TABLE II

Pole of Arc	Sun	Arc Intensity	Solar Intensity	Solar Identification
3118·645	657	2	2	Cr^+
3356·265	238	2	−2*d?*	
90·083	109	2	−2*d?*	
3451·228	235	2	−3	
51·318	343	2	0	
82·426	452	2	−2	
3515·817	808	2	−3*N*	
3960·896	917	3	−1	Ce^+
4024·222	226	5	−2	
66·330	375*w*	2	2	*Co*
4314·289	320	4	1	*Ti*
57·573	519	4	0*Nd?*	*Cr*
61·248	247	2	−1	
4451·546	590*m*	5	3	*Mn*
55·259	322*m*	3	2	*Mn* − *Ti*
80·690	706	2	−3	
4579·522	514	2	−1*d?*	*Co?*
4704·623	677	3	−3	

AN INDEX TO SOUTHERN METEOR SHOWERS.

R. A. McIntosh.

Meteor observers in the southern hemisphere have been handicapped up to the present by not knowing at the outset of a night's work what meteor radiants may be expected to be in activity, and consequently to what portions of the sky attention should be directed for best results. Thus, except on a few occasions when the more prominent annual showers are active, a very large area of sky has to be watched and considerable time elapses before the centres of radiation in activity become apparent.

The need for some guide as to the more prominent meteor showers in the southern hemisphere has been felt ever since the first pioneering observations were made. After eight years of activity the Meteor Section of the New Zealand Astronomical Society has accumulated sufficient data to enable a preliminary outline of southern meteoric activity to be published.

While the present index is not to be regarded as in any sense final and complete, it is hoped that it will prove of immediate benefit to observers in enabling them to plan their work in advance in an effort to determine the durations of the many showers listed here for the first time, their exact positions in the sky and the dates of their maxima.

The 320 radiation centres given in the table represent the mean positions of what are believed to be the principal meteor showers situated on or south of the celestial equator. These positions have been obtained by arranging the various observed radiants in related groups. In cases where single

radiants revealed a large number of meteors on one night these radiants have been included in spite of the lack of further corroboration on other dates.

The material for this paper was obtained mainly from the three reports of the New Zealand Meteor Section, covering the years 1927 to 1934, but recourse was also had to *Denning's General Catalogue of Meteor Radiants*, the publications of the American Meteor Society, the journals and memoirs of the British Astronomical Association, and Russian observations published by the Tashkent Observatory and Mirovédénié (Russian amateurs). These publications yielded a number of meteor radiants in southern declination. Although no claim is made that the index is complete, it is believed that little published material has been overlooked.

The task of grouping the radiants in their related families was a difficult one, in which a number of factors had to be kept steadily in view. The modern conception of radiation was the principal guide, and daily motion in radiants was looked for rather than stationary groupings. The effect of zenith attraction, placing northern observations too far north, had also to be allowed for.

It is only in recent years that a strict definition of meteoric radiation has been generally adopted. The writer was therefore faced with considerable difficulty in drawing a line of demarcation between good and bad in early lists of radiants. Where a rigid definition of radiation would have resulted in practically all the British radiants being rejected, a little elasticity justified the inclusion of radiants based on observations spread over several days.

Radiants covering intervals of several weeks were sometimes included when their positions were confirmed by modern and properly determined radiants, but the period of activity has been confined to that revealed by the modern observations. If this had not been done, bridges would have been provided linking distinct showers and providing apparently stationary radiants enduring for long periods.

For facility of reference the radiants have been arranged in order of right ascension. In the case of moving radiants they have been inserted at their earliest observed position, and their last observed position is also given. Where two or more radiants possess the same right ascension the northernmost have been given priority.

In pursuance of long-established practice each radiant has been given the name of the star which lies closest to it. Where no suitable star was available the constellation name only has been given. When several showers occur near the same star they have all been given the same name, but Roman numerals denote the order of their visibility.

An examination of the index reveals a large number of radiants which apparently are in daily motion, no less than 58 cases being given, in the majority of which the motion indicated seems probable. Now that attention has been drawn to them it is hoped that observers will give special attention to these showers so that the reality and extent of the motion can be established. Other radiants of which further observations would be

welcomed are the four cases in which stationary radiation is apparently established, namely, groups 114, 203, 264 and 283, the radiants in all cases lying close to the ecliptic. When additional data are available it will probably be found that these apparently stationary radiants will be resolved into a number of minor streams all showing the motion required by theory.

The New Zealand work reveals a great preponderance of observations in the months April to August, while the remaining months have not been satisfactorily covered. It would be inadvisable, therefore, to attempt at present to draw any conclusions as to the distribution of radiants.

No.	Period	Radiant 1900 α	Radiant 1900 δ	No. Rads.	Name
		°	°		
1	July 26–Aug. 4	1 9	−15 −15	6	β Cet iv
2	Sept. 14–17	2	−16	2	6 Cet
3	Sept. 1–8	3	− 2	3	— Cet
4	July 26–28	5½	− 2½	2	— Cet
5	Oct. 30–Nov. 2	6	−15½	2	— Cet
6	July 15–26	8½ 17½	−22 −20½	4	β Cet ii
7	July 26	9	−20½	2	β Cet iii
8	Aug. 13–14	11	−31½	2	α Scl
9	Sept. 27	12	− 2	1	20 Cet
10	July 28–31	13½	−34½	2	σ Scl
11	July 26–30	15	−11½	4	η Cet
12	Aug. 8	15	−22	1	— Cet
13	July 26–27	15	−42	2	υ Phe
14	Aug. 5–9	16	− 4	2	34 Cet
15	Sept. 5–6	18	− 6	3	θ Cet i
16	Jan. 22–28	18	−20	2	— Cet
17	Aug. 16–20	19	−18	2	— Cet
18	July 19–20	21	−43	2	γ Phe
19	Aug. 1	21½	−11½	1	θ Cet ii
20	July 29–Aug. 15	25	−10	9	χ Cet
21	July 16–19	29	−20	2	υ Cet
22	July 26–31	30 37	−34 −37	2	— Phe
23	July 26–Aug. 4	31 39	−17 −16	5 5	— Cet
24	Oct. 25	31½	− 9	2	— Cet
25	Aug. 7–12	34	− 2	2	70 Cet
26	Oct. 18–19	34½	− 5½	2	67 Cet
27	Oct. 10–19	35	−12	3	ρ Cet
28	Oct. 25–Nov. 3	35½	−10½	4	— Cet
29	Nov. 12–19	37	−33	2	θ For
30	July 22–Aug. 1	38	− 2	3	75 Cet
31	Aug. 5	40	−44	1	— Eri
32	Oct. 5–10	41 47	− 3 − 6	2	δ Cet
33	Dec. 8–21	43	−60	2	— Hor
34	July 29–Aug. 4	45 49	−21 −21	4	— Eri

No.	Period	Radiant 1900 α	Radiant 1900 δ	No. Rads.	Name
		°	°		
35	Oct. 15–23	47½	− 3	6	94 Cet
36	July 22	51½	−32½	1	— For
37	Jan. 4–12	56	−13	3	π Eri
38	Nov. 6–9	57	− 8	2	δ Eri i
39	Nov. 25–28	57	− 8	2	δ Eri ii
40	Oct. 5–6	59	−13	2	γ Eri
41	July 31–Aug. 1	65	−42	2	α Hor
42	Feb. 25–27	66	−63	2	— Ret
43	Sept. 6–13	68	− 3½	2	υ Eri
44	Oct. 30–31	72	− 0½	2	— Ori
45	Mar. 13–14	72	−53½	1	λ Pic
46	Oct. 20–21	73	−14	2	64 Eri
47	Sept. 29–30	75	−18	2	μ Lep
48	Nov. 27–Dec. 6	80	−30	3	— Col
49	Oct. 15–18	83	−14½	3	ζ Lep
50	Oct. 13–23	84	− 2	7	ζ Ori
51	Oct. 12–22	91 99	−14 −17	8	α CMa i
52	Oct. 18–21	92	− 4½	3	— Ori
53	Sept. 18–19	93½	− 0½	2	— Ori
54	Mar. 31	101	−16	1	α CMa ii
55	Dec. 3–6	101	−46½	2	X Pup
56	Nov. 10–19	103	−12	2	θ CMa
57	Feb. 11–16	103	−25	1	— CMa
58	Oct. 11–26	104	− 3	4	— Mon
59	Oct. 20–24	104	−13½	2	μ CMa
60	Oct. 24–30	112½	− 5	2	25 Mon
61	Dec. 4–12	113 117	−45 −47½	3	σ Pup
62	Jan. 10–15	114 120	−30 −29	2	p Pup
63	Nov. 15–16	114½	− 9	2	γ Mon
64	Mar. 16	116	− 8	1	— Mon
65	Dec. 3–4	117½	−40½	2	α Pup
66	Jan. 14–18	120	− 5	2	— Mon
67	Oct. 24–31	120½	− 6½	2	— Mon
68	Nov. 6–16	121 132	− 2 − 3	7	— Hya
69	Jan. 16–21	132	−54	3	δ Vel
70	Apr. 29–May 3	146	0	2	— Sex
71	Mar. 13–23	147	− 5	3	6 Sex
72	Jan. 24	149½	−24½	1	— Ant
73	Jan. 10	155	−25	1	— Ant
74	Apr. 15–28	156	−66½	2	θ Car
75	Jan. 1–11	157½	− 8	2	— Sex
76	Apr. 11–18	162½	− 1½	2	— Sex
77	Apr. 11–14	166	−16	2	δ Cra
78	Jan. 6	168	−59	1	χ Car
79	Apr. 9–10	170	− 1½	2	— Leo
80	Jan. 19	170	−63	1	— Car
81	Apr. 29–May 3	174	− 1	2	υ Leo
82	Mar. 7–14	174	−42	3	— Cen

No.	Period	Radiant 1900 α	Radiant 1900 δ	No. Rads.	Name
		°	°		
83	May 9–11	176	−18	2	ζ Cra
84	Mar. 5–17	176	−56	2	— Cen
85	Jan. 16–20	177	−17	3	η Cra
86	June 28	178	− 5	1	— Vir
87	May 31	178	− 7	1	— Vir
88	Apr. 29–May 3	179	−10	2	— Vir
89	Apr. 12	180	−17	1	— Crv
90	Apr. 29–May 11	180	−21	4	ϵ Crv
		186	−20		
91	Apr. 12–16	184	0	2	η Vir
		188	0		
92	Jan. 12	184	−64	1	α Cru
93	May 9	185	−13	1	— Crv
94	May 31	185	−20½	2	ζ Crv
95	Mar. 18–25	186½	−18	2	δ Crv
96	Apr. 9–19	186	− 8	7	χ Vir
		195	− 7		
97	Apr. 16–21	188½	−31½	2	— Hya
98	May 1–12	189	− 5	2	γ Vir
99	May 11	191	−58	2	β Cru
100	Feb. 18–20	191½	−33	2	— Cen
101	Apr. 13–14	192	−14½	2	— Vir
102	Mar. 19–31	194	− 3	2	46 Vir
103	Apr. 29–May 12	196	− 6	6	θ Vir
104	Apr. 10	196	−34	1	ι Cen
105	Apr. 8–11	196	−45½	2	— Cen
106	Apr. 30–May 9	198	−22	3	γ Hya ii
		203	−19		
107	Jan. 24–Feb. 3	198	−24	3	γ Hya i
108	May 31	199	−10	1	α Vir ii
109	Apr. 9–21	202	−30	4	4 Cen
		214	−30½		
110	Mar. 7–11	203	−34	3	T Cen
111	Jan. 10–14	204	− 6½	2	74 Vir
112	Feb. 10–13	206	−43	2	μ Cen
113	Apr. 12–14	208	− 2½	5	— Vir
114	Apr. 4–30	208½	−10	24	α Vir i
115	May 3–11	211	−41	2	χ Cen
116	Apr. 9–11	212	−24	3	π Hya
		216	−26		
117	Feb. 15–21	214	−13	2	λ Vir
118	Apr. 29–May 3	214	−41	3	η Cen
119	Apr. 19–23	215	− 6	4	ι Vir
120	May 11	215	−10	1	κ Vir
121	Mar. 20–28	217	−45	2	τ Lup
122	Mar. 26–28	218	−13	2	α Lib
123	Apr. 21–24	218½	−27	3	51 Hya
124	July 7	220	−25	1	4 Lib
125	Apr. 10	220	−48	1	α Lup
126	Apr. 10–14	220	−65	2	α Cir
127	Apr. 9–26	225	− 3	7	— Lib
128	Apr. 17–21	226	−22	6	ι^1 Lib

No.	Period	Radiant 1900 α	Radiant 1900 δ	No. Rads.	Name
		°	°		
129	June 25	227	− 5	1	— Lib
130	Apr. 4–6	230	−21	1	— Lib
131	Apr. 19–22	231	− 8	3	β Lib
132	May 9–11	232	−15	2	γ Lib
133	May 3–9	233	−23½	3	42 Lib
134	Apr. 13–21	233½	−19	9	κ Lib
		238½	−22		
135	May 18–23	234	− 2	2	μ Ser ii
136	June 6–12	234	−21½	2	λ Lib i
137	Mar. 2–9	235	−17	4	η Lib
138	Apr. 1–13	235½	−18½	3	θ Lib
139	May 31	236	− 2	1	μ Ser iii
140	Mar. 27	236	− 3	2	μ Ser i
141	Apr. 17–19	236	−15	3	48 Lib
142	July 8–11	237	− 3	3	— Ser
143	June 28–July 7	237	−18	13	λ Lib ii
		251	−18		
144	July 5–8	238	−19	9	β Scr
145	June 8–13	239	0	5	χ Ser
		248	− 1		
146	May 29–June 11	240	−21	8	ω^2 Scr
		247	−18		
147	May 28–June 11	241	−13	5	χ Scr
		247	−18		
148	Apr. 9–11	241	−25½	2	σ Scr
149	Mar. 6–11	241	−53	3	— Scr
150	Apr. 19–May 9	242	−25	6	ρ Oph
		254	−23		
151	July 7–8	242	−39	3	— Lup
152	May 31	243	−27½	2	13 Scr
153	May 11–16	243	−32	2	— Scr
154	May 10–11	243	−48	2	γ^2 Nor
155	July 7	244	−39	1	— Nor
156	July 5–8	245	− 7	5	v Oph
		248	− 9		
157	May 6–15	246	−26	4	α Scr
158	Apr. 4–17	247½	−50	4	ρ^2 Ara i
		253	−53		
159	May 17–24	248	−22½	2	ω Oph
160	May 7–14	248½	−15	3	ϕ Oph
161	May 15	249½	−25	1	25 Scr
162	June 1–15	250	−10	3	ζ Oph
163	June 1–10	250	−22	9	ξ Oph ii
		259	−23		
164	July 8	252	−30	1	— Scr
165	June 6–15	254	−11½	4	— Oph
166	June 15	254	−51	1	ρ^2 Ara ii
167	May 31	256	−17	2	η Oph
168	Apr. 27–May 5	257	− 1	2	— Oph
169	July 5–9	257	− 8	9	μ Oph
		261	−12		
170	May 19–22	258	−23	3	ξ Oph i

No.	Period	Radiant 1900 α	Radiant 1900 δ	No. Rads.	Name
		°	°		
171	Apr. 13–21	260	−36	3	υ Scr
		266	−36		
172	Apr. 3–6	261½	−32	1	— Oph
173	June 30–July 10	262	−20	10	μ Sgr
		275	−20		
174	July 9	263	−29½	2	45 Oph
175	July 1–9	263½	−21½	2	52 Oph
176	July 21–28	264	−18	3	ξ Ser
		269	−20		
177	June 7	264½	−42½	1	θ Scr
178	June 8–9	265	−13½	4	o Ser i
179	June 21–July 2	265	−21	4	58 Oph
180	June 14–21	266	−18½	2	— Oph
181	July 20	266	−33	2	— Sgr
182	Aug. 10–11	267	−12	2	o Ser iii
183	Aug. 1–6	267	−12½	2	o Ser ii
184	June 14–15	268	−26	3	3 Sgr
185	Apr. 13–22	269	−10	7	ν Oph
186	May 2–11	270½	−27	8	γ^1 Sgr
187	Aug. 4–13	271	−3	2	η Ser ii
188	Mar. 13–28	272	−40	5	λ CrA
		283½	−38		
189	June 8–10	273	−13	3	— Aql
190	July 10–17	273	−36	2	ϵ Sgr ii
		277½	−37		
191	June 25–30	274	−6	3	η Ser i
		277	−3		
192	Oct. 22	275	−15½	1	— Aql
193	Apr. 10–22	275	−32	8	δ Sgr
		278	−34		
194	June 8–11	276	−1½	4	61 Ser
195	June 8–15	276	−28	8	ϕ Sgr
		285	−28		
196	May 4–5	276½	−25	4	λ Sgr ii
197	June 14–19	276½	−26	3	λ Sgr iii
198	June 8–14	277	−35	2	ϵ Sgr i
199	July 30–Aug. 4	278	−6	2	6 Aql
200	June 15	278	−8	1	1 Aql
201	June 10–19	280	−11	8	— Aql
		291	−12		
202	July 30–Aug. 5	282	−13	2	— Sgr
203	July 2–19	283	−15	9	— Sgr
204	June 16	284	−3½	1	λ Aql
205	May 4–7	284	−17	3	— Sgr
206	Aug. 6–10	284	−20½	2	ξ^1 Sgr
207	June 1	284	−36	2	ϵ CrA ii
208	Apr. 28–May 5	284	−37	4	ϵ CrA i
209	May 12	284½	−34	1	— Sgr
210	July 10–20	285	−25	4	ψ Sgr iii
211	June 28–July 5	285	−25	6	ψ Sgr ii
212	Apr. 27–May 3	285	−26	3	ψ Sgr i
213	Apr. 4–6	285	−53	1	ρ Tel i

No.	Period	Radiant 1900 α	Radiant 1900 δ	No. Rads.	Name
		°	°		
214	July 28–Aug. 4	286	−37	3	γ CrA
215	May 3–4	286	−53	2	ρ Tel ii
216	Mar. 22	286	−57	1	μ Tel
217	July 25–31	288	− 8	2	20 Aql
218	June 15–22	290	−18	4	ρ^1 Sgr
219	June 15–22	291 297	−27 −25	2	χ^1 Sgr
220	July 23–Aug. 4	292 297	−10 −11	3	37 Aql ii
221	Aug. 1–7	292 297	−23 −22	4	50 Sgr i
222	July 5–7	292½	− 8½	2	κ Aql
223	June 6–8	293	−13½	2	37 Aql i
224	Dec. 8–17	293	−21	2	50 Sgr ii
225	Aug. 4–6	294	0	3	ι Aql
226	July 23–30	294½	−10½	2	37 Aql iii
227	July 14–23	295	−23	3	53 Sgr
228	Sept. 20–24	295	−32	2	— Sgr
229	May 2–4	295	−42	2	ι Sgr
230	July 15–16	295½	−13	2	55 Sgr
231	July 29–Aug. 1	296	− 6	3	— Aql
232	July 13–24	297	0	4	η Aql
233	May 3–7	298	− 3½	4	— Aql
234	July 23–31	300 305	− 9 − 8	6	— Cap
235	July 22–31	300 308	−11 −10	15	α Cap ii
236	May 4–11	301	−24	3	— Sgr
237	June 28–July 5	302	− 5½	5	— Aql
238	July 4–7	302	− 9	3	α Cap i
239	July 10–20	302 317	−14 −11	10	β Cap ii
240	July 10–15	302 313	−17 −19	12	σ Cap
241	May 3–11	303	−14	5	β Cap i
242	July 28–Aug. 6	303	−47	3	α Ind ii
243	July 10–18	303½	−13½	5	ξ Cap
244	Apr. 13–15	304	−66½	2	δ Pav
245	Apr. 16–23	304½	−51	2	η Ind
246	May 1–6	307½	−17	2	ρ Cap
247	May 7–8	308	−49	3	α Ind i
248	July 2–6	311	−14	3	τ^2 Cap
249	July 16–23	312	−43½	2	ι Mic
250	July 18–29	313	−30	4	— Cap
251	Aug. 8–15	314	−10	7	7 Aqr
252	May 2–6	314	−34	2	ν Mic i
253	July 4–10	314	−35	2	ν Mic ii
254	July 30	317	− 9	2	— Aqr
255	Aug. 9–12	320	−15	3	ι Cap
256	Nov. 25	321	− 5	1	β Aqr ii
257	July 31–Aug. 8	321	− 5½	6	β Aqr i
258	June 1	322	−53½	1	θ Ind

No.	Period	Radiant 1900 α	Radiant 1900 δ	No. Rads.	Name
		°	°		
259	July 26–30	323	−41	3	θ^2 Mic
260	Apr. 29–May 7	323½	−17	9	γ Cap
261	July 8–14	324	−53½	2	δ Ind
262	July 21–Aug. 12	324½	− 4	8	— Aqr
263	July 2–5	325	− 4	2	— Aqr
264	July 18–Aug. 5	325	−15	26	δ Cap
265	May 4–8	325	−34	8	ι PsA
266	July 28–Aug. 3	326	−26	3	— PsA
267	July 10–11	327	0	3	— Aqr
268	Apr. 30–May 8	327	− 2	6	o Aqr
269	July 2–4	327	−24½	2	— PsA
270	Aug. 12–14	327	−32	2	θ PsA
271	Nov. 3–6	328½	−12	2	μ Cap
272	July 31–Aug. 11	330 339	−14 −10	7	ι Aqr ii
273	Apr. 28–May 16	330½ 346½	− 3 + 3½	27	η Aqr. Maximum May 5
274	July 14–22	330½ 339	−30 −30	11	β PsA ii
275	July 28–Aug. 2	331 334	− 8 − 8	11	θ Aqr
276	July 1–12	331 339	−13 −12	4	τ^1 Aqr
277	Aug. 12–23	331 339	−13 −10	6	τ^2 Aqr
278	June 24–July 1	331 337	−47 −48	2	α Gru
279	Aug. 3–8	332	− 1	2	γ Aqr
280	July 25–Aug. 5	332 338	−15 −12	13	ι Aqr i
281	Aug. 5–14	334 339	−27½ −26	5	λ PsA
282	July 2–4	334	−31	3	— PsA
283	July 25–Aug. 15	335	0	23	ζ Aqr i
284	Sept. 1–14	335	− 2	3	ζ Aqr ii
285	July 22–Aug. 9	335 351½	−17 −12	44	δ Aqr. Maximum July 28
286	May 4–5	336	−28	1	ζ PsA
287	May 12	336	−33½	2	β PsA i
288	Sept. 7–8	337	−11	2	σ Aqr
289	July 28–Aug. 3	337	−13	3	70 Aqr
290	July 26–Aug. 8	337 350	−33 −30	24	α PsA
291	Aug. 13–14	338	−24	3	ϵ PsA
292	July 20–Aug. 5	340 346	− 8 − 7	3	λ Aqr i
293	Aug. 8–9	340½	−27	2	20 PsA
294	Aug. 10–20	341 347	−12 −12	5	74 Aqr ii
295	Aug. 13–14	342	− 7	3	λ Aqr ii
296	July 28–Aug. 1	342	−12	3	74 Aqr i
297	Aug. 6–7	343	−17½	2	77 Aqr

No.	Period	Radiant 1900 α	Radiant 1900 δ	No. Rads.	Name
		°	°		
298	June 14–22	344	−45	2	θ Gru ii
299	Sept. 14–23	345	0	6	3 Psc
300	Aug. 25	345	−45	1	ι Gru
301	Aug. 13–21	346	0	4	5 Psc i
302	Aug. 24–Sept. 9	346	−0½	2	5 Psc ii
303	May 4–5	346	−46	2	θ Gru i
304	Aug. 16–20	346½	−27½	2	— PsA
305	July 9–12	347	0	2	— Psc
306	July 15–31	347	−1	5	— Psc
307	July 28–Aug. 1	347	−58	2	γ Tuc
308	July 2–8	348½	−9	5	ψ^2 Aqr
309	July 15–31	349	−1	4	— Psc
310	July 28–Aug. 1	349	−32	2	μ Scl
311	Aug. 6–10	350 359	−18 −14	5	98 Aqr
312	Aug. 7–13	351	−21	4	101 Aqr
313	July 20–26	351	−38½	2	— Scl
314	Aug. 13–16	351	−62½	2	η Tuc
315	Aug. 13–25	352	−3	4	14 Psc
316	July 19–Aug. 1	352 11	−18 −18	13	β Cet i
317	Oct. 16–21	352½	−6	2	24 Psc
318	July 19–30	354	−15	5	ω^2 Aqr
319	Aug. 1–11	354 4	−20½ −20	6	108 Aqr
320	July 28–Aug. 2	357	−5	5	27 Psc