

## MISCELLANEOUS SPECTROSCOPIC NOTES

WILLIAM P. BIDELMAN

Warner and Swasey Observatory, Case Western Reserve University, Cleveland, Ohio 44106

*Received 1988 June 13*

## ABSTRACT

Results of slit-spectrograph observations are reported for approximately 260 stars. The data presented range from recognition of many new Ap, Am, and other unusual stars to H $\alpha$  observations of early-type supergiants and Be stars. The material discussed was obtained over the past 40 years at a number of U. S. observatories and at the Dominion Astrophysical Observatory in Victoria, B. C.

*Key words:* stellar spectroscopy–spectral classification–peculiar stars

## I. Introduction

After somewhat over 40 years as a stellar spectroscopist, the writer found in going over his accumulated plate material that he was in possession of a fair amount of useful information that it seemed desirable as well as expedient to publish. This is the aim of the present paper.

## II. The Observations

Most of the data have come from observing programs whose results were never reported in full. For example, many stars noted as peculiar in the *Henry Draper Catalogue* were observed at Lick; some results were published in the first supplement to Bertaud's Ap and Am star catalog (Bertaud 1960), but not all. The stars noted as Ap or Am by Walther and Zirin at Harvard were also observed (Bidelman 1966); a few of their stars for which the writer's classification differed from theirs are included here. An extensive program of observation at H $\alpha$  of the most-luminous supergiants was carried out at Lick and, at the invitation of L. Gratton, at Cordoba (Whitford 1959); a similar program devoted to the observation of the brighter northern Be stars was carried out both at Lick and, some 12 years later, at the Warner and Swasey Observatory (Bidelman and Weitenbeck 1976). Some results from these two H $\alpha$  programs appear in Bidelman (1976), but the details are given here. Also at Lick a considerable number of nearly-equal-magnitude close binary systems were observed by then-student John A. Williams, in a search for new composite spectra.

The largest Lick program involved the observation of some 500 stars of *Henry Draper Catalogue* type B8–A5 believed to have variable radial velocity (Shane 1957). Normal stars from this program are listed in a recent paper by Bidelman, Ratcliff, and Svolopoulos (1988), but the peculiar objects are given here.

Many of the stars discussed were noted in a visit made by the writer to the Dominion Astrophysical Observatory

in the spring of 1966 in which, thanks to a grant from the H. H. Rackham School of Graduate Studies at the University of Michigan and to the good offices of R. M. Petrie, he was able to inspect a large number—though not all—of the spectrograms in possession of that observatory. A considerable number of new peculiar objects were found. Confirmation of many of these was obtained by subsequent slit observations with the now-defunct 0.95-m reflector of the University of Michigan, though some of the presumed discoveries were not confirmed and others were not followed up but are, nevertheless, listed here.

## III. Results

It was, of course, inevitable that a great many of the stars observed have been studied by others in more recent times. Some effort has been made to avoid unnecessary duplication with previously-published data, but this is practically impossible. In some cases we have differed with others, and thus have intentionally included our data.

A list of "notable stars" is given in Table I, which is largely self-explanatory. Two-decimal magnitudes are visual in the *UBV* system; others are taken from various sources. The column headed "Slit Observation" states where the writer's own observations were made; that titled "First Noted" indicates where the object was first deemed to be of interest, usually by staff members of the relevant observatory, but in the case of the Dominion Astrophysical Observatory largely by the writer. No attempt has been made to credit the observatories responsible for first calling attention to the numerous objects contained in the Mount Wilson emission-line-star catalogs or to the stars observed because of their variable radial velocity, for which reference may be made to Abt and Biggs (1972) and/or Batten, Fletcher, and Mann (1978). Spectral types given for the high-luminosity stars studied at H $\alpha$  are taken from the literature and are thus

TABLE I  
Notable Stars

Name	$\alpha$ (1900)	$\delta$	Mag.	First Noted	Slit Observation	Comments
HD 1826	0 17.6	+28 55	7.00		Lick	Am SB P=1.43 d. LR And
HD 3125	0 29.4	- 5 6	7.01		Lick	composite gK + ? ADS 475
HD 3200	0 30.2	+55 10	7.8	Michigan	Michigan	mild Ap Si
HR 146	0 30.8	+59 47	5.79	DAO	Michigan	unusual spectrum; resembles 2 Cas (q.v.) except K line weaker
HD 3891(A)	0 36.4	+70 50	7.9		Lick	Ap Si: SB ADS 582(A)
Case 22	0 38.0	+61 44	10.3	W&S	Lick	Dec. 22, '54 plate shows a strong absorption feature near H $\beta$ in this red object. A10?
+11 $^{\circ}$ 102(B)	0 45.0	+11 17	11		Lick	strong G band in F or G high-proper-motion star ADS 686(B)
HR 323	1 1.8	-36 12	6.61		McDonald	Am (known) SB2 P=10.62 d.
HD 6832	1 3.9	+61 17	8.30	DAO		Ap Hg-Mn ADS 958(A)
+57 $^{\circ}$ 216	1 5.7	+57 43	8.5	DAO		Ap Hg HD 236650
HD 7254	1 7.7	+33 35	6.75	DAO	Michigan	Ap Si-Cr
HR 386	1 15.0	+78 12	6.07	HCO		has this high-latitude B9 Iab star escaped from h and $\chi$ Persei?
HD 8159	1 15.8	+57 46	8.2	HCO	Lick	AO Ib
HD 8862	1 22.3	+43 32	6.6		Lick	mild Ap Si SB
HD 9492	1 28.1	+43 34	8.1	HCO	Lick	Ap Cr ADS 1222(A)
Es 1076	1 37.7	+60 7	9.8	WO	Lick	K type with very strong CH and $\lambda$ 4077. CH star?
HD 10547	1 37.7	+44 55	8.6	HCO	Lick	appears normal
HR 526(B)	1 43.1	+47 24	6.85:		Lick	Am SB2 ADS 1438(B)

not new determinations.

The degree to which the comments in the last column of the table should be taken seriously differs widely from object to object. Many, hopefully most, of the remarks are definitive, but the difficulties involved in classifying stars

of marginal peculiarity are well known. The  $\delta$  Delphini and the supposed strong-helium stars especially should be taken with a grain of salt. It may also be questioned whether all of the Be stars noted as showing H $\alpha$  self-reversals qualify as "shell" stars, though many certainly do.

TABLE I (Continued)

Name	$\alpha$ (1900)	$\delta$	Mag.	First Noted	Slit Observation	Comments
HD 12288	1 55.5	+69 6	7.73-7.75	HCO	Lick	Sept. 2, '56 plate shows a complex spectrum with very strong Cr II, Si II and more V540 Cas
HD 13256	2 4.5	+60 14	8.61		Lick	Dec. 6, '58 plate shows very strong H $\alpha$ emission, unusual for a B1 Ia star MWC 705
HD 13406	2 5.9	-13 24	7.42	HCO	Lick	Am
HD 13664(A)	2 8.1	+34 3	9.0		McDonald	moderate Am ADS 1711(A)
HD 14535	2 15.8	+56 47	7.46	HCO	Lick, W&S	Nov. 1, '61 Lick plate shows moderately strong bright H $\alpha$ and slight P Cygni absorption in this A2 Iap? star. Aug. 31, '72 W&S plate confirms, with strong P Cygni absorption
HD 14581	2 16.3	+56 24	8.5	DAO	Michigan	weak Ap Si
HD 14688	2 17.1	+16 25	6.8	DDO	Lick	Am SB P=4.32 d.
HD 14956	2 19.6	+57 14	7.21	HCO	Lick	Jan. 3, '59 plate shows fairly strong bright H $\alpha$ in this B2 Ia star V475 Per
+60 <sup>o</sup> 493	2 23.3	+60 43	8.44		Lick	Oct. 16, '59 plate shows moderately weak bright H $\alpha$ in this B0.5 Ia star
HD 16691	2 35.5	+56 28	8.70		Lick	Sept. 14, '57 plate shows broad weak bright H $\alpha$ in this O5f star
HR 791	2 36.2	+67 24	5.95		Lick	Am SB P=2.54 d.
HD 16855	2 37.1	+43 7	6.76		Lick	Am SB
HD 20873(A)	3 16.8	+29 27	8.5		Lick	Am SB ADS 2499(A)
HR 1113	3 34.6	+37 16	5.57		W&S	Dec. 2, '70 plate shows a weak self-reversal at H $\alpha$ MWC 463
HD 23610	3 41.4	+22 38	8.12	DAO		Am

Observation dates are given where deemed important. To summarize: It is hoped that most of the results given are new and will be of interest to others.

I am happy to express my heartfelt gratitude to many people for making this paper possible. First and foremost, to W. W. Morgan of the Yerkes Observatory, who in-

TABLE I (Continued)

Name	$\alpha$ (1900)	$\delta$	Mag.	First Noted	Slit Observation	Comments
HD 24177	3 45.9	+45 39	8.0		DAO	strong He and K
HD 24346	3 47.3	+ 9 40	8.3	HCO	Lick	slightly weak-lined F
AS 79	3 54.5	+53 47	10	MtW	McDonald	Nov. 3, '69 plate shows a weak fairly broad $H\beta$ emission and an absorption spectrum of early M
HD 25914	4 1.2	+56 50	7.99	HCO	Lick	Dec. 6, '58 plate shows a very faint broad emission at $H\alpha$ in this B6 Ia star
HD 27395	4 14.3	+49 48	7.4	W&S	Lick	composite G3 Ib + ?; primary perhaps peculiar ADS 3141
HD 28942	4 28.5	+52 18	8.5	Michigan	Michigan	Nov. 18, '65 plate shows very sharp $H\gamma$ and $H\delta$ cores, plus Fe II and other lines. A-type shell?
HD 30685	4 44.7	+61 19	6.6	DAO	Michigan	probable Am
GP Ori	4 57.1	+15 11	10 var	Dearborn	Lick	Jan. 14, '58 visual plate shows weak $C_2$ bands and no ZrO HD 286340
HD 32576	4 59.1	+14 44	6.7	W&S	Michigan	probably normal
HD 32992	5 2.0	+14 14	8.2	W&S	Michigan	mild Am
-21°1074	5 2.6	-21 43	9.3	Michigan	McDonald	Nov. 1, '69 plate shows very strong Ca II emission in an M0 giant
HD 34018	5 9.2	+67 53	7.4	HCO	Lick	$\delta$ Del
+33°997	5 11.2	+33 56	10		Lick, McDonald	Nov. 18, '59 Lick plate shows pronounced P Cygni structure at $H\alpha$ and displaced D3. A later McDonald plate shows the spectrum much veiled and clearly composite, probably gK + Be MWC 490 HD 242257
HR 1728	5 11.8	+33 39	6.15-6.82		Lick	Ap Hg (known) SB2 P=4.13 d. AR Aur
22 Ori	5 16.7	- 0 29	4.73	DAO		strong He SB?

spired and directed my interest in stellar astronomy; second, to the several observatory directors who not only enabled me to obtain my data but also thankfully allowed

me to keep my plates for an inordinate time; and finally, to the numerous assistants, employed or volunteer, who actually took a great many of the spectrograms involved.

TABLE I (Continued)

Name	$\alpha$ (1900)	$\delta$	Mag.	First Noted	Slit Observation	Comments
HD 35533	5 20.3	+15 35	7.5	DDO	Lick	Ap Si
HD 35575	5 20.6	- 1 35	6.42		Michigan	Jan. 26, '68 plate appears to show unusual weak lines (Ti II, Cr II?) not seen on other plates
HD 36662	5 28.3	+45 25	8.47	DAO		Mn II present and probably also Hg II
HR 1902	5 30.9	+26 52	5.83		Lick	Ap Si SB ADS 4208
28 Cam	5 38.4	+56 53	6.8	Michigan	Michigan	either Ap Cr or very weak Am HD 38129
HD 39018	5 44.7	+18 0	7.72		Lick	Jan. 11, '62 plate shows a strong H $\alpha$ self-reversal MWC 779
HD 39847	5 50.1	+25 19	7.7	HCO	McDonald	composite, of unusual character. The cooler component is of type G or later, but unusually faint compared to the hotter, which is about A2
HD 40652	5 55.1	+38 28	8.1	HCO	Lick	mild Ap Si
HD 40678	5 55.3	+23 41	7.35	DAO	Michigan	Ap Si
HD 40978	5 57.2	+46 33	7.26		Lick	Apr. 2, '59 plate shows a weak self-reversal at H $\alpha$ MWC 131
HD 41724/5	6 1.8	+35 08	7.7	HCO		DAO plate indicates Am
HD 43246	6 10.1	+28 54	7.38	HCO	W&S	March 5, '71 plate shows double H $\alpha$ emission with the shortward component somewhat stronger. The intensities are reversed on a Sept. 21, '72 plate SB2 P=23.18 d. AS 122
9 Gem	6 10.8	+23 46	6.25	YO	Lick	March 13, '62 plate shows a very weak narrow H $\alpha$ emission in this B3 lab star

Among those deserving special mention are S. Svolopoulos at Lick, C.-Y. Yang at Michigan, and A. J. Weitenbeck at Warner and Swasey, but there were many others who

made very substantial contributions to my work. I thank them all, and hope that they share with me the satisfaction of seeing, at long last, the miraculous transformation of a

TABLE I (Continued)

Name	$\alpha$ (1900)	$\delta$	Mag.	First Noted	Slit Observation	Comments
HD 43561	6 11.8	+20 29	8.48	HCO	McDonald	Am
HD 45314	6 21.6	+14 57	6.64		Lick	Jan. 11, '62 plate shows a fairly strong self-reversal at H $\alpha$ SB MWC 140
HD 48716	6 39.6	+13 26	8.3	HCO	Lick	Al Ib
HD 48953/4	6 41.0	+16 52	6.7	HCO/DAO	W&S	Ap Sr-Eu
HR 2508	6 42.8	- 8 53	5.07	MtW	McDonald	Rather strong Ca II emission
HD 49699	6 44.6	-12 33	7.5		Lick	March 1, '59 plate shows strong bright H $\alpha$ and strong P Cygni absorption MWC 822
HD 49888	6 45.5	-12 29	7.21		W&S	Jan. 31, '73 plate shows strong H $\alpha$ absorption with very weak emission wings MWC 534
HD 50064	6 46.4	+ 0 25	8.21		Lick	Jan. 15, '58 plate shows quite strong narrow H $\alpha$ emission, unusual for a B6:Ia star MWC 536
HR 2633	6 56.6	+5 42	6.59	DAO		strong He lines
HR 2647	6 57.9	+ 9 17	5.97		Lick	mild Am SB
HD 55228	7 7.0	+16 15	8.5	HCO	McDonald	probably a very-late-type Am, though K is quite strong
HR 2768(A)	7 13.1	-30 43	6.29	HCO	Lick	probable $\delta$ Del
HR 2840	7 21.1	+11 12	6.41	DAO		variable He lines
HR 2859	7 23.2	-11 21	5.79	HCO	W&S	Nov. 6, '72 plate shows moderately strong H $\alpha$ absorption with very faint emission borders ADS 6104(AB) M.W. 230
HD 60054(B)	7 27.6	-20 42	9.1		McDonald	gK5 ADS 6159(B)=BDS 4119(B)
HD 60470	7 29.5	+52 25	8.6	Michigan	Michigan	F3 Ib-II at high latitude; perhaps slightly weak lines

fuzzy image on a spectrograph slit back into the real, honest-to-goodness celestial object from which it originated—not completely understood perhaps, but nearing understanding.

## REFERENCES

- Abt, H. A., and Biggs, E. S. 1972, *Bibliography of Stellar Radial Velocities* (Tucson, AZ: Kitt Peak National Observatory).  
 Batten, A. H., Fletcher, J. M., and Mann, P. J. 1978, *Pub. Dom. Ap.*

TABLE I (Continued)

Name	$\alpha$ (1900)	$\delta$	Mag.	First Noted	Slit Observation	Comments
HR 2921	7 31.5	-14 16	5.70		Lick	Jan. 31, '59 plate shows a weak self-reversal at H $\alpha$ MWC 565 ADS 6208(A)
HD 61600	7 35.0	+37 40	7.6	HCO	Lick	moderate Am ADS 6276
3 Pup	7 39.8	-28 43	3.96		W&S	Feb. 18, '72 plate shows double bright H $\alpha$ with the shortward component much fainter than the longward SB P=137.8 d. MWC 570
HR 3026	7 43.1	-15 44	6.34		Lick	K emission present, probably somewhat abnormally strong QY Pup
HD 63347	7 43.4	+71 21	7.2	DAO	Michigan	Ap Sr-Cr-Eu
10D -30°5135	7 45.2	-30 53	8.75-9.88	MtW	Lick	Dec. 17, '58 plate shows double bright H $\alpha$ with the longward component much the stronger PW Pup M.W. 231
HD 64566	7 49.4	-23 3	6.7		W&S	Jan. 30, '73 plate shows a rather weak self-reversal at H $\alpha$ MWC 853
SA 99-1368	7 52.5	- 0 23	11		Lick	probable weak S
HD 68119	8 6.0	+49 33	8.9	HCO	Lick	moderately weak-lined F LTT 12149
HD 72357	8 27.3	+22 13	9.1		Michigan	Am
HD 72459	8 27.9	+50 44	8.5	Michigan	Michigan	probable Am
HD 76227	8 49.7	-29 11	9.8	HCO	McDonald	Fp; SrII $\lambda$ 4077 is very strong, but $\lambda$ 4215 is weak. Perhaps very late Am
17 Hya(B)	8 50.6	- 7 35	6.87		McDonald	appears normal ADS 7093(B)
HD 77105	8 55.3	-13 54	8.8	HCO	Lick	Very strong $\lambda$ 4077, somewhat weak K; late Am or perhaps Ap Sr-Eu
HD 79870	9 11.5	+75 20	7.4	HCO	Lick	Am
HR 3719	9 17.5	+75 33	6.26	DAO	Michigan	probable Am
HD 81405	9 20.3	+48 13	7.6	HCO	Lick	Am

*Obs.*, 15, 121.

Bertaud, Ch. 1960, *J. Observateurs*, 43, 129.

Bidelman, W. P. 1966, *Vistas Astr.*, 8, 53.

\_\_\_\_\_. 1976, in *Be and Shell Stars*, ed. A. Slettebak (Dordrecht: Reidel), p. 457.

Bidelman, W. P., Ratcliff, S. J., and Svolopoulos, S. 1988, *Pub. A.S.P.*,

TABLE I (Continued)

Name	$\alpha$ (1900)	$\delta$	Mag.	First Noted	Slit Observation	Comments
HD 81976	9 24.0	+33 45	8.1		Lick	Am SB2
HD 83270/1	9 32.1	+69 0	8.1	HCO/DAO		Am
HR 3858	9 36.7	-23 8	4.77		W&S	Apr. 3, '71 plate shows a very weak self-reversal at H $\alpha$ MWC 197
22 Leo	9 46.2	+24 52	5.32	DAO	Michigan	probable Am
HD 85931	9 50.1	+21 27	9.1	HCO	Lick	probably normal
HR 4110	10 23.7	-57 8	4.66	HCO	Cordoba	Feb. 17, '59 plate shows sharp H $\alpha$ absorption but much weaker than usual for type; filled-in? V399 Car
HD 93457	10 42.3	+41 37	6.8	DAO		Am ADS 7929
HD 93700	10 44.0	+22 14	9.0	Michigan	Michigan	Ap Sr-Eu
HD 93946	10 45.6	+50 48	8.5	HCO	Lick	Am
51 UMa	10 59.0	+38 47	6.00	DAO	Michigan	probable Am ADS 8046(A)
HD 96003	10 59.3	+13 12	6.7	W&S	Michigan	Ap Sr-Cr
HD 96571	11 2.5	+86 11	7.2		Lick	Ap Sr-Eu SB
HD 97336/7	11 7.1	+25 11	8.3	HCO	Michigan	not composite
HD 100054(B)	11 25.7	+60 15	8.1		Lick	Am SB ADS 8191(B)
HR 4451	11 28.2	-15 43	6.05		W&S	$\lambda$ 4077 very strong, G band present but hydrogen rather strong; composite or peculiar?
HD 100764	11 30.7	-14 2	8.80	HCO	Lick	moderately strong Ca II emission; unusual IRAS colors for this carbon star
HR 4487	11 33.5	-61 16	5.15	Lick	Mt. Stromlo	a remarkable Ap star that deserves detailed study; see A.J. 71, 795
HD 102925	11 45.9	+69 24	7.1		Lick	Am SB

100, in press.

Bidelman, W. P., and Weitenbeck, A. J. 1976, in *Be and Shell Stars*, ed. A. Slettebak (Dordrecht: Reidel), p. 29.Shane, C. D. 1957, *A.J.*, 62, 294.Whitford, A. E. 1959, *A.J.*, 64, 294.

TABLE I (Continued)

Name	$\alpha$ (1900)	$\delta$	Mag.	First Noted	Slit Observation	Comments
V422 Cen	11 46.8	-41 54	11.6-12.1pg	Michigan	McDonald	Jan. 18, '70 plate shows H $\gamma$ and [O III] $\lambda$ 4363 emission, plus TiO absorption
HD 103354	11 49.0	+18 43	7.8	HCO	Lick	normal
+31 <sup>o</sup> 2314	11 51.5	+31 23	10.89		McDonald	Am
HD 105199	12 1.7	+30 49	9.83		McDonald	early Am
HD 105967	12 6.6	+ 4 37	6.93	Lick	Lick	Am; observation suggested by O. Eggen
HD 107452(A)	12 16.0	-10 55	8.25	McDonald	Lick	Ap Sr-Cr-Eu; narrow and broad K ADS 8523(A)
HD 109764	12 32.1	+ 9 21	6.59	HCO	Lick	Am
HD 111057	12 41.5	+17 03	8.46		McDonald	Am
HD 112197	12 49.7	+22 8	9.01		McDonald	marginal early Am
HD 112734	12 53.8	+28 52	6.97		Lick	$\delta$ Del SB
RT Vir	12 57.6	+ 5 43	7.41-8.70		W&S	May 13, '76 plate shows fairly strong bright H $\alpha$
HD 114761	13 7.5	+30 32	8.45	Dearborn	McDonald	K5 III
HD 115403	13 11.9	+20 21	7.61		McDonald	slightly weak-lined A7
HD 116275	13 17.5	-12 40	7.77		Lick	mild Am SB ADS 8878(A)
HD 116379	13 18.2	+18 48	7.92	DA0		sharp H; appears metal-poor
HD 118478	13 32.1	+82 30	8.9	DA0		high-latitude B4 helium variable
HD 123884	14 5.1	-17 31	9.37	Y0	Lick	this high-latitude A0 star merits analysis. It is probably a post-asymptotic-branch star of moderately high luminosity
HD 126031	14 18.0	+15 24	7.62		Michigan	Am
HD 127263	14 25.3	+47 35	8.12	HCO	Lick	Am

## SPECTROSCOPIC NOTES

1093

TABLE I (Continued)

Name	$\alpha$ (1900)	$\delta$	Mag.	First Noted	Slit Observation	Comments
HD 128661	14 33.1	+36 22	7.13-7.46		Lick	early Am SB2 P=3.33 d. BW Boo
HD 134305	15 4.0	+12 52	7.25	DDO	Michigan	Ap Sr
HR 5654	15 7.5	+19 21	5.79-6.02		W&S	ZrO present, thus MS FL Ser
HD 136239	15 14.4	-58 48	7.8	HCO	Cordoba	March 14, '59 plate shows rather weak bright H $\alpha$ in this B1.5 Ia star
HD 138406	15 26.8	+62 5	6.8		Lick	Am SB
HD 139609	15 34.0	+12 36	7.44	DAO		Ap Hg-Si
HR 5829(B)	15 35.0	+80 47	7.31	DAO		stronger than normal Ca II emission SB ADS 9696(B)
R Ser	15 46.1	+15 26	5.16-14.4		W&S	Aug. 16, '77 plate shows strong enough ZrO to call MS
HD 142282	15 48.6	+53 13	6.5	HCO	Michigan	probably normal ADS 9816(A)
HD 144999	16 3.6	+29 16	7.8	MtW	Lick	Am ADS 9930(A)
HD 145939	16 8.5	-13 43	10.0	Leiden	McDonald	high-latitude B2 V; strong He:
HD 149379	16 29.2	+40 19	7.2		Lick	G5 II comp? ADS 10111
HD 151604	16 43.3	+41 57	7.97	HCO	McDonald	Am
HD 151746	16 44.2	+74 5	6.8		Lick	Am SB close visual dbl.
HR 6450	17 15.8	-37 43	6.41	HCO	Lick	June 29, '58 plate shows a well-marked sharp emission at H $\alpha$ in this B3 Iap star
HR 6455	17 16.1	+25 38	5.38		Lick	slight Am SB
HR 6467	17 17.8	+48 17	6.43		Michigan	moderately weak-lined
HD 158013	17 21.7	+57 5	6.6		Lick	Am SB P=8.22 d.
HD 158116(A)	17 22.3	+29 33	7.24	MtW	Michigan	$\delta$ Del ADS 10553(A)
HR 6532	17 27.6	+12 00	6.42	DAO		Hg II (known) SB P=6.80 d.

TABLE I (Continued)

Name	$\alpha$ (1900)	$\delta$	Mag.	First Noted	Slit Observation	Comments
HD 160319	17 34.1	-28 52	7.20	Michigan	W&S	May 4, '71 plate shows a very weak self-reversal at H $\alpha$
XX Oph	17 38.6	- 6 14	8.59-10.2		Lick	July 13, '58 plate shows emission H $\alpha$ , Fe II, and [O I] and a strong absorption, probably Si II, at $\lambda$ 6345 MWC 269
HR 6619	17 41.9	+31 33	6.23	NLO	Lick	very sharp H lines and a trace of Si II; a high-latitude class II star or an imposter
HD 162064	17 44.0	-19 52	9.26		Lick	July 6, '58 plate shows a weak bright H $\alpha$ with faint P Cygni absorption in this B0 Ia star
HR 6641	17 44.4	+47 39	6.43		Lick	slight Am SB P=2.82 d.
+29 $^{\circ}$ 3148	17 52.8	+29 17	10	Leiden	McDonald	Am
HR 6758	18 1.1	+12 0	7.05,7.45			A is a normal rapidly rotating A star, B is the Sr-Eu-Cr component ADS 11056
102 Her	18 4.4	+20 48	4.36	DAO	Michigan	strong He and K SB? ADS 11102(A)
HD 168812	18 16.6	+28 56	6.5	DAO	Michigan	Ap Hg
-14 $^{\circ}$ 5037	18 19.4	-14 42	8.24		Lick	July 20, '57 plate shows quite strong narrow H $\alpha$ emission, unusual for a B1.5 Ia star MWC 928 V433 Sct
HD 170282	18 23.4	-38 29	10.3	HCO	McDonald	shows C <sub>2</sub> "tail bands"
HR 6941	18 25.1	+ 4 0	6.69	DAO	Michigan	strong He and K ADS 11399(A)
HD 170938	18 26.9	-15 46	7.87		Lick	June 24, '58 plate shows a moderately strong sharp bright H $\alpha$ in this B1 Ia star SB?
HD 171347	18 29.3	-17 4	7.0		Michigan	appears normal

## SPECTROSCOPIC NOTES

1095

TABLE I (Continued)

Name	$\alpha$ (1900)	$\delta$	Mag.	First Noted	Slit Observation	Comments
HR 6984	18 31.6	+34 22	6.10		W&S	Aug. 1, '71 plate shows a fairly strong H $\alpha$ self-reversal SB MWC 604
HD 171871	18 32.0	+51 2	7.39	DAO	Michigan	strong He and K; very sharp lines SB?
HR 7013	18 35.9	+65 24	6.06		Lick	probable $\delta$ Del SB
HR 7018	18 36.7	+62 26	5.61	DAO	Michigan	Ap Hg-Y-Zr SB?
-1 <sup>o</sup> 3542	18 36.9	- 1 24	9.22		Lick	May 31, '59 plate shows very weak broad H $\alpha$ emission in this B8 Ia: star
HD 172865	18 37.4	+30 12	6.94		Lick	composite gK + A: ADS 11579(AB)
HD 172976	18 38.0	+44 10	7.3	HCO	Lick	Am
HR 7115	18 48.1	+36 25	6.09	DAO		variable He $\lambda$ 4121 and Si II
HR 7173	18 54.5	+10 0	6.75	DAO		strong He lines SB?
HD 176674	18 56.3	+14 25	7.9	W&S	Michigan	composite B + A
+11 <sup>o</sup> 3707	18 57.9	+11 07	10.57		Lick	July 11, '58 plate shows fairly weak bright H $\alpha$ in this B1 Ia: star
HD 177427	18 59.5	-29 14	6.9		W&S	Aug. 29, '71 plate shows a fairly strong H $\alpha$ self-reversal MWC 976
HD 177983	19 1.8	+15 42	7.2	W&S	Michigan	$\delta$ Del
HR 7249	19 2.4	-19 27	5.34-5.60		W&S	Aug. 21, '72 plate shows a moderately weak H $\alpha$ self-reversal SB2 MWC 311 V4024 Sgr
HD 178330	19 3.1	+20 16	7.4	DAO		strong CH and CN; Ba II star?
Case 56	19 3.5	+ 7 44	11.3	W&S	Lick	fairly weak S-type star
HD 178591	19 4.1	+40 54	6.94	DAO	Michigan	Ap Si

TABLE I (Continued)

Name	$\alpha$ (1900)	$\delta$	Mag.	First Noted	Slit Observation	Comments
HD 178929	19 5.4	-20 31	7.9	HCO	Lick	marginal Ap Si star. Has the spectrum changed?
HD 179002	19 5.7	- 7 35	6.76		Lick	slightly composite spectrum G5 II + earlier ADS 12126
HD 179711	19 8.5	+11 51	7.6	Michigan	Michigan	Ap Si
HD 180165	19 10.4	+10 2	7.0	DAO		strong CN and CH
+14 <sup>o</sup> 3854	19 12.0	+14 27	8.84	HCO	Lick	Ap Si-Cr HD 231041
HD 180585	19 12.0	+11 40	7.9	Michigan	Michigan	Ap Sr
HD 182032	19 17.7	+22 19	7.43	DAO	Michigan	strong He ADS 12355(AB)
2 Sge	19 19.8	+16 45	6.27		Lick	early Am (known) SB2 P=7.39 d.
3 Sge	19 20.2	+16 46	6.82		Lick	early Am SB HD 182571
HD 182830	19 21.4	+15 21	8.05	W&S	Lick	composite gK + A ADS 12435(A)
HD 184591	19 30.1	+17 56	7.2		Lick	slightly composite spectrum; K0 III + earlier ADS 12623
HD 185842	19 36.0	- 2 33	7.1	DAO		strong He SB
14 Cyg	19 36.2	+42 35	5.40	NLO	Lick	probable Ap Si SB
+37 <sup>o</sup> 3585	19 40.5	+37 42	8.93	DAO		strong Mn II lines SB HD 225573
HD 186841	19 41.7	+23 50	7.86		Lick	Oct. 28, '58 plate shows quite weak sharp H $\alpha$ emission in this B1 Ia star
+29 <sup>o</sup> 3736	19 42.4	+29 55	8.8	DAO		Ap Hg-Mn SB HD 332677
12 Vul	19 46.8	+22 21	4.95		Lick	Aug. 11, '58 plate shows a fairly strong self-reversal at H $\alpha$ MWC 323
HD 188037	19 48.1	+22 12	7.75-8.12	Lick	Lick	unusual composite, M4/5 + A. The cool star appears to be a normal giant; is the hotter a H-B star? ADS 13055 NS Vul

## SPECTROSCOPIC NOTES

1097

TABLE I (Continued)

Name	$\alpha$ (1900)	$\delta$	Mag.	First Noted	Slit Observation	Comments
HD 188383	19 49.8	+26 20	6.81	DAO	Michigan	weak but definite Am
$\phi$ Aq1	19 51.5	+11 9	5.28		Lick	probably early Am SB P=3.32 d.
HR 7646	19 56.2	+45 30	5.92		Lick	slight Am
15 Vu1	19 57.0	+27 29	4.62-4.67	YO	Lick	Am (known) SB? NT Vu1
+33 <sup>o</sup> 3733	20 1.8	+34 00	10	Lick		Ap Si HD 227588
HD 191420	20 4.7	+45 42	8.15	HCO	Lick	probably a late $\delta$ Del
28 Cyg	20 5.7	+36 33	4.91-4.97		W&S	Aug. 5, '71 plate shows a rather weak H $\alpha$ self-reversal in this well-known shell star-see Mich. Publ. 4, 199 SB? MWC 329 V1624 Cyg
HD 191746	20 6.4	+28 8	7.17	DAO	Michigan	strong He
HR 7717	20 7.5	+ 0 34	6.27		Lick	the brighter component is AOn:, the fainter Ap Cr-Eu. B.S. Cat. notes optical-why? ADS 13506
HD 192382	20 9.5	+36 26	8.7		Lick	probable Am SB
HD 192517	20 10.2	+29 54	7.08	DAO	Michigan	strong He
HD 192660	20 10.9	+40 1	7.54		Lick	Aug. 12, '57 plate shows very faint H $\alpha$ emission, with slight P Cygni absorption, in this B0 Ia star SB
1 Del	20 25.5	+10 34	5.92-6.07	DAO		DAO plate Aug. 9, 1919, shows a shell spectrum very similar to the 1929 plates (Publ. D.A.O. 7, 1) MWC 1019 ADS 13920(AB)
HD 195358	20 25.7	+19 5	6.6		Lick	July 5, '58 plate shows a very strong reversal at H $\alpha$ MWC 1020 ADS 13921(A)
HD 195592	20 27.2	+43 59	7.08		Lick	July 13, '57 plate shows strong H $\alpha$ emission, unusual for an O9.5 Ia star SB MWC 347

TABLE I (Continued)

Name	$\alpha$ (1900)	$\delta$	Mag.	First Noted	Slit Observation	Comments
HD 196025	20 29.6	+ 6 32	6.99	DAO		strong He ADS 14017(A)
+41 <sup>o</sup> 3807	20 30.6	+41 16	10.05		Lick	Sept. 8, '57 plate shows weak H $\alpha$ emission in this O6f star
$\iota$ Del	20 33.0	+11 2	5.43		Lick	early Am SB P=11.04 d.
HR 7903	20 34.7	+21 28	6.08	DAO		rather odd spectrum; Ap Cr? SB?
HR 8009	20 50.7	+40 20	6.71		Lick	Aug. 7, '58 plate shows a very weak H $\alpha$ self-reversal MWC 356 ADS 14413(A)
12 Aqr(A)	20 58.7	- 6 13	5.7		Lick	spectrum slightly composite, as K is somewhat weak; new close binary ADS 14592(A)
HD 201032	21 2.0	+62 59	7.3		Lick	late Am SB P=2.30 d.
HR 8106	21 7.1	+53 9	5.73	NLO	Michigan	unusual Ap, with sharp H cores, Si II and other lines, Mg II wk SB
HD 202313	21 9.9	+30 33	7.6		Lick	Ap Si SB
HD 202431	21 10.7	+70 25	7.6		Michigan	Am
HD 203731	21 19.0	+40 16	7.52		W&S	July 7, '72 plate shows a moderately weak self-reversal at H $\alpha$ MWC 369
HD 204722	21 25.5	+43 54	7.66		Lick	Aug. 22, '58 plate shows a moderately strong H $\alpha$ self-reversal SB MWC 370
HD 205333	21 29.5	+38 5	8.0	HCO	Lick	Ap Si
HD 207329	21 43.1	+51 39	7.60		W&S	Aug. 11, '72 plate shows a very weak self-reversal in bright H $\alpha$ , which is quite broad and moderately strong, in this B1.5e Ib? star MWC 378
HR 8338	21 44.4	+38 11	6.12	DAO		P II suspected
HD 208174	21 49.4	+27 53	6.7		Lick	Am SB

## SPECTROSCOPIC NOTES

1099

TABLE I (Continued)

Name	$\alpha$ (1900)	$\delta$	Mag.	First Noted	Slit Observation	Comments
HD 208392	21 50.9	+62 8	7.02-7.17		W&S	Aug. 11, '72 plate shows a fairly strong self-reversal at H $\alpha$ MWC 380 EM Cep
+53 <sup>o</sup> 2749	21 55.0	+53 59	8.86		Lick	Oct. 28, '58 plate shows very strong bright H $\alpha$ SB P=225.2 d. MWC 647 HD 235679
$\eta$ PsA	21 55.1	-28 56	5.33-5.44		W&S	Oct. 3, '72 plate shows a fairly strong H $\alpha$ self-reversal SB ADS 15536
+58 <sup>o</sup> 2373	21 58.1	+59 01	9.34		Lick	Nov. 30, '58 plate shows a very faint broad H $\alpha$ emission in this B5 Ia star HD 239828
HR 8407	21 58.9	+44 10	5.60	HCO	Lick	slightly enhanced Si II ADS 15578
HD 210208	22 3.7	+42 27	7.5		Lick	Dec. 18, '56 plate shows broad He, sharp H cores, wk H $\beta$ . W&S objective-prism plate Aug. 7, '75 shows faint H $\alpha$ emission SB?
HD 212094	22 16.7	+53 18	8.30	W&S	Michigan	composite gK + early A ADS 15856
HR 8549	22 22.4	+36 57	6.46	DAO		strong He and K ADS 15942(A)
6 Lac	22 26.2	+42 37	4.51	DAO		strong He and K SB P=880 d.
+37 <sup>o</sup> 4637	22 32.2	+37 39	9.51		Michigan	Am
HD 214605/6	22 34.3	+68 41	7.5	HCO/DAO		Am
$\epsilon$ PsA	22 35.1	-27 34	4.12-4.24		W&S	Oct. 3, '72 plate shows a weak H $\alpha$ self-reversal MWC 392
HD 214946	22 36.7	+44 29	7.1		Lick	$\delta$ Del SB2

TABLE I (Continued)

Name	$\alpha$ (1900)	$\delta$	Mag.	First Noted	Slit Observation	Comments
HD 214974	22 36.9	+66 38	8.4	Uppsala	Michigan	composite gK + early A. See Obs., 58, 156
HD 215848	22 43.0	+54 13	7.78	HCO	Lick	gB2:, not B8
HD 216411	22 47.6	+58 28	7.20		Lick	Sept. 2, '57 plate shows strong bright H $\alpha$ in this B1 Ia star SB MWC 1074
+63 <sup>o</sup> 1907	22 52.5	+63 56	9.10		Lick	Sept. 20, '58 plate shows moderately strong bright H $\alpha$ in this B1 Ia star
HD 217401(A)	22 55.3	+13 29	8.22	HCO	Lick	Am ADS 16437(A)
HD 217602	22 56.8	+15 25	8.24	HCO	Lick	Am
2 Cas	23 5.5	+58 47	5.70	Washburn	Michigan	sharp H lines and a very large Balmer jump, but probably not a normal mid-A supergiant; perhaps in a post-red-giant stage ADS 16556(A)
HD 218998	23 7.4	+51 10	9.2	Michigan	McDonald	Ap Sr-Cr-Eu
$\chi$ Aqr	23 11.7	- 8 16	4.90-5.06		W&S	ZrO strong enough to be called MS
HR 8873	23 14.6	+34 15	6.32	DAO	Michigan	somewhat strong Si II
HD 220582	23 19.8	+24 57	7.2		Lick	Aug. 17, '58 plate shows a moderately weak H $\alpha$ self-reversal MWC 661
74 Peg	23 32.6	+16 16	6.26	DAO	Michigan	Am: SB P=11.23 d.
HD 222841	23 39.0	+45 23	8.9	HCO	Lick	Ap Si
HR 9005	23 41.8	+66 13	5.95	DAO		strong He
HD 223247	23 42.8	+27 50	8.2	Michigan	Michigan	$\delta$ Del
HD 225093	23 58.3	+72 36	7.5		Lick	mild early Am SB2
HD 225114	23 58.5	+69 45	8.0	HCO	Lick	Ap Si-Cr