The Great Meteor of 18th August 1783

Martin Beech

Bright meteors are rare and spectacular events. Here I examine accounts of and reactions to one of the most spectacular ever seen: the great meteor of August 1783.

Introduction

Imagine the scene: The date is Monday, August 18th, 1783. It is a warm and pleasant summer's evening just past nine o'clock. On the north-east terrace of Windsor Castle can be seen a group of six people, four gentlemen and two lady companions. Their early evening has been spent in pleasant conversation and the weather being fine a stroll on the terrace is both welcome and calming. As far as the eye can see the ground stretches away from the castle in grass land and well ordered lines of trees. The sky is clear and serene, excepting a ring of clouds and haze that stretches around the horizon. The six friends are admiring the tranquil view and enjoying the quietude when with a sudden drawing in of awareness their eyes are attracted towards the north western horizon. In this northern quarter a flashing, lambent light has appeared, nearly half-as-large as a full moon. It hangs almost stationary at first. This bluish coloured apparition gradually increases in brightness and now with perceivable motion flies parallel to the horizon heading towards the east. As it moves eastward the ball of brilliant light, now casting strong and startling shadows, transforms itself into a drawn out band of many smaller bodies, forming a precession of fiery globes trailing a brighter leading nucleus. No sound is heard as this flaming brand streaks towards its ultimate extinction in the south eastern quarter of the heavens. For some thirty seconds, slightly less perhaps, this shining meteor leaves our six companions enthralled and dumb-struck, such a sight they have never witnessed before. On recovering their wits the conversation is excited, the company after all has been fortunate enough to behold one of nature's most remarkable of sights: the *Draco Volans* or flying dragon, in modern less romantic terms, a brilliant fire-ball or bolide.

The Great Meteor of August 1783

The account given in the introduction above is a somewhat fanciful attempt at recreating the events of August 18th, 1783 as seen by a group of six companions from Windsor Castle. The account is based on that given by Tiberius Cavallo, one of the six companions on the terrace.[1] While it is not clear why this company happened to be at Windsor on that day, it is certain that between 9.15 and 9.30 of that night a very bright meteor, having entered the Earth's atmosphere over the open waters of the North Sea, passed along the whole eastern coast of Scotland and England. Travelling still further over the English Channel it eventually dissipated somewhere over south-western France, or as some reports would suggest, Northern Italy! Covering a distance of at least a thousand miles this rare meteoric phenomenon ranks among the brightest and most spectacular of such objects ever recorded. Bright meteors are of general interest, but this meteor is particularly interesting to the historian of science for at least two reasons. First, its appearance prompted a detailed investigation by Charles Blagden (1748–1820).[2] This investigation is particularly interesting because of the conclusions he draws and because it offers some insight to the meteoric phenomenon as it was then understood. The second reason why this meteor is of interest is because of the etchings, engravings and water colour pictures that were produced of it. These pictures being the first detailed and generally accurate representations of such a phenomenon.

As one can imagine, such a spectacular event as this meteor, occurring as it did at a time when many people in Scotland and England were awake and active, would lead to many and varied eye-witness accounts and observations. Indeed, a series of such reports appeared in Volume 74 (1784) of the *Philosophical Transactions of the Royal Society*.

Blagden assembled many of the detailed eye-witness accounts of the meteor but surprisingly made no attempt to publish a map showing the meteor's path. We try to do this below. Table 1 shows some of the more reliable accounts of where the meteor was and what it was doing. From this data we have drawn the meteor's path through the British Isles in Figure 1. In his investigations Blagden suggests that the meteor's path may have deviated from a straight line, but the evidence for this is not clear and was probably an optical effect due to the meteor changing shape rather than direction of motion.

Pictures of the Great Meteor

Various artists have over many centuries drawn depictions of comets in their works.[3] Meteors it seems have fared less favourably in the artistic eye. This is probably due to the fact that relatively speaking comets are long-

Table 1. Some of the more accurate descriptions of the meteor's position as it travelled over Scotland and England.[2] The last column represents the approximate ground distance from the observer if the meteor was at a height of 80 km.

Observer	*Location*	*Comments*	*Distance* (km)*
General Murray	Blair Athol (Scotland)	Passed through zenith.	—
W. Cooper	Hartlepool	First seen in NNW heading ESE. '...It passed directly over our heads...'	—
N. Pigott	Hewit Common (Nr. York)	First seen in the WNW at an altitude of 30°. Became extinct in SSE at an elevation of 20°.	150 (WNN)
R. L. Edgeworth	Edgeworthstown+ (Nr. Mullingar)	First seen in the North running parallel to the horizon at an elevation of 10°.	500 (N)
T. Cavallo	Windsor	First seen in WNW headings ESE approximately 25° above and parallel to horizon.	200 (E)
A. Aubert	Deptford (Kent)	First seen in the NW highest in due east at an elevation of 35°.	150 (E)

* Based on an average height of 80 km   + Now called Meathras Troin.

lived phenomena, bright meteors are less common and short-lived. While crude sketches of actual fire-balls had been produced long before the great meteor of 1783, those made of it rank among the first serious attempts at capturing such a phenomenon in a detailed and integrated scene. On its course over Britain the meteor was observed by at least two artists who were sufficiently skilled and motivated by what they saw to try and capture the scene. These two artists were Henry Robinson (?–?) who saw the meteor from Winthorpe near Newark-upon-Trent, and Thomas Sandby who was one of Cavallo's companions on the terrace of Windsor Castle. We shall discuss Robinson's etching first. Unfortunately, little is known about Henry Robinson whose etching, 'An Accurate Representation of the Meteor Which Was Seen on Augt 18th, 1783' is shown in Figure 2. The only information that is readily

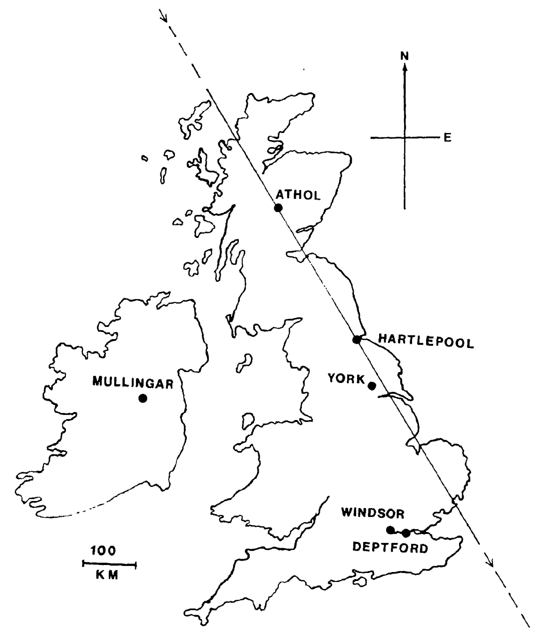

Figure 1. This figure shows the approximate path of the meteor based on the accounts given in Table 1. Blagden[2] suggested that the meteor's path performed an eastward kink after passing York but this was probably a projection effect and we have thus drawn the path as a straight line.

available on this work and the artist is that contained in the text accompanying the picture. Here we are told that Robinson is a schoolmaster and that the plate is dedicated to Roger Pocklington Esq. As many of the eye-witness accounts have stated, the first sight of this magnificent meteor was a startling experience; this is clearly shown on the expression of the unidentified figure in the lower right hand corner. That the meteor was very bright is also clear from the highlighting of the cottage and trees to the left and the clouds and brick-work to the right of the composition. While Robinson notes that the meteor first appeared round, he has drawn it at the later stage when a tail was well developed. Here it is clear that many fragments have broken off the leading body. The 'wiggley' shape of their tails suggest that they flickered, this being in contrast to the straight trails (and short-lived trains) left by the lesser shooting stars. No evidence of a residual train is apparent. Robinson's etching is both pleasing and dramatic, and gives a clear idea of how spectacular this meteor must have appeared when seen from the quiet of the rural England.

We suggested above that two artists saw and produced pictures of the great meteor. This is not quite correct. While Thomas Sandby witnessed the meteor from Windsor, it was his brother Paul Sandby (1725–1809) who seemed to be the most enthusiastic about recording the event. Thomas Sandby was Deputy-Ranger of Windsor Great Park from 1746 to his death in 1798. He was a skilled draftsman and architect, serving for a while in the military as draftsman to the chief engineer of Scotland. He was one of the founder members of the Royal Academy and served as its first professor of architecture.[4] By all accounts, he was an entertaining lecturer and carried out his duties with much zeal and enthusiasm. Paul Sandby was initially employed in the same manner as his elder brother, this time, however, in the military drawing office. Between 1745 and 1753 he was engaged as draftsman to the survey of Scotland. On leaving this survey he went to live with Thomas at Windsor. Here he produced a wealth of fine drawings and aquatints, many of which are still held in the Windsor gallery. Between 1768 and 1799 he was chief drawing master at the Royal Military

Figure 2. 'An accurate representation of the meteor which was seen on August 18th, 1783,' by Henry Robinson. (Copyright Trustees of the British Museum.)

Academy at Woolwich. Paul like his brother was also elected a founder member of the Royal Academy, and is probably best remembered as the father of the English water-colour school renowned in later times for its landscape reproductions.[4,5]

The Sandbys produced a total of three reproductions of the view from Windsor Castle; here we show their final version in Figure 3.

The scene depicted in Figure 3 is as dramatic as that of Robinson's. The brightness of the meteor is once again clearly represented by the highlighted trees, clouds and brick-work. Similarly, strong shadows are cast by the six spectators. Perhaps the most striking feature of this print is not immediately obvious to our 'modern eye'. Look at the meteor images again. The key point, not to over state the obvious, is that there are three images. It is as if a series of time-lapse photographs have been taken and the prints superimposed to show the development and movement of the meteor. In this day and age such a technique of superposition of images is common place, in the eighteenth century, however, this was an unusual and innovative step. In his review, Blagden[2] argues that that long tail of the meteor was present throughout its passage down England. The initial circular image and the later development of the tail are thus the result of a projection effect. The depiction of the tail in both Robinson's and the Sandby prints are essentially the same, both showing a main bright nucleus and a procession of lesser fragments. The prints produced by the Sandbys, however, would seem to indicate more luminous material between the separated fragments.

It is not known how many copies of their final works (Figures 2 and 3) Robinson and the Sandbys produced. In 1865, however, when A. S. Herschel was discussing the progress of meteoric astronomy in the year 1863–4 he compares pictures of a fireball seen from Athens on the 19th of October 1863, with those produced by Robinson and the Sandbys. He comments,[6]

> 'On comparing this drawing [of the 1863 fire-ball] with the original and somewhat scarce engravings by San[d]by and Robinson of the great meteor of the 18th of August, 1783, there appears ground for concuring...that fire-balls, like the celebrated stone-falls of L'Aigle and Stannern, exist in space as a crowd of bodies revolving one about another, before entering the atmosphere...'

Eighty years after the event occurred, then, the engravings by Robinson and the Sandbys appear to be rare, but more importantly are still considered scientifically useful. Herschel's comments are interesting for a second reason. The idea that the brighter meteors were collections of small bodies rotating about each other was popular for a number of years during the latter part of the nineteenth century, and the pictures by Robinson and the Sandbys were used as supporting evidence for this theory. This however, is another story in the history of meteor astronomy and we leave it for now.

Blagden's meteoric model

Very little is known about the early life and education of Charles Blagden (1748–1820).[7] It is known that he studied medicine in Edinburgh and received his MD in 1768. He was elected a fellow of the Royal Society in 1772 and between 1776 and 1780 served as a medical officer in the British Army. In 1784 his scientific standing and respect was such that he was elected secretary of the Royal Society, securing this office by a large majority vote. Blagden was a close friend of Sir Joseph Banks, then President of the Royal Society, and it seems that it was upon Banks' request that Blagden performed the detailed investigation of the great meteor of 1783.[2]

Before we consider Blagden's ideas on the structure of meteors a few comments are in order as to why the study of this particular meteoric event is of historical interest. To do this we have to briefly review the early history of meteor astronomy.

The first generally accepted 'scientific' explanation for the meteors dates back to *c.* 350 BC and Aristotle. In Aristotle's doctrine it was argued that through the Sun's heat action two types of vapours or exhalations were given off at the Earth's surface. One was hot and dry, the other cold and moist. The latter vapours rose

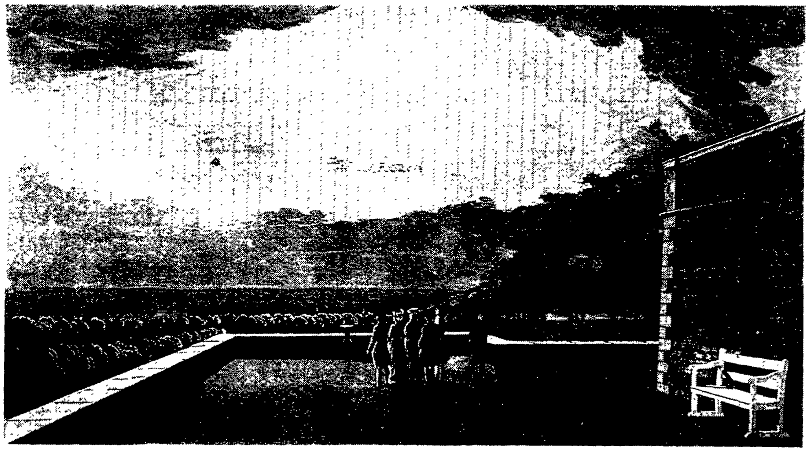

Figure 3. The Meteor of August 18th, 1783' by Paul and Thomas Sandby. (Copyright Trustees of the British Museum.)

upwards and formed clouds, the former vapours rose to the very top of the Earth's atmosphere (or the base of the lunary stratum). Here if the conditions warranted it these dry vapours ignited. It was these burning vapours that gave rise to the fiery meteoric phenomena. Aristotle's theory made the meteors phenomena of the Earth's atmosphere, and it was not for nearly two thousand years that anyone questioned this assertion. Following the appearance of several bright meteors Edmond Halley in 1714 was the first person to compare Aristotle's ideas with actual data. From his improved knowledge of the structure of the Earth's atmosphere and his estimates of meteor heights, Halley rejected Aristotle's theory and suggested an extraterrestrial origin for the meteors. While Halley later returned to an Aristotellian-type argument for the origin of meteors, the seed of the true explanation had been planted.[8,9] This seed, however, required nearly one-hundred years gestation before it could burst forth into blossom. Several factors contributed to the eventual downfall of Aristotle's rising vapours theory. Improved observations were one factor, but perhaps the main important synthesis of thought, explanation and observation was supplied by the German born scientist E. F. F. Chladni, who presented arguments for the extra-terrestrial origin of and similarity between meteors and meteorites in two treatises published in 1794 and 1819.[10] Between the times of Halley and Chladni ideas on meteor origin and structure were most often in a no-man's-land between Aristotle's vapours and Halley's extraterrestrial 'collection of atoms'. An example of such a theory was offered by W. Reynolds as late as 1818.[9,11] In this model meteors were produced through rising and igniting vapours but meteorites were produced if these vapours ignited explosively in which case the vapours were compressed sufficiently to produce meteoric stone and iron. The great meteor of 1783 and Blagden's report of it, is thus important because they both appeared just before the meteor paradigm shifted away from the Aristotelian vapours to an extraterrestrial solid body concept.

Blagden begins his investigation by boldly rejecting both Aristotle's vapours and Halley's later idea that meteors arise through the successive ignition of flammable material

> '...Dr Halley gives no just explanation of the nature of these vapours, nor of the manner in which they can be raised, ..., nor does he account for the regular arrangement in a straight and equable line of such prodigious extent, or for their continuing to burn in such rarefied air. Indeed it is very difficult to conceive, how vapours could be prevented, in those regions where there is in a manner no pressure, from spreading out on all sides in consequence of their natural elasticity.,... Besides, it is to be expected, that such trains would sometimes take fire in the middle, and so present the phenomenon of two meteors at the same time, receding from one another in a direct line...'

Interestingly Blagden is essentially applying the same arguments used by Halley eighty years earlier to reject the Aristotelian theory. Blagden, however, is not compelled as Halley was to argue for an extraterrestrial origin of the meteors. Indeed, he continues in his text with arguments against such a theory;

> '...Most observers describe the meteors, not as looking like solid bodies, but rather like a fine luminous matter, perpetually changing its shape and appearance... I think whoever carefully peruses the various accounts of fireballs, ..., will perceive that these phenomena do not correspond with the idea of a solid nucleus...'

Interestingly, Blagden also advances the argument that the bright meteors cannot have solid bodies because it would be expected that every now and then some fragment of their constituent material would fall intact to the ground. It was twenty years after Blagden's report that E. Biot in 1803 investigated the fall of stones in L'Aigle, France, and concluded that they did in fact fall from the sky.[10] Biot's investigation confirmed what folk tradition had known for centuries and gave rise and legitimacy to the new science of meteoritics. Blagden was simply expounding upon the current wisdom of his time: stones do not fall from the sky. Having dismissed both the solid body and igniting vapour theories of meteor origin, Blagden has cleared the path for his own ideas on the meteor phenomena. He writes,

> '...What then can these meteors be? The only agent in nature with which we are acquainted, that seems capable of producing such phenomena is electricity. I do not mean that by what is already known of the fluid, all the difficulties relative to meteors can be solved, as the laws, by which its motions on a large scale are regulated in those regions so nearly empty of air, can scarcely, I imagine, be investigated in our small experiments with exhausted

> vessels, but only that several of the facts point out a near connexion and analogy with electricity, and that none of them are irreconcilable to the discovered laws of that fluid...'

Indeed, Blagden is correct. There are several attributes of electricity that could explain meteoric phenomena. Blagden's earlier arguments clearly point to the fact that he believes meteors to be phenomena of the Earth's upper atmosphere. In this way he has to explain their high velocities,

> '...Electricity moves with such a prodigious velocity as to elude all the attempts hitherto made by philosophers to detect it; but the swiftness of meteors, stating it at 20 miles a second, is such as no experiments yet contrived could have discovered, and which seems to belong to electricity alone...'

This analogy neatly solves the problem of meteor speed. His main argument for the link between the meteoric and electrical phenomena, however, derives from the supposed connection between meteors and the aurora.

> '...the electrical origin of meteors is deduced from their connexion with the northern lights, and the resemblance they bear to these electrical phenomena, as they are now almost universally allowed to be...in my opinion, the most remarkable analogy of all, and that which tends most to elucidate the origins of these meteors, is the direction of their course, which seems, in the very large ones at least, to be constantly from or towards the north or north-west quarter of the heavens, and indeed approach very nearly to the present magnetic meridian... Whether their motion shall be from the northern quarter of the heavens or toward it,..., I consider them in the former case as masses of the electric fluid repelled, or bursting from the great collected body of it in the north; and in the latter case, as masses attracted towards the accumulation...'

Blagden's argument is (from our point of view) an example illustrating the point that one should not propose scientific theories on data with low number statistics. His arguments, however, do seem to address many of the problems related to the appearance of bright fireballs. Blagden is sufficiently aware of the similarities (and differences) between bright meteors and the lesser shooting stars to know that they require some further comments. He notes that the shooting stars do not follow his rule of northward/southward only motion, so suggests that they occur lower down in the atmosphere where the magnetic influences are not so great. In this way he continues by discussing the heights at which the various electrical phenomena occur.

> '...If the foregoing conjectures be just, distinct regions are alloted to the various electrical phaenomena of our atmosphere. Here below we have thunder and lightning, from the unequal distribution of the electrical field among the clouds, in the loftier regions, whither the clouds never reach, we have the various gradations of falling stars, till beyond the limits of our crepuscular atmosphere the fluid is put into motion in sufficient masses to hold a determined course and exhibit the different appearances of what we call fire-balls; and probably at a still greater elivation above the earth, the electricity accumulates in a lighter less condensed form to produce the wonderfully diversified streams and coruscations of the aurora borealis.'

This then is Blagden's meteoric model and it is indeed part of a grand synthesis of atmospheric phenomena. His arguments satisfactorily describe most of the observational data then available on bright meteors and also places the meteors and fireballs in the overall scheme of things that occur in the Earth's upper atmosphere.

The idea that the meteors were products of electrical phenomena did not prove to be very popular with the general astronomical community, and as we hinted above it was soon shown to be an inadequate model by various researchers in the early years of the nineteenth century. The idea did not, however, entirely disappear and even as late as 1905 George Brown[12] tried to resurrect the electrical theory of meteors in a modified form.

Conclusions

In this article we have attempted to recreate the events surrounding the appearance of the great meteor of August 18th. By all accounts it was a spectacular object and one that prompted detailed investigation of the fireball phenomenon. The meteor appeared at a time when astronomers were in an undecided state as to meteor origin: were they caused by rising and igniting vapours, or were they due to the disruption of solid bodies crashing into the Earth's atmosphere. We have seen that Charles Blagden rejected both of these ideas and concluded that the meteors were simply upper atmospheric electrical phenomena. Some forty years after the great meteor swooped over Great Britain, however, the general consensus of astronomers had shifted towards the extraterrestrial hypothesis of meteor origin. In the case of the shooting stars final proof of this assertion came in November 1833 with the Leonid meteor storm, but this again is another story in meteor history.

Author's Note
This article is an abbreviated version of the original essay. The full text is available upon request.

Address: South Barn, Collapit, nr Kingsbridge, Devon.

References

1 Cavallo, T. *Philos. Trans. R. Soc. London*, **74**, 108 (1784).
2 Blagden, C. *Philos. Trans. R. Soc. London*, **74**, 201 (1784).
3 Olson, R.J.M. *Fire and Ice: A History of Comets in Art.* Walker and Company, New York, 1985.
4 Ball, J. in *Paul and Thomas Sandby: Founder Members of the Royal Academy*. Charles Skilton, London, 246 (1985).
5 Redgrave, S. *A Dictionary of Artists of the English School.* George Bell and Sons, London (1878).
6 Herschel, A.S. *Mon. Not. R. Astron. Soc.*, **25**, 158 (1865).
7 Gillispie, C.C. (ed.) *Dictionary of Scientific Biography*. Charles Scribners Sons, New York, 153–4 (1970).
8 Beech, M. *Astron. Q.* (in press).
9 Beech, M. *Q. J. R. Astron. Soc.*, **28**, 455 (1987).
10 Burke, J.G. *Cosmic Debris: Meteorites in History*. University of California Press, California (1986).
11 Reynolds, W. *Am. J. Sci.*, **1**, 266 (1818).
12 Brown, G. *Nature*, **72**, 604 (1905).