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The apparent magnitudes m_{pg} and the spectral types were taken from Binnendijk's[4] paper; the spectral types have been determined by Morgan. A least-squares solution gave

$$m_{pg} = -0^{m}.65\,(n_m - 10) + 9^{m}.27\,. \quad (1)$$

For B4–B9 stars distributed over nearly the whole northern sky,

$$M_v = -0^{m}.64\,(n_m - 10) + 4^{m}.28 \quad (2)$$

has been found.[2] The scope of both curves is the same, the difference $m - M = +5^{m}.10$ (corrected with the mean color index $-0^{m}.11$ of the 10 stars) allows us either to correct the zero point of equation (2) or to find a spectroscopic parallax of the Pleiades. Taken as a distance modulus, it yields $\pi = 0''.010$. Binnendijk has found from a discussion of all available parallax determinations (trigonometric, dynamical, proper-motion, dark-material, spectrum-magnitude) that $\pi = 0''.010 \pm 0''.003$, and Gratton,[5] from a similar discussion, adopted $\pi = 0''.0098 \pm 0''.0007$. These are the same values as result from our $m - M$. The good agreement is considered as a confirmation of the zero point of equation (2).

TABLE 1

Star	m_{pg}	Sp.	Last H Line	Star	m_{pg}	Sp.	Last H Line
16 Tauri	5.33	B8	$H16$	21 Tauri	5.65	B8	$H16$
17 Tauri	3.52	B6	$H19$	23 Tauri	4.04	B6	$H18$
18 Tauri	5.50	B8	$H16$	25 Tauri	2.74	B7	$H20$
19 Tauri	4.10	B6	$H17.5$*	He 722	5.29	B8	$H16$
20 Tauri	3.73	B7	$H19$	27 Tauri	3.46	B8	$H19$

* Since the existence of $H18$ is doubtful, $H17.5$ was used in the calculation.

The influence of line broadening by rotation on the quantum number of the last line has been neglected. Formerly, no certain influence could be discovered.[2] It seems to be certain that stellar rotation of about 100 or 200 km/sec results in a reduction of the quantum number of considerably less than 1 for stars with not extraordinarily high last-line numbers.

G. R. Miczaika

Heidelberg Observatory
April 14, 1950

REVISED STANDARDS FOR SUPERGIANTS ON THE SYSTEM OF THE YERKES SPECTRAL ATLAS

In order to define with precision an empirical system such as the Yerkes spectral classification,[1] it is necessary to give types for a considerable number of stars; in fact, the accuracy of such a system can be said to depend on the number of standards available.

[4] *Ann. Sterrew. Leiden*, **19**, 2, 1946.

[5] *Zs. f. Ap.*, **15**, 46, 1938.

[1] W. W. Morgan, P. C. Keenan, and Edith Kellman, *An Atlas of Stellar Spectra* (Chicago: University of Chicago Press, 1943).

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TABLE 1

STANDARD STARS

Star	α (1900)	δ (1900)	Sp.	m_{vis}	Star	α (1900)	δ (1900)	Sp.	m_{vis}
195592	20h27m2	+43° 59′	O9 I	7.15	13 Mon	6h27m5	+ 7° 24′	A0 Ib	4.50
218915	23 6.7	+52 31	O9 I	7.06	η Leo	10 1.9	+17 15	A0 Ib	3.58
ι Ori	5 30.5	− 5 59	O9 III	2.87	HR 618	2 1.7	+57 57	A1 Ia	5.90
α Cam	4 44.1	+66 10	O9.5 Ia	4.38	14433	2 14.8	+56 47	A1 Ia	6.54
ζ Ori	5 35.7	− 2 0	O9.5 Ib	2.05	16778	2 36.3	+59 24	A2 Ia	7.71
19 Cep	22 2.1	+61 48	O9.5 Ib	5.17	HR 7573	19 47.8	+24 44	A2 Ia	5.67
47432	6 33.5	+ 1 42	O9.5 III	6.13	α Cyg	20 38.0	+44 55	A2 Ia	1.33
ε Ori	5 31.1	− 1 16	B0 Ia	1.75	ν Cep	21 42.6	+60 40	A2 Ia	4.46
15 Sgr	18 9.3	−20 45	B0 Ia	5.42	9 Per	2 15.4	+55 23	A2 Ib	5.22
194839	20 22.8	+41 3	B0 Ia	7.45	HR 8345	21 45.6	+40 41	A2 Ib	6.49
205196	21 28.6	+57 4	B0 Ib	7.36	213470-1	22 26.5	+56 43	A3 Ia	6.73
48434	6 38.3	+ 4 2	B0 III	5.78	HR 641	2 6.6	+58 6	A3 Ib	6.50
κ Ori	5 43.0	− 9 42	B0.5 Ia	2.20	HR 8443	22 3.7	+52 49	A3 Ib	6.50
6675	1 2.4	+69 10	B0.5 Ib	7.1	HR 825	2 42.1	+56 40	A5 Ia	6.53
187459	19 45.0	+33 12	B0.5 Ib	6.35	164514	17 56.4	−22 54	A5 Ia	7.28
κ Aql	19 31.5	− 7 15	B0.5 III	5.04	HR 2874	7 25.6	−22 49	A5 Ib	4.80
κ Cas	0 27.3	+62 23	B1 Ia	4.24	19 Aur	5 13.4	+33 51	A5 II	5.16
216411	22 47.6	+58 28	B1 Ia	7.16	φ Cas	1 13.8	+57 42	F0 Ia	5.25
ζ Per	3 47.8	+31 35	B1 Ib	2.91	α Lep	5 28.3	−17 54	F0 Ib	2.69
ρ Leo	10 27.5	+ 9 49	B1 Ib	3.85	ι1 Sco	17 40.6	−40 5	F2 Ia	3.14
ο Per	3 38.0	+31 58	B1 III	3.94	89 Her	17 51.4	+26 4	F2 Ia	5.48
10 Per	2 18.2	+56 9	B2 Ia	6.24	ν Aql	19 21.4	+ 0 8	F2 Ib	4.86
χ2 Ori	5 58.0	+20 8	B2 Ia	4.71	HR 7055	18 41.2	−10 14	F2 Ib–II	5.81
9 Cep	21 35.2	+61 38	B2 Ib	4.87	22 And	0 5.1	+45 31	F2 II	5.08
ε CMa	6 54.7	−28 50	B2 II	1.63	ν Her	17 54.7	+30 12	F2 II	4.48
14134	2 12.1	+56 40	B3 Ia	6.66	44 Cyg	20 27.2	+36 36	F5 Ia	6.30
ο2 CMa	6 58.8	−23 41	B3 Ia	3.12	α Per	3 17.2	+49 30	F5 Ib	1.90
55 Cyg	20 45.5	+45 45	B3 Ia	4.89	35 Cyg	20 14.8	+34 40	F5 Ib	5.18
χ Aur	5 26.2	+32 7	B3 Ib	4.88	ν Per	3 38.4	+42 16	F5 II	3.93
9 Gem	6 10.9	+23 46	B3 Ib	6.26	41 Cyg	20 25.3	+30 2	F5 II	4.09
ι CMa	6 51.7	−16 55	B3 II	4.39	HR 690	2 16.9	+54 55	F7 Ib	6.46
5 Per	2 4.5	+57 10	B5 Ia	6.36	45 Dra	18 30.9	+56 58	F7 Ib	4.95
η CMa	7 20.1	−29 6	B5 Ia	2.43	δ CMa	7 4.3	−26 14	F8 Ia	1.98
167838	18 11.9	−15 28	B5 Ia	6.64	γ Cyg	20 18.6	+39 56	F8 Ib	2.32
67 Oph	17 55.6	+ 2 56	B5 Ib	3.92	HR 2974	7 37.0	−31 26	G0 Ia	6.64
15497	2 24.6	+57 15	B6 Ia	7.20	HR 8752	22 55.9	+56 25	G0 Ia	5.48
183143	19 23.0	+18 5	B7 Ia	6.93	HR 207	0 40.9	+59 2	G0 Ib	6.49
14322	2 13.8	+55 27	B8 Ia	6.84	μ Per	4 7.6	+48 9	G0 Ib	4.28
14542	2 15.9	+56 56	B8 Ia	6.95	β Cam	4 54.5	+60 18	G0 Ib	4.22
β Ori	5 9.7	− 8 19	B8 Ia	0.34	β Aqr	21 26.3	− 6 1	G0 Ib	3.07
53 Cas	1 55.6	+63 54	B8 Ib	5.62	ε Leo	9 40.2	+24 14	G0 II	3.12
13 Cep	21 51.5	+56 8	B8 Ib	6.01	83 Vir	13 39.1	−15 41	G0 II	5.71
HR 1035	3 21.0	+59 36	B9 Ia	4.42	α Sge	19 35.6	+17 47	G0 II	4.37
σ Cyg	21 13.5	+38 59	B9 Ia	4.28	104 Aqr	23 36.6	−18 22	G0 II	4.95
4 Lac	22 20.5	+48 58	B9 Iab	4.64	ζ Mon	8 3.6	− 2 42	G2 Ib	4.41
HR 1804	5 20.7	+30 7	B9 Ib	5.72	HR 3459	8 38.8	− 6 52	G2 Ib	4.70
172324	18 34.5	+37 21	B9 Ib	8.0	22 Vul	20 11.2	+23 12	G2 Ib	5.38
43836	6 13.3	+23 19	B9 II	7.03	α Aqr	22 0.7	− 0 48	G2 Ib	3.19
HR 964	3 8.1	+56 46	A0 Ia	5.92	ξ Pup	7 45.1	−24 37	G3 Ib	3.47
HR 1040	3 21.9	+58 32	A0 Ia	4.76	α1 Cap	20 12.1	−12 49	G3 Ib	4.55

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TABLE 1—*Continued*

Star	α (1900)	δ (1900)	Sp.	m_{vis}	Star	α (1900)	δ (1900)	Sp	m_{vis}
HR 8692...	22h45m9	+50° 9′	G4 I*b*	6.43	π^6 Ori.....	4h53m4	+ 1° 34′	K2 II	4.73
25 Gem....	6 35.0	+28 17	G5 I*b*	6.54	56 Ori.....	5 47.2	+ 1 50	K2 II	5.01
9 Peg.....	21 39.8	+16 53	G5 I*b*	4.52	o^1 CMa....	6 50.0	−24 4	K3 I*ab*	4.12
ω Gem.....	6 56.3	+24 21	G5 II	5.21	η Per.....	2 43.4	+55 29	K3 I*b*	3.93
β Sct.....	18 41.9	− 4 51	G5 II	4.47	ι Aur.....	4 50.5	+33 0	K3 II	2.90
AX Sgr....	18 2.6	−18 34	G8 I*a*	8.0–9.0*	π Her.....	17 11.6	+36 55	K3 II	3.36
RW Cep...	22 19.4	+55 28	G8 I*a*	6.8–7.5	γ Aql.....	19 41.5	+10 22	K3 II	2.80
ε Gem.....	6 37.8	+25 14	G8 I*b*	3.18	ψ^1 Aur.....	6 17.2	+49 20	K5 I*ab*	5.10
56 UMa....	11 17.3	+44 2	G8 II	5.06	ξ Cyg	21 1.3	+43 32	K5 I*b*	3.92
ζ Cyg	21 8.7	+29 49	G8 II	3.40	HR 8726...	22 52.1	+49 12	K5 I*b*	5.10
θ Lyr.....	19 12.9	+37 57	K0 II	4.46	6 Gem†....	6 6.3	+22 56	M1 I*a*	6.30
ζ Cep.....	22 7.4	+57 42	K1 I*b*	3.62	μ Cep†.....	21 40.4	+58 19	M2 I*a*	4.0–4.8
HR 2334...	6 22.1	+ 0 22	K1 II	5.29	α Ori†.....	5 49.8	+ 7 23	M2 I*ab*	0.1–1.2
θ Her.....	17 52.8	+37 16	K1 II	3.99	119 Tau†...	5 26.3	+18 31	M2 I*b*	4.73
ε Peg.....	21 39.3	+ 9 25	K2 I*b*	2.54					

* Photographic magnitude.

† Spectral types of the M supergiants may vary slightly.

In this respect the Yerkes spectral atlas leaves something to be desired, since at certain seasons of the year it is not always possible to find suitable standards. In addition, there has been a gain in accuracy effected during the last seven years; in the case of the supergiants especially, the number of significant subdivisions recognizable has increased considerably; for example, the B stars of luminosity class I can now be separated with ease into groups of higher and lower luminosity.

The revised standards are listed in Table 1. Numbers without prefixes are from the *Henry Draper Catalogue*. The description of the luminosity classes is similar to that given in the spectral atlas.

The only star for which a considerable change in type has been made is RW Cep. The type is uncertain because of the extreme range in excitation of the lines present. We have placed it and the similar spectrum of AX Sgr at G8 I*a;* there are certain criteria which suggest a type of K rather than G, and Dr. Philip Keenan is of the opinion that class K is to be preferred; the star is definitely not of class M, as given in the spectral atlas.

Omissions from the present list include ε Aur, ρ Cas, and ζ Cap, all of which have been omitted because of spectral peculiarities, and α Sco, whose spectrum can be seriously affected by its blue companion in the region of H and K.

We are greatly indebted to Dr. W. P. Bidelman for placing a number of excellent spectrograms at our disposal and for allowing us to include in the table several stars now being discussed by him. We have also had the advantage of a number of discussions with Dr. Keenan.

W. W. Morgan
Nancy G. Roman

Yerkes Observatory
July 2, 1950

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