

Air and Space this Week

Item of the Week

Uranus

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Two anniversaries this week pertain to the seventh planet from the Sun, Uranus: March 8 (some sources say 13) is the 240th anniversary of the discovery of Uranus by William Herschel and March 10 is the 54th anniversary of the discovery of Uranus' ring system.

The Discovery of Uranus

The period from 1769-1803 was marked by a number of important astronomical advances. Copernicus had the Solar System (mostly) figured out before 1600, and Galileo confirmed it, and did a whole lot more, not long after that. Newton had worked out gravity, and had derived his famous Three Laws, and Kepler had derived his own Three Laws. Halley's Comet returned as he predicted it would. Astronomical inquiry and the technology that enabled it were advancing rapidly.

I picked 1769 as the start of this interesting period because that was the year of an important Transit of Venus. It was an opportunity for astronomers to collaborate around the world to observe the event, from which the Earth-Venus distance was hoped to be determined. Britain even sent Captain James Cook, greatest of the early Navigators, on his first voyage. His goal was Tahiti, and he carried astronomers that would make an observation of the Transit from a place there to this day called "Point Venus," which later was the place from which HMS Bounty sailed on its fateful voyage. He was also tasked with exploring the unknown area that contained what we know as New Zealand. He was successful, and he also was able to make observations of a Transit of Mercury, at a place still called "Mercury Bay." The strait between New Zealand's North and South Islands is named for him.

Alas, the difficulty of making exact timings of transit events, and the distorting effect of the venusian atmosphere, caused the collective attempt to determine Venus' distance accurately failed. But the willingness to attempt "Big Science" and collaborate internationally paid dividends later. And Cook made many important discoveries in his three famous voyages of exploration.

Wilhelm Friedrich Herschel was born in Hanover on November 15, 1739, which was part of the Holy Roman Empire at the time. His father was in the Hanoverian Guard, where he served as bandmaster. Young William and his siblings shared their father's musical aptitude; William joined the Guard and served as an oboist in the band. This was the time of the Seven Year War, and he decided that the army life wasn't for him. He departed and moved across the Channel

to Dover, arriving virtually penniless. His oboe skills were apparently outstanding, and he had no trouble earning a living making music. He ultimately became the house organist at the Octagon Chapel.

Music paid the bills, but his heart was elsewhere. He'd been interested in astronomy from boyhood, and now he had the chance to get serious about it. He could live off his music, but he couldn't make enough to purchase a telescope that met his observational desires. So, he decided to make his own.

Telescope lenses were difficult to grind, so Herschel decided to make a mirror-based telescope, in the design of Newton. Mirrors in those days were not made of glass coated with silver or (today) aluminum, they were made of a special alloy of metal, called [speculum](#) (from which we get the adjective "specular" for an almost-ideal reflection of light. Grinding speculum wasn't particularly difficult, but grinding and polishing it to the exacting standards necessary for the telescope to operate properly was another matter, indeed. Herschel **failed over 200 times** in his attempt to make a suitable mirror, before he succeeded. With it, and the telescope around it, he began making observations of the night sky in earnest, starting on March 4, 1774. He was assisted in these early days by a brother, for a time, and for a longer time by his sister, Caroline, who would prove to be a good observer in her own right (she discovered six comets).

The Milky Way attracted Herschel's interest. Why could he see so many stars in certain directions and relatively so few in others? He knew that some suggestions had been made years before that the Milky Way could be a large, flat, disc-shaped grouping of (all?) stars, with the Earth lying near the disc's center. When one looked in the sky along the plane of the disc, one would see many stars, but when one looked perpendicularly to the disc, they would only see those stars that happened to be "above" or "below" nearby stars. But nobody had really followed up on those ideas. Herschel resolved to be the somebody that did follow up, and would do so by systematically plotting stars in different areas of the sky relative to the disc (Milky Way).

While Herschel was systematically "reviewing" the sky, comet specialist Charles Messier was doing so, too. Messier kept finding small blotches of light that would get him all excited, but would prove not to be a comet. He decided to make a catalog of these objects he could refer to so as to not be fooled by them again. That list is famous today, and familiar to all backyard astronomers.

On the night of **March 13**, 1781, Herschel encountered an object during his review of the sky, something unlike anything he had seen before. It wasn't a star-like point of light, rather, it was a small greenish disc. He watched it over the next few nights and noted that it was moving slowly relative to the stars around it. He knew that the motion was an indication that the new object was much closer than the stars, but he wasn't a mathematician, and could not calculate anything from his positional observations. But Anders Lexell, a [gifted mathematician](#) at St. Petersburg, could, and when he worked with Herschel's data, he was shocked to find that it was in orbit around the Sun, and was much farther from it than Saturn. Thus, "a new planet swam into our ken!" [See note below about the quote.]

Herschel became quite famous overnight. King George III gave him the title of “Royal Astronomer” and granted him a £200 annual stipend. The title was more honorary than official, as Nevil Maskelyne was the real “Astronomer Royal,” but the money that came with it allowed Herschel to drop music altogether.

Out of gratitude, Herschel began referring to the new planet, “Georgium Sidus,” Latin for “George’s Star.” Given the prevailing nationalism of the time in general, and with problems in dealing with King George III specifically, it should come as no surprise that Herschel was pretty much the only one who called the new planet that.

The names of four of the five previously-known planets, at least in English, were all Olympian gods, chosen because that planet had a trait similar to the of their Olympian namesake. Saturn was not an Olympian. Rather, he was a Roman deity conflated with the Greek’s Cronos, a Titan. Recall that mores were rather slack with that crowd; Cronos and his sister, Ops (Rhea to the Greeks), begat the Olympians Jupiter, Neptune, Pluto, Juno, Ceres, and Vesta.

So what to call this new planet? If the others were Olympians and their father, why not name the new planet after the father of Saturn?

The mythological genealogy gets a bit complex. Gaea, Mother Earth, begat Uranus unassisted (what was he, a bud?). Together, they begat 12 children (the Titans), along with three [Cyclopes](#) (not the ones Odysseus encountered), and the three [Hecatoncheires](#). I’ll spare you the gruesome details, but domestic discord was extreme in Uranus’ household and the youngest Titan, Cronos, ended up killing bad old dad.

So let’s name the new planet after the not-so-dearly-departed! Thirteen-year-olds have been happy ever since at the choice. [BTW: the common pronunciation, with the accent on the second syllable long A, is not preferred. The preferred pronunciation is bad enough, with the emphasis on the first syllable, and no long A.]

Herschel would go on to make many new discoveries (some call him the “Father of Stellar Astronomy”). His observations gave great credence to the notion that earlier notions of the nature of the Milky Way were correct. He demonstrated that at least some of the stars seen very close together actually are, and rotating around their common center of mass. And he was focused on more than just stars; not only did he discover a planet, he discovered that it had two moons he named Oberon and Titania (these names stuck). He also found two new moons of Saturn (the fifth and sixth discovered, named Mimas and Enceladus).

Messier’s list of non-comets contained but a hundred or so entries. Herschel had been keeping track of notable objects he saw during his “reviews,” and his list numbered over 1500. He noticed they tended to be of two types, clusterings of stars and what appeared to be glowing gas. Some of the former contained only a relatively-few stars, others seemed to be much larger. Herschel was among the first to propose that the larger clusters might be other objects like our own Milky Way. This was a long time before Henrietta Leavitt and Edwin Hubble [came along!](#)

I chose the closing year of the time period under discussion at 1803, which was the year that the international scientific community became convinced that stones can actually fall from the sky, when a shower of meteors hit the small French village of L'Aigle; see [here](#).

CODA: The “swum into our ken” reference above is from [Keats’ poem](#), *On First Looking into Chapman’s Homer*, “Then felt I like some watcher of the skies, when a new planet swims into his ken.” The word in this case is not derived from the German “kennen,” meaning to know, but rather comes from the [Scottish](#) for “[to know](#).” The etymology of “[kin](#)” also shows it to be different. I encountered “ken” in use years ago in eastern Kentucky, where many of the descendants of the original Scotch-Irish have some words and expressions from the old country. See the stories by [Jesse Stuart](#) for examples (my grandmother once gave me a signed copy of “Save Every Lamb.” She spoke like Jesse wrote. Well, I swanee.).

The Discovery of the Rings of Uranus

William Herschel kept observing Uranus throughout the rest of his career. He not only discovered Oberon and Titania, he also once thought he saw rings around Uranus, like Saturn’s only much, much fainter. He was a gifted observer at the eyepiece, for sure, but it is highly unlikely that he actually saw anything real given the capabilities of his equipment; I suspect it may have been stray light in his telescope’s optics, tired eyes, or some other observational error. He published on the topic, however, and nothing came of it because nobody else could see the rings to confirm the discovery. Now fast-forward two centuries.

Voyager 2 was being prepared for its August 20, 1977, launch, with a flight plan that included fly-bys of Jupiter and Saturn, and if Congress relented, Uranus and Neptune, too. Earlier that year, on **March 10**, three intrepid astronomers were aboard the [Kuiper Airborne Observatory](#). They were aloft hoping to observe a rare event: Uranus occulting a star named SAO 158687. They were going to try to do the same type of observation the Radio Science Team on *Mariner 4* [successfully pulled off](#) – assessing the basic characteristics of Uranus’ atmosphere by the way it cut off the star’s light as it passed in front of it, well in advance of any spacecraft fly-by. The team, led by Cornell astronomer James Elliot, included Edward Dunham and Jessica Mink.

The state of scientific supporting technology in 1977 was pretty meager by today’s standards. Elliot *et al.* were using the *KAO*’s telescope and recording the light on a strip-chart paper recorder. As the critical moment approached, the pen in the recorder made five small dips, signifying five minor drops in brightness, before the actual occultation. They were barely noticed in real-time, because the three were focused on the way the light would drop off from Uranus’ limb when the occultation began a few moments later. However, as the chart kept rolling after the star had reappeared, the recorder captured another five minor drops in light.

This was an “aha moment” that hit the team like a thunderbolt. Five drops in brightness, both sets the same amount of time before/after the occultation, could only mean one thing: Uranus had a [ring system](#)!

The excitement on the *KAO* at that moment would have been something to experience. Elliot quickly reached for the nearest green quadrille notepad so familiar to Federal labs of that

period (and today), and, shaking with excitement, began to draft a discovery telegram that would announce this discovery to the world. The [message draft](#) is in possession of the National Air and Space Museum, and you can see the excitement in his shaky handwriting and his wordsmithing.

[Personal note: NASM has a LOT of the world's most important artifacts relating to aviation and Space exploration. It's hard to pick a favorite, but if you ask a curator or other expert there if they have any favorite objects "in the corner somewhere" that they think are particularly cool, they will probably surprise you. Two such come to mind: the [camera](#) cut off of the *Surveyor 3* spacecraft on the Moon by the *Apollo 12* astronauts and returned to Earth, and Jim Elliot's telegram draft. For me, the draft captures the essence of the *Ecstasy of Discovery!*]

Believe it or not, one of the best resources I encountered for the Herschel part of this Item is the very first book I bought with my own money as a kid, *The Picture History of Astronomy, 3rd Revised Edition*, by Patrick Moore, back in 1967 (first published in 1961).

Last Edited on 06 March 2021