LYRID METEOR SHOWER — ACTIVITY AND MAGNITUDE DISTRIBUTION

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ABSTRACT. A series of visual observations of the Lyrid meteor shower, carried out at the Skalnaté Pleso Observatory in 1945-1952 at four different returns of the stream, is analysed. A mean curve of activity of the Lyrids is derived and discussed. The peak number of the Lyrids, comprising about 40 meteors per hour, was observed in 1946. The activity of the Lyrids appears to be symmetrical around its maximum at the solar longitude 31.5°. The magnitude distribution of the Lyrids, with its mean population index $r = 2.9$, exhibits some sudden changes around the maximum of the shower's activity; the peak hourly rate in 1946 is presumably effected by an increase in the relative number of fainter meteors. A filamentary structure of the Lyrid stream is suggested.

МЕТЕОРНЫЙ ПОТОК ЛИРИД : АКТИВНОСТЬ И РАСПРЕДЕЛЕНИЕ ЗВЕЗДНЫХ ВЕЛИЧИН. В работе изучаются визуальные наблюдения метеорного потока Лирид, полученные во время 4 возвращений роя в 1945-1952 гг. в обсерватории Скалнате Плесо. Получается и обсуждается средная кривая активности потока. Самое высокое число Лирид, насчитывающее 40 метеоров в час, наблюдалось в 1946 г. Кривая активности потока оказывается симметричной, с максимумом при долготе Солнца $31{,}5^{\circ}$. Распределение звездных величин Лирид со средным индексом $r = 2{,}9$ показывает быстрые изменения в близости максимума потока; высокое часовое число Лирид в 1946 г. сопровождается изменением средней звездной величины Лирид, являющегося следствием быстрого возраста относительного числа более слабых метеоров. Предлагается гипотеза филаментарной структуры роя Лирид.

METEORICKÝ ROJ LYRÍD : AKTIVITA A FUNKCIA JASNOSTI. V práci sa analyzujú vizuálne pozorovania meteorického roja Lyríd, získané počas 4 návratov roja v rokoch 1945-1952 na observatóriu na Skalnatom Plese. Odvádza a analyzuje sa stredná krivka aktivity Lyríd. Najvyšší počet Lyríd, dosahujúci frekvenciu 40 meteorov za hodinu, pozoroval sa r. 1946. Aktivita Lyríd sa ukazuje byť symetrická voči maximu, ktoré nastáva pri dĺžke Slnka 31,5°. Funkcia jasnosti Lyríd má stredný populačný index r = 2,9 a prejavuje náhle zmeny okolo maxima aktivity roja; vysoká frekvencia roja v r. 1946 bola zrejme spôsobená náhlym vzostupom relatívneho počtu slabších meteorov. Vyslovuje sa hypotéza o filamentárnej štruktúre roja Lyríd.

1. OBSERVATIONS AND THEIR TREATMENT

The visual data on the Lyrid meteor stream compiled from meteor observations carried out at the Skalnaté Pleso Observatory and presented in this paper, represent four different returns of the stream, between 1945 and 1952. The data include a total of 479 records of the Lyrids and 722 records of sporadic meteors obtained on 13 nights during 97.6 hours of observational time. The observations were carried out by a standard group of observers and the method of observations is presented elsewhere /Kresáková, 1966; Štohl, 1969/.

The list of the observers who participated in the observations is given in Table 1, together with the observing time and number of recorded stream and sporadic meteors. The treatment of the data and the whole analysis is similar to that presented in the analyses of the Geminids and Orionids /Porubčan et al., 1980; Štohl and Porubčan, 1981/. Similarly, the observations were divided into approximately half-hour intervals for which the corrected rates for the observers were derived by applying personal coefficients /Table 1 - Ľ. Pajdušáková as the standard observer/, coefficients for cloudiness and converting the observed rates to the zenithal, taking into account the daily motion of the stream radiant as derived for the 1950.0 equinox /Kresák and Porubčan, 1970/ and given by

$$\alpha = 271.9 + 1.23 \quad (\odot - 32)$$

$$\delta = 33.3 + 0.17 \quad (\odot - 32) .$$

The corrected half-hour rates of the Lyrids f_+ and of the sporadic meteors f_- for the individual observers and different returns of the stream are presented in Table 2. The table lists the dates of observations, abbreviations of observers /as in Tab. 1/, percentage of cloudiness and recorded numbers of stream and sporadic meteors. A summary of observations in different years is listed in Table 3.

Table 1
List of observers

Observer	Abbr.	t	n_+	n_-	c_p			
					1945	1946	1947	1952
Bečvář A.	T	648	58	49	1.15	1.20	1.10	-
Bečvářová K.	Kl	190	24	33	-	1.43	-	-
Dzubák M.	M	472	47	54	-	1.19	1.15	-
Guth V.	G	388	27	41	-	-	-	1.48
Hartmanová M.	H	337	36	39	-	1.54	-	-
Kiss V.	Ki	210	3	7	1.74	-	-	-
Kresák Ľ.	K	693	32	89	-	-	1.13	1.16
Kresáková M.	Ka	418	35	62	-	-	-	1.11
Mrkos A.	A	605	108	104	-	0.87	0.91	-
Olejník Š.	O	120	1	12	-	1.20	-	-
Pajdušáková Ľ.	L	1310	95	195	1.00	1.00	1.00	1.00
Uhlár J.	U	120	-	11	1.31	-	-	-
Vadovič F.	V	344	13	26	-	-	1.44	-
		5855	479	722				

Table 2
List of observations

Day	Sun	Time (UT)	Obs.	Cl	n_+	n_-	f_+	f_-
			April 1945					
15	25.55	19:43-20:13	T	-	-	1	-	1.2
"	"	"	Ki	-	-	-	-	-
"	"	"	L	-	-	-	-	-
"	25.57	20:13-20:43	T	-	1	7	2.9	8.0
"	"	"	Ki	-	-	4	-	7.0
"	"	"	L	-	-	6	-	6.0
"	25.59	20:43-21:13	T	-	1	1	2.5	1.2
"	"	"	Ki	-	-	-	-	-
"	"	"	L	-	-	-	-	-
16	26.61	21:36-22:06	T	-	1	-	2.0	-
"	"	"	L	-	-	1	-	1.0
"	"	"	U	-	-	1	-	1.3
"	"	"	Ki	-	1	1	3.0	1.7
"	26.63	22:06-22:36	T	-	-	3	-	3.4
"	"	"	L	-	-	2	-	2.0
"	"	"	U	-	-	1	-	1.3
"	"	"	Ki	-	-	-	-	-

Table 2 (cont.)

Day	Sun	Time (UT)	Obs.	Cl	n_+	n_-	f_+	f_-
"	26.65	22:36-23:06	L	-	-	4	-	4.0
"	"	"	U	-	-	5	-	6.6
"	"	"	Ki	-	1	2	2.5	3.5
"	26.67	23:06-23:36	L	-	-	7	-	7.0
"	"	"	U	-	-	4	-	5.2
"	"	"	Ki	-	1	-	2.3	-
			April 1946					
21	31.18	20:10-20:40	T	-	2	4	6.3	4.8
"	"	"	L	-	-	6	-	6.0
"	"	"	A	-	1	7	2.3	6.1
"	"	"	M	-	1	3	3.1	3.6
"	"	"	Kl	-	2	4	7.5	5.7
"	"	"	H	-	1	5	4.0	7.7
"	31.20	20:40-21:10	T	-	1	1	2.7	1.2
"	"	"	L	-	4	6	8.8	6.0
"	"	"	A	-	4	18	7.7	15.7
"	"	"	M	-	3	4	7.9	4.8
"	"	"	Kl	-	2	4	6.3	5.7
"	"	"	H	-	3	3	10.2	4.6
"	31.22	21:10-21:40	T	-	5	-	11.5	-
"	"	"	L	-	3	7	5.8	7.0
"	"	"	A	-	6	6	10.0	5.2
"	"	"	M	-	2	1	4.6	2.1
"	"	"	Kl	-	3	3	8.2	4.3
"	"	"	H	-	3	1	8.9	1.5
"	31.24	21:40-22:10	T	-	11	2	22.4	2.4
"	"	"	L	-	6	5	10.2	5.0
"	"	"	A	-	9	4	13.3	3.5
"	"	"	M	-	8	2	16.2	2.4
"	"	"	Kl	-	7	8	17.0	11.4
"	"	"	H	-	5	3	13.1	4.6
"	31.26	22:10-22:40	T	-	7	3	12.8	3.6
"	"	"	L	-	17	3	26.0	3.0
"	"	"	A	-	32	3	42.6	2.6
"	"	"	M	-	8	7	14.6	8.3
"	"	"	Kl	-	1	9	2.2	12.9
"	"	"	H	-	10	5	23.5	7.7
"	31.28	22:40-23:10	T	-	12	-	20.1	-
"	"	"	L	-	12	5	16.8	5.0
"	"	"	A	-	25	2	30.4	1.7
"	"	"	M	-	15	1	25.0	1.2

Table 2 (cont.)

Day	Sun	Time (UT)	Obs.	Cl	n_+	n_-	f_+	f_-
21	31.28	22:40-23:10	Kl	-	8	4	16.0	5.7
"	"	"	H	-	9	2	19.4	3.1
"	31.29	23:10-23:27	T	-	5	-	14.0	-
"	"	"	L	-	8	4	18.6	7.1
"	"	"	A	-	10	3	20.2	4.6
"	"	"	M	-	5	1	13.8	2.1
"	"	23:10-23:20	Kl	-	1	1	5.7	4.3
"	"	23:10-23:27	H	-	2	-	7.2	-
22	32.24	22:24-22:44	T	30	3	1	11.2	2.5
"	"	"	A	30	5	1	13.5	1.8
"	"	"	H	30	3	1	14.3	3.2
"	"	22:26-22:44	L	35	3	3	11.0	7.4
26	36.04	20:04-20:34	T	-	1	1	3.3	1.2
"	"	"	M	-	-	1	-	1.2
"	"	"	L	-	-	5	-	5.0
"	"	"	A	-	-	8	-	7.0
"	36.06	20:34-21:06	T	-	-	2	-	2.2
"	"	"	M	-	1	4	2.5	4.5
"	"	"	L	-	-	2	-	1.9
"	"	"	A	-	-	5	-	4.1
29	39.05	22:18-22:48	H	-	-	10	-	15.4
"	"	"	O	-	-	5	-	6.0
"	"	22:29-22:48	L	-	-	5	-	7.9
"	39.07	22:48-23:18	H	-	-	1	-	1.5
"	"	"	O	-	-	1	-	1.2
"	"	"	L	-	1	4	1.4	4.0
"	39.09	23:18-23:42	L	-	2	7	3.2	8.8
"	"	23:18-23:48	H	-	-	3	-	4.6
"	"	"	O	-	1	4	1.5	4.8
"	39.11	23:48-00:18	H	-	-	5	-	7.7
"	"	"	O	-	-	2	-	2.4
"	"	"	L	-	1	4	1.2	4.0
			April 1947					
17	27.13	22:38-23:08	T	-	-	2	-	2.2
"	"	"	M	-	1	4	1.6	4.6
"	"	"	K	-	1	3	1.6	3.4
"	"	22:47-23:08	L	-	1	2	2.0	2.9
"	"	22:56-23:08	A	-	1	-	3.1	-
"	27.15	23:08-23:38	T	-	3	3	4.3	3.3
"	"	"	M	-	1	10	1.5	12.0
"	"	"	K	-	1	7	1.5	7.9

Table 2 (cont.)

Day	Sun	Time (UT)	Obs.	Cl	n_+	n_-	f_+	f_-
17	27.15	23:08-23:38	L	-	2	8	2.6	8.0
"	"	"	A	-	3	5	3.5	4.6
"	27.17	23:38-00:08	M	-	1	4	1.4	4.6
"	"	"	K	-	-	4	-	4.5
"	"	"	L	-	-	4	-	4.0
"	"	"	A	-	-	8	-	7.3
19	29.02	21:01-21:37	T	-	-	4	-	3.7
"	"	"	V	-	1	4	2.4	4.8
"	"	"	L	-	-	4	-	3.3
"	"	"	A	-	-	3	-	2.3
"	"	21:19-21:37	K	-	-	1	-	1.9
20	30.01	21:30-22:00	T	-	2	2	3.9	2.2
"	"	"	V	-	-	3	-	4.3
"	"	"	M	-	-	3	-	3.4
"	"	"	K	-	-	4	-	4.5
"	30.03	22:00-22:30	T	-	-	3	-	3.3
"	"	"	V	-	-	2	-	2.9
"	"	"	M	-	-	3	-	3.4
"	"	"	K	-	-	2	-	2.3
"	30.04	22:15-22:30	A	-	1	4	2.8	7.3
"	30.05	22:30-23:00	T	-	1	3	1.6	3.3
"	"	"	V	-	2	2	4.1	2.9
"	"	"	M	-	1	1	1.7	1.2
"	"	"	K	-	1	6	1.6	6.8
"	30.07	23:00-23:23	A	-	1	4	1.6	4.7
"	"	23:00-23:33	T	-	2	6	2.6	6.0
"	"	"	V	-	1	4	1.7	5.2
"	"	"	M	-	-	5	-	5.2
"	"	"	K	-	3	2	4.1	2.1
21	30.14	00:47-01:17	V	-	1	3	1.6	4.3
"	"	"	L	-	1	3	1.1	3.0
"	"	"	A	-	2	6	2.0	5.5
"	"	"	K	-	2	4	2.5	4.5
"	30.17	01:17-01:52	V	-	1	1	1.3	1.2
"	"	"	L	-	-	8	-	6.9
"	"	"	A	-	2	7	1.7	5.5
"	"	"	K	-	1	6	1.0	5.8
22	31.92	20:29-20:54	A	15	1	2	3.0	2.5
"	"	20:29-20:59	V	5	2	3	7.1	4.5
"	"	"	L	-	1	2	2.3	2.0
"	31.94	20:59-21:29	V	30	3	1	12.1	2.0
"	"	"	L	10	4	3	8.9	3.3

Table 2 (cont.)

Day	Sun	Time (UT)	Obs.	Cl	n_+	n_-	f_+	f_-
22	31.94	20:59-21:29	A	20	2	2	4.5	2.2
"	31.96	21:29-21:59	V	-	-	1	-	1.4
"	"	"	L	-	-	4	-	4.0
"	"	"	A	5	1	3	1.7	2.9
"	31.98	21:59-22:29	V	15	2	2	5.3	3.3
"	"	"	L	25	1	1	2.1	1.3
"	"	"	A	20	2	3	3.6	3.4
			April 1952					
19	29.76	22:17-22:47	G	-	1	3	2.2	4.4
"	"	"	L	-	1	10	1.5	10.0
"	"	"	Ka	-	-	6	-	6.7
"	"	"	K	-	1	9	1.7	10.4
"	29.78	22:47-23:17	G	15	33	4	7.1	6.9
"	"	"	L	15	3	5	4.8	5.8
"	"	"	Ka	25	1	4	2.0	5.8
"	"	"	K	15	2	6	3.7	8.1
"	29.80	23:17-23:47	G	5	2	5	4.0	7.8
"	"	"	L	15	1	4	1.5	4.6
"	"	"	Ka	35	2	4	4.2	6.6
"	"	"	K	35	1	3	2.2	5.2
"	29.82	23:47-00:17	G	-	1	1	1.8	1.5
"	"	"	L	5	-	4	-	4.2
"	"	"	Ka	5	1	3	1.4	3.5
"	"	"	K	5	-	2	-	2.4
20	30.74	22:12-22:42	G	-	-	4	-	5.9
"	"	"	L	-	-	10	-	10.0
"	"	"	Ka	-	-	5	-	5.6
"	"	"	K	-	2	6	3.5	7.0
"	30.76	22:42-23:12	G	-	1	2	2.1	3.0
"	"	"	L	-	1	5	1.4	5.0
"	"	"	Ka	-	3	3	4.6	3.3
"	"	"	K	-	-	3	-	3.5
"	30.78	23:12-23:41	G	-	-	5	-	7.7
"	"	"	L	-	2	1	2.7	1.0
"	"	"	Ka	-	3	2	4.4	2.3
"	"	"	K	-	3	5	4.6	6.0
"	30.80	23:42-00:14	G	-	2	3	3.4	4.2
"	"	"	L	-	3	4	3.4	3.8
"	"	"	Ka	-	4	5	5.0	5.2
"	"	"	K	-	5	3	6.6	3.3
21	30.83	00:34-01:04	G	-	3	2	5.0	3.0

Table 2 (cont.)

Day	Sun	Time (UT)	Obs.	Cl	n_+	n_-	f_+	f_-
21	30.83	00:34-01:04	L	-	2	4	2.2	4.0
"	"	"	Ka	-	3	5	3.7	5.6
"	"	"	K	-	2	4	2.6	4.6
"	30.85	01:04-01:34	G	-	7	4	11.2	5.9
"	"	"	L	-	8	6	8.6	6.0
"	"	"	Ka	-	10	8	12.0	8.9
"	"	01:10-01:28	K	-	3	2	6.3	3.9
"	30.87	01:34-02:01	G	-	5	4	8.7	6.6
"	"	"	L	-	5	8	5.9	8.9
"	"	"	Ka	-	5	10	6.5	12.3
"	"	01:38-01:56	K	-	1	2	2.0	3.9
22	32.68	22:12-22:42	K	55	1	1	3.8	2.4
"	"	"	L	45	-	3	-	5.2
"	"	"	Ka	55	1	1	3.6	2.3
"	32.70	22:42-23:12	K	45	1	1	2.8	2.0
"	"	"	L	20	2	2	3.4	2.5
"	"	"	Ka	45	1	2	2.7	3.8
"	"	"	G	35	-	3	-	6.6
"	32.72	23:12-23:42	K	30	1	3	2.1	4.8
"	"	"	L	15	-	4	-	4.6
"	"	"	Ka	30	1	4	2.0	6.2
"	"	"	G	40	2	1	6.2	2.4

Table 3

Year	Observers	Nights	No. of records Orionids	Sporadic	All records
1945	4	2	6	50	56
1946	7	4	300	245	545
1947	6	4	60	204	264
1952	4	3	113	223	336
Total	21	13	479	722	1 201

2. ACTIVITY OF THE LYRID METEOR STREAM

The Lyrids are a meteor shower of shorter activity, and it takes the Earth only two days to cross its main part, almost. The visual data of this shower from the Skalnaté Pleso Observatory presented here, are not complete enough to cover the whole period of activity in the individual returns. Therefore, an approximative curve of activity has been depicted by compounding all observations available to produce a general feature of the stream as observed at Skalnaté Pleso in 1945-1952, i.e. during the first years of regular meteor observations at this high altitude observatory.

Table 4 summarizes the reduced hourly rates of all observations. The observations are arranged according to the solar longitudes of the mid-points of about one hour observing periods /1950.0 equinox/. Besides the dates and times of observing periods, the table lists the number of observers in each interval /O/, the zenithal hourly rates of the Lyrids /F_+/ and the rates of sporadic meteors /F_-/, together with their natural uncertainties ε_+ and ε_-, respectively / $\varepsilon_\pm = \pm F_\pm \cdot n_\pm^{-1/2}$, where n_+ and n_- are the numbers of the stream and sporadic records/.

Table 4

Sun	Date	Time (UT)	t	O	F_+	ε_+	F_-	ε_-
25.56	15.4.45	19:43-20:43	60	3	1.0	1.0	7.4	1.7
25.59	15.4.45	20:43-21:13	30	3	1.7	1.7	0.8	0.8
26.62	16.4.45	21:36-22:36	60	4	1.2	0.8	2.7	0.9
26.66	16.4.45	22:36-23:36	60	3	1.6	1.1	8.8	1.9
27.14	17.4.47	22:38-23:38	60	5	4.3	1.1	9.8	1.5
27.17	17.4.47	23:38-00:08	30	4	0.7	0.7	10.2	2.3
29.02	19.4.47	21:01-21:37	36	5	1.0	1.0	6.4	1.6
29.77	19.4.52	22:17-23:17	60	4	5.8	1.7	14.5	2.1
29.81	19.4.52	23:17-00:17	60	4	3.8	1.3	9.0	1.8
30.02	20.4.47	21:30-22:30	60	5	1.5	0.9	7.5	1.5
30.06	20.4.47	22:30-23:33	63	5	4.2	1.2	8.3	1.4
30.16	21.4.47	00:47-01:52	65	4	2.8	0.9	9.2	1.5
30.75	20.4.52	22:12-23:12	60	4	2.9	1.1	10.8	1.8
30.79	20.4.52	23:12-00:14	62	4	7.5	1.6	8.4	1.6
30.84	21.4.52	00:34-01:34	60	4	12.9	2.1	10.5	1.8
30.87	21.4.52	01:34-01:56	22	4	11.6	2.9	15.8	3.2
31.19	21.4.46	20:10-21:10	60	6	11.1	2.3	12.0	1.5
31.23	21.4.46	21:10-22:10	60	6	23.5	2.8	8.2	1.3
31.27	21.4.46	22:10-23:10	60	6	41.6	3.3	9.1	1.4
31.29	21.4.46	23:10-23:27	17	6	26.5	4.8	6.0	2.0
31.93	22.4.47	20:29-21:29	60	3	12.6	3.5	5.5	1.5
31.97	22.4.47	21:29-22:29	60	3	4.2	1.7	5.4	1.5
32.24	22.4.46	22:24-22:44	20	4	25.0	6.7	7.4	3.0
32.64	22.4.52	22:12-23:12	60	4	4.7	1.9	7.1	2.0
32.72	22.4.52	23:12-23:42	30	4	5.2	2.6	9.0	2.6
36.05	26.4.46	20:04-21:06	62	4	1.4	1.0	6.8	1.3
39.06	29.4.46	22:18-23:18	60	3	0.5	0.5	12.0	2.4
39.10	29.4.46	23:18-00:18	60	3	2.0	1.0	10.8	2.2

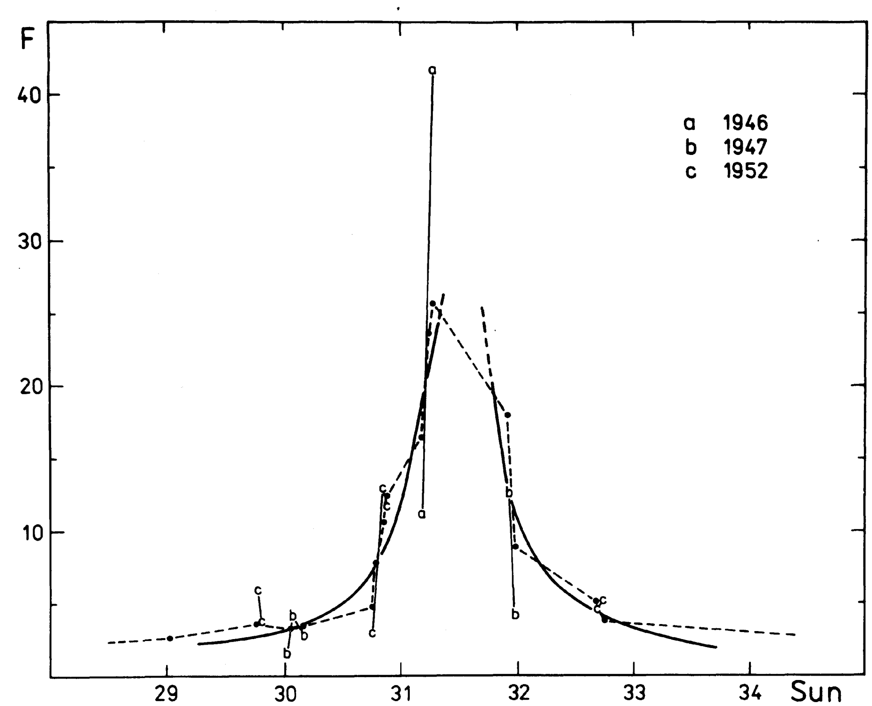

Fig. 1 : The zenithal hourly rates of the Lyrids, F, plotted against the solar longitude at the time of observation /1950.0 equinox/. The observations in different years are denoted by different markings and data from individual nights are connected by straight lines. The resulting smoothed rates are connected by dashed lines and the general course of activity is approximated by the full curve.

The observations summarized in Table 4 cover a period of 14 days, from 25° to 39° of solar longitude and the corresponding hourly rates around the maximum activity of the Lyrids are plotted in Figure 1. Two short intervals in 1946, presented in Table 4 /$\odot = 31\overset{\circ}{.}29$ and $32\overset{\circ}{.}24$/, are not included in the figure. The former was disturbed by moonshine and the latter of only 20 minutes of observation was the only interval on one particular night. In Fig. 1, observations in different years are denoted by different letters and the dashed line represents the smoothed hourly rates of the compound observations. It can be seen that the ascending branch of activity is better covered by observations from different returns than the descending branch. The maximum rate of about 40 Lyrids was observed in 1946 at $\odot = 31.3$. However, since reaching this rate the observations were interrupted due to moonshine, the real maximum, probably even of a higher rate, is supposed to have occurred later. The full line in Fig. 1 has been drawn to indicate the general trend, but is not meant to determine the exact form of the activity of the Lyrids.

Unfortunately, only the observations in 1946 were carried out close to the expected maximum of the Lyrids. Nevertheless, the 1946 observations are exceptional in high hourly rates with a maximum which is at least two times higher than other known observations of the Lyrids. The only exception are the observations in 1922, with a maximum rate of up to 100 Lyrids per hour, as reported by H.N. Russell from the observations in Greece /Lovell, 1954/.

Our visual data on the Lyrids show that the activity of the stream rises and falls rather steeply, and both ascending and descending branches are likely to be symmetrical with respect to the maximum. The absolute peak of activity is not defined, but it might be inferred from the compound data from different returns as approximated in Fig. 1, by the full curve at a solar longitude of about 31.5°. The data compiled from different sources give the value of 31.7° /Millman and McKinley, 1963; Cook, 1973/ which is in very good agreement with the value presented above. As for the duration of the stream, if it is measured between points where the strength of the stream is one half of the maximum value, Fig. 1 yields 1 day, which is the value presented by Cook /1973/. If the duration is measured between points where the strength is only one quarter of the maximum, we obtain approximately 2 days, which is comparable with the value of 2.3 days given by Millman and McKinley /1963/.

3. MAGNITUDE DISTRIBUTION AND ITS VARIATION

The magnitude distribution of the Lyrids and of the sporadic meteors, as recorded by the individual observers, is presented in Table 5. Observers with an insufficiently low number of records, namely observers Ki, O, U and V, have not been included in Table 5, nor have they been taken into account in the following magnitude analysis.

The magnitude scales of the observers included in Table 5, with their corresponding personal coefficients, were derived earlier on the basis of more extensive data, virtually for the same period of observations /cf. Štohl and Porubčan, 1981/. All these observers are experienced and the differences between their magnitude scales are negligible. We therefore accept their scales and records uncorrected, assuming $\nu = 1.00$ and $\mu = 0.0$ to be their personal coefficients.

The mean magnitudes of the Lyrids $\bar{m}_+$ and of the sporadic meteors $\bar{m}_-$, derived from the records of the observers included in Table 5, are presented in Table 6 for each period of observations. To reduce the possible strong influences of very bright random meteors with corresponding deviations in the mean magnitudes, we have introduced the effective mean magnitudes $\bar{m}_+^*$ and $\bar{m}_-^*$, calculated under a somewhat artificial assumption by taking all bright meteors with $m < 0$ to be of magnitude $m = 0$. This effective mean magnitude is related to the actual mean magnitude and to the population index, the relation having been studied in a previous paper /Porubčan et al., 1980/. The effective mean magnitudes $\bar{m}_+^*$ and $\bar{m}_-^*$ for each period of observations are given in Table 6.

Table 5

Obs / m	T	Kl	M	G	H	K	Ka	A	L	Total
					Lyrids:					
-6				1		1	1		1	4
-5				0		0	0		0	0
-4				0		0	0		0	0
-3				0		0	0		0	0
-2				1		0	1		1	3
-1		1	1	0	1	0	0	2	2	7
0	1	0	0	0	0	2	0	1	0	4
1	5	1	4	3	2	1	2	7	6	31
2	12	4	7	8	8	5	6	9	17	76
3	19	11	17	9	8	11	21	23	34	153
4	13	6	12	4	14	7	4	60	28	148
5	8	1	6	1	3	5	0	6	6	36
Total	58	24	47	27	36	32	35	108	95	462
					Sporadic meteors:					
-2	1		1			1				3
-1	0		0			1	1		1	3
0	0		0			0	0		0	0
1	1		1	3	1	4	5	2	5	22
2	7		5	9	5	12	10	9	27	84
3	15	16	23	14	19	28	27	42	68	252
4	16	14	13	12	12	28	17	36	68	216
5	9	3	11	2	2	15	2	15	26	85
6	0	0	0	1	0	0	0	0	0	1
Total	49	33	54	41	39	89	62	104	195	666

The grand mean magnitude of the whole set of Lyrid data is $\bar{m}_+ = 2.98$ and of the sporadic data $\bar{m}_- = 3.38$. These values agree with similar values obtained earlier for the Skalnaté Pleso Observatory data by Kresáková /1966/. The corresponding values of the population index of the magnitude distribution is $r_+ = 2.9$ for the Lyrids and $r_- = 3.7$ for the sporadic meteors.

Unfortunately, visual data on Lyrids from the Skalnaté Pleso Observatory are not extensive enough to investigate in detail the variations in magnitude distribution of the Lyrids in the course of their activity. On the other hand, the data are homogeneous enough to allow us to determine the principal behaviour and changes in the magnitude distribution of the Lyrids, at least. Such an analysis, basically of the same data, was carried out earlier by Kresáková /1966/ for four chosen periods in the Lyrid's activity; the periods are separated by the solar longitudes 30.5°, 31.0° and 31.5°. She found no evidence of any systematic changes of the population index r with the position within the stream, though she did not exclude the possibility of concentration of brighter meteors towards the stream's centre. For the centre of the stream she accepted the 31.0° solar longitude.

Table 6

Sun	$\bar{m}_+$	$\bar{m}_+^*$	n_+	$\bar{m}_-$	$\bar{m}_-^*$	n_-
25.56	2.00	2.00	1	3.29	3.29	14
25.59	1.00	1.00	1	3.00	3.00	1
26.62	1.00	1.00	1	4.84	4.84	6
26.66	-	-	0	3.82	3.82	11
27.14	3.57	3.57	14	3.61	3.61	44
27.17	5.00	5.00	1	3.40	3.40	20
29.06	-	-	0	3.01	3.01	12
29.77	1.75	2.25	12	2.85	2.85	47
29.81	2.75	2.75	8	3.27	3.27	26
30.02	4.67	4.67	3	2.81	3.09	21
30.06	2.12	2.12	9	3.48	3.48	27
30.16	3.50	3.50	8	3.71	3.71	34
30.75	3.00	3.00	7	3.53	3.53	38
30.79	2.91	2.91	22	3.29	3.29	28
30.84	1.63	2.26	38	3.49	3.49	35
30.87	2.90	2.90	16	2.63	2.63	24
31.19	2.88	2.88	24	3.43	3.43	65
31.23	2.75	2.75	68	3.74	3.74	42
31.27	3.57	3.57	156	3.25	3.25	44
31.29	2.39	2.55	31	3.89	3.89	9
31.93	1.88	2.13	8	4.00	4.00	9
31.97	2.25	2.25	4	3.63	3.63	11
32.24	4.08	4.08	14	4.00	4.00	6
32.64	3.67	3.67	6	2.92	3.15	13
32.72	3.75	3.75	4	2.50	2.50	12
36.05	2.50	2.50	2	3.75	3.75	28
39.06	2.00	2.00	1	3.55	3.55	20
39.10	2.00	2.00	3	2.89	2.89	19
Total	2.98	3.05	462	3.38	3.39	666

Let us investigate this question on the basis of our effective mean magnitude, thus suppressing the effects of the random deviations caused by extremely bright shower meteors. As can be seen from Table 6, variations in the effective mean magnitudes $\bar{m}_+^*$ are still considerable during the Lyrid's activity, in most cases, however, because of the very low number of records. To outline the general tendency in the actual variation of the magnitude distribution of the Lyrids, Table 7 gives the effective mean magnitudes $\bar{m}_+^*$, as well as $\bar{m}_-^*$ for longer periods around the maximum activity of the Lyrids, with a large number of records in each. For the time of the maximum we accept solar longitude 31.5°, as found in the present paper.

Table 7

Sun Interval	Sun Mean	$\bar{m}_+^*$	n_+	$\bar{m}_-^*$	n_-
-30.00	27.49	2.85	38	3.33	181
30.00-31.00	30.50	2.70	103	3.36	207
31.00-31.25	31.21	2.78	92	3.55	107
31.25-31.50	31.28	3.40	187	3.36	53
31.50-33.00	32.30	3.33	36	3.35	51
33.00-	38.07	2.17	6	3.45	67
Total		3.05	462	3.39	666

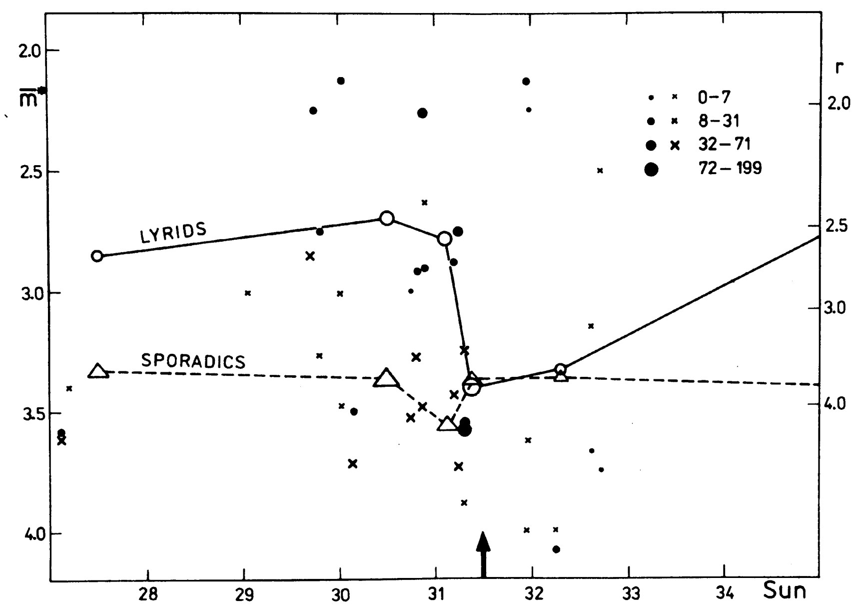

Fig. 2 : Variation in the effective mean magnitudes $\bar{m}^*$ of the Lyrids and of the sporadic meteors. /Denotations are explained in text/.

Figure 2 shows the values of $\overline{m}_+^*$ and $\overline{m}_-^*$ both for all the periods of Table 6 /represented by dots and crosses, respectively, weighted according to the proper number of records/ and for the longer periods of Table 7 /circles and triangles, respectively, connected by full and dashed lines/. We can see that, while the effective mean magnitudes of the sporadic meteors show a reasonably steady character, there is a definite tendency towards a variation in the effective mean magnitudes of the Lyrids. We should also mention that the concentration of brighter meteors, found by Kresáková, actually occurs just before the maximum of the Lyrid´s activity, but it is followed by a sudden rapid decrease in the number of bright meteors right in the shower´s maximum.

However, we should be careful in drawing any definite conclusions based on this behaviour of the effective mean magnitudes of the Lyrids. The main reason for this is in the possible changed conditions in different years of observations included in the analysis. The effective mean magnitudes for the Lyrids and for the sporadic meteors in different years of observations are as follows:

Year	$\overline{m}_+^*$	n_+	$\overline{m}_-^*$	n_-	Δm^*
1945	/1.33/	3	3.75	32	/-2.42/
1946	3.22	299	3.49	233	-0.27
1947	3.02	47	3.51	178	-0.49
1952	2.69	113	3.14	223	-0.45
Total	3.05	462	3.39	666	-0.34

In 1952 the observations were affected partly by cloudiness and by moonlight; the lower values of $\overline{m}_+^*$ and $\overline{m}_-^*$ occurring just before the shower´s maximum can be influenced by this effect at least partly.

On the other hand, the 1946 observations, carried out under relatively good conditions, with a sufficiently high number of records, confirm the sudden increase in the effective mean magnitudes, i.e. the decrease in the relative number of bright Lyrids in the shower maximum. We should note that this change occurs within a time span of a few hours only. At the same time, the effective mean magnitude of the sporadic meteors remains practically unchanged. It is also important that, while the hourly rates of the sporadic meteors remain unchanged within the same period, the hourly rates of the Lyrids exhibit a rapid increase just when the effective mean magnitude $\overline{m}_+^*$ increases. In fact, the absolutely highest rate of the Lyrids recorded at the Skalnaté Pleso Observatory, amounting to 40 meteors per hour, was accompanied by a sudden increase of the Lyrid´s mean magnitude. We conclude that the high rate of the Lyrids at their 1946 maximum is brought about by a sudden increase in the relative number of fainter meteors.

In 1947 we do not have observations from the period of the Lyrids´ maximum activity, nor from the phase immediately preceding it. Unlike 1946, the hourly rates after the maximum are accompanied by a decrease in the effective mean magnitude $\bar{m}_+^*$, i.e. by an increase in the relative number of brighter meteors.

It, therefore, seems reasonable to conclude that the Lyrid shower is not a stream with a steady structure along its orbit, showing the same variation in hourly rates and in magnitude distribution every year. Instead, the stream seems to have a finer structure, presumably with narrow filaments composed of meteoroids of different mass distribution. This conclusion seems to be in very good agreement with other investigations of hourly rates /cf., e.g. Lovell, 1954/, as well as of the variations in the position of the Lyrids' radiant /cf. Ceplecha, 1952/.

REFERENCES

Ceplecha, Z.: 1952, Bull. Astron. Inst. Czechosl. 3, 95.

Cook, A.F.: 1973, In: Evolutionary and Physical Properties of Meteoroids, NASA SP-319, Washington, 183.

Kresák, Ľ., Porubčan, V.: 1970, Bull. Astron. Inst. Czechosl., 21, 153.

Kresáková, M.: 1966, Contr. Astron. Obs. Skalnaté Pleso 3, 75.

Lovell, A.B.C.: 1954, Meteor Astronomy, Oxford, 260.

Millman, P.M., McKinley, D.W.R.: 1963, In: The Moon, Meteorites and Comets, The Solar System, Vol. 4, Chicago Press, 715.

Porubčan, V., Kresáková, M., Štohl, J.: 1980, Contr. Astron. Obs. Skalnaté Pleso 9, 125.

Štohl, J., Porubčan, V.: 1981, Contr. Astron. Obs. Skalnaté Pleso 10, 39.

Štohl, J.: 1969, Contr. Astron. Obs. Skalnaté Pleso, 4, 25.