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PARALLAXES OF STARS DETERMINED FROM SPECTRAL CLASS AND
PROPER MOTION

In continuation of the lists published in *Lick Observatory Bulletin* No. 339 we give here two more lists of parallaxes determined from spectral class and proper motion. As the procedure is exactly the same as that followed previously it need not be described here.

THIRD LIST: THE PARALLAXES OF 64 STARS WITH
LARGE PROPER MOTION

The present list contains only stars with proper motions exceeding 0".50 annually (see *Lick Obs. Bull.*, 11, 1, 1923) for which parallaxes have not previously been published. The agreement between the spectral-class and proper-motion parallaxes is not so good as for the first list, and the differences have more of a systematic character, the proper-motion parallaxes generally being the larger. This systematic difference seems to vary both with apparent magnitude and with spectral class. Thus, from F to K the mean difference $M_H - M_s$ decreases from $+2^m.4$ to $+0^m.1$ and from apparent magnitude 7^m.0 to 10^m.0 it increases from $+0^m.6$ to $+1^m.5$.

Among the several possible explanations are the following:

(a) Systematic errors are possible in the spectral classification of faint F and G stars.

(b) Systematic errors may exist in the reduction curve from H to M.

(c) It is possible that absolutely faint F and G stars do exist, thus introducing systematic errors into the mean M.

Attention may be called to the three white stars CPD-48°1280, -47°7499, and -40°7356, for all of which a fairly large parallax is expected from the proper motion.

The results are collected in Table I, the first six columns of which need no further explanation. The seventh column contains the quantity $m+5+5 \log \mu$ for which the symbol H is used. Next are the parallaxes derived from spectral class and from proper motion, while the last column contains the adopted parallax. For this adopted parallax the geometrical mean has again been taken after assigning double weight to the spectral class parallax.

TABLE I

Star	m	Sp	δ	1900.0	δ	μ	H	π_s	π_H	π
CPD -68° 3597	8 ^m .7	K0	0 ^h	0 ^m .3	-68° 22'	0".53	12 ^m .3	0".033	0".038	0".035
CPD -38° 14	9.1	K5		11.1	-38 7	1.00	14.1	55	72	60
Cord B 118	7.8	G5		19.3	-27 35	0.67	11.9	30	40	33
Cord A 389	7.2	G5		44.5	-23 46	0.52	10.8	40	40	40
Cord B 315	7.2	G5		48.1	-30 54	0.63	11.2	40	44	41
Chri 174	9.4	K		50.4	+68 30	0.76	13.8	36	34	35
Lpz I 259	9.0	F2		54.5	+14 4	0.55	12.7	6	22	9
Gou 992	7.8	G0	1	0.1	-40 1	0.59	11.6	22	32	25
Cord A 869	8.9	K5		48.0	-22 56	0.86	13.6	60	53	58
Gou 1990	7.3	G0		56.3	-41 12	0.58	11.1	28	35	30

TABLE I—Continued

Star	m	Sp	δ	1900.0	δ	μ	H	π_s	π_H	π
Gou 2201	6.3	G5	2 ^h	6 ^m 4	—51° 19'	2 ^s 23	13 ^m 0	0 ^s 050	0 ^s 100	0 ^s 063
Cord B 1044	8.1	G0		36.3	—30 34	0.60	12.0	19	32	23
Gou 4141	7.0	F8	3	40.2	—50 58	0.52	10.6	28	35	30
Gou 4297	8.4	K0		47.2	—42 53	0.62	12.4	36	41	38
Gou 5173	7.8	G0	4	30.1	—68 6	0.50	11.3	22	30	24
C P D —65° 361	9.6	G0		37.6	—65 39	1.47	15.0	10	33	15
Nic 1360	8.4	G5	5	26.6	+ 0 2	0.51	11.9	23	30	25
Alb 1860	8.8	K0		37.5	+ 2 39	0.54	12.5	30	34	31
Gou 6886	8.3	G0		45.7	—70 13	1.26	13.8	17	48	24
Gou 7009	6.5	K0		51.7	—50 23	0.60	10.4	87	69	82
C P D —69° 757	8.3	F0	7	38.4	—69 50	0.61	12.2	6	24	10
C P D —48° 1280	9.2	A3		43.8	—48 39	0.50	12.7		32	32
Cord B 4791	6.9	G0	8	2.9	—29 6	0.55	10.6	33	36	34
Gou 15615	7.4	K5	11	20.3	—61 6	0.51	11.0	120	100	113
C P D —43 5524	7.4	K5		36.2	—43 52	0.72	11.7	120	109	116
Be C 1671	8.2	G5	12	17.9	+73 48	0.51	11.7	25	33	27
C P D —77° 859	9.0	K5		33.6	—77 18	0.83	13.6	58	58	58
La Plata I 3869	8.3	G0		46.6	—56 1	0.60	12.2	17	30	21
Nic 3508	9.5	K2		55.2	— 2 10	0.73	13.8	26	34	29
C P D —40° 6050	9.2	G5	13	3.0	—41 6	0.69	13.4	16	33	20
B D +4° 2696	9.5	G		3.2	+ 4 19	0.54	13.2	12	25	15
C P D —34 5560	7.6	F5		7.0	—34 13	0.51	11.1	15	29	19
B D —7° 3632	9.6	F8		25.1	— 8 3	1.19	15.0	8	36	13
Cord B 8592	9.6	G0		27.8	—27 10	0.52	13.2	10	23	13
Gou 18442	7.4	G5		27.9	—59 0	0.51	10.9	36	38	36
Gou 18463	7.1	G0		28.7	—38 23	0.50	10.6	30	33	31
La Plata I 4383	7.7	G0		45.1	—56 56	0.61	11.6	23	33	26
Gou 18837	7.5	G5		46.3	—50 26	0.65	11.6	35	44	38
C P D —63° 3218	9.0	K0	14	13.0	—64 0	0.51	12.5	26	32	28
B D —7° 3856	9.3	K5		25.6	— 8 12	1.26	14.8	50	50	50
Lu 6145	8.2	G5		26.7	+35 53	0.51	11.7	25	32	27
C P D —47° 7499	9.5	B9	15	50.2	—47 21	0.85	14.1		52	52
C P D —40° 7356	10.1	A0	16	25.5	—40 6	1.05	15.2		66	66
Gou 23312	7.0	G0	17	9.2	—75 14	0.98	12.0	32	55	38
Gou 23548	7.6	F5		17.8	—41 24	0.59	11.5	15	33	20
Lu 7228	8.6	G0		36.2	+37 16	0.94	13.5	15	38	20
Alb 5924	9.0	K0		42.8	+ 4 59	0.70	13.2	28	36	30
C P D —56° 9037	8.7	K5	18	49.2	—56 6	0.50	12.2	66	52	61
B D —20° 5385	9.4	G0		58.0	—20 35	0.70	13.7	10	29	14
B D —0° 3676	9.3	G0	19	8.2	— 0 45	0.53	12.9	11	24	14
C P D —45° 9704	9.1	F8		16.5	—45 15	0.81	13.6	10	30	14
Alb 6750	10.5	K5		29.6	+ 4 21	0.58	14.3	29	31	30
Harv II 7019	9.1	K5		51.8	—12 49	0.51	12.6	55	44	51
Harv II 7042	7.6	G0		55.5	—12 31	0.50	11.1	24	30	26
δ Pavonis	3.6	G5		58.9	—66 26	1.63	9.7	209	166	193
Lpz II 10245	9.0	F2	20	33.7	+ 5 18	0.90	13.8	6	29	10
Gou 28703	6.6	G0		51.0	—44 29	1.14	11.9	38	63	45
C P D —34° 8843	8.7	F5		55.9	—34 27	1.31	14.3	9	42	15
Gou 29168	6.7	G0	21	10.8	—61 46	0.62	10.7	36	42	38
Gou 29865	7.3	G0		45.6	—73 54	0.52	10.9	28	35	30
C P D —51° 11806	9.1	G5	22	16.3	—51 17	1.58	15.1	17	50	24
La Plata I 7174	7.8	G0		29.8	—55 7	0.51	11.3	22	30	24
C P D —67° 3959	9.2	K0	23	11.0	—67 28	0.50	12.7	25	30	27
B D —8° 6177	9.7	G0		38.3	— 8 27	0.64	13.7	9	25	13

FOURTH LIST: THE PARALLAXES OF 185 CLASS A STARS

The material for this list consists of all Class A stars (B8 to A5) for which radial velocities have been given in *Publ. Domin. Astroph. Obs.*, **2**, 1, 1922. A trigonometric parallax is known in only 5 cases.

For the derivation of the spectral parallax the data given in *Publ. A. S. P.* **34**, 147, 1922, were used, except that for silicon stars and stars with moderately strong metallic lines the value $M=0^m0$, and for c -stars $M=-1^m4$ was adopted. If the spectral class given by Plaskett differs from the Henry Draper estimate an

absolute magnitude corresponding to the mean has been adopted; e.g. Boss 192, A0 and F2, mean

$$M = \frac{1^m2 + 2^m9}{2} = 2^m1. \text{ For the proper-motion parallax}$$

the regression curve given in *Publ. A. S. P.*, **34**, 156, 1922, was used.

The results are collected in Table II which is arranged in exactly the same way as Table I except for the last column where the geometrical mean is now taken after assigning *equal* weights to the spectral- and proper-motion parallax.

TABLE II

Star	m	Sp	δ	1900.0	δ	μ	H	π_s	π_H	π
23 Andromedae	5 ^m 73	A5	0 ^h	8 ^m 3	+40° 29'	0 ^s 195	7 ^m 2	0 ^s 020	0 ^s 014	0 ^s 017
Boss 87	5.92	B9		24.8	+59 25	047	4.3	11	12	12
λ Cassiopeiae	4.88	B8		26.2	+53 59	048	3.3	16	13	14
Boss 119	5.76	A3		30.8	+59 47	016	1.8	4	4	4
Boss 140	5.98	A5		36.3	+24 5	108	6.2	19	26	22
Boss 180	6.12	A0		44.7	+44 27	070	5.3	10	17	14
Boss 192	6.22	A0		48.0	+52 9	091	6.0	15	23	10
Boss 208	6.00	B9		52.2	+65 49	046	4.3	11	11	11
ψ^1 Piscium pr.	5.55	A2	1	0.3	+20 56	055	4.2	15	14	15
ψ^1 Piscium seq.	5.82	A0		0.3	+20 56	046	4.1	12	12	12
43 Andromedae	5.16	A2		1.2	+43 24	177	6.4	18	26	22
ψ^2 Piscium	5.63	A2		2.6	+20 12	125	6.1	15	22	18
35 Cassiopeiae	6.32	A0		14.4	+64 8	061	5.2	10	15	12
47 Andromedae	5.53	A0		17.9	+37 12	075	4.9	14	19	16
ω Cassiopeiae	5.54	A0		34.9	+67 32	056	4.2	8	14	11
Boss 440	5.18	A0		52.2	+64 8	049	3.6	16	13	14
Boss 447	6.14	A2		54.1	+11 49	035	3.8	12	9	10
63 Andromedae	5.56	A0	2	14.4	+49 42	050	4.1	8	13	10
Boss 533	6.54	A2		14.9	+56 47	011	1.7	5	3	4
Boss 573	6.51	A2		26.5	+51 52	010	1.5	10	3	5
μ Arietis	5.72	A0		36.7	+19 35	056	4.4	12	14	13
Boss 636	5.87	A0		43.0	+24 47	069	5.1	12	17	14
41 Arietis	3.68	B8		44.1	+26 51	132	4.3	28	33	30
π Persei	4.62	A2		52.4	+39 16	063	3.6	24	18	21
Boss 687	5.95	A2		56.2	+81 5	046	4.2	13	11	12
Boss 774	5.64	A0	3	18.2	+33 11	044	3.8	13	11	12
Boss 781	4.42	B9		21.0	+59 36	004	-2.6	7	1	3
Boss 799	6.41	A0		24.2	+73 0	035	4.1	9	9	9
7 Tauri	5.92	A2		28.5	+24 7	032	3.5	7	8	8
Boss 850	5.40	A0		38.8	+70 34	070	4.6	16	17	16
Boss 853	5.64	B9		39.0	+45 22	036	3.4	8	10	9
Boss 883	5.38	A3		44.3	+25 17	115	5.7	18	28	22
31 Tauri	5.62	B9		46.6	+ 6 15	007	-0.2	10	2	5
Boss 925	5.68	B8		56.4	+ 9 43	006	-0.4	12	2	5
Boss 969	5.64	B8	4	8.1	+61 36	026	2.7	11	7	9
Boss 1040	5.74	A5		22.1	+21 24	118	6.1	20	30	24
81 Tauri	5.49	A5		24.9	+15 29	110	5.7	22	27	24
Boss 1068	5.70	B9		28.4	+28 46	023	2.5	12	6	8
Boss 1114	5.35	A3		38.9	+10 58	098	5.4	19	25	21
5 Camelopard.	5.58	A0		46.9	+55 6	007	-0.2	8	2	4
18 Orionis	5.50	A0	5	10.5	+11 14	013	1.1	4	4	4
Boss 1260	5.39	A0		12.4	+33 39	046	3.7	8	12	10
Boss 1369	5.70	B8		30.9	+26 52	033	3.3	17	9	12
26 Aurigae	5.49	A2		32.2	+30 26	016	1.5	25	8	14
Boss 1383	5.70	B8		32.6	+ 7 29	026	2.8	11	7	9

TABLE II—Continued

Star	m	Sp	δ	1900.0	δ	μ	H	π_S	π_H	π
28 Camelopard.	6 ^m 79	A0	5 ^h	38 ^m 4	+56° 53'	0 ^s 045	5 ^m 1	0 ^s 09	0 ^s 011	0 ^s 011
137 Tauri	5.57	B9		46.7	+14 9	017	1.8	8	5	6
54 Orionis	6.56	B9		47.4	+20 17			8		8
35 Camelopard.	6.30	A5		56.6	+51 35	046	4.6	15	12	13
68 Orionis	5.70	B9	6	6.0	+19 49	015	1.6	12	4	7
Boss 1647	5.08	A2		26.2	+11 36	043	3.3	19	12	15
49 Aurigae	5.05	A0		29.0	+28 6	024	2.0	17	6	10
53 Aurigae	5.54	A0		32.1	+29 4	030	2.9	8	8	8
ψ Aurigae	4.80	A2		50.4	+45 14	025	1.8	22	7	12
Boss 1852	6.20	B9	7	6.4	+81 26	029	3.5	6	8	7
49 Geminorum	6.89	A0		6.7	+25 55	018	3.2	7	5	6
Boss 1859	6.66	B9		8.4	+24 53	016	2.7	2	4	4
Boss 1879	4.80	A2		10.9	+49 38	009	-0.4	22	3	8
η Canis Minoris	5.34	A5		22.6	+ 7 9	045	3.6	9	12	10
7 Canis Minoris	5.26	A5		26.9	+ 2 8	013	0.9	24	4	10
24 Lyncis	4.96	A2		34.5	+58 57	068	4.2	20	17	18
Boss 2027	6.84	A5		37.9	+24 29	042	4.9	12	11	11
ξ Canis Minoris	5.11	B8		46.5	+ 2 1	025	2.1	10	7	8
Boss 2206	5.87	A0	8	14.6	+24 20	034	3.6	12	9	10
Boss 2210	5.58	A2		16.2	+53 22	113	5.9	17	29	21
24 Cancri	7.10	A3		20.7	+24 52	095	7.0	8	22	13
29 Cancri	5.90	A2		23.0	+14 33	022	2.6	14	6	9
33 Lyncis	5.83	A2		28.3	+36 46	057	4.6	15	14	14
37 Cancri	6.48	A0		32.7	+ 9 56	042	4.6	9	11	10
40 Cancri	6.52	A0		34.4	+20 19	036	4.3	5	9	7
41 Cancri	6.32	A2		34.7	+19 54	036	4.1	11	10	10
42 Cancri	6.72	A5		35.0	+20 4	021	3.3	13	6	9
59 Cancri	5.48	A3		50.8	+33 18	098	5.5	17	25	20
63 Cancri	5.64	A5		52.0	+15 58	064	4.6	21	16	18
Boss 2494 pr.	6.4	A5	9	12.3	+35 47	058	5.2	14	15	14
Boss 2494 seq.	6.6	A5		12.3	+35 47	058	5.4	13	15	14
7 Leonis	6.21	A0		30.5	+14 49	042	4.3	10	11	10
22g Leonis	5.33	A2		46.3	+24 52	194	6.8	24	38	30
23 Leo. Min.	5.35	A0	10	10.6	+29 48	074	4.7	15	19	17
42 Leonis	6.10	B9		16.5	+15 29	049	4.6	10	13	11
53 Leonis	5.27	A0		44.0	+11 4	033	2.9	15	9	12
69 Leonis	5.40	A0	11	8.7	+ 0 29	040	3.4	14	10	12
Boss 2993	5.98	A0		16.9	+64 53	036	3.8	11	10	10
Boss 3027	6.13	A0		24.8	+81 41	146	6.9	11	35	20
Boss 3072	6.10	A0		35.0	+58 31	020	2.6	10	5	7
7 Virginis	5.24	A0		54.8	+ 4 13	024	2.1	7	7	7
3 Comae	6.34	A0	12	5.5	+17 22	013	1.9	6	4	5
Boss 3198	5.68	A0		12.5	+29 30	055	4.4	13	14	13
5 Draconis	5.41	A2		14.4	+75 43	026	2.5	17	7	11
Boss 3354	5.81	A0		48.3	+83 58	028	3.0	12	7	9
32 Camelopard.	5.28	A2		48.4	+83 57	032	2.8	18	8	12
14 Can. Venat.	5.11	B9	13	1.1	+36 20	027	2.3	16	12	14
Boss 3459	5.68	A0		16.7	+ 2 37	086	5.4	13	22	17
Boss 3494	5.41	A0		24.8	+60 28	091	5.2	14	23	18
81 Urs. Maj.	5.48	A0		30.3	+55 52	020	2.0	8	5	6
84 Urs. Maj.	5.53	A0		42.9	+54 56	015	1.4	4	4	4
Boss 3591	5.84	A5		48.7	+29 8	119	6.2	19	30	24
86 Urs. Maj.	5.65	A0		50.1	+54 13	026	2.7	13	7	10
3 Ursae Min.	6.34	A3	14	6.2	+75 4	056	5.0	12	14	13
κ Bootis	6.75	A5		9.9	+52 16	065	5.8	12	16	14

TABLE II—Continued

Star	m	Sp	δ	1900.0	δ	μ	H	π_s	π_H	π
Boss 3674	6 ^m 09	A0	14 ^h	13 ^m 8	+51° 46'	0 ^s 025	3 ^m 1	0 ^s 006	0 ^s 007	0 ^s 006
Boss 3730	6.57	A0		30.4	+47 13	038	4.5	10	10	10
108 Virginis	5.54	B9		40.4	+ 1 9	042	3.6	13	11	12
47 Bootis	5.59	A0	15	2.2	+48 32	064	4.6	8	16	11
Boss 3911	5.52	A3		17.2	+52 17	017	1.7	17	5	9
Boss 3984	6.75	A2		34.9	+43 56	004	-0.2	9	1	3
Boss 4004	5.48	A0		40.2	+52 40	062	4.5	8	16	11
ν Serpentis	5.72	A0		42.7	+14 25	061	4.6	13	15	14
45 Serpentis	5.63	A5	16	2.9	+10 10	029	2.9	21	8	13
8 Hercules	6.07	A0		4.2	+17 30	047	4.5	10	12	11
Boss 4113	5.40	A0		6.0	+68 4	068	4.6	14	17	15
19 Ursae Minoris	5.51	B8		13.7	+76 8	009	0.3	12	3	6
Boss 4160	5.98	A0		16.2	+73 38	025	3.0	6	7	6
23 Hercules	6.20	A2		19.1	+32 34	022	2.9	11	6	8
25 Hercules	5.53	A3		21.9	+37 37	026	2.6	17	7	11
Boss 4187	5.66	A2		22.2	+55 26	023	2.5	7	6	6
34 Hercules	6.22	A2		27.4	+49 10	084	5.8	12	21	16
Boss 4214	5.55	A0		28.8	+45 50	028	2.8	13	7	10
σ Hercules	4.25	A0		30.9	+42 39	037	2.1	25	10	16
Boss 4223	5.54	A3		31.3	+79 11	154	6.4	17	36	25
Boss 4263	6.18	A2		40.9	+55 53	091	6.0	6	22	12
Boss 4276	5.95	A0		45.0	+13 26	038	3.8	11	10	10
Boss 4349	6.36	A0	17	2.0	+43 57	017	2.6	5	5	5
Boss 4358	5.38	A5		4.5	+36 4	030	2.8	8	8	8
Boss 4359	6.27	A2		4.5	+40 39	040	4.3	6	10	8
63 Hercules	6.19	A3		6.9	+24 21	021	2.8	13	6	9
Boss 4382	5.47	A3		11.7	+62 59	047	3.9	17	13	15
Boss 4401	5.32	A2		16.1	+25 37	027	2.5	9	8	8
73 Hercules	5.70	A3		19.9	+23 3	063	4.7	16	16	16
Boss 4428	5.16	A5		23.7	+ 0 25	066	4.3	25	17	21
77 x Hercules	5.81	A2		24.1	+48 21	015	1.5	14	4	7
Boss 4432	5.66	A2		24.4	+60 7	035	3.4	15	9	12
78 Hercules	5.58	A0		27.9	+28 29	026	2.7	13	7	10
53 Ophiuchi	5.77	A2		29.8	+ 9 39	017	2.0	7	5	6
79 Hercules	5.67	A0		33.4	+24 22	023	2.5	13	6	9
Boss 4484	6.97	A2		38.1	+41 42	017	3.2	8	5	6
30 Draconis	5.19	A2		46.7	+50 48	208	6.8	18	50	30
Boss 4543	6.88	B9		54.9	+43 26	013	2.5	7	4	5
Boss 4572	6.06	A0	18	0.5	+48 28	024	3.0	6	6	6
Boss 4587	6.00	A3		3.8	+26 15	030	3.4	13	8	10
24 Ursae Min	5.86	A3		7.8	+87 0	054	4.6	14	15	14
107 Hercules	5.05	A5		17.1	+28 49	046	3.3	27	12	18
Boss 4661	5.04	A2		20.9	+55 26	023	1.8	20	6	11
Boss 4730	5.60	A0		36.7	+62 26	032	3.1	4	8	6
46 Draconis	5.08	A0		40.7	+55 26	023	1.9	10	6	8
9 Lyrae	5.16	A2		46.2	+32 26	025	2.2	18	7	11
10 Aquilae	5.94	A3		54.2	+13 46	052	4.5	7	13	10
19 Lyrae	5.77	A0	19	7.9	+31 7	014	1.5	7	4	5
21 Aquilae	5.10	B8		8.7	+ 2 7	007	-0.7	5	2	3
22 Aquilae	5.40	A2		11.6	+ 4 40	017	1.6	8	5	6
Boss 4905	5.46	A0		11.9	+14 23	018	1.8	14	5	8
Boss 4939	6.24	A0		17.4	+54 12	038	4.1	9	10	10
Boss 4957	6.31	B9		20.8	+50 5	010	1.3	3	3	3
5 Vulpeculae	5.58	A0		21.9	+19 54	040	3.6	13	11	12
Boss 5035	6.20	A3		38.5	+40 1	031	3.7	13	8	10
ν Aquilae	5.72	A2		40.8	+ 7 22	055	4.4	14	14	14
Boss 5057	5.90	A0		44.4	+69 6	028	3.1	12	7	9
14 Sagittae	5.47	A0		58.9	+15 45	012	0.9	4	3	3
21 Vulpeculae	5.20	A3	20	10.2	+28 24	026	2.3	20	7	12
40 Cygni	5.45	A0		23.9	+38 7	073	4.8	13	19	16

TABLE II—Concluded

Star	m	Sp	δ	1900.0	δ	μ	H	π_S	π_H	π
Boss 5259	6 ^m 99	A0	20 ^h	26 ^m 5	+10° 57'	0 ^o 023	3 ^m 8	0 ^o 007	0 ^o 006	0 ^o 006
Boss 5260	6.39	A0		26.7	+10 55	004	-0.6	8	1	3
Boss 5264	5.87	B9		27.0	+55 44	016	1.9	11	4	7
Boss 5283	5.59	B9		30.6	+46 21	029	2.9	8	8	8
73 Draconis	5.18	A2		32.8	+74 37	016	1.2	5	4	4
13 Delphini	5.59	A0		42.8	+ 5 38	006	-0.5	8	2	4
56 Cygni	5.07	A5		46.6	+43 41	178	6.4	26	44	33
Boss 5442	5.57	A0	21	4.4	+29 48	027	2.8	13	7	10
Boss 5447	5.73	B9		7.1	+53 9	022	2.4	12	6	8
35 Vulpeculae	5.38	A0		23.3	+27 11	041	3.4	8	11	9
74 Cygni	5.09	A5		32.9	+39 58	009	-0.1	26	3	9
79 Cygni	5.62	A0		39.3	+37 50	038	3.5	13	10	11
27 Aquarii	5.50	A0		42.2	+ 2 14	014	1.2	8	4	6
Boss 5621	5.68	B9		46.9	+19 22	037	3.5	7	10	8
Boss 5630	5.76	A0		48.9	+19 13	019	2.2	12	5	8
Boss 5656	6.49	A0		56.0	+57 10	016	2.5	9	4	6
21 Pegasi	5.75	A0		58.4	+10 54	016	1.8	7	4	5
Boss 5722	6.36	B9	22	8.3	+71 37	031	3.9	5	8	6
Boss 5737	5.70	A0		10.5	+42 28	058	4.5	13	14	13
Boss 5815	5.80	A3		28.0	+39 16	019	2.2	15	5	9
Boss 5826	6.26	A0		30.4	+69 51	062	5.3	10	16	13
Boss 6032	6.74	A2	23	22.0	+70 8	053	5.3	9	13	11
69 Pegasi	5.87	A0		22.7	+24 37	053	4.5	7	13	10
79 Pegasi	5.91	A3		44.6	+28 17	074	5.2	7	18	11
Boss 6161	6.71	A0		54.8	+86 9	038	4.6	8	10	9

NOTES TO TABLE II

Boss 119	Instead of the Boss proper motion of 0 ^o 001, a value of 0 ^o 016, derived from 20 meridian observations was adopted. $M_S = -1^m.4$ as the spectrum resembles that of α Cygni.
Boss 636	Very faint silicon lines, therefore $M = +1^m.2$ was adopted.
41 Arietis	Miss Maury has VIac.
Boss 1383	May be a binary, no correction applied.
68 Orionis	Miss Maury has VIIab.
81 Urs. Maj.	Miss Maury has VIII P.
κ Bootis	Double star.
σ Herculis	Miss Maury has VIIb.
30 Draconis	The weighted mean of the Yale (0 ^o 019) and Allegheny (-0 ^o 004) parallaxes is 0 ^o 003. A strange case, as the proper motion seems to be very well established, and, were the trigonometric parallax correct, would lead to a linear motion of 350 km/sec. The radial velocity is -59.1 whereas the computed velocity (61 Cygni cluster) is -57.9 km/sec. It is thus made probable that the spectral parallax which accords best with the cluster parallax is nearest to the truth.
9 Lyrae	Miss Maury has IX.
21 Aquilae	"K and 4481 of hair line sharpness;" M may be -4 ^m .

The agreement between the two series of parallaxes can, on the whole, be regarded as satisfactory, for even in the worst case (Boss 3984, $\pi_S = 0^o.009$ $\pi_H = 0^o.001$) the discordance is not larger than occurs between two first-class modern photographic determinations.

The systematic difference between the two series leaves nothing to be desired, the mean difference in absolute magnitude taken in the sense $M_S - M_H$ being only +0^m.22, corresponding to only 11 per cent difference in the parallaxes.

In Table III a comparison is given with (a) the parallaxes determined by Adams by the spectrographic method; (b) the trigonometric values; and (c) parallaxes computed on the supposition that the stars belong to moving clusters.

TABLE III

Star	π_{H+S}	π_{AS}	π_{tr}	$\pi_{mv.cl.}$
λ Cassiopeiae	0 ^o 014			0 ^o 014 Perseus
35 Cassiopeiae	12			16 Perseus
63 Andromedae	10			12 Perseus
Boss 774	12			11 Perseus
7 Tauri	8		2	
Boss 853	9			9
Boss 1040	24	26		27 Hyades
81 Tauri	24	27		28 Hyades
Boss 1114	21	27		29 Hyades
5 Camelopardalis	4	12		
26 Aurigae	14	26		
40 Cancr	7	10		7 Praesepe
41 Cancr	10	17		7 Praesepe
42 Cancr	9	14		
Boss 2494	14	18		
7 Leonis	10	10		7 Praesepe
22 Leonis	30	24		

Star	π_{H+8}	π_{AS}	π_{tr}	$\pi_{mv.cl.}$
23 Leo. Min.	17	10		
3 Comae	5	8		
14 Canum Venat.	14	12		
η Bootis	14	16	28	
Boss 3911	9	16		
23 Herculis	8	8		
25 Herculis	11	13		
77 Herculis	7	12	18	
79 Herculis	9	10		
30 Draconis	30	16	3	13 61 Cygni
5 Vulpeculae	12	10		
40 Cygni	16	14		
56 Cygni	33		31	
79 Cygni	11	14		

It will be seen that the agreement with all three is entirely satisfactory as the differences are:

$$\pi_{\text{Adams}} - \pi_{S,H} = +0.0016 \text{ (24 stars)}$$

$$\pi_{\text{trig}} - \pi_{S,H} = -0.002 \text{ (5 stars only)}$$

The mean parallax for the five stars belonging to the *Perseus* cluster is 0".0114 whereas the computed value is 0".0124, in excellent agreement. For the *Hyades* these values are 0".024 and 0".028 respectively and for *Praesepe* 0".009 and 0".007 (Kohlschütter). For the last two clusters Adams's parallaxes give 0".027 and 0".012, respectively.

KNUT LUNDMARK.

September 2, 1922.

WILLEM LUYTEN.

ON THE RELATION OF MEAN PARALLAX TO PROPER MOTION AND APPARENT MAGNITUDE

THIRD PAPER

In two recent papers I have given new determinations of the formulae connecting mean parallax with proper motion and apparent magnitude. I have shown that the assumption:

$$m + 5 + 5 \log \pi = a + c (m + 5 + 5 \log \mu), \text{ or } M = a + cH$$

is not at variance with the facts, when a and c are made dependent on spectral class. This conclusion is supported by a comparison with formulae derived by other investigators.¹ The most recent general formula was derived by Kapteyn and van Rhijn² and reads:

$$\log \pi_{m,\mu} = -0.690 - 0.0713m + 0.645 \log \mu$$

$$\text{or: } M = -1.680 - 0.0015 m + 0.645 H.$$

The coefficient of m is too small to have any real significance and can safely be neglected.

From an investigation of stars with proper motions exceeding 0".50 annually the writer found the relation:

$$M = H - 5^m 58^s$$

Adams, Joy, Strömberg and Burwell⁴ also find a marked correlation between the absolute magnitudes of the Cepheids and the quantities $0.2m + \log \mu$. It may appear that this might have been expected beforehand as the v -components of the proper motions have been used for deriving the absolute magnitudes. However, this was only done to establish the *system*, whereas the *individual* absolute magnitudes were derived from spectral line intensities.

¹ v. Rhijn's dissertation, Groningen, 1915, formulae for A and B stars.

² *Mt. Wilson Contributions*, No. 188.

³ *Lick Obs. Bull.*, 11, 1, 1923.

⁴ *Mt. Wilson Contributions*, No. 199, p. 18.

Now that our assumption:

$$M = a + cH$$

appears to be substantially correct, it may be of interest to examine its relation to the fundamental laws of stellar statistics.

Starting from assumed forms for the density-, the velocity-, and the luminosity-law, Schwarzschild⁵ has, analytically, derived formulae for a large number of statistical parameters. His three fundamental assumptions are:

$$\text{Density: } D(r) = 10^{a_0 - a_1 r - a_2 r^2} \quad \rho = -5.0 \log r \quad (1)$$

$$\text{Luminosity: } \Phi(J) = 10^{b_0 - b_1 M - b_2 M^2} \quad M = -2.5 \log J \quad (2)$$

$$\text{Velocity: } \Psi(T) = 10^{c_0 - c_1 T - c_2 T^2} \quad G = -5.0 \log T \quad (3)$$

$$T = \text{tangential velocity} = \mu r.$$

He then finds:

$$\log \bar{\pi}_{m,\mu} = R_0 - R_1 m - R_2 g \dots \dots \dots (4)$$

where $g = +5.0 \log \mu$ and the coefficients R_0 , R_1 , R_2 are related to the nine fundamental constants by the equations:

$$R_0 = -0.1 \frac{a_1 + b_1 + c_1 + 1.1}{a_2 + b_2 + c_2},$$

$$R_1 = \frac{0.2 b_2}{a_2 + b_2 + c_2}, \quad R_2 = \frac{0.2 c_2}{a_2 + b_2 + c_2}.$$

Transforming our equation (4) to the form:

$$M = a + cH$$

⁵ *Astr. Nach.*, 190, 361, 1912.

we obtain:

$$M(\bar{\pi}) = (5 + 5R_0 - 25R_2) + (1 - 5R_1 - 5R_2)m \\ + 5R_2H \dots\dots\dots (5)$$

This $M(\bar{\pi})$ and the one derived from Kapteyn and van Rhijn's formula are computed from the arithmetical mean of the parallaxes whereas I have used the mean M or the M derived from the geometrical mean of the parallaxes. In order to find the relation between these two we make the supposition that "if π be the true parallax of a star and π_0 the most probable mean parallax of stars of the same magnitude and proper motion, the quantities

$$z = \log \frac{\pi}{\pi_0}$$

are distributed in accordance with the law of errors."⁶

The difference between the two absolute magnitudes mentioned above is then given by:

$$\frac{5}{h\sqrt{3.1416}} + 5 \log \left(e^{-\frac{1}{4 \text{ mod}^2 h^2}} \right)^7$$

where h is the measure of precision of the error curve

$z = \log \frac{\pi}{\pi_0}$ and has to be derived empirically. We know

$h = \frac{0.4769}{\rho}$ and for ρ we shall adopt the value 0.15.

Finally we have:

$$M(\overline{\log \pi}) - M(\bar{\pi}) = +0^m60.$$

This will affect only the constant a and leave the others unaltered. According to Kapteyn and van Rhijn's general, and my special formulae for different spectral classes, we must then have:

$$1 - 5(R_1 + R_2) = 0, \\ \text{or } a_2 = 0.$$

⁶ v. Rhijn's dissertation, p. 5.

⁷ cf. *Publ. A.S.P.*, **34**, 158, 1922.

This would lead to the conclusion that the density law is of the simple form:

$$D(r) = 10^{a_0 - a_1 \rho}$$

instead of the form given by (1), or, in any case, that the coefficient of ρ^2 is very small compared with the coefficients of the quadratic terms in Φ and Ψ . The relation $M = H - 5^m58$ found by me for stars with proper motion above a certain limit and therefore applicable to the stars in a limited volume of space round the Sun, leads to

$$1 - 5(R_1 + R_2) = 0$$

$$\text{and } 5R_2 = 1,$$

$$\text{or } a_2 = 0, b_2 = 0.$$

This would mean that the quadratic term disappears in the luminosity law as well as in the density law. For the density we cannot draw any further conclusions as it is well known that Schwarzschild's form leads to $D=0$ for $r=0$ and is therefore not valid for small distances. In this particular case we can safely put

$$D(r) = C.$$

For the other formulae, however, stars were used occupying regions in space where the density is *not* constant, and we therefore come to the conclusion that at least one of our three fundamental laws is not expressible in a simple exponential form. It is generally accepted that the luminosity curve closely resembles an error curve and the simplest assumption we can make is therefore that $\Psi(T)$ is not of the form adopted by Schwarzschild.

This has been found before from empirical data and the simplest form in which we can at present express $\Psi(T)$ with any accuracy is as the sum of two error curves.

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