

Astronomy in 1848: the rings of Saturn, the Leviathan of Parsonstown, and the moon Hyperion

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In the 1880s a biography was written about Sir William Rowan Hamilton (1805-1865), mathematician and Royal Astronomer of Ireland,¹ of more than 2000 pages [Graves 188x], which mainly consists of the non-work-related parts of Hamilton's correspondences with other important scientists, and with friends he had made in the higher classes of Ireland and England.²

In the letters every now and then events are described which are related to astronomy; often vivid sketches of visits and conversations which contribute to the image we have of astronomers of those days, and of how they experienced their work. It is a pity that these letters have fallen into oblivion because they sometimes throw a light on in astronomy well-known events. Such as in 1848, when the earth crossed through the plane of Saturn's rings and Hyperion, the eighth moon of Saturn, was discovered.

The rings of Saturn

Although the rings of Saturn have a breadth of about one hundred thousand kilometres, they are only about thirty metres thick. Once every roughly fifteen years the earth crosses the plane of Saturn's rings, and they change from an impressive ellipse into a wafer-thin line which can only be seen with good telescopes.

The rings were seen for the first time in 1610 by Galileo Galilei (1564-1642), who presumed that the protrusions he saw were two companions of Saturn, while later he drew them as a sort of handles at both sides of the planet. In 1655 the earth crossed the plane of the rings, making it possible for Christiaan Huygens (1629-1695) to conclude that it concerned a flat ring. Still that same year, when the rings had entirely disappeared, William Balle (ca 1631-1690) observed a faint dark line or shadow crossing Saturn, and he concluded that it was a closed ring [Lynn 1902].

¹ Hamilton became famous because of his way to describe mechanics, and because of the quaternions from which later vector analysis emerged. Hamiltonian mechanics is now used in for instance quantum mechanics en cosmology, and his quaternions are used where rotations and equilibrium play a role, such as in space travel, gaming and robotics.

² That makes the biography rather unbalanced, which in the course of years contributed to the contemporary negative interpretations. For a more positive view on Hamilton's private life see [Van Weerden & Wepster 2018].

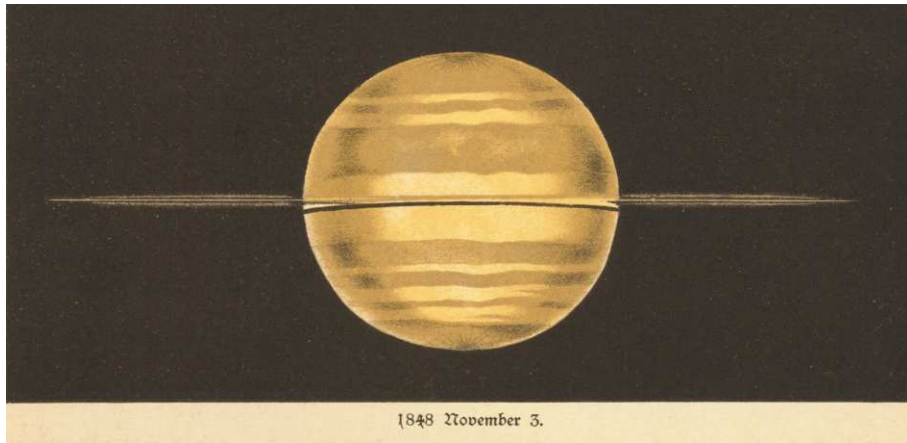


Figure 1: Saturn as seen on 3 November 1848. Weiß, E. (1888), *Bilder-Atlas der Sternennwelt*. Eßlingen: Verlag von J.F. Schreiber.

In 1675 Giovanni Cassini (1625-1712) discovered that the ring consisted of two parts, and the division between this A- and B-ring is now called the Cassini division.³ The C-ring, located within the bright B- and A-ring, was discovered on 15 November 1850 by William Bond (1789-1859), on 29 November by William Dawes (1799-1868), and again a few days later by William Lassell (1799-1880). In 1856 James Clerk Maxwell (1831-1879) reasoned that the rings had to be made up of loose particles [Maxwell 1859, p. 38].

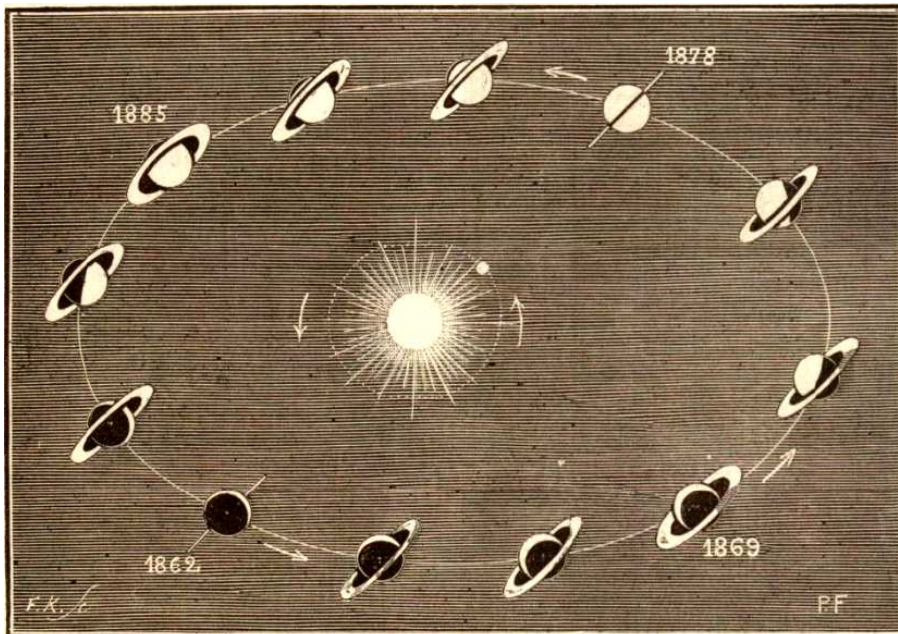


Figure 2: An 1881 representation of Saturn's orbit around the Sun. Seen from a point very high above the plane of Saturn's orbit the rings actually should, in every position, be drawn almost completely opened, but in this way it is more easy to imagine how the size of the rings varies periodically when seen from the earth. Flammarion, C. (1881), *Astronomie Populaire*. Paris: C. Marpon et E. Flammarion, éditeurs. <http://gallica.bnf.fr/ark:/12148/bpt6k96291926/f582.item>.

³ In [Maxwell 1859, p. 2] Ball (Balle) is mentioned as the discoverer of this division, but that is based on a misunderstanding, see [Lynn 1902].

With the telescopes of the first half of the nineteenth century, during the earth's ring plane crossings the rings were often invisible for long periods of time. Also in 1848 there was a ring plane crossing, and during that crossing Sir William Rowan Hamilton visited Lord Rosse (1800-1867) and his new telescope.

The Leviathan

In the early 1840s the Irish nobleman William Parsons, better known as Lord Rosse, built at his castle in Birr, formerly known as Parsonstown, a mirror telescope with a six foot objective diameter, or almost 1,83 metre. That made the telescope the largest one in the world, and it was called the 'Leviathan of Parsonstown'.

Leviathan was a biblical sea monster, but the name was used then for anything that was overwhelmingly large. Lord Rosse's telescope was indeed world famous. For instance, in 1869 the famous French science fiction writer Jules Verne (1828-1905) wrote in his *Round the Moon* that

we know that the instrument mounted by Lord Rosse at Parsonstown, which magnifies 6500 times, brings the moon to within an apparent distance of sixteen leagues [Verne 1916, p. 228].⁴

The Leviathan was built between two walls, which made it possible to move along the meridian, the local north-south line, and some metres east-west. This allowed the telescope to follow a celestial object for a while. Using the Leviathan, in 1845 Lord Rosse discovered that one of the nebulae in the night sky had a spiral structure; this object is now known as the Whirlpool Nebula (Messier 51).

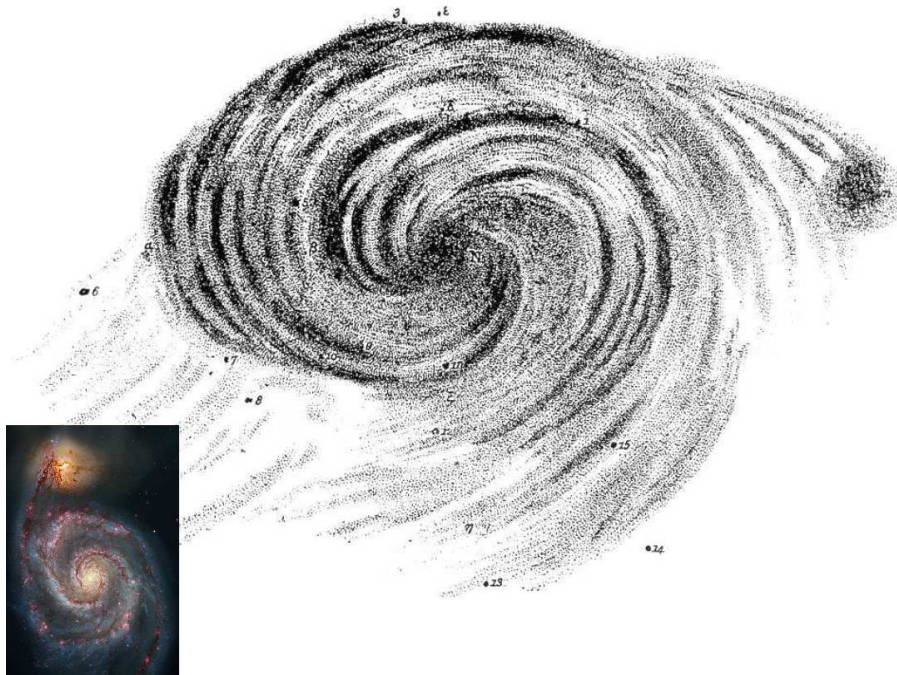


Figure 3: A drawing of the Whirlpool Nebula by Lord Rosse, March 1848. W. Steinicke (2012), *The M51 Mystery*. http://www.klima-luft.de/steinicke/Artikel/M51_Mystery.pdf. The smaller image, *M51 Hubble Remix*, Astronomy Picture of the Day on 26 December 2009, shows a photograph of M51 made with the Hubble space telescope. (S. Beckwith (STScI), Hubble Heritage Team, (STScI/AURA), ESA, NASA, R. Gendler. <https://apod.nasa.gov/apod/ap091226.html>.

⁴ A league is five miles or about eight kilometres.

Soon thereafter more of these spiral nebulae were discovered. But times were very difficult in Ireland, and between 1846 and 1848 the work was halted because of the Irish Great Famine. Lord and Lady Rosse (1813-1885) seem to have done much to help in any case the people who were dependent on them, which brought them much sympathy [Steinicke, 2010, p. 100].

The rings of Saturn a day too early

As mentioned, invited by Lord Rosse Hamilton visited Birr Castle in August 1848. Hamilton was not known as an enthusiastic practical astronomer. Although he was in fact quite good at it, the then usual and not always very exciting measurements of star positions at Dunsink Observatory in Dublin were mostly carried out by his assistant Charles Thompson (ca 1794-1876). But he was enthusiastic about observing special phenomena such as eclipses and comets, and furthermore he was a specialist in optics. Hamiltonian mechanics was a continuation to his way to mathematically describe the whole of optics in one go, and in 1835 he was knighted for his prediction of conical refraction which thereafter was found experimentally.⁵ It can be seen in later letters that during his visit he extensively discussed optics with Lord Rosse [Graves 188x, vol 2, p. 635].



Figure 4: The 1,8 metre mirror is brought to the Leviathan. In the background Birr Castle can be seen, where Lord Rosse lived. Also his earlier three foot (0,9 metre) telescope can be seen halfway between the castle and the large telescope. In 1835 Hamilton wrote proudly to his wife that he “was the first to point [the three feet telescope] at a celestial object” [Graves 188x, vol 2, p. 122]. The low building to the left of the large telescope was mentioned by Hamilton as a place to warm up between observations. <http://birrcastle.com/astronomy>. © Birr Scientific and Heritage Foundation, courtesy of the Earl of Rosse.

Also the Royal Astronomer of England, George Biddell Airy (1801-1892), was visiting Parsonstown and through the letters he sent to his wife it is known that the view of the telescope was not entirely good at lower altitudes. On 1 September Airy wrote that the day before alterations had been made to the Leviathan, and that for Saturn the view was greatly superior to what it had been before [Airy 1896, p. 200].

⁵ A web page giving a good idea of what conical refraction is: M. Jeffrey, *Hamilton's Diabolical Legacy*, <http://nonsmoothland.com/conref.html>.

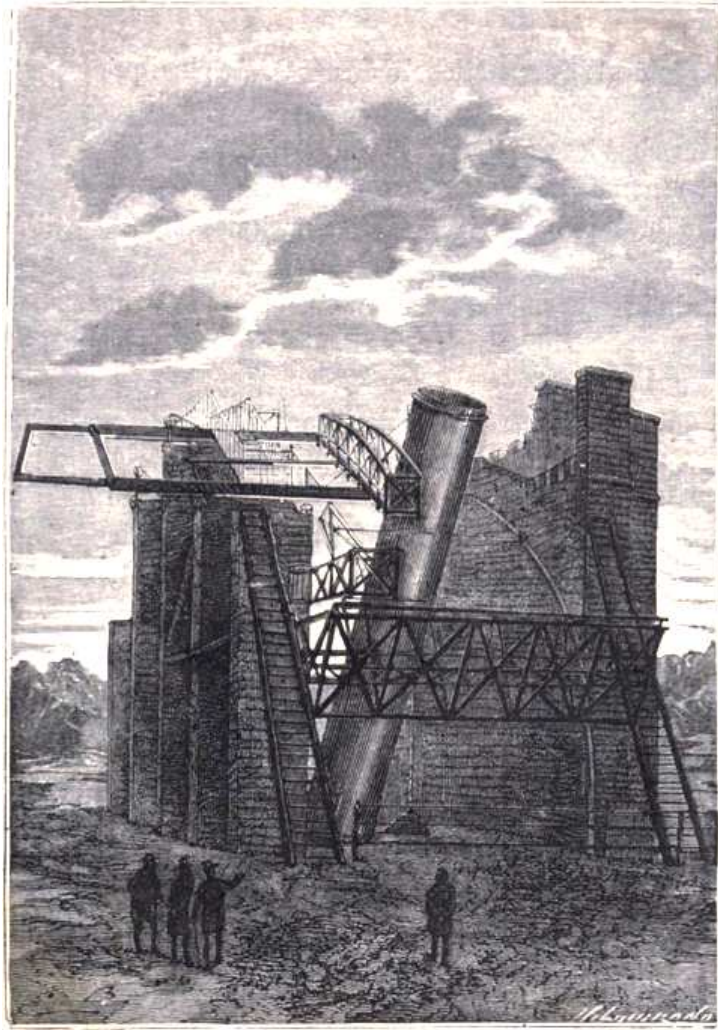


Figure 5: A drawing of the Leviathan in one of the French editions of Jules Verne's *From the Earth to the Moon* [Verne 1868, p. 73]. In figure 4 the telescope is seen from the other side.

Because that year the earth would cross the plane of the rings of Saturn, it was expected that the rings could not be seen from 22 April 1848 until 19 January 1849. In-between they would be visible for a short time, from 3 to 12 September 1848. The view of the Leviathan appeared to be so good that in the night of 2 to 3 September Hamilton happily wrote to a friend:

A pleasant day has been wound up, this evening, by a good view, with the great telescope, [...] of the planet Saturn, with several of its satellites, and the Ring: very faint, thin, and ghost-like, to be sure, but certainly seen. This is the more remarkable and satisfactory because the ring's reappearance is announced in the Nautical Almanac for tomorrow (Sept. 3); and in fact I doubt whether with any other telescope in the world it could be seen to-night. So it will be something to remember that I saw the Ring here a day too soon, namely, on Sept. 2, 1848 [Graves 188x, vol 2, pp. 625-626].⁶

⁶ In those days Saturn crossed the meridian about an hour after midnight in Dublin time, UTC - 25 minutes. It is known from other letters that Hamilton counted the night to the day before.

Bad weather and earlier observations

Hamilton thus thought that they were the first to see the rings again, but the re-appearance was seen by others even earlier. In the *Sidereal Messenger* of 1848 Ormsby Mitchel (1809-1862) of the Cincinnati observatory wrote:

On the night of the first of September [...] I directed [our refractor] to Saturn, without any expectation of seeing the edge of the ring. The field of view was illuminated with the light of the micrometer lamp, and yet, the moment the planet entered the field, I instantly caught a delicate filament of light extending beyond the limb of the planet, which I recognized at once to be the edge of the ring. It is impossible to describe the delicacy and beauty of this appearance. The micrometer wires, in the field of view, are composed of the most minute spider's web, and yet these lines, minute as they are, looked like large cords, when compared with the faint and almost evanescent light reflected from the edge of the ring [Mitchel 1848, p. 5].

In Parsonstown they had not observed that night because of the bad weather. In the night of 2 to 3 September Hamilton wrote in a postscript:

You would have been amused if you had been here last night, to watch Lord Rosse, Mr. Airy, and myself [...] taking courage by degrees to avow that we were not sorry – were glad – were very glad, to find that the sky was overcast. For five previous nights in succession, we had been up and out, to a late hour, using the telescopes in the open air; nothing very new in kind was expected [...]; and we were all quite happy to be able, without the reproach of losing any opportunity out of doors, to stay comfortably within. Indeed there is a low and partially dome-roofed building near the great telescope [...] where a good turf-fire is kept for eye-glasses and men to come and warm themselves at it at intervals. [...] I had there a cosy fireside chat some nights ago with Mrs. Sabine, about my old pupil, Lord Adare, who is likewise an old friend of hers, [...] and in the same room I have been writing to you, by starts, this evening. But still we preferred to linger over our tea in the drawing-room of the castle last night, and then to get to our beds, for once, at a moderately early hour. I read, however, in my room a long article or essay on Plato, and afterwards some chapters in the Bible; thus was up till twelve o'clock, [...] but twelve appeared quite early after the five preceding nights, and I awoke refreshed this morning [Graves 188x, vol 2, p. 624].

Non-disappeared rings and Hyperion

Because the rings of Saturn are so thin, during a ring plane crossing moons can be seen which are normally outshone by the light of the rings. Ring plane crossings are therefore very suitable to search for new Saturn moons. In early 1848 already seven moons were known: Titan was discovered by Christiaan Huygens in 1655; Giovanni Cassini discovered four moons, Iapetus in 1671, Rhea in 1672, and Tethys and Dione in 1684; Mimas and Enceladus were discovered in 1789 by William Herschel (1738-1822).

It was predicted that in the summer of 1848 the rings would disappear again on 12 September, and already a few days later William Bond and his son George Bond (1825-1865), of the Cambridge observatory in Massachusetts, found the eighth moon. In the official publication William Bond described their discovery:

On the 16th September, a point of light, resembling a star of the 17th magnitude, was noticed in the plane of Saturn's ring, between Titan and Japetus, by Mr. G.P. Bond [Bond 1848].

Which means that the very first astronomer who saw Hyperion was George Bond, and not his father William Bond.

In the official publication Bond does not mention the rings of Saturn. Yet he did mention them in a letter he wrote in the beginning of September to Mitchel, who partially published it in the *Sidereal Messenger*. According to Bond they had

not lost sight of the ring of Saturn at any time since the “disappearance” in April [Mitchel 1848, pp. 5-6].⁷

They did not see the rings in their entirety all the time, but always at least parts of them. Therefore, in the end neither the group in Parsonstown, nor Mitchel was the first to see the reappearance of the rings, because the Bonds did not lose sight of them.

Incidentally, William Lassell from Liverpool found Hyperion two days after the Bonds, just as he, two years later, would see the C-ring a few days after the Bonds. But in 1848 he published sooner: even before ‘account had been received from Professor Bond’ [Lassell 1848] he described his find and gave the moon her name, Hyperion.



Figure 6: In 1848 Hamilton could not have imagined this; neither the form, nor the quality of the image, nor the little spacecraft which used his quaternions and made this photo: a ‘true colour’ image of Hyperion by Cassini on 26 September 2005. NASA/JPL/SSI/G. Ugarkovic.

⁷ In the same *Sidereal Messenger* Mitchel also writes: “In 1832, the edge of the ring of Saturn was directed toward the Earth. At that time, so far as I know, there was but one or two telescopes in the old world, of sufficient power to follow and hold the ring in all its phases. Sir John Herschel never lost it in his great reflector, and when the plane of the ring passed through the earth, he describes the edge of the ring as a thread of light, or golden wire, on which the satellites were strung like beads” [Mitchel 1848, p. 6]. But this telescope, with a length of 40 feet or about 12 metres, had been dismantled in 1840.

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