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APPENDIX I: REPORT OF THE COMMITTEE ON SPECTROPHOTOMETRY

(Prepared by J. B. Oke, Chairman of the Committee)

There are two basic problems in spectrophotometry. One is the absolute calibration of the energy distribution in the spectrum of some standard star. The second is the setting up of secondary standards around the sky which can be used in practical spectrophotometry. Recent work on these two problems will be discussed.

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The first problem consists of two parts. The first is to measure the flux at different wavelengths relative to some standard wavelength. The second is to measure the absolute flux, in ergs/cm²/sec/Angstrom at one wavelength. Only the first of these will be considered. Kienle reported some preliminary results obtained by Bahner at the McDonald Observatory at the previous IAU meeting in Berkeley. Further reductions have not changed appreciably the figures quoted. Bahner reports tentative results that the energy distribution in the continuous spectrum of α Lyr can be represented by a Planck function of 14 000 °K from 4000 Å to 6400 Å and by a Planck function of 8600 °K from 3200 Å to 3600 Å with a Balmer discontinuity (defined by Barbier and Chalonge) of 0·54.

Chalonge is continuing his absolute calibration work and hopes to have new results within a year. His report is quoted hereafter:

Spectrophotométrie absolue

Nous avons entrepris depuis deux ans un nouveau travail en vue de comparer quelques étoiles B au corps noir, et de déterminer la distribution de l'énergie dans leur fond continu entre le rouge et la limite ultraviolette du spectre.

La comparaison se fait en deux étapes:

(1) Nous comparons les étoiles à une source luminescente donnant un spectre continu riche en ultraviolet assez semblable à celui d'une étoile. Le travail se fait dans l'atmosphère très pure du Jungfraujoch. La source, est placée dans un relai de télévision construit à 3700 m d'altitude sur l'arête Est de la Jungfrau et nous l'observons depuis la station astronomique du Sphinx distante d'un kilomètre environ, située à 3670 m d'altitude.

La source apparaît comme une étoile de magnitude 3 et son spectre peut être pris avec exactement le même dispositif qu'une étoile véritable: réflecteur de 25 cm d'ouverture à miroirs aluminiés, et spectrographe à optique de quartz.

Les conditions dans lesquelles ces spectres sont obtenus sont excellentes. L'extinction par diffusion exercée par un kilomètre d'air à une pression voisine de 490 mm de mercure est faible et facile à déterminer avec précision.

Plusieurs étoiles ont été ainsi étudiées: ϵ Per, 10 Lac, S Mon et l'étude est étendue à α Lyr, bien que cette étoile nous semble constituer un étalon beaucoup moins recommandable par suite de sa grande discontinuité de Balmer.

Les observations ont été faites sur plaques Kodak 103 aD entre 6100 Å et 3100 Å. Nous espérons les étendre cet automne jusqu'à 6500 Å en utilisant des plaques 103 aF.

(2) Il reste à comparer la source luminescente au corps noir. Une première étude a été faite par J. P. Mehltretter au Happel-Laboratorium de Heidelberg. Cette détermination sera contrôlée cette année à l'Observatoire de Haute-Provence par comparaison de la source fluorescente à une lampe à ruban de tungstène à fenêtre de quartz étalonnée également à Heidelberg, mais en utilisant exactement le même dispositif expérimental que pour les comparaisons stellaires.

Nous espérons avoir les premiers résultats du travail pour le Congrès de Hambourg.

Construction d'une source standard

La source luminescente dont il vient d'être question s'est montrée extrêmement maniable et pratique: elle permet de définir avec beaucoup de précision une température de couleur (mais non une intensité absolue). Elle est constituée par un mélange de microcristaux de sels minéraux très stables dont la luminescence est excitée par la raie de résonance d'une lampe à mercure à basse pression.

Cette source qui donne un bon spectre continu entre 2900 Å et plus de 8000 Å, a été construite sous la direction du Dr M. Servigne et nous nous proposons d'établir plusieurs sources

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identiques, de déterminer leur courbe d'énergie et de les mettre à la disposition des spectrophotométristes qui pourraient en avoir besoin.'

Haritonov has recently published (1) new absolute measurements of a number of stars. His absolute calibration of α Lyr is slightly dependent on the values adopted by Code (2). The reddest points which he measures appear to be systematically in error. Within a year or two it should be possible to adopt a standard absolute energy distribution for α Lyr. In the mean time different workers will undoubtedly use somewhat different absolute calibrations. Over the range from 4000Å to 6500Å the absolute calibration of Haritonov is bluer than that of Bahner by about 0·05 mag. Over the same range the calibration used by Oke, which is a modification of that published by Code, is bluer than that of Bahner by 0·10 mag. The Balmer discontinuity used by Bahner is somewhat larger than that used by Haritonov and Oke. More work is required in the infra-red between 6500Å and 12 000Å.

A less difficult problem is to set up a sequence of spectrophotometric standard stars around the sky which can be used by observers with scanning instruments. These stars should be accurately related to each other over the whole observable spectral range and also related to an absolute standard star such as α Lyr. Kron and Oke were requested at the Berkeley meeting to pick a sequence of photometric and spectrophotometric standards in the declination zone from $+15°$ to $-15°$. A tentative list (table 2) of photometric standards has been chosen for this purpose. From this list a group of stars suitable for spectrophotometric standards was picked. To minimize the effects of absorption lines and band width, stars of spectral types from O9·5 to Al were selected. Some of these stars with large Balmer discontinuities may prove difficult to work with photographically. The proposed list of stars is given in Table 1 attached. It includes some of the stars previously used by Oke (3) for spectrophotometric standards.

All of these stars except κ Aql have been observed carefully at Mount Wilson during the last two years by Oke and Smith between 3390Å and 5556Å. Many of these stars have also been observed from 5556Å to 10 800Å. The relative fluxes are available but not yet published. Bahner in connection with his absolute calibration work has observed 25 stars between 3196Å and 6404Å. These stars cover the spectral range from O9 to F5. Three stars have been observed both by Bahner and by Oke and Smith. Between λ 3390 and λ 6404 the maximum difference in the relative fluxes is only 0·02 mag. To the red of 4000Å the differences are negligible. Haritonov (1) has also observed relative fluxes between 3300Å and 7200Å for 16 stars of spectral types O9·5 to A7. A comparison of his results with those of Bahner and Oke for stars in common reveal differences as large as 0·07 mag.

It is important that several spectrophotometric observers work on the proposed list of stars in Table 1. Since these stars are far south of the zenith for northern observers, relatively few of them have been observed except in the program of Oke and Smith.

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Table 1

Proposed List of Spectrophotometric Standards

Name	α(1950)	δ(1950)	Spec.	V	B–V
ξ²Cet	2 25·5	+ 8 14	B9III	4·27	−0·05
ε Ori	5 33·7	− 1 14	BoIa	1·70	−0·18
γ Gem	6 34·7	+16 27	AoIV	1·94	0·00
η Hya	8 40·6	+ 3 35	B3V	4·30	−0·20
α Leo	10 05·7	+12 13	B8V	1·34	−0·12
θ Crt	11 34·1	− 9 31	B9	4·9	
θ Vir	13 07·4	− 5 16	Ao	4·4	
109 Vir	14 43·7	+ 2 06	AoV	3·74	−0·00
ζ Oph	16 34·4	−10 28	O9·5V	2·56	+0·02
α Lyr	18 35·2	+38 44	AoV	0·03	0·00
κ Aql	19 34·2	− 7 08	Bo·5III	4·96	−0·01
58 Aql	19 52·2	+ 0 08	Ao	5·8	
ε Aqr	20 45·0	− 9 41	A1 V	3·77	+0·01
29 Psc	23 59·3	− 3 18	B8	5·1	

Table 2

A SUGGESTED LIST OF PHOTOMETRIC STANDARDS

prepared by J. E. Breckinridge and G. E. Kron

(*Part* 1)

HD	*Name*	*Sp*	*V*	*B – V*	*U – B*	*V*	*P – V*
886	γ Peg	B2 IV	2·81	−0·21	−0·85	2·86	−0·34
9270*	η Psc	G8 III	3·62	+0·98	+0·76	3·71	+0·90
10476	107 Psc	K1 V	5·23	+0·83	+0·50	5·33	+0·78
10700	τ Cet	G8 V	3·50	+0·72	+0·20	3·60	+0·64
—	BD +2°348	M2	10·03	+1·44	+1·08	—	—
15318	ξ² Cet	B9 III	4·27	−0·05	−0·12	4·30	−0·16
16160	HR 753A	dK4	5·82	+0·98	+0·78	5·90	+0·90
—	HR 753B	M6	11·66	+1·62	+1·10	—	—
18331	HR 875	A1 V	5·17	+0·07	+0·04	—	—
20630	K Cet	G5	4·83	+0·68	+0·18	4·90	+0·59
21120*	o Tau	G8 III	3·58	+0·89	+0·63	—	—
21364	ξ Tau	B8	—	—	—	3·71	−0·16
22049	ε Eri	K2 V	3·74	+0·89	+0·58	3·81	+0·82
26965*	o² Eri A	dKo	—	—	—	4·22	+0·74
27371*	γ Tau	Ko III	3·61	+0·99	+0·82	—	—
27697*	δ Tau	Ko III	3·74	+0·98	+0·83	3·84	+0·93
30652	π⁴ Ori	F6 V	3·18	+0·46	+0·01	3·24	+0·36
30836*	π³ Ori	B2 III	3·68	−0·16	−0·81	3·69	−0·27
33111	β Eri	A3 III	2·79	+0·12	+0·07	2·81	+0·03
35299	HR 1781	B2 V	5·71	−0·21	−0·87	5·72	−0·30
35468	γ Ori	B2 III	1·63	−0·22	−0·87	1·62	−0·36
36395	BD −3°1123	dM1	7·96	+1·48	+1·20	8·09	+1·46
36468	δ Ori	O9·5 II	2·20	−0·20	−1·06	—	—
36512	υ Ori	Bo V	4·62	−0·26	−1·09	—	—
36591	BD −1°935	B1 V	5·36	−0·20	−0·96	5·37	−0·30
37043*	ι Ori	O9 III	2·76	−0·25	−1·09	—	—
37128	ε Ori	Bo Ia	1·70	−0·18	−1·04	—	—
38678	ζ Lep	A3 V	3·53	+0·09	+0·04	—	—
38899	134 Tau	B9 IV	4·89	−0·07	−0·17	—	—

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HD	*Name*	*Sp*	*V*	*B−V*	*U−B*	*V*	*P−V*
39400	56 Ori	K0	—	—	—	—	—
— *	BD+17°1320	M0	9·63	+1·50	+1·18	—	—
47105	γ Gem	A0 IV	1·93	0·00	+0·01	—	—
53244	γ CMa	B8 II	—	—	—	—	—
56537*	λ Gem	A3 V	3·58	+0·11	+0·10	—	—
69267*	β Cnc	K4 III	3·55	+1·49	+1·76	3·62	+1·40
71155	HR 3314	A0 V	3·90	−0·02	−0·01	—	—
74280	η Hya	B3 V	4·30	−0·20	−0·74	4·29	−0·32
79469	θ Hya	A0p	3·88	−0·06	−0·13	—	—
87901	α Leo	B8 V	1·34	−0·12	−0·37	1·37	−0·24
91316	ρ Leo	B1 Ib	3·85	−0·14	−0·95	3·86	−0·27
100889	θ Crt	B9	—	—	—	—	—
102647	β Leo	A3 V	2·13	+0·08	+0·05	2·19	−0·01
102870	β Vir	F8 V	3·62	+0·55	+0·09	3·67	+0·46
106625	γ Crv	B8 II	2·58	−0·10	−0·36	2·61	−0·21
110379/80	γ Vir	F0 V	—	—	—	2·80	+0·25
114330	θ Vir	A0	—	—	—	—	—
116658	α Vir	B1 V	0·97	−0·24	−0·94	1·03	−0·35
117176	70 Vir	G5 V	4·98	+0·71	+0·25	5·04	+0·62
121370	η Boo	G0 IV	2·69	+0·58	+0·19	2·76	+0·50
130109	109 Vir	A0 V	3·74	0·00	−0·02	3·75	−0·11
130819	α^1 Lib	F5 IV	5·17	+0·40	−0·01	5·20	+0·32
130841	α^2 Lib	F1n	2·75	+0·13	+0·05	2·80	+0·06
135742	β Lib	B8 V	2·61	−0·11	−0·37	2·60	−0·20
140573	α Ser	K2 III	2·66	+1·16	+1·23	2·75	+1·12
141003	β Ser A	A2 IV	3·66	+0·06	+0·06	3·68	−0·01
141004	λ Ser	G0 V	4·43	+0·60	+0·11	4·48	+0·52
142860	γ Ser	F6 V	3·84	+0·48	−0·01	3·89	+0·39
149757*	ζ Oph	O9·5 V	2·56	+0·02	−0·86	2·58	−0·09
154363*	BD−4°4225	K5 V	7·76	+1·14	+1·03	7·92	+1·05
157881	BD+2°3312	K7 V	7·57	+1·35	+1·26	7·66	+1·24
159561	α Oph	A5 III	2·07	+0·15	+0·08	2·13	+0·05
161096	β Oph	K2 III	2·78	+1·16	+1·24	2·86	+1·07
161868	γ Oph	A0 V	3·73	+0·04	+0·03	3·77	−0·04
172167	α Lyr	A0 V	+0·03	0·00	−0·01	—	—
177724	ζ Aql	B9n	2·99	0·00	−0·01	—	—
184279*	BD+3°4065	cB2e	6·82	+0·02	−0·83	—	—
184915	κ Aql	B0.5 III	4·96	−0·01	−0·87	4·98	−0·13
186791	γ Aql	K3 II	—	—	—	2·85	+1·44
187642	α Aql	A7 IV, V	0·75	+0·22	+0·06	0·86	+0·12
188350	58 Aql	A0	—	—	—	—	—
188512	β Aql	G8 IV	3·72	+0·86	+0·49	3·82	+0·77
196867*	α Del	B9 V	3·76	−0·05	+0·20	3·81	−0·18
198001	ε Aqr	A1 V	3·77	+0·01	+0·04	3·81	−0·11
206778*	ε Peg	K2 Ib	2·45	+1·57	+1·66	2·49	+1·49
209750*	α Aqr	G2 Ib	2·99	+0·99	+0·64	3·03	+0·88
216494	74 Aqr	B9	5·81	−0·08	−0·32	5·80	−0·17
218045	α Peg	B9 V	2·48	−0·03	−0·04	2·52	−0·12
219615	γ Psc	G8 III	—	—	—	3·83	+0·81
222368	ι Psc	F7 V	4·13	+0·51	+0·01	4·21	+0·40
—	BD+1°4774	dM2	8·98	+1·49	+1·08	9·06	+1·35
224926	29 Psc	B8	—	—	—	—	—

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Part 2

HD	*R*	*R–I*	*U*	*V*	*B*	*G*	*R*	*I*
886	3·06	−0·22	−2·00	−1·16	−0·55	−0·06	+0·61	+1·41
9270*	3·23	+0·32	+0·89	+0·40	+0·14	0·00	−0·15	−0·28
10476	4·87	+0·29	+0·52	+0·24	+0·10	0·00	−0·10	−0·15
10700	3·16	+0·26	+0·17	+0·11	+0·04	0·00	−0·05	−0·10
BD+2°348	9·02	+0·86	—	—	—	—	—	—
15318	4·45	−0·13	−0·97	−0·94	−0·47	−0·05	+0·51	+1·02
16160	5·36	+0·36	+0·99	+0·44	+0·22	−0·01	−0·21	−0·37
HR 753B	10·26	+1·28	+2·32	+1·60	+0·96	+0·24	−1·18	−2·56
18331	5·26	−0·04	−0·61	−0·78	−0·36	−0·03	+0·40	+0·79
20630	4·57	+0·22	+0·06	+0·02	+0·01	0·00	−0·01	+0·06
21120*	3·28	+0·32	+0·68	+0·31	+0·10	+0·01	−0·11	−0·21
21364	—	—	−1·29	−0·98	−0·46	−0·05	+0·51	+1·05
22049	3·33	+0·30	+0·69	+0·33	+0·14	0·00	−0·15	−0·24
26965*	4·07	+0·31	+0·48	+0·23	+0·10	0·00	−0·11	−0·19
27371*	3·30	+0·34	+0·99	+0·42	+0·15	0·00	−0·14	−0·28
27697*	3·41	+0·34	+1·00	+0·41	+0·14	0·00	−0·14	−0·26
30652	3·05	+0·16	−0·39	−0·28	−0·12	−0·01	+0·13	+0·29
30836*	3·86	−0·19	−1·90	−1·09	−0·49	−0·04	+0·58	+1·28
33111	2·82	−0·01	—	—	—	—	—	—
35299	5·91	−0·23	—	—	—	—	—	—
35468	1·84	−0·25	−2·02	−1·16	−0·55	−0·06	+0·60	+1·35
36395	6·87	+0·84	+2·09	+1·23	+0·74	+0·10	−0·84	−1·69
36468	2·44	−0·24	−2·24	−1·16	−0·54	−0·05	+0·59	+1·37
36512	4·84	−0·25	−2·27	−1·20	−0·58	−0·05	+0·63	+1·43
36591	5·53	−0·20	—	—	—	—	—	—
37043*	2·95	−0·24	−2·24	−1·17	−0·55	−0·05	+0·60	+1·38
37128	1·88	−0·20	−2·14	−1·10	−0·50	−0·05	+0·55	+1·28
38678	3·61	−0·05	—	—	—	—	—	—
38899	5·04	−0·14	—	—	—	—	—	—
39400	—	—	—	—	—	—	—	—
BD+17°1320*	8·64	+0·74	+1·98	+1·18	+0·66	+0·04	−0·70	−1·41
47105	2·02	−0·09	−0·71	−0·86	−0·42	−0·04	+0·46	+0·89
53244	4·24	−0·16	—	—	—	—	—	—
56537*	3·64	−0·05	−0·61	−0·77	−0·37	−0·05	+0·41	+0·79
69267*	2·77	+0·52	—	—	—	—	—	—
71155	4·03	−0·14	—	—	—	—	—	—
74280	4·47	−0·21	−1·85	−1·11	−0·54	−0·04	+0·58	+1·32
79469	4·01	−0·15	−1·01	−0·94	−0·47	−0·04	+0·51	+1·02
87901	1·48	−0·17	−1·30	−1·02	−0·46	−0·07	+0·53	+1·08
91316	4·01	−0·19	−1·93	−1·06	−0·48	−0·04	+0·53	+1·14
100889	—	—	—	—	—	—	—	—
102647	2·18	−0·06	−0·64	−0·76	−0·37	−0·05	+0·42	+0·84
102870	3·39	+0·16	−0·20	−0·18	−0·06	−0·02	+0·09	+0·22
106625	2·72	−0·16	—	—	—	—	—	—
110379/80	2·64	+0·10	−0·55	−0·43	−0·16	−0·02	+0·18	+0·45
114330	—	—	—	—	—	—	—	—
116658	1·19	−0·26	−2·08	−1·18	−0·53	−0·06	+0·59	+1·34
117176	4·68	+0·24	+0·14	+0·05	+0·04	−0·02	−0·02	−0·02
121370	2·45	+0·20	−0·07	−0·14	−0·05	−0·03	+0·07	+0·19
130109	3·86	−0·10	—	—	—	—	—	—
130819	5·03	+0·11	−0·43	−0·37	−0·13	−0·01	+0·14	+0·37
130841	2·82	−0·03	−0·54	−0·70	−0·32	−0·04	+0·35	+0·72
135742	2·72	−0·14	−1·27	−1·03	−0·48	−0·03	+0·52	+1·10

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HD	*R*	*R–I*	*U*	*V*	*B*	*G*	*R*	*I*
140573	2·10	+0·37	+1·62	+0·69	+0·27	−0·02	−0·25	−0·46
141003	3·74	−0·06	−0·06	−0·80	−0·37	−0·03	+0·41	+0·80
141004	4·20	+0·20	−0·13	−0·11	−0·03	−0·01	+0·04	+0·16
142860	3·67	+0·14	−0·37	−0·28	−0·09	−0·01	+0·10	+0·27
149757*	2·64	−0·07	−1·69	−0·88	−0·36	−0·04	+0·40	+0·95
154363*	7·04	+0·49	+1·44	+0·70	+0·40	−0·02	−0·38	−0·71
157881	6·67	+0·60	+1·87	+0·97	+0·54	−0·02	−0·52	−1·00
159561	2·10	0·00	−0·52	−0·69	−0·31	−0·03	+0·35	+0·69
161096	2·24	+0·39	+1·59	+0·68	+0·29	−0·02	−0·26	−0·47
161868	3·84	−0·09	−0·73	−0·85	−0·39	−0·04	+0·43	+0·86
172167	+0·15	−0·09	−0·81	−0·92	−0·44	−0·04	+0·49	+0·93
177724	3·10	−0·07	−0·80	−0·89	−0·41	−0·04	+0·45	+0·87
184279*	6·99	−0·06	−1·63	−0·88	−0·37	−0·04	+0·41	+0·91
184915	5·02	−0·09	−1·79	−0·92	−0·38	−0·05	+0·42	+0·96
186791	—	—	+2·45	+1·14	+0·47	−0·01	−0·46	−0·91
187642	0·76	+0·02	−0·54	−0·62	−0·30	−0·01	+0·31	+0·68
188350	—	—	−0·63	−0·76	−0·33	−0·03	+0·38	+0·67
188512	3·35	+0·31	+0·48	+0·23	+0·11	−0·01	−0·10	−0·18
196867*	3·91	−0·11	−1·07	−0·96	−0·45	−0·04	+0·49	+1·00
198001	3·86	−0·11	−0·72	−0·88	−0·42	−0·04	+0·46	+0·91
206778*	—	—	+2·59	+1·15	+0·47	−0·01	−0·46	−0·89
209750*	—	—	+0·92	+0·38	+0·15	−0·01	−0·14	−0·21
216494	5·95	−0·14	−1·21	−0·97	−0·47	−0·04	+0·51	+1·05
218045	2·63	−0·08	−0·85	−0·93	−0·44	−0·05	+0·49	+1·00
219615	—	—	+0·74	+0·34	+0·13	+0·01	−0·15	−0·31
222368	3·94	+0·19	−0·29	−0·22	−0·09	0·00	+0·09	+0·24
BD + 1°4774	7·95	+0·87	+1·94	+1·18	+0·68	+0·09	−0·78	−1·64
224926	—	—	−1·51	−1·05	−0·51	−0·05	−0·56	−1·22

Table 3. Monochromatic magnitudes m ($^1/_\lambda$) of ten southern early-type stars

(prepared by L. H. Aller, D. J. Faulkner, R. Norton)

The energy distributions (on a wave-number, $^1/_\lambda$ scale) were obtained by comparison with northern standards, ε Orionis, α Leonis, 58 Aquilae, and ξ_2 Ceti, which have been observed by A. Code and by J. B. Oke.

λ(Å)	$\lambda^{-1}(\mu^{-1})$	α Eri	α Car	δ Car	ζ Pup	κ Vel	β Cm	β Cen	τ Sco	α Pav	α Gru
3400	2·94	+0·37	+1·91	+0·12	−0·31	+0·18	−0·14	−0·07	−0·19	+0·22	+0·58
3509	2·85	+0·35	+1·82	+0·12	−0·31	+0·15	−0·15	−0·08	−0·18	+0·22	+0·56
3571	2·80	+0·33	+1·75	+0·12	−0·31	+0·16	−0·12	−0·08	−0·18	+0·22	+0·53
3650	2·74	+0·32	+1·60	+0·12	−0·29	+0·17	−0·11	−0·09	−0·17	+0·19	+0·50
3704	2·70	+0·30	+1·18	+0·14	−0·26	+0·16	−0·09	−0·10	−0·17	+0·18	+0·48
3860	2·59	−0·13	+0·10	−0·14	−0·20	−0·15	−0·18	−0·17	−0·20	−0·11	−0·06
3906	2·56	−0·14	+0·05	−0·16	−0·18	−0·16	−0·18	−0·17	−0·19	−0·12	−0·11
4040	2·48	−0·13	−0·01	−0·12	−0·14	−0·11	−0·10	−0·13	−0·15	−0·12	−0·11
4190	2·39	−0·09	−0·01	−0·07	−0·08	−0·06	−0·05	−0·07	−0·08	−0·05	−0·07
4367	2·29	0·00	0·00	0·00	0·00	0·00	0·00	0·00	0·00	0·00	0·00
4464	2·24	+0·02	0·00	+0·04	+0·02	+0·02	+0·03	+0·03	+0·03	+0·03	+0·02
4590	2·18	+0·04	−0·02	+0·06	+0·06	+0·04	+0·06	+0·07	+0·08	+0·07	+0·05
4673	2·14	+0·05	−0·03	+0·09	+0·08	+0·06	+0·08	+0·10	+0·10	+0·09	+0·07
4902	2·04	+0·10	−0·04	+0·16	+0·13	+0·11	+0·15	+0·16	+0·16	+0·15	+0·12
5060	1·98	+0·12	−0·05	+0·19	+0·18	+0·17	+0·20	+0·20	+0·20	+0·18	+0·14
5128	1·95	+0·13	−0·05	+0·21	+0·20	+0·19	+0·22	+0·23	+0·21	+0·19	+0·16
5263	1·90	+0·15	−0·06	+0·23	+0·23	+0·21	+0·25	+0·26	+0·24	+0·21	+0·18
5560	1·80	+0·19	−0·07	+0·31	+0·31	+0·25	+0·31	+0·33	+0·31	+0·28	+0·24
5810	1·72	+0·22	−0·09	+0·40	+0·40	+0·31	+0·35	+0·39	+0·43	+0·33	+0·29

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Notes to Table 2

1. The *UBV* data represent means from the three references.
2. Eggen's PV measures were converted through a stable and well established transformation to the Kron and Mayall PV system. After the conversion of Eggen's data, Eggen's and Kron's material were averaged with equal weight.
3. There are over 700 six-color measures on these standard stars. Stars with fewer than two good measures was not entered into the tabulation.
4. Detailed comments:

HD	Remarks
9270	Possibly variable in six-color *U*
21120	Spectroscopic Binary
26965	ADS 3093Å; High velocity $V_r = -42$ km/sec; $S' = 115$ km/sec
27371	H. L. Johnson says variable ± ·1
27697	H. L. Johnson says variable ± ·1
30836	Only 2, six-color measures; Six-color I: 0^m08 difference, other colors OK
37043	Spectroscopic Binary
BD +17°1320	High velocity; Looks double in 120″
56537	Six-color data from Whitford and Sears, unpublished; $n = 2$
69267	ADS 4704Å
149757	Strongly reddened
154363	High velocity
184279	Possibly variable in six-color *I*
196867	Possibly variable in six-color *I*
206778	Variable in six-color *U*
209750	Variable

5. The material in this table represents standard photoelectric data compiled from several sources. The photoelectric data and information concerning the systems are found in the following references.

UBV	1. Johnson, H. L., Morgan, W. W. *Astrophys. J.*, **117**, 313, 1953.
	2. Johnson, H. L., Harris, D. *Astrophys. J.*, **120**, 196, 1954.
	3. Hogg, A. R. Mt. Stromlo Observatory, November, 1958.
PV	1. Eggen, O. J. *Astr. J.*, **60**, 131, 1955.
	2. Kron, G. E. *Astr. J.*, **65**, 581, 1960.
R I	1. Kron, G. E., Smith, J. L. *Astrophys. J.*, **113**, 324, 1951.
	2. Kron, G. E., White, H. S. *Astrophys. J.*, **118**, 502, 1953.
	3. Kron, Gascoigne, White *Astr. J.*, **62**, 205, 1957.
Six Color	1. Stebbins, J., Whitford, A. E. *Astrophys. J.*, **102**, 318, 1945.
	2. Stebbins, J., Kron, G. E. *Astrophys. J.*, **123**, 440, 1956.
	3. Kron, G. E. *Publ. astr. Soc. Pacif.*, **70**, 561, 1958.
	4. Whitford, A. E., Sears, R. L., unpublished.
	5. Feinstein, Gordon, Kron, unpublished.
	6. Breckinridge, Kron, unpublished.

Pilowski (1961–62) has carried out a comprehensive review of earlier (to 1955) photographic studies from 4000 Å–10 000 Å for giants and main sequence stars of all spectral classes and several sub-dwarfs. The observed energy distribution is related to the scale of effective temperatures (more accurately the radiometric radiation temperature). Departures from effective black body radiation disappears for G-M stars in the infrared, while the influence of the Paschen absorption affects the A stars. A marked characteristic of the departures from a black body is a 'wave' in the region 4000–6000 Å which is weak in the B stars, nearly disappears in the A stars, and strongly increases in amplitude to $c_2/T = 3{\cdot}6$, and weakens thereafter. It

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differs for giants and dwarfs, but in G sub-dwarfs the wave resembles that in giants. The departures of F5 stars from a black body seem small in the interval 4000–10 000 Å. From a comparison of infra-red brightness measurements by Johnson, at 22 000 Å, with the predicted brightness derived from the energy distribution at wavelengths less than 10 000 Å, Pilowski finds a confirmation of his temperature scale.

Pilowski, K. *Veröff. astr. Station, Technische Hochschule Hannover*, no. 5, 6 (1961–62).

APPENDIX 2: REPORT OF THE COMMITTEE ON STELLAR CLASSIFICATION

(prepared by William P. Bidelman, President)

General Comments

The present report, like that of three years ago, consists largely of a list of papers dealing with the concerns of this committee (see Bibliography). So many excellent review articles pertaining to stellar classification have appeared recently that any extensive report here would be superfluous. Special reference must be made to those by Keenan (**306**) and Strömgren (**310**) on qualitative and quantitative methods of classification, respectively, and to that by Blaauw (**288**) on calibration problems. Other summarizing articles that should be mentioned are those by Voigt (**312**), Greenstein (**300**), Herbig (**302**) and Joy (**304**). In addition, a transcript of a short conference on spectral classification held in December 1961 at the Kitt Peak National Observatory has recently appeared (**296**). The participants did not represent all points of view—spectrophotometric and wide-band photometric work were hardly discussed—but this publication should nevertheless prove of interest to all those working in stellar classification. Finally, it may be noted that work on the spectral classification of variable stars has been ably summarized by Herbig elsewhere in these reports (p. 372).

During the past three years new or increased activity has occurred in our field at many observatories in both hemispheres. The accompanying bibliography, which is rather similar to that included in the last *Draft Reports*, covers mainly the years 1961–63, but a few papers previously overlooked are also included. Some changes in arrangement have suggested themselves: papers dealing with spectrum scanning, multi-color photometry, and calibration problems have been listed separately. No attempt has been made, however, to be complete in the section on multi-color photometry; for example, few references are given to three-color wide-band stellar photometry. Unpublished work reported to the writer is recorded in the relevant sections of the Bibliography. It must be strongly emphasized, however, that these notes do not really reflect work in the field as a whole in any satisfactory fashion, for reports are missing from many individuals and institutions. It was nevertheless thought desirable to publish the information received.

In order to have a correct idea of the extent of present work in stellar classification one must refer not only to the Bibliography of the present report, but also to the several annual reports of the various observatories. And, for the southern hemisphere, reference must also be made to the very useful *Information Bulletin for the Southern Hemisphere*, edited by Sahade.

The triennium has seen advances in the classification of stars at both ends of the spectral sequence (**236, 142**), as well as a vigorous development of narrow-band photometric work