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THE GREAT COMET OF 1858: A ROAD SIGN TO THE STARS

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ABSTRACT

During an expedition to the Texas–Mexican border area in September–October 1858, the Belgian astronomer Jean–Charles Houzeau (1820–1888) admired "a beautiful comet". At that moment, he was not aware that the comet had already been discovered in June 1858 by Giovanni Battista Donati. Houzeau sent detailed descriptions of his whereabouts to his family and to a colleague at the University of Brussels.

Donati's comet, with its curved tail extending 40 degrees across the sky, became a big news event, and inspired visual artists worldwide. Many paintings and sketches were produced. Some of these artworks show quite literal transcriptions of the surroundings, and even have scientific overtones, whereas others are more artistic than exact. The comet also inspired jewelry artisans, and poets: some lyric poems include — just like some artworks do — elements that refer to mid–nineteenth century scientific developments.

A basic ephemeris analysis shows that the cometary passages allegedly attributed to the same comet in the time span 104–1858 AD cannot be assigned to a single comet. An analysis of a drawing by William Hayes Hilton leads to the conclusion that the artist could not possibly have painted the landscape and the starscape at the same moment and at the date suggested by the position of the comet with respect to the star Arcturus. A similar conclusion is reached for a painting by British artist William Dyce. The artistic representations of this comet indirectly contributed to familiarization of the mid–nineteenth century public with some specific stars and constellations. As such, Donati's comet showed the road to the stars.

KEYWORDS: Comet Donati, Comet Tuttle, Comet Halley, nineteenth century literature and art, Jean–Charles Houzeau, comet mania, Abraham Lincoln

1. INTRODUCTION

Jean–Charles Houzeau de Lehaie (1820–1888) was a Belgian astronomer at the Royal Observatory of Belgium. During the social upheavals of 1848[1], Houzeau took a republican stand and was dismissed. He then left Belgium and travelled around Europe, working in various libraries and archives. In 1854 he was recalled to Belgium for survey work on the triangulation of the Kingdom, but when this project was interrupted in 1857 he left for New Orleans, in search for his revolutionary dream of freedom.

His principal reasons for leaving his native country were his dissatisfaction with Belgian politics, his views that Europe was too parochial, and his desire to discover a country with more individual freedom and with a more egalitarian society. Houzeau adhered to Fourierism, i.e., the set of ideas first put forward by the French utopian socialist Charles Fourier (1772–1837).

On May 24, 1858, he arrived in San Antonio, Texas, where he stayed until 1862. His original plan was to return home after several months, but he was caught in the American Civil War, and his final time overseas turned out to be almost 20 years. During that period he wrote hundreds of letters to his parents, to his spouse and to his colleagues at the university in Brussels.

In a letter to his parents, after returning from a field trip to the Rio Grande near the Mexican border, he wrote on October 17, 1858 "*I have discovered and admired a beautiful comet, that almost was lost in the fire of the sunset …*".[2] (Houzeau 1994). Two weeks later, in a subsequent letter to his parents, he mentions that the head of "*la belle comète de Donati*"[3] is near the star Arcturus, and that the tail passed over σ and ζ Bootes. In this, and in later letters, he also mentions that already in the prairie, he knew that this comet was not the comet of 1556 (C/1556 D1) dubbed "Charles V". The Great Comet of 1556 was nicknamed the comet of Charles V because, when the Emperor saw it for the first time, he cried: "*By these signs, then, my fate summons me*" (Aspaas, 2018; Heward, 1899): he regarded the comet as a command from Heaven to resign the Crown, and thus he retired to a retreat in Spain.[4]

2. COMET DONATI IN THE PRESS

The comet became a true media event in newspapers and popular magazines of the times, and entailed a fascination of the public, and even led to some comet mania. The newspaper *Daily Alta California* of October 8, 1858, though, gives a lot of exact information — including coordinates and orbital elements — that had been provided by Detroit Observatory (Ann Arbor). The newspaper explains that the comet will not be visible after October 16, that the comet visits us for the first time, that its orbit is parabolic and that the comet will thus never return, and that the comet is not a harbinger of pestilence, famine and evil.

Houzeau's preoccupancy with the issue of the identity of the comet of Charles V and Donati's comet can be easily understood. Ten years earlier, John Russell Hind (1823–1895), assuming that the comet of 1556 had already been seen in 1264, calculated that 292 years after its 1556 apparition, it would visit us again in 1848 (Hind, 1848). Hence, some people speculated that the comet of 1858 was the somewhat late Charles V comet. In 1857, a paper *The Great Comet, Now Rapidly Approaching, Will it Strike the Earth?* (Anonymous, 1857) appeared that warned for a coming "*monstrous body*". That comet was first noted in 1264, the paper said, and again in 1556, and now it would make its appearance between May 1857 and January 1858. The writer alluded to a probability of collision, and the consequent "*End of all Things*". The appearance of the comet of 1264 is connected to the death of Pope Urban IV (1195–1264). *The Illustrated London Almanack* (1847) reports, on page 65, that "*The chroniclers of the time … connect the appearance of the comet with the death of Pope Urban, who fell sick (they assert) on the very day when the comet was first seen, and died at the exact time it disappeared — viz., on the last day of September, 1264!* ".

The times of "passage" listed in Hind's paper lead to a straightforward ephemeris of that alleged comet, and yields a period of 290.3 ± 0.2 years for the six passages from 104 to 1556 AD. Figure 1 shows the seven cometary passages allegedly attributed to that same comet. The dashed line through the filled symbols is the linear ephemeris. This result looks amazingly accurate, yet it stands for one of the greatest pitfalls of ephemeris calculation: the period precision is entirely due to the long time–baseline of almost 1500 years and is totally illusory. The lower broken line through the open symbols stands for the differences between observed and calculated times of passage (the so–called *O–C* diagram). The trend of the

[1] The "revolutions" of 1848 were a series of political upheavals throughout Europe.

[2] "*… je n'ai pas été sans découvrir et sans observer une belle comète, qui se perdait presque dans les feux du couchant, …*" .

[3] *Comet C/1858 L1 was first observed by Giovanni Battista Donati (1826–1873) on June 2, 1858.*

[4] *Heward cites an anonymous English treatise of 1618 : "In the time of Charles the Emperor, surnamed the Great, a blazing star appeared, in the contemplation whereof the Emperor, having his eyes earnestly bent upon the star and considering profoundly thereupon, at length was wrapped into a great astonishment touching the significance of the same; and sending for a philosopher named Eginard, reasoned with him to and fro about the star, saying in conclusion that the appearing thereof did threaten unto him some dire calamity."*

observed *minus* calculated times of passage clearly shows that comet Donati cannot possibly be identified with any of the other comets. A totally different diagram would emerge for a truly periodic comet: Figure 2, for example, shows the *O–C* diagram for the last four perihelion passages of comet Halley. The labels refer to the observational technique employed for rediscovery and reveal that almost every point in this diagram has been obtained with a detector that differs from the one related to the previous data points. The dashed line is a third–degree polynomial fit. However, each observational entry has an accuracy that is an order of magnitude better than the preceding point, whereas the same also holds for the computational techniques. The diagram also shows the date of rediscovery (expressed in days before perihelion) and is a vivid illustration of the fact that the observational technique directly influences the computational result: the earlier the rediscovery occurs (as, for example, in 1982), the longer is the orbital arc that enters the orbit calculation and the more accurate the *C* term in *O–C*. The polynomial fit is also reproduced in Figure 1; the seemingly straight line is plotted from the moment when Halley saw "his" comet for the first time to the comet's latest apparition in 1985. The different character of the *O–C* curves for comets Halley and Donati is evident.

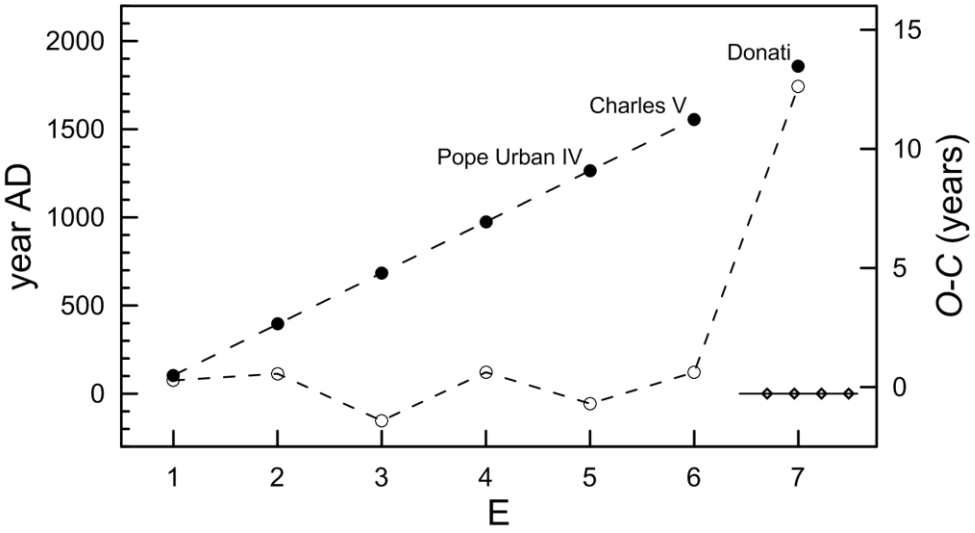

Figure 1. Seven cometary passages allegedly attributed to the same comet since AD 104, versus passage number E. The lower broken line through the open symbols refers to the vertical axis on the right, and represents the differences between observed and calculated times of passage. The four ◊ symbols are the O–C values for Halley's comet based on a linear ephemeris, and the line is the fitted polynomial of third degree in Figure 2. The line extends from 1682, when Halley saw "his" comet for the first time, to the comet's latest apparition in 1985.

New calculations of the orbit of the comet of 1556 by Martinus Hoek (1834–1873) led him to the conclusion that "*the non–identity, that now definitely follows from the non–appearance of the comet that was expected in 1858, also follows from the now obtained orbital elements*"[5] (Hoek, 1861). For a detailed discussion of the orbits of these medieval comets, see Carter (2017), who draws the conclusion that astronomers have selected only the medieval data that affirmed their presupposed theory, in fact, Halley's belief that all comets were periodic.

In a letter of July 28, 1860 to his university colleague Nicolas–Constant Schmit (1832–1879), Houzeau mentions (Schmit, 1860) that in 1857 already—thus four years before Hoek—he published his own opinion that comet Charles V was not the one seen in 1264, and that the comet that he saw the same month (discovered by H. P. Tuttle in June 1860), was also not the one of 975. Houzeau (1857) clearly stated the importance of the study of the cometary paths: "*The return of the comet of Charles V is one of those mystifications that shine with a varnish of science, but that do not have a more realistic foundation for it. It is not true that the comet observed in the times of Charles V, in 1556, is the same one that appeared in 1264. This one is also not the same as the one of 975. The hypothesis of the identity of these three stars is not sustainable from the moment when one takes the trouble to study their respective paths in the sky.*" [6]

[5] "*Die Nicht-Identität, die jetzt am sichersten aus dem Ausbleiben des im Jahre 1858 erwarteten Cometen hervorgeht, würde aus den jetzt erhaltenen Elementen ebenso gefolgert werden.*"

[6] "*Le retour de la comète de Charles-Quint est une de ces mystifications qui brillent d'un vernis de science, mais qui n'en ont pas pour cela de fondement plus réel. Il n'est pas vrai que la comète observée du temps de Charles-Quint, en 1556, soit la même qui etait apparue en 1264. Celle-ci n'est pas non plus la même que celle de 975. L'hypothèse de l'identité de ces trois astres n'est pas soutenable, du moment où l'on se donne la peine d'étudier leurs marches respectives dans le ciel.*"

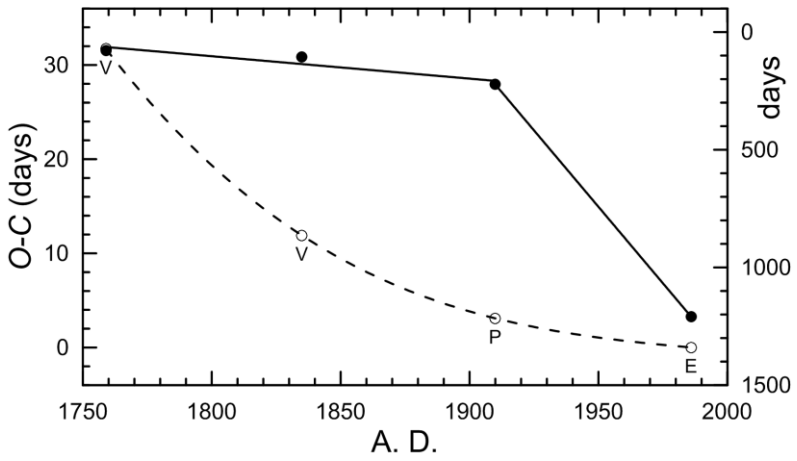

Figure 2. O–C diagram for the last four perihelion passages of comet Halley (○, left y axis). Labels V stand for visual observations, P for photographic, and E for electronographic data. The dashed line represents a polynomial of third degree. The right y axis (●) shows discovery date in days before perihelion. Full lines are linear fits. Source: Sterken (2000).

And in his letter to Schmit, Houzeau adds that "*soon the time will come that the facts will vindicate me, and I recall this note with some pleasure, because it went against the mainstream by which almost all astronomers let themselves be swept along – by laziness or by extreme precaution*".[7]

3. COMET DONATI IN VISUAL ART

Comet Donati was the first comet ever to be systematically photographed for scientific purposes. George Phillips Bond (1825–1865), at Harvard College Observatory, published a monumental treatise with dozens of drawings and engravings of the comet (Bond, 1862). Olson and Pasachoff (1998) present more than half a dozen reproductions of paintings and drawings by British artists. Many of these paintings are interesting because they show the position in the sky with respect to the constellation Ursa Major, and to Arcturus, the brightest star in the northern celestial hemisphere. Gasperini et al. (2011) outline and discuss the relations and interconnections between a scientific discovery, the artistic movements of the period, and the different social environments in a worldwide context.

A most interesting drawing was made by William Hayes Hilton (1829–1909), who made a stunning sketch of Donati's comet over a stagecoach. This sketch (Figure 3) was dated 1858, but the exact date of the drawing was not given. The picture, besides some faults in perspective, is intriguing in many aspects. The timing can be estimated from the relative position of the comet's head with respect to Arcturus: Plate XII of Bond (1862), with the comet's head West of Arcturus, was taken on October 4, and Plate XIII, with the head directly East, was taken exactly 24 hours later. Figure 4 shows the path of the comet from September 12 to October 17, 1858, as well as the path of the Moon, and the moonphases from Last Quarter to New Moon. The dashed lines are links to guide the eye. The ⊙ symbol gives the position of the Sun on October 5. The brightest stars of Ursa Major and of Bootes are also shown. The scene depicted in the drawing appears to be on a flat section of desert with a hill in the background. Ahnert (2014) situates the scene near Ewell's Stage Station (elevation 4550 ft, GPS location 32.1231, –109.6505) that was constructed about 4 miles south of present–day town of Dos Cabezas (Arizona), between Apache Pass and Dragoon Springs.

The *Daily Alta California* newspaper of November 20, 1858, cites the Arkansas *Fort Smith Times* of October 27 that mentions the arrival of the Overland Mail California at Fort Smith (AR): "*on Tuesday evening the stage that left San Francisco, on the 4th inst., arrived, with five through passengers… there were 3 through passengers from San Francisco, to wit W. H. Hilton, W. H. Ware and E. Janen.*" The stage had been detained two days at Kern river (CA) by high water, and 4 hours at Boggy, in the Choctaw Nation (Atoka County, Oklahoma).

Waterman L. Ormsby, the only through passenger on the first westbound stage of the Butterfield Overland Mail gives the travel schedule for September 16 (Ormsby, 1968): the cumulative distance from San Francisco to Fort Smith is 2233.5 miles and the total travel time allowed is 485 hours or about 20 days. Taking into account the two days delay, Hilton's reported arrival time in Fort Smith was pretty exact. *The New York Times* of October 14, 1858 gives a most detailed itinerary of the 2765 mile route from San Francisco to St. Louis that was covered in 596.5

[7] "*Voilà bientôt le temps où les faits vont me donner raison, et je rappelle cette note avec quelque plaisir, parce qu'elle allait alors contre le courant où presque tous les astronomes se laissaient entraîner, – par paresse ou par extrême prudence.*"

hours, thus at an average speed of 4.6 miles/hour (7.5 km/h). The stretch from Fort Yuma (CA) to El Paso (TX, formerly Franklin) via Tucson (AZ) is quite linear and yields a daily average travel distance of 100 miles. That means that the coach arrived in Dragoon Springs (32.0378, –110.0780) about 82 hours after leaving Tucson, or 12.74 days after leaving San Francisco, thus on October 17 around midnight. Since the remaining distance to Ewell's Stage Station is about 30 miles, that place was probably reached in the early morning hours of October 17.

It is evident that, if the scenery really corresponds to the Dragoon Springs–Ewell's Stage Station area, the drawing could never have been made in mid–October because at that moment the comet's head was already very low, and far away from Arcturus, with the Moon just past First Quarter. Other anomalies in Hilton's artwork are the position of the Full Moon North of Ursa Major, the location of the Milky Way, the shape of the comet's tail, and the large number of faint stars that cannot possibly be seen during the twilight hours. It is obvious that Hilton did not make his drawing *in situ*, but that he either made a sketch of the comet shortly after leaving San Francisco, and later combined it with a landscape obtained in southern Arizona, or that he copied the comet and the starry night from other sources.

The moment of the depiction, with the comet at its greatest radiance on October 5, had been much publicized because of the passage of the cometary head past Arcturus, and also because that moment brought quite a change in the orientation of the tail (Anonymous, 1858). Clerke (1893) describes this very clearly: "*But the most striking view was presented on October 5, when the brilliant star Arcturus became involved in the brightest part of the tail, and during many hours contributed, its lustre undiminished by the interposed nebulous screen, to heighten the grandeur of the most majestic celestial object of which living memories retain the impress.*"

Hilton's sketch shows the consequence of constructing a painting from multiple studies over a period of time of several weeks to months. It is striking that numerous landscape painters have achieved visually accurate starscape and landscape combinations. Like, for example, James Poole (1803–1886) with his magnificently accurate large–size oil on canvas painting that shows all realistic elements related to the comet and the stars, including a reflection in a pond (Poole, 2018). There also is William Dyce's (1806–1864) *Pegwell Bay – a Recollection of October 5th 1858,* that portrays a magnificent landscape with a rather modest comet (Dyce, 1858).

Also Cornelis van der Grient (1827–1918) produced a most realistic etching in 1858–1860, (van der Grient, 2018) that really mirrors Bond's picture of October 10, 1858. Concerning the engravings in Bond's work, i.e. positive effects upon a dark background, he calls them "*almost a distinct branch of art*" in which it is not permitted to produce effects at the sacrifice of precision, "*otherwise the scientific value of the representation is entirely lost*".

An offshoot of the nineteenth–century cometary appearances was visible in fashion, in particular in the exquisite jewels of the crowned heads in Europe that featured "star–diamond" gems. Franz Xavier Winterhalter's (1805–1873) famous 1865 portrait of the 28–year old Empress Elisabeth of Austria (in the Sisi Museum in the Hofburg, Vienna) wearing a set of diamond stars in her hair is a marvelous example of comet–inspired decorative art .

4. COMET DONATI IN POETRY

The comet inspired many poets: see Gasperini et al. (2011) for some examples from the English and French literature. An interesting poem in Dutch is by Frans Friederich Christiaan Steinmetz (1827–1897), who blends scientific thoughts with religious beliefs. He mentions Ursa Major and Arcturus (Steinmetz, 1862), though wonders about the godly law to which the comet conforms its path. He argues that scholars may very well be able to calculate the comet's distance and orbit, but are just unable to explain anything. The poet is convinced that the comet will return after centuries, hence he will see it from the Heavens—as he writes, from the "*Empire of Love and Light*". In the same vein, Harme Bevoort (1801–1875), in a poem written on October 9, 1858, calls the comet "*Donati's star*" and explains that it follows the same orbit since "*sixty centuries*" (Bevoort 1858). Bevoort's religious overtones, however, seem in stark contrast with his October 1830 call to arms of the Dutch archers against the separatist southern provinces whose armed revolution led to the creation of Belgium in 1830. (Bevoort 1830).

Bevoort's verse line is a reference to the Ussher chronology of the history of the world, constructed from a literal interpretation of the Old Testament (Ussher, 1658). This timeline, as well as similar chronologies by Kepler, Newton and others, places the first day of creation in the fourth millenium BC. It is also referred to by Edgar Allan Poe (1809–1849) in his "prose poem" *Eureka* (Poe, 1848)*: "I can afford to wait a century for readers when God himself has waited six thousand years for an observer."* Both above–mentioned poems incorporate views of the developing nineteenth–century mechanistic universe, in conjunction with social thought in the first half of the nineteenth century that was almost always associated with a religious vision of human destiny (amidst a Victorian crisis of faith).

5. COMET DONATI AND LINCOLN

During the Illinois campaign for the U. S. Senate in 1858, Abraham Lincoln (1809–1865) and Stephen Douglas (1813–1861) held a series of seven oratorical contests, and one such debate took place in "Egypt" (Jonesboro, Illinois) on September 15, 1858. Lincoln observed the comet from the porch of the Union House hotel as he relaxed during the evening before the debate (Olson 2013). That was a quite early observation, at the moment that the comet had a tail of about five degrees long, with a "small star" visible through the axis of the tail (Bond, 1862). Agnes Clerke (1842–1907) observed that "*Not before the early days of September was it generally recognised with the naked eye, though it had been detected without a glass at Pulkowa, August 19. But its growth was thenceforward surprisingly rapid, as it swept with accelerated motion under the hindmost foot of the Great Bear, and past the starry locks of Berenice*" (Clerke, 1893).

6. DISCUSSION

The appearance of Comet Donati was of a very distinct geometry that allows dating of almost any visual artwork in the blink of an eye. Houzeau's very first description of the comet can be dated as October 4 or 5, about the same time that William Hayes Hilton and other artists depicted or described the sky. But in a letter to his parents of December 7, 1858 Houzeau (1994) specified that he saw the comet for the first time on September 19, though did not spot it on September 17 (the 18th was clouded).[8] From Bond (1862) we also know that on September 15, the tail was about 5 degrees long, and it thus follows that Lincoln could never have observed the comet in all its magnificence. The same applies to William Dyce's painting of which the production date is unknown. The non–dominant comet makes it look as if the artist recorded a viewing of around mid–September, as it was seen by Abraham Lincoln and observed by Houzeau. Since there exists a sketch of the scene made in 1857, evidently without the comet (Dyce, 1857), it is clear that Dyce had the same approach as Hilton, that is, constructing a painting from previous studies over a period of time. Pointon (1978) suggests that Dyce chose to paint the day on which the comet appeared at its most brilliant, but in reality it shows detailed strata of chalk cliffs below a just visible trail of the comet.

The appearance of Donati's comet led to a unique description of sightings by a self–exiled established astronomer who lived as a "frontierman" in complete isolation, without any access to libraries, scholarly books or journals. In contrast to Houzeau, self–taught artist Hilton had no astronomy knowledge. And he was a soldier, miner, cattle drover, stock broker and rancher in Texas, Mexico, Chile, Arizona and California (Bliss, 1963). Dyce, on the other hand, was more knowledgeable in recent developments in Victorian science, and combined facets of geology and astronomy in his artwork.

The discoveries of the mid–19th century, especially in geology and astronomy, revealed the great age of the Earth and the vastness of space. The revolutionary theories of Charles Darwin (1809–1882) and Alfred Russel Wallace (1823–1913) clearly influenced the visual art of the times. Exactly one year after the comet passed out of sight, Darwin published his *On the Origin of Species*, the Introduction of which he began by saying "*the origin of species – that mystery of mysteries*" (Darwin, 1859). But the mastermind of that phrase on speciation was no one less than John Herschel (1792–1871), who wrote to Wallace "*Of course I allude to that mystery of mysteries, the replacement of extinct species by others'* and *'the origination of fresh species, could it ever come under our cognizance, would be found to be a natural in contra–distinction to a miraculous process*" (Herschel, 1837).

Houzeau, during his five–year residence in the Texas prairie, had — just like Darwin and Wallace — intensely observed animal life, as follows from his letter of June 26, 1864, to his brother Auguste Houzeau de Lehaie (1832–1922): that the "'*mens'* [mind] *of mammal and man differs only in quantity and not in quality*" (Houzeau, 1994).[9] The study was published almost thirty years later (Houzeau, 1872), and was reviewed by (Wallace, 1872) who stated "*If this work had appeared a few years ago it would have created for its author a considerable reputation. Even now, had it been written in Europe after a careful study of all the best authorities on the subject, it might have been made a very valuable and important treatise.*"

Houzeau's saga clearly demonstrates that isolated individual scientists, whether in exile or in a technologically less–developed society, who cannot participate in the activities of the global scientific community—whatever their creative abilities, genius and hard work—may not succeed in making major contributions to scientific knowledge.

[8] "*… j'ai aperçu la comète pour la première fois le 19 sept. J'étais alors dans la prairie, sans communications avec le monde intellectuel. La soirée du 18 avait été couverte; le 19, avant la fin du crépuscule, j'ai remarqué l'astre, qui eut attiré mon attention le 17 s'il avait eu autant d'éclat. A cette époque la comète ne se dégageait pas du crépuscule, dans nos régions. Je vous ai dit à peu près tout le reste. Je l'ai suivie pendant 48 jours, jusqu'au 5 novembre inclusivement. On la soupçonnait encore les jours suivants. … Dans la 1ère décade d'octobre, plus d'un degré de la queue était visible à l'heure où paraissaient les tertiaires du Bouvier. Dès le 30 sept. je notais que le noyau paraissait en même temps qu'Arcturus, ou peu s'en fallait.*"

[9] " *… que le 'mens' d'un mammifère et de l'homme ne diffère qu'en quantité non en qualité.*"

Figure 3. Butterfield Overland Mail stage wagon in Arizona, by William Hayes Hilton, 1858. Courtesy The Huntington Library, San Marino, California.

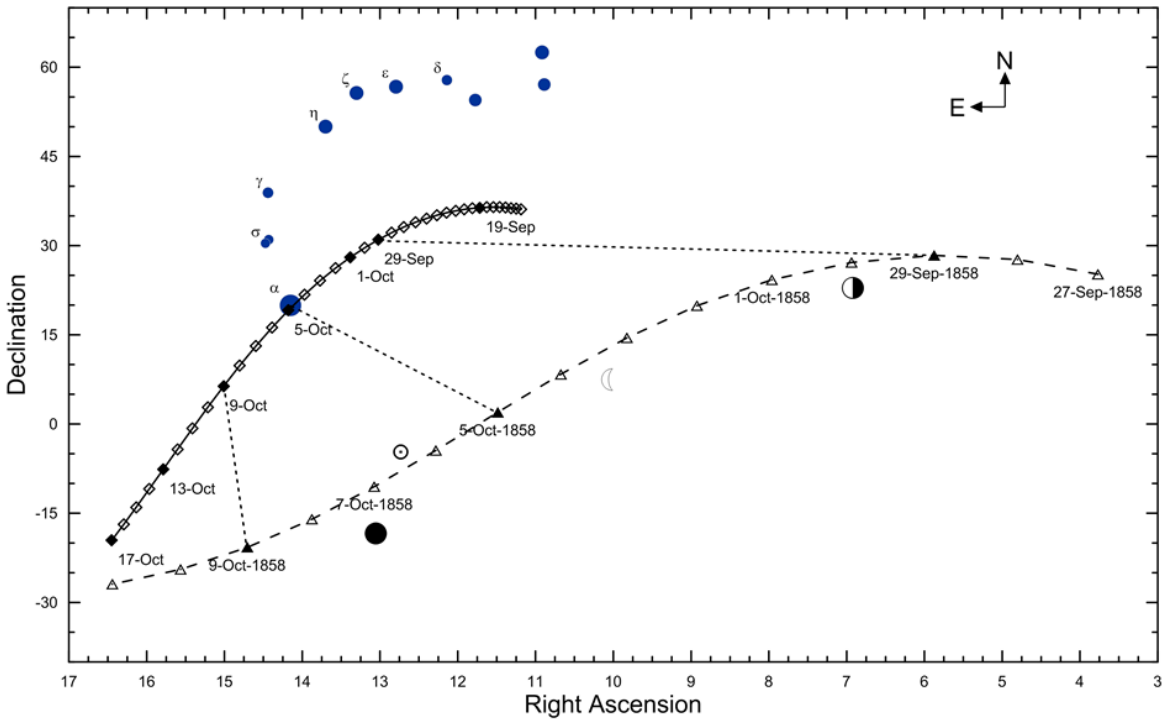

Figure 4. Path of the comet (◊) from September 12 to October 17, 1858. The path of the Moon (Δ) and the moon phases from Last Quarter to New Moon are also shown. The dashed lines are links to guide the eye. The ⊙ symbol gives the position of the Sun on October 5. The filled bullet symbols represent the brightest stars of constellations Ursa Major and Bootes, the symbol sizes are proportional to the brightness of the stars.

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