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Research Note

More Southern Dark Dust Clouds

Aa. Sandqvist
Stockholm Observatory, S-13300 Saltsjöbaden, Sweden

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Summary. A catalogue of 95 dark dust clouds of high visual opacity class has been compiled from a study of the ESO (B) Atlas ($-42\overset{\circ}{.}5 > \delta$), listing the equatorial and galactic coordinates of the cloud centers, the approximate areas and estimated opacity classes. Together with more northern clouds of high opacity, these southern clouds form a system inclined to the galactic plane in a manner similar to that of Gould's Belt of early type stars.

Key words: dark clouds — Gould's Belt

Recent comprehensive surveys of molecules in interstellar dust clouds (e.g. H_2CO—Dieter, 1973; CH—Hjalmarson et al., 1977) have depended heavily upon Lynds' (1962) Catalogue of Dark Nebulae as a source for clouds. The dust clouds thus surveyed are limited to the galactic longitude range of 350°–0°–240° by the mere limitation of sky coverage in declination ($\delta > -33°$) of the plates in the National Geographic Society-Palomar Observatory Sky Survey from which Lynds catalogued the clouds.

In a project purporting to extend the sky coverage to $\delta > -46°$, Sandqvist and Lindroos (1976), hereafter referred to as SL, have surveyed the Whiteoak southern extension to the Palomar Sky Atlas and have presented a catalogue of 42 dark dust clouds of opacity classes ranging from 4 to 6. The reason for limiting the survey to high opacity clouds was that these clouds were subsequently observed in the 6-cm line of the formaldehyde molecule which favours clouds of high opacity. This has extended the galactic longitude range of clouds surveyed for H_2CO to 336°–0°–271° which, however, still leaves a large part of the fourth quadrant unobserved. This quadrant is of great importance for the study of the kinematics of the local interstellar matter since it is here that different models predict the strongest kinematical divergence from each other (e.g. Lindblad et al. 1973, Burton and Bania 1974). Therefore, when the ESO (B) Atlas made the remainder of the southern sky accessible for a similar cloud survey, it was decided to compile a complementary catalogue of southern dark dust clouds, with future molecular line observations from the southern hemisphere in mind.

Details of the ESO (B) Atlas are given by Holmberg et al. (1974). All those plates available in September 1976 have been examined. This includes the whole southern sky south of $\delta = -42\overset{\circ}{.}5$ with the exception of the area south of $\delta = -82\overset{\circ}{.}5$, the band between $\delta = -77\overset{\circ}{.}5$ and $\delta = -82\overset{\circ}{.}5$ from $\alpha = 0^h$ to 14^h and from $\alpha = 20^h$ to 24^h and a single $5° \times 2°$ area at $\alpha = 5^h40^m$, $\delta = -46\overset{\circ}{.}5$. Thus about 99% of the whole sky has been surveyed for dark clouds through the catalogues of Lynds (1962), SL and the present paper. The remaining one per cent is located at quite high galactic latitude and it is unlikely that additional dark clouds will be found there.

Table 1 contains the 95 dark clouds chosen from the ESO (B) Atlas. The number of the cloud is given in Column (1) and begins with 101 to avoid confusion with the SL clouds. The 1950.0 equatorial coordinates of the center of the cloud is given in Columns (2) and (3) with the corresponding galactic coordinates given in Columns (4) and (5). The approximate area in square degrees is given in Column (6) and the opacity class, on a scale from 1 to 6 with 6 as the apparently darkest, is listed in Column (7). Since no red plates were available, the opacity classes must be considered as estimates and more uncertain than those made by Lynds for her catalogue, although a serious attempt was made to follow her scale as closely as possible.

30 clouds of opacity class 4 were found to have an average area of 0.069 square degrees, while 37 clouds of opacity class 5 and 28 clouds of opacity class 6 have average areas of 0.030 and 0.016 square degrees, respectively. This continues the relation found by Lynds and SL, viz. that the average area of the clouds of a specific opacity class decreases as the value of that class increases. However, judging solely from a comparison of average areas, as in SL, it would seem likely that our opacity class 4 and Lynds' opacity class 5 are comparable while our classes of 5 and 6 are comparable with Lynds' opacity class 6. Therefore, all the SL clouds and the

Table 1. Southern dark dust clouds

(1) Cloud	(2) α (1950.0) (h) (m)	(3) δ (1950.0) (°) (′)	(4) l (°)	(5) b (°)	(6) Area (sq. deg.)	(7) Opacity class
101	7 29.3	−46 53	259.26	−13.28	0.006	5
102	7 12.8	−48 23	259.47	−16.43	0.005	5
103	7 32.6	−46 50	259.47	−12.76	0.005	5
104	7 41.6	−49 07	262.25	−12.46	0.073	5
105	7 37.3	−49 44	262.49	−13.36	0.001	5
106	7 26.3	−50 58	262.85	−15.48	0.002	5
107	7 31.0	−50 39	262.88	−14.67	0.001	5
108	7 51.7	−50 09	263.98	−11.51	0.016	5
109	8 19.8	−49 28	265.81	− 7.30	0.040	4
110	8 25.0	−50 30	267.15	− 7.20	0.001	6
111	8 24.2	−50 52	267.38	− 7.52	0.005	6
112	8 25.1	−50 51	267.44	− 7.39	0.001	6
113	8 32.7	−50 07	267.56	− 5.98	0.001	6
114	9 11.5	−45 24	268.17	2.03	0.011	4
115	9 20.6	−45 37	269.45	3.01	0.007	6
116	9 24.4	−44 59	269.49	3.93	0.005	6
117	9 27.9	−45 14	270.11	4.18	0.005	5
118	9 34.0	−45 27	271.05	4.74	0.040	4
119	9 25.5	−50 57	273.74	− 0.25	0.013	5
120	9 27.0	−51 23	274.21	− 0.41	0.006	6
121	9 44.7	−50 50	275.93	1.84	0.012	4
122	10 32.6	−46 21	279.86	10.05	0.017	5
123	10 41.4	−60 00	287.68	− 1.24	0.006	5
124	10 58.0	−63 28	290.97	− 3.48	0.018	6
125	11 05.1	−61 49	291.06	− 1.64	0.008	6
126	11 06.9	−62 00	291.32	− 1.73	0.014	6
127	11 12.2	−60 36	291.39	− 0.19	0.006	5
128	11 09.0	−64 17	292.41	− 3.75	0.024	5
129	11 25.9	−61 53	293.38	− 0.84	0.022	4
130	11 32.2	−64 17	294.79	− 2.91	0.008	4
131	11 47.6	−58 17	294.99	3.36	0.010	4
132	10 49.3	−76 49	296.21	−15.82	0.012	5
133	10 55.0	−76 51	296.53	−15.70	0.020	5
134	11 08.0	−76 16	296.99	−14.86	0.017	5
135	11 05.0	−77 17	297.24	−15.86	0.612	5
136	11 59.3	−64 53	297.75	− 2.79	0.018	6
137	12 02.8	−65 00	298.14	− 2.84	0.016	4
138	11 36.3	−75 00	298.25	−13.07	0.012	4
139	12 21.4	−65 55	300.18	− 3.47	0.009	6
140	12 25.5	−65 38	300.58	− 3.14	0.006	6
141	12 19.0	−72 00	300.66	− 9.54	0.033	4
142	12 28.3	−63 28	300.69	− 0.96	0.048	5
143	12 22.1	−71 28	300.84	− 8.98	0.036	5
144	12 33.3	−62 56	301.22	− 0.39	0.004	6
145	12 28.5	−70 47	301.30	− 8.25	0.072	6
146	12 32.6	−70 22	301.61	− 7.81	0.022	5
147	12 34.2	−69 14	301.68	− 6.67	0.012	5
148	12 36.8	−65 08	301.72	− 2.56	0.003	5
149	12 34.4	−69 45	301.73	− 7.19	0.005	6
150	12 40.0	−61 49	301.94	0.76	0.018	4
151	12 38.0	−69 36	302.03	− 7.02	0.004	6
152	12 44.4	−68 59	302.59	− 6.39	0.004	6
153	12 47.3	−76 38	302.90	−14.03	0.034	6
154	12 49.7	−76 52	303.04	−14.27	0.054	6
155	12 51.4	−61 17	303.29	1.32	0.014	5
156	12 55.3	−76 54	303.37	−14.30	0.076	6
157	12 53.8	−61 43	303.57	0.88	0.010	4
158	13 01.2	−77 08	303.70	−14.55	0.026	6
159	13 02.5	−77 27	303.76	−14.87	0.027	6
160	13 03.0	−76 45	303.83	−14.17	0.014	6
161	12 58.3	−61 18	304.12	1.28	0.086	4
162	12 58.5	−60 53	304.16	1.70	0.057	4
163	13 14.7	−57 24	306.47	5.03	0.020	4
164	14 08.6	−57 19	313.61	3.64	0.026	4

Table 1. (continued)

(1) Cloud	(2) α (1950.0) (h) (m)	(3) δ (1950.0) (°) (′)	(4) l (°)	(5) b (°)	(6) Area (sq. deg.)	(7) Opacity class
165	14 44.4	−65 04	314.78	− 5.13	0.012	6
166	14 50.0	−63 32	316.01	− 4.02	0.005	5
167	14 22.5	−55 08	316.16	5.07	0.007	6
168	17 25.8	−76 32	316.58	−21.97	0.013	4
169	14 56.0	−62 55	316.89	− 3.79	0.087	4
170	15 03.6	−64 13	317.01	− 5.33	0.054	4
171	14 58.4	−63 09	317.02	− 4.12	0.034	4
172	15 09.0	−62 30	318.40	− 4.15	1.158	4
173	15 22.8	−60 53	320.65	− 3.65	0.036	4
174	15 21.3	−58 52	321.60	− 1.87	0.016	5
175	15 15.4	−50 15	325.53	5.85	0.051	4
176	15 23.4	−49 50	326.85	5.50	0.006	5
177	15 38.5	−52 25	327.29	2.02	0.008	5
178	16 10.0	−52 46	330.73	− 1.31	0.007	4
179	16 02.8	−45 49	334.55	4.61	0.013	5
180	16 09.4	−46 04	335.23	3.65	0.015	5
181	15 59.6	−43 09	335.90	6.98	0.011	5
182	16 34.0	−48 47	336.23	− 1.21	0.029	4
183	16 45.1	−50 21	336.24	− 3.60	0.008	5
184	16 36.3	−48 45	336.51	− 1.47	0.031	4
185	16 54.7	−50 32	337.07	− 4.90	0.009	6
186	16 52.8	−49 31	337.68	− 4.02	0.012	5
187	16 29.4	−44 52	338.57	2.03	0.024	4
188	16 31.0	−44 57	338.70	1.76	0.017	4
189	16 37.7	−45 42	338.94	0.39	0.103	4
190	16 43:1	−46 22	339.06	− 0.76	0.001	5
191	16 42.3	−45 54	339.32	− 0.35	0.014	5
192	16 45.1	−46 06	339.48	− 0.85	0.020	5
193	17 59.3	−46 40	346.20	−11.75	0.002	6
194	17 42.7	−44 30	346.68	− 8.16	0.007	4
195	17 44.3	−43 42	347.52	− 8.00	0.007	5

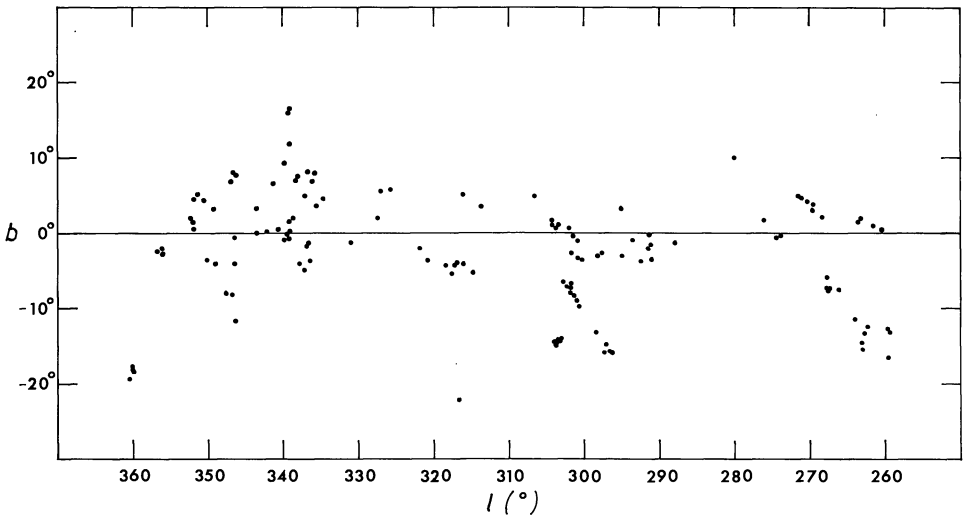

Fig. 1. The galactic distribution of southern dark dust clouds of high opacity

clouds in the present paper will be grouped together regardless of opacity class and comparisons will be made with Lynds' clouds of opacity class 5 and 6 grouped together.

The distribution along the Milky Way of all the SL clouds and the clouds in the present paper is shown in Figure 1. This figure may serve as a complement to Figures 2 and 8 of Lynds (1962) which cover the galactic longitude range 350°–0°–240°. In order to estimate the positions of the centers of mass of all the darkest clouds along the complete Milky Way, the mean galactic latitude, weighted by the area and the opacity class, of the clouds in intervals of 10° in longitude were computed using the same relation as Lynds. All Lynds clouds of

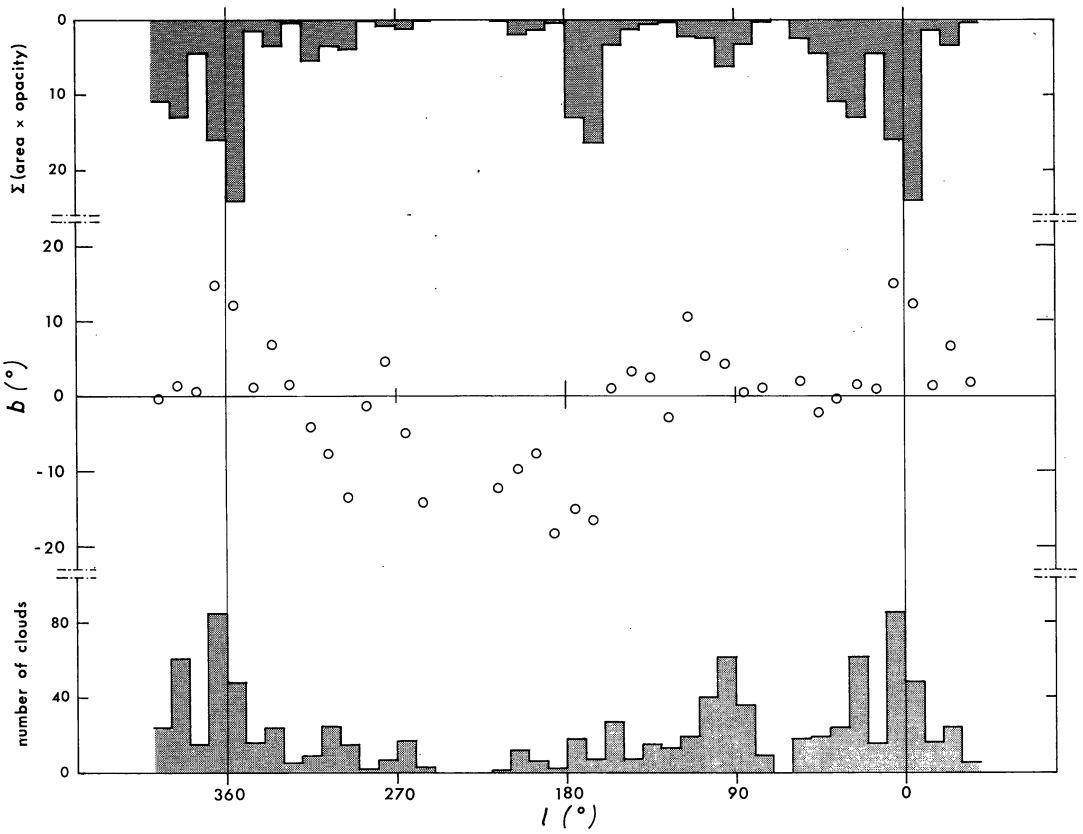

Fig. 2. The galactic distribution of centers of mass of dark dust clouds of high opacity. Top histogram—sum of (area × opacity class) for clouds vs. galactic longitude; bottom histogram—number of clouds vs. galactic longitude

opacity class 5 and 6, together with all the SL and the present paper clouds were used for this analysis. The result is shown in Figure 2, which also contains histograms of the number of clouds and the sum of the (area × opacity class) for the clouds in longitude intervals of 10° versus galactic longitude.

Lynds found a tendency for the darkest clouds to lie slightly above the galactic plane and not to exhibit any association with the inclined Gould's Belt of bright stars. It is obvious from Figure 2 that this conclusion can no longer stand after the southern clouds have been included in the sample. The distribution of the darkest clouds clearly shows a preference towards the general direction of the galactic center, but it can easily be seen that, whereas the clouds in the longitude range 320°–0°–120° do indeed lie mainly at positive latitudes, there is a strong cloud preference for negative latitudes in the longitude range 120°–320°. This reflects a behaviour similar to that of Gould's Belt which is not surprising since Lindblad et al. (1973) have already suggested that some of the dark clouds, the local neutral hydrogen and the Gould's Belt of early type stars may be related. SL strengthened this suggestion by obtaining kinematic data for some of the clouds in the fourth galactic quadrant, observing them in the 6-cm H_2CO line. It is hoped that observations in molecular lines of remaining southern dark dust clouds will soon be completed so that kinematic studies can be applied to the full system of the local interstellar matter.

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