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Carina's Jewels

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This beautiful image of NGC 3324, found in the southern constellation Carina, is a collaboration between Russ Jacob in Australia, who acquired the data, and Shawn Nielson from Kitchener-Waterloo, who processed the image in the SHO palette (silicon, hydrogen, and oxygen). It was imaged using a Sky-Watcher 8″ f/5 reflector with a ZWO ASI1600mm pro cooled CMOS camera on an NEQ6 Sky-Watcher mount, and Hα, OIII, SII 6.5-nm Astronomic filters for a total of 6 hours. Processing was done in PixInsight.

CO line have a similar bimodal structure aligned with the quasar jets (~200 pc). The CO gas in the vicinity of both the eastern and western jet components at the location of ~80 pc from the quasar core are moving at high velocities, up to ±600 km s^{-1} relative to the core. Features show clear evidence of strong interaction between the jets and interstellar medium (ISM), a conclusion supported by high-temperature and high-density environments in the ISM of the quasar host galaxy suggested by the CO emission.

The sizes of the impacted gaseous clouds and the jets are much smaller than the typical size of a galaxy at this age, an indication that quasar radio activity is in its infancy. "We are perhaps witnessing the very early phase of jet evolution in the galaxy," says Satoki Matsushita, a research fellow at Academia Sinica Institute of Astronomy and Astrophysics. "It could be as early as several tens of thousands of years after the launch of the jets."

"MG J0414+0534 is an excellent example because of the youth of the jets," summarizes Kaiki Inoue, a professor at Kindai University, Japan, and the lead author of the research paper. "We found telltale evidence of significant interaction between jets and gaseous clouds even in the very early evolutionary phase of jets. I think that our discovery will pave the way for a better understanding of the evolutionary process of galaxies in the early Universe."

Prepared with material provided by the Institute of Astronomy at the University of Tokyo. ✶

Feature Articles / Articles de fond

Philipp Fauth: Last of the Great Lunar Mappers

by Klaus Brasch

"Everyone is a moon and has a dark side which he never shows to anyone."
– Mark Twain

"We are all like the bright moon, we still have our darker side."
– Kahlil Gibran

"Moonlight drowns out all but the brightest stars."
– J.R.R. Tolkien

Abstract

Lunar mapping and cartography during the 19th and early 20th centuries were almost exclusively the domain of German amateurs doing progressively better and more accurate visual work. Philipp Johann Heinrich Fauth was a leading early 20th century selenographer and planetary observer, and widely recognized for his outstanding visual work and craftsmanship. He aspired to produce the largest and most detailed map of the Moon available at the time. Sadly, he also became a very controversial figure because of his persistent support and advocacy of the "glacial cosmogony" theory positing that *ice was the basic substance of all cosmic processes, and ice moons, ice planets, and the* "global ether" (also made of ice) had determined the entire development of the Universe, a pseudo-scientific idea proposed by the eccentric and erratic, Hanns Hörbiger. Despite these travails, Fauth's legitimate astronomical work was recognized by the IAU and a lunar crater is named in his honour.

My mother passed away recently at the age of 101. Among her many remarkable qualities was a lifelong fascination with astronomy and whether or not we are alone in the Universe. Though not scientists, my parents were both instrumental in my becoming one and instilling in me a deep appreciation of the natural world. Although I eventually became a biologist, my first (and still) love is astronomy, something that pleased my mother very much, as she felt I had inherited that from her. After all, she maintained, her maiden name was Fauth, and that she was directly related to renowned early 20th-century selenographer Philipp Fauth.

Philipp J.H. Fauth (1867–1941) (Figure 1) was one of the last lunar amateur observers and cartographers relying primarily on visual work, at a time when photography was progressively yielding more accurate, if not yet as detailed, maps of our closest neighbor in space (Brasch, 2015; 2016). In this regard, he followed in the footsteps of a long line of 18th- and 19th-century German selenographers beginning with Johann Schröter, followed by W. Lohrmann, W. Beer, and J. von Mädler, and ending with Johann Krieger, Fauth's contemporary. Only the work of English amateurs H. Percy Wilkins and Patrick Moore exceeded such efforts in their massive, but overly crowded 300-inch map of the Moon (Wilkins and Moore, 1955). Born in the Bad Dürkheim area of Germany, Fauth was a musical prodigy who became a schoolteacher, but whose abiding interest in astronomy was sparked early in life during the apparition of the spectacular naked-eye Comet Coggia in 1874 (Sheehan and Dobbins, 2001; Dobbins, 2014).

Like so many amateur astronomers then as now, Philipp began with a modest 76-mm refractor, but later acquired a 162-mm aperture refractor and started serious lunar work in 1890 in

Figure 1 — Philipp Fauth ca. 1930. (Ph. Fauth Archives)

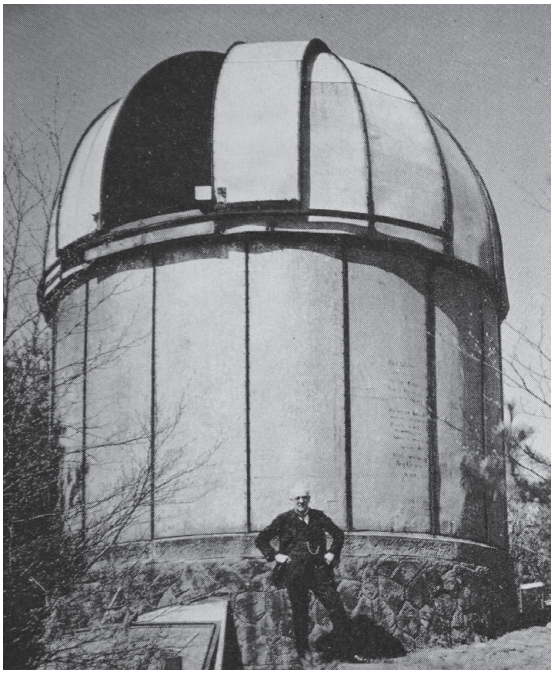


Figure 2 — Fauth's observatory housing his 385-mm Schupmann-Medial refractor. (public domain)

southern Germany in the city of Kaiserslautern. (Coincidently, that was also the birth city of my maternal grandfather, likewise named Philip Fauth). In 1895, with support from the Prussian Academy of Sciences, he built an observatory on a hilltop (Kirchberg) west of Kaiserslautern at Landstuhl, where he subsequently acquired a series of first-rate telescopes, including a 176-mm Pauly apochromat, as well as a 200- and 260-mm Schmidt reflectors (Behm, 2011). In 1911, thanks to Ellen Waldhauser, a wealthy benefactor, he acquired a superb if rare design 385-mm diameter Schupmann-Medial apochromatic refractor for his imposing new observatory on Kirchberg (Figure 2) (Fauth, 1959; Sheehan and Dobbins, 2011; de.Wikipedia, 2019).

As Joseph Ashbrook (1965) indicated, "Fauth was perhaps the most capable and versatile of all active visual observers of the moon between about 1890 and 1940. He combined descriptive selenography with cartography, measurements of craters, and statistical studies." In the process, he developed a very distinctive hachure drawing style (Figure 3), later replaced by contours to emphasize vertical relief (Figure 4).

In addition to the Moon, Fauth was also a keen solar and planetary observer, most notably of Jupiter and Mars (Fauth, 1924). He undertook extended surveys of Jupiter's ever-changing cloud drift rates, including the Great Red Spot and applied his equally meticulous drawing style in depicting these subtle features (Figure 5). In the same monograph, his masterful renditions of Martian albedo features are also noteworthy (Figure 6). In his summary of the 1924 opposition of Mars, he remarks on the appearance of the "Kanäle" (canals), which he pointedly puts in quotation marks, "They appear as wide, soft-toned lines and are only rarely seen

Figure 3 — The crater Clavius as portrayed by Fauth using hachure style (public domain)

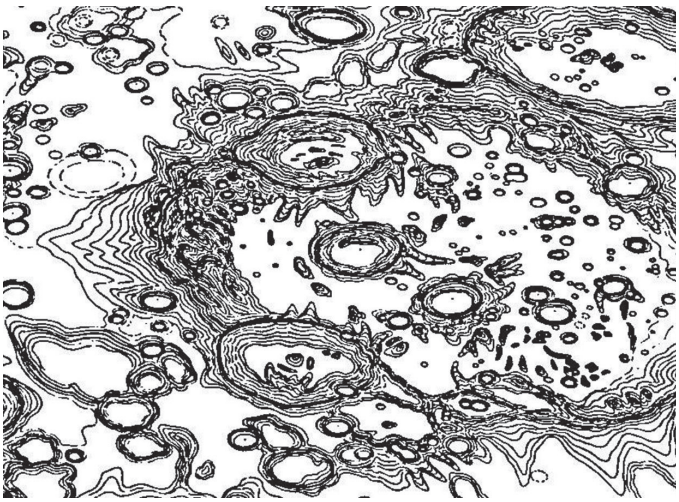


Figure 4 — Clavius in semi-contour style used by Fauth in his later work (public domain)

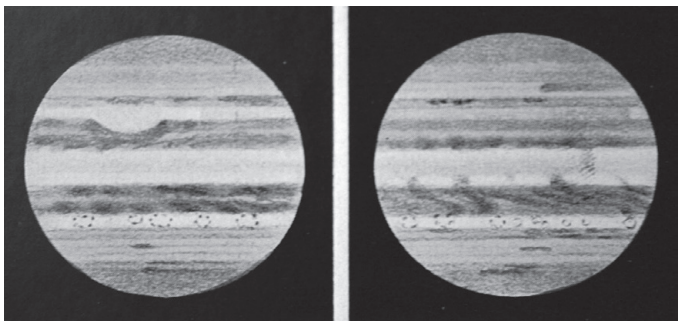


Figure 5 — Sketches of Jupiter by Fauth in 1916-17 (K. Brasch Archives)

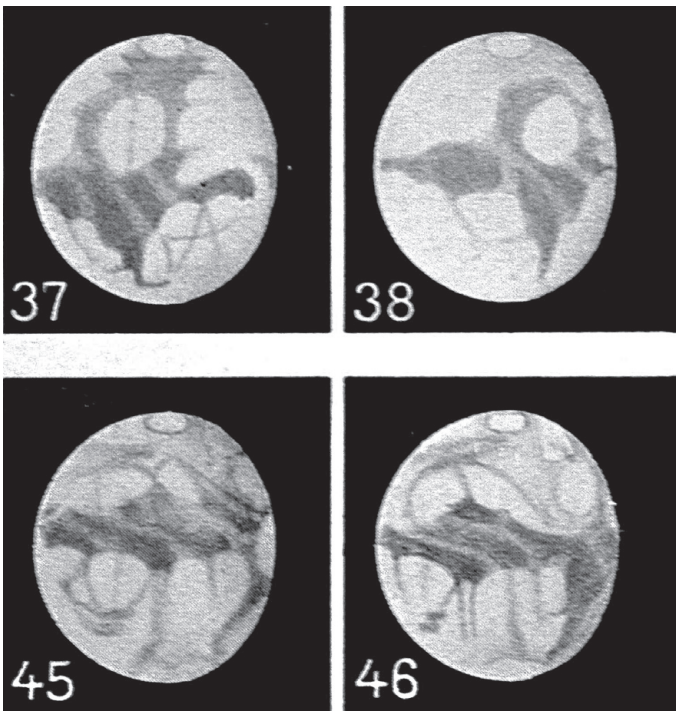


Figure 6 — Sketches of Mars by Fauth from the 1924 opposition (K. Brasch Archives)

extending from the dazzlingly bright south Polar Regions." This suggests that Fauth viewed the canals not as artificial structures but natural contrast features and quite diffuse at that. Although by 1924, the "artificial vs natural" debate over the supposed Martian canals had subsided, it was really not fully resolved until the *Mariner 4* flyby in 1965 (Brasch, 2018).

After publication of two notable monographs (Fauth, 1893; 1895), as well as articles in German astronomical journals, Fauth gained considerable recognition both as observer and cartographer. He also corresponded regularly with other astronomers, including most notably Max Wolf at the University of Heidelberg, a pioneer in astrophotography and discoverer of several minor planets and comets (Fauth, 1959). To quote Thomas Dobbins (2014), "The depth of understanding of the nature of lunar topography demonstrated by Fauth was superior to that possessed by the majority of his contemporaries. The morphology revealed by his methodical measurements of

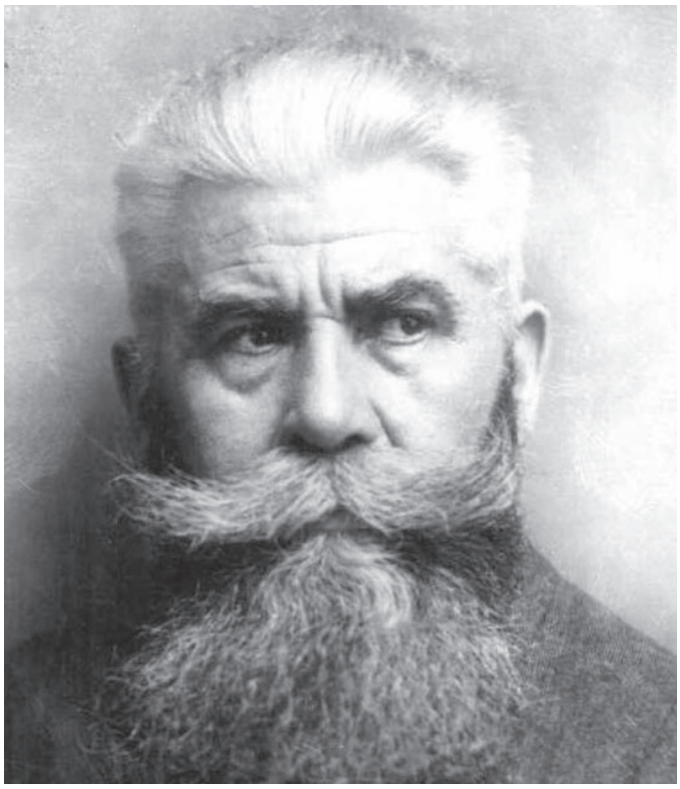


Figure 7 — Hanns Hörbiger in later life (Wikipedia)

the depth-to-diameter ratios of hundreds of lunar craters and the slopes of their exterior and interior walls led him to reject the prevailing volcanic theories of the origin of lunar craters." The volcanic origin of the craters was very much favoured in the late 1800s thanks to Nasmyth and Carpenter's compelling, if flawed, "fountain" theory and their magnificent plaster of Paris models of the lunar surface (Brasch, 2015).

Fauth's reputation continued to rise after that. Because of truly acute vision and careful observation, he discovered numerous new craterlets, rilles, and fissures on the Moon that had not been previously charted. He published his first significant book (Fauth, 1906) and the only one translated into English in 1907 under the title *The Moon in Modern Astronomy*.

Unfortunately, just as he was gaining recognition as a talented astronomer and was even offered a position at the newly established National Observatory in Mexico City, Fauth came under the influence of another amateur astronomer, Hanns Hörbiger (Figure 7). This eccentric individual, a successful Austrian inventor and engineer, was also the author of several fanciful cosmological theories none of which were based on solid science (Ashbrook, 1965; Sheehan and Dobbins, 2001). Most infamous was his glacial cosmogony theory, which among other things, held that ice is universal in the cosmos and covers most planets, comets and meteorites, solar explosions and sunspots result from chunks of ice falling into it, all geological events are catastrophic and rapid, humans and dinosaurs co-existed, and so forth. Regrettably, despite its total lack of scientific validity, this theory still has some adherents

Figure 8 — Fauth & Co, surveyor telescope ca. 1880. (public domain)

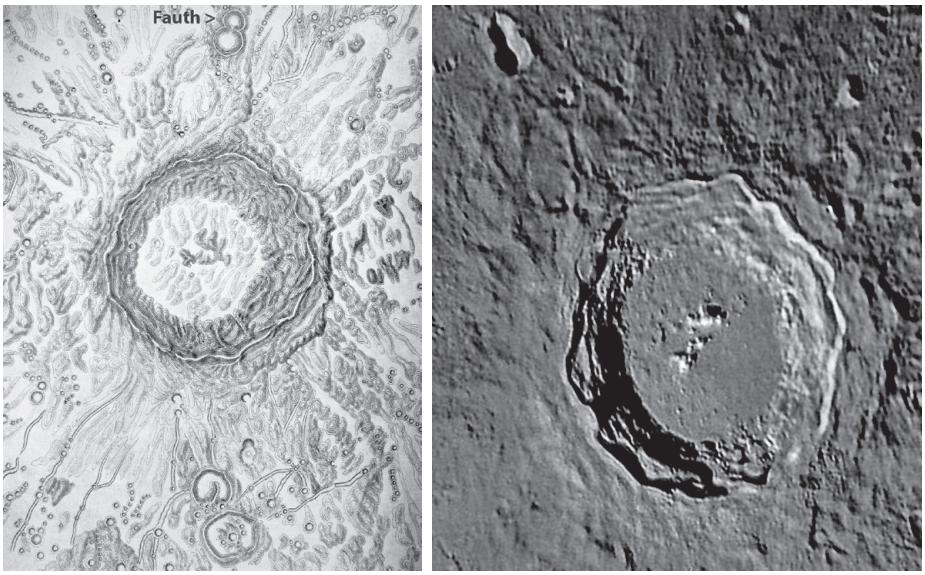
today (Topper, 2004) under the acronym of WEL, after the German *Welteislehre* (Cosmic Ice Doctrine).

After publication in 1913 of his and Hörbiger's nearly 800-page tome *Hörbigers Glazial-Kosmogonie* (Hörbiger's Glacial Cosmogony) in 1913, Fauth's astronomical reputation was irreparably damaged (de.wikipedia 2019). This was an erratic, pseudo-scientific work and immediately rejected by the scientific community at the time (Ashbrook, 1965). Both authors, known for their unyielding and combative personalities, attributed their rejection by others as reactionary and jealousy. Although some authors maintain that Fauth tried to distance himself from the glacial cosmology idea later in life (Behm, 2011), that seems unlikely given his rigid personality. Others, who grudgingly still valued Fauth's observational work, regarded him as gifted but deranged. For a full analysis of Hörbiger's delusional and paranoid personality, see Sheehan and Dobbins (2001).

Despite his fall from scientific grace, Fauth continued working on his planned 1:1,000,000 scale *Grosse Mondkarte* (Great Moon atlas) after Hörbiger's death in 1931. On 1928 May 24, while residing in Munich, he wrote to Yerkes Observatory in what appears to be an attempt to regain acceptability as a legitimate astronomer. Although it is not clear he ever sent it, the letter is addressed "Dear Sirs" and proceeds as follows: "I have the honor of sending you some specimens of the results of my studies of the moon obtained by the 385 mm Medial of my observatory at Landstuhl. You would oblige me very much by putting at my disposal photos of the moon of recent date obtained by the 40-inch refractor of the Yerkes Observatory, as these would advance considerably my studies. Thanking you very much in anticipation, I am, Dear Sirs, yours very truly (signed) Phil. Fauth."

Sadly, Fauth did not finish his *magnum opus* by the time of his death in 1941. He did, however, finish some 22 sheets toward that end. In 1936, he published *Unser Mond* (Our Moon), by far his most useful and acclaimed publication (Ashbrook, 1965). His son Hermann (Fauth, 1959) finally completed his father's *Mondatlas* (Fauth, 1964), by which time it had become largely obsolete, except as a useful historical reference.

Philipp Fauth's tarnished reputation aside, his skills as lunar and planetary observer and cartographer were acknowledged in a number of ways. Streets bear his name in Kaiserslautern and other locations where he worked, but more importantly, in 1923 the International Astronomical Union named a lunar crater after him (de.wikipedia, 2019). This small, double crater, is prominently located just south of majestic Copernicus (Figures 8 and 9), a fitting tribute to a very skilled, if misguided, amateur astronomer.



Postscript

The Fauth family name is also linked with astronomy in another, more unusual, way. In an informative article by Bart Fried (1994), titled *The German-American Connection*, the author relates the history of three German optical entrepreneurs who came to the United States in the late 1800s. Camill Fauth (1847–1925) joined

Figure 9 & 10 — The great crater Copernicus as portrayed by Fauth (left) and as imaged by the author (right). The doublet crater Fauth lies just above the southern wall of Copernicus. (Wikimedia and K. Brasch, respectively)

countryman and instrument maker William Würdermann in 1870, to help build and maintain instruments for the ongoing United States Coast Survey ordered in 1807 by Thomas Jefferson. Würdermann established a profitable business in Washington, DC, producing ever-better instruments including portable transit, surveyor, and zenith telescopes. Eventually Fauth and brothers-in-law George N. Saegmuller and Henry Lockwood established their own business in 1874, under the name of Fauth & Co. They manufactured various surveying and measuring instruments (Figure 10), as well as equatorial mounts for astronomical telescopes. In the process, they won awards at the Cincinnati Industrial Exhibitions of 1876 and 1882. After Fauth retired back to Germany in 1887, Saegmuller continued trading under the name Fauth & Co, until 1892. The largest known telescope made by Fauth & Co is an 8-inch refractor at Santa Clara University in California (Fried, 1994). ✶

Klaus Brasch is professor emeritus of biology at California State University, San Bernardino, a docent in the public program at Lowell Observatory, and a long-standing member of the RASC.
He thanks Dr. Dale Cruickshank and Dr. William Sheehan for a generous gift of original Philipp Fauth documents, and Lowell Observatory archivist Lauren Amundson for ongoing assistance.

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The Biological Basis for the Canadian Guideline for Outdoor Lighting 1. General Scotobiology

by Robert Dick, M.Eng., P.Eng., FRASC

Abstract

The subject of limiting outdoor lighting seems straightforward—it saves electricity and reduces glare, but society has a predilection for activity at night that requires more than natural light. This extends beyond urban areas. "Cottage country" is well lit along the shoreline, and even campgrounds filled with amateur astronomers have lots of unshielded lights. Although these tend to be red, they still undermine our night vision (Dick, 2016) and change the nocturnal ambience.

The main problem of whether outdoor lighting is good or bad depends on who is judge. Is there a less equivocal way to assess or define acceptable outdoor lighting, especially in rural areas? Must rural lighting follow "Best Practices" for cities?

This is the first in a series of papers that will discuss the science behind the ecological impacts of artificial (anthropogenic) light at night. It will propose rational solutions to reduce these impacts and will define the characteristics of artificial light that minimize these disruptions that we call lighting with "low-ecological impact."

Although taking an ecological approach to outdoor lighting is unusual, we have observed that if the nocturnal environment is preserved for wildlife, it is usually sufficient for astronomy. Although it is understood that observatories may require a curfew during the three weeks centred on the new Moon. This first paper will set the stage for this somewhat unorthodox exploration into light.

Scotobiology

Scotobiology is the study of the biological need for periods of darkness. Unlike photobiology, it concentrates on the benefits of darkness, not the benefits of light— subtle but significant. This study began following the 2003 Ecology of the Night Conference hosted by Parks Canada in the Muskoka District north of Toronto. Although light pollution was generally believed to be a problem for astronomers, it became evident from the diversity of research topics; it is an ecological and human health issue.

Scotobiology transcends the usual fragmented fields of animal biology and behaviour, and human heath and vision, which