

ART. LX.—*First Catalogue of Radiant Points of Meteors* ;
by EDWIN F. SAWYER.

THE following meteoric radiant points have been deduced from my observations, embracing the recorded paths of nearly 600 shooting stars, seen during the last two years (1877–8) at Cambridge, Mass. Among the number may possibly be found one or two doubtful positions, and a few strongly suspected and probably new showers requiring confirmation. The other positions either confirm those deduced by other observers, and heretofore considered rather doubtful, or are those of old and well established meteor systems. The limits of duration of the several showers are naturally uncertain; the results showing only the observed duration, and not the true period, which important element should receive the closest attention of observers in the future. Considerable complication has arisen from the large number of known radiants, and more attention should be given to establishing and identifying beyond a doubt the true positions of those already catalogued, with their limits of duration, than to the discovery of new and in many cases no doubt pseudo-meteor streams.

The theoretical shifting of the radiant point of a shower from day to day as the earth changes its position, should also, it seems (in the majority of cases), be practically shown in deducing the results; although the approximate character of this class of observations, renders it difficult to notice any shifting of position at intervals of less than a week. This important point should engage the attention of all observers, as going far to demonstrate the period of long enduring showers.

In deducing my results, great care has not only been exercised in regarding the peculiarities of each individual meteor mapped, such as length of path, velocity, magnitude, etc., but

List of Radiant Points.

No. (Sawyer).	Dates of Observations.	Radiant point.		No. of Meteors.	Remarks.
		R. A.	Dec.		
	1878.				
1	Dec. 31-Jan. 7.	$97\frac{1}{2} + 17$		8	Meteors faint and rapid, possibly a new shower. Radiant, very near γ Geminorum.
	1878.				
2	Jan. 29-Feb. 3.	167 + 42		7	Quite faint, short and rapid meteors. Confirms Heis (M. 2), $169^{\circ} + 45^{\circ}$, Jan. 16-Feb. 1.
	1878.				
3	Feb. 24-26.	145 + 8		5	Meteors very faint, with medium velocity and length of path; one stationary meteor. Denning, from Italian Met. Asso. Obs., 1872, at $147^{\circ} + 4^{\circ}$, Feb. 1-Mar. 12.
	1878.				
4	March 26-31.	204 + 34		4	Meteors quite brilliant and slow, with medium length of path. Evidently confirms Greg and Herschel, at $198^{\circ} + 32^{\circ}$, Mar. 25-Apr. 24.
	1877.				
5	May 3-7.	223 + 21		4	Meteors faint, short and rapid. Denning, at $220^{\circ} + 21^{\circ}$, April 21, 1874. Radiant near ξ Bootis.
	1877.				
6	June 24-July 3.	287 + 25		7	Meteors generally faint, short and quick. Radiant near β Cygni. Denning, at $285^{\circ} + 32^{\circ}$, June 15-17, 1877. Tupman, at $280^{\circ} + 29^{\circ}$, June 29-30, 1870.
	1878.				
7	July 28.	337 - 33		4	Meteors bright and very slow, with long paths. Herschel, at $339^{\circ} - 34^{\circ}$, July 20-Sept. 20. Seen well by A. S. Herschel, July 28, 1865.
	1878.				
8	July 21-23.	291 + 27		7	Meteors faint and quick, with medium length of path. Denning, from Italian Met. Asso. Obs., 1872, at $287^{\circ} + 27^{\circ}$, July 15-Aug. 2. Compare No. 6.
	1878.				
9	July 23.	285 + 49		5	Meteors quite bright, short and slow. Denning, from Italian Met. Asso. Obs., 1872, at $285^{\circ} + 44^{\circ}$, July 15-Aug. 2.
	1877.				
10	Aug. 10.	43 - 56		41	Perseids. Meteors brilliant, with quite long paths. Duration of observation, $\frac{3}{4}$ of an hour. Horary No. 55.
	1877.				
	Aug. 11.	43 + 57		12	Observation from 9.30 to 10.30. Meteors bright and short.
	1878.				
	Aug. 10.	$44 + 56\frac{1}{2}$		58	Meteors very bright, short and rapid. Duration of observation $1\frac{1}{2}$ hours. Horary No. 33. Position deduced from one stationary meteor and several short tracks near the focus.
	1878.				
11	Aug. 10.	8 + 55		8	Meteors bright, short and rapid. Confirms Denning, at $8^{\circ} + 53^{\circ}$, Aug. 3-16, 1877. Radiant between α and ξ Cassiopeiæ.
	1878.				
12	Aug. 23-Sept. 1.	282 + 42		21	Active shower; meteors bright and rapid, with quite long paths. Mean of 5 positions from Greg's Table, 1876, at $281^{\circ} + 38^{\circ}$, July 29-Sept. 25.
	1878.				
13	Aug. 25-Sept. 1.	335 + 64		6	Meteors generally bright, short and rapid. Greg and Herschel, at $335^{\circ} + 67^{\circ}$, Aug. 6-31. Schiaparelli and Zezioli, at $340^{\circ} + 65^{\circ}$, Aug. 28.
	1878.				
14	Aug. 25-30.	237 + 65		11	Position well deduced; meteors bright, short and rapid. Denning, from Italian Met. Asso. Obs., 1872, at $235^{\circ} + 65^{\circ}$, Aug. 24-Sept. 14.
	1878.				
15	Aug. 20-27.	274 + 20		7	Short, quick meteors. Denning, from Italian Met. Asso. Obs., 1872, at $270^{\circ} + 20^{\circ}$, Aug. 24-Sept. 14.
	1878.				
16	Sept. 30-Oct. 2.	23 + 17		7	Strongly suspected, and possibly a new shower. Meteors quite bright, short and rapid.

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		R. A.	Dec.		
17	1878. Sept. 27-30.	$3 + 21$		7	Exact. Meteors bright, short and swift. A new shower. ?
18	1878. Sept. 18-27.	$333 + 23$		5	Rather uncertain. Meteors bright, short and slow. Denning, from Italian Met. Asso. Obs., 1872, at $333^{\circ} + 27^{\circ}$, Aug. 24-Sept. 14.
19	1877. Oct. 28.	$356 + 40$		8	Position exact. Active shower, 8 recorded during $\frac{1}{4}$ of an hour; early eve. Meteors faint and short. Schiaparelli and Zizioli, at $352^{\circ} + 41$, Nov. 13.
20	1878. Oct. 17-22.	$28 + 33$		6	Meteors generally quite bright, short and rapid. Confirmed by H. Corder, Oct. 22-31, ? 1878, at $32^{\circ} + 34^{\circ}$ Radiant near ϵ Triangulum. Possibly new.
21	1878. Oct. 21-22.	$47 + 27$		4	Faint, short and rapid meteors. Greg and Herschel, at $43^{\circ} + 26^{\circ}$, Oct. 18-Nov. 13. Denning, at $47^{\circ} + 28^{\circ}$, Oct. 8; and from Italian Met. Asso. Obs., 1872, at $45^{\circ} + 26^{\circ}$, Oct. 29-Nov. 13.
22	1878. Oct. 20-29.	$24 + 19$		9	Meteors bright, short and generally rapid. Radiant near β Arietis. Gruber, at $21^{\circ} + 22^{\circ}$, Oct. 17-24.
23	1877. Oct. 30-Nov. 11.	$30 + 21$		7	Meteors faint, with short paths. Radiant near α Arietis. Evidently confirms Tupman (94), at $30^{\circ} + 22^{\circ}$, Nov. 3, 1869. Compare No. 22.
24	1877. Nov. 4-11.	$60 + 18$		5	Taurids I. Meteors generally quite brilliant, with medium length of path. Denning, average position at $60^{\circ} + 20^{\circ}$, Oct. 17-Nov. 13, 1877.
25	1877. Nov. 30-Dec. 9.	$80 + 22$		10	Taurids II. Meteors generally quite bright and quick, with medium length of path. Denning, Nov. 25-Dec. 13, at $80^{\circ} + 25^{\circ}$.
	1878. Nov. 26-29.	$82 + 21$		9	Meteors quite bright, generally slow, with medium length of path. Principally seen on Nov. 29.
26	1878. Nov. 24.	$330 + 63$		4	Strongly suspected. Meteors faint, quick and short, and recorded during 1 hour's observation in W. Denning, from Met. Ass. Obs., 1872, at $330^{\circ} + 66^{\circ}$, Nov. 25-Dec. 31.
27	1878. Nov. 23-29.	$76 + 46$		8	Rapid, short and faint meteors. 3 recorded in rapid succession on the 24th. Position exact. Confirms a radiant deduced at Pola, Nov. 27, 1872, at $76^{\circ}.5 + 46^{\circ}$.
28	1878. Nov. 24-29.	$25 + 26$		5	Meteors quite bright, short and slow. Denning, from Italian Met. Asso. Obs., 1872, at $24^{\circ} + 27^{\circ}$, Nov. 25-Dec. 31.
29	1877. Dec. 1-9.	$97 + 16$		6	Meteors generally faint, with very rapid motion. Possibly new. Radiant center very near γ Geminorum. Compare No. 1.
30	1877. Dec. 7-9.	$54 + 35$		4	Strongly suspected. Meteors quite faint and quick, with quite long paths.
31	1877. Dec. 28-29.	$104 + 33$		5	Geminids. Meteors faint, short and quick.
	& 1878, Dec. 22-26.	$102 + 35$		5	Geminids. Meteors faint, short and quick.
32	1878, Dec. 25.	$114 + 18$		5	Meteors generally bright, short and rapid; all recorded during 1 hour's watch; good radiation. Schmidt, Jan., at R. A., $115^{\circ} + 15^{\circ}$.

during the past year a certain weight has been attached to each meteor mapped, showing the accuracy of the path recorded, on a scale of one to four, and its corresponding value used in deducing the centers of radiation; and the results are believed to be as nearly correct as the number of meteors recorded and the nature of the observations will allow. Observations were taken nearly every fair night in the absence of the moonlight, but were confined principally to the evening hours, between 6 and 11 p. m. The exceptions were morning watches in April, 1878, August, 1877-8, and November, 1877-8, for the appearance of the Lyraids, Perseids, and Leonids. With the exception of the Perseids, these gave negative results; only two or three scattering members from each stream being recorded. The periods of watching each evening varied from one to four hours in duration, and aggregate 187 hours in all. The observations were mostly confined to the eastern quarter of the sky, the few exceptions being watches in the west during the months of August, September and November, 1878.

In deducing the results, the method employed by Prof. Schiaparelli, (i. e. deducing the material obtained from each evening's observations, or those of a few evenings at most), has been used. The positions deduced from less than four meteors (of which there were a large number), have been rejected. In giving weight to the different positions deduced by me, observers should bear in mind that the small number of meteors, recorded in many of the cases, result from one or more of the following causes:

I. The shortness of the period from which each shower is deduced, averaging about five days, the average period of most observers being from twenty to thirty days. II. To the generally unfavorable hours, between which the observations were taken, before midnight, when meteors are much less abundant, than during the morning hours. III. To the small number of hours during which I was able to watch each evening, especially in the spring and winter months; several showers being deduced from one or two hours' watch only.

Corresponding observations of the same meteors are doubtless of great value in determining the heights, etc., of the meteors, as well as their radiant points, and during the latter part of last August, the writer together with Mr. Seth C. Chandler, Jr., made a series of observations at stations some seventy miles apart; the reduction of the same is now being done by Mr. Chandler.

Another series has been partly arranged and carried out by the writer and Mr. Oliver C. Wendell, of Lowell, Mass., and it is to be hoped that other observers will, during the coming year, be found willing to engage in this important work.