History

On an 1850 report of a fireball from the Scorpiid-Sagittariid Complex

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In the night of 13-14 May 1850 both Sir William Rowan Hamilton and his son William Edwin saw a meteor which was "many degrees more brilliant than Jupiter." This meteor has now been recognized as a member of the so-called Scorpiid-Sagittariid Complex. It makes Hamilton's report the earliest one of this complex, the hitherto earliest one stemming from 1878.

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1 Introduction

On the 14th of May 1850 the Astronomer Royal of Ireland, Sir William Rowan Hamilton (1805–1865), sent a short report to *Saunders's Newsletter*, a Dublin daily newspaper, in which he described the observation of a "splendid" meteor (Hamilton, 1850). The report is not available open access and therefore given hereafter in its entirety.

Before giving Hamilton's report it is useful to know that as Ireland's Astronomer Royal he lived at Dunsink Observatory, which was built in 1785 at an elevated place about eight kilometers northwest of Dublin. Regularly attending the meetings of the Royal Irish Academy, Hamilton had the habit of walking to and from Dublin along the Royal Canal, which runs just over a kilometer south of the observatory. His usual route has been described by the organizers of the annual *Hamilton Walk*[a] and the *Quaternions by the Royal Canal: podcast tour*.[b]

Having taken this route means that on his way home Hamilton walked along the canal in a westward direction towards the Ashtown crossing, which must have been there already in 1850, both Maynooth and Clonsilla train station having been opened in 1848. At the Ashtown crossing he turned to the north, walked past Dunsinea, the house of family members, and then ascended the sloping fields towards the observatory. From Hamilton's 1880s biography it is known that he entered the observatory grounds through an iron wicket gate at the south side of the demesne,[c] and also in his days the hall-door was facing south.

Hamilton passed Dunsinea at its east side as can be seen in Figures 1 and 2, and as he wrote in the report given hereafter, he could see Jupiter and Spica, Alpha Virginis. At the time of the observation Jupiter was in the southwest at an altitude of about 23° and Spica in the south-southwest at about 22°, and also having needed only a few minutes to reach the observatory, Hamilton will have seen the meteor when he had already passed Dunsinea and was crossing the sloping fields.

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[a]http://archive.maths.nuim.ie/hamiltonwalk. On one of these walks Hamilton found the quaternions, from which vector analysis emerged. This discovery is commemorated annually.

[b]http://ingeniousireland.ie/product/dublin-eureka-by-the-royal-canal-app-audio-guide

[c]Graves (1882; 1885; 1889)

2 The report

On the Meteor of the Night of May 13th 1850

To the Editor of Saunders's News Letter.
Observatory of Trinity College, near Dublin, May 14, 1850.

Sir – Although I do not see your valuable paper regularly, yet, as most of my fellow-citizens of Dublin do so, it occurs to me that they may like to have, through you, some particulars respecting the appearance of a splendid Meteor which was seen last night by two persons here, and will probably be found to have been noticed in other places also.

As I was walking out from Dublin, after attending the meeting of the Royal Irish Academy, which was held on the evening of yesterday, and when I had almost arrived at the Observatory under my charge, I was startled by a sudden light in the heavens on my left hand, and not much to the west of the south. Instantly turning to that side I saw what to me, who have not hitherto happened to witness many meteors (except the ordinary shooting stars), appeared to be by far the most beautiful celestial phenomenon that had ever been presented to my eyes. An orb of blueish light and of a planetary appearance, but by many degrees more brilliant than Jupiter – to which planet I had been looking the moment before – was seen to sail steadily, and, as it seemed, somewhat slowly, along over an arch of at least ten (or possibly fifteen) degrees, kindling at first till it attained a dazzling lustre, and then subsiding from a sort of incandescent brightness; yet not so gradually but that it might appear at last to have been suddenly extinguished: the whole progress of the phenomenon having not occupied, as I suppose, more than two or three seconds of time.

It was impossible, during the sudden apparition of so much beauty, to be cool enough to do more than gaze; but scarcely half a minute had elapsed, from its withdrawal, when I endeavoured to recall with care any particulars which it seemed possible to fix from recollection. As well as I could judge in the starlight, it was then about five minutes after mean midnight, Dublin time. I formed the estimates, already mentioned, of the duration and extent of the phenomenon. I remem-

Figure 1 – In this Google Maps screen print north is up, west is to the left. Dunsink Observatory can be seen at the top, Dublin is located in the southeast but outside this map, the Royal Canal can be seen at the bottom. Walking north from the Ashtown Crossing on what is now Scribblestown Avenue, along what then was Dunsinea and now the Teagasc Ashtown Food Research Center, Hamilton entered the observatory grounds from the south.

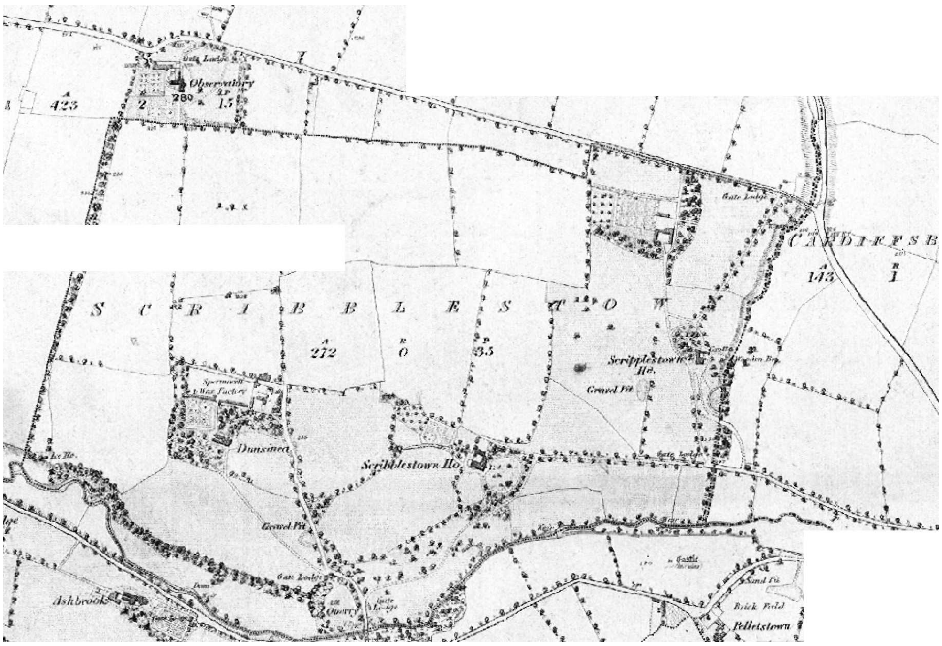

Figure 2 – This is a combination of four map sheets from the first Edition of the 1-inch *Ordnance Survey*, made between 1829 and 1842. In the map of Figure 1 the north, east and west borders are chosen to be equal to those in this map, but here the Royal Canal is not visible. Comparing the maps it can clearly be seen how many features of the grounds south of the observatory in Hamilton's days are still recognizable today. And how amazingly accurate the surveyors were. Dunsinea still seems to exist; if it is the same building indeed, the house now contains the Teagasc Ashtown National Food Centre Library.

See for these historical maps `http://www.buildingsofireland.ie/cgi-bin/viewcounty.cgi?county=6` and `http://maps.osi.ie/publicviewer/#V2,711016,738210,9,7`.

bered also that the course of the meteor had seemed to be nearly parallel to the horizon and towards the west, but with a somewhat downward direction; and I fixed on the star Spica Virginis as one which would enable me to recover, at least approximately, the point of the heavens towards which the object had been moving. But, as an instance of the difficulty of recording, or rather of observing, without previous practice, the precise particulars of a sight so evanescent, I ought to add that I felt myself unable to declare, even from a recollection so very recent, whether the course of the meteor had been higher or lower than one which should have passed the above-mentioned star.

After not many minutes I reached the hall-door of the Observatory, which was opened for me by my son, William Edwin Hamilton. It would be trifling, and therefore inexcusable, to mention that circumstance here were it not that he had happened to be the second of the two observers, to whom allusion was made above. He met me, full of the beauty of the spectacle, of which he had been another witness, described the colour of the meteor as blue, and compared its appearance to that of the electric spark in the discharge of a highly charged jar; and entered into several particulars respecting the precise time and place of the phenomenon, which I verified and recorded, so far as was possible, on the instant, and of which the results may perhaps be of some utility or at least of some interest to those persons who are engaged in the study of meteoric astronomy. It appears that while he was sitting in the transit chair and was watching the gradual passage of the star Alpha of the Northern Crown, out of the field of the transit telescope, at the moment when that star had passed the last of the wires, by about an interval from one wire to another, he was startled by a sudden light shining through the southern window of the observing room – this window, although facing the south, being distant by several feet towards the west from the large slit in the roof to which the transit instrument was directed. The meteor seemed to occupy about a second in crossing the window; and immediately after its disappearance he traced on one of the transit pillars, before my return, a rude representation of its course. And on my requesting him to point out on the window itself the exact track which the meteor had taken, he drew at the time a line which agreed well with my own recollection.

I have to-day, along with my assistant, Mr. Charles Thompson – who took the transit last night of the star last referred to – made some measurements and calculations, founded on the foregoing particulars, and suppose that the following deductions from what was noticed by my son are not erroneous by more than a few seconds of time, and perhaps by a few degrees of space. It may then be stated that the beautiful meteor of last night (or rather of this morning), as seen from the transit chair of this Observatory, in latitude 53° 23' $13\frac{1}{2}$" North, and in longitude 25 minutes 21 seconds of time West of Greenwich, attained its greatest brightness, which was of a blue colour, at about four minutes and seven seconds after the mean midnight (local time) of Monday, the 13th of May, 1850; having then an azimuth of about thirty degrees to the West of the South, and an altitude of about sixteen degrees, which would answer, in round numbers, to a right ascension of thirteen hours, thirty minutes, and a north polar distance of one hundred and six degrees.

I am, sir, your obedient servant,
William Rowan Hamilton.

3 The observation data of the meteor

Remarkably much can be inferred from Hamilton's report. The only thing not immediately clear however is the date of the appearance of the meteor. Hamilton calls it "the Meteor of the Night of May 13th," and since he observed the meteor after midnight that seems to indicate that it appeared in the night of the 12–13th of May, but that cannot be the case. The meetings of the Royal Irish Academy were held on Mondays,[d] the meteor therefore appeared on what we would now would call the first minutes of the 14th of May 1850, which is indeed corroborated by Hamilton's remark that it was "rather of this morning."

The almost exact time of the appearance of the meteor, up to only a few seconds, is known by the fact that Thompson had taken the transit of Alphekka, the star Alpha of the Northern Crown.[e] Apparently directly after Thompson finished the observations William Edwin had taken Thompson's place in the transit chair; he recorded that Alphekka had just "passed the last of the wires, by about an interval from one wire to another." Alphekka just having crossed the meridian can clearly be seen in Figure 3.

A quite precise determination of the latitude of the path of the meteor was given by William Edwin, who saw it through the window facing south; the position of the chair and the window having been fixed allowed for such precision. That window was several feet west of the opening in the roof through which the transit of Alphekka had been observed; William Edwin therefore saw the meteor somewhat west of south, as also Hamilton reported. But William Edwin will not have seen the begin and end points of the path since he saw it only for about one second through the window; the determination of the longitude came from Hamilton's observation that it was travelling over "at least ten or possibly fifteen degrees" in the direction of Spica, and extinguished before reaching it. The combination of these two observations made it possible for Hamilton to provide such precise data.

[d] The meetings having taken place on Mondays can be read in Hamilton's biography, see Graves (1882; 1885; 1889). Also the day that he found the quaternions was a Monday; he then was walking with his wife towards Dublin to preside a meeting of the Royal Irish Academy, (Van Weerden, 2015, p. 12).

[e] Thompson measured the crossing of Alphekka over the meridian, the local north-south line, by observing the crossings over the wires of the transit instrument. In those days star transits were routinely measured in order to gain a better knowledge of their locations, as well as for regulating the observatory's central clock. See for instance (Lang, 1826) for an example of transit measurements.

According to the website of Dunsink Observatory,[f] its precise location is 53°23'12.30", −06°20'10.40"; its altitude as given by the *Astronomical Almanac for the Year 2016* is 85 m above sea level. In his report Hamilton gave Dublin mean time, which was measured at Dunsink Observatory, as 25 minutes and 21 seconds behind Greenwich mean time, which indeed exactly corresponds to the longitude given by Dunsink Observatory.

As regards the path of the meteor, Hamilton mentioned an error of a few seconds in time, and "perhaps" a few degrees of space. Therefore, in order to visualize the path of the meteor using Stellarium,[g] hereafter seconds will be neglected, and the time difference with Greenwich time will be rounded off to $-00^{\rm h}25^{\rm m}$.

Summarizing what is known about the meteor, Hamilton and Thompson calculated that the meteor attained its greatest brightness when at an altitude of about 16°, and an azimuth of about 30° west of south, or 210°. The brightness was "by many degrees more brilliant than Jupiter," its duration was 2–3 seconds, its colour blue, and it moved over 10–15 degrees. Its velocity was "somewhat slowly." It moved in a direction "nearly parallel to the horizon and towards the west" but somewhat downward. It headed towards Spica, but did not go past it.

4 Visualizing the path and a possible radiant

Using Stellarium to visualize the path of the meteor, three stars have been chosen as representing the point of greatest brightness, of which the ephemerides were given by Hamilton, a theoretical starting point, and a possible radiant.

For the point of greatest brightness the star HIP 66423A was chosen;[h] it was as close as possible to this point and is represented in Figure 4 by the rightmost circle. Its azimuth and altitude at the time of the appearance of the meteor were, rounded off, 210°10' and 16°15', respectively.

The starting point has been chosen as having had a distance to the point of greatest brightness of 15 degrees. Hamilton's largest estimation of the path of the meteor has been chosen because he did not see the real starting point; he reacted to the light of the meteor when he turned around to look at it. Hamilton also reported that the path had been nearly horizontal, therefore a difference in altitude has been chosen of 1.5 degrees. Although slightly influenced by the curvature of the coordinate system due to the chosen field of view, it can be seen in the screenshot that such a difference between the two points indeed seems to show a path as Hamilton described; almost horizontal but somewhat downwards. For this starting point the star HIP 71850 has been chosen, represented by the circle in the middle. Its azimuth and altitude were 194°0' and 17°30', respectively.

As regards a possible radiant, the considerations to choose the star HIP 81686, with azimuth and altitude 163°40' and 20°25', respectively, were that Hamilton mentioned that the speed of the meteor was somewhat slowly, and that its path was about ten to fifteen degrees, which is not very long for such a bright meteor; it seems to indicate that the meteor stayed rather close to the radiant. The radiant has therefore been assumed to have been at a distance from the starting point of two times the length of the visible path: about 2×15 degrees from the starting point, and consequently 2×1.5 degrees higher in altitude. That corresponds to an azimuth and altitude of 165° and 20°30', respectively, or a right ascension $\alpha = 16^{\rm h}28^{\rm m} = 248°$ and a declination $\delta = -15°$.

5 The Scorpiid-Sagittariid Complex: Anthelion

The estimated radiant of Hamilton's meteor thus had as its celestial coordinates $\alpha = 248°$ and $\delta = -15°$. That fits in well with the values in the table given by Gary Kronk in his 2014 book *Meteor Showers : An Annotated Catalog*[i] for possible radiants of the Scorpiid-Sagittariid Complex (Kronk, 2014, p. 131), which gives values for α between 232° and 350°, and for δ between $= -28°$ and +3°. In the chapter 'June showers' Kronk writes about the Scorpiid-Sagittariid Complex:

> This is the largest region of activity during the year, completely spanning the months of May through July and the constellations of Libra, Ophiuchus, Sagittarius, Scorpius, and Capricornus. Several individual radiants seem to be active each year, but research shows that few of these radiants produce annual displays. [...] None of these radiants produce more than 1–2 meteors per hour. [...] C. Hoffmeister (Hoffmeister, 1948) called this region the "Scorpius-Sagittarius System" [...] and said [the meteors] generally appear 165° west of the Sun [...].
>
> The earliest account of meteors coming from this region appeared in the 1878 July issue of The Observatory. W.F. Denning discussed three fireballs that were seen on 1878 June 7 (Denning, 1878). The first appeared in daylight, while the other two appeared in the early evening. In his conclusion, Denning said these last two appeared to diverge from a radiant near the star Antares. He gave the position as $\alpha = 246°$, $\delta = -20°$ and added that this was "not far from that of the detonating fireball of June 17, 1873."

[f] Dunsink Observatory: https://www.dunsink.dias.ie.

[g] Stellarium Night Sky Viewer, http://www.stellarium.org.

[h] The star designation HIP comes from the Hipparcos star catalogue, Hipparcos having been the astrometric satellite which measured star positions between 1989 and 1993.

[i] In this book Kronk describes over a 100 meteor showers, together with the history of their discovery and historical observations. (Kronk, 2014).

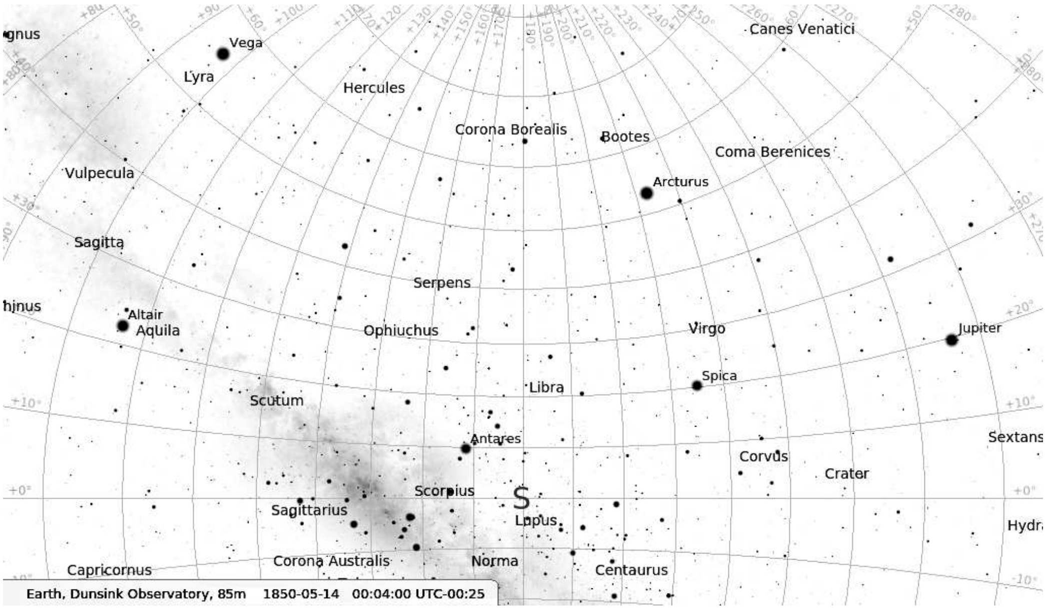

Figure 3 – In this STELLARIUM screen print west is to the right, the coordinates shown are azimuth and altitude. Alphekka, the brightest star of Corona Borealis, can be seen at the top; in accordance with Hamilton's report it just crossed the meridian. Jupiter is on the right side, in the south-west. The location settings in STELLARIUM have been set to the geographical coordinates as given by Dunsink Observatory; the time has been set to 25 minutes behind Greenwich Mean time, or for practical purposes UTC. For clarity, information other than time and place on the bar at the bottom of the screen has been removed and the bar itself has been moved, but no further modifications were made.

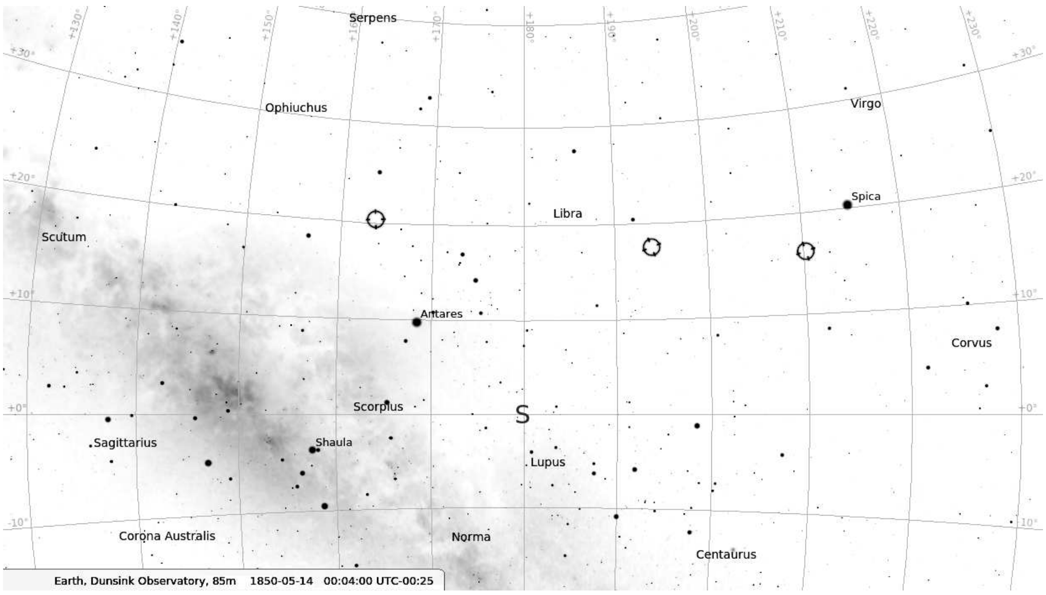

Figure 4 – Again west is to the right, the coordinates are azimuth and altitude, and the same time and location settings have been used as in Figure 3. While modifying the bar and adding the circles, for which each time a new screenshot was made, much care has been taken not to alter anything else. The circles indicate, from right to left, the point of greatest brightness, the starting point, and a possible radiant, each represented by a star as close as possible to the respective locations. The curvature of the coordinate system can be recognized in the apparent curvature of the theoretically derived and extended path.

Kronk further adds that "today, these "Ecliptical Currents" are known as "antihelion" radiants. [...] According to R. Lunsford (2004), "this material orbits the sun in low-inclination, direct orbits, and encounters the Earth on its inbound or pre-perihelion portion of its orbit." The meteors encounter Earth perpendicular to our planet's direction of motion." (Kronk, 2014, p. 127).

Lunsford gives radiants for Anthelion meteors (Lunsford, 2004, p. 82); for May 15 he gives as the celestial coordinates of the radiant $\alpha = 248°$, $\delta = -22°$, to which again the data given by Hamilton correspond very well, even if these points have shifted somewhat since Hamilton's time. It must be admitted that the declination of the estimated radiant of the 1850 meteor, $-15°$, is quite some degrees higher than $-22°$; yet the measure of what was "somewhat downward" of the meteor's path has been guessed, Hamilton mentioned an possible error of "a few degrees," and Lunsford does not give widths of these radiants. Again fitting very well with the Anthelion meteors is the "somewhat slowly" velocity of the 1850 meteor as mentioned by Hamilton; Lunsford records that the Anthelion meteors "appear to be of average velocity, lacking both very fast and very slow meteors." (Lunsford, 2004, p. 81).

6 Conclusion

It has been shown that Hamilton's meteor can be recognized as having come from one of the Anthelion radiants, the Scorpiid-Sagittariid Complex. Kronk mentioned that the earliest account of meteors coming from this region was from W.F. Denning in 1878, and Denning did mention a "detonating fireball" in 1873. The meteor seen by Hamilton and his son in 1850 therefore appeared and was reported 23 years before the observation of this earliest fireball.

7 Acknowledgements

I would like to thank my colleague Rob van Gent for his quick insight into the conditions of this meteor; I had not thought of searching for a radiant. Many thanks are due to the people of the Boston College Libraries for providing a very fine scan of the pages of *Saunders's News-letter*. And of course to my library colleagues Memet Ozberk and Wiebe Boumans for helping me with the request.

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