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PHOTOMETRIC CLASSIFICATION OF STARS AND THE INTERSTELLAR EXTINCTION NEAR THE CAMELOPARDALIS AND PERSEUS BORDER

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Abstract. 157 stars down to 11th mag in a 3°×4° area at ℓ=149°, b = −0.3° have been measured in the Vilnius photometric system. Magnitudes V, color indices, spectral classes, absolute magnitudes, color excesses and distances of the stars are determined. The interstellar extinction in all the area appears at a distance of about 100 pc, grows monotonically and at a distance of 500 pc it reaches ∼2 mag in the area of the dark cloud L 1391 and 0.7–1.7 mag in the remaining area. At larger distances the extinction is affected by a selection effect.

Key words: interstellar medium: clouds, extinction – stars: fundamental parameters, distances – techniques: photometric

1. INTRODUCTION

The Camelopardalis dark clouds, which occupy a large area north of the galactic equator (between the galactic longitudes 141–150°), is still a poorly investigated area. The distances of the clouds and their extinctions are known with a low accuracy and only in some occasional directions.

Some years ago, we started a systematic photometric investigation of stars in the Camelopardalis area in order to get more exact distances and absorbing properties of the clouds. In the first paper by Zdanavičius, Zdanavičius and Kazlauskas (1996, Paper I) a 3×3 sq. deg area near the corner of Camelopardalis, Cassiopeia and

Perseus, with the center at $\ell = 143°$, $b = +1.5°$, was investigated. In the present paper we investigate an area of similar size with the center at $\ell = 148.5°$, $b = -1.0°$, located about ~7° south-east of the first area. The new area is limited by the coordinates RA(2000) = $3^h45^m - 4^h03^m$ and DEC(2000) = +50°51′ – +54°24′. Its northern half is in the Camelopardalis and the southern half is in the Perseus constellation.

The area contains several interesting objects – a H II region S 205 (Sharpless 1959), ionized by the O8 star HD 24451 and open clusters NGC 1444 and King 7. Another H II region, S 206, is located near the south-east border of the investigated area. The Lynds (1965) catalog of bright nebulae lists the following H II regions: S 205, S 206 and L 148.11-0.45. In other sources the last nebula is considered as an extension of S 205. According to Fich & Blitz (1984), the galactic coordinates of S 205 are $\ell = 148.84°$, $b = -1.24°$ and its distance from the Sun is 900 pc. The nebula S 206 is at $\ell = 150.68°$, $b = -0.77°$, its distance is 3.3 kpc, i.e., it is located in the Perseus spiral arm.

No detailed study of the extinction in the area have been done so far. Only crude estimates of the extinction in large areas near the galactic equator have been done by FitzGerald (1968) and Neckel & Klare (1980). According to the last work, in the direction of $\ell = 148°$, $b = -1°$ the extinction A_V grows up to ~3.5 mag at 1 kpc and probably does not increase any more with increasing distance. The absence of additional extinction beyond 2 kpc in the direction of $\ell = 150$–$210°$ was confirmed by Moffat et al. (1979) and Fich & Blitz (1984). Rydström (1978) has investigated the interstellar extinction in a number of areas in Camelopardalis by using a spectrophotometric method. For the area at $\ell = 148°$, $b = +1°$, which is the closest to the area investigated in the present paper, Rydström obtains zero extinction up to 100 pc and $A_V \approx 2.0$ mag at 1 kpc.

Our area almost coincides with the Champ 11 of the investigation of fields along the galactic equator initiated many years ago by Boulon, Duflot & Fehrenbach (1958), Bouigue (1959) and Bouigue, Boulon & Pedoussaut (1961). These authors have determined MK spectral types, magnitudes V and color indices B–V for 70 BD stars in the area.

A glance at the E and O copies of the Palomar Atlas shows that the northern part of our area is covered by a dark cloud which extends here from the north and west directions. In the Khavtassi (1960) catalog of dark clouds all this huge cloud is marked as number

241. The Lynds (1962) catalog of dark clouds identifies a smaller cloud, L 1391, in the area.

2. OBSERVATIONS AND REDUCTIONS

The observations were done in 1996 and 1997 by J. Zdanavičius and K. Zdanavičius with the 1.65 m telescope at the Molėtai Observatory in Lithuania and in 1996 by K. Černis with the 1 m telescope at the Maidanak Observatory in Uzbekistan.

At the Molėtai Observatory a single-channel photometer with a permanently rotating filter wheel, containing seven filters of the Vilnius system, and a thermoelectrically cooled photomultiplier FEU-79 were used. The photometer works in the photon counting mode. To track the changes of atmospheric transparency during a night, a comparison star BD+51 798 (G0 V) was observed frequently. For obtaining the transformation equations to the standard Vilnius system, stars from the standard regions SA 4 (Černis & Jasevičius 1992) and SA 64 (Zdanavičius et al. 1978) were observed. Some common stars observed at the Maidanak Observatory were used for reductions of the Molėtai observations to the standard system. Observations at the Maidanak Observatory were done by a similar photometer, but without permanent rotation of filters.

Reductions of the magnitudes and color indices to outside the atmosphere were made both with constant and time-dependent atmospheric extinction coefficients. The latter were obtained from observations of the extinction star. Since the comparison star and the program stars are close, their air mass differences are always small. As a result, there was no difference between the results obtained in each way. In both cases the extinction corrections depending on star's spectral class and luminosity were included (Zdanavičius 1975, 1996). The instrumental color indices were transformed to the standard system.

The results are presented in Table 1 which gives the following information: the identification number (shown on the chart in Fig. 1), BD and HD (HDE) numbers, right ascension and declination (2000), V magnitude, color indices (six columns), and the number of independent observations n. The line below gives the rms errors of the magnitudes and color indices. For the majority of stars the limiting magnitude is close to 11.0 mag. Only some fainter stars have been measured.

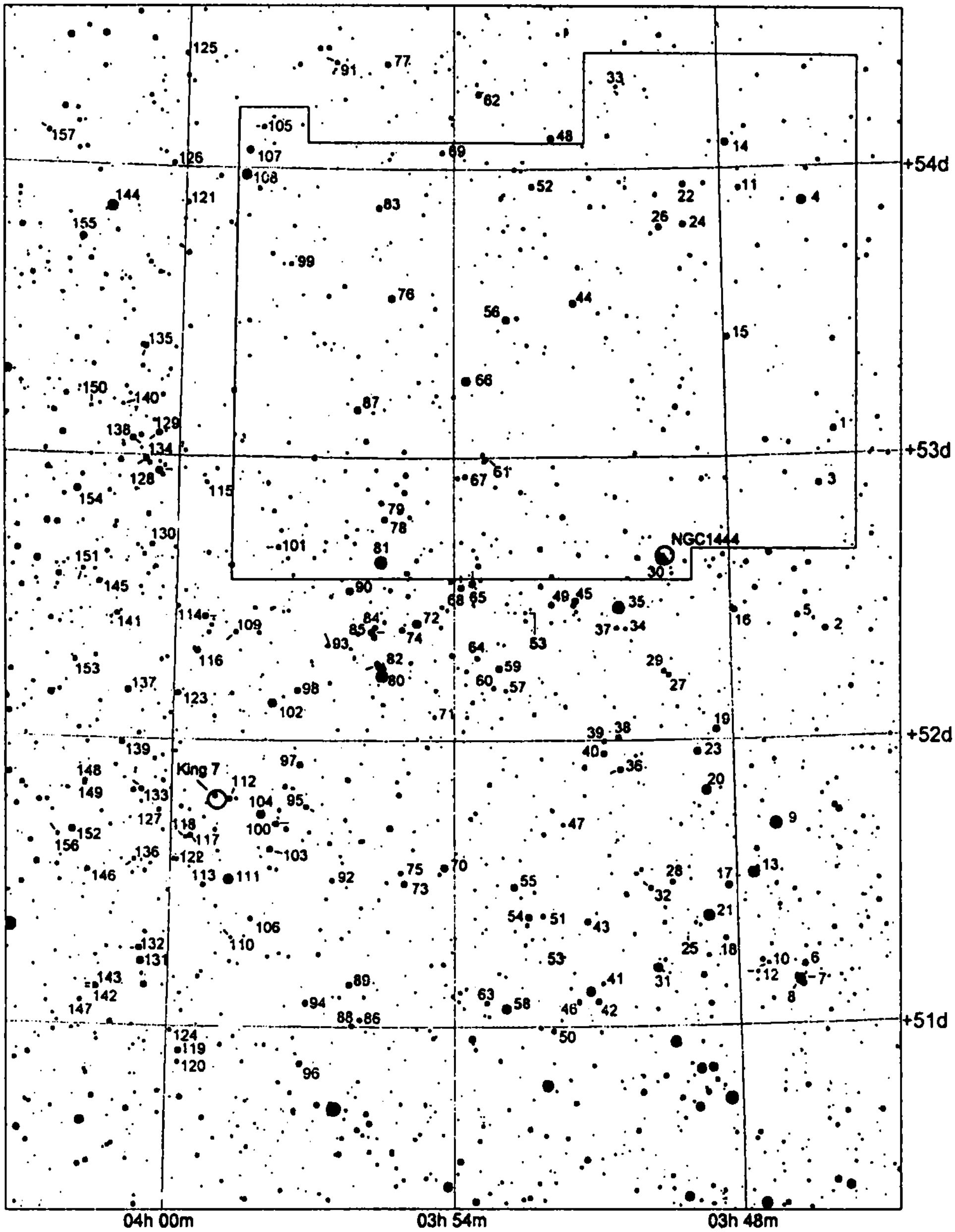

Fig. 1. The identification chart. The coordinates are for the 2000.0 epoch. The rectangle limits the dark cloud area. The open clusters NGC 1444 and King 7 are shown.

Table 1. Results of photometry in the Vilnius system.

No.	BD	HD HDE	α(2000) h m s	δ(2000) ° ′ ″	*V*	*U–V*	*P–V*	*X–V*	*Y–V*	*Z–V*	*V–S*	*n*
1.	52 710		3 45 36.3	53 06 01	9.665	3.359	2.299	1.416	0.780	0.273	0.660	3
					0.014	0.018	0.012	0.003	0.008	0.012	0.004	
2.	51 770	232830	3 45 57.3	52 23 52	9.298	2.370	1.860	1.218	0.536	0.197	0.500	2
					0.024	0.006	0.004	0.004	0.003	0.003	0.004	
3.	52 711	23243	3 45 58.5	52 55 02	9.065	2.810	1.976	1.106	0.581	0.215	0.469	3
					0.014	0.006	0.004	0.004	0.003	0.004	0.005	
4.	53 698	232892	3 46 06.3	53 54 20	8.088	6.820	5.792	4.066	1.719	0.695	1.581	2
					0.011	0.034	0.017	0.008	0.002	0.002	0.004	
5.	51 773	232832	3 46 32.2	52 26 48	9.891	2.411	1.900	1.265	0.531	0.207	0.522	3
					0.037	0.006	0.005	0.013	0.004	0.005	0.014	
6.	50 816	232833	3 46 40.7	51 12 10	9.958	2.224	1.647	0.778	0.329	0.117	0.237	3
					0.027	0.005	0.008	0.014	0.011	0.013	0.008	
7.	50 818		3 46 46.0	51 09 15	9.360	2.379	1.831	1.190	0.544	0.192	0.504	3
					0.041	0.004	0.008	0.007	0.007	0.008	0.008	
8.	50 819		3 46 48.0	51 08 28	9.652	1.899	1.420	0.782	0.426	0.163	0.331	3
					0.051	0.007	0.011	0.006	0.009	0.011	0.009	
9.	51 774	23384	3 47 10.7	51 42 24	6.875	2.080	1.580	0.942	0.398	0.148	0.364	3
					0.016	0.004	0.003	0.003	0.001	0.001	0.003	
10.	50 820		3 47 26.3	51 12 25	11.090	2.651	2.230	1.547	0.645	0.261	0.597	3
					0.053	0.016	0.016	0.014	0.014	0.008	0.017	
11.	53 699	232834	3 47 31.5	53 57 00	10.255	3.314	2.879	1.944	0.688	0.381	0.753	2
					0.011	0.012	0.010	0.010	0.004	0.004	0.005	
12.	50 821		3 47 40.1	51 10 37	11.040	2.735	2.239	1.513	0.628	0.250	0.621	3
					0.018	0.021	0.017	0.012	0.006	0.006	0.007	
13.	51 775		3 47 40.2	51 31 46	7.306	2.116	1.532	0.676	0.291	0.110	0.217	3
					0.016	0.004	0.003	0.003	0.001	0.001	0.003	
14.	53 700	232836	3 47 47.7	54 06 43	9.086	2.229	1.778	1.231	0.517	0.195	0.521	2
					0.011	0.005	0.004	0.005	0.005	0.006	0.004	
15.	52 712	232837	3 47 52.8	53 25 35	9.359	2.439	1.954	1.312	0.555	0.225	0.536	2
					0.004	0.005	0.006	0.003	0.004	0.008	0.004	
16.	52 713	232838	3 47 54.3	52 28 09	9.828	3.502	3.055	2.045	0.711	0.410	0.760	2
					0.004	0.008	0.006	0.015	0.009	0.013	0.004	
17.	51 776	232839	3 48 13.1	51 29 07	9.593	4.038	3.409	2.349	0.930	0.381	0.883	3
					0.010	0.024	0.009	0.006	0.003	0.002	0.003	
18.	50 824		3 48 18.5	51 17 49	10.453	4.751	4.005	2.745	1.100	0.469	0.980	3
					0.017	0.053	0.055	0.027	0.004	0.004	0.006	
19.	51 777	23524	3 48 22.9	52 02 18	8.675	2.709	2.270	1.581	0.633	0.279	0.636	2
					0.010	0.005	0.004	0.005	0.002	0.002	0.003	
20.	51 778	23565	3 48 37.6	51 49 25	7.671	2.625	2.145	1.455	0.587	0.234	0.568	2
					0.010	0.004	0.003	0.004	0.002	0.002	0.003	
21.	50 828	23581	3 48 39.6	51 22 34	7.226	4.052	3.460	2.390	0.899	0.399	0.838	3
					0.366	0.015	0.022	0.016	0.011	0.021	0.014	

Table 1 (continued)

No.	BD	HD HDE	α(2000) h m s	δ(2000) ° ′ ″	V	U–V	P–V	X–V	Y–V	Z–V	V–S	n
22.	53 701	232840	3 48 47.0	53 57 59	9.481	2.619	1.924	0.994	0.466	0.166	0.360	2
					0.012	0.006	0.005	0.004	0.007	0.004	0.005	
23.	51 779	232843	3 48 47.5	51 57 41	8.631	3.908	3.306	2.273	0.889	0.378	0.834	2
					0.011	0.009	0.007	0.005	0.002	0.002	0.003	
24.	53 702	232841	3 48 48.0	53 49 19	9.435	2.520	1.902	1.134	0.506	0.184	0.459	2
					0.011	0.006	0.005	0.004	0.005	0.004	0.004	
25.			3 49 06.1	51 18 46	12.955	2.983	2.266	1.325	0.637	0.233	0.517	11
					0.034	0.043	0.020	0.018	0.019	0.019	0.019	
26.	53 703		3 49 20.3	53 48 52	10.162	5.942	5.038	3.524	1.420	0.604	1.269	2
					0.011	0.095	0.059	0.028	0.004	0.004	0.004	
27.	51 780		3 49 21.3	52 14 08	10.394	2.615	2.067	1.424	0.640	0.239	0.603	3
					0.010	0.012	0.006	0.005	0.003	0.003	0.004	
28.	51 782		3 49 23.8	51 29 55	10.514	4.019	3.418	2.392	1.023	0.390	0.911	2
					0.011	0.040	0.029	0.026	0.006	0.005	0.004	
29.	51 781		3 49 27.2	52 14 51	10.179	2.488	1.844	1.020	0.438	0.156	0.368	3
					0.010	0.009	0.004	0.004	0.004	0.002	0.004	
30.	52 714	23675	3 49 27.6	52 39 21	6.745	1.516	1.186	0.934	0.538	0.185	0.444	2
					0.004	0.009	0.012	0.019	0.004	0.009	0.004	
31.	50 835	23727	3 49 44.8	51 11 47	8.934	2.618	1.751	0.904	0.490	0.196	0.375	2
					0.033	0.008	0.021	0.016	0.010	0.023	0.015	
32.	51 783		3 49 52.0	51 28 34	10.252	2.376	1.843	1.177	0.515	0.189	0.489	2
					0.011	0.008	0.007	0.009	0.004	0.004	0.005	
33.	53 704		3 50 15.3	54 18 42	10.928	2.461	1.836	1.050	0.542	0.201	0.425	2
					0.012	0.011	0.009	0.008	0.005	0.005	0.007	
34.	51 784	232845	3 50 16.7	52 24 03	10.733	1.723	1.387	0.898	0.497	0.184	0.357	2
					0.012	0.012	0.012	0.010	0.006	0.005	0.005	
35.	52 715	23800	3 50 25.1	52 28 56	6.910	1.500	1.151	0.849	0.488	0.185	0.421	3
					0.007	0.006	0.009	0.009	0.006	0.004	0.007	
36.	51 787		3 50 28.1	51 53 53	9.911	4.393	3.702	2.522	1.019	0.407	0.935	3
					0.015	0.030	0.023	0.018	0.012	0.012	0.010	
37.	51 785		3 50 28.9	52 24 15	10.419	4.882	4.127	2.887	1.163	0.464	1.040	3
					0.010	0.054	0.050	0.026	0.003	0.003	0.004	
38.	51 786		3 50 29.0	52 00 33	9.682	2.417	1.837	1.109	0.501	0.187	0.457	3
					0.032	0.015	0.016	0.014	0.012	0.015	0.013	
39.	51 788		3 50 47.4	51 59 44	10.545	3.636	3.084	2.072	0.790	0.352	0.799	3
					0.015	0.021	0.014	0.010	0.005	0.007	0.007	
40.	51 789		3 50 48.5	51 57 14	9.386	2.508	1.783	0.857	0.398	0.153	0.305	3
					0.015	0.010	0.010	0.006	0.004	0.006	0.007	
41.	50 838		3 50 54.5	51 08 27	11.140	2.855	1.972	1.044	0.558	0.212	0.414	2
					0.029	0.025	0.025	0.025	0.020	0.021	0.025	
42.	50 839		3 51 01.8	51 04 43	9.963	2.360	1.784	0.908	0.384	0.148	0.302	3
					0.017	0.008	0.006	0.005	0.004	0.006	0.008	

Table 1 (continued)

No.	BD	HD HDE	α(2000) h m s	δ(2000) ° ′ ″	V	U–V	P–V	X–V	Y–V	Z–V	V–S	n
43.	50 840	232849	3 51 13.3	51 21 32	9.638	2.339	1.702	0.852	0.382	0.138	0.259	2
					0.086	0.014	0.023	0.017	0.015	0.029	0.013	
44.	53 705	232847	3 51 18.5	53 32 40	9.006	2.697	2.282	1.552	0.604	0.257	0.623	2
					0.010	0.005	0.004	0.004	0.002	0.003	0.003	
45.	52 716	23933	3 51 22.0	52 30 17	8.691	2.456	1.814	0.979	0.430	0.154	0.340	3
					0.007	0.024	0.023	0.013	0.009	0.007	0.009	
46.	50 842		3 51 25.9	51 04 38	10.694	3.062	2.269	1.318	0.623	0.222	0.503	2
					0.012	0.014	0.010	0.008	0.006	0.006	0.005	
47.	51 790		3 51 42.6	51 42 04	11.049	3.532	2.971	2.068	0.823	0.370	0.826	3
					0.017	0.041	0.050	0.037	0.017	0.015	0.011	
48.	53 706	23945	3 51 45.7	54 07 37	8.613	2.163	1.627	0.907	0.375	0.139	0.342	2
					0.010	0.004	0.004	0.004	0.002	0.002	0.003	
49.	52 717		3 51 52.8	52 29 27	9.804	4.401	3.823	2.639	1.029	0.412	0.926	2
					0.006	0.007	0.053	0.032	0.026	0.003	0.007	
50.	50 845		3 51 58.6	50 58 26	10.410	2.491	2.034	1.376	0.601	0.235	0.554	3
					0.031	0.007	0.010	0.017	0.015	0.033	0.013	
51.	50 846		3 52 09.9	51 22 37	10.446	2.273	1.763	1.146	0.542	0.203	0.477	2
					0.203	0.008	0.025	0.017	0.010	0.024	0.017	
52.	53 707		3 52 12.6	53 57 23	9.829	3.107	2.281	1.276	0.606	0.214	0.510	2
					0.012	0.009	0.005	0.005	0.002	0.006	0.004	
53.	52 718		3 52 28.4	52 27 35	10.753	2.957	2.402	1.691	0.740	0.290	0.696	2
					0.014	0.024	0.043	0.016	0.009	0.016	0.034	
54.	50 848	232850	3 52 28.7	51 22 27	9.296	2.362	1.840	1.177	0.543	0.209	0.477	4
					0.083	0.012	0.021	0.019	0.011	0.020	0.014	
55.	51 792	232851	3 52 46.6	51 28 52	9.325	4.453	3.348	2.307	1.118	0.426	1.020	3
					0.035	0.027	0.024	0.022	0.017	0.013	0.011	
56.	53 708	24094	3 52 49.0	53 29 02	8.317	1.599	1.318	0.989	0.558	0.209	0.448	2
					0.018	0.004	0.004	0.003	0.002	0.004	0.004	
57.	51 791		3 52 54.5	52 10 37	10.907	2.535	1.795	0.920	0.453	0.157	0.377	2
					0.016	0.031	0.020	0.014	0.017	0.018	0.012	
58.	50 849	24129	3 52 58.3	51 03 04	7.857	1.637	1.169	0.604	0.333	0.127	0.252	3
					0.036	0.011	0.021	0.021	0.012	0.019	0.013	
59.	51 793	24142	3 53 02.6	52 15 20	8.407	3.647	3.032	2.091	0.869	0.337	0.813	3
					0.007	0.016	0.014	0.016	0.013	0.009	0.004	
60.	51 794		3 53 09.8	52 11 07	10.315	1.954	1.466	0.831	0.439	0.165	0.352	3
					0.008	0.012	0.010	0.008	0.006	0.007	0.008	
61.	52 719		3 53 17.9	53 00 42	10.927	2.939	2.145	1.186	0.590	0.220	0.452	3
					0.014	0.010	0.012	0.006	0.006	0.004	0.004	
62.	53 709		3 53 23.3	54 17 04	9.970	5.290	4.529	3.104	1.180	0.561	1.063	2
					0.011	0.045	0.029	0.021	0.004	0.005	0.004	
63.	50 850		3 53 23.7	51 04 20	10.428	2.258	1.795	1.197	0.547	0.206	0.472	2
					0.125	0.009	0.022	0.017	0.010	0.018	0.013	

Table 1 (continued)

No.	BD	HD HDE	α(2000) h m s	δ(2000) ° ′ ″	V	U–V	P–V	X–V	Y–V	Z–V	V–S	n
64.	51 795		3 53 31.4	52 17 35	10.120	2.677	2.047	1.253	0.565	0.240	0.508	3
					0.008	0.013	0.016	0.011	0.012	0.017	0.007	
65.	52 720	24189	3 53 37.4	52 33 48	8.426	2.323	1.867	1.246	0.537	0.201	0.510	2
					0.004	0.047	0.013	0.020	0.011	0.010	0.009	
66.	52 722	24203	3 53 43.8	53 16 25	8.159	2.392	1.979	1.376	0.566	0.226	0.551	3
					0.008	0.011	0.006	0.017	0.009	0.011	0.009	
67.	52 721		3 53 44.8	52 56 36	10.120	3.435	3.023	2.034	0.690	0.413	0.728	1
					0.038	0.032	0.020	0.012	0.015	0.010	0.009	
68.	52 723	232852	3 53 51.8	52 33 00	9.482	2.861	2.435	1.616	0.615	0.268	0.599	2
					0.018	0.007	0.016	0.024	0.014	0.007	0.005	
69.	53 710		3 54 14.2	54 04 28	10.299	1.821	1.471	1.037	0.562	0.215	0.458	2
					0.012	0.006	0.006	0.006	0.004	0.005	0.005	
70.	51 796	24275	3 54 16.6	51 32 58	8.535	2.461	1.701	0.787	0.358	0.137	0.276	2
					0.011	0.005	0.004	0.004	0.003	0.002	0.004	
71.	51 797		3 54 27.8	52 04 48	10.767	3.614	3.033	2.111	0.862	0.342	0.809	3
					0.012	0.034	0.023	0.019	0.004	0.007	0.006	
72.	51 798	24341	3 54 51.1	52 25 15	7.853	2.501	2.058	1.448	0.612	0.235	0.587	st
					0.018	0.008	0.009	0.007	0.005	0.008	0.006	
73.	51 800	232855	3 55 08.2	51 29 26	9.473	3.912	3.272	2.255	0.922	0.364	0.855	2
					0.011	0.015	0.011	0.007	0.004	0.003	0.005	
74.	51 799	24376	3 55 09.9	52 23 43	9.252	2.104	1.528	0.702	0.314	0.116	0.226	3
					0.023	0.025	0.016	0.019	0.015	0.014	0.024	
75.	51 801		3 55 11.6	51 31 42	9.982	2.695	1.999	1.163	0.501	0.195	0.455	2
					0.012	0.009	0.006	0.006	0.003	0.003	0.004	
76.	53 712	24386	3 55 23.1	53 33 28	8.471	2.193	1.738	1.190	0.499	0.190	0.495	2
					0.011	0.004	0.004	0.003	0.002	0.003	0.003	
77.	53 711		3 55 28.4	54 23 09	9.945	5.044	4.318	2.944	1.163	0.498	1.025	2
					0.014	0.038	0.025	0.019	0.006	0.005	0.007	
78.	52 724	232857	3 55 32.6	52 47 25	9.479	2.252	1.808	1.207	0.509	0.191	0.514	2
					0.015	0.010	0.008	0.003	0.008	0.006	0.007	
79.	52 725		3 55 36.9	52 50 55	10.335	2.665	2.236	1.500	0.595	0.256	0.581	3
					0.014	0.007	0.006	0.014	0.005	0.003	0.004	
80.	51 803	24421	3 55 37.1	52 13 38	6.793	2.204	1.734	1.181	0.509	0.194	0.491	2
					0.010	0.005	0.003	0.003	0.003	0.002	0.004	
81.	52 726	24431	3 55 38.5	52 38 30	6.702	1.421	1.132	0.898	0.530	0.183	0.429	4
					0.015	0.006	0.008	0.009	0.009	0.003	0.009	
82.	51 802	232858	3 55 38.8	52 15 39	8.558	2.375	1.802	1.004	0.430	0.157	0.375	4
					0.011	0.008	0.012	0.010	0.007	0.008	0.004	
83.	53 713	232856	3 55 39.6	53 52 42	9.455	2.338	1.858	1.255	0.533	0.205	0.514	2
					0.011	0.005	0.004	0.004	0.002	0.004	0.004	
84.	51 804	232859	3 55 45.6	52 24 08	9.306	1.983	1.394	0.718	0.375	0.143	0.302	3
					0.029	0.038	0.028	0.027	0.027	0.027	0.028	

Table 1 (continued)

No.	BD	HD HDE	α(2000) h m s	δ(2000) ° ′ ″	V	U–V	P–V	X–V	Y–V	Z–V	V–S	n
85.	51 805		3 55 50.4	52 23 12	9.100	5.250	4.531	3.112	1.217	0.513	1.112	3
					0.008	0.041	0.018	0.010	0.005	0.006	0.008	
86.	50 857		3 56 04.2	51 00 30	10.309	1.957	1.449	0.860	0.482	0.179	0.383	3
					0.025	0.013	0.012	0.011	0.008	0.007	0.006	
87.	52 727		3 56 08.2	53 10 12	9.150	6.046	5.196	3.616	1.410	0.622	1.254	3
					0.014	0.036	0.030	0.007	0.003	0.004	0.002	
88.	50 858		3 56 14.8	50 59 21	10.649	2.650	1.991	1.311	0.606	0.231	0.528	3
					0.025	0.015	0.012	0.012	0.008	0.007	0.005	
89.	50 859		3 56 18.2	51 07 59	9.839	2.071	1.557	0.927	0.506	0.205	0.379	3
					0.021	0.007	0.008	0.008	0.004	0.016	0.005	
90.	52 728	24503	3 56 18.6	52 32 06	8.919	2.355	1.704	0.845	0.381	0.107	0.311	2
					0.010	0.007	0.058	0.033	0.020	0.022	0.018	
91.	53 714		3 56 37.9	54 23 32	10.232	2.737	2.075	1.232	0.533	0.196	0.436	2
					0.013	0.008	0.008	0.007	0.003	0.006	0.006	
92.	51 806		3 56 40.3	51 30 01	10.468	2.776	2.060	1.268	0.578	0.229	0.502	2
					0.012	0.010	0.009	0.009	0.005	0.005	0.005	
93.	51 807		3 56 47.0	52 20 12	10.668	2.398	1.890	1.257	0.579	0.213	0.531	3
					0.008	0.012	0.012	0.009	0.009	0.011	0.007	
94.	50 863		3 57 12.4	51 04 00	9.579	1.975	1.469	0.812	0.429	0.164	0.312	3
					0.014	0.006	0.008	0.007	0.004	0.007	0.005	
95.	51 808		3 57 13.3	51 45 39	10.223	5.651	4.874	3.429	1.366	0.601	1.266	3
					0.012	0.122	0.090	0.021	0.007	0.006	0.004	
96.	50 864	232862	3 57 19.9	50 51 21	9.571	3.095	2.708	1.875	0.695	0.349	0.728	3
					0.025	0.020	0.009	0.007	0.004	0.006	0.005	
97.	51 809		3 57 22.5	51 54 33	9.660	2.068	1.485	0.680	0.269	0.111	0.260	2
					0.013	0.008	0.007	0.008	0.005	0.004	0.006	
98.	51 810	232861	3 57 25.7	52 10 24	9.708	2.462	1.801	0.861	0.377	0.139	0.293	2
					0.011	0.009	0.005	0.005	0.003	0.003	0.004	
99.	53 715		3 57 37.0	53 40 28	10.683	2.511	1.888	1.078	0.551	0.186	0.430	2
					0.013	0.008	0.007	0.007	0.007	0.010	0.009	
100.	51 811		3 57 51.3	51 41 53	9.797	2.723	2.135	1.450	0.649	0.240	0.595	2
					0.011	0.010	0.008	0.006	0.004	0.003	0.004	
101.	52 729		3 57 51.5	52 41 26	10.102	2.756	2.229	1.738	1.012	0.362	0.847	3
					0.014	0.012	0.006	0.007	0.003	0.007	0.003	
102.	51 812	24688	3 57 58.1	52 07 42	8.011	3.504	2.919	2.003	0.802	0.310	0.743	2
					0.010	0.008	0.004	0.004	0.002	0.001	0.004	
103.	51 813		3 57 59.8	51 36 33	10.088	2.582	2.016	1.352	0.608	0.246	0.534	2
					0.011	0.009	0.007	0.006	0.004	0.004	0.005	
104.	51 814	24708	3 58 10.8	51 44 01	8.188	2.319	1.702	0.954	0.408	0.154	0.372	2
					0.010	0.004	0.004	0.003	0.002	0.002	0.004	
105.	53 716		3 58 16.0	54 09 27	10.345	2.440	1.826	1.116	0.603	0.224	0.487	2
					0.011	0.009	0.007	0.007	0.004	0.007	0.005	

Table 1 (continued)

No.	BD	HD HDE	α(2000) h m s	δ(2000) ° ′ ″	V	U–V	P–V	X–V	Y–V	Z–V	V–S	n
106.	50 866		3 58 22.5	51 21 40	10.828	2.595	2.092	1.434	0.605	0.240	0.564	3
					0.038	0.019	0.019	0.019	0.018	0.024	0.019	
107.	53 717	24723	3 58 35.3	54 04 31	8.301	2.463	1.813	0.889	0.374	0.137	0.289	2
					0.012	0.004	0.004	0.004	0.002	0.002	0.005	
108.	53 718	24733	3 58 38.2	53 59 21	6.928	2.454	1.729	0.819	0.343	0.126	0.283	2
					0.012	0.004	0.003	0.004	0.001	0.002	0.004	
109.	51 815		3 58 45.5	52 22 51	10.371	1.332	1.061	0.665	0.354	0.131	0.298	2
					0.012	0.009	0.004	0.009	0.009	0.009	0.004	
110.	50 868		3 58 46.8	51 17 29	11.849	3.965	3.289	2.250	0.937	0.340	0.916	3
					0.022	0.077	0.039	0.036	0.024	0.014	0.011	
111.	51 817	24775	3 58 50.9	51 29 57	7.726	5.100	4.328	3.044	1.234	0.541	1.157	2
					0.010	0.008	0.007	0.006	0.002	0.002	0.004	
112.	51 816		3 58 51.1	51 47 09	9.812	2.531	1.888	1.121	0.483	0.187	0.423	2
					0.011	0.009	0.007	0.006	0.003	0.006	0.004	
113.	51 818		3 59 23.5	51 28 43	10.361	2.908	2.091	1.098	0.520	0.187	0.420	3
					0.011	0.015	0.006	0.005	0.003	0.004	0.004	
114.	52 730	232863	3 59 24.8	52 26 13	9.862	3.750	3.112	2.157	0.887	0.347	0.829	3
					0.014	0.018	0.011	0.007	0.004	0.005	0.003	
115.	52 731		3 59 25.5	52 54 41	10.962	2.561	1.986	1.300	0.602	0.229	0.555	3
					0.015	0.009	0.011	0.007	0.005	0.004	0.005	
116.	51 819	232864	3 59 34.5	52 18 46	9.451	1.385	1.094	0.670	0.360	0.137	0.284	2
					0.012	0.005	0.005	0.004	0.002	0.002	0.004	
117.	51 820	232865	3 59 40.5	51 39 13	9.842	4.007	3.344	2.307	0.931	0.363	0.849	3
					0.010	0.012	0.008	0.011	0.002	0.002	0.004	
118.	51 821		3 59 46.1	51 38 52	11.009	2.474	1.849	1.055	0.444	0.161	0.366	1
					0.021	0.026	0.024	0.023	0.015	0.015	0.018	
119.	50 871	232866	3 59 50.8	50 53 39	9.994	2.650	2.246	1.559	0.631	0.275	0.584	2
					0.042	0.009	0.024	0.031	0.014	0.028	0.027	
120.	50 870		3 59 51.2	50 51 16	10.541	2.416	1.780	0.912	0.399	0.149	0.255	2
					0.046	0.019	0.022	0.031	0.033	0.026	0.014	
121.	53 719		3 59 56.2	53 53 15	10.609	2.759	2.013	1.087	0.544	0.185	0.447	2
					0.013	0.008	0.007	0.005	0.003	0.004	0.006	
122.	51 823		3 59 56.3	51 34 02	11.234	1.715	1.328	0.792	0.407	0.142	0.360	2
					0.014	0.010	0.009	0.010	0.008	0.008	0.010	
123.	51 822		3 59 59.3	52 09 27	9.802	3.256	2.794	1.969	0.863	0.347	0.824	1
					0.012	0.014	0.015	0.013	0.005	0.005	0.007	
124.	50 872		4 00 01.5	50 57 56	11.232	2.766	2.082	1.209	0.559	0.213	0.441	3
					0.018	0.018	0.016	0.009	0.006	0.007	0.017	
125.	53 720		4 00 01.6	54 24 49	10.106	3.853	3.219	2.269	1.001	0.384	0.954	2
					0.013	0.011	0.011	0.009	0.004	0.007	0.006	
126.	53 721		4 00 16.5	54 01 21	10.564	2.871	2.324	1.609	0.742	0.271	0.672	2
					0.012	0.011	0.009	0.008	0.004	0.005	0.006	

Table 1 (continued)

No.	BD	HD HDE	α(2000) h m s	δ(2000) ° ′ ″	V	U–V	P–V	X–V	Y–V	Z–V	V–S	n
127.	51 824		4 00 20.2	51 44 26	10.547	3.867	3.196	2.239	0.943	0.376	0.848	2
					0.012	0.037	0.024	0.019	0.006	0.005	0.009	
128.	52 734	24942	4 00 28.7	52 56 51	8.608	2.100	1.634	1.050	0.459	0.167	0.426	8
					0.007	0.006	0.009	0.006	0.005	0.007	0.009	
129.	52 732	232867	4 00 30.0	53 04 31	9.540	2.730	2.012	1.039	0.458	0.160	0.377	3
					0.014	0.006	0.006	0.004	0.005	0.003	0.003	
130.	52 733	232869	4 00 35.3	52 41 22	10.165	2.012	1.466	0.730	0.353	0.135	0.266	3
					0.014	0.007	0.009	0.007	0.005	0.004	0.007	
131.	50 873	24993	4 00 40.8	51 12 23	8.854	2.352	1.752	0.999	0.410	0.159	0.364	3
					0.016	0.004	0.004	0.003	0.002	0.002	0.003	
132.	50 874	232870	4 00 41.9	51 15 00	9.498	2.279	1.763	1.191	0.536	0.190	0.531	3
					0.016	0.007	0.007	0.004	0.002	0.003	0.004	
133.	51 825		4 00 42.5	51 48 47	10.042	4.470	3.710	2.572	0.979	0.425	0.902	2
					0.011	0.041	0.022	0.018	0.005	0.008	0.004	
134.	52 735	24979	4 00 46.2	52 59 09	9.083	2.303	1.646	0.796	0.383	0.149	0.294	3
					0.014	0.018	0.011	0.012	0.006	0.005	0.003	
135.	52 736		4 00 49.7	53 22 38	9.915	1.939	1.487	0.932	0.507	0.193	0.413	3
					0.014	0.018	0.011	0.012	0.006	0.006	0.004	
136.	51 826		4 00 50.0	51 33 50	11.034	2.382	1.708	0.826	0.403	0.165	0.280	2
					0.014	0.014	0.012	0.019	0.006	0.009	0.018	
137.	51 827	25030	4 01 03.0	52 09 54	8.609	5.024	4.276	2.916	1.092	0.501	1.008	3
					0.010	0.012	0.012	0.007	0.002	0.002	0.003	
138.	52 737		4 01 03.2	53 03 18	9.725	2.669	2.099	1.433	0.646	0.236	0.607	3
					0.014	0.016	0.005	0.007	0.005	0.003	0.006	
139.	51 828		4 01 08.2	51 58 36	9.899	4.444	3.769	2.538	0.998	0.422	0.892	2
					0.012	0.028	0.029	0.016	0.004	0.004	0.004	
140.	500001		4 01 17.5	53 10 16	11.562	2.409	1.739	0.907	0.447	0.170	0.329	9
					0.008	0.011	0.010	0.011	0.008	0.011	0.011	
141.	52 738		4 01 18.8	52 26 20	10.848	5.882	4.717	3.372	1.279	0.600	1.199	4
					0.026	0.074	0.063	0.022	0.005	0.005	0.003	
142.	50 876		4 01 35.5	51 06 43	9.941	2.776	2.317	1.566	0.625	0.251	0.616	3
					0.016	0.007	0.005	0.004	0.002	0.003	0.004	
143.	50 877		4 01 35.6	51 07 10	11.377	2.507	1.838	0.930	0.441	0.126	0.334	2
					0.028	0.029	0.018	0.016	0.017	0.020	0.016	
144.	53 722	25056	4 01 37.4	53 51 58	7.042	4.038	3.125	2.208	0.964	0.359	0.875	2
					0.012	0.004	0.004	0.004	0.002	0.002	0.004	
145.	52 739		4 01 42.7	52 33 09	10.465	3.928	3.339	2.314	0.951	0.375	0.887	3
					0.014	0.022	0.013	0.009	0.004	0.005	0.003	
146.	51 829		4 01 49.1	51 31 20	10.665	3.145	2.632	1.814	0.747	0.294	0.727	2
					0.015	0.028	0.020	0.019	0.007	0.008	0.008	
147.	50 881		4 01 53.7	51 03 51	10.574	3.074	2.542	1.752	0.749	0.293	0.703	2
					0.025	0.018	0.017	0.013	0.006	0.005	0.005	

Table 1 (continued)

No.	BD	HD HDE	α(2000) h m s	δ(2000) ° ′ ″	V	U–V	P–V	X–V	Y–V	Z–V	V–S	n
148.	51 830		4 01 54.8	51 49 58	10.419	2.178	1.628	0.911	0.467	0.168	0.371	2
					0.013	0.008	0.007	0.007	0.005	0.007	0.009	
149.	51 831		4 01 55.3	51 49 26	10.510	2.050	1.525	0.815	0.416	0.155	0.305	2
					0.013	0.009	0.007	0.007	0.006	0.004	0.007	
150.			4 01 58.1	53 09 45	11.749	2.395	1.655	0.823	0.415	0.149	0.365	1
					0.023	0.027	0.021	0.026	0.014	0.020	0.014	
151.	52 740	232872	4 02 04.0	52 35 40	10.610	1.740	1.295	0.662	0.329	0.129	0.250	2
					0.011	0.006	0.005	0.005	0.003	0.004	0.006	
152.	51 833	232875	4 02 08.8	51 39 56	9.147	4.129	3.510	2.369	0.876	0.395	0.843	3
					0.011	0.019	0.007	0.005	0.002	0.001	0.003	
153.	51 832		4 02 11.9	52 16 00	10.576	2.370	1.744	0.827	0.372	0.132	0.275	3
					0.011	0.011	0.005	0.004	0.005	0.003	0.006	
154.	52 741	25141	4 02 14.5	52 52 40	8.891	1.385	1.042	0.616	0.324	0.132	0.268	3
					0.016	0.009	0.011	0.006	0.005	0.003	0.003	
155.	53 723	232875	4 02 15.7	53 45 13	8.849	1.655	1.330	0.972	0.540	0.192	0.458	2
					0.012	0.004	0.003	0.004	0.002	0.002	0.005	
156.	51 848		4 02 27.2	51 38 41	10.782	2.676	2.183	1.528	0.627	0.242	0.619	2
					0.013	0.015	0.012	0.012	0.006	0.009	0.006	
157.	53 724		4 03 05.4	54 07 22	10.123	2.615	2.222	1.542	0.609	0.261	0.640	2
					0.012	0.007	0.006	0.006	0.003	0.004	0.006	

3. INTERSTELLAR REDDENING LAW

In the area we find seven heavily reddened stars of spectral classes O8–B1 which are suitable for determining the interstellar reddening law. Five of them were classified in the MK system by Hiltner (1956) and two by Bouigue (1959). Table 2 gives their spectral types and color excess ratios. Table 3 gives the mean color excess ratios for the six stars (excluding No. 116) and for the first five stars, compared with the corresponding ratios for the normal interstellar reddening law (see also in Straižys et al. 1999).

Color-excess ratios for the first five stars are rather similar, and they coincide within the determination errors, estimated in Straižys et al. (1999). Their mean values coincide well with the corresponding ratios for the normal reddening law. At the same time, the ratios for the two last stars (No. 116 and No. 155), which include the ultraviolet magnitudes U and P, and the violet magnitude X, are somewhat

Table 2. Color-excess ratios E_{m-V}/E_{Y-V} for seven O8–B1 stars used to derive the mean interstellar reddening law for the investigated area. The m passbands are U, P, X, Y, Z, V and S.

m	λ^{-1}	30	35	56	81	101	116	155
		B0.5 III	B1 IV	B1 III	O9 IV-V	B2 Iab	B1 IV	B0.5 V
U	2.925	2.73	2.72	2.57	2.68	2.63	3.41	2.85
P	2.683	2.15	2.13	2.18	2.13	2.15	2.76	2.31
X	2.479	1.73	1.70	1.74	1.70	1.71	1.82	1.77
Y	2.152	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Z	1.943	0.33	0.36	0.37	0.34	0.36	0.38	0.35
V	1.843	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S	1.541	0.83	0.85	0.80	0.81	0.83	0.76	0.86

Table 3. The Camelopardalis interstellar extinction law compared to the normal law. Cam I is for the six stars of Table 1 (excluding the star No. 116) and Cam II is for the first five stars. Data for the normal law are from Straižys (1977, 1992).

	$\frac{E_{U-V}}{E_{Y-V}}$	$\frac{E_{P-V}}{E_{Y-V}}$	$\frac{E_{X-V}}{E_{Y-V}}$	$\frac{E_{Z-V}}{E_{Y-V}}$	$\frac{E_{V-S}}{E_{Y-V}}$
Cam I	2.70±0.18	2.18±0.20	1.72±0.02	0.35±0.01	0.83±0.01
Cam II	2.67±0.06	2.15±0.04	1.72±0.02	0.35±0.01	0.82±0.01
Normal law	2.62	2.14	1.76	0.36	0.84

larger than the ratios for normal redening law. This can be explained by (1) a really peculiar extinction law, (2) a peculiarity or binarity of the stars, (3) wrong classification of the stars. The last possibility probably should be excluded since an error by one spectral subclass does not change the situation. Until the real cause of the peculiar color excess ratios is found, we shall consider that the interstellar reddening law between 300–660 nm is normal in all the investigated area.

For the determination of the ratio $R = A_V/E_{B-V}$ infrared photometry in the R,I,J,K,L system would be useful. However, in the literature we found infrared photometry only for one of these stars, HD 24431 (Castor & Simon 1983), which, according to *Hipparcos*, is a close visual binary star with $\Delta m = 2.9$ mag and $\rho = 0.73''$ (Schrijver 1997). Since we do not know spectral class of the secondary, it is dangerous to base the R determination on this star. Since the dust cloud in the area is not very dense, we should not expect the enlarged dust grains due to coagulation. Therefore, we decided to accept the normal value of the R ratio which changes between 3.15 for early-type stars and 3.8 for M-type supergiants.

4. CLASSIFICATION OF STARS AND DETERMINATION OF THEIR INTERSTELLAR EXTINCTION

Spectral classes, absolute magnitudes, color excesses, extinctions A_V and distances r were determined using a classification code written by one of the authors (K.Z.) for normal solar chemical composition stars. This code includes the following three methods.

(1) Classification by the various Q,Q diagrams calibrated in terms of spectral classes and absolute magnitudes (Straižys et al. 1982).

(2) Finding the closest standard by fitting Q-parameters of a program star with Qs for a set of standards. The standards are 684 imaginary stars of various MK spectral types with the intrinsic color indices taken from the Straižys (1992) monograph (Tables 66–69). The absolute magnitudes of the standards, according to their MK type, are taken from the same source (Appendix 1) with some corrections according to the *Hipparcos* parallaxes. The number of standards was enlarged by interpolation of the intrinsic color indices. Q-parameters are defined by the equation

$$Q_{1234} = (m_1 - m_2) - (E_{12}/E_{34})(m_3 - m_4), \qquad (1)$$

where color-excess ratios for various spectral types are taken from Straižys (1992). Spectral class and absolute magnitude of the best fitted standard were prescribed to the program star.

(3) Finding the closest standards using the same set of standards as in method (2). This was done by calculating the "weights" for each Q-parameter and for all used standards. If the difference of Q values between the standard and the program star was smaller than the error of Q, the weight of the standard for the given Q-parameter has been set to be 1. The weights of other standards

decrease with increasing difference between Q values of the standard and the program star. Then the weights off all Qs for each standard were summed, and the parameters (in our case – spectral and luminosity classes) of the standard having the largest sum of weights were taken as the parameters of the program star.

In most cases, the different methods give spectral classes which agree within one spectral subclass. The internal rms error of spectral class is ~1 decimal subclass and of A_V it is about ±0.2 mag. The absolute magnitude scale corresponds to the newest distance modulus of the Hyades (3.3 mag, Perryman et al. 1998) and the *Hipparcos* parallaxes.

In Table 4 the following information is given: identification number, the adopted spectral class and M_V, spectral class from other sources, color excess E_{B-V}, interstellar extinction A_V, distance r, $\sigma_{\rm Sp}$ and the quality of M_V determination. The standard deviation $\sigma_{\rm Sp}$ is calculated using the differences of all the dereddened color indices of the program star and the closest standard star. It is given in 0.01 mag units. The quality of M_V, given in the last column, has the following meanings: *a* is for the stars when all the used classification methods give sufficiently close absolute magnitudes, ΔM_V <0.4 mag, *c* is for the stars with ΔM_V >1.4 mag and *b* is for the intermediate cases.

5. RESULTS AND DISCUSSION

The plot of A_V vs. distance diagram for all the investigated stars shows a sharp rise of extinction at 100 pc. At larger distances the rise of extinction becomes slower, and it almost stops at about 1 kpc. However, in this diagram an extremely large scatter of stars, considerably exceeding the errors of A_V determination, is observed. For example, at a distance of 500 pc the values of A_V show the scatter between ~0.6 mag and ~2.2 mag. No doubt, this scatter is caused by the cloudy structure of the interstellar dust and uneven density of individual clouds.

The surface density of these clouds is evidently higher in the upper part of the area where the L 1391 dark cloud is situated. Fig. 2 shows the A_V vs. r diagram for the dark area which on the identification chart (Fig. 1) is limited by the rectangular line. The area seems to be very uniform and the scatter of stars in the diagram is relatively small. Here the extinction rises steeply and linearly from

Table 4. Results of photometric classification of stars.

No.	BD	Sp photom.	Sp other	M_V	E_{B-V}	A_V	r pc	σ_{Sp}	M_V qual.
1.	52 710	A0.2 II		−3.0	0.76	2.47	1090	8	c
2.	51 770	F5.0 V	F8, F0 II	3.7	0.09	0.29	115	0	b
3.	52 711	B9.5 III	A0, B9 III	−0.3	0.54	1.74	340	2	a
4.*	53 698	M2.5 III	M2, M0 III	−1.0	0.59	1.98	260	4	b
5.	51 773	F8.0 IV	F5	2.8	0.04	0.12	250	0	b
6.	50 816	A2.0 V	A0, A1 V	1.8	0.17	0.56	330	2	a
7.*	50 818	F4:							
8.	50 819	B6.0 V	B8	−0.5	0.42	1.32	580	2	b
9.*	51 774	F2.0 V	F0	3.1	0.00	0.00	57	1	a
10.	50 820	G2.3 V		4.6	0.12	0.40	165	3	b
11.*	53 699	K2.5 V	K0, K3 III	6.6	0.00	0.00	54	0	a
12.	50 821	G2.0 IV	G0	3.0	0.09	0.30	350	1	c
13.*	51 775	A1.0 V	A0, A0 V	1.7	0.14	0.44	108	1	b
14.	53 700	F8.0 V	G0, F6 V	4.1	0.02	0.06	97	3	b
15.	52 712	F8.0 V	G0, F6 V	4.2	0.08	0.26	96	1	a
16.*	52 713	K2.8 V	K5, K3 III	6.6	0.02	0.07	43	1	a
17.	51 776	K0.8 IV	K5	2.9	0.23	0.77	153	1	b
18.	50 824	K1.5 III		0.8	0.31	1.10	510	1	a
19.*	51 777		G8 IV, G5 V						
20.*	51 778	G2.0 IV	G5 V	3.0	0.04	0.14	80	1	b
21.*	50 828	K1.9 IV	K0 V	3.0	0.15	0.50	56	3	b
22.	53 701	A1.5 V	A3	1.7	0.35	1.14	210	2	b
23.	51 779	K0.7III-IV	K0 IV	2.3	0.17	0.60	140	1	b
24.*	53 702	F0.0 V	A7	2.8	0.19	0.62	160	1	a
25.*		A4.3 V		2.2	0.49	1.60	680	1	a
26.	53 703	K3.3 III		0.5	0.55	1.97	350	1	b
27.*	51 780	F6.0 V		3.7	0.22	0.71	158	1	b
28.	51 782	G7.0III-IV		2.0	0.43	1.48	260	3	c
29.*	51 781	A6.6 V	A	2.4	0.22	0.72	260	1	a
30.*	52 714	B0.2 II	B0 III, B0 Ib	−5.6	0.67	2.12	1110	1	b
31.*	50 835	A1.5 II	A0, A0 IV	−3.2	0.35	1.13	1590	2	c
32.	51 783	F4.0 IV		2.5	0.11	0.36	300	1	a
33.	53 704	B8.0 V		1.0	0.56	1.78	430	1	a
34.	51 784	B3.0 V	F5, B3 III	−1.0	0.58	1.85	950	2	b
35.*	52 715	B2.0 Ib	B2, B1 IV	−5.9	0.49	1.54	1800	1	b
36.	51 787	K0.5 III		0.8	0.27	0.94	430	1	b
37.	51 785	K1.0 III		0.8	0.44	1.53	420	1	b
38.	51 786	F0.0 V	F0, A4 III	3.0	0.18	0.58	166	1	a
39.	51 788	K0.9 IV		4.1	0.09	0.31	168	1	b
40.	51 789	A1.0 V	A0, A0 V	1.1	0.28	0.89	300	1	a
41.	50 838	A0.0 III		−0.9	0.50	1.60	1220	6	c
42.	50 839	A5.0 V		2.3	0.16	0.52	270	2	b

Table 4 (continued)

No.	BD	Sp photom.	Sp other	M_V	E_{B-V}	A_V	r pc	σ_{Sp}	M_V qual.
43.	50 840	A1.5 V	A0, A1 V	1.7	0.24	0.79	270	1	a
44.*	53 705	G7.2 V	K0, G8 IV	5.4	0.02	0.07	51	1	b
45.	52 716	A5.0 V	A2, A5 III	2.3	0.21	0.68	139	0	b
46.	50 842	A5.0 V		1.9	0.46	1.49	290	0	a
47.	51 790	K0.6 V		6.0	0.23	0.76	72	1	a
48.	53 706	F0.0 V	A3, A9 II	2.8	0.03	0.08	140	1	b
49.	52 717	K0.7 III	K2, K3 III	0.8	0.30	1.04	390	4	c
50.	50 845	F9.5 V		4.3	0.08	0.27	147	1	a
51.	50 846	F4.0 V		3.4	0.11	0.36	220	3	c
52.	53 707	A2.0 V		1.3	0.54	1.75	230	0	a
53.	52 718	G1.5 V		4.5	0.24	0.80	123	0	b
54.	50 848	F3.4 V	F5, A9 III, F0 V	3.2	0.14	0.44	135	2	b
55.	51 792	F7.0 Ib	K0	−4.2	0.79	2.63	1510	4	c
56.*	53 708	B1.0 IV	B8, B1 III	−3.9	0.72	2.28	970	1	b
57.	51 791	A0.0 V		0.8	0.37	1.18	610	1	a
58.*	50 849	B6.0 III	B9, B9 II, A0 III	−1.3	0.27	0.84	460	1	c
59.*	51 793	G5.4 III	G5, G8 III, K0 II	1.1	0.23	0.80	200	1	b
60.	51 794	B6.0 V		−0.4	0.45	1.41	730	2	b
61.	52 719	A0.0 V		0.8	0.56	1.81	460	1	b
62.	53 709	K3.5 III		0.6	0.26	0.94	490	2	b
63.	50 850	F1.3 V		3.7	0.20	0.66	164	9	c
64.	51 795	F0.0 V	A5	2.8	0.29	0.94	189	2	a
65.*	52 720	F6.0 V	F6 V	3.7	0.09	0.29	77	2	b
66.*	52 722		G0, G0 V, G2 V						
67.	52 721	K3.0 V		6.7	0.00	0.00	48	2	a
68.	52 723	G9.0 V	K0, F8 V	5.7	0.00	0.00	57	1	b
69.	53 710	B2.0 V	B	−1.6	0.72	2.28	840	1	a
70.	51 796	A1.5 IV	A2, A2 V	0.8	0.21	0.68	260	1	b
71.	51 797	G8.8III-IV		2.6	0.23	0.79	300	1	a
72.*	51 798	G0.0 V	G0, G1 V	4.4	0.11	0.35	42	2	b
73.	51 800	K0.0III-IV	K2	2.0	0.23	0.81	210	2	a
74.	51 799	A0.0 V	A0, B9 V	1.6	0.20	0.64	250	1	a
75.	51 801	A8.8 V		2.4	0.27	0.88	220	1	c
76.*	53 712	F7.8 V	F8, F8 V	4.1	0.00	0.00	75	3	b
77.	53 711	K2.2 III	K2, K2 III	0.7	0.35	1.24	400	2	a
78.	52 724	F8.0 V	G0, F5 V	4.1	0.00	0.01	119	1	b
79.	52 725	G7.0 V		5.4	0.00	0.00	97	1	a
80.*	51 803	F6.0 V	F5	3.7	0.05	0.15	39	3	b
81.*	52 726		O5, O8, O9 IV-V	−4.8	0.71	2.24	710	1	*
82.*	51 802		A5						
83.*	53 713	F8.0 V	G5, G0 III	4.1	0.04	0.12	111	0	a
84.*	51 804		A0						

Table 4 (continued)

No.	BD	Sp photom.	Sp other	M_V	E_{B-V}	A_V	r pc	$\sigma_{\rm Sp}$	M_V qual.
85.	51 805	K3.0 III	K2	0.6	0.33	1.18	290	2	b
86.	50 857	B5.0 III		−1.7	0.49	1.54	1240	1	b
87.	52 727	K4.2 III		0.4	0.44	1.58	270	3	b
88.	50 858	F3.0 IV		2.5	0.23	0.75	300	1	a
89.*	50 859		B8						
90.	52 728	A0.8 V	A0, B9 III, A0 V	1.5	0.26	0.83	210	1	a
91.	53 714	F2.0 III		1.8	0.18	0.60	370	4	c
92.	51 806	F1.0 IV		2.3	0.27	0.86	290	2	a
93.*	51 807	F3.0 IV		2.5	0.19	0.62	320	6	c
94.*	50 863		A1 IV						
95.	51 808	K4.0III-IV		1.7	0.44	1.61	240	3	b
96.*	50 864		K0, G8 II						
97.	51 809	A3.0 V		1.9	0.06	0.20	330	2	a
98.	51 810	A3.0 IV	A0, A2 V	1.2	0.20	0.65	370	3	b
99.	53 715	B8.0 V		1.0	0.57	1.80	380	2	a
100.	51 811	F6.0 V		3.8	0.23	0.75	112	1	b
101.	52 729	B1.0 II	B2 Iab	−5.5	1.24	3.96	2130	1	a
102.	51 812	G7.0 III	G5, K0 III	0.9	0.11	0.36	220	1	b
103.	51 813	F5.0 V		3.7	0.20	0.63	142	2	b
104.	51 814	F0.0 V	F0, F0 IV	2.8	0.06	0.21	109	2	a
105.	53 716	B6.8 V		0.0	0.65	2.08	450	1	b
106.	50 866	G1.5 V		4.5	0.06	0.21	167	1	b
107.	53 717	A4.0 V	A2, A7 III	1.7	0.17	0.55	162	2	c
108.*	53 718		A0, A7 V						
109.	51 815	B2.5 V	B6 V	−1.3	0.42	1.34	1170	0	b
110.	50 868	G8.5III-IV		2.0	0.30	1.04	580	4	b
111.*	51 817	K3.0III-IV	K2, K2-3 Ib	1.8	0.38	1.37	81	3	b
112.	51 816	F0.0 V	F5	2.8	0.18	0.58	193	2	a
113.	51 818	A2.0 IV	A2	0.9	0.42	1.36	420	1	b
114.	52 730	G8.0III-IV	G5	2.0	0.26	0.88	250	1	b
115.	52 731	F0.0 V		2.5	0.33	1.07	300	10	c
116.*	51 819	B3.0 V	B9, B1 IV	−1.0	0.41	1.29	680	1	a
117.	51 820	G9.0 III	K5	0.8	0.23	0.77	450	0	a
118.	51 821	A7.5 V		2.6	0.22	0.73	340	2	a
119.*	50 871		K2						
120.	50 870	A2.5 V		1.9	0.25	0.81	370	3	b
121.	53 719	A0.0 V		0.8	0.49	1.57	450	1	b
122.	51 823	B5.0 V		−0.1	0.41	1.30	1020	1	a
123.	51 822	G6.0 V		5.1	0.35	1.17	51	4	b
124.	50 872	A5.0 V		2.3	0.38	1.24	350	2	a
125.	53 720	G6.0 IV		3.1	0.49	1.62	119	1	b
126.	53 721	F8.0 V		4.1	0.30	0.96	126	2	a

Table 4 (continued)

No.	BD	Sp photom.	Sp other	M_V	E_{B-V}	A_V	r pc	σ_{Sp}	M_V qual.
127.	51 824	G5.6 III		1.1	0.33	1.13	460	2	b
128.*	52 734	F5.0 V	F5	3.6	0.00	0.00	100	1	c
129.	52 732	A4.0 V	A2	1.7	0.28	0.91	240	2	c
130.	52 733	B8.4 V	B8	1.2	0.30	0.94	400	1	a
131.	50 873	A9.0 V	A2	3.0	0.14	0.46	120	1	a
132.	50 874	F5.0 V	G	3.6	0.08	0.25	135	3	c
133.	51 825	K1.5 III		0.8	0.18	0.64	530	2	b
134.	52 735	B9.5 V	A0, B9-A0 V	0.6	0.30	0.95	320	1	a
135.*	52 736	B5.0 V	A0	−0.1	0.54	1.69	460	0	a
136.	51 826	A0.0 V		0.8	0.31	0.99	710	2	b
137.	51 827	K3.0 III	K2, K1 Ib	0.6	0.21	0.73	280	1	b
138.	52 737	F6.0 V		3.8	0.22	0.73	110	0	a
139.	51 828	K1.0 III		0.8	0.22	0.77	460	2	b
140.*		B9.0 V		1.0	0.40	1.30	710	2	a
141.	52 738	M1.7 III		1.5	0.17	0.61	560	10	c
142.	50 876	G7.0 V		5.3	0.04	0.12	80	0	b
143.	50 877	A0.5 V		1.6	0.34	1.11	540	3	b
144.*	53 722	F9.0 Ib	G5, F9-G0 Ib, G0 II	−4.6	0.52	1.74	960	1	c
145.	52 739	K0.0 IV		3.2	0.32	1.08	173	2	b
146.	51 829	G6.0 IV		3.1	0.17	0.55	250	1	b
147.*	50 881	G4:							
148.	51 830	B7.2 V		0.7	0.48	1.52	440	2	a
149.	51 831	B7.2 V		0.4	0.41	1.30	580	3	b
150.*		B9.5 III		−0.1	0.32	1.03	1460	1	a
151.	52 740	B7.0 V	A2	0.6	0.30	0.95	650	1	b
152.	51 833	K2.2III-IV	K0, K0 III	2.0	0.06	0.20	250	0	b
153.	51 832	A2.0 V		1.8	0.22	0.71	410	2	a
154.	52 741	B3.5 V	B8, B5 V	−1.4	0.36	1.13	680	1	b
155.*	53 723	B1.2 V	B3, B0,5 V, B1 III	−3.5	0.69	2.18	1080	1	b
156.	51 848	G2.5 V	G5	4.6	0.10	0.31	149	1	b
157.	53 724	G7.0 V		5.3	0.02	0.09	89	5	c

NOTES:

4. Hip 17590, π=1.45, σ=1.18.
7. ADS 2751, V_A/V_B=10.1/10.4, Sep=2.6″.
9. Hip 17675, π=18.05, σ=0.85.
11. Hip 17706, π=17.65, σ=2.13.
13. Hip 17718, π=8.12, σ=0.92.
16. Hip 17736, π=21.70, σ=1.85.
19. Hip 17782, π=19.75, σ=2.97, H_A/H_B=9.505/9.827, Sep=0.36″, K0 V + K1 V (Christy & Walker 1969).

20. Hip 17800, π=16.24, σ=1.05.
21. Hip 17807, π=5.81, σ=0.92.
24. Hip 17822, π=4.87, σ=1.48.
25. 2GSC3333:113.
27. ADS 2781, V_A / V_B=10.3/13.3, Sep=2.7″.
29. ADS 2781B, Sep=70.2″.
30. Hip 17877, ADS 2783, π=0.33, σ=1.12, H_A / H_B=6.895/9.897, Sep=8.74″
31. Hip 17905, π=0.55, σ=1.26.
35. Hip 17693, π=2.34, σ=0.98.
44. ADS 2802, V_A / V_B=8.8/14.2, Sep=8″.
56. Hip 18151, π=0.29, σ=1.23.
58. Hip 18160, π=3.15, σ=0.97.
59. Hip 18167, π=4.00, σ=1.17.
65. Hip 18207, π=10.08, σ=1.20.
66. Hip 18218, ADS 2828, π=15.76, σ=1.95, H_A / H_B=8.765/9.495, Sep=0.366″, G2 V + G5 V (Christy & Walker 1969).
72. Hip 18309, π=15.36, σ=1.07.
76. Hip 18351, π=12.77, σ=1.15.
80. Hip 18366, π=25.04, σ=0.86.
81. Hip 18370, π=0.48, σ=1.04, H_A / H_B=6.912/9.822, Sep=0.73″. Absolute magnitude is taken for the spectral type O9 IV-V.
82. Hip 18372, ADS 2896, π=2.87, σ=2.05, H_A / H_B=9.011/10.167, Sep=1.05″.
83. Hip 18375, π=4.87, σ=1.50.
84. ADS 2855, V_A / V_B=9.2/10.1, Sep=7.8″.
89. ADS 2863, V_A / V_B=10.0/10.6, Sep=2.4″.
93. BDS 1934 V_A / V_B=10.6/11.4, Sep=18.3″.
94. ADS 2877, V_A / V_B=9.6/11.5, Sep=6.4″.
96. Cou 2357, visual binary, Sep=0.74″(Heintz 1998).
108. Hip 18585, π=3.31, σ=0.79, eclipsing spectral binary of β Lyr type, P=1.76 d (Szabados 1997).
111. Hip 18604, ADS 2896, π=-0.02, σ=2.29, H_A / H_B=7.816/11.032, Sep=12.27″.
116. Hip 18653, π=-0.61, σ=1.41.
119. Hip 18668, ADS 2908, π=5.27, σ=4.85, H_A / H_B=10.332/12.121, Sep=3.45″.
128. Hip 18712, π=8.68, σ=1.21.
135. BDS 1965 V_A / V_B=10.2/10.4, Sep=22.8″.
140. 2GSC3718:1167.
144. Hip 18795, π=-0.62, σ=0.77.
147. ADS 2927, V_A / V_B=10.5/11.9, Sep=2.6″.
150. 2GSC3718:1636.
155. Hip 18834, π=-1.88, σ=1.10.

~100 to ~300 pc, reaching $A_V \approx 2.0$ mag. Then the growth of extinction slows down and at 1 kpc it reaches ~2.4 mag. However, this may be only the lower value of the extinction. More distant stars have not been observed in the area due to the limiting magnitude. The two broken curves are the dependencies of A_V on r for the limiting magnitude $V_{\rm lim}$ = 11.0 mag and two absolute magnitudes, M_V = 0.0 and +1.0. These absolute magnitudes correspond to B8–A1 V and G5–K5 III stars which are well represented in the area. More luminous stars are rare. The plot areas between the two limiting curves and to the right from them are heavily affected by the limiting magnitude effect: here the stars with high values of extinction may be missing.

It seems that surface density of the observed stars in the remaining part of the investigated area is not sufficient for the separation of smaller fields with a uniform dependence of extinction vs. distance. Therefore, in Fig. 3 we show the A_V vs. r diagram for all stars together. It seems that everywhere in the area both transparent and obscured fields may be found. Even in the directions with a rich background of faint stars some heavily reddened stars are seen (Nos. 28, 46, 55, 95, 155). On the other side, some stars exhibit very low extinction for their distance (Nos. 5, 12, 32, 97, 133, 141, 152). If we exclude stars No. 55 and No. 155, other stars in Fig. 3 with $r > 700$ pc exhibit the extinction values between 1.2 and 1.9 mag, i.e., the stars in this part of area are much less obscured than the stars within the L 1391 cloud.

There are two exceptional stars – No. 111, classified as K3 III-IV, and No. 123, classified as G6 V. Both stars are at close distances (81 pc and 51 pc), but exhibit high extinction values (1.4 and 1.2 mag). We suspect, these stars are unresolved binaries of close spectral types, and their distances may be wrong.

As it was mentioned in the introduction, two open clusters are present in the area. According to Pena & Peniche (1994), the NGC 1444 cluster is at 906 pc distance and its $E_{b-y} = 0.54$. Taking $E_{B-V}/E_{b-y} = 1.25$ and $A_V/E_{B-V} = 3.2$ we obtain $A_V = 2.16$ mag. This value of A_V is plotted both in Fig. 2 and Fig. 3, since it is at the suthern border of the dark cloud, and its attachment to one of these fields is somewhat problematic. Its position is near the lower edge of the extinction values for the dark cloud and at the upper edge for the extinction values in the remaining area.

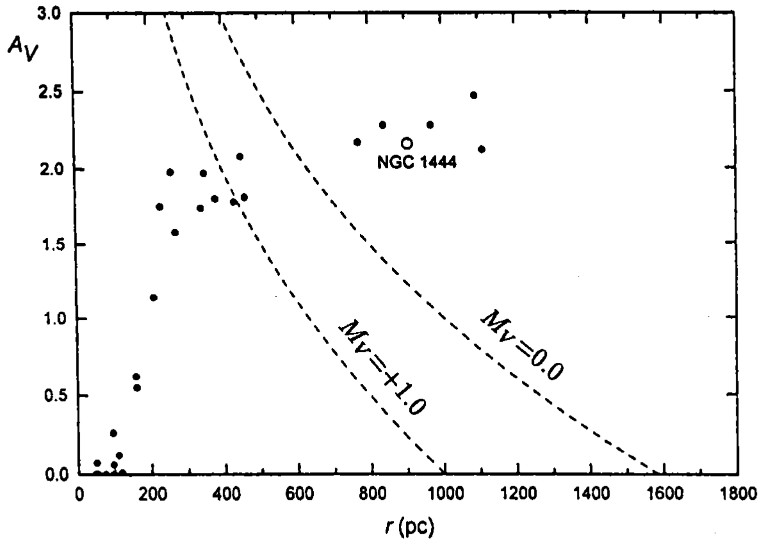

Fig. 2. The dependence of interstellar extinction on distance in the direction of the dark cloud L 1391. Binary stars with $\Delta m < 3.0$ and $\rho < 10''$ are excluded. For explanation of the two broken curves see the text.

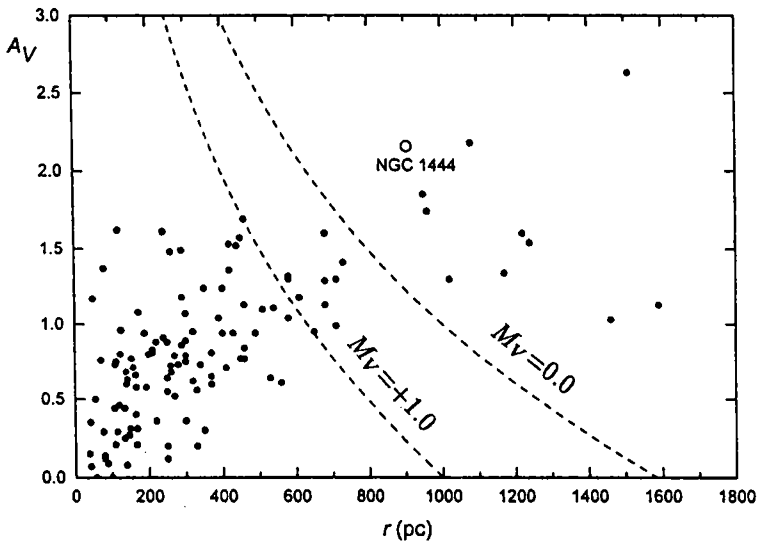

Fig. 3. The dependence of interstellar extinction on distance in the remaining part of the investigated area. Binary stars with $\Delta m < 3.0$ and $\rho < 10''$ are excluded. For explanation of the two broken curves see the text.

The cluster King 7 probably belongs to the Perseus spiral arm, since its distance according to Durgapal et al. (1997) *UBVRI* photometry is 2.2 kpc. The same source gives $E_{B-V} = 1.25$, which corresponds to $A_V = 4.0$. The cluster was also investigated by Phelps et al. (1994) in the B,V,I system, but the instrumental magnitudes and color indices were not transformed to the standard system.

Our earlier investigation of the area at the Cam-Cas border (Zdanavičius et al. 1996) also shows that interstellar extinction starts to grow at a distance of 100 pc and it reaches 2 mag at about 400 pc. This result is quite similar to the extinction run with distance found for the darkened area in the present paper. This means that the Camelopardalis dark clouds form a huge unique system of dust clouds extending by about 20 degrees parallel to the galactic equator. This cloud system is seen very well in the Photographic Panorama of the Milky Way published by the ESO (Laustsen et al. 1987). At a distance of 100 pc, linear extension of the clouds along the galactic longitude is about 40 pc.

Within our area there are 18 stars with Vilnius photometry and having parallaxes determined by the *Hipparcos* orbiting observatory. However, six of these stars are more distant than 150 pc, and their parallaxes are of rather low accuracy. The remaining 12 stars are not sufficient to obtain a reliable correlation between photometric and trigonometric distances and to estimate the distance errors. We are planning to publish a detailed comparison of both distance scales based on much larger number of stars in the surrounding Camelopardalis area.

The general conclusion is that the Camelopardalis dark clouds are among the closest dust formations in the solar vicinity. Probably, they are even closer than the system of the Taurus–Perseus clouds south of galactic equator (130–160 pc, Straižys, Černis & Bartašiūtė 2001).

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