	
1035		B9p	038	521	334	-040	2							B9Ia	VB 4.6^{m}
1069	36 Per	F0	104	574	431	109	6							F4 III	
1131	38 Per	B1	063	312	007	-025	2							B1 III	SB,VB 4.6^{m}
1135	41 Per	F5	106	825	470	140	2							F5 II	
1140	16 Tau	B5	150	790	-050	026	2							B7 IV	
1144	18 Tau	B8	150	790	-087	033	2							B8 V	
1178	27 Tau	B8	112	805	-105	035	2							B8 III	
1201		F0	135	630	400	134	1	138							
1203	ζ Per	B1	038	245	055	-031	2							B1 Ib	
1268	41 Tau	A0p	120	707	-155	021	2								
1269	42 Tau	F0	127	618	370	138	1								
1287	44 Tau	F0	128	735	357	143	1								

		McDonald Observatory							Lick Observatory						
HR		Sp	l	c	e-a	m	Number of Obs.	m Series B	l	c	e-a	m	Number of Obs.	MK Type	Remarks
1292	45 Tau	F0	127	620	390	146	1	143							
1329	50 Tau	A3	190	790	325	155	1								Met.l.st.
1331	51 Tau	A5	175	795	300	150	1	143							
1341	56 Tau	A0p	130	710	-102	072	1								
1376	63 Tau	A2	175	737	367	223	3							Met. l.st.SB	
1380	64 Tau	A5	235	990	180	150	2							A7 V	
1387	65 Tau	A3	228	1054	157	135	4							A7 V	
1388	67 Tau	F0	180	855	285	135	1	134							
1389	68 Tau	A2	240	1095	060	106	2							A2 IV	
1394	71 Tau	A5	173	908	282	116	2							F0 V SB	
1403		A5	180	788	323	145	1							Met. l. st.	
1408	76 Tau	F0	148	707	355	141	1	136							
1411	77 Tau	H0	018	345	1180	394	1								
1412	78 Tau	K0	208	997	210	136	13							A7 III SB	
1414	79 Tau	A5	215	912	245	171	2								
1427		A5	225	988	195	139	2							A7 V	
1430	83 Tau	F0	185	818	303	155	1	132							
1432	85 Tau	F0	140	662	375	135	1								SB
1444	86 Tau	A5	185	840	292	134	2							F0 V	
1472	89 Tau	F0	155	752	345	137	1	131							
1543	1 Ori	F8	088	440	509	165	10	154						F6 V	
1620	102 Tau	A5	227	1035	180	126	1							A7 V	
1641	η Aur	B3	111	546	-163	-003	4							B3 V	
1672	16 Ori	A2	205	850	310	184	1							Met.l.st.	
1713	β Ori	B8p	030	430	-043	-023	2							B8 Ia	

HR		Sp	l	c	e-a	m	Number of Obs.	m Series B	l	c	e-a	m	Number of Obs.	MK Type	Remarks
		McDonald Observatory							Lick Observatory						
1749	20 Aur	B3	135	623	-147	007	3								
1791	β Tau	B8	118	715	-122	-002	3							B7 III	
1852	δ Ori	B0	042	220	-302	022	2							O 9.5 II SB	
1903	ε Ori	B0	035	162	-140	-074	1							B0 Ia	
1905	122 Tau	A5	195	890	242	128	1								
2034	136 Tau	A0	200	1168	-022	036	1							A0 III SB	
2047	54 Ori	F8	055	315	660	216	2							G0 V	
2085	16 Lep	F0	137	642	365	131	3	126						F0 V	
2095	37 Aur	A0p	147	1010	-112	048	1							Sp.Var.VB	4.8^m
2135	62 Ori	B2p	031	169	224	-068	5							B2 Ia	
2143	40 Aur	A3	193	918	285	143	1							SB 2-sp	
2220	71 Ori	F5	095	461	500	158	10	155							
2238	2 Lyn	A0	252	1110	035	095	2							A2 V	
2241	74 Ori	F5	097	469	474	142	16	143							
2264	45 Aur	F5	100	590	497	149	2							SB	
2375		A2	210	997	190	102	1								
2385	13 Mon	A0p	067	933	-027	-013	1							A0 Ib	
2398	49 Aur	A0	185	1112	-050	052	1								
2421	γ Gem	A0	214	1172	018	054	5							A0 IV SB	
2466	26 Gem	A0	260	1050	095	115	2							SB	
2484	31 Gem	F5	097	539	496	144	20	144						F5 IV	
2529	36 Gem	A0	205	1165	-010	070	2								
2585	16 Lyn	A2	217	1133	038	066	1							A2 V	
2657	γ C Ma	B5	108	732	-140	-004	2							B8 II	
2693	δ C Ma	F8p	065	652	825	181	2							F8 Ia	
2707	21 Mon	F0	145	818	347	143	2	132							

HR		Sp	l	c	e-a	m	Number of Obs.	m Series B	l	c	e-a	m	Number of Obs.	MK Type	Remarks
		McDonald Observatory							Lick Observatory						
2751		A0	190	1142	090	074	1							A3 III-IV	
2763	54 Gem	A2	230	1072	120	122	1							A3 V	
2777	δ Gem	F0	133	710	361	099	3	097						F0 IV VB	4^m.5
2820	1 C Mi	A2	227	1110	112	110	10								
2845	β C Mi	B8	140	900	-090	020	2							B 8 V	
2849	22 Lyn	F5	088	430	497	129	2	140							
2851	5 C Mi	A5	185	981	242	112	5								
2852	62 Gem	F0	136	659	353	105	16	103						F0 V	
2857	64 Gem	A2	249	1039	145	129	2								
2880	7 C Mi	A5	175	1090	235	095	2								
2886	68 Gem	A2	201	1168	035	071	2								
2906		F8	068	443	565	155	2								
2927	25 Mon	F5	095	600	495	155	2	149							
2930	71 Gem	F0	105	633	460	136	5	125						F3 III	
2946	24 Lyn	A2	193	1125	082	082	1							A3 III	
3102	11 Pup	F8	062	475	805	205	2							G0 Ib	
3173	27 Lyn	A2	227	1135	032	074	1							A2 V	
3188	29 Mon	G0	025	300	1188	372	2							G2 Ib	
3262	18 Cnc	F5	078	412	515	151	11								
3314		A0	233	1095	-005	091	1							A0 V	
3323	1 U Ma	G0	020	340	995	319	2							G4 II-III	
3482	ε Hya	F8	075	537	757	219	2							Comp SB	
3492	13 Hya	A0	210	1108	-040	068	3							A0 V	
3555	59 Cnc	A3	224	987	175	143	2								
3572	α Cnc	A3	234	1046	172	150	3							Met.l.st.	

HR		McDonald Observatory Sp	l	c	e-a	m	Number of Obs.	m Series B	Lick Observatory l	c	e-a	m	Number of Obs.	MK Type	Remarks
3579		F5	102	510	503	163	3							F5 V	VB 2^m
3595	69 Cnc	A0	177	1051	-065	051	2								
3616	13 U Ma	F8	083	435	545	191	3							F7 IV-V	VB 3.2^m
3619	15 U Ma	A3p	185	792	360	150	2							Met.l.st.	
3624	14 U Ma		152	682	430	236	2							Met.l.st.	SB
3662	18 U Ma	A5	210	924	206	146	2							A5 V	
3690	38 Lyn	A2	227	1050	074	106	2							A3 V	VB 1.9^m
3757	23 U Ma	F0	130	750	363	117	2	113						F0 IV	
3759	31 Hya	F5	097	455	507	169	3							F6 V	
3775	25 U Ma	F8p	073	472	510	152	4							F6 IV	
3849	38 Hya	B3	120	620	-140	006	1							B5 V	
3852	14 Leo	Comp	117	580	590	200	2							Comp	SB
3873	ε Leo	G0p	030	357	950	306	2							G0 II	
3888	29 U Ma	F0	135	820	315	121	2							F2 IV	
3928	19 L Mi	F5	093	468	510	164	3								SB
3974	21 L Mi	A5	212	915	185	149	2							A7 V	
3975	η Leo	A0p	088	905	-027	-027	3							A0 Ib	
3982	α Leo	B8	135	837	-065	-003	1							B7 V	
4031	ζ Leo	F0	137	900	342	102	6	109						F0 II-III	
4054	40 Leo	F5	095	480	510	150	2	154						F6 IV	
4084		F2	107	525	420	090	2								
4090	30 L Mi	F0	165	933	275	129	2	128						F0 V	
4112	36 U Ma	F5	064	357	585	181	3							F8 V	
4133	47 Leo	B0p	037	212	-135	-039	1							B1 Ib	
4141	37 U Ma	F0	135	612	388	124	3	126						F1 V	

		McDonald Observatory							Lick Observatory						
HR		Sp	l	c	e-a	m	Number of Obs.	m Series B	l	c	e-a	m	Number of Obs.	MK Type	Remarks
4288	49 U Ma	F0	183	953	272	158	2							Met.l.st.	
4310	63 Leo	F0	140	710	380	140	2							F2 III-IV	
4399	78 Leo	F5	115	602	475	131	2							F2 IV	VB 2.7^m
4439		F5	070	395	547	163	2								VB 1.3^m
4527	93 Leo	F8	109	730	570	160	2							Comp	SB
4540	β Vir	F8	062	390	630	210	2							F8 V	
4707	12 Com	F5	127	802	513	147	11							Comp	SB
4753	18 Com	F5	100	588	485	149	2	168							
4883	31 Com	G0	038	343	760	218	2							G0 III	
4916	8 Dra	F0	150	710	313	137	2	136							
4931	F8 U Ma	F0	130	602	417	155	2	151						F2 V	VB 4.6^m
4968-9	α Com	F5	095	443	500	124	3	124							VB nearly equal comp.
4981	53 Vir	F2	085	480	507	133	3	112							
4983	β Com	G0	060	340	655	215	5							G0 V	
5017	20 C Vn	F0	155	848	365	195	2	175						F0 II-III p	
5110		F0	105	668	422	122	2							F2 IV	SB
5185	4 Boo	F5	093	437	557	199	3	188						F7 V	
5304	12 Boo	F5	072	427	592	190	3							F8 IV	SB
5338	99 Vir	F5	072	443	572	156	3							F7 III-IV	
5365	18 Boo	F0	118	535	440	120	2	140							
5435	γ Boo	F0	204	1005	220	100	2							A7 III	
5447	28 Boo	F0	120	550	397	103	7	099						F2 V	
5487	107 Vir	F5	112	588	420	098	3	121						F3 IV	
5634	45 Boo	F0	105	493	472	136	2	148						F5 V	
5747	β Cr B	F0p	203	810	347	159	3							F0p	SB

		McDonald Observatory							Lick Observatory						
HR		Sp	l	c	e-a	m	Number of Obs.	m Series B	l	c	e-a	m	Number of Obs.	MK Type	Remarks
5933	γ Ser	F5	087	430	535	141	2	145	091	424	528	166	2,4	F6 V	
5936	12 Cr B	F2	135	692	372	114	3	123							
5968	15 Cr B	F8	055	337	685	185	3		053	337	682	198	3,4		
5986	13 Dra	F8	072	455	597	187	1		074	455	594	190	2,1	F8 IV-V	SB
6093	50 Ser	F0							139	664	375	145	1,3	F0 V	
6095	γ Her	F0							168	927	310	151	1,4	A9 III	
6237		F0							110	583	393	122	2,1	F2 V	
6254	52 Her	A2p							241	1011	104	145	2,1	A2p	
6279	53 Her	F0							145	683	335	137	2,2		
6332	59 Her	A2							242	1106	018	107	2,5		
6355	60 Her	A3							255	1000	156	149	1,5	A3 IV	
6410	δ Her	A2							231	1072	090	101	2,2	A3 IV	
6436	69 Her	A2							243	1074	037	122	2,3	A2 V	
6507		A5							186	901	258	135	2,2		
6554	24 Dra	A5							168	766	324	177	2,2	Met.l.st.	
6555	25 Dra	A5							173	820	265	145	2,2	Met.l.st.	
6556	α Oph	A5							218	996	190	128	3,1	A5 III	
6656	30 Dra	A2							248	1064	024	117	1,2		
6685	89 Her	F5p	091	992	403	049	2		089	998	350	049	4,2	F2 Ia	SB
6707	94 Her	F0							112	824	396	084	3,4	F2 II	
6723	68 Oph	A2							219	1089	030	076	2,1	A1 V	SB
6771	72 Oph	A3							242	1011	160	147	3,4	A4 V	
6794	101 Her	A3							220	1107	172	115	3,2		
6877	107 Her	A5							198	1012	220	129	4,2		
6903	2 Lyr	A2							216	1152	032	096	2,2		SB

		McDonald Observatory							Lick Observatory						
HR		Sp	l	c	e-a	m	Number of Obs.	m Series B	l	c	e-a	m	Number of Obs.	MK Type	Remarks
6985		F2							126	540	426	161	2,2		
6987		F2							120	580	408	133	2,2		SB
7056	6 Lyr	A3							224	970	239	167	2,3	Met.l.st.	SB
7057	7 Lyr	A3							152	762	332	142	2,1	F0 IV	
7061	110 Her	F5							090	486	507	154	2,2	F6 V	
7069	111 Her	A3							256	995	153	150	1,4	A3 V	
7102	9 Lyr	A2							241	1079	115	122	2,6		
7172	11 Aql	F5							062	435	601	174	1,1		
7215	16 Lyr	A5							216	923	207	149	2,3		
7253		A5							165	766	316	139	2,2		SB
7261	17 Lyr	F0							122	690	390	121	2,6		VB $5^m.0$
7266	19 Aql	F2							134	670	378	147	2,2		
7303	22 Aql	A2							229	1212	071	071	2,2		
7315	25 Aql	A5							205	1051	199	124	1,5		
7331	28 Aql	F0							178	938	288	138	1,2		
7377	δ Aql	F0							157	736	345	107	2,1	F0 IV	SB
7387	32 Aql	F0							134	1049	564	051	2,1	F2 Ib	
7420	10 Cyg	A2							201	1031	163	114	2,3	A5 V	
7469	13 Cyg	F5							112	532	431	148	2,4		
7495		F2							126	665	472	181	2,4		
7534	17 Cyg A	F5							095	458	527	159	1,1	F5 V	
7557	α Aql	A5							199	897	242	127	1,1	A7 IV,V	
7610	61 Aql	A2							252	1083	007	103	2,5		SB
7619	24 Cyg	A3							211	1035	127	111	2,3	A3 IV,V	VB $2^m.5$
7653	15 Vul	A5							208	1005	212	152	2,2	Met.l.st.	

		McDonald Observatory							Lick Observatory						
HR		Sp	l	c	e-a	m	Number of Obs.	m Series B	l	c	e-a	m	Number of Obs.	MK Type	Remarks
7730	30 Cyg	A2							186	1190	093	066	2,3	A3 III	
7731	21 Vul	A3							182	1028	196	104	2,2		
7740	33 Cyg	A3							211	1066	116	112	2,2	A3 IV-V	SB
7770	35 Cyg	F5p	098	730	745	185	3		091	728	734	179	2,3	F5 Ib	SB
7796	γ Cyg	F8p	079	616	823	221	9							F8 Ib	
7834	41 Cyg	F5p							116	851	456	141	2,4	F5 II	
7858	3 Del	A2							266	1036	090	137	2,5		
7871	4 Del	A2							238	1089	119	123	2,1	A3 V	
7883	5 Del	A2							263	1059	060	128	2,3		SB
7906	α Del	B8	175	975	-070	060	2							B9 V	
7928	δ Del	A5							154	827	312	130	2,1	A7 III	
7984	56 Cyg	A5							220	908	236	169	2,2		
8097	γ Equ	F0p							209	763	346	205	2,3	F0p	
8162	α Cep	A5	185	900	250	160	4		193	902	254	151	2,2	A7 IV,V	
8267	5 Peg	F0							148	849	311	126	3,5		
8279	9 Cep	B2p	040	303	215	-025	6							B2 Ib	
8334	10 Cep	A2p	062	817	440	-060	1							A2 Ia	
8344	13 Peg								121	567	429	143	3,3		
8371	13 Cep	B9p	035	437	650	-046	5							B8 Ib	
8428	19 Cep	Oe5	042	165	035	-029	3							O 9.5 Ib	
8430	24 Peg	F5							103	480	490	164	4,2	F5 V	SB
8454	29 Peg	F5							101	678	521	147	3,4	F5 II-III	
8463		A2	245	995	155	165	2								
8494	ε Cep	F0	171	797	314	144	21		167	790	314	149	1,2	F0 IV	
8585	α Lac	A0	255	1090	007	119	3							A2 V	

		McDonald Observatory							Lick Observatory						
HR		Sp	l	c	e-a	m	Number of Obs.	m Series B	l	c	e-a	m	Number of Obs.	MK Type	Remarks
8613	9 Lac	A5	185	910	265	129	2		178	924	262	115	1,2	A7 IV	
8622	10 Lac	Oe5	062	217	-234	-042	7							09 IV	
8634	ζ Peg	B8	160	950	-083	013	2							B8 V	
8640	12 Lac	B2	075	329	-156	002	3							B2III	Beta C Ma st.
8641	43 Peg	A0	215	1140	-025	075	2							Al V	
8665	46 Peg	F5							079	433	541	148	3,7	F7 V	
8697	49 Peg	F5							080	465	516	137	3,5	F7 IV	
8717	50 Peg	A0	225	1135	-015	075	2							Al V	
8826	59 Peg	A3	205	1075	125	101	9		207	1067	134	094	3,6		
8830	7 And	F0	157	740	323	127	21		155	734	330	135	3,2	F0 V	SB
8880	62 Peg	A5	208	988	190	120	3		203	985	189	113	4,6	A5 IV	
8903	67 Peg	A0	170	945	-090	040	2								
8911	8 Psc	A2p	233	970	067	123	2		240	956	072	115	2,2	Sp.	Var.
8947	15 And	A0	240	1090	095	125	2								
8963	75 Peg	A0	240	1085	-015	095	1								SB
8965	17 And	B8	136	885	-115	019	3							B8 V	
8969	17 Psc	F8	076	412	571	159	5		081	419	561	164	3,6	F7 V	
8976	19 And	A0	190	950	-087	063	2							B8 V	
8984	18 Psc	A5							208	910	225	150	2,4	A7 V	
9039	82 Peg	A3	217	972	190	156	2		215	977	195	131	4,6		
9072	28 Psc	F5							110	618	445	124	2,3	F4 IV	SB

APPENDIX II.

Photoelectric Hβ- line Photometry of Standard O, B and A Stars Observed by D. L. Crawford at McDonald Observatory

(726 Observations of 33 Standard Stars)

HR	β	n	MK		α (1900)		δ		m_V
153	2.627	10	B2	V	0^h	$31^m.4$	$+53^\circ$	$21'$	3.72
193	2.668	11	B2	V	0	39.2	+47	44	4.70
801	2.693	20	B3	V	2	37.6	+27	17	4.58
1034	2.709	14	B3	V	3	20.9	+48	43	4.94
1144	2.752	10	B8	V	3	39.2	+24	32	5.63
1178	2.700	10	B8	III	3	43.2	+23	45	3.80
1552	2.607	18	B2	III	4	45.9	+05	26	3.78
1641	2.691	12	B3	V	4	59.5	+41	06	3.28
3410	2.858	8	A0	V	8	32.4	+06	03	4.18
3454	2.654	11	B3	V	8	38.0	+03	45	4.32
4133	2.545	5	B1	Ib	10	27.6	+09	49	3.85
4554	2.876	8	A0	V	11	48.6	+54	15	2.54
5511	2.851	22	A0	V	14	41.2	+02	19	3.76
5685	2.695	27	B8	V	15	11.7	-09	01	2.74
5944	2.612	11	B1	V	15	52.8	-25	50	3.00
5953	2.595	14	B0	V	15	54.4	-22	20	2.54
6092	2.704	15	B5	IV	16	16.7	+46	33	3.91
6141	2.672	9	B2	V	16	24.1	-24	54	4.87
6588	2.663	23	B3	V	17	36.6	+46	04	3.79
6629	2.908	43	A0	V	17	42.9	+02	45	3.74
7178	2.746	45	B9	III	18	55.2	+32	33	3.30
7235	2.876	48	B9.5	V	19	00.8	+13	43	3.02
7446	2.562	37	B0.5	III	19	31.5	-07	15	5.04
7447	2.708	15	B5	III	19	31.6	-01	31	4.28
7906	2.805	54	B9	V	20	35.0	+15	34	3.86
7977	2.530	24	B3	Ia	20	45.5	+45	45	4.89
8143	2.583	19	B9	Iab	21	13.5	+38	59	4.28
8585	2.906	50	A0	V	22	27.2	+49	46	3.85
8622	2.585	45	09	V	22	34.8	+38	32	4.91
8634	2.778	18	B8	V	22	36.5	+10	19	3.61
8781	2.845	21	B9	V	22	59.8	+14	40	2.57
8965	2.728	26	B8	V	23	33.2	+42	43	4.28
8976	2.831	23	B8	V	23	35.5	+43	47	4.33

COPY

Strömgren ONR

3 March 1960

Dr. Lyman Spitzer, Jr.
Princeton University Observatory
Princeton, New Jersey

Dear Lyman:

Having discussed the question of the budget for the second year of my ONR contract with Miss Jean Streeter and Mr. Leslie Vivian I am now ready to formulate the request. I would propose the following budget for the year July 1, 1960 through June 30, 1961:

Salary for a Research Associate, 6 months	$4,000
Scanner for automatic recording of location of every image pair on a photographic plate for which the ultraviolet image is stronger than the yellow image	8,000
Time with electronic computers	2,000
Travel, communications and report preparation	1,000
	15,000
Overhead at 40 per cent of salaries	1,600
Total	$16,600

I enclose an extra copy of the original proposal to the ONR since Miss Streeter indicated that she would appreciate it if a copy were sent along with the request for the second year.

Sincerely,

Bengt Strömgren

Princeton University
Department of Astronomy
Princeton, New Jersey

Quarterly Report

to

The Office of Naval Research

Contract in support of

Investigations of problems of star formation
based on observational studies of chemical composition and average
distance from the galactic plane for unevolved F and G stars
of disc population and halo population II

Period covered by report:
September 1 - November 30, 1959

Principal Investigator: Bengt Strömgren

Quarterly Report September 1 - November 30, 1959

Prepared by : Bengt Strömgren

Since the present contract became effective only in October, 1959, this first report is relatively brief.

1. New filters have been ordered for the planned u b g v photometry. For the wave-length 3450 Å (u) a new glass filter combination will be used, namely

	U G 11	8 mm
plus	W G 3	1 mm

According to Jenaer Glaswerk Schott und Gen. the properties of this filter glass combination are as follows

Peak wavelength	3450 Å
Max transmission	30 per cent
Half-width	400 Å
Tenth-width	580 Å

Transparency above 4000 Å including the infrared is less than 0.001 per cent.

Transparency above the Balmer limit is very small in comparison with ultraviolet filters previously used.

For 4100 Å(b), 4700(g) and 5500(v) Baird-Atomic interference filters with half-width between 100 Å and 200 Å will be used.

The delivery of the glass filters and the interference filters during December, 1959, has been promised.

2. For the digitizing equipment a suitable Brown Recorder has been ordered, and after comparison of equipment from Coleman Electronics and the Datex Corporation digitizing equipment from the latter firm has been selected. It is expected that the digitizing equipment will be in operation in March or April, 1960. It will be tested during May, 1960.

3. Photometric observations on the program will begin during an observing period at the Kitt Peak National Observatory. The time January 7 - 31, 1960 has been assigned to me. The main purpose of the observations on the program during this period is to test the properties of the new u b g v filter set. The program stars have been selected.

4. The design work for the four-channel photometer for photoelectric u b g v photometry has been started. The relative merits of plane-grating and concave grating designs have been discussed with Dr. D. Richardson, Bausch and Lomb Optical Co., and a plane grating design has been chosen. For the collimator a mirror of focal length 200 mm will be used while a plane-grating with 1200 lines per mm (used in the first order) will provide the dispersion. Four separate cameras placed side by side will be used for the four wave-length bands, u (3450- 3650 Å), b(4000 - 4200Å), g(4600-4800 Å) and v(5400 - 5600 Å). In the interest of space economy and rigidity a plane mirror will be used to reverse the directions of the rays coming from the plane grating. A detailed description of the four-channel photometer design will be included in the next quarterly report.

5. Preparation of the observing list of program stars to be observed at Mount Palomar Observatory during the observing period July 15 - September 30, 1960, assigned to me has begun.

6. No funds have yet been expended.

Bengt Strömgren

December 30, 1959

Princeton University
Department of Astronomy
Princeton, New Jersey

Quarterly Report

to

The Office of Naval Research

Contract in support of

Investigations of problems of star formation
based on observational studies of chemical composition and average
distance from the galactic plane for unevolved F and G stars
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Bengt Strömgren

December 30, 1959

Fac Strömgren

THE INSTITUTE FOR ADVANCED STUDY
PRINCETON, NEW JERSEY

6 July 1959

Dear Robert:

I enclose a copy of the proposal to ONR. This has been approved by Lyman Spitzer and is now being considered by R. J. Woodrow in behalf of Princeton University. Mrs. Hobson could still make any changes that you might suggest as it will take about two weeks for the University to process the matter.

Sigrid and I hope that Kitty and you have a wonderful time and send our warmest regards.

Sincerely,

Bengt

Bengt Strömgren

RO said ok as is

Fac Strömgren

6 July 1959

Dr. Shirleigh Silverman
Physical Science Division
Office of Naval Research
Department of the Navy
Washington 25, D. C.

Dear Dr. Silverman:

Referring to our previous correspondence I would like to inform you that I have now worked out a proposal to the Office of Naval Research for a contract in support of "Investigations of problems of star formation based on observational studies of chemical composition and average distance from the galactic plane for unevolved F and G stars of disc population and halo population II".

My discussions with members of your staff on January 28, 1959, were most helpful to me. I have since had an opportunity to discuss in detail the questions of the observing time required for the planned project with Dr. A.E. Whitford, Director of Lick Observatory, and Dr. I. S. Bowen, Director of Mount Wilson and Palomar Observatories. Observing time that I requested for 1959 (Lick Observatory) and 1960 (Mount Wilson and Palomar Observatories) has been assigned to me, and my observing program for 1961 and 1962 (Mount Wilson and Palomar Observatories) has been approved in principle. I enclose a photostat copy of a letter of June 29, 1959 from Dr. Bowen on this matter.

Since the planned project would require the support of an Observatory that would serve as a base for instrument development and laboratory work, I have asked the Department of Astronomy of Princeton University to sponsor the project. The Chairman of the Department, Dr. Lyman Spitzer, Jr., has promised his full co-operation. Dr. Robert Oppenheimer, Director of the Institute for Advanced Study, has approved the arrangement.

I enclose a draft of the proposal. This draft has the approval of Dr. Lyman Spitzer, Jr., but it has not yet been considered and acted upon by the Administrative Officer of Princeton University concerned. I hope, however, that it will be sent to The Office of Naval Research within about two weeks. In the meantime I am sending the draft copy of the proposal for your information.

Sincerely yours,

Bengt Strömgren

COPY

Princeton University
Department of Astronomy
Princeton, New Jersey

Proposal to

The Office of Naval Research

for a contract in support of

Investigations of problems of star formation based on observational studies of chemical composition and average distance from the galactic plane for unevolved F and G stars of disc population and halo population II

Funds requested: $40,700.

Period: September 1959 - September 1962

Principal Investigator: Bengt Strömgren

Approved: Lyman Spitzer, Jr.
Chairman, Department
of Astronomy

Approved: ____________________

It has been known for several years that the relative heavy-element content in the atmospheres of halo population II stars in our galaxy is much lower than that of population I stars and stars of the disc population (cf. Chamberlain and Aller 1951; also Helfer, Wallerstein and Greenstein 1959). While the chemical composition of the atmospheres of population I stars corresponds roughly to that of present interstellar matter, the atmospheres of halo population II stars are deficient in heavy-element content by factors of 10 to 100 in comparison with present interstellar matter.

Strong reasons can be advanced in favor of the assumption that the chemical composition of the atmospheres of the stars in question, as presently observed, is about the same as the chemical composition of the interstellar matter out of which they were once formed.

The difference in chemical composition between present interstellar matter and the young population I stars on the one hand, and the old halo population II stars on the other, suggests that the composition of interstellar matter in our galaxy has been changing with time, and that the relative heavy-element content was much lower than the present value in the early phases of evolution of the galaxy.

Hoyle and Lyttleton have suggested that formation of heavy elements in stars and subsequent dissipation of the stellar matter into interstellar space is the main mechanism by which the heavy-element content of interstellar matter is increased in the course of evolution of our galaxy. This general idea has more recently been investigated theoretically by Schwarzschild and Spitzer (1953), Hoyle (1954) and (1958), Salpeter (1955), Burbidge, Burbidge, Fowler and Hoyle (1957), van den Bergh (1957), Schmidt (1959), and Mathis (1959).

The pioneer work of Lindblad, Oort, and Baade indicated, and more recent work has confirmed, that our galaxy becomes more and more flattened toward its principal plane in the course of its evolution, and that therefore distance from the galactic plane is correlated with the epoch of formation of a star, i.e. with its age. For a recent discussion of the problems of the correlation of age, chemical composition, and distance from the galactic place cf. "Le Problème des Populations Stellaire", Pont. Ac. Sc. 1958, particularly Oort (1958), and Hoyle (1958).

It is clearly of great importance to carry out extensive observational tests of the theoretical picture of the evolution of our galaxy just referred to. One possible approach is the following:

I. For a suitable sample volume containing the solar neighborhood and extending at least to 1500 parsec in the direction at right angles to the galactic plane above and below the plane the frequency function of the atmospheric heavy-element content of the stars is determined. The investigation is made for all stars in a definite mass range, and the frequency function should cover the whole range of heavy-element content, from that of the young population I stars, through that of the disc population, to the minimum value found for extreme halo population II stars. The frequency function should give the relative number of stars per interval of heavy-element content for the sample volume in question.

II. For the same sample volume the distribution of distance from the galactic plane is determined for groups of stars, subdivided according to relative heavy-element content.

A detailed theoretical picture of the evolution of our galaxy will lead to predictions regarding the distribution functions just referred to. Hence, if the observational data are available, a quantitative test of the picture can be carried out.

At the present time little information is available regarding the distribution functions in question. Clearly, the observational problem can only be solved if methods are available for determining, 1. fairly accurate distances, and 2. the atmospheric heavy-element content, for large numbers of stars, including quite faint stars.

During the last ten years I have developed methods for spectral classification through photoelectric narrow-band photometry (B. Strömgren, 1956a, 1956b, 1958a, 1958b, 1958c, also B. Strömgren and K. Gyldenkerne 1955). With the help of these methods it is possible to derive relatively accurate absolute magnitudes, and hence distances for large numbers of faint stars. Also, it is possible to determine an index of heavy-element content which can be calibrated by theoretical calculations, based on model-atmosphere work, or by detailed analysis of a limited number of typical stellar atmospheres such as is now in progress at Mount Wilson and Palomar Observatories under the direction of J. L. Greenstein.

I propose that the method of photoelectric narrow-band photometry be applied in an effort to determine the distribution functions referred to. I would limit the sample of stars to the mass range 0.9 - 1.2 solar masses, and to unevolved or only slightly evolved stars which are still near the main sequence in order that the atmospheric composition be a reliable indicator of chemical composition at the epoch of formation of the star.

The observational procedure is described below:

The star samples will be limited to the color range B-V $+0^m.30$ to $+0^m.50$ for the halo population II. The properties of the s tars in this range (subdwarf F stars) are well known for stars in our immediate neighborhood from the work of Nancy G. Roman (1954). For population I and the disc population the matching color range B-V $+0^m.40$ to $+0^m.65$ will be studied (the range of effective temperature then being the same).

The population I and disc population stars will be investigated as follows:

1a. For all stars in the Henry Draper catalogue brighter than $8^m.25$ visual, north of declination $-20°$, and of spectral types F5, F8 and G0, photoelectric narrow-band photometry will be obtained at the wave-lengths 3600Å (u), 4100Å (b), 4700Å (g), and 5400Å (v), with bandwidths of 200 - 300 Å. The experience I have obtained shows that such photometry will determine with relatively high accuracy, 1. the absolute magnitude, with of probable error $0^m.1$ - $0^m.2$, provided inter-stellar reddening can be neglected, or accurately allowed for, which is the case for the sample of nearby-stars in question , 2. an index of heavy-element content, and 3. an index of effective temperature, independent of chemical composition. For the stars in the B-V range $+0^m.40$ - $+0^m.48$ Hβ photometry (cf. B. Strömgren, 1956b and 1958a) will be obtained to increase the accuracy of the determination of absolute magnitude. For the color range B-V $0^m.49$ - $0^m.65$ the u b g v photometry just described is quite adequate, and Hβ photometry is not so valuable here (because of the relative weakness of the Hβ line, and its distortion by blends).

The total number of stars in the program is 5500, of which about 700 will form a complete sample of stars in the color range B-V $0^m.40$ - $0^m.65$ within 45 parsec.

1b. For all stars brighter than $13^{m}.5$ photographic in 4 high-galactic latitude Bergedorf areas ($3^{\circ}.5$ x $3^{\circ}.5$) covering 50 square degrees, i.e. for altogether about 2500 stars, u b g v photometry as described above will be obtained. It is expected that about 1000 of these stars will be in the color range B-V $0^{m}.40$ - $0^{m}.65$. For stars in the color range $0^{m}.40$ - $0^{m}.48$ $H\beta$ photometry will also be obtained. Again, it will be possible to derive with adequate precision from the photometry, 1. the absolute magnitude, 2. a heavy-element content index and, 3. an index of effective temperature which is independent of chemical composition. The sample in question will be complete for distances from the galactic plane up to 400 parsec for G stars and about 1000 parsec for F stars.

Programs 1a and 1b will yield the desired distribution functions of heavy-element content and distance from the galactic plane for population I and disc population stars. However, the number of halo population II stars included in these samples is far too small for a reliable determination of the distribution functions through their range of heavy-element content. Therefore, the addition of suitable halo population II samples is necessary.

<u>The halo population II stars will be investigated as follows:</u>

2a. In an area of 4000 square degrees in high galactic latitude an attempt will be made to discover and investigate practically all halo population II stars in the color range B-V $0^{m}.30$ - $0^{m}.50$ (subdwarf F stars) and in the magnitude range $9^{m}.0$ - $12^{m}.0$ photographic. A technique that combines photographic and photoelectric color observations, and which I have used successfully in an investigation of Bergedorf Eichfeld 92, will be used: With a Schmidt telescope the high-galactic area in question is covered by plates having one ultraviolet exposure and one, suitably displaced, yellow (or green) exposure.

An image pair is thus obtained for each star. The two exposures are so chosen that the ultraviolet and the yellow image will be equally strong for normal F7 stars (U-V = +0.48) in the magnitude range in question. In high galactic latitude the yellow image will be stronger than the ultraviolet image for the great majority of stars in the magnitude range in question. The halo population II F stars will stand out, having a stronger ultraviolet image because of their untraviolet excess (cf. Roman 1954). If the stars for which the ultraviolet image is the strongest are selected then the desired halo population II F stars are included, as are nearly all stars with ultraviolet excess intermediate between halo population II and disc population. However, according to known high-galactic latitude statistics a relatively large number of population I and disc population F stars and a few A stars will also be included. It is therefore intended to investigate the whole sample through photoelectric u b g v photometry. Thereby a list of halo population II stars and intermediate stars will be definitely established and investigated further through the addition of Hβ photometry. As before, the absolute magnitude, a heavy-element index and an effective-temperature indes, independent of chemical composition, will be obtained. It is expected that a sample of 50000 stars in the photographic survey will yield 3000 stars for further photoelectric photometry, and that about 100 halo population stars and intermediate stars will be found and investigated. The latter will form the desired sample necessary to supplement sample la. It will be nearly complete to a distance of about 200 parsec from the galactic plane. (Once the list of these stars has been established it is relatively easy to obtain spectra and proper motions for them). For greater distances it will be supplemented by sample 2b described below.

The sample of population I A and F stars in high galactic latitude brighter than $12^{m}_{.}0$ photographic, which is of necessity investigated in the described procedure, will be very useful for a determination of the distribution of distance from the galactic plane for these stars, and for a thorough investigation of the small interstellar reddening present in high galactic latitudes.

2b. In an area of 2000 square degrees in high galactic latitude it will be attempted to discover and investigate practically all halo population II stars in the color range B-V $+0^{m}_{.}30$ to $+0^{m}_{.}50$ and from $12^{m}_{.}0$ to $15^{m}_{.}5$ photographic magnitude. The technique used will be the same as that described under 2a. However, the task will be much simplified by the fact that there are few, if any, A and early F stars in the relevant magnitude range in high galactic latitude. It is therefore expected that the list of stars for which the ultraviolet image is stronger than the yellow image, and for which photoelectric photometry is to be carried out, will largely contain the desired population II stars, including stars intermediate in ultraviolet excess between the extreme subdwarf F stars in the color range B-V $0^{m}_{.}30$ - $0^{m}_{.}50$ and the disc population in the same range of effective temperature. This expectation was fully confirmed by the experience I gained in using the method for Bergedorf Eichfeld 92 to photographic magnitude $15^{m}_{.}5$. According to the results obtained for Bergedorf Eichfeld 92 the photographic ultraviolet-yellow (or ultraviolet-green) survey will probably lead to a list of 2000 stars to be further investigated through u b g v photometry, and probably about 1000 of these stars will be found by the photoelectric photometry to be halo population II stars. Photoelectric $H\beta$ photometry will be obtained for about 300 of these stars. Distances from the galactic plane up to about 1500 parsec will be reached by the survey.

For the four programs just described telescope observing time will be required, as follows:

Program	Instrument	Number of hours	Years
1a			
Photoelectric u b g v photometry	Lick Observatory, 36-inch	100	1959
	Mount Palomar Observatory, 20-inch	300	1960, 1961
	AURA National Observatory, 16-inch*	200	1960, 1961
Photoelectric Hβ photometry	Mount Palomar Observatory, 20-inch	100	1960, 1961
	Mount Wilson Observatory, 60-inch	100	1960, 1961
1b			
Photoelectric u b g v photometry	AURA National Observatory, 36-inch*	300	1960, 1961
Photoelectric Hβ photometry	Mount Wilson Observatory, 60-inch	20	1961
2a			
Photographic photometry	Copenhagen Observatory, 20-inch Schmidt	40	1961
Photoelectric u b g v photometry	AURA National Observatory, 36-inch*	200	1962
Photoelectric Hβ photometry	Mount Wilson Observatory, 60-inch	100	1962
2b			
Photographic photometry	Mount Palomar Observatory, 48-in.Schmidt	50	1960
Photoelectric u b g v photometry	Mount Wilson Observatory, 100-inch	200	1961
	AURA National Observatory, 36-inch*	50	1961
Photoelectric Hβ photometry	Mount Wilson Observatory, 100-inch	100	1962

* In collaboration with D. L. Crawford, Astronomer, AURA National Observatory

The observing time with the Lick Observatory, Mount Wilson Observatory and Mount Palomar Observatory instruments in 1959 and 1960 have been definitely assigned to me by Dr. A. E. Whitford (Director, Lick Observatory) and Dr. I. S. Bowen (Director, Mount Wilson and Palomar Observatories). With regard to observing time with the Mount Wilson and Palomar instruments in 1961 and 1962, Dr. Bowen has informed me that the time could in all probability be made available to me, but that observing time is not definitely assigned so far ahead of time. As far as the AURA National Observatory instruments are concerned, Dr. D. L. Crawford is willing to take the time required for the present program out of time assigned to him as National Observatory Astronomer, and Dr. A. B. Meinel, National Observatory Director, has approved this arrangement. The time with the Copenhagen 20-inch Schmidt has been put at my disposal by Dr. A. Reiz, Director, provided the telescope is in operation in 1961, which it almost certainly will be.

The following auxiliary equipment is needed for carrying out the observational programs described:

Photometers. I have at my disposal a two-channel $H\beta$ photometer constructed with the help of a grant from the Office of Naval Research. The necessary filters and electronics for $H\beta$ photometry are also available. However, my experience in completing a program of 3000 stars observed with this photometer at McDonald Observatory in collaboration with Dr. D. L. Crawford indicates that it is necessary to add digitizer and print-out equipment if a larger program is to be handled successfully. This instrumentation is commercially available at a cost of approximately $3,500. For the photoelectric u b g v photometry the interference filters are available, but it would be desirable to construct a four-channel photometer for the purpose. My past experience shows that a four-channel photometer should be very satisfactory for differential photometry relative to a small number of standard stars measured in advance through successive filter measures in the usual fashion. The cost of the four-channel photometer would be approximately $3,000.

Scanner. The photographic photometry of 4000 image pairs on a Schmidt telescope plate of the Bergedorf Eichfeld 92, referred to above, was carried out with a standard Eichner microphotometer. The same procedure could be used for the photographic photometry involved in program 1b, however the task would be too big to be practicable in the case of program 2b. I would therefore propose that a scanner be built which would automatically record the location on the photographic plate of every image pair for which the ultraviolet image is stronger than the yellow image. A relatively simple design for 4" x 4" plates (larger plates would have to be cut) has been discussed in some detail with Mr. L. C. Eichner, the maker of the Eichner microphotometer. The cost is estimated to be $7,500.

Assistance, and time with electronic computers, would be needed, 1. to help carry out the observations, 2. to help carry out the reductions of the photometric observations, and 3. to help carry out the model-atmosphere computations required for the calibration of the composition index obtained from photoelectric narrow-band photometry in terms of heavy-element content. The requirements are:

Research Associate. It would be desirable for me to have the collaboration of a Research Associate for 1 year, at a salary of $8,000 for the year.

Computer-Secretary. It would be desirable to have the help of a Computer-Secretary for 1 year, salary $4,000 for the year.

Time with Electronic Computers. In order to carry out the great amount of computations in connection with the reductions of the photometry and the model-atmosphere work it would be necessary to use time with electronic computers, at an estimated cost of $5,000.

The proposed project budget is therefore as follows:

Digitizer and print-out equipment for photoelectric photometer	$ 3,500.
Four-channel photometer for photoelectric u b g v photometry	3,000.
Scanner for automatic recording of location of every image pair on a photographic plate for which the ultraviolet image is stronger than the yellow image	7,500.
Research Associate, 1 year	8,000.
Computer-Secretary, 1 year	4,000.
Time with electronic computers, for reduction of observations and model-atmosphere calculations	5,000.
Miscellaneous expenses and travel	2,500.
	$33,500.
Overhead, 60 per cent of salaries	7,200.
Total	$40,700.

References

S. van den Bergh 1957, Ap. J. 125, 445.

E. M. Burbidge, G. R. Burbidge, W. A. Fowler, F. Hoyle 1957, Rev.Mod.Phys. 29, 547

J. Chamberlain and L. H. Aller 1951, Ap. J. 114, 52

H. L. Helfer, G. Wallerstein and J. L. Greenstein 1959, Ap. J. 129, 700.

F. Hoyle 1954, Ap. J. Suppl. Series No. 5, Vol. 1, 121.

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J. S. Mathis 1959, Ap. J. 129, 259.

J. H. Oort, Le Problème des Populations Stellaires (Pont. Ac. Sc.), 415

N. G. Roman 1954, A. J. 59, 307

E. E. Salpeter 1955, Ap. J. 121, 161.

M. Schmidt 1959, Ap. J. 129, 243

M. Schwarzschild and L. Spitzer 1953, Observatory 73, 77.

B. Strömgren 1956a, Vistas in Astronomy (Ed. A. Beer), Vol. 2, p. 1336.

B. Strömgren 1956b, Third Berkeley Symposium (Ed. J. Neyman), Vol. 3, p. 49.

B. Strömgren 1958a, Le Problème des Populations Stellaires (Pont. Ac. Sc.), p. 385.

B. Strömgren 1958b, Le Problème des Populations Stellaires (Pont. Ac. Sc.), p. 245.

B. Strömgren 1958c, Observatory, Vol. 78, p. 137.

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Princeton University
Department of Astronomy
Princeton, New Jersey

Proposal to

The Office of Naval Research

for a contract in support of

Investigations of problems of star formation
based on observational studies of chemical composition and average
distance from the galactic plane for unevolved F and G stars
of disc population and halo population II

Funds requested: $40,700. Period: September 1959 - September 1962

Principal Investigator: Bengt Strömgren

Approved: Lyman Spitzer, Jr.
Chairman, Department
of Astronomy

Approved: ____________________

It has been known for several years that the relative heavy-element content in the atmospheres of halo population II stars in our galaxy is much lower than that of population I stars and stars of the disc population (cf. Chamberlain and Aller 1951; also Helfer, Wallerstein and Greenstein 1959). While the chemical composition of the atmospheres of population I stars corresponds roughly to that of present interstellar matter, the atmospheres of halo population II stars are deficient in heavy-element content by factors of 10 to 100 in comparison with present interstellar matter.

Strong reasons can be advanced in favor of the assumption that the chemical composition of the atmospheres of the stars in question, as presently observed, is about the same as the chemical composition of the interstellar matter out of which they were once formed.

The difference in chemical composition between present interstellar matter and the young population I stars on the one hand, and the old halo population II stars on the other, suggests that the composition of interstellar matter in our galaxy has been changing with time, and that the relative heavy-element content was much lower than the present value in the early phases of evolution of the galaxy.

Hoyle and Lyttleton have suggested that formation of heavy elements in stars and subsequent dissipation of the stellar matter into interstellar space is the main mechanism by which the heavy-element content of interstellar matter is increased in the course of evolution of our galaxy. This general idea has more recently been investigated theoretically by Schwarzschild and Spitzer (1953), Hoyle (1954) and (1958), Salpeter (1955), Burbidge, Burbidge, Fowler and Hoyle (1957), van den Bergh (1957), Schmidt (1959), and Mathis (1959).

The pioneer work of Lindblad, Oort, and Baade indicated, and more recent work has confirmed, that our galaxy becomes more and more flattened toward its principal plane in the course of its evolution, and that therefore distance from the galactic plane is correlated with the epoch of formation of a star, i.e. with its age. For a recent discussion of the problems of the correlation of age, chemical composition, and distance from the galactic place cf. "Le Problème des Populations Stellaire", Pont. Ac. Sc. 1958, particularly Oort (1958), and Hoyle (1958).

It is clearly of great importance to carry out extensive observational tests of the theoretical picture of the evolution of our galaxy just referred to. One possible approach is the following:

I. For a suitable sample volume containing the solar neighborhood and extending at least to 1500 parsec in the direction at right angles to the galactic plane above and below the plane the frequency function of the atmospheric heavy-element content of the stars is determined. The investigation is made for all stars in a definite mass range, and the frequency function should cover the whole range of heavy-element content, from that of the young population I stars, through that of the disc population, to the minimum value found for extreme halo population II stars. The frequency function should give the relative number of stars per interval of heavy-element content for the sample volume in question.

II. For the same sample volume the distribution of distance from the galactic plane is determined for groups of stars, subdivided according to relative heavy-element content.

A detailed theoretical picture of the evolution of our galaxy will lead to predictions regarding the distribution functions just referred to. Hence, if the observational data are available, a quantitative test of the picture can be carried out.

At the present time little information is available regarding the distribution functions in question. Clearly, the observational problem can only be solved if methods are available for determining, 1. fairly accurate distances, and 2. the atmospheric heavy-element content, for large numbers of stars, including quite faint stars.

During the last ten years I have developed methods for spectral classification through photoelectric narrow-band photometry (B. Strömgren, 1956a, 1956b, 1958a, 1958b, 1958c, also B. Strömgren and K. Gyldenkerne 1955). With the help of these methods it is possible to derive relatively accurate absolute magnitudes, and hence distances for large numbers of faint stars. Also, it is possible to determine an index of heavy-element content which can be calibrated by theoretical calculations, based on model-atmosphere work, or by detailed analysis of a limited number of typical stellar atmospheres such as is now in progress at Mount Wilson and Palomar Observatories under the direction of J. L. Greenstein.

I propose that the method of photoelectric narrow-band photometry be applied in an effort to determine the distribution functions referred to. I would limit the sample of stars to the mass range 0.9 - 1.2 solar masses, and to unevolved or only slightly evolved stars which are still near the main sequence in order that the atmospheric composition be a reliable indicator of chemical composition at the epoch of formation of the star.

The observational procedure is described below:

The star samples will be limited to the color range B-V $+0^m.30$ to $+0^m.50$ for the halo population II. The properties of the stars in this range (subdwarf F stars) are well known for stars in our immediate neighborhood from the work of Nancy G. Roman (1954). For population I and the disc population the matching color range B-V $+0^m.40$ to $+0^m.65$ will be studied (the range of effective temperature then being the same).

The population I and disc population stars will be investigated as follows:

1a. For all stars in the Henry Draper catalogue brighter than $8^m.25$ visual, north of declination -20°, and of spectral types F5, F8 and G0, photoelectric narrow-band photometry will be obtained at the wave-lengths 3600Å (u), 4100Å (b), 4700Å (g), and 5400Å (v), with bandwidths of 200 - 300 Å. The experience I have obtained shows that such photometry will determine with relatively high accuracy, 1. the absolute magnitude, with of probable error $0^m.1$ - $0^m.2$, provided interstellar reddening can be neglected, or accurately allowed for, which is the case for the sample of nearby-stars in question , 2. an index of heavy-element content, and 3. an index of effective temperature, independent of chemical composition. For the stars in the B-V range $+0^m.40$ - $+0^m.48$ $H\beta$ photometry (cf. B. Strömgren, 1956b and 1958a) will be obtained to increase the accuracy of the determination of absolute magnitude. For the color range B-V $0^m.49$ - $0^m.65$ the u b g v photometry just described is quite adequate, and $H\beta$ photometry is not so valuable here (because of the relative weakness of the $H\beta$ line, and its distortion by blends).

The total number of stars in the program is 5500, of which about 700 will form a complete sample of stars in the color range B-V $0^m.40$ - $0^m.65$ within 45 parsec.

1b. For all stars brighter than $13^{m}.5$ photographic in 4 high-galactic latitude Bergedorf areas ($3^{\circ}.5 \times 3^{\circ}.5$) covering 50 square degrees, i.e. for altogether about 2500 stars, u b g v photometry as described above will be obtained. It is expected that about 1000 of these stars will be in the color range B-V $0^{m}.40$ - $0^{m}.65$. For stars in the color range $0^{m}.40$ - $0^{m}.48$ $H\beta$ photometry will also be obtained. Again, it will be possible to derive with adequate precision from the photometry, 1. the absolute magnitude, 2. a heavy-element content index and, 3. an index of effective temperature which is independent of chemical composition. The sample in question will be complete for distances from the galactic plane up to 400 parsec for G stars and about 1000 parsec for F stars.

Programs 1a and 1b will yield the desired distribution functions of heavy-element content and distance from the galactic plane for population I and disc population stars. However, the number of halo population II stars included in these samples is far too small for a reliable determination of the distribution functions through their range of heavy-element content. Therefore, the addition of suitable halo population II samples is necessary.

<u>The halo population II stars will be investigated as follows:</u>

2a. In an area of 4000 square degrees in high galactic latitude an attempt will be made to discover and investigate practically all halo population II stars in the color range B-V $0^{m}.30$ - $0^{m}.50$ (subdwarf F stars) and in the magnitude range $9^{m}.0$ - $12^{m}.0$ photographic. A technique that combines photographic and photoelectric color observations, and which I have used successfully in an investigation of Bergedorf Eichfeld 92, will be used: With a Schmidt telescope the high-galactic area in question is covered by plates having one ultraviolet exposure and one, suitably displaced, yellow (or green) exposure.

An image pair is thus obtained for each star. The two exposures are so chosen that the ultraviolet and the yellow image will be equally strong for normal F7 stars (U-V = +0.48) in the magnitude range in question. In high galactic latitude the yellow image will be stronger than the ultraviolet image for the great majority of stars in the magnitude range in question. The halo population II F stars will stand out, having a stronger ultraviolet image because of their untraviolet excess (cf. Roman 1954). If the stars for which the ultraviolet image is the strongest are selected then the desired halo population II F stars are included, as are nearly all stars with ultraviolet excess intermediate between halo population II and disc population. However, according to known high-galactic latitude statistics a relatively large number of population I and disc population F stars and a few A stars will also be included. It is therefore intended to investigate the whole sample through photoelectric u b g v photometry. Thereby a list of halo population II stars and intermediate stars will be definitely established and investigated further through the addition of $H\beta$ photometry. As before, the absolute magnitude, a heavy-element index and an effective-temperature indes, independent of chemical composition, will be obtained. It is expected that a sample of 50000 stars in the photographic survey will yield 3000 stars for further photoelectric photometry, and that about 100 halo population stars and intermediate stars will be found and investigated. The latter will form the desired sample necessary to supplement sample 1a. It will be nearly complete to a distance of about 200 parsec from the galactic plane. (Once the list of these stars has been established it is relatively easy to obtain spectra and proper motions for them). For greater distances it will be supplemented by sample 2b described below.

The sample of population I A and F stars in high galactic latitude brighter than $12^{m}.0$ photographic, which is of necessity investigated in the described procedure, will be very useful for a determination of the distribution of distance from the galactic plane for these stars, and for a thorough investigation of the small interstellar reddening present in high galactic latitudes.

2b. In an area of 2000 square degrees in high galactic latitude it will be attempted to discover and investigate practically all halo population II stars in the color range B-V $+0^{m}.30$ to $+0^{m}.50$ and from $12^{m}.0$ to $15^{m}.5$ photographic magnitude. The technique used will be the same as that described under 2a. However, the task will be much simplified by the fact that there are few, if any, A and early F stars in the relevant magnitude range in high galactic latitude. It is therefore expected that the list of stars for which the ultraviolet image is stronger than the yellow image, and for which photoelectric photometry is to be carried out, will largely contain the desired population II stars, including stars intermediate in ultraviolet excess between the extreme subdwarf F stars in the color range B-V $0^{m}.30$ - $0^{m}.50$ and the disc population in the same range of effective temperature. This expectation was fully confirmed by the experience I gained in using the method for Bergedorf Eichfeld 92 to photographic magnitude $15^{m}.5$. According to the results obtained for Bergedorf Eichfeld 92 the photographic ultraviolet-yellow (or ultraviolet-green) survey will probably lead to a list of 2000 stars to be further investigated through u b g v photometry, and probably about 1000 of these stars will be found by the photoelectric photometry to be halo population II stars. Photoelectric $H\beta$ photometry will be obtained for about 300 of these stars. Distances from the galactic plane up to about 1500 parsec will be reached by the survey.

For the four programs just described telescope observing time will be required, as follows:

Program	Instrument	Number of hours	Years
1a			
Photoelectric u b g v photometry	Lick Observatory, 36-inch	100	1959
	Mount Palomar Observatory, 20-inch	300	1960, 1961
	AURA National Observatory, 16-inch*	200	1960, 1961
Photoelectric Hβ photometry	Mount Palomar Observatory, 20-inch	100	1960, 1961
	Mount Wilson Observatory, 60-inch	100	1960, 1961
1b			
Photoelectric u b g v photometry	AURA National Observatory, 36-inch*	300	1960, 1961
Photoelectric Hβ photometry	Mount Wilson Observatory, 60-inch	20	1961
2a			
Photographic photometry	Copenhagen Observatory, 20-inch Schmidt	40	1961
Photoelectric u b g v photometry	AURA National Observatory, 36-inch*	200	1962
Photoelectric Hβ photometry	Mount Wilson Observatory, 60-inch	100	1962
2b			
Photographic photometry	Mount Palomar Observatory, 48-in. Schmidt	50	1960
Photoelectric u b g v photometry	Mount Wilson Observatory, 100-inch	200	1961
	AURA National Observatory, 36-inch*	50	1961
Photoelectric Hβ photometry	Mount Wilson Observatory, 100-inch	100	1962

* In collaboration with D. L. Crawford, Astronomer, AURA National Observatory

The observing time with the Lick Observatory, Mount Wilson Observatory and Mount Palomar Observatory instruments in 1959 and 1960 have been definitely assigned to me by Dr. A. E. Whitford (Director, Lick Observatory) and Dr. I. S. Bowen (Director, Mount Wilson and Palomar Observatories). With regard to observing time with the Mount Wilson and Palomar instruments in 1961 and 1962, Dr. Bowen has informed me that the time could in all probability be made available to me, but that observing time is not definitely assigned so far ahead of time. As far as the AURA National Observatory instruments are concerned, Dr. D. L. Crawford is willing to take the time required for the present program out of time assigned to him as National Observatory Astronomer, and Dr. A. B. Meinel, National Observatory Director, has approved this arrangement. The time with the Copenhagen 20-inch Schmidt has been put at my disposal by Dr. A. Reiz, Director, provided the telescope is in operation in 1961, which it almost certainly will be.

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References

S. van den Bergh 1957, Ap. J. 125, 445.

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J. Chamberlain and L. H. Aller 1951, Ap. J. 114, 52

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N. G. Roman 1954, A. J. 59, 307

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M. Schmidt 1959, Ap. J. 129, 243

M. Schwarzschild and L. Spitzer 1953, Observatory 73, 77.

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