

very glad to hear of fresh names of real workers, for ill-health has robbed the Association of a great deal of help which it would doubtless have continued to receive from Mr. Denning, Mr. Blakeley, and others, who, it is hoped, will soon regain their strength. The Director desires to thank most heartily all who have helped him in this very interesting work, and to ask for assistance again during the coming year, not only from the regular workers, but also from any who will send him chance observation they may make of brilliant meteors, giving as many details as possible. In the following pages will be found detailed reports of some of the best known meteor showers seen in the period from October 1, 1892, to December 31, 1893; a catalogue of radiant points during the same time; a list of bright meteors and fireballs; and a table showing the heights and real paths of 15 meteors, kindly contributed by Mr. Denning.

HENRY CORDER,  
Director of the Section.

### Meteor Showers, 1892-93.

#### ORIONIDS OF OCTOBER, 1892.

This shower was not well observed at this return, as the weather was not very good. Three observers report on it, the following being a summary of their observations.

Mr. W. H. Milligan, of Belfast, found a radiant of Orionids at  $92^{\circ} + 15^{\circ}$ , between the dates of October 19 and 23 other bright meteors were apparently directed from Gemini.

Mr. T. W. Backhouse, of Sunderland, was watching on various dates from October 16 to 29, the best display of Orionids being on the 18th, with a radiant at  $90^{\circ} + 17^{\circ}$ , and meteors were also directed from near  $\gamma$  Geminorum at  $98^{\circ} + 18^{\circ}$ , but out of 28 meteors mapped in the whole period, only about eight were conformable to either of these showers.

The Director, at Bridgwater, was on the watch on about 14 nights in October, especially on the 17th, 23rd, and 29th, but on the last named date the combined shower of Orion-Geminids had almost ceased. In this period only nine meteors, out of a total of 177, were true Orionids, with a radiant at  $87^{\circ} + 18^{\circ}$ , but 22 more were from the Geminid positions near  $\nu - \gamma - \xi$ , or at  $96^{\circ} + 18^{\circ}$ ,  $99^{\circ} + 15^{\circ}$ , and  $98^{\circ} + 11^{\circ}$ , the first named agreeing very well with the five tracks of Mr. Backhouse. Indeed, this Geminid display has seemed to the Director to be the more important of the two on some occasions, especially after the chief Orionid dates (October 16 and 17). The meteors from Orion are very swift, and though very rarely above second magnitude, almost invariably leave streaks, even in larger proportion than the Perseids. The meteors from near  $\gamma$  Geminorum are somewhat similar, but are often much brighter, and three beautiful yellow meteors, rather brighter than first magnitude, were recorded, all leaving streaks. It does not appear that there is much shifting of

the Orionid radiant. Mr. W. F. Denning has found it pretty stationary at various times, and the writer has also noticed the exact character of the radiation, and as the two showers may be observed at the same time, it cannot be a case of shifting, though they might be branches of one shower; the difference in the character of the meteors is, however, against this view.

#### TAURIDS OF NOVEMBER 1892.

This long-continued shower was observed by several Members of the Section, and the main radiant point near A Tauri well determined, as under :—

$65^{\circ} + 20^{\circ}$	-	-	Milligan.
$60^{\circ} + 21^{\circ}$	-	-	Pope.
$60^{\circ} + 21^{\circ}$	-	-	Rheden.
$59^{\circ} + 21^{\circ}$	-	-	Corder (20 meteors).

Besides these, there were two other positions mapped from Bridgwater, one near Aldebaran at  $73^{\circ} + 16^{\circ}$ ; the other near the Pleiades at  $55^{\circ} + 24^{\circ}$  (13 meteors). The first has often been seen before, though it is but a feeble stream, the meteors orange, and very slow. That near the Pleiades has shown some signs of shifting in the direction of A Tauri, but no actual junction with the latter shower has been seen. The shower is earlier than the true Taurids, commencing in October, and the meteors somewhat quicker and with shorter paths.

The true Taurids last all through November, and are a very interesting shower, though it is not often that more than five or six can be seen in an hour. In 1892 the middle of the month was cloudy, so that only scattered observations were made, and none of the green fireballs, which often characterise the shower, were seen.

#### THE ANDROMEDES OF NOVEMBER 1892.

A great shower of these meteors was expected this season, on or about the 27th, but it did not show itself in England. Certainly, the weather was cloudy, but information received from the Tyrol, where Herr Joseph Rheden was observing them, would go to prove that the shower had not commenced on the evening of the 23rd in this hemisphere, but that in America a splendid shower was in progress when night set in there. The stream has evidently suffered some perturbation of its orbit, for not only 'was the radiant far from its usual position north of  $\gamma$  Andromedæ, but the date was also much earlier; the maximum display being on the 23rd, whilst on the 26th and 27th scarcely a member of the shower was seen.

It will not be necessary to reproduce the long list of radiant positions here, they will be found in the general list. Suffice it to say, that when first seen at Bridgwater, on November 19, there was a large area of radiation, extending from near  $\beta$  Andromedæ to  $\tau$  in the same constellation, and even as far as  $\gamma$  Trianguli. A watch was kept on this night both before and after midnight.

In about five hours 74 meteors were seen, of which about 30 were Andromedes, and at one time in the evening they were falling at the rate of 12 an hour. During a short interval on the evening of November 20, four Andromedes were seen; but clouds came on, and nothing more was seen of the shower excepting during a brief watch on November 26, when it was dying out.

On November 23, Herr Rheden saw 40 meteors between  $7^h 26^m$  and  $10^h 20^m$ , of which a large proportion were Andromedes, and a few more on November 24. This observation forms an interesting link in the history of the shower, carrying it on until the great storm of meteors seen in America on the evening of the 23rd, and showing that it was almost over again by the same time on November 24 in Europe.

At Sunderland, Mr. Backhouse was very unfortunate. He missed the early apparition of the shower, and his watch on the nights of November 24, 26 to 28, lasting for 148 minutes in all (the sky was at times partially overcast), gave him only six meteors, none of which appear to have belonged to the expected shower.

Herr J. Plassmann, at Warendorf, had a similar experience on the dates November 22, 25, and 26, the other nights being overcast.

Miss E. Brown reports that a gentleman at Cirencester saw quite a miniature shower of meteors in the S.W. between  $10^h 30^m$  and  $10^h 45^m$  on the night of November 26, but Miss Brown herself saw nothing in short watches before that hour.

At Belfast, Mr. Milligan saw a few meteors radiating from  $25^\circ + 45^\circ$  above  $\gamma$  Andromedæ on November 25, no doubt belonging to the shower, and this observation, taken with that made at Bridgwater on the 26th, would seem to show that the radiant had moved on from near  $\beta$  Andromedæ on the 19th to near  $\gamma$  by the later date, thus taking up its usual position in other years on the 27th of November.

At Bridport, Rev. S. J. Johnson saw only a few stragglers of the shower, and other observers seem to have had no success.

To summarise these scanty results, it would seem that the shower commenced on the evening of November 19, and reached its maximum on November 23, and that only a few belated meteors remained on the usual date of November 27. Not many bright ones were seen, most of them being of the 3rd and 4th magnitudes only, dull orange in colour and slow in movement. Several of them which had trains appeared as moving streaks during the end of their course, the nucleus having died out. It is to be hoped that observations will continue to be made of this interesting shower, as it is evident that it is not thoroughly understood yet, and the great dispersion of the radiant may throw some light on the question of branch showers, and those large areas of meteoric radiation, such as the Ursids, where the whole of a large constellation seems the outlet for a vast stream of scattered meteors.

The following table shows the details of Mr. Backhouse's watch for meteors of the recently expected Andromede shower. The

## PART I.]

## REPORT OF THE METEORIC SECTION.

5

columns will bear the same explanation as those of the Leonid table. (See next page.)

Time.	O.	Sky.	O <sup>l</sup> .	Hindrance.	Mag. vis.	F.
11 mo. 24:						
9 <sup>h</sup> 20 to 10 <sup>h</sup> 5 - -	10	*6	6	—	—	—
10 <sup>h</sup> 15 „ 11 <sup>h</sup> 30 - -	5	*6	3	—	—	—
Total - -	15	—	9	—	—	0
11 mo. 25 - - -						
	—	—	—	Overcast.	—	—
11 mo. 26:						
8 <sup>h</sup> 19 to 8 <sup>h</sup> 21 - -	2	*5	1	Moonlight and thin cloud	—	—
12 <sup>h</sup> 59 „ 13 <sup>h</sup> 21 - -	20	1*	20	Very faint aurora - -	—	1
13 <sup>h</sup> 35 „ 13 <sup>h</sup> 46 - -	5	1*	5	„ - -	—	1
13 <sup>h</sup> 48 „ 13 <sup>h</sup> 53 - -	2	1*	2	„ - -	—	—
17 <sup>h</sup> 25 „ 17 <sup>h</sup> 31 - -	6	1*	6	—	—	—
17 <sup>h</sup> 35 „ 17 <sup>h</sup> 55 - -	4	1*	4	—	—	—
17 <sup>h</sup> 57 „ 18 <sup>h</sup> 5 - -	1	1*	1	Slight twilight.	—	—
Total - -	40	—	39	—	—	2
11 mo. 27:						
(.92) 4 <sup>h</sup> 20 to 4 <sup>h</sup> 51 - -	—	—	—	Not much sky; no stars but $\gamma$ and Vega seen, and they not very long.	—	—
(.92) 5 <sup>h</sup> 2 „ 5 <sup>h</sup> 3 - -	1	*3	*3	Twilight and moonlight; then it clouded over.	4	—
7 <sup>h</sup> 55 „ 8 <sup>h</sup> 4 - -	6	*1	*6	Thin cloud and moonlight	3	—
8 <sup>h</sup> 34 „ 8 <sup>h</sup> 42 - -	8	*4	3*2	Partly thin cloud and moonlight.	5-5½	—
(.92) 8 <sup>h</sup> 45 „ 8 <sup>h</sup> 59 - -	14	*7	9*8	„ - - -	6-5½	—
(.92) 9 <sup>h</sup> 14 „ 9 <sup>h</sup> 18 - -	4	*7	2*8	„ - - -	6-5½	—
(.92) 9 <sup>h</sup> 28 „ 9 <sup>h</sup> 30 - -	2	*6	1*2	„ - - -	6½-5½	—
(.92) 9 <sup>h</sup> 48 „ 10 <sup>h</sup> 5 - -	17	*9	15*3	Partly thin cloud and slight moonlight.	6½-6	1
(.92) 10 <sup>h</sup> 21 „ 10 <sup>h</sup> 28 - -	7	1*	7	Slight moonlight - -	6½	1
12 <sup>h</sup> 55 - -	1	1*	1	Thin cloud - - -	6½	—
Total - -	60	—	41	—	—	2
11 mo. 28:						
6 <sup>h</sup> 0 to 7 <sup>h</sup> 30 - -	12	*5	6	Moonlight and thin cloud.	—	—
10 <sup>h</sup> 0 „ 10 <sup>h</sup> 10 - -	7	*4	2*8	Moonlight.	—	—
16 <sup>h</sup> 55 „ 17 <sup>h</sup> 4 - -	5	*8	4	—	—	1
17 <sup>h</sup> 45 „ 18 <sup>h</sup> 4 - -	7	1*	7	—	—	1
18 <sup>h</sup> 17 „ 18 <sup>h</sup> 19 - -	2	1*	2	Twilight - - -	6-6½	—
Total - -	33	—	23	—	—	2
Grand Total - -	148	—	111	—	—	6

(.92) means spectacles of about that power.

# LEONIDS OF NOVEMBER 1892.

The weather was not favourable at the time of the Leonid shower, but Mr. Backhouse was able to watch on the early morning of November 15, when between two and six o'clock (50 minutes watching) only two meteors were seen, both believed to be Leonids. Again, on the morning of November 17, a watch was kept for 70 minutes, when six meteors were seen, none of them Leonids. On the morning of November 20, at Bridgewater, in about four hours only four Leonids were seen, the radiant being much further to the south-east than usual, near  $\gamma$  Leonis at  $153 + 21\frac{1}{2}$ . Still there is very little doubt, by the appearance of the meteors, that they were members of the true shower which seems to have reached a very low point now, and does not seem at all to increase in intensity as the time for its maximum in 1899 approaches.

## LEONIDS, NOVEMBER 1892.

Mr. Backhouse gives the following account of his watch for Leonids this year. "O" means the total number of minutes watch in the interval mentioned in the previous column; "Sky," the proportion of clear sky visible; "O'," the number of minutes corrected for "sky"; "Hindrance," other hindrances to visibility of meteors; "Mag. vis.," the faintest stars visible; "F," the number of meteors seen in each interval of first column; and  $\Omega$  the number of meteors taken to be Leonids at the time of observation.

Time.	O.	Sky.	O'.	Hindrance.	Mag. vis.	F.	$\Omega$
11 MO. 14:							
13 <sup>h</sup> 37 to 14 <sup>h</sup> 8	- 16	*9	14	—	—	0	—
14 <sup>h</sup> 40 „ 15 <sup>h</sup> 40	- 7	*8	5	—	—	1	1
16 <sup>h</sup> 59 „ 17 <sup>h</sup> 37	- 22	*7	16	Slight moonlight	- 6 $\frac{3}{4}$	1	
17 <sup>h</sup> 53 „ 18 <sup>h</sup> 2	- 5	*8	4	Do., and twilight	- 6 $\frac{1}{2}$	(1)*	0
Total	- 50	—	39	—	—	2	2
11 MO. 16:							
8 <sup>h</sup> 51 to 9 <sup>h</sup> 11	- 17	1*	17	—	—	4	0
10 <sup>h</sup> 50 „ 12 <sup>h</sup> 57	- 18	1*	18	—	—	1	0
16 <sup>h</sup> 55 „ 17 <sup>h</sup> 53	- 30	1*	30	—	—	1	0
18 <sup>h</sup> 5 „ 18 <sup>h</sup> 10	- 5	1*	5	Twilight	- 6 $\frac{1}{2}$	0	—
Total	- 70	—	70	—	—	6	—
Grand Total	- 120	—	109	—	—	8	2

\* Seen with field-glasses and not included in totals.

## GEMINIDS OF DECEMBER 1892.

This shower was very well observed in several places, although what should have been the best nights (December 10 and 11) were more or less overcast.

At Bristol, Mr. Denning was watching for some time, especially on December 12, and registered a number of Geminids, an account of which he has sent to the "Monthly Notices." As Prof. A. S. Herschel was watching at Slough, and the writer at Bridgwater, several meteors were found in the lists common to two or three observers, and Mr. Denning worked out the true paths, which are given, by his kind permission, in another part of this report. Mr. Backhouse and Mr. Milligan also saw something of the shower. It was evident that there was a double centre of radiation, one shower being directed from Castor, and another from near Pollux; a third being suspected near  $\theta$  Geminorum. Perhaps it is not necessary to reproduce the list of radiants here, as they are given in the general table.

Generally the meteors of this shower are very small and uninteresting, having short paths and rarely leaving streaks; but on this occasion a good many bright ones were seen, especially perhaps from the Pollux radiant, which has been observed in former years, though hardly so strongly marked before.

At Bridgwater 73 meteors of the combined showers were counted, only nine of the brightest leaving any streaks. The magnitudes were as follows:—12 1st mag., 17 2nd mag., 24 3rd mag., 20 4th, and smaller. Five of them were coloured yellowish green. This shows just twice as many of the two brighter magnitudes as there were in 1877, when exactly the same number of Geminids were registered.

On December 12 the hourly number of Geminids reached 14.

There is often a shower of long streak-leaving meteors from near  $\iota$  or  $\delta$  Gem., which is contemporaneous with the earlier part of the Geminid display. Nothing was seen of it this year by either of the observers.

## THE QUADRANTIDS OF JANUARY 1893.

The very brilliant full moon and cold weather prevented most observers from seeing anything of this shower, although short watches were kept in some places. Fortunately, at Belfast, Mr. Milligan braved both cold and moonlight, and was very justly rewarded by what, under the circumstances, must have been an unusually fine display of these meteors. He writes, "I kept watch on the night of January 2, from 12.0 till 2.0 a.m., and during that time counted upwards of 25 meteors, some of them rather bright in the strong moonlight. The radiant was well marked at  $230^{\circ} + 50^{\circ}$ . They apparently slacked off towards 2 a.m., when I retired. They, however, were still visible the following evening, as I saw one myself, and heard of several others being seen in the N.E. sky."

The great fireball seen on the evening of January 4, at several places, rivalling the moon in splendour, may have belonged to this shower. Mr. Backhouse, who was wintering in Tenerife, was also on the watch, but only saw five Quadrantids.



WATCH FOR QUADRANTID METEORS, 1892-3.

Time of Watching.	Minutes of Observations.	Area of visible Sky.	Minutes of Observations corrected for Sky.	Hindrance to Visibility.	Magnitude of faintest Stars Visible.	Number of Meteors seen.	Rate per Hour.	Number of Quadrants seen.
<i>At Santa Cruz de Tenerife.</i>								
1892, 12 mo. 30 :								
18°30 to 18°50 -	5	9	4.5	—	—	0	—	—
<i>At Puerto Orotava, Tenerife.</i>								
1892, 12 mo. 31 :								
18°43 to 19°10 -	7	1	7	Moonlight and slight twilight.	—	1	8.6	1
<i>At Puerto Orotava.</i>								
1893, 1 mo. 1 :								
(92) 18°26 to 18°43 -	7	4	2.8	Bright moonlight.	4½	2	40	2
(92) 18°45 „ 19°0 -	14	5	7	„	—	3	25.7	2
(92) 19°1 „ 19°12 -	11	2	2.2	Bright moonlight and slight twilight.	4	0	0	0
Total -	32	—	12	—	—	5	25.0	4
<i>At Puerto Orotava.</i>								
1 mo. 2 :								
— } 17°26 to 19°12 {	31	1	31	Bright moonlight, and at end slight twilight.	6	0	—	—
(92) }	51	1	51		6½	0	—	—
Total -	82	—	82	—	—	0	—	—
Grand Total -	126	—	106	—	—	6	3.4	5

(92) means with spectacles of that power.

THE LYRIDS OF APRIL 1893.

The splendid weather of the spring months made it not only easy but pleasurable to watch the sky for long periods at what is usually a very inclement period of the year, so that although no very brilliant return of the Lyrids seems to have occurred, several Members of this Section were able to give a good record.

Mr. Denning has published an interesting account of his observations in "Nature" for May 4. He was watching at intervals on the nights of April 18, 20, 21, and in 8½ hours counted 56 meteors, of which 18 were Lyrids. On the 20th the radiant was at 272° + 33°, and on the 21st at 273° + 34°.

On the latter date some brilliant meteors were seen, one being as bright as Venus and leaving a long streak.

It is curious to find that Mr. Denning's very clearly marked radiant is not shown so distinctly in the observations of some other Members of the Section, though his great experience in meteor observation makes it seem very rash to say anything in the way of dissent. However, it must be told that at Bridgwater two distinct centres of radiation were found, and these were well upheld by the observations of Mr. R. W. Blakeley, at Dewsbury, whose great assistance during the spring the Director is glad to acknowledge, and also to some extent by the few meteors seen by Mr. Ferrington at Shrewsbury.

From these it would seem that there was another shower in progress near  $\theta$  Herculis,  $267^\circ + 37^\circ$ , giving swifter meteors, with a larger proportion of streaks. At Bridgwater, 15 Herculids were seen with nine streaks, and only 10 Lyrids from  $276^\circ + 34^\circ$ , with two streaks.

Mr. Blakeley's radiants come out at  $266^\circ + 37^\circ$  for the Herculids, and at  $276^\circ + 34^\circ$  for the true Lyrids, and in this case also the finer shower seems to have been the Herculids.

It may be well to state that in the years 1877, 1878, 1879, 1880, the radiant appeared to the writer to be always at the normal position; but in 1882, when more than usual were seen, it was near  $\theta$  Herculis at  $268 + 37^\circ$ , 26 meteors.

It still remains a question whether there are two distinct showers, or whether they are only branches of one stream.

It is rather strange that several showers should have double radiants; in two or three cases the different appearance of the meteors leads one to suppose that the streams are quite distinct, and in some years one prevails, and in others a different one, or both may appear together, as in the Lyrids of this season.

The hourly number of meteors in April never seemed to rise above 10 or 12, and of these only half were Lyrids at the best time of the shower.

#### THE AQUARIDS OF MAY 1893.

This most interesting shower is very difficult to observe, for as the radiant does not rise until morning twilight, the meteors do not appear until daybreak. They are, however, so very fine that the observer is repaid if only two or three are seen. This year, in a watch of three hours, on the morning of May 7, only two Aquarids were seen, with splendid streaks about  $30^\circ$  long, and a radiant at  $338\frac{1}{2}^\circ - 3\frac{1}{2}^\circ$ . Mr. Milligan saw none, though he watched for them.

#### PERSEIDS OF AUGUST 1893.

This favourite shower was well observed at various stations, and a number of observations of bright meteors sent in, as well as general results and accounts of the shower. More than a thousand meteors were recorded by five or six observers, of which Mr. Blakeley contributed more than 300, which he mapped out of a still larger total. Mr. Milligan saw more than 100, the Director 380, and other Members of the Section added to it, besides which Mr. Denning sent in several reports of his interesting and valuable observations.

The shower was evidently not a remarkable one in any way. The hourly number does not seem to have risen much above 40



for one observer, even on August 10, and on the other nights of observation, generally about 12 to 15 meteors were seen in the hour. The Perseids themselves far outnumbered the "sporadic" meteors on August 10, but on most other nights were quite in a minority, though it should be added that at Bridgwater the nights of the 9th, 11th, and 12th, were overcast, and probably the Perseids on those dates would approach in number the total for August 10; this is indicated by the results of short watches kept by Mr. Backhouse, for on August 9, 17 meteors out of 19 in about an hour were Perseids, and on August 11, when 13 out of 20, in rather less than an hour, were from this radiant.

A fair number of brilliant meteors were seen, especially by Mr. Backhouse at Sunderland, but perhaps the contemporaneous display of Cygnids produced almost half of them. At any rate, at Bridgwater, a very small proportion of the Perseids were brighter than a first magnitude star, and none of exceptional brilliancy. The very bright Perseids generally end up with a very vivid pale green flash, leaving a streak for some seconds, but none of these were recorded at Bridgwater, and it would not appear that many were seen elsewhere. Meteors of the apparent size of Jupiter and Sirius were fairly abundant. These are generally yellow in colour, and some deep orange.

The attention of several observers was given to the shifting of the radiant point, and the results were fairly accordant and conclusive, although on the maximum dates the radiant seemed to be rather diffuse, and the progression was not so well seen.

The following table will show the results arrived at, and a comparison of the positions found by different observers may be made at a glance.

Date.	Denning.	Blakeley.	Corder.	Booth and Milligan.
	R.A. Dec.	R.A. Dec.	R.A. Dec.	R.A. Dec.
Aug. 5	$39^{\circ} + 55^{\circ}$	$39^{\circ} + 54^{\circ}$	$\begin{smallmatrix} \circ & \circ \\ - & - \end{smallmatrix}$	$\begin{smallmatrix} \circ & \circ \\ - & - \end{smallmatrix}$
" 8	$41 + 56$	$42 + 55$	$\left\{ \begin{smallmatrix} 42 + 46 \\ 35 + 56 \end{smallmatrix} \right\}$	—
" 9	$43 + 57$	$44 + 55$	—	$43 + 57$ Booth.
" 10	$45 + 57$	$44 + 56$	$\left\{ \begin{smallmatrix} 40 + 56\frac{1}{2} \\ 44 + 57\frac{1}{2} \\ 47 + 58\frac{1}{2} \end{smallmatrix} \right\}$	$45 + 57$ Milligan.
" 12	$48 + 58$	$44 + 55$	—	$48 + 51$ Booth.
" 13	$48 + 58$	—	$48 + 59$	—
" 14	$49 + 57$	$49 + 55$	$54 + 59$	Perhaps Camelids.
" 15	—	$51\frac{1}{2} + 59$	$55 + 57$	
" 16	$52 + 57$	—	—	—
" 18	$54 + 58$	$54 + 62$	—	—
" 21	—	—	—	$55 + 57$ Milligan.

The observations of Mr. Denning and Mr. Blakeley, show the movement of the radiant in R.A. very well indeed, though it is curious to note that it appeared almost stationary to Mr. Blakeley from August 9 to 12, at  $44^{\circ} + 55^{\circ}$ , whilst at Bridgwater it seemed to change its place very considerably, from  $40^{\circ} + 56\frac{1}{2}^{\circ}$  to

$47^{\circ} + 58\frac{1}{2}^{\circ}$  during the one night of August 10. This observation was very carefully made, the meteors evidently coming from near  $\eta$  Persei early in the evening, and as certainly from near B.C. Camelopardi later in the night. The Bridgwater radiant at  $54^{\circ} + 59^{\circ}$  on August 14 was believed by the observer to indicate a distinct shower of Camelids, the meteors appearing to differ in character; Mr. Denning believes them to have been true Perseids, although it will be seen that the position does not at all agree with those found by Mr. Denning and Mr. Blakeley. The former saw a shower of Camelids on this date at  $61^{\circ} + 60^{\circ}$ , and if the position at  $54^{\circ} + 59^{\circ}$  had not been very well defined, it might be thought to be a confusion of the two showers of Perseids and Camelids. Several meteors were seen which appeared to be true Perseids, but they were not well observed, and therefore not mapped.

Amongst other observers, Rev. S. J. Johnson, at Bridport, saw a number of Perseids on August 9, and a few on other dates. Mr. J. Wykes, at Birmingham, saw over 30 on August 10. Mr. Milligan at Belfast, had bad weather, but it was clear on August 10, and partly so on August 9, and upwards of 100 meteors were counted, including a brilliant blue rocket-like meteor as bright as  $\gamma$  at 9.30 on August 10. Mr. Pope, at Dingwall, was, as usual, unlucky, his station so far north being very unfavourable for astronomical work, and very few meteors were seen. Mr. Davis, at Reading, saw a good many brilliant meteors on different nights, and Rev. W. R. Waugh saw more than 20 Perseids at Portland. Unfortunately also, Mr. Booth was almost prevented from watching by cloudy skies, a few being seen on August 9.

Most observers mention the brilliant and phenomenal lightning seen all over the country on August 9, in many cases the flashes being almost continuous for hours.

Herr J. Plassmann, of Warendorf, sends a list of tracks for August, but unfortunately, the resulting radiants are not marked with sufficient clearness.

### PERSEID SHOWER, 1893.

*Observed at Sunderland and Seaton Carew (Co. Durham).*

Date and Time of Watching.	Duration in Minutes.	Minutes of Duration corrected for State of Sky.	Hindrance to Visibility.	Mag. (Stellar) visible.	Number of Meteors seen.	Rate per Hour.	Number of Perseids seen.
8 mo. 8: h m h m 9 <sup>h</sup> 44 to 10 <sup>h</sup> 21 - -	23	21	Twilight; haze and gaslight.	5 <sup>1</sup> -6 <sup>1</sup>	2	5 <sup>1</sup> .7	1
10 <sup>h</sup> 31 „ 11 <sup>h</sup> 17 - -	19	19	—	—	7	22 <sup>1</sup> .1	5
11 <sup>h</sup> 30 „ 11 <sup>h</sup> 40 - -	2	2	Hazy - - -	6	0	0	0
Total - -	44	42	—	—	9	12 <sup>9</sup> .0	6

Date and Time of Watching.	Duration in Minutes.	Minutes of Duration corrected for State of Sky.	Hindrance to Visibility.	Mag. (Stellar) visible.	Number of Meteors seen.	Rate per Hour.	Number of Perseids seen.
<b>8 mo. 9:</b>							
h m h m 9 <sup>h</sup> 52 to 10 <sup>h</sup> 5 - -	3	3	Twilight - -	6-6½	1	20°0	1
10 <sup>h</sup> 35 „ 11 <sup>h</sup> 25 - -	32	32	—	—	11	20°6	11
11 <sup>h</sup> 40 „ 12 <sup>h</sup> 40 - -	33	30	—	—	7	14°0	5
Total - -	68	65	—	—	19	17°5	17
<b>8 mo. 10:</b>							
10°0 to 10°35½ - -	16½	13	Slight twilight at first	—	6	27°7	6
10°44 „ 10°46 - -	2	1	Thin cloud - -	5½	0	0	0
11°2 „ 11°19 - -	14	11	Partly thin cloud - -	6-7	3	16°4	3
Total - -	32½	25	—	—	9	21°6	9
<b>8 mo. 11:</b>							
10°0 to 10°19 - -	9	8	Partly thin cloud - -	6-7	2	15°0	2
11°16 „ 11°56 - -	15	15	—	—	8	32°0	5
11°58 „ 13°40 - -	32½	32½	—	—	10	18°5	6
Total - -	56½	56	—	—	20	21°4	13
<i>At Seaton Carew.</i>							
<b>8 mo. 12:</b>							
9°57 to 10°0 - -	3	3	Partly thin cloud - -	—	1	22°2	1
10°50 „ 13°51 - -	11	10	—	—	5	30°0	1
Total - -	14	13	—	—	6	27°7	2
<i>At Seaton Carew.</i>							
<b>8 mo. 13:</b>							
10°10 to 10°15 - -	5	5	—	—	1	12°0	0
11°4 „ 11°23 - -	8	7	—	—	2	17°1	0
Total - -	13	12	—	—	3	15°0	0
Grand Total - -	228 hrs. 3½	213	—	—	66	18°6	47

## ORIONIDS, OCTOBER 1893.

Weather either cloudy or foggy during the Orionid period, and almost no observations made. On October 10, a few were seen at Bridgwater, with radiant at  $90^{\circ}+16^{\circ}$ . This is a very early date, and shows that there is very little, if any, shifting of this radiant during the period of the shower, and adds proof to the belief that the strong shower of almost similar meteors from

$\gamma$  and  $\gamma$  Geminorum seen a few days later in several years, is quite separate from the Orionids. These Geminids were slightly observed on October 22, from  $97^\circ + 19^\circ$ , 4 meteors only.

#### LEONIDS OF NOVEMBER 1893.

As we are now nearing the maximum display of the Leonids it becomes more important to obtain evidence of the strength of the shower. This year there was not much opportunity on account of cloudy skies. One or two were seen on November 7, and a long watch was kept at Bridgwater on November 12. In the evening none were seen during about two hours, and watching was resumed at  $12^h 30^m$ , but no Leonids appeared until  $14^h 30^m$ , when a very few began to fall. At about  $15^h 15^m$  they became more numerous, and were indeed the only meteors seen for about 20 minutes, when unfortunately it clouded over completely. Only about a dozen were seen in November, which could possibly have been Leonids, and two centres of divergence were found; one, the true Leonids at  $155^\circ + 23^\circ$ ; the other at  $152^\circ + 28^\circ$  may have been the shower from Leo Minor, which has often been noticed at about this date.

From American sources we learn that some brilliant Leonids were seen in that country, and that the shower was unusually strong on dates later than we generally expect it, especially about November 14 and 15.

#### TAURID AND LEONID SHOWER.

Time.	O.	Sky.	O'.	Hindrance.	Mag. Vis.	F.	R.	$\delta$	$\Omega$
11 mo. 3: h m h m 10 <sup>o</sup> to 10 <sup>30</sup> -	4	'8	3	—	—	o	o	o	—
11 mo. 4: 6 <sup>44</sup> to 9 <sup>11</sup> -	22	'94	20 <sup>7</sup>	Mist and twilight.	5 $\frac{1}{2}$ -6 $\frac{1}{2}$	o	o	—	—
9 <sup>43</sup> „ 11 <sup>10</sup> -	25	1 <sup>o</sup>	25	Mist - -	6 $\frac{1}{2}$	1	2 <sup>4</sup>	o	—
13 <sup>50</sup> „ 13 <sup>52</sup> -	2	1 <sup>o</sup>	2	Auroral light -	—	o	—	—	—
Total -	49	—	48	—	—	1	1 <sup>25</sup>	o	—
11 mo. 5: 6 <sup>10</sup> to 7 <sup>57</sup> -	14	'8	11 <sup>2</sup>	Slight twilight and gaslight.	6-6 $\frac{1}{2}$	o	o	—	—
8 <sup>3</sup> „ 11 <sup>30</sup> -	22	—	17	Thin cloud at times.	6 $\frac{1}{2}$ -7	1	3 <sup>5</sup>	o	—
17 <sup>53</sup> - - -	2	'2	'4	Twilight -	4 $\frac{1}{2}$	1	—	o	—
Total -	38	—	29	—	—	2	4 <sup>1</sup>	o	—
11 mo. 6: 6 <sup>40</sup> to 7 <sup>2</sup> -	10	'9	9	—	o	o	—	—	—
7 <sup>31</sup> „ 7 <sup>35</sup> -	4	'6	2 <sup>4</sup>	—	o	o	—	—	—
9 <sup>30</sup> „ 10 <sup>30</sup> -	11	'7	7 <sup>7</sup>	—	—	1	—	1 <sup>9</sup>	—
Total -	25	—	19	—	—	1	3 <sup>2</sup>	1	—

Time.	O.	Sky.	O'.	Hindrance.	Mag. Vis.	F.	R.	♂	♀
11 mo. 7: h m h m 7'25 to 7'40 -	8	*6	5	Gaslight -	6-6½	1	—	1	—
8'49 „ 9'5 -	14	1*	14	Partly gaslight	6½-7	0	—	—	—
10'0 „ 11'20 -	4	*5	2	—	—	0	—	—	—
Total -	26	—	21	—	—	1	2'9	1	—
11 mo. 8:									
7'30 to 9'39 -	14	—	7'6	Thin cloud -	6	2	7'5	1	—
9'39 „ 11'10 -	13	—	12'7	—	—	2	4'6	0	—
Total -	27	—	20	—	—	4	12	1	—
11 mo. 9:									
8'16 to 8'50 -	10	*5	5	—	—	0	—	—	—
10'25 - -	1	*6	1	—	—	0	—	—	—
Total -	11	—	6	—	—	0	0	0	—
Grand Total	180	—	146	—	—	9	3'7	3	—
At Ayton.									
11 mo. 13:									
8'34 to 8'43 -	9	*4	4	—	—	0	0	—	0
11 mo. 15:									
9'30 to 9'50 -	19	*7	13'3	—	—	0	—	—	—
10'0 „ 10'39 -	13	*9	11'7	—	—	0	—	—	—
10'45 „ 11'5 -	4	*8	3'2	—	—	1	—	—	0
Total -	36	—	28	—	—	1	2'1	—	0
Grand Total	45	—	32	—	—	1	1'9	—	0

*Explanation*.—This table shows the principal times of my watch in the recent Taurid and Leonid meteor periods. It is the same as those previously sent. ♂ denotes what I took at the time to be a Taurid, and ♀ a Leonid.

All the observations are at Sunderland, except 11 mo. 13, which was at Great Ayton, in Yorkshire.

### TAURIDS OF NOVEMBER 1893.

The true Taurids of November were exceedingly scarce this season, and during a number of watches only seven were seen at Bridgwater, and Mr. Backhouse recorded fewer still. This radiant, as usual, was at  $61^{\circ} + 21^{\circ}$ .

A large number of brilliant meteors, which are recorded in a special list, were, however, seen at about this time, and especially during the last week of October. These were from a number of different centres, in Cetus, Aries, and Musca, and probably in some years all these have been more or less confused with the Taurids proper, which, however, come a week or two later.

## ANDROMEDES, 1893.

One or two meteors which were directed from near  $\gamma$  Andromedæ in the last week of November may have belonged to this shower, but nothing else seems to have been seen of it this year.

## GEMINIDS, 1893.

Some evenings during this shower were very clear, but clouds generally came up later when meteors were becoming more abundant. The cold weather and the influenza epidemic also prevented much work at that time, and as the reports show that several other centres were active in Lynx and elsewhere, no very clear account can be given. Mr. Backhouse recorded 37 meteors, of which perhaps 23 were Geminids, including two very brilliant ones. Mr. Milligan was also watching, but considered the Lyncids from about  $120 + 40$  to be the chief shower.

Mr. Denning tried to arrange for a simultaneous watch between himself at Bristol, Prof. A. S. Herschel, at Slough, and H. Corder, at Bridgwater, but owing to the causes mentioned above very little came of it. Prof. Herschel was the most successful, and he also found a radiant in Lynx, and other meteors were from Castor and near Pollux, but the paths are so scattered that from the small numbers mapped it would not be safe to say exactly where the radiants were this season.

## WATCH FOR GEMINIDS, 1893.

Interval of Watch.	Minutes of Observation.	Area of clear sky.	Minutes of Observation corrected for Sky.	Hindrance to Visibility.	Magnitude of faintest Stars Visible.	Number of all Meteors seen.	Rate per Hour.	Number of Geminids seen.
<i>At Torquay.</i>								
12 mo. 6: h m h m 10°5 to 10°10	5	7	3.5	—	—	0	0	—
12 mo. 8:								
5°55 to 6°3	6	8	4.8	Partly thin cloud	6-7	0	0	—
6°55 „ 7°25	16	8	12.8	„	6-7	0	0	—
10°0 „ 10°8	8	8	6.4	—	—	0	0	—
Total	30	—	24	—	—	0	0	—
12 mo. 9:								
6°45 to 6°55	4	1*	4	Small area of sky visible.	—	1	15	0
7°26 „ 8°26	32	1*	32	—	—	2	3.7	0
9°35 „ 10°55	23	1*	23	—	—	3	7.8	3
11°27 „ 11°46	9	1*	9	—	—	1	6.7	—
Total	68	—	68	—	—	7	6.2	—



Interval of Watch.	Minutes of Observation.	Area of clear Sky.	Minutes of Observation corrected for Sky.	Hindrances to Visibility.	Magnitude of faintest Stars visible.	Number of all Meteors seen.	Rate per Hour.	Number of Gemini-ids seen.
<b>12 mo. 10:</b>								
h m h m 6 <sup>24</sup> to 7 <sup>52</sup> -	17	1'	17	—	—	0	0	—
17 <sup>6</sup> „ 17 <sup>48</sup> -	26	7, 1', 9	24	Auroral light	6 $\frac{1}{2}$	6	15 <sup>0</sup>	2
17 <sup>56</sup> „ 18 <sup>10</sup> -	4	9	2	Slight twilight	6 $\frac{1}{2}$ -6	0	0	—
Total -	47	—	43	—	—	6	8 <sup>4</sup>	—
<b>12 mo. 11:</b>								
5 <sup>45</sup> to 5 <sup>55</sup> -	5	9	4 <sup>5</sup>	—	—	0	0	—
8 <sup>11</sup> „ 9 <sup>26</sup> -	42	1	42	—	—	7	10 <sup>0</sup>	6
10 <sup>0</sup> „ 12 <sup>18</sup> -	20	1', 9	19	—	—	1	3 <sup>2</sup>	1
Total -	67	—	65 $\frac{1}{2}$	—	—	8	7 <sup>3</sup>	—
<i>At Sunderland.</i>								
<b>12 mo. 12:</b>								
8 <sup>52</sup> to 9 <sup>56</sup> -	24	5, 1'	22 <sup>5</sup>	Misty - - -	6 $\frac{1}{2}$	3	8 <sup>0</sup>	3
10 <sup>26</sup> „ 10 <sup>56</sup> -	12	1'	12	—	—	4	20 <sup>0</sup>	2
11 <sup>44</sup> „ 12 <sup>58</sup> -	24	1', 9, 4	21	—	—	6	17 <sup>1</sup>	4
Total -	60	—	55 $\frac{1}{2}$	—	—	13	14 <sup>1</sup>	—
<b>12 mo. 13:</b>								
9 <sup>30</sup> to 9 <sup>50</sup> -	19	9	17 <sup>1</sup>	—	—	3	10 <sup>6</sup>	1
9 <sup>59</sup> „ 14 $\frac{1}{2}$ -	9	5, 1'	6	—	—	0	0	—
18 <sup>20</sup> „ 18 <sup>35</sup> -	13	1'	13	Slight twilight	6 $\frac{1}{2}$ -6 $\frac{1}{2}$	0	0	—
Total -	41	—	36	—	—	3	5 <sup>0</sup>	—
<b>12 mo. 14:</b>								
7 <sup>30</sup> to 8 <sup>5</sup> -	14	1'	14	Slight moonlight, and partly thin cloud.	6-5 $\frac{1}{2}$	0	0	—
9 <sup>36</sup> „ 10 <sup>24</sup> -	17	—	17	Gaslight and partly thin cloud.	6 $\frac{1}{2}$ -5 $\frac{1}{2}$	0	0	—
Total -	31	—	31	—	—	0	0	—
<b>Grand Total</b>	<b>349</b>	<b>—</b>	<b>326<math>\frac{1}{2}</math></b>	<b>—</b>	<b>—</b>	<b>37</b>	<b>6<sup>8</sup></b>	<b>22</b>