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MATHEMATICAL, PHYSICAL AND CHEMICAL SCIENCES.

THE DISTRIBUTION OF

AEROLITES IN SPACE

By ARTHUR HARVEY

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[91]

VII.—The Distribution of Aerolites in Space.

By ARTHUR HARVEY.

(Read May 20, 1896.)

The periodicity of swarms of shooting stars is now generally admitted. The great fall of the 11th and 12th November, 1799, was described by Humboldt and Bonpland, who were in South America and found that a similar display had been seen on the same days, thirty-three years before. In 1831, 1832 and 1833, at the same period of the year, there was an abundance of these meteors, and Arago was induced to write, in 1835, that "there exists a zone composed of millions of small bodies whose orbit cuts "the plane of the ecliptic at about the point which our earth annually "occupies between the 11th and 13th of November. A new planetary-world "is beginning to be revealed." Olbers investigated the subject and found the period of revolution of these meteorites to be a little over thirty-three years, while the most numerous aggregation in the orbit was that through which the earth had passed in 1766, 1799 and 1832, and he predicted a fine display for 1866. A brilliant shower was noted on the 13th and 14th November of that year, especially in England, and we may reasonably expect another in 1899. We see some of this swarm every year, but its orbit is not packed with equal thickness in all parts, and the numbers therefore vary. Necessarily, however, they seem to come from the same radiant point in the heavens, and as this is near γ Leonis, they are called Many other swarms are now recognized as periodical, each Leonids. having its separate radiant and its special days, each as the Geminids from 6-12 December, the Lyrids from 20-26 April, the Perseids about the 10th of August.

It was perceived about thirty years ago that the orbit of the Leonids is closely related to that of Tempel's comet, seen in 1866. A swarm on November 27th has the same elements as Biela's comet. The Perseids' orbit agrees with that of the bright comet 1862 III. The new astronomy therefore holds that there is an intimate connection between comets and shooting stars, and it is thought that through some repulsive action, which is most violent near perihelion, the loosely aggregated materials of comets get scattered into a long trail, if not into a complete ring. The incandescence of these materials, by friction in our atmosphere, when the earth in its revolution swoops through their path, is thought to give rise to the phenomenon of shooting stars.

Professor Newton, of Yale, calculates at seven and a half millions the number that daily fall, and the same astronomer has made another in-

teresting calculation based on the Bielids observed at Beyrout, Marseilles, and Montcalieri, in 1885. The number seen was some 75,000 an hour, and during that display the earth travelled 100,000 miles. This then was a very rich part of that meteor-stream. Even there, the calculation goes on to prove, and it is easy to repeat and check it, the meteors were on an average 20 miles apart.

Shooting stars are, however, like others—many more can be seen with a telescope than without one—and it would in the present state of our knowledge be rash to fix a limit to their number, and though their bulk is very small, it is enough to form an important part of the material lying on the deep sea bottom, far from shore, and has been estimated to add 100 tons a day to the weight of the earth. The material found is a mere dust of iron oxide.

They do not differ from one another in size alone. Some move much more rapidly than others, some have longer or broader trails, some trails appear to last longer, and they differ in colour too. In short, with a little experience, one may tell an Andromede from a Perseid, Leonid or Lyrid, without reference to its radiant.

It may be here mentioned that the writer, availing himself of a Barton electric furnace, placed at his disposal, applied the intense heat of the electric arc to the surface of several kinds of minerals—chiefly quartz and spar containing particles of various metallic ores. They became incandescent in a flash; numerous fragments splintered off at a white heat, showing how trails are formed and how their colours vary, also how the "crust" on meteorites is formed. The wonder is how any meteors can reach the earth except as cosmic dust.

The present writer, observing shooting stars in 1893, was surprised to find Perseids in July, continuing well into September. In 1894 they were fairly abundant during the last week in July, while on their special day they were very sparse. A similar observation was being made at Pultava, and it stands to reason that the ring, if formed from the materials of comets, must be enormously diffuse. The tails of these bodies are seen to flicker-to emit streams in several directions. There must be successive emissions, perhaps several at each perihelion passage, and the planets affect them and cause a direct motion of their periheiia and of the perihelia of their swarm rings. If we were to reduce the orbits of the various Perseids we encounter to one set of co-ordinates and place the eye at the nodal region, we should see their paths, diverging like brushes of rays, to cover an enormous extent in space. Prof. Newton says the disintegrating force must be in the plane of the earth's orbit, but it seems to the writer that if it emanates from the sun, the earth does not at all control it-the materials would be thrown from the comet in the shape of a cone, whose apex is at the comet and whose base is enormously expanded. How full space now begins to seem; not an

empty void in which seven or eight planets pursue their solitary circlings, but a *plenum*, with numberless streams of matter circulating through it, each composed of countless bodies of all sizes. It takes the earth close upon two months to go through that part of its orbit crossed by the disintegrated particles of comet 1862 III.

These paragraphs lead to the proper consideration of the present inquiry—whether there is a periodicity among aerolites, and whether aerolites are connected with shooting stars and recognized comets. Many writers assume that bolides, aerolites and shooting stars are identical. The writer has come to believe that aerolites are not all the discards of comets, but rather small comets themselves. To arrive at a conclusion on this point, 357 have been classified according to the days they fell, and it would be difficult to distribute the supply more evenly throughout the months or the days of the year. January comes a little short, while May is unusually well supplied, but there seems no special reason for attaching weight to the differences, which are doubtless accidental. The whole list is appended, but the summary by months is sufficient to prove this statement:

January	24	May	42	September	31
February	2 8	June	31	October	28
March	28	July	26	November	29
April	29	August	29	December	32

Total...... 357

The next elassification made refers to the hours of their fall. This important detail is not given in half the cases, but we find for these

Between	6 a.m. and	6 p.m	127
"	6 p.m. and	l 6 a.m	37
		-	
			164

The reason for the difference is worth inquiring into, and it is to be hoped that the importance of the subject to the study of physical astronomy will cause more careful records to be kept of all nocturnal bolides as well as of diurnal aerolites.

It is evident that as a general rule aerolites which strike us in the day time are on their way from the sun—these which fall at night on their way to it. If they were flying directly to or from it, they would be most numerous at about noon or at about midnight, for at other hours, equal areas on the earth's surface are obliquely inclined to the sun and present a smaller target to such missiles. But they are affected by the attraction of the earth, and their paths become bent, generally so as to follow the earth in its course. Their velocity, we must remember, is enormous. A recent committee of the British Association reports that

"fire balls appear at a height of between 20 and 130 miles and have a "velocity of between 17 and 80 miles per second, averaging 34.4 miles per "second." The earth travels in its orbit 18.3 miles per second. Gravity, from the furthest confines of the sun's power, would only account for half the velocity of the average meteor, so their proper motion may be from 30 to 40 miles per second in some cases, while in others it may be much less. We should therefore expect that the following of the earth would be very noticeable—that most diurnal meteorites would fall in the afternoon and most nocturnal ones after midnight. We find the table confirm this reasoning for the day observations, not for the others, but the numbers tabulated are scarcely enough to form a fair average, even in the former case. The table is given to show how much there is yet to do, and the work, which is difficult at a provincial centre, is easier where works of reference are more accessible.

AEROLITES FALLING.

From	mie	dnight	to	1	a.m	ı	0	From	11	p.m.	to	midnight	1
"	1:	a.m.	"	2	"		0	45	10	"	"	11	1
"	2	"	"	3	"		3	"'	9	"	"	10	2
"	3	"	"	4	"		2	:4	8	"	"	9	8
"	4	::	"	5	"		0	"	7	44	65	8	5
66	5	"	"	6	"		7	"	6	"	"	7	8
"	6	"	"	7	"	•••••	5	"	5	".	••	6	11
"	7	"	"	8	"		7	"	4	"	"	5	18
"	8	"	"	9	"		7	" "	3	""	"	4	23
"	9	""	"	10	"'		7	"	2	"	"	3	6
"	10	"	"	11	"	•••••	8	"	1	"	"	2	11
""	11	"	no	on			8	"	noc	on	"	1	16

We may further arrange them thus :

Falling	from	midnight	to 6 a.m.	12
66	"	6 a.m.	to noon	42
"	"	noon	to 6 p.m.	85
"	61	6 p.m.	to midnight	25
1				
				64

164

There is but one case known to the author of a meteorite falling during a display of shooting stars, viz., a stone that fell at Mazapil, Mexico, during a shower of Bielids. This was perhaps a coincidence, and is so considered by Stanislas Meunier, of the Paris Museum d'Histoire Naturelle, in a paper sent to the Scientific Society of Chili, on Chili meteorites. It is of interest to note the analogy between recently observed comets and some aerolites. The comets the writer has obcerved seem

to have a nebulous glimmer surrounding a softly shining but fairly defined luminous cloud, in which a somewhat more brilliant nucleus or several nuclei may be seen. Telescopic stars can be seen through them. Photographic representations represent a bladder or bubble containing or inclosing something, with a bright glow about the nucleus and some wisps of light to form the trail. They may well be assemblages of meteoric stones flying in aswarm, which would not obstruct the view of the heavens beyond. Such may have been the aerolites which fell at L'Aigle, in Normandy, reported on by Biot, 1803. They appeared like a small rectangular cloud, and a vast number of stones weighing 10, 11 and even 17 lbs., fell to the ground,-two or three thousand of them, covering an elliptical area 71 miles long by 3 miles broad. Such was probably the aerolite of 1876, which was seen in Texas, Kansas, Missouri, Illinois, Indiana and Ohio, and is described as "a fireball surpassing the moon in " apparent size, followed by a great number of smaller meteors, certainly " 100 of them, many of which were larger than Venus or Jupiter." One fell and was found near Bloomington, O., others may have fallen too. but the majority sailed away across Lake Erie "like a flock of wild "geese, * * * moving with about the same velocity and grace of " regularity." Such were the thousands that fell at Winnebago, Minn., and very many others. These bodies were probably too small to be emi'ting light of themselves (such light in the case of visible comets being perhaps due to heat caused by the clashing of their parts in concentration or in frequent collisions) or if luminous, too small to attract the attention of a comet seeker, but they nevertheless seem to have been small comets, whose career of growth or of disintegration was suddenly cut short by collision with our planet.

A careful inspection of the table shows that in at least three cases two aerolites have fallen on the same day in places widely separated. Where they fall only a few miles apart, they may perhaps have been parts of one body, and the explosion may have caused the separation, also a change in the direction of flight, which the resistance of the air, acting on the changed shape of the missiles, may have increased. These reasons, however, do not account for such distances as between the two which fell on May 26th, 1826-one near Ajen in France, the other, near Ecaterineslaw in Russia-or the two of May 13th, 1895, one at Moestel Pank, Isle of Oesel, in the Baltic, the other at Gnarrenburg, Hanover. From the similarity of the analysis of some siderites that have been found in the United States, at considerable distances apart, Mr. G. F. Kunz has already inferred that they may have been parts of the same meteorite, which was broken up after entering the air. My table gives strength to that inference and leads much farther. When it is completed as to i e past and has received the additions of another generation, it will perhaps be seen that aerolites do not always fly in single file or in closely packed

clusters, but that there are doubles and triples and double clusters, too, among them as well as among the stars, their relatives.

Those which the little earth thus intercepts can, however, be both a small portion of the whole. All the other planets must receive their share, and the sun himself yet more. Perhaps almost all that are by the planets (which deflect without catching them) imprisoned within the solar system, must ultimately fall into the sun, as a boat is swallowed by a Those, however, which with a high initial velocity come into whirlpool. the sun's range and are not deflected by some planet, can have no resting place among our family of worlds. Like wandering Jews they can have no home, but must travel without ceasing. Whirling around or past the sun, they must move on and ever on, with retarded speed, in dim starlight and inconceivable cold, until they feel the incipient influence of another stellar mass. Then, like a canoe above Niagara, their rate of motion will increase, at first imperceptibly, but there can be no drawing back. Feeling the throb of a new life they must again be hurried on, and so thread their way from one star's vicinity to another, adding perhaps a nodule here or some dust elsewhere. Time fades into nothingness on such journeys. Light, at 187,000 miles a second, takes years to travel from star to star, and almost an infinity must be consumed by the meteors, much of whose swiftness is lost in the struggle to get away from this to other systems. Perchance, however, some of them may grow, increasing until they have mass enough to crush all their particles within themselves into coherence, when they would melt with the fervent heat evolved, and at some such stage become self-luminous and join the celestial family as stars, as some of the new splendours yet lying in the womb of Cosmos.

It is perhaps much to build so lofty a theory on a statistical table, which is as imperfect as the Carlisle tables of mortality, and, like them, needs to be extended over many years in many countries. Yet these figures lead directly to the inference, which is in line with other reasonings and observations, that aerolites are evenly distributed throughout space, that they move at various angles with the plane of the ecliptic, that the universe is a *plenum*, in which change and therefore growth and dissolution must be going on. And this, while adding another proof of the universality and unity of Law, does allow some privileges to one who is tempted to gild the hard prose of fact with the poetry of imagination.

_	January.	Place of Fall.	Hour.
1,	, 1869	Hessle 1ArnoSweden	12.30 p.m.
1,	1887	Biela Krymitchoe Russia	
2,	1825	ArezzoItaly	
3,	1877	Warrenton	
4,	1797	Bjelaya Zerkow	
7,	1856	I. of WightEngland	
8,	1834	Volhynia	9.30 a.m
10,	1622		
13,	1824	Rinalzo	8.30 n m
18,	1865	Supuhee ² GoruckpurIndia	0.00 p.m.
19,	1867	Khetrie	9.00 a.m.
20,	1891	Novara	0.00 0.111
21,	1887	DecewsvilleOntario	
23,	1814	Scholakoff	••••••
23,	1852	Nellore	1 90 n m
23,	1872	Yatour ³	4.00 p.m.
23,	1870	Nedagolla	•••••
23.	1877	Cyntheana 4 Ky II S A	4.00
25.	1845	La Pressoir Brance	4.00 p.m.
27.	1886	Nammianthal Madras I. 4	3.00 p.m.
28.	1883	St Canrais Girondo Dan	
20	1838	Kako Onde	2.45 p.m.
20, 90`	1980	Pultuel	• • • • • • • • • • • •
21	1998	Magaamhar	7.00 p.m.
)1,)1	1970	Mascomoes	•••••
,	10/9	La Becasse	•••••••

LIST OF AEROLITES, CLASSIFIED BY THE DATE OF THEIR FALL.

¹ Described by Nordenskield. Thousands fell-area not distinctly elliptical. Heaviest stones flew furthest.

² In the Paris Catalogue this is given as 23rd May, 1865.

³ This may be a misprint both in the name and year of fall and is omitted in the summary.

⁴ No common interval exists between any of these of the 23rd January, and none have been seen since 1877. The presumption therefore is against periodicity and in favour of coincidence. The date is worth examining further. The material of each is different, viz. : Scholakoff is Lucéite; Nellore is Bellajite; Nedagolla is Burlingtonite : Cyntheana is Parnallite.

⁵ Summarised as 24.

LIST OF AEROLITES, CLASSIFIED BY THE DATE OF THEIR FALL.

February.	Place of Fall.	Hour.
2, 1785	Witness	• • • • • • • • • • •
3, 1860	AlexandriaItaly	11.45 a.m.
3, 1882	Mocs Austria-Hungary	•••••
4, 1871	Koniska ¹ MinnU.S.A	•••••
6, 1818	SwaffhamEngland	•••••
19, 1825	Nanjemoy	12.00 m.
10, 1853	Girgenti Sicily Italy	1.00 p.m.
10, 1874	EsthervilleU. S. A	
12, 1875	lowa Co " " "	10.15 p.m.
13, 1839	Little Piney	3.30 p.m.
14. 1861	Tocane St. Apre France	•••••
14, 1873	New Haven ² ConnU. S. A	
15, 1848	DhawarIndia	
16, 1883	AlfanelloBresciaItaly	3.00 p.m.
16, 1827	MhowIndia	3.00 p.m.
16, 1876	JudesgherryMysore	
18, 1815	Durala "	12.00 m.
18, 1815	Bachmut	
18, 1824	Timoschin	
I8, 1880	TajimaJapan	5.30 a.m.
19, 1796	³	
19, 1884	Pirthalla	
19, 1785	Eichstadt	•
24, 1886	Assisi	
25. 1841	Chanteloup	
25. 1847	Linn Co Iowa. II. S. A	
28, 1857	Parnallee	12 00 m
29, 1868	Motta di Conti Piedmont Itely	11.00 a.m.
	and a construction for the second sec	11.00 a.m.

¹ Heard and seen-not found.

² Group seen near Venus—not heard or found.
 ³ A huge fireball seen all over Spain and Portugal—not found.

⁴ Two on 18th, 1815, may be parts of one fall.

LIST OF AEROLITES, CLASSIFIED BY THE DATE OF THEIR FALL.

	March.	Place of Fall.	Hour.
~			
4,	1875	Sitathali India	• • • • • • • • • • • • •
6,	1853	Seegowlee	•••••
8,	1798	Villefranche ¹ France	6.00 p.m.
12,	1811	PoltavaRussia	11.00 a.m.
12,	1891	CompiègneFrance	• • • • • • • • • • • • •
13,	1859	Aix "	
14,	1881	Penn's Siding Middleboro England	3.30 p.m.
15,	1806	Alais	5.00 p.m.
16,	1853	2	
16,	1863	PulsoraIndoreIndia	
18,	1877	WenerSweden	
19,	1718	³ England	
19,	1882	FukutomiJapan	1.00 p.m.
19,	1884	Djati Pengilon Java	
20,	1868	Daniel's Kuill Griqualand Africa	
21,	1676	4Italy.	
22,	1841	GrunebergSilesia	3.30 p.m.
22,	1846	Bagnere de Luchon France	oreo prim
24,	1857	StavropolCaucasus Bussia	500 n m
25,	1807	Timoschin ⁵	0.00 p.m.
25,	1843	Bishcoville	• • • • • • • • • • • •
26,	1865	Vernon Co Wisconsin "	0.00 n m
27.	1886	Cedar Creek Arkansas "	2.00 p.m.
28.	1859.	Harrison Co Indiana "	a.oo p.m.
28	1860	Rhurtnur T-22-	4.00 p.m.
30	1818	Zabongway Vollamia D	•••••
30,	1988	St Maamla Auka T	• • • • • • • • • •
90,	1975	St. Mesmin Aube France	• • • • • • • • • • •
	1010	Zsadany	•••••
60			

¹ Dated the 12th in Meunier's catalogue.

² Great fire ball seen all over Western Europe.

³ A huge fire ball seen throughout England.

⁴ Seen everywhere in N. Italy.

⁵ Possibly some misprint. See previous date, February 18th, 1824.

LIST OF AEROLITES, CLASSIFIED BY THE DATE OF THEIR FALL.

April.	Place of Fall.	Hour.
1, 1857	San JoséCosta Rica	••••••
2, 1882	Paulofka SaratovRussia	• • • • • • • • • • • •
4, 1859	Mexico Luzon Phillipine Ids	
5, 1804	Possil GlasgowScotland,	
6, 1805	DoroninskSiberiaRussia	5.00 p.m.
6, 1885	ChandpurIndia	
7, 1887	LalitpurNyagong "	
9, 1628	England	•••••
9, 1844	Killeter	
10, 1802	ToulouseFrance	· · · · • • • • • • • • • • • • • • • •
10. 1818		
11, 1715	SchellinPrussiaGermany	4.00 p.m.
12, 1812	ToulouseFrance	1.30 p.m.
12, 1864	Nerft	4.45 a.m.
15, 1812	ErzlebenPrussiaGermany	4.00 p.m.
15, 1857	Kaba Austria-Hungary	10.30 p.m.
17, 1621	Lahore India	
17, 1851	Güttersloh PrussiaGermany	8.00 p.m.
18, 1838	AkburpurIndia	
18, 1895	Niagara Falls 1 New York U.S.A	2.00 a.m.
19, 1808	Borgo S. Donino Parma Italy	12.00 nı.
20, 1876	RowtonShropshireEngland	3.15 p.m.
24, 1875	NageriaIndia	
26, 1803	L'Aigle Normandy France	1.00 p.m.
26, 1842	Pusinsko-SeloCroatia Austria-Hungary	3.00 p.m.
27. 1840	Karakol ² Russia	12.00 m.
29, 1877	LuleaSweden	3.30 p.m.
29, 1844	Killeter ³ Tyrone Ireland	
30, 1873	RomeItaly	
29		

¹ Lighted up the whole sky. Not seen to fall. ² Given elsewhere as of 9th May, 1880. Perhaps difference between old style and new style accounts for difference.

³ Possibly wrong, see April 9th, supra-

LIST OF AEROLITES, CLASSIFIED BY THE DATE OF THEIR FALL.

	lay.	Place of Fall.	Hour.
1,	1860	New ConcordOhioU.S.A	12,45 p.m*
2,	1890	WinnebagoIowa "	
5,	1869	KrähenbergBavariaGermany	6.30 p.m.
7.	1618	ParisFrance	
8,	1829	Forsyth	3.30 p.m.
8.	1846	Monte Milone	9.30 a.m.
8.	1872	Dyalpur	
9.	1827	Nashville	4.00 p.m.
10.	1879	Estherville	5.00 p.m.
11.	1874	Sevrukoro ¹ KourskRussia	11.45 p.m.
12.	1861	-Gootka	
12.	1855	Moestel Pank ² I. of OeselRussia	3 30 p.m.
12.	1855	Gnarrenburg Hanover	5.00 p.m.
13.	1861	Poitiers' France	oroo prim
14	1861	Canellas	1.00 n m
14,	1864	Oroneil	800 p.m.
14,	1874	Nash Co N Carolina U S A	2.30 p.m.
15	1874	Harbour Grace 3 Newfoundland	2.00 p.m.
17	1074	Ponth Sectiond	* * * * * * * * * * * *
17	1955	Igust Livonia Russia	•••••
17,	1000	Hougon Hosso Commany	•••••
17,	1970	Gradanfrai Silasia "	••••••
10	10/9	London 4 England	1.00 m m
10,	1000	Colonian 5 Aion France	4.00 p.m.
19,	1820	Baulagrand Restaringslam Durate	••••••
19,	1020	Faulograd	0.00
19,	1808	NekovaAustria-Hungary	8.00 a.m.
20,	1848		4.15 a.m.
20,	18/4	Virba	• • • • • • • • • • • • •
20,	1884	Tysne	
21,	1871	Searsmont ^o Maine U. S. A	8.15 a.m.
21,	1808	Stannern Moravia Austria	6.00 a.m.
21,	1867	Sommer Co U. S. A	
21,	1868	SloaveticAgramAustria-Hungary	10.30 a.m.
22,	1869	Kernouve	10.00 p.m.
23,	1865	GopalpurJessoreIndia	6.00 p.m.
23,	1869	Clarac	
24,	1892	Cross RoadsN. CarolinaU. S. A	5.00 a.m.
26,	1751	Hradshina Croatia Austria-Hungary	6.00 p.n.
26,	1893	Beaver Creek B. Columbia Canada	
27,	1866	Pokra BusteeIndia	
30,	1866	St. Mesmin 7 Troyes France	
30,	1887	Powder Mill Creek Tennessee U. S. A	· · · · · · · · · · · · · · · · · · ·
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42

¹ Given by Meunier as of the 12th May, 1875.

² Probably connected with the same group as the next.

³ Seen and heard-not found. ⁴ Seen-not found.

⁵ Probably the same fall or collection as the next.

⁶ Given by Meunier as at 31st inst.

⁷ Probably the same as given at 30th March.

LAST OF AEROLITES, CLASSIFIED BY THE DATE OF THEIR FALL.

2, 1843. Utrecht Holland. 8.00 p. 2, 1863. Scheikahr StattenCourland Russia. 7.30 a. 3, 1822. Angers 1 France 8.30 p. 4, 1828. Richmond Virginia. U.S. A 8.30 a. 4, 1828. Richmond Virginia. U.S. A 8.30 a. 4, 1842. Aumières France		June.	Place of Fall.	Hour.
2, 1863. Scheikahr StattenCourland Russia	. 2	1843	Utrecht Holland.	8.00 p.m.
3, 1822	-,	1863	Scheikahr Statten Courland Russia	7.30 a.m.
4, 1828 Richmond Virginia U. S. A 8.30 a. 4, 1842 Aumières. France 6.1838 Chandakapur India 12.00 n 7, 1855 St. Denis Westrem Belgium 7.45 p. 7.45 p. 7, 1876 Vavilovka Cherson Russia 7.45 p. 9, 1896 Knyahinya Austria-Hungary 5.00 p. 9, 1867 Tadjera Sétif Algiers 10.30 p 11, 1878 La Charea Mexico 11.30 a 12, 1840 Uden Brabant Holland 10.30 p. 13, 1850 Kegen Japan dawn. 13, 1850 Kegen Japan dawn. 15, 1821 Juvinas France 3.30 p. 16, 1794 Siena Italy 7.00 p. 19, 1688 Veroua Italy 10.00 a. 19, 1688 Veroua Italy 10.00 a. 19, 1688 Veroua Italy 10.00 p. 19, 1688 Veroua Italy 10.00 p.	-,	1892	Angers 1 France	8 30 n m.
4, 1842 Aumières. France 6, 1838 Chandakapur India 12.00 n 7, 1855 St. Denis Westrem. Belgium 7.45 p. 7, 1876 Vavilovka Cherson Russia 7.45 p. 9, 1896 Knyahinya Austria-Hungary 5.00 p. 9, 1867 Tadjera Sétif Algiers 10.30 p 11, 1878 La Charca Mexico 11.30 a 12, 1840 Uden Brabant Holland 10.30 a 12, 1840 Uden Brabant Holland 10.30 a 12, 1840 Uden Brabant Holland 10.30 a 12, 1841 Chatcau Renard France 1.30 p. 13, 1850 Seint-Onge " 6.00 a./ 13, 1850 Kegen Japan dawn. 15, 1821 Juvinas France 3.30 p. 16, 1794 Siena Italy 7.00 p. 16, 1860 Kasculi India 5.00 a./ 17, 1870 Ibbenbühren Prussia Germany	4	1828	Bichmond Virginia USA	8 30 a m.
a. 1012 Humeren 12.00 m 6, 1838 Chandakapur India 12.00 m 7, 1855 St. Denis Westrem Belgium 7.45 p. 7, 1876 Vavilovka Cherson Russia 7.45 p. 9, 1896 Knyahinya Austria-Hungary 5.00 p. 9, 1867 Tadjera Sétif Algiers 10.30 p 11, 1878 La Charca Mexico 11.30 a 12, 1840 Uden Brabant Holland 10.30 a 12, 1840 Uden Brabant Holland 10.30 a 12, 1840 Uden Brabant Holland 10.30 a 12, 1841 Chateau Renard France 1.30 p. 13, 1819 Saint-Onge " 6.00 a./ 13, 1850 Kegen Japan dawn. 15, 1821 Juvinas France 3.30 p. 16, 1794 Siena Italy 7.00 p. 16, 1860 Kaseuli India 5.00 a./ 17, 1870 Ibbenbühren Prussia Germany 2.00 p.	т, 4	1849	Aumières France	0.00 4.111
7, 1855 St. Denis Westrem	-, 6	1838	Chandakanur India	12.00 m
7, 1830	7	1855	St Danis Westrom Belgium	7.45 n m
9, 1890	•, 7	1976	Vavilavka Chargon Bussia	7.40 p.m.
9. 1867 Tadjera	·,	1010	Vaviovka	5 00 m m
11. 1878. La Charca Mexico 11.30 a 12. 1840 Uden Brabant Holland 10.30 a 12. 1840 Uden Brabant Holland 10.30 a 12. 1840 Uden Brabant Holland 10.30 a 12. 1841 Charnsallas Delhi India 8.00 a. 12. 1841 Chateau Renard. France 1.30 p. 13. 1819 Saint-Onge " 6.00 a. 13. 1850 Kegen Japan dawn. 15. 1821 Juvinas France 3.30 p. 16. 1794 Siena Italy 7.00 p. 16. 1860 Kasculi India 5.00 a. 17. 1870 Ibbenbühren Prussia Germany 2.00 p. 19. 1688 Verona Italy 22. 1723 Ploschkowitz Bohemia Austria 25. 1876 Kansas City Missouri U. S. A<	9,	1090	Knyaninya Austria-Hungary	5.00 p.m.
11, 1878 La Charca	Ч.	1807	Tadjera	10.30 p.m.
12, 1840 Uden Brabant Holland 10.30 a 12, 1834 Charnsallas Delhi India 8.00 a. 12, 1834 Chateau Renard. France 1.30 p. 13, 1810 Saint-Onge " 6.00 a. 13, 1850 Kegen Japan dawn. 15, 1821 Juvinas France 3.30 p. 16, 1794 Siena Italy 7.00 p. 16, 1860 Kasculi India 5.00 a. 17, 1870 Ibbenbühren Prussia Germany 2.00 p. 19, 1688 Verona Italy 22, 1723 Ploschkowitz Bohemia Austria 25, 1876 Kansas City Missouri U. S. A 25, 1880 Farmington Kansas " 12.55 p 26, 1864 Dolgowla Volhynia Russia 7.00 a. 28, 1861 Mikenskoi 2 Caueasus " 7.00 a. 28, 1872 Tennasilm Esthonia " 12.00 m <td>11,</td> <td>18/8</td> <td>La Charca</td> <td>11.30 a.m.</td>	11,	18/8	La Charca	11.30 a.m.
12, 1834 Charnsallas	12,	1840	UdenBrabantHolland	10.30 a.m.
12, 1841 Chateau Renard	12,	1834	CharnsallasDelhiIndia	8.00 a.m.
13, 1819. Saint-Onge " 6.00 a.1 13, 1850. Kegen Japan dawn. 15, 1821. Juvinas France 3.30 p. 16, 1794. Siena Italy 7.00 p. 16, 1860 Kasculi India 5.00 a. 17, 1870. Ibbenbühren Prussia Germany 2.00 p. 19, 1688. Verona Italy 2.00 p. 10 19, 1876. Vavilovka Kherson Russia 10 22, 1723. Ploschkowitz Bohemia Austria 10 25, 1876. Kansas City Missouri U. S. A 12.55 p 26, 1864. Dolgowla Volhynia Russia 7.00 a. 28, 1872. Tennasilm Esthonia " 12.00 m 28, 1876. Ställdalen Sweden 11.30 a 20, 1843. Mannegaum India	12,	1841	Chateau RenardFrance France	1.30 p.m.
13, 1850 Kegen	13,	1819	Saint-Onge "	6.00 a.m.
15, 1821 Juvinas	13,	1850	KegenJapan	dawn.
16, 1794 Siena	15,	1821	JuvinasFrance	3.30 p.m.
16, 1860 Kasculi India 5.00 a. 17, 1870 Ibbenbühren Prussia Germany 2.00 p. 19, 1688 Verona Italy	16,	1794	SienaItaly	7.00 p.m.
17, 1870. IbbenbührenPrussia Germany 2.00 p. 19, 1688. Verona Italy 19 19, 1876. Vavilovka Kherson Russia 19 22, 1723. Ploschkowitz Bohemia Austria 11 25, 1876. Kąnsas City Missouri U. S. A 12.55 p 26, 1864. Dolgowła Vołnynia Russia 7.00 a. 28, 1861. Mikenskoi ² Caucasus " 12.00 n 28, 1872. Tennasilm Esthonia " 12.00 n 29, 1843. Mannegaum. India " 130 a	16,	1860	KaseuliIndia	5.00 a.m.
19, 1688. Verona Italy Italy 19, 1876. Vavilovka Kherson Russia 22, 1723. Ploschkowitz Bohemia Austria 25, 1876. Kąnsas City Missouri U. S. A 25, 1890. Farmington Kansas " 12.55 p 26, 1864. Dolgowla Volhynia Russia 7.00 a 28, 1861. Mikenskoi ² Caueasus " 12.00 n 28, 1876. Ställdalen Sweden 11.30 a 20, 1843. Mannegaum India	17,	1870	IbbenbührenPrussiaGermany	2.00 p.m.
19, 1876 VavilovkaKhersonRussia	19,	1688	Verona Italy	
22, 1723. Ploschkowitz. Bohemia Austria.	19,	1876	VavilovkaKhersonRussia	
25, 1876 Kansas CityMissouri U. S. A 12.55 p 25, 1890 Farmington Kansas " 12.55 p 26, 1864 Dolgowla Volhynia Russia 7.00 a 28, 1861 Mikenskoi ² Caucasus " 7.00 p 28, 1872 Tennasilm Esthonia " 12.00 n 28, 1876 Ställdalen Sweden 11.30 a 20, 1843 Mannegaum India	22,	1723	PloschkowitzBohemiaAustria	
25, 1890 Farmington Kansas " 12.55 p 26, 1864 Dolgowla Volhynia Russia 7.00 a. 28, 1861 Mikenskoi ² Caucasus " 7.00 p. 28, 1872 Tennasilm Esthonia " 12.00 n 28, 1876 Ställdalen Sweden 11.30 a 20, 1843 Mannegaum India	25,	1876	Kansas City Missouri	
26, 1864 DolgowłaVolhynia Russia. 7.00 a. 28, 1861 Mikenskoi ² Caucasus	25,	1890	Farmington	12.55 p.m.
28, 1861 Mikenskoi ² Caucasus	26,	1864	Dolgowla	7.00 a.m.
28, 1872 TennasilmEsthonia	28,	1861	Mikenskoi ² Caucasus	7.00 n.m.
28, 1876 Ställdalen Sweden 11.30 a 20, 1843 Mannegaum India	28.	1872	Tennasilm	12.00 m.
20, 1843 Mannegaum India	28.	1876.	Ställdalen	11.30 a.m
	20	1843.	Mannegaum. India	
30 1886 Argonting	30	1886	Nagava Conception	
			Augusta conception	

¹ Some authority gives this on the 9th ; Meunier gives the 2nd June.
² Also reported from Grosnaya on 16th. Difference between old and new style ?

LIST OF AEROLITES, CLASSIFIED BY THE DATE OF THEIR FALL.

	July.	Place of Fall.	Hour.
3,	1753	Krawin	. 8.00 p.m.
4,	1842	LogronoSpain	
4,	1848	Marmanda France	
5,	1825	Torrecillos de Campo	
7,	1855	St. Denis Westren (a)Belgium	
8,	1811	Berlanguillas	. 8.00 p.m.
8,	1874	Franklin Co	•
11,	1868	Ornans	
12,	1820	LasdanyRussia	5.30 p.m.
14,	1845	La Vivionnère Manche France	3.00 n.m.
14,	1847	Brannau	3.45 a.m.
14,	1860	Dhurmsala India	2.30 n.m.
15,	1878	Tieschietz Moravia Austria	1.45 n m
16,	1771	France 1	p
17,	1840	CeresetoPiedmont Italy	7.30 a.m.
18,	1831	VoulléFrance	
18,	1889	Ferguson	6.00 p.m.
19,	1894	Boiœ ² Greece	oroto prim
20,	1860		
22,	1838	MontlivaultFrance	
23,	1872	Lancé	5 30 n m
14,	1790	Barbotan	9.00 p.m.
24,	1837	Gross Divina Austria-Hungary	11 30 a m
7,	1894	Lick Observatory 4. California U.S. A	11.00 0.11
1,	1708	Sherness	
1.	1859	Montpreis	
c			

(a) Given as 7th June by Meunier.
 ¹ A fire ball seen over a large part of France.

² Seen and heard, not found.

³ Seen over New York and the Central States.

⁴ Seen, heard, figured and described, not found.

LIST OF AEROLITES, CLASSIFIED BY THE DATE OF THEL. FALL.

August.	Place of Fall.	Hour.
1, 1835	Charlotte	
1, 1879	NagayaArgentina	
1, 1862	MorlansFrance	
2, 1882	Paulovka	4.30 p.m.
4, 1835	Cirencester England	4.30 p.m.
5, 1812	Chantonnay Vendée France	2.00 a.m.
5, 1856	OviedoSpain	•••••••••••
5, 1855	Petersburg	3.30 p.m.
7, 1823	Nobleboro'	4.30 p.m.
7, 1822	RadanahAgraIndia	
8, 1863	Pillitsfer LivoniaRussia	12.30 p.m.
10, 1818	Smolensk "	
10, 1863	Putney 1 England	
10, 1885	Grozae	· · · · · · · · · · · · ·
11, 1859	Bethlehem	
11, 1863	Shytal	
12, 1865	Dundrum Ireland	7.00 p.m.
13, 1852	Sidmouth	· · · · , · · · · · · ·
14, 1829	Deal	11.30 p.m.
14, 1846	Cape GirardeauMissouri	3.00 p.m.
16, 1875	Feid-chair La Calle Algeria	12.00 m.
18, 1783		
18, 1870	Cahezzo de MayoMurciaSpain	
20, 1894	PhalerumGreece	
25, 1865	UmjhiawarBeharIndia	9.00 a.m.
26, 1865	AumaleAlgeria	11.00 a.m.
29, 1892	Bath	4.00 p.m.
30, 1887	Taborg	
3I, 1892	OrvinioRoneItaly	5.15 a.m.
29		
1		

¹ Seen-not found.

² Throughout northwestern Europe-1,000 miles of a course.

LIST OF AEROLITES, CLASSIFIED BY THE DATE OF THEIR FALL.

September	Place of Fall.	Hour.
3, 1808	Lizza	3.30 p.m.
4, 1852	Mezö Madares Transylvania " "	4.30 p.m.
4, 1857	Krasnoslobodsk	
5, 1814	AgenFrance	12.00 m.
ə, 1854	Lenum	
5, 1878	Dandapur GorukpurIndia	n • • • • • • • • • •
7, 1753	Liponas ¹ AinFrance.	1.00 p.m.
7, 1865	MuddoorIndia	
8, 1868	Sanguis St. Etienne.B. Pyrenées France	2.30 a.m.
9, 1829	Krasnoj UgalRussia	2.00 p.ni.
9, 1831	Znorow	3.30 p.m.
10, 1813	Limerick Ireland	6.00 a.m.
10, 1825	LiancourtFrance	
13, 1768	Lucé	4.30 p.m.
13, 1822	La Baffe, EpinalVosges "	7.00 a.m.
13, 1858	Renne "	
14, 1511	CremaItaly	
14, 1825	Honolulu Sandwich Ids	10.30 a.m.
15, 1814	EkaterineslawRussia	12.00 m.
16, 1843	KleinwardenPrussiaGermany	4.30 p.m.
19, 1869	TjabéJava	9.00 p.m.
20, 1676	England ²	
21, 1885	MuddoorMysoreIndia	7.00 a.m.
22, 1887	Phu-HongBinkchankCochin China	
22, 1851	London England	
22, 1873	Nowo Urei ³ Penza Russia	
22, 1893	Zabrodje	
23, 1873	Khaipur	
24, 1864	Mont de MarsanFrance	
26, 1873	Santa BarbaraBrazil	
26, 1885	Washington Co ⁴ Pennsylvania U. S. A	
31		

¹ Given by Meunier as of the 8th.

² Seen throughout the midland counties.

³ This is the aerolite in which diamonds were found.

⁴ Heard and seen, not found.

Sec. III., 1896. 8.

LIST OF AEROLITES, CLASSIFIED BY THE DATE OF THEIR FALL.

(October.	Place of Fall.	Hour.
1.	1868	Lodran	
3,	1815	ChassignyFrance	8.00 a.m.
3,	1819	Politz Gera Reuss Germany	
3,	1865	MoffatScotland	••••••
13,	1883	NgaweJava	
4,	1857	Des Ormes ¹	
5,	1852	NamurBelgium	
5,	1866	JamkeirAhmednuggurIndia	
6,	1827	BialystockPoland	9.30 a.m.
6,	1869	LumpkinGeorgiaU. S. A	11.45 a.m.
7,	1861	Klein Menow MecklenburgGermany	1.30 p.m.
8,	1803	Saurette	10.00 a.m.
10,	1857	Ohaba	12 m.
13,	1838	Tulbagh	9.00 a.m
13,	1787	KharkovRussia	3.00 p.m.
13,	1819	PolitzGermany	8.00 a.m.
13,	1852	Burkut	3.00 p.m.
13,	1877	Sarbanovic ² Servia	2.00 p.m.
14,	1824	ZabrukBohemiaAustria-Hungary	8.00 a.m.
18,	1954	TobergGermany	
19,	1863	Athens ³ Greece	
21,	1844	FavarsFrance	6.45 a.m.
21,	1876	RochesterU. S. A	8.45 p.m.
25,	1859	England 4	
29,		PresignéFrance	
30,	1883	NgawieJava	
31,	1872	OrvinioRomeItaly	
31,	1849	Monroe N. Carolina U. S. A	. 3.00 p.m.
28			

¹ Meunier gives this date, elsewhere stated as the 1st. ² Meunier gives same date in 1872.

³ Am. Journ. of Science gives 18th.

⁴ Seen over all England.

LIST OF AEROLITES, CLASSIFIED BY THE DATE OF THEIR FALL.

November.	Place of Fall.	Hour.
		10
2, 1836	Maceo ¹ R. del NorteBrazil	•••••
4, 1879	Kalumba Salhara India	• • • • • • • • • • • •
5, 1851	Nulles	5.30 p.m.
8, 1878	Rakafka	
10, 1886	MalmeJapan	5.00 a.m.
12, 1856	Trenzana Lombardy Italy	4.00 p.m.
12, 1843	VerkneTschirskayaRussia	
13, 1835	Belmont France	
14, 1825	Leith Scotland	
15, 1860	Denisville,N. JerseyU. S. A	• • • • • • • • • • • • • •
16, 1492	EnsisheimAlsaceGermany	. 12.30 p.m.
17, 1887	Ireland ²	• • • • • • • • • • • • • • • • • • • •
17, 1793	GiginaSpain	. 12.30 a.m.
19, 1881	Gross Lieben ThalOdessaRussia	. 6.30 a.m.
19, 1856	TrenzanoBresciaItaly	
20, 1768	MauerkirchenBavariaGermany	. 4.00 p.m.
23, 1810	CharsonvilleFrance	. 1.30 p.m.
24, 1804	St. Louis PotosiMexico	• • • • • • • • • • • • • • • • • • • •
25, 1833	Brünn Moravia Austria-Hungar	y 6.30 p.m.
25, 1857	Blanko " " "	
26, 1758	Scotland ³	• • • • • • • • • • • • • • • • • • • •
26, 1846	SchönenbergBavaria Germany	. 2.45 p.m.
26, 1874	KerilisCotes du Nord France	10.30 a.m.
27, 1627	Mont Vaisins "	•••
27, 1824	PragueBohemia	
27, 1868	DanvilleAlabamaU.S. A	5.00 a.m.
27, 1885	. DhuliaKandeishIndia	6.00 p.m.
30, 1822	. Allahabad "	6.00 p.m.
30, 1850	. Shalka Bengal "	4.30 p.m.
29	· · · · · ·	

¹ Given as the 8th in one account.

² The whole of Ireland.

³ All the North of Scotland.

LIST OF AEROLITES, CLASSIFIED BY THE DATE OF THEIR FALL.

December.	Place of Fall.	Hour.
1, 1825,	Berlin Prussia	
2. 1852	Bustee ¹ India	
5, 1842	Epinal	
5, 1863	East of England and Scotland	
5, 1868	Frankfort	
u, 1866	Cangas de OnisSantanderSpain	
7, 1863	Touraine la Grosse Louvain Belgium	11.00 a.m.
ō, 1861	Midland Counties	
8, 1863	London" "	
9. 1858	Montrejeau	7.30 a.m.
10, 1863	Inly	
10, 1871	Bandong. Java	1.30 p.m.
11, 1741	LondonEngland	
11, 1864	Putney Lodge "	
12, 1872	Louisville Kentucky	
13, 1795	Wold Cottage England	3.30 p.m.
13, 1798	Krahnt	8.00 p.m.
13, 1813	Luotolaks	
13, 1803	St. NicholasBavariaGermany	10.30 a.m.
13, 1852	BorkutAnstria Hungary	
13, 1863	PutneyEngland	
14, 1807	Weston Connecticut U. S. A	6,30 a.m.
17. 1852	DoverEngland	
17, 1863	Newcastle-on-Tyne "	
19. 1798	BenaresIndia	
21, 1876	Rochester ² Indiana	• • • • • • • • • • • •
22, 1863	MamboomBengalIndia	9.00 a.m.
22, 1868	Motecka Nugla Bhurtpur "	
24, 1858	MolinaMurciaSpain	
25, 1869	MoursoukArabia	
27, 1848	SchieNorway	
27, 1853	The Channel England	
27, 1857	Queng Yonk	2.30 a.m.
32 3		

¹ A white meteorite with pink grains.

² Given at this date in *October* in Harvard catalogue. This is Meunier's date. ³ Rochester meteor, 21st not included; it was counted in October.

