ORIONID METEOR SHOWER: ACTIVITY AND MAGNITUDE DISTRIBUTION

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Abstract: A series of visual observations of the Orionid meteor shower, comprising over 2500 records of meteors observed during 6 different returns of the shower in 1944—1950 at the Skalnaté Pleso Observatory, is analysed and discussed. A mean course of activity, based on zenital hourly rates is derived, showing a main maximum at the solar longitude $\odot_{1950.0} = 207.8°$ and a secondary maximum at $\odot_{1950.0} = 209.8°$. The magnitude distribution of the Orionids reveals a decrease in its index r_+ from the lowest value $r_+ \approx 2.9$ at about $\odot \approx 205$—$206°$ to the highest value $r_+ \approx 3.2$—3.3, identical with the corresponding value r_- of the sporadic meteors, at about $\odot \approx 212°$.

1. Data and Their Analysis

Visual meteor observations at the Skalnaté Pleso Observatory became a regular part of its programme right after foundation of the Observatory in 1944, and were carried out permanently, mostly by a standard team of observers for more than ten years. The data on the Orionids presented in this paper are compiled from six different returns of the shower, between 1944 and 1950, with the exception of 1948; they include a total of 956 records of the Orionids and 1830 records of the sporadic meteors recorded in 32 different nights during 305.6 hours of net observational time. The method of observations was described in details in other analyses made by Kresáková (1966) and Štohl (1969). A complete list of the observers who participated in the observations is given in Table 1. The table presents the abbrevations of the observers, as well, together with their observing time and numbers of shower and sporadic meteors.

Analysis of the data used in this paper and their treatment is similar to that made in a previous paper analysing visual observations of the Geminids obtained by the same team of observers at the Skalnaté Pleso (Porubčan et al., 1980). To study the rate changes, all observations were divided, where possible, into half-hour intervals, for which the rates of shower and sporadic meteors for individual observers were derived.

Using the personal coefficients, the observed rates were reduced with respect to the standard observer L (Ľ. Pajdušáková), who attended observations in all six returns of the Orionid shower. For the personal coefficients were used the values found by Štohl (1969) on the basis of sporadic meteors recorded in respective years at the Skalnaté Pleso; they are summarized in Table 1. Furthermore, the observed rates were reduced to

Table 1
List of observers

Observer	Abbr.	t	n_+	n_-	c_p					
					1944	1945	1946	1947	1949	1950
Bečvář A.	T	867	138	175	0.99	1.15	1.20	1.10	—	
Dzubák M.	M	1116	70	250	0.91	1.08	—	—	—	—
Hartmanová M.	H	220	18	52	—	1.52	—	—	—	—
Jančík T.	J	180	19	15	—	—	—	—	—	1.51
Kresák Ľ.	G	785	133	208	—	—	1.03	—	—	—
Mrkos A.	A	1071	209	294	—	—	0.87	0.91	1.02	
Olejník Š.	O	488	9	116	1.04	—	—	—	—	—
Pajdušáková Ľ.	L	3007	360	720	1.00	1.00	1.00	1.00	1.00	1.00

standard observing conditions applying the coefficients of cloudiness (Guth, 1941), and then were converted to the zenithal rates using simple cosine factor ($\cos^{-1} z_R$, z_R — the zenithal distance of the apparent radiant), taking into account the motion of shower radiant with the solar longitude. As the reference radiant the values were taken, derived from photographic observations of the Orionids (Kresák and Porubčan, 1970) for the equinox 1950.0, given by

$$\alpha = 94.7 + 0.65\,(\odot - 208°),$$
$$\delta = 15.9 + 0.11\,(\odot - 208°); \qquad (1)$$

corrections for the zenith attraction of the apparent radiant were applied as well. No correction for the limiting stellar magnitudes was applied in the analysis, as in early observations at the Skalnaté Pleso this parameter was not noted; however, the conditions at the Skalnaté Pleso do not change much as far as the limiting stellar magnitude concerns.

The corrected observed half-hour rates of the Orionids f_+ and the sporadic meteors f_- for individual observers and periods are listed in Table 2. Observations from different years are arranged according to the respective solar longitudes reduced to equinox 1950.0. Furthermore, table lists the dates of observations, abbreviations of observers as given in Table 1, percentage of cloudiness and the recorded number of shower n_+ and sporadic n_- meteors. Observations in 1945 and 1946 were partly disturbed by the moonshine, rates in the particular periods (1945, October 20 and 1946, October 21 after 02:00 UT) are evidently underestimated. Correction for this effect is very spurious, in further analysis these periods have been therefore omitted. A summary of all observations is presented in Table 3 which for each year gives: number of observers participating in the observations, number of nights on which the observations were carried out, number of records of the Orionids and sporadic meteors, as well as the total number of meteors recorded.

Table 2

Day	Sun	Time (UT)	Obs.	Cl	n_+	n_-	f_+	f_-
			October 1944					
14	200.64	00:35—10:05	L	—	—	8	—	8.0
14	200.64	00:35—01:05	M	—	1	6	1.3	5.5
14	200.64	00:35—01:05	O	—	1	12	1.4	12.5
14	200.66	01:05—01:35	L	—	2	3	2.6	3.0
14	200.66	01:05—01:35	M	—	—	5	—	4.6
14	200.66	01:05—01:35	O	—	2	9	2.7	9.4
14	200.68	01:35—02:05	L	—	—	10	—	10.0
14	200.68	01:35—02:05	M	—	1	10	1.1	9.1
14	200.68	01:35—02:05	O	—	—	17	—	17.7
14	200.70	02:05—02:35	L	—	—	12	—	12.0
14	200.70	02:05—02:35	M	—	1	10	1.1	9.1
14	200.70	02:05—02:35	O	—	1	12	1.3	12.5
14	200.72	02:35—03:08	L	—	—	5	—	4.5
14	200.72	02:35—03:08	M	—	1	10	1.0	8.3
14	200.72	02:35—03:08	O	—	—	13	—	13.5
15	202.45	20:25—20:55	L	20	—	3	—	3.7
15	202.45	20:25—20:55	M	5	—	2	—	1.9
15	202.45	20:25—20:55	O	15	—	4	—	4.8
15	202.47	20:55—21:25	M	5	—	8	—	7.6
15	202.57	23:25—23:55	L	—	1	12	1.7	12.0
15	202.57	23:25—23:55	M	—	1	15	1.5	13.6
15	202.57	23:25—23:55	O	—	—	4	—	4.2
15	202.59	23:55—00:25	L	—	1	7	1.5	7.0
15	202.59	23:55—00:25	M	—	—	10	—	9.1
15	202.59	23:55—00:25	O	—	—	3	—	3.1
16	202.61	00:25—00:55	L	—	1	8	1.4	8.0
16	202.61	00:25—00:55	M	—	2	13	2.6	11.8
16	202.61	00:25—00:55	O	—	1	5	1.5	5.2
16	202.63	00:55—01:27	L	—	5	4	6.2	3.8

Table 2 (Continued)

Day	Sun	Time (UT)	Obs.	Cl	n_+	n_-	f_+	f_-
16	202.63	00:55—01:27	M	—	3	7	3.4	6.0
16	202.63	00:55—01:27	O	—	4	4	5.2	3.9
16	203.51	22:08—22:38	L	—	—	10	—	10.0
16	203.51	22:08—22:38	M	15	—	6	—	6.3
16	203.51	22:08—22:38	O	15	—	2	—	2.4
16	203.52	22:38—23:08	L	—	—	10	—	10.0
16	203.52	22:38—23:08	O	15	—	9	—	10.9
19	206.42	20:28—20:58	L	—	—	4	—	4.0
19	206.42	20:28—20:58	M	—	—	4	—	3.6
19	206.42	20:28—20:58	O	5	—	5	—	5.5
19	206.44	20:58—21:28	L	5	—	3	—	3.2
19	206.44	20:58—21:28	M	5	—	7	—	6.7
19	206.44	20:58—21:28	O	10	—	4	—	4.6
19	206.46	21:28—21:58	L	—	—	7	—	7.0
19	206.46	21:28—21:58	M	15	—	3	—	3.2
19	206.46	21:28—21:58	O	10	—	4	—	4.6
19	206.49	21:58—22:31	L	15	1	5	2.6	5.3
19	206.49	21:58—22:31	M	20	—	2	—	2.0
19	206.49	21:58—22:31	O	10	—	9	—	9.4
20	207.32	18:00—18:30	L	—	—	3	—	3.0
20	207.32	18:00—18:30	M	—	—	5	—	4.6
20	207.34	18:30—19:00	L	—	—	5	—	5.0
20	207.34	18:30—19:00	M	—	—	5	—	4.6
20	207.34	18:40—19:00	T	—	—	7	—	10.4
20	207.36	19:00—19:30	L	—	—	3	—	3.0
20	207.36	19:00—19:30	M	—	—	7	—	6.4
20	207.36	19:00—19:30	T	—	—	6	—	5.9
20	207.38	19:30—20:02	L	—	—	5	—	4.7
20	207.38	19:30—20:02	M	—	—	13	—	11.1
20	207.38	19:30—20:02	T	—	—	11	—	10.2
20	207.55	23:45—00:15	L	—	1	8	1.5	8.0
20	207.55	23:45—00:15	M	—	6	5	8.3	4.6
21	207.58	00:15—00:45	L	—	3	5	4.2	5.0
21	207.58	00:15—00:45	M	—	7	6	9.0	5.5
21	207.60	00:45—01:15	L	—	5	3	6.6	3.0
21	207.60	00:45—01:15	M	—	3	7	3.6	6.4
21	207.62	01:15—01:45	L	—	5	4	6.3	4.0
21	207.62	01:15—01:45	M	—	6	7	6.9	6.4
22	209.44	21:20—21:50	L	30	1	4	4.5	5.6
22	209.44	21:20—21:50	M	15	1	6	3.4	6.3
22	209.47	21:50—22:25	L	20	5	3	13.3	3.2
22	209.47	21:50—22:25	M	5	3	2	6.2	1.6
			October 1945					
16	203.32	23:28—23:58	M	—	—	8	—	8.6
16	203.32	23:28—23:58	H	—	1	7	2.5	10.6
16	203.32	23:35—23:58	L	—	3	12	6.4	15.7
16	203.34	23:58—00:28	L	—	3	10	4.5	10.0
16	203.34	23:58—00:28	M	—	3	8	4.9	8.6
16	203.34	23:58—00:28	H	—	1	12	2.3	18.2
17	203.36	00:28—00:58	L	—	1	7	1.4	7.0
17	203.36	00:28—00:58	M	—	2	12	3.0	13.0
17	203.36	00:28—00:58	H	—	1	7	2.1	10.6
17	203.38	00:58—01:32	L	—	8	14	9.3	12.4
17	203.38	00:58—01:29	M	—	4	8	5.5	8.4
17	203.38	00:58—01:28	H	—	4	6	8.0	9.1
17	203.42	01:55—02:28	L	5	2	12	2.3	11.5
17	203.42	01:55—02:28	M	5	4	7	5.7	8.2

Table 2 (Continued)

Day	Sun	Time (UT)	Obs.	Cl	n_+	n_-	f_+	f_-
17	203.42	01:55—02:28	H	15	2	4	3.9	6.4
17	203.44	02:28—02:58	L	10	6	5	7.9	5.5
17	203.44	02:28—02:58	M	10	7	8	10.0	9.5
17	203.44	02:28—02:58	H	15	3	6	6.3	10.6
17	203.46	02:58—03:35	L	—	6	9	5.8	7.3
17	203.46	02:58—03:35	M	—	5	10	5.3	8.8
17	203.46	02:58—03:35	H	—	6	10	8.9	12.3
20	206.39	01:40—02:10	L	10	4	1	5.4	1.1
20	206.39	01:40—02:10	T	10	3	—	4.7	—
20	206.39	01:43—02:10	M	5	2	2	3.1	2.5
20	206.41	02:10—02:40	L	25	2	2	3.2	2.6
20	206.41	02:10—02:40	M	5	2	1	2.7	1.1
20	206.41	02:10—02:40	T	20	—	2	—	2.8
20	206.43	02:40—03:10	L	25	—	1	—	1.3
20	206.43	02:40—03:10	M	10	—	1	—	1.2
20	206.43	02:40—03:10	T	15	1	2	1.6	2.7
20	206.45	03:10—03:40	L	20	6	4	8.9	4.9
20	206.45	03:10—03:40	T	15	3	6	4.9	8.0
20	206.46	03:40—03:57	L	10	3	7	7.1	13.6
20	206.46	03:40—03:57	M	5	5	4	12.2	8.0
20	206.46	03:40—03:57	T	10	5	1	13.6	2.2
			October 1946					
16	203.01	22:20—22:50	L	—	1	5	2.2	5.0
16	203.01	22:20—22:50	T	—	1	2	2.7	2.4
16	203.03	22:46—23:20	A	—	2	8	2.9	6.1
16	203.03	22:50—23:20	L	—	1	3	1.9	3.0
16	203.03	22:50—23:20	T	—	2	6	4.6	7.2
16	203.03	22:52—23:20	G	—	2	4	4.2	4.4
16	203.05	23:20—23:40	T	—	—	1	—	1.8
16	203.06	23:20—23:58	L	—	3	1	4.0	0.8
16	203.06	23:20—23:58	A	—	2	4	2.3	2.7
16	203.06	23:20—23:58	G	—	4	2	5.5	1.6
19	205.22	03:40—04:10	A	—	3	2	3.2	1.7
19	205.22	03:40—04:10	G	—	5	3	6.3	3.1
19	205.99	22:22—22:52	T	—	1	7	2.6	8.4
19	206.00	22:34—22:52	L	—	2	3	6.9	5.0
19	206.00	22:34—22:52	G	—	2	4	7.1	6.9
19	206.01	22:52—23:22	L	—	2	7	3.7	7.0
19	206.01	22:52—23:22	T	—	3	12	6.9	14.4
19	206.01	22:52—23:22	G	—	5	11	9.6	11.3
19	206.03	23:22—23:52	L	—	3	12	5.0	12.0
19	206.03	23:22—23:52	T	—	2	9	4.0	10.8
19	206.03	23:22—23:52	G	—	6	12	10.2	12.4
19	206.05	23:52—00:25	L	—	1	16	1.4	14.5
19	206.05	23:52—00:25	T	—	6	7	9.8	7.6
19	206.05	23:52—00:25	G	—	8	7	11.2	6.6
20	206.11	01:10—01:52	L	—	11	11	10.0	7.9
20	206.11	01:10—01:52	G	—	5	7	4.7	5.1
20	206.14	01:52—02:22	L	—	5	5	6.1	5.0
20	206.14	01:54—02:22	G	—	2	10	2.7	11.0
20	206.16	02:22—02:52	L	—	7	4	8.4	4.0
20	206.16	02:22—02:52	G	—	7	4	8.7	4.1
20	206.18	02:52—03:22	L	—	7	6	8.4	6.0
20	206.18	02:52—03:22	G	—	7	10	8.6	10.3
20	206.20	03:22—03:52	L	—	6	5	7.2	5.0
20	206.20	03:22—03:52	G	—	3	2	3.7	2.1
20	207.00	22:50—23:20	T	—	4	7	8.9	8.4

Table 2 (Continued)

Day	Sun	Time (UT)	Obs.	Cl	n_+	n_-	f_+	f_-
20	207.00	22:50—23:20	G	—	7	6	13.4	6.2
20	207.02	23:20—23:34	G	—	3	4	11.3	8.8
20	207.03	23:20—23:50	T	—	7	10	13.9	12.0
20	207.03	23:40—23:50	L	—	5	9	24.0	27.0
20	207.05	23:50—00:20	T	—	7	10	12.6	12.0
20	207.05	23:55—00:20	L	—	5	12	9.0	14.4
21	207.05	00:08—00:20	G	—	3	7	11.3	18.0
21	207.07	00:20—00:50	L	—	3	18	4.2	18.0
21	207.07	00:20—00:50	T	—	5	5	8.4	6.0
21	207.07	00:20—00:50	G	—	8	18	11.5	18.5
21	207.09	00:50—01:30	L	—	6	8	5.8	6.0
21	207.09	00:50—01:30	G	—	7	12	7.0	9.3
21	207.09	00:50—01:22	T	—	8	2	11.8	2.3
21	207.14	02:08—02:20	L	10	1	4	3.3	11.0
21	207.14	02:08—02:20	G	—	1	1	3.1	2.6
21	207.15	02:20—02:50	L	—	4	19	4.8	19.0
21	207.15	02:20—02:50	G	—	5	7	6.2	7.2
21	207.18	02:50—03:30	L	—	5	11	4.5	8.2
21	207.18	03:00—03:30	G	—	6	12	7.4	12.4
25	211.10	01:32—02:02	L	—	5	7	6.1	7.0
25	211.10	01:32—02:00	A	—	10	10	11.4	9.3
25	211.10	01:32—02:02	G	—	10	5	12.6	5.2
25	211.12	02:02—02:32	L	—	6	6	7.2	6.0
25	211.12	02:02—02:32	A	—	8	7	8.4	6.1
25	211.12	02:02—02:32	G	—	4	3	4.9	3.1
26	212.11	01:42—02:12	L	—	3	11	3.6	11.0
26	212.11	01:42—02:12	A	—	8	16	8.4	13.9
26	212.11	01:42—02:12	G	—	6	16	7.5	16.5
26	212.13	02:12—02:42	L	—	4	11	4.8	11.0
26	212.13	02:12—02:42	A	—	4	14	4.2	12.2
26	212.13	02:12—02:42	G	—	4	14	4.9	14.4
26	212.15	02:42—03:12	L	—	3	16	3.6	16.0
26	212.15	02:42—03:12	A	—	6	11	6.2	9.6
26	212.15	02:42—03:12	G	—	8	9	9.8	9.3
26	212.17	03:12—03:42	L	—	2	7	2.4	7.0
26	212.17	03:12—03:42	A	—	5	12	5.2	10.4
26	212.17	03:12—03:42	G	—	2	11	2.5	11.3
27	213.09	01:22—02:02	L	—	4	10	3.7	7.5
27	213.09	01:22—02:02	A	—	4	10	3.2	6.5
27	213.09	01:22—02:02	G	—	3	7	2.8	5.4
			October 1947					
15	200.95	02:40—03:10	L	—	2	8	2.4	8.0
15	200.95	02:40—03:10	A	—	4	10	4.4	9.1
15	200.97	03:10—03:40	L	—	—	8	—	8.0
15	200.97	03:10—03:30	A	—	—	6	—	8.2
16	201.94	02:25—03:05	L	—	2	8	1.8	6.0
16	201.94	02:25—03:05	A	—	6	11	4.9	7.5
20	206.78	23:40—00:10	L	—	9	5	14.0	5.0
20	206.78	23:40—00:10	T	—	2	4	3.4	4.4
21	206.80	00:10—00:40	L	—	9	5	12.9	5.0
21	206.80	00:10—00:40	T	—	5	4	7.9	4.4
21	207.77	23:30—00:00	L	—	10	10	15.9	10.0
21	207.77	23:30—00:00	T	—	7	3	12.2	3.3
22	207.79	00:00—00:30	L	—	9	9	13.1	9.0
22	207.79	00:00—00:30	T	—	7	11	11.2	12.1
22	207.79	00:03—00:30	A	—	6	16	8.8	16.2
22	207.81	00:30—01:00	L	—	11	4	15.0	4.0

Table 2 (Continued)

Day	Sun	Time (UT)	Obs.	Cl	n_+	n_-	f_+	f_-
22	207.81	00:30—01:00	T	—	13	8	19.5	8.8
22	207.81	00:30—01:00	A	—	6	6	7.4	5.5
22	207.81	01:00—01:30	L	—	5	7	6.4	7.0
22	207.83	01:00—01:30	T	—	8	8	11.3	8.8
22	207.84	01:06—01:30	A	—	9	8	13.1	9.1
22	207.86	01:30—02:00	L	—	7	5	8.7	5.0
22	207.86	01:30—02:00	T	—	9	5	12.3	5.5
22	207.86	01:30—02:00	A	—	10	9	11.3	8.2
22	207.87	02:00—02:15	A	—	7	1	15.5	1.8
22	207.87	01:00—02:21	T	—	5	6	9.5	9.4
22	207.88	02:00—02:30	L	—	10	13	12.1	13.0
22	207.90	02:30—03:00	L	—	9	7	10.8	7.0
22	207.90	02:35—03:00	A	—	14	8	18.3	8.7
22	207.90	02:38—03:00	T	—	11	3	19.7	4.5
22	207.91	03:00—03:20	A	—	6	3	9.8	4.1
22	207.92	03:00—03:40	L	—	7	10	6.3	7.5
22	207.92	03:00—03:40	T	—	13	10	12.8	8.2
23	208.88	02:15—02:45	L	—	5	4	6.0	4.0
23	208.88	02:15—02:45	A	—	4	11	4.4	10.0
23	208.90	02:45—03:15	L	—	5	7	6.0	7.0
23	208.90	02:45—03:15	A	—	7	13	7.6	11.8
23	209.76	23:26—23:56	L	—	3	8	4.8	8.0
23	209.76	23:26—23:56	A	—	4	10	7.0	11.0
23	209.78	23:56—00:26	L	—	9	6	13.1	6.0
23	209.78	23:56—00:26	A	—	8	5	12.8	5.5
25	210.80	00:27—00:57	L	—	1	8	1.4	8.0
25	210.80	00:27—00:57	A	—	2	9	3.0	9.9
25	210.82	00:57—01:27	L	—	3	8	3.8	8.0
25	210.82	00:57—01:27	A	—	4	8	5.6	8.8
26	211.85	01:43—02:23	L	—	2	15	1.8	11.2
26	211.85	01:43—02:23	A	—	2	13	2.0	10.8
			October 1949					
19	205.33	01:00—01:30	L	—	3	5	3.9	5.0
19	205.33	01:00—01:30	A	—	7	6	9.3	6.1
19	205.35	01:30—02:00	L	—	2	6	2.5	6.0
19	205.35	01:30—02:00	A	—	4	1	5.1	1.0
20	206.33	01:00—01:30	L	—	5	4	6.5	4.0
20	206.33	01:00—01:30	A	—	7	7	9.3	7.1
20	206.35	01:30—02:00	L	—	4	4	5.0	4.0
20	206.35	01:30—02:00	A	—	7	6	8.9	6.1
21	207.33	01:07—01:37	L	—	8	3	10.2	3.0
21	207.33	01:07—01:37	A	—	9	7	11.7	7.1
21	207.35	01:37—02:07	L	—	6	10	7.4	10.0
21	207.35	01:37—02:07	A	—	6	7	7.5	7.1
21	207.37	02:07—02:37	L	—	12	5	14.5	5.0
21	207.37	02:07—02:37	A	—	5	7	6.2	7.1
22	208.32	01:05—01:35	L	—	1	8	1.3	8.0
22	208.32	01:05—01:35	A	—	9	6	11.7	6.1
22	208.34	01:35—02:05	L	—	4	15	4.9	15.0
22	208.34	01:35—02:05	A	—	4	6	5.0	6.1

Table 2 (Continued)

Day	Sun	Time (UT)	Obs.	Cl	n_+	n_-	f_+	f_-
			October 1950					
15	201.08	00:10—00:40	L	—	—	9	—	9.0
15	201.08	00:10—00:40	J	—	3	5	6.7	7.6
15	201.10	00:40—01:10	L	—	2	4	2.7	4.0
15	201.10	00:40—01:10	J	—	2	3	4.1	4.5
16	202.13	01:30—02:00	L	—	3	7	3.8	7.0
16	202.13	01:30—02:00	J	—	4	1	7.6	1.5
16	202.15	02:00—02:30	L	—	4	4	4.9	4.0
16	202.15	02:00—02:30	J	—	3	1	5.5	1.5
17	203.10	01:00—01:30	L	—	4	8	5.2	8.0
17	203.10	01:00—01:30	J	—	3	2	5.9	3.0
17	203.12	01:30—02:00	L	—	4	8	5.0	8.0
17	203.12	01:30—02:00	J	—	4	3	7.6	4.5

Table 3

Year	Obs.	Nights	No. of records		All records
			Orionids	Sporadic	
1944	4	8	76	475	551
1945	4	2	108	216	324
1946	4	7	336	607	943
1947	3	8	297	364	661
1949	2	4	103	113	216
1950	2	3	36	55	91
Total	8	32	956	1830	2786

2. Activity of the Orionids

The Orionids belong to the meteor showers with activity of longer duration, the Earth crosses their orbit for about two weeks. Visual observations are handicapped by usually not good weather conditions in this period of the year. Observations from the Skalnaté Pleso Observatory from the period 1944—1950 are not complete enough in this respect, the coverage of observations along the period of activity of the Orionids is not sufficient for deriving complete activity curves for individual returns. For this reason a curve of activity have been derived by joining all observations available.

The reduced hourly rates from all observations, arranged according to the solar longitudes of the mid-points of about one hour observing periods (equinox 1950.0) are summarized in Table 4. Furthermore, Table 4 contains dates and times of observing periods, number of observers participating in each interval (O), zenithal hourly rates of the Orionids (F_+) and the corresponding rates of the sporadic meteors (F_-), together with their natural uncertainties ε_+ and ε_- ($\varepsilon_\pm = \pm F_\pm n_\pm^{-1/2}$, where n_+ and n_- are numbers of the shower and the sporadic records, respectively). Table 4 gives for each interval, also mean magnitudes $\bar{m}_+$ and $\bar{m}_-$ of the Orionids and the sporadic meteors, together with the mean effective magnitudes $\bar{m}^*_+$ and $\bar{m}^*_-$, i.e. mean magnitude values for which all meteors brighter than $m = 0$ are taken as those of magnitude $m = 0$, reducing thus possible influence of random variations in the number of very bright meteors (for conversion of $\bar{m}^*$ to $\bar{m}$ and to r, cf. Porubčan et al., 1980). The observations cover a period of 13 days, from 200 to 213° of the solar longitude. Having in mind that in some intervals the net observing time of individual observers was not at all the same, the rate of each observer was

Table 4

Sun	Date	Time (UT)	t	O	F_+	ε_+	F_-	ε_-	$\bar{m}_+$	$\bar{m}^*_+$	n_+	$\bar{m}_-$	$\bar{m}^*_-$	n_-
200.65	14.10.44	00:35—01:35	60	3	2.7	1.1	14.3	2.2	3.33	3.33	6	2.58	2.58	43
200.69	14.10.44	01:35—02:35	60	3	1.2	0.7	23.5	2.8	2.00	2.00	3	2.94	2.94	71
200.72	14.10.44	02:35—03:08	33	3	0.7	0.7	17.5	3.3	4.00	4.00	1	2.89	2.89	28
200.96	15.10.47	02:40—03:40	60	2	3.4	1.4	16.6	2.9	3.33	3.33	6	3.31	3.31	32
201.09	15.10.50	00:10—01:10	60	2	6.8	2.6	12.6	2.7	3.00	3.00	7	3.14	3.14	21
201.94	16.10.47	02:25—03:05	40	2	6.7	2.4	13.5	3.1	3.25	3.25	8	3.26	3.26	19
202.14	16.10.50	01:30—02:30	60	2	10.9	2.9	7.0	1.9	2.86	2.86	14	2.31	2.31	13
202.46	15.10.44	20:25—21:25	60	3	—	—	9.0	2.2	—	—	—	3.18	3.18	17

Table 4 (Continued)

Sun	Date	Time (UT)	t	O	F_+	ε_+	F_-	ε_-	$\bar{m}_+$	$\bar{m}_+^*$	n_+	$\bar{m}_-$	$\bar{m}_-^*$	n_-
202.58	15.10.44	23:25—00:25	60	3	1.6	0.9	16.3	2.3	4.33	4.33	3	3.51	3.51	51
202.62	16.10.44	00:25—01:27	62	3	6.8	1.7	12.9	2.0	2.44	2.44	16	3.07	3.10	41
203.02	16.10.46	22:20—23:20	60	4	6.2	2.1	9.4	1.8	2.89	2.89	9	3.00	3.00	28
203.06	16.10.46	23:20—23:58	38	4	5.9	2.0	3.4	1.2	2.56	2??56	9	3.00	3.00	8
203.11	17.10.50	01:00—02:00	60	2	11.8	3.1	11.8	2.6	2.60	2.60	15	3.00	3.00	21
203.33	16.10.45	23:28—00:28	60	3	6.9	2.1	23.9	3.2	3.00	3.00	11	3.74	3.74	57
203.37	17.10.45	00:28—01:32	64	3	9.8	2.2	20.2	2.7	2.85	2.85	20	3.08	3.18	54
203.43	17.10.45	01:55—02:58	63	3	12.0	2.5	17.2	2.7	2.88	2.88	24	3.60	3.60	42
203.46	17.10.45	02:58—03:35	37	3	13.3	3.2	18.9	3.5	3.29	3.29	17	3.34	3.34	29
203.52	16.10.44	22:08—23:08	60	3	—	—	15.8	2.6	—	—	—	3.19	3.19	37
205.22	19.10.46	03:40—04:10	30	2	9.5	3.4	4.8	2.1	1.88	2.25	8	3.00	3.00	5
205.34	19.10.49	01:00—02:00	60	2	10.4	2.6	9.0	2.1	2.31	2.31	16	2.78	3.00	18
206.00	19.10.46	22:22—23:22	60	3	11.9	3.1	18.6	2.8	2.93	2.93	15	3.25	3.25	44
206.04	19.10.46	23:22—00:25	63	3	13.9	2.7	21.3	2.7	2.96	2.96	26	3.46	3.69	63
206.11	20.10.46	01:10—01:52	42	2	14.7	3.7	13.0	3.1	2.87	2.87	16	3.11	3.11	18
206.15	20.10.46	01:52—02:52	60	2	13.0	2.8	12.0	2.5	2.24	2.24	21	3.09	3.09	23
206.19	20.10.46	02:52—03:52	60	2	14.0	2.9	11.7	2.4	2.74	2.78	23	3.13	3.13	23
206.34	20.10.49	01:00—02:00	60	2	14.8	3.1	10.6	2.3	3.09	3.09	23	3.52	3.52	21
206.40	20.10.45	01:40—02:40	60	3	6.4	1.8	3.4	1.2	2.23	2.23	13	2.63	2.63	8
206.43	19.10.44	20:28—21:28	60	3	—	—	9.2	1.8	—	—	—	2.29	2.86	27
206.44	20.10.45	02:40—03:57	77	3	8.5	1.8	9.4	1.8	1.87	2.26	23	3.12	3.12	26
206.48	19.10.44	21:28—22:31	63	3	0.9	0.9	10.5	1.9	2.00	2.00	1	3.14	3.14	30
206.79	20.10.47	23:40—00:40	60	2	19.1	3.8	9.4	2.2	3.24	3.24	25	3.06	3.28	18
207.02	20.10.46	22:50—23:50	60	3	26.0	5.1	20.9	3.5	2.42	2.65	26	3.25	3.28	36
207.06	20.10.46	23:50—00:50	60	3	18.6	3.3	28.2	3.4	2.90	2.94	31	3.44	3.44	70
207.09	21.10.46	00:50—01:22	32	3	16.4	3.6	11.7	2.5	2.71	2.71	21	3.23	3.23	22
207.15	21.10.46	02:08—02:50	42	2	9.7	2.9	22.6	4.1	3.82	3.82	11	3.06	3.06	31
207.18	21.10.46	02:50—03:30	40	2	11.9	3.6	20.6	4.3	3.00	3.00	11	2.96	2.96	23
207.33	20.10.44	18:00—19:00	60	3	—	—	10.4	2.2	—	—	—	3.48	3.48	25
207.34	21.10.49	01:07—02:07	60	2	18.4	3.4	13.6	2.6	3.41	3.41	29	3.63	3.63	27
207.37	20.10.44	19:00—20:02	62	3	—	—	13.8	2.1	—	—	—	3.18	3.18	45
207.37	21.10.49	02:07—02:37	30	2	20.7	5.0	12.1	3.5	3.18	3.24	17	3.00	3.00	12
207.56	20.10.44	23:45—00:45	60	2	11.5	2.8	11.6	2.4	2.71	2.71	17	3.46	3.46	24
207.61	21.10.44	00:45—01:45	60	2	11.7	2.7	9.9	2.2	3.00	3.00	19	3.19	3.19	21
207.78	21.10.47	23:30—00:30	60	3	24.6	3.9	20.2	2.9	3.13	3.13	39	2.69	2.76	49
207.82	22.10.47	00:30—01:30	60	3	24.2	3.4	14.4	2.2	3.27	3.27	52	3.10	3.10	41
207.86	22.10.47	01:30—02:30	60	3	22.6	3.3	15.1	2.4	2.67	2.67	48	3.87	3.87	39
207.91	22.10.47	02:30—03:40	70	3	25.3	3.3	13.7	2.1	3.07	3.07	60	3.59	3.61	41
208.33	22.10.49	01:05—02:05	60	2	11.4	2.7	17.6	3.0	3.28	3.28	18	3.14	3.14	35
208.89	23.10.47	02:15—03:15	60	2	12.0	2.6	16.4	2.8	2.90	2.90	21	2.91	2.97	35
209.46	22.10.44	21:20—22:25	65	2	13.7	4.3	8.4	2.2	1.80	1.90	10	3.40	3.40	15
209.77	23.10.47	23:26—00:26	60	2	18.8	3.8	15.2	2.8	3.13	3.13	24	3.21	3.21	29
210.81	25.10.47	00:27—01:27	60	2	6.9	2.2	17.4	3.0	2.60	2.60	10	3.73	3.73	33
211.11	25.10.46	01:32—02:32	60	3	16.9	2.6	12.2	2.0	3.14	3.14	43	3.53	3.53	38
211.85	26.10.47	01:43—02:23	40	2	3.8	1.9	22.0	4.2	3.75	3.75	4	3.36	3.36	28
212.12	26.10.46	01:42—02:42	60	3	11.1	2.1	26.3	2.9	3.38	3.38	29	3.45	3.45	82
212.16	26.10.46	02:42—03:42	60	3	9.9	1.9	21.2	2.6	3.62	3.62	26	3.38	3.38	66
213.09	27.10.46	01:22—02:02	40	3	6.5	1.9	12.9	2.5	3.55	3.55	11	3.22	3.22	27

weighted according to the individual length of his observation, with respect to the whole interval. The hourly rates around the maximum activity of the Orionids in between the solar longitudes 205—212° for each year are plotted in Fig. 1. Two intervals from 1945 and two from 1946, in which the observations were disturbed by the moonshine, as was already mentioned above, are not included in the figure.

From Fig. 1 it can be seen, that observations carried around the maximum of activity of the Orionids are not spread uniformly and that only the ascending branch of activity is well defined by consistent observations from different returns. The descending branch is covered by relatively few observations. The maximum observed hourly rate of about 25 Orionids, was recorded in 1947 at $\odot = 207.9°$. We should mention, however, that in

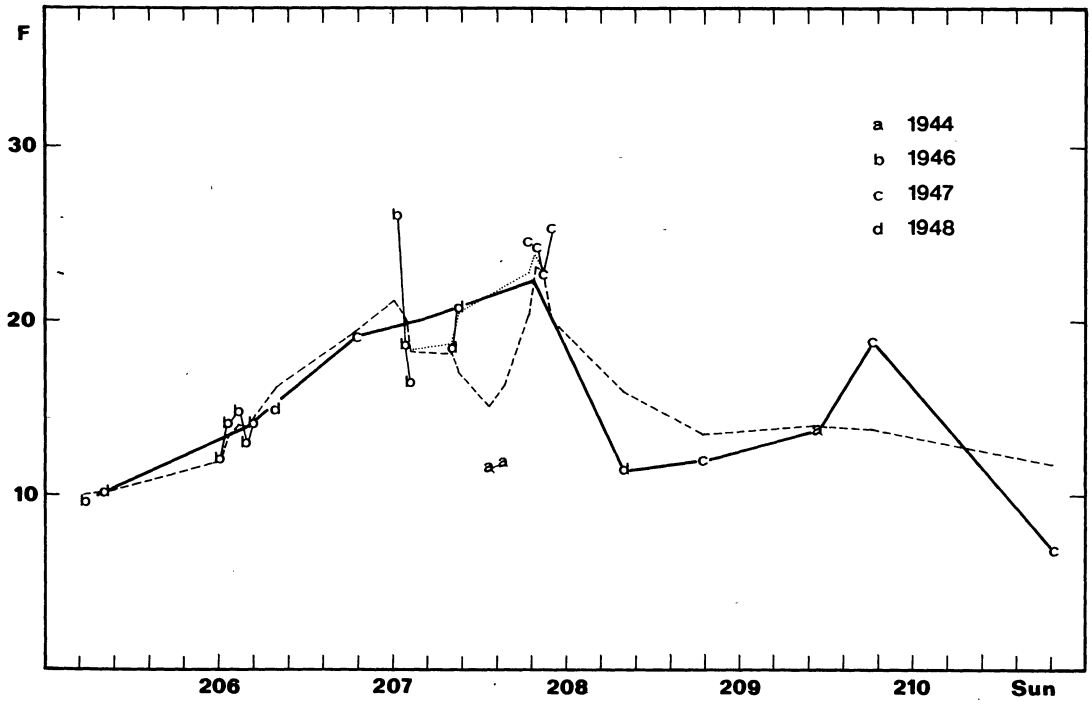

Fig. 1. The reduced hourly rates of the Orionids, F, plotted against the solar longitude at the time of observation (equinox 1950.0). Individual years are distinguished by different markings and data from individual nights are connected by straight lines. The smoothed hourly rates are designated by dashed line and weighted mean rates within each half degree of the solar longitude are connected by heavy line.

1946 in one observing period at $\odot = 207°$ the rate raised up to 26 meteors, but this rate was derived from observations of relatively short period and presumably refers to a random enhancement of meteor particles within the stream. The smoothed hourly rates of observations presented in Fig. 1 are connected by a dashed line. Close to the maximum of activity at about $\odot = 207.6°$, there are two observations from 1944 with unusually low rate of shower meteors. We remind that a similar case appeared in an earlier analysis of the Geminids from visual observations made at Skalnaté Pleso (Porubčan et al., 1980) and from this can be inferred that such low rate in both cases is apparently due to a low experience of observers at the beginning of the whole meteor observing programme at Skalnaté Pleso in 1944 and perhaps to a wrong identification of the shower membership. Omitting these observations, the course of the Orionids activity near the maximum is much more uniform (line made of points). By a full line in Fig. 1 the mean values of the observed hourly rates from all observations are shown, divided into 0.5° intervals of the solar longitude and weighted according to the number of meteors observed in particular observation.

Our visual data show that activity of the Orionids is rising up not very steeply, the ascending branch is relatively flat in comparison with the descending branch which is steeper. The absolute peak of activity is not defined exactly, but it might be inferred that the maximum of the Orionids activity as found from different returns occurs around the solar longitude 207.8°. Compiling data from different sources, Millman and McKinley (1963) found the position of the maximum to be at $\odot = 207.0°$, while Cook (1973) gives for it the value $\odot = 207.7°$, which is in very good agreement with our results. Though the descending branch of activity is not represented by observations as good as the ascending branch, there appears an expressive secondary maximum at $\odot = 209.8°$, which is mainly based on observations from 1947. It is certainly very interesting to note that similar course of activity of the Orionids, with two maxima at the same solar longitudes (~208 and 210°) was observed in 1938 (Prentice, 1941), i.e. nine years earlier at a return of higher activity.

Taking into account the curve of activity shown in Fig. 1, the shower duration may be estimated. If we define the main shower duration as the time interval between two instants when the rate of

shower meteors is approximately one half of the maximum value, we get 5.5 days. This value is almost twice as much as that given by Cook (1973) and is comparable with the value given by Millman and McKinley (1963).

3. Magnitude Distribution and Its Variation

Magnitude distribution of the Orionids with its possible changes in the course of the shower activity on the basis of the Skalnaté Pleso visual data was studied earlier in some aspects by Kresáková (1966). In her study main emphasis was placed on deriving the magnitude distribution index r (denoted by $\varkappa$ in her paper), for which she found the mean value $r_+ = 2.9$, as compared with the value $r_- = 3.4$ for sporadic meteors of the same period. She also found a sudden increase of r_+ at the solar longitude $\odot = 212.0°$ ($r_+ = 4.0$),i.e. about 4 days after the maximum activity of the shower, as well as some undefinite concentration of bright meteors towards the stream's centre.

The aim of the present analysis is to study variations of the magnitude distribution in more details, with exclusion of the influence of the magnitude scales of the observers, as well as of the observing conditions. Moreover, as we can see from Kresáková's data, the high value $r_+ = 4.0$ for the inner boundary of the stream ($\odot \geqq 212°$) was derived from relatively small number of records ($n_+ = 71$), obtained in two nights in 1946. It might also be of importance to examine in more details the magnitude distribution around the maximum of the shower ($\odot = 207.8°$), which is included in Kresáková's broad part (b), covering the shower's activity in between $205° \leqslant \odot \leqslant 209°$, with the largest amount of records (684 out of the total of 1015 records included in her paper).

A scrutiny of the original records of the visual observations from the Skalnaté Pleso Observatory reveals that in some periods of the Orionid activity in the years 1946 and 1947 two additional showers were suspected and partly recorded. There was some misunderstanding in their denotation in the original records; we counted meteors of both these showers as the sporadic ones, though in Kresáková's analysis they were included among the Orionids. The total number of such records amounts to 36. By this fact, as well as by exclusion of some observers, the discrepancy between the total number of records used in this paper and that given by Kresáková is explained.

Magnitude distribution of the Orionids and the sporadic meteors, as recorded by individual observers, is given in Table 5. Analysis of the magnitude scales of individual observers, based on the magnitude estimates of the sporadic meteors, reveals that with the exception of the observers O and J there is very steady magnitude scale for all

Table 5

m \ Obs.	T	M	H	J	G	A	O	L	Total
					Orionids				
−3	2	1	0	0	1	0	0	1	5
−2	0	0	0	0	0	1	0	0	1
−1	0	1	0	0	3	0	0	1	5
0	4	1	0	0	3	3	0	9	20
1	6	7	2	2	5	15	1	21	59
2	41	15	4	4	25	52	4	73	218
3	44	30	7	5	53	61	2	140	342
4	27	15	5	8	28	36	2	96	217
5	14	0	0	0	15	41	0	19	89
Total	138	70	18	19	133	209	9	360	956
					Sporadic meteors				
−5	0	1	0	0	0	0	1	1	3
−4	0	0	0	0	0	0	0	0	0
−3	0	1	1	0	0	1	0	0	3
−2	2	0	0	0	1	0	0	1	4
−1	1	1	0	0	0	2	0	5	9
0	3	0	1	0	7	6	0	9	26
1	10	20	2	1	11	14	8	26	92
2	29	47	7	5	22	50	32	93	285
3	58	82	18	5	69	109	44	240	625
4	37	65	15	4	50	54	30	248	503
5	35	29	6	0	48	57	1	97	273
6	0	4	2	0	0	0	1	0	7
Total	175	250	52	15	208	294	116	720	1830

Table 6

Obs.	n_+	$\bar{m}_+$	σ_+	n_-	$\bar{m}_-$	σ_-
T	138	2.84	1.36	175	3.20	1.38
M	70	2.61	1.25	250	3.12	1.35
H	18	2.83	0.99	52	3.25	1.49
J	19	3.00	1.05	15	2.80	0.94
G	133	2.97	1.36	208	3.37	1.33
A	209	3.11	1.32	294	3.21	1.31
O	9	2.56	1.01	116	2.79	1.17
L	360	2.95	1.13	720	3.33	1.18
Total	956	2.94		1830	3.23	

the other observers (Table 6). We therefore accept as the personal coefficients the values $v = 1.00$ and $\mu = 0.00$ for all observers expect of O and J. As far as the observers O and J concerns, accepting the magnitude scale of the observer L as the standard one, their coefficients have the values: $v = 1.01$ and $\mu = +0.57$ for the observer O and $v = 1.25$ and $\mu = -0.17$ for the observer J. Taking into account very low total number of meteors recorded by the observer J ($n_+ = 19$, $n_- = 15$), it seems reasonable to exclude his observations from the further analysis completely. In the case of the observer O, his magnitude estimates might be corrected according to his personal coefficients given above.

On the other hand, from our analysis of the variations in magnitude distribution the following observing periods were excluded because of significant influence of the moonlight, which is difficult to account for: Oct. 20, 1945 (1:40—3:47 UT); Oct. 20, 1946 (2:00—3.52 UT). Moreover, to eliminate large random variations as much as possible, all periods were excluded, in which the total number of records of Orionids was not larger than 10.

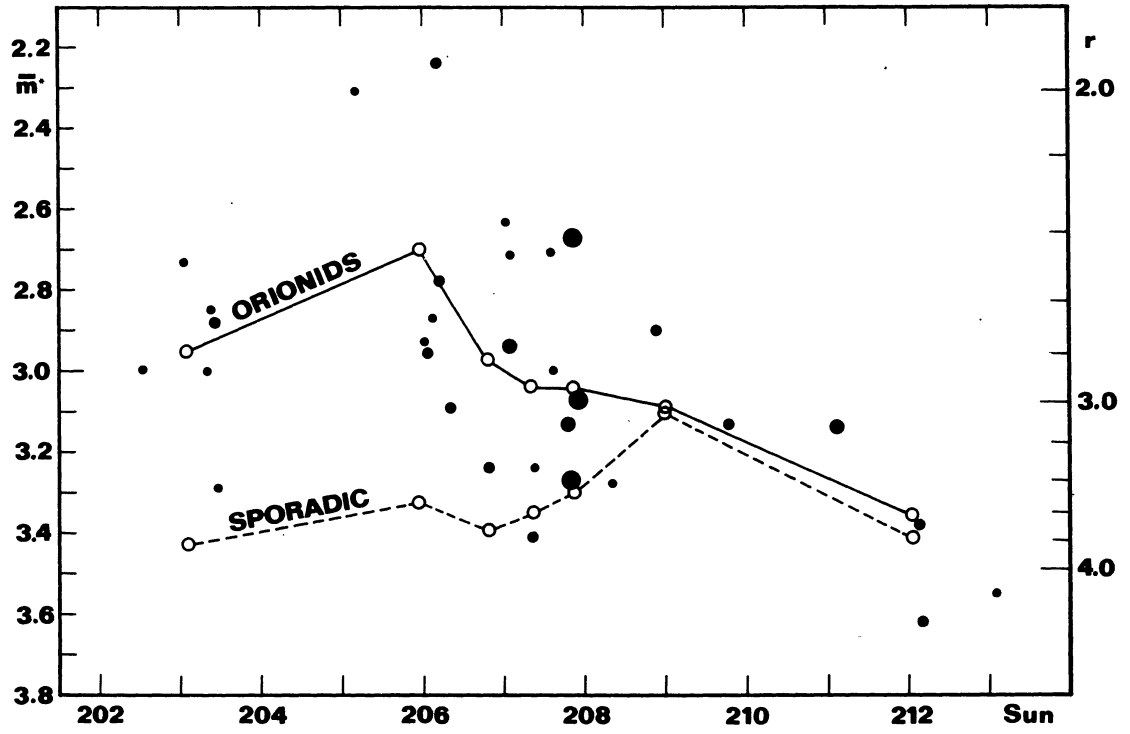

Fig. 2. The variation of the effective mean magnitude $\bar{m}^*$ as well as the magnitude distribution index r of the Orionids (dots for individual periods, circles and full line for the intervals of Table 7) and for the sporadic meteors (circles and dashed line).

Table 7

⊙	Σt	$\bar{m}^*_+$	r_+	n_+	$\bar{m}^*_-$	r_-	n_-
203.07	444	2.95	3.04	109	3.43	3.27	310
205.96	345	2.70	2.88	117	3.32	3.22	189
206.80	240	2.97	3.05	105	3.39	3.25	145
207.34	242	3.04	3.09	103	3.35	3.23	106
207.85	250	3.04	3.09	199	3.30	3.22	170
209.00	180	3.09	3.11	63	3.10	3.12	99
212.03	220	3.36	3.24	109	3.41	3.26	213
Total		3.02	3.08	805	3.35	3.23	1232

The remaining set of the corrected data comprises 805 magnitude estimates of the Orionids and 1232 magnitude estimates of the sporadic meteors. The resulting mean effective magnitudes $\bar{m}^*_\pm$ are shown in Fig. 2 by dots. The size of any individual dot indicates the weight of the particular value of $\bar{m}^*_\pm$, according to the square root of the number of magnitude estimates used for its calculation. It is seen that the individual values of $\bar{m}^*_\pm$ are dispersed considerably, but the steady tenden-

cy of decrease in $\bar{m}_+^*$ from the solar longitude $\odot \approx 205$ to $\odot \approx 214$ is quite evident.

To find out the character of this decrease, the whole set of data was divided into 7 groups according to the solar longitude, with possibly similar numbers of the Orionids in each. Table 7 gives the values of the mean solar longitude $\odot$ for each group, together with the values of the effective mean magnitudes $\bar{m}_+^*$ and $\bar{m}_-^*$, the corresponding numbers n_+ and n_- and the magnitude distribution indices r_+ and r_-. The values $\bar{m}_+^*$ for each group are shown in Fig. 2 by circles, connected by a full line, the values $\bar{m}_-^*$ are denoted by circles connected by a dashed line.

We can see that there is a definite change in the magnitude distribution of the Orionids in course of their activity. The decrease in $\bar{m}_+^*$ and r_+ does not occur suddenly, but has a steady, smooth character, from the lowest value $\bar{m}_+^* = 2.7$ ($r_+ \approx 2.9$) at about $\odot \approx 206°$, i.e. even before the maximum of the Orionids activity ($\odot = 207.8°$), to the highest recorded value of about $\bar{m}_+^* = 3.3$—3.4 ($r_+ = 3.2$—3.3), identical with the corresponding value for sporadic meteors, at about $\odot \approx 212°$.

We can conclude that the large, bright particles are concentrated in the outer part of the stream, with a peak occurring about 2 days before the maximum visual activity of the Orionids, while the smaller particles are more pronounced in the inner part of the stream, as more as we go further towards the inner edge of the stream. At this edge the magnitude distribution of the Orionids is undistinguishable from that of the sporadic meteors.

The peak of the bright meteors at about $\odot \approx$ 205—206° is actually confirmed by the observations in different years, namely 1944, 1945, 1946 and 1949. On the other hand, it looks more like a complex of isolated regions in the stream, where the relative number of larger particles is enhanced, similarly as is the case at the Geminid meteor stream (cf. Porubčan et al., 1980; Kashcheev and Lebedinets, 1959).

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METEORICKÝ ROJ ORIONÍD: AKTIVITA A FUNKCIA JASNOSTI

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Súhrn

V práci sa analyzujú vizuálne pozorovania meteorického roja Orionid, zahrnujúce okolo 2500 záznamov meteorov, zaznamenaných počas 6 rozličných návratov roja v rokoch 1944—1950 na observatóriu na Skalnatom Plese. Odvodená stredná krivka aktivity, redukovaná na štandardné pozorovacie podmienky a radiant v zenite ukazuje, že aktivita Orionid, pokiaľ ide o polohu maxima, je pomerne stála; ukazuje sa však náznak výskytu pomerne silného sekundárneho maxima približne dva dni po hlavnom maxime. Maximálna frekvencia Orionid na štandardného pozorovateľa je okolo 25 meteorov za hodinu. Dĺžka trvania roja medzi okamihmi, keď jeho aktivita je polovičná v porovnaní s maximálnou, je približne 5.5 dní. Maximum aktivity nastáva okolo dĺžky Slnka 207.8°; sekundárne maximum, pozorované najmä roku 1947, nastáva pri dĺžke Slnka 209.8°.

Pozorovaná funkcia jasnosti Orionid ukazuje výrazný a trvalý pokles indexu r od jeho minimálnej hodnoty $r_+ \approx 2.9$ pri dĺžke Slnka 205—206°, po maximálnu hodnotu $r_+ \approx 3.2$—3.3 pri dĺžke Slnka približne 212°; táto maximálna hodnota je fakticky totožná so zodpovedajúcou pozorovanou hodnotou $r_- = 3.23$ sporadických meteorov z obdobia celej činnosti roja Orionid.

МЕТЕОРНЫЙ ПОТОК ОРИОНИД: АКТИВНОСТЬ И РАСПРЕДЕЛЕНИЕ ЗВЕЗДНЫХ ВЕЛИЧИН

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Резюме

В работе изучаются визуальные наблюдения метеорного потока Орионид, насчитывающие около 2500 наблюдений метеоров, зарегистрированных в течение 6 разных оборотов потока в 1944–1950 гг. на обсерватории Скалнате-Плесо. Приведенная средняя кривая активности, редуцированная на страндартные условия наблюдений и на радиант в зените, показывает, что активность Орионид с точки зрения положения максимума является относительно постоянной; показывается, однако, что существует относительно активный вторичный максимум, наступающий приблизительно через два дня после главного максимума. Максимальное часовое число Орионид, приведенное к стандартному наблюдателю, достигает 25 метеоров. Продолжительность активности потока между моментами, когда численность потока не меньше половины максимальной численности, приблизительно 5,5 дня. Максимум активности наступает около долготы Солнца 207,8°; положение вторичного максимума, наблюденного главным образом в 1947 г., находится на долготе Солнца 209,8°.

Распределение звездных величин метеорного потока Орионид показывает выразительное и постоянное падение коэффициента r с его минимального значения $r_+ \approx 2.9$ при долготе Солнца 205–206°, до максимального значения $r_+ \approx 3{,}2$–$3{,}3$ при долготе Солнца приблизительно 212°; это максимальное значение фактически отвечает значению $r_- = 3{,}23$ спорадических метеоров, полученному из всего периода активности метеорного потока Орионид.