

Catalogue of diffuse interstellar band measurements

Theodore P. Snow Jr., Donald G. York, and Daniel E. Welty

Princeton University Observatory

(Received 20 May 1976; revised 23 November 1976)

Diffuse band data have been collected from the literature and reduced statistically to a common measurement system, enabling correlation analyses to be made with a larger quantity of data than previously possible. A full listing of the catalogued data is presented, along with some discussion of the correlations. One important application of such studies is the identification of cases of peculiar diffuse band behavior, and a table is given showing all cases of band strengths deviating by more than twice the mean dispersion from the best-fit correlations. This table may be useful in planning further observations.

INTRODUCTION

IN THE 40 years since the discovery of the diffuse interstellar bands, many attempts have been made to identify their origin by analyzing the correlations of band strengths with other quantities such as interstellar reddening. Generally good correlations are found, but due to the large amount of observational scatter and to the expectation that such correlations should occur in any case as a result of mixing of the interstellar medium, these studies have produced no firm conclusions regarding the origin of the bands.

While there are still some possible correlations which might usefully be explored, such as those between band strength and ultraviolet extinction (Wu *et al.* 1977) or infrared extinction (Snedden *et al.* 1977), perhaps the greatest usefulness such studies can have is to indicate cases of lines of sight which are clearly discrepant. By identifying these cases it might be possible to determine the conditions which cause the unusual diffuse band behavior, hereby gaining some clue to the nature of the absorbers. Some possible examples of this approach have been pointed out by Smith, Snow, and York (1977).

One problem which has plagued research on the diffuse bands is the difficulty of obtaining a large, uniformly treated data set. Many different observing techniques have been employed so that even the units used to measure the band strengths can differ from one author to another. In this paper are collected all published data on four of the most prominent bands, converted statistically to a common measurement system in each case. It is hoped that this will provide an improved baseline against which to identify cases of peculiar diffuse band behavior for further study.

I. DATA-HANDLING PROCEDURES

An exhaustive literature search was made, and all bodies of diffuse band data which would be found were punched onto computer cards. The data of Herbig (1975) were adopted as the standard, and least-squares

fitting to this standard was done for each reference which had at least 15 stars in common with Herbig. Sufficient data for this could be found only for the bands at 4430, 5780, 5797, and 6284 Å, and all others were dropped from consideration.

After as many references as possible for each band had been fitted to Herbig's data, then a new standard data set was established by converting several of the largest data groups to the Herbig system (using the linear transformations derived from the least-squares fits) and the remaining references were fitted to this new standard, called standard A. The references included for each band in standard A are listed in Table I. In Table II are listed the least-squares fitting parameters for each reference. Observers with less than ten stars in common with standard A were dropped at this point. Among those deleted were York (1971), Buscombe and Kennedy (1968), Baker (1949), Butler and Thompson (1958), and several sources listing only a few stars.

After the fitting procedure was complete, all the data were converted to the Herbig system, using the coefficients from Table II. The tabulated values give central depths for $\lambda 4430$, and equivalent widths for $\lambda \lambda 5780$, 5797, and 6284. The large body of data which resulted is listed in Table III, with multiple entries for each star included in more than one reference. The photometric data in Table III come primarily from the *UBV* cata-

TABLE I. References included in standard A.

Band	References
4430	Herbig (1975), ^a Duke (1951), Baerentzen <i>et al.</i> (1967), Wampler (1966)
5780	Herbig (1975), ^a Merrill <i>et al.</i> (1937), Bromage and Nandy (1973)
5797	Herbig (1975), ^a Merrill <i>et al.</i> (1937), Bromage and Nandy (1973)
6284	Herbig (1975), ^a Murdin (1972), Merrill <i>et al.</i> (1937), Bromage and Nandy (1973)

^a Adopted standard reference to which the other data groups were fitted by least-squares calculation.

TABLE II. Parameters of the least-squares fits.

	Band	Slope ^a	Intercept ^a	σ^a	Standard ^b
1. Murdin (1972)	6284	4.753	0.160	0.134	H
3. Snow (1973)	4430	0.658	2.113	1.617	A
	5780	0.075	0.395	0.091	A
	5797	0.253	0.191	0.046	A
4. Wu (1972)	5780	0.561	0.152	0.077	A
	5797	0.299	0.132	0.064	A
5. Duke (1951)	4430	0.681	1.114	1.763	H
6. Walker (1963) ^c	4430	1.090	2.452	1.891	A
7. Walker (1963) ^c	4430	0.235	3.166	2.048	A
8. Merrill et al. (1937)	5780	0.613	0.184	0.091	H
	5797	0.935	0.118	0.073	H
	6284	0.469	0.017	0.096	H
9. Underhill (1956)	4430	0.607	2.186	1.074	A
10. Stoeckly and Dressler (1964)	4430	0.812	2.590	1.260	A
11. Wampler (1966)	4430	1.146	1.635	2.520	H
12. Walker and Hodge (1966)	4430	0.636	1.179	1.786	A
14. Bromage and Nandy (1973)	5780	0.535	0.253	0.130	H
	5797	0.292	0.202	0.065	H
	6284	0.646	-0.103	0.118	H
15. Marionni (1971)	6284	1.809	-0.559	0.091	A
17. Butler and Seddon (1958a)	4430	2.581	0.665	1.222	A
18. Butler and Seddon (1958b)	4430	3.527	0.949	0.950	A
21. Greenstein and Aller (1950)	4430	2.678	1.825	1.852	A
22. Beals and Blanchet (1938)	4430	0.026	2.470	1.633	A
23. Baerentzen <i>et al.</i> (1967)	4430	169.424	0.675	1.557	H
24. Gammelgaard <i>et al.</i> (1975)	4430	Assumed identical to Ref. 23			

^a The least-squares solutions were of the form $S_s = mS_R + y$, where S_s and S_R are the band strengths in the standard and reference systems, respectively; m is the slope, and y is the intercept. σ is the rms deviation of the points used in the calculation from the derived fit.

^b H: Herbig (1975) was used as the standard data set; A: standard A, defined in Table I, was used.

^c Walker (1963) lists $\lambda 4430$ data obtained in two distinct measurement systems; therefore this reference is treated as two separate data collections.

logue of Blanco *et al.* (1968), but other, sometimes less reliable, sources had to be used in many cases. This caution is especially important for the V magnitudes, which are included only as an aid to compiling observing lists from this table. The infrared and ultraviolet photometry for some stars will soon be available (Sneden *et al.* 1977; Wu *et al.* 1977). References for the spectral classifications and the diffuse band data are indicated in the table. The polarization data are primarily from Hiltner (1956) or from Serkowski *et al.* (1975) or from the several references given in the latter paper. Color excesses are based on the intrinsic colors of Johnson (1966). The values of λ_{\max} in Table III are taken from Serkowski *et al.* (1975), wherein values of P at λ_{\max} can be found.

II. CORRELATIONS

The entire catalogue of diffuse band data was written onto magnetic tape, and a computer program was developed for selecting stars according to any of several criteria, such as galactic longitude region or reference, and plotting the correlation between any pair of quantities in the catalogue. The correlations between diffuse band strength and infrared and ultraviolet extinction indices are discussed elsewhere (Sneden *et al.* 1977 and Wu *et al.* 1977, respectively).

In Figs. 1 and 2 are shown the correlations of $\lambda 4430$, 5780, and 6284 with $E(B - V)$, with a diagonal line indicating the least-squares fit through the data. Mea-

surements by different observers of diffuse bands in a given star are plotted separately in these figures and corresponding points are connected with a vertical line. The rms dispersion from this fit is indicated in the cap-

TABLE III(a). Identification of special cases.

Catalogue entry	Object	Reference
SC 900000	CD - 33° 12155	7
900001	CD - 33° 12242	7
900002	Arp e	7
900003	Arp b	7
900004	MWC 14	21
900005	HD 37614/5	6
900015	IC 348 No. 4	11
900016	IC 348 No. 10	11
900017	IC 348 No. 12	11
900018	NGC 2024	11
900019	NGC 2344 No. 14	11
900020	NGC 2344 No. 16	11
900021	NGC 2344 No. 20	11
900022	Herschel 36	11
900023	NGC 6649 No. 9	11
900024	BN Vul	11
900025	VI Cyg. No. 12	11
900026	VI Cyg. No. 6	11
900027	IC 1805 No. 5	9
900028	IC 1805 No. 7	9
900029	A.D.S. 13312 C	9
900030	IC 4996 No. 20	9
900031	IC 4996 No. 37	9
900032	NGC 6910 No. 5	9
900033	NGC 7380 No. 4	9
900034	NGC 7380 No. 3	9
900035	HD 190429 N	9
900036	HD 190429 S	9

CATALOGUE OF DIFFUSE INTERSTELLAR BAND MEASUREMENTS 115

TABLE III (b). Diffuse band catalogue.

Table with columns: STAR NUMBER, L II, B II, DIFFUSE BANDS (4430, 5780, 5797, 6284), (E-B-V), POLARIZATION (MAX, PV), MAG, SPECTRAL TYPE, REFS. Rows include stars like HD 12301, HD 12302, HD 12323, etc.

Table with columns: STAR NUMBER, L II, B II, DIFFUSE BANDS (4430, 5780, 5797, 6284), (E-B-V), POLARIZATION (MAX, PV), MAG, SPECTRAL TYPE, REFS. Rows include stars like HD 12301, HD 12302, HD 12323, etc.

CATALOGUE OF DIFFUSE INTERSTELLAR BAND MEASUREMENTS 117

TABLE III (b) (continued)

Table with columns: STAR NUMBER, L II, B II, DIFFUSE BANDS (4430, 5160, 5797, 6284), (E(B-V)), POLARIZATION (MAX, DU), MAG, SPECTRAL TYPE, REFS. The table lists numerous stars with their associated measurements and references.

CATALOGUE OF DIFFUSE INTERSTELLAR BAND MEASUREMENTS 119

TABLE III (b) (continued)

Table with columns: STAR NUMBER, L II, B II, DIFFUSE BANDS, E(B-V), POLARIZATION, MAG, SPECTRAL TYPE, REFS. The table lists numerous star observations with their respective parameters and references.

CATALOGUE OF DIFFUSE INTERSTELLAR BAND MEASUREMENTS 121

TABLE III (b) (continued)

Table with columns: STAR NUMBER, L I I B 31, DIFFUSE BANDS (4330, 5160, 5197, 6284), E(B-V), POLARIZATION (MAX, PV), MAG, SPECTRAL TYPE, REFS. The table contains two columns of data, each listing star parameters and diffuse band measurements.

TABLE III (b) (continued)

STAR NUMBER	L 11	B 11	4430	DIFFUSE BANDS	5100	5207	4284	E(B-V)	POLARIZATION	MAG	SPECTRAL TYPE	REFS
HD 225094	116 13	4 48	3 850					0.240	0.80	19.0	B1 E	200 12
HD 225095	117 22	1 24	13 844	0.490	0.211	0.552	0.620	3.13	0.80	18.0	B0 IV P	200 12
HD 225140	117 44	0 14	4 723	0.417		0.336	0.500	2.44	0.80	19.0	F 200 12	
HD 225190	116 43	3 76	5 722				0.800	7.4	0.85	19.0	B2	12 12
HD 225251	71 34	3 07	6 605				1.120	0.9	0.80	18.0	B0 IV	200 23
HD 225268	71 58	2 86	9 940				0.700	0.0	0.07	20.0	B0 V	200 23
HD 227460	72 88	2 40	4 562				0.440	0.5	0.83	20.0	B1	200 12
HD 227584	72 47	2 04	7 163	0.455			0.455	1.25	10.0	0.8	B1 III	200 6
HD 227611	72 33	2 16	9 902	0.830			0.830	2.07	0.8	0.8	B1 III	PE 200 4
HD 227626	72 85	2 04	6 812	0.497			0.497	9.2	7.0	0.8	B0 IV	200 6
HD 227634	72 85	2 04	6 812	0.497			0.497	9.2	7.0	0.8	B0 IV	200 6
HD 227649	72 00	1 47	7 357	0.815			0.815	6.6	8.0	0.8	B1 III	200 6
HD 227757	73 27	2 15	5 080	0.418			0.418	3.2	0.8	0.8	B1 V	200 23
HD 227802	74 39	2 55	5 555	0.520			0.520	9.3	8.1	0.8	B1 V	200 23
HD 228002	72 85	1 22	4 562	0.440			0.440	7.0	8.0	0.8	B1 V	E 200 4
HD 228052	73 86	1 86	6 902	0.710			0.710	8.8	8.1	1.1	23 23	
HD 228053	74 56	2 16	4 402	0.330			0.330	8.4	8.1	1.1	23 23	
HD 228101	73 25	1 31	5 080	0.340			0.340	8.8	8.1	1.1	IV	PE 200 23
HD 228199	73 85	1 52	4 995	0.410			0.410	9.3	8.0	0.8	B1 V	200 12
HD 228263	72 85	1 22	4 562	0.440			0.440	7.0	8.0	0.8	B1 V	200 12
HD 228306	72 85	1 22	4 562	0.440			0.440	7.0	8.0	0.8	B1 V	200 12
HD 228343	72 85	1 22	4 562	0.440			0.440	7.0	8.0	0.8	B1 V	200 12
HD 228454	72 85	1 22	4 562	0.440			0.440	7.0	8.0	0.8	B1 V	200 12
HD 228553	74 56	2 16	4 402	0.330			0.330	8.4	8.1	1.1	23 23	
HD 228690	75 50	1 47	4 122	0.550			0.550	9.3	8.0	0.8	B1 V	200 12
HD 228712	78 06	3 09	0 402	0.402	0.289	0.480	1.380	8.7	8.0	0.8	B1 IA	200 30
HD 228779	73 17	0 50	12 874	1.610			1.610	9.0	5.0	1.8	200 23	
HD 228791	76 30	1 65	6 076	0.340			0.340	9.0	8.2	1.1	200 12	
HD 228807	76 17	1 15	5 556	0.390			0.390	8.2	8.1	1.1	200 12	
HD 228814	76 17	1 15	5 556	0.390			0.390	8.2	8.1	1.1	200 12	
HD 228841	76 40	1 68	10 207	0.895			0.895	8.0	0.7	0.5	P 200 5	
HD 228874	76 17	1 15	5 556	0.390			0.390	8.2	8.1	1.1	200 12	
HD 228940	75 06	0 34	4 477	0.800			0.800	9.2	8.0	0.8	B1 V	200 6
HD 228982	78 18	2 63	12 282	1.400			1.400	9.2	8.0	0.8	B1 V	200 6
HD 228915	78 01	2 41	6 537	0.890			0.890	9.7	8.1	1.1	200 6	
HD 228929	77 58	2 08	12 807	1.400			1.400	9.6	8.0	0.8	B1 V	200 6
HD 228941	76 17	1 15	5 556	0.390			0.390	8.2	8.1	1.1	200 12	
HD 228953	76 17	1 15	5 556	0.390			0.390	8.2	8.1	1.1	200 12	
HD 228959	75 80	4 40	12 010	1.930			1.930	10.0	8.1	0.8	1A	P 200 5
HD 229155	77 35	1 17	6 944	1.300			1.300	8.5	8.1	0.8	B1 V	200 23
HD 229196	78 18	2 63	8 807	1.220			1.220	8.5	0.8	0.5	200 23	
HD 229202	78 18	1 63	10 803	1.180			1.180	9.5	0.8	0.5	200 11	
HD 229238	76 17	1 15	5 556	0.390			0.390	8.2	8.1	1.1	200 12	
HD 229261	76 17	1 15	5 556	0.390			0.390	8.2	8.1	1.1	200 12	
HD 229274	76 17	1 15	5 556	0.390			0.390	8.2	8.1	1.1	200 12	
HD 229287	76 17	1 15	5 556	0.390			0.390	8.2	8.1	1.1	200 12	
HD 229292	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229294	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229295	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229296	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229297	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229298	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229299	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229300	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229301	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229302	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229303	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229304	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229305	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229306	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229307	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229308	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229309	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229310	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229311	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229312	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229313	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229314	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229315	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229316	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229317	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229318	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229319	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229320	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229321	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229322	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229323	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229324	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229325	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229326	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229327	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229328	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229329	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229330	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229331	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229332	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229333	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229334	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229335	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229336	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229337	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229338	130 49	6 71	2 822	0.230			0.230	6.7	8.1	1.1	II	200 6
HD 229339	130 49	6 71	2 822	0.230			0.230					

CATALOGUE OF DIFFUSE INTERSTELLAR BAND MEASUREMENTS 123

TABLE III (b) (continued)

Table with columns: STAR NUMBER, L 11 B 11, DIFFUSE BANDS, E(B-V), POLARIZATION, MAG, SPECTRAL TYPE, REFS. The table contains two columns of star data, each with multiple rows of measurements.

Notes to Table III(b)

On the first line for each star are two reference numbers. The second number (which appears also on succeeding lines for each star) refers to the source of the diffuse band data for that line. The diffuse band references are listed by number in Table II. The first reference number gives the source of the position, color, and spectral type listed for each star. This number is assigned as follows.

- 100 catalogue of Kennedy and Buscombe (1974)
200 Blanco et al. (1968)
300 Hiltner (1956)

- 400 Bonner Durchmusterung or Cordoba Durchmusterung the diffuse band reference (from Table II)
1-30 Kennedy and Buscombe (1974) plus the diffuse band reference corresponding to the last two digits
201-230 Blanco et al. plus the corresponding diffuse band reference
301-330 Hiltner plus the corresponding diffuse band reference
401-430 BD or CD plus the corresponding diffuse band reference

TABLE IV. Stars with unusual band strengths.

Star	Peculiar ratio	Deviation (σ) ^a	No. of observations ^b	Star	Peculiar ratio	Deviation (σ) ^a	No. of observations ^b
HD4717	EW(5780)/E(B - V)	+2.16	1	194153	AC(4430)/E(B - V)	-2.04	1
5458	AC(4430)/E(B - V)	+2.02	1	197512	AC(4430)/E(B - V)	-2.56	1
13338	AC(4430)/E(B - V)	-2.19	1	200775	AC(4430)/E(B - V)	-2.70	2
13476	EW(5780)/E(B - V)	+2.00	1	204827	AC(4430)/E(B - V)	-2.66	4
	EW(5780)/AC(4430)	+2.54	1/3	217035AB	EW(5780)/AC(4430)	+2.23	1/3
13659	AC(4430)/E(B - V)	-2.09	1	225146	AC(4430)/E(B - V)	+2.40	4
14250	AC(4430)/E(B - V)	-2.40	1	HD226868	AC(4430)/E(B - V)	-2.43	1
14442	AC(4430)/E(B - V)	+2.73	1	228263	AC(4430)/E(B - V)	-2.12	1
17543	EW(5780)/E(B - V)	+2.15	1	228712	EW(5780)/E(B - V)	-2.63	1
24534	AC(4430)/E(B - V)	-2.92	1	229059	AC(4430)/E(B - V)	-2.06	4
37128	EW(5780)/AC(4430)	+2.08	2/4		EW(5780)/E(B - V)	-3.69	2
38131	AC(4430)/E(B - V)	+2.31	1	229159	AC(4430)/E(B - V)	-2.56	1
38563AB	AC(4430)/E(B - V)	-3.54	1	311999	AC(4430)/E(B - V)	+3.02	1
40893	AC(4430)/E(B - V)	+2.64	1	329379	AC(4430)/E(B - V)	-3.18	1
46711	AC(4430)/E(B - V)	+4.13	4	SC90015	AC(4430)/E(B - V)	-2.38	1
50064	EW(5780)/E(B - V)	+3.01	2	90016	AC(4430)/E(B - V)	-3.30	1
	EW(6284)/E(B - V)	+2.16	2	90018	AC(4430)/E(B - V)	-5.88	1
	EW(5780)/AC(4430)	+2.83	2/2	BD-145037	EW(5780)/AC(4430)	+4.10	1/2
52382	AC(4430)/E(B - V)	+2.19	1	+23771	AC(4430)/E(B - V)	+3.31	1
63964	AC(4430)/E(B - V)	-3.68	1	+233730	AC(4430)/E(B - V)	+2.04	2
64760	EW(5780)/AC(4430)	+2.34	1	+233745	AC(4430)/E(B - V)	+3.93	3
97471	AC(4430)/E(B - V)	+2.44	1	+243843	AC(4430)/E(B - V)	-2.11	1
109978	AC(4430)/E(B - V)	+2.19	1	+273550	AC(4430)/E(B - V)	+3.16	1
114213	AC(4430)/E(B - V)	-3.90	2	+404212	AC(4430)/E(B - V)	+2.05	1
147889	EW(6284)/E(B - V)	-2.63	2	+404219	EW(5780)/E(B - V)	+3.16	1
148605	EW(5780)/E(B - V)	-2.15	1		EW(5780)/AC(4430)	+3.89	1/1
152408	AC(4430)/E(B - V)	+2.56	1	+413804	EW(5780)/E(B - V)	+3.47	1
154445	EW(6284)/E(B - V)	-10.09	1		EW(5780)/AC(4430)	+3.97	1/1
156247AB	AC(4430)/E(B - V)	-3.00	1	+413807	AC(4430)/E(B - V)	+2.81	1
166734	AC(4430)/E(B - V)	+2.61	2	+421286	AC(4430)/E(B - V)	+2.40	1
167838	AC(4430)/E(B - V)	+2.17	5	+570513	AC(4430)/E(B - V)	-2.42	1
168607	EW(5780)/E(B - V)	+2.15	1/4	+600261	AC(4430)/E(B - V)	-2.39	1
173300	AC(4430)/E(B - V)	-2.25	1	+612352	AC(4430)/E(B - V)	+2.06	1
176914	AC(4430)/E(B - V)	+2.08	1	+612550	AC(4430)/E(B - V)	+2.09	1
190457	AC(4430)/E(B - V)	-2.98	1	+631964	AC(4430)/E(B - V)	+2.81	1
193946	AC(4430)/E(B - V)	-2.52	1				

^aThe deviations from the least-squares fits are given in units of σ , the rms dispersion from each fit, as indicated in the captions to Figs. 1 and 2. The value of σ for the EW(5780)/AC(4430)

correlation is 0.088 A.

^bFor the EW(5780)/AC(4430) ratio, the number of values for each band is given in the form No. (5780)/No. (4430).

tion. As expected, these straight-line fits closely match those derived by Herbig (1975) on the basis of his data. It is interesting to note that in the cases of $\lambda\lambda 4430$ and 5780, the least-squares fit does not pass through the origin, but instead intercepts the vertical axis at a positive value. This will be discussed below. Regional variations apparently exist (Herbig 1975).

Table IV lists all stars in the catalogue whose diffuse band strengths place them more than 2σ away from the least-squares fits to the correlations shown in Figs. 1 and 2. Also considered, but not shown in the figures, was the correlation of $\lambda\lambda 5780$ with $\lambda 4430$. When multiple measurements were available for a given band in any star, the mean of these measurements was used in determining whether the star deviates significantly from the least-squares fit. The table indicates the number of measurements averaged together in each case, as well as the magnitude of the deviation in terms of the rms dispersion σ .

The requirement that a star must deviate from the best fit by at least 2σ to be listed in Table IV is evidently quite stringent, because several cases of peculiar band

strengths already reported in the literature are not in Table IV. For example, it has been pointed out by several authors (e.g., Wampler 1966) that the stars embedded in dark clouds have low diffuse band strengths, yet only the most extreme example from the well-known ρ Ophiuchi cloud complex (Snow and Cohen 1974), HD147889, appears in Table IV. Hence, this table is not exhaustive, but it is preferable to confine considerations to the most outstanding cases of diffuse band peculiarities.

As noted earlier, and as found by Herbig (1975), the least-squares fits to the diffuse band correlations tend to intercept the y axis at a positive value, rather than passing through the origin as would be expected if the bands are produced in the same clouds which cause the observed $E(B - V)$ color excesses. As has been pointed out by Smith, Snow, and York (1976), this may be understood as being due to significant diffuse band contributions from low-column-density, (frequently) high-velocity clouds. Several examples of lines of sight containing such clouds may exist; an outstanding case in ρ Leo which has a color excess of 0.08 and as noted by

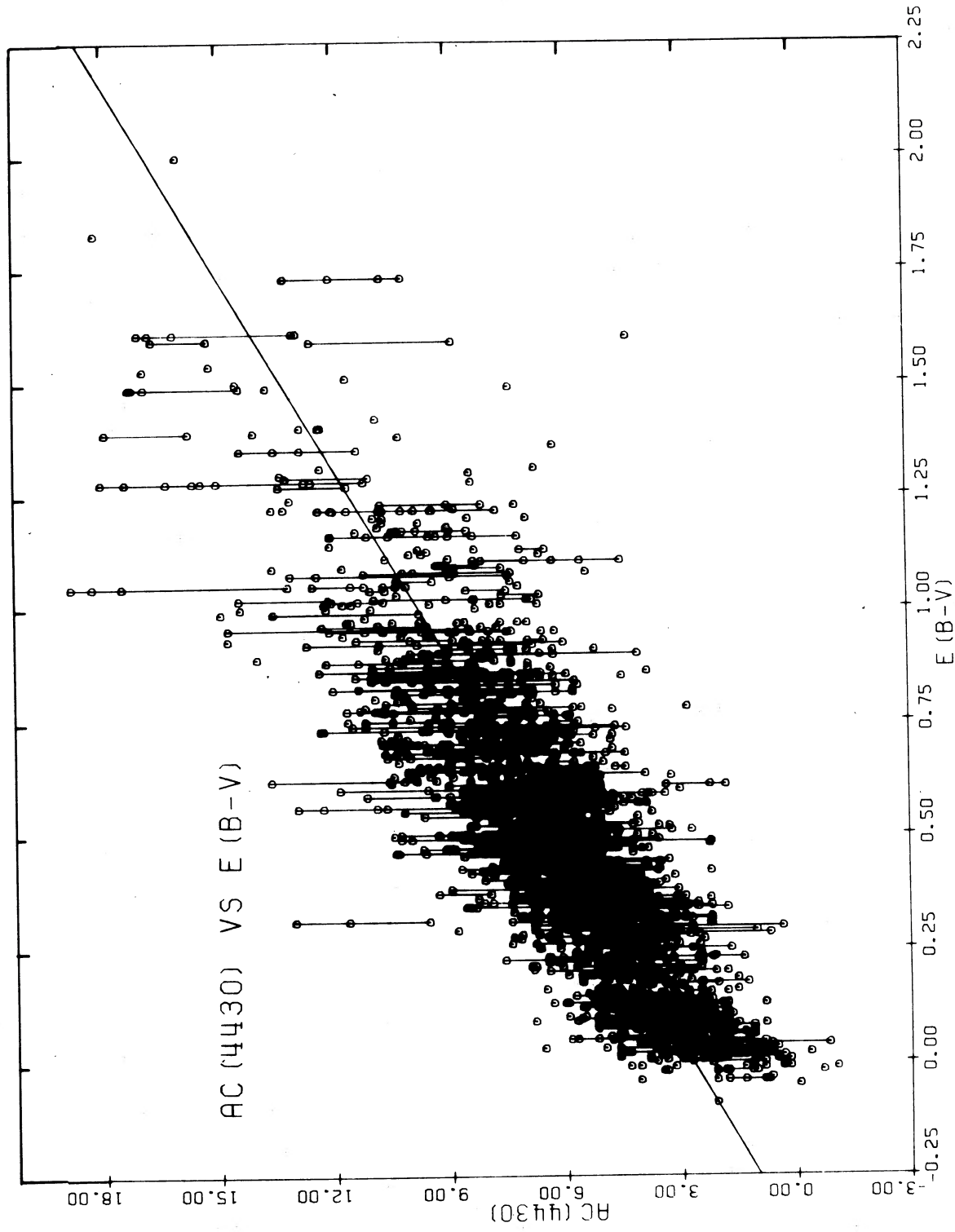


FIG. 1. The correlation of $\lambda 4430$ with $E(B - V)$, for all stars in the catalogue. Multiple measurements for a given star are connected by a vertical line. The diagonal line is the least-squares fit through the data. The rms dispersion σ in this correlation is $A_c(\lambda 4430) = 7.02 E(B - V) + 2.74$.

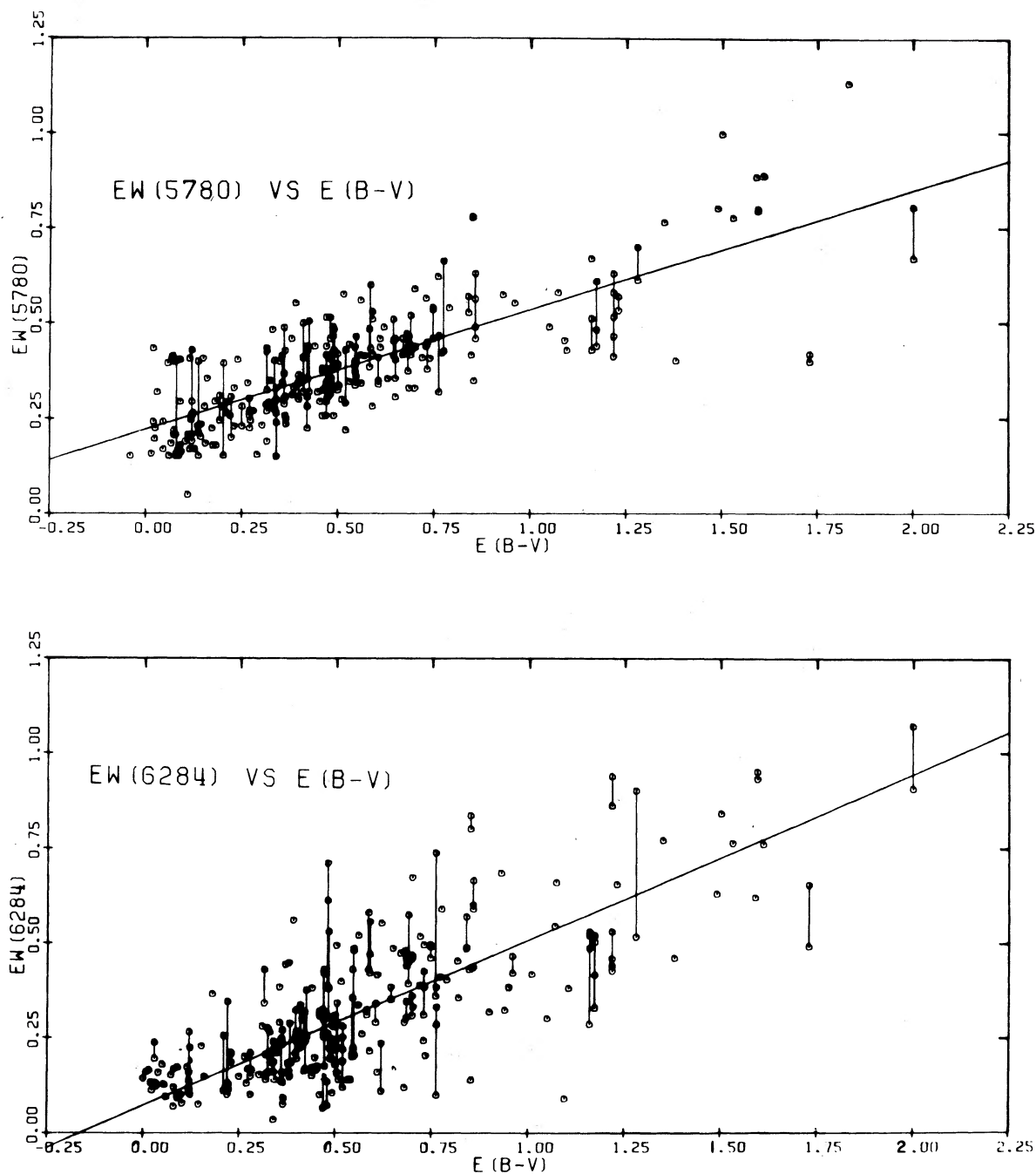


FIG. 2. The correlations of $\lambda\lambda 5780$ and 6284 with $E(B - V)$. The dispersions from the least-squares fits are $\sigma = 0.096 \text{ \AA}$ and $\sigma = 0.174 \text{ \AA}$ (equivalent width), respectively. The equations of the solid lines are $W_{\lambda}(5780) = 0.31 E(B - V) + 0.22$ and $W_{\lambda}(6284) = 0.44 E(B - V) + 0.07$.

several authors (e.g., Duke 1951; Wampler 1966) has a substantial 4430-\AA band. It is well known that ρ Leo shows multiple cloud components with anomalously high Ca II/Na I ratios (Marschall and Hobbs 1972; Hobbs 1974; Siluk and Silk 1974). It may be that enhanced diffuse band contributions from such clouds (often seen only as high-velocity components) are an important

cause of the positive y -axis intercepts of the least-squares fits. This possibility has been discussed in greater detail by Smith, Snow, and York (1976).

It is interesting to note that because the fits were not forced through the origin in the present study, those lightly reddened stars such as ρ Leo which have substantial diffuse band strengths usually thought to be

CATALOGUE OF DIFFUSE INTERSTELLAR BAND MEASUREMENTS 127

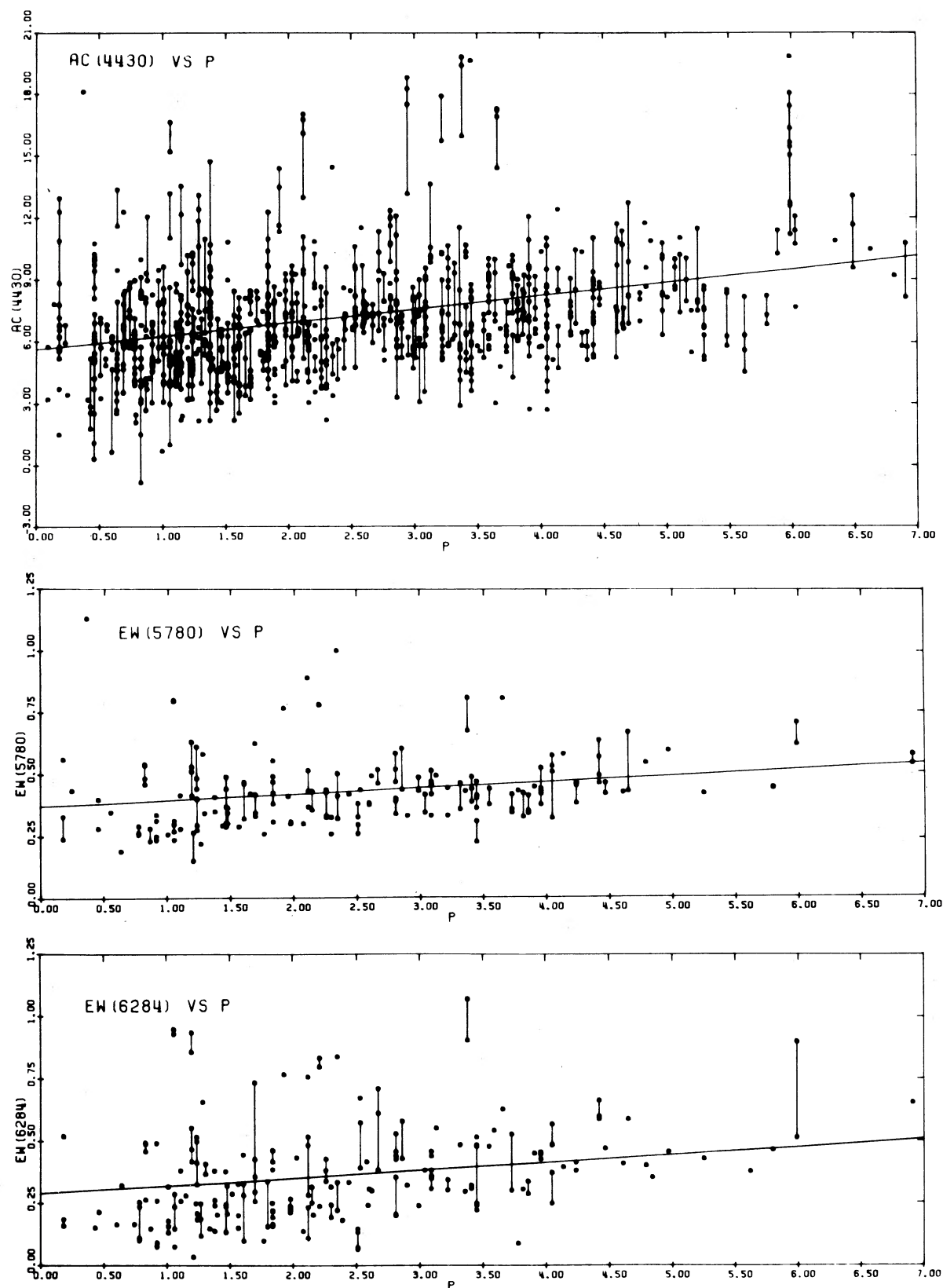


FIG. 3. The correlations of $\lambda\lambda 4430$, 5780, and 6284 with polarization. The dispersions are $\sigma = 2.64\%$, 0.14 \AA , and 0.25 \AA , respectively. The equations of the solid lines are $A_c(4430) = 0.64P + 5.63$; $W_\lambda(5780) = 0.023P + 0.372$; $W_\lambda(6284) = 0.031P + 0.289$.

peculiar, lie within 2σ of the best-fit correlations, and do not appear in Table IV. The relatively low slopes of the fits may also explain the failure of several dark cloud stars to lie more than 2σ below the correlations. In short, it appears that relatively weak bands in lines of sight dominated by a single thick cloud and relatively strong bands in those containing primarily low-mass, lightly reddened clouds are normal.

Figure 3 shows the correlations of $\lambda\lambda 4430, 5780,$ and 6284 with polarization. These plots show little evidence for good correlations, as mentioned by Greenstein and Aller (1950) on the basis of a much smaller data sample. Undoubtedly this lack of correlation is due to the patchiness of grain alignment. One potentially useful aspect of these plots is that they can be used to identify lines of sight which are dominated by a single cloud rather than several clouds. If within a single cloud the polarization is uniform, then strong polarization results in cases where primarily one cloud is observed. The stars in the ρ Ophiuchi region, for example, are distinguishable in this manner in Fig. 3, because they tend to have small ratios of diffuse band strength to polarization.

Help with the data preparation was provided by Messrs. D. Davis and R. Hill. Ms. E. Knudsen did the preliminary programming for the catalogues. Dr. J. Mead provided invaluable assistance in writing magnetic tapes containing positional and photometric data. Mr. T. A. Peck at Sedgwick Printout Systems, Inc., greatly expedited the production of the principal data table. This research has been supported by National Aeronautics and Space Administration contract NAS5-1810 with Princeton University.

REFERENCES

- Baerentzen, J., Gammelgaard, P., Hilberg, T., Jorgenson, K. F., Kristenson, H., Nissen, P. E., and Rudkjobing, M. (1967). *J. Obs.* **50**, 83.
- Baker, E. A. (1949). *Publ. R. Obs. Edin.* **1**, 15.
- Beals, C. S., and Blanchet, G. H. (1938). *Mon. Not. R. Astron. Soc.* **98**, 398.
- Blanco, V. M., Demers, S., Douglas, G. G., and Fitzgerald, M. P. (1968). *Publ. U.S. Naval Obs.* **21**, 1.
- Bromage, G. E., and Nandy, K. (1973). *Astron. Astrophys.* **26**, 17.
- Buscombe, W., and Kennedy, P. M. (1968). *Mon. Not. R. Astron. Soc.* **139**, 417.
- Butler, H. E., and Seddon, H. (1958a). *Publ. R. Obs. Edin.* **2**, 113.
- Bulter, H. E., and Seddon, H. (1958b). *Publ. R. Obs. Edin.* **2**, 187.
- Butler, H. E., and Thompson, G. I. (1958). *Publ. R. Obs. Edin.* **2**, 225.
- Duke, D. (1951). *Astrophys. J.* **113**, 100.
- Gammelgaard, P. (1975). *Astron. Astrophys.* **43**, 85.
- Greenstein, J. L., and Aller, L. H. (1950). *Astrophys. J.* **111**, 328.
- Herbig, G. H. (1975). *Astrophys. J.* **196**, 129.
- Hiltner, W. A. (1956). *Astrophys. J. Suppl.* **2**, 389.
- Hobbs, L. M. (1974). *Astrophys. J.* **191**, 381.
- Johnson, H. L. (1966). *Ann. Rev. Astron. Astrophys.* **4**, 193.
- Kennedy, P. M., and Buscombe W. (1974). *MK Spectral Classifications Published Since Jaschek's La Plata Catalogue* (Northwestern U., Evanston, IL).
- Marionni, P. A. (1971). Unpublished.
- Marshall, L. M., and Hobbs, L. M. (1972). *Astrophys. J.* **173**, 43.
- Merrill, P. W., Sanford, R. F., Wilson, O. C., and Burwell, C. G. (1937). *Astrophys. J.* **86**, 274.
- Murdin, P. (1972). *Mon. Not. R. Astron. Soc.* **157**, 461.
- Serkowski, K., Mathewson, D. S., and Ford, V. L. (1975). *Astrophys. J.* **196**, 261.
- Siluk, R. S., and Silk, J. (1974). *Astrophys. J.* **192**, 51.
- Smith, Wm. H., Snow, T. P., and York, D. G. (1976). Preprint.
- Snedden, C., Gehrtz, R., Hackwell, J. A., York, D. G., and Snow, T. P. In preparation.
- Snow, T. P. (1973). *Astron. J.* **78**, 913.
- Snow, T. P., and Cohen, J. G. (1974). *Astrophys. J.* **194**, 313.
- Stoockly, R., and Dressler, K. (1964). *Astrophys. J.* **139**, 240.
- Underhill, A. B. (1956). *Publ. DAO* **10**, 201.
- Walker, G. A. H. (1963). *Mon. Not. R. Astron. Soc.* **125**, 141.
- Walker, G. A. H., and Hodge, S. M. (1966). *Publ. DAO* **12**, 401.
- Wampler, E. J. (1966). *Astrophys. J.* **144**, 921.
- Wu, C.-C. (1972). *Astrophys. J.* **178**, 681.
- Wu, C.-C., van Duinen, R. J., Snow T. P., and York, D. G. (1977). In preparation.
- York, D. G. (1971). *Astrophys. J.* **166**, 65.

Note added in proof: Due to a problem in obtaining a final version of the catalogue, magnitudes for some stars were omitted. They may be obtained from references cited. Complete printouts are available from the authors. The magnitude of HD 3360 should be 3.7.

THEODORE P. SNOW AND DONALD G. YORK: Princeton University Observatory, Princeton, New Jersey 08540

DANIEL E. WELTY: Department of Astrophysics, University of Chicago, Chicago, Illinois 60637