

## Carbon star V Aql in Aquila – History and physical nature

Dr. Wolfgang Steinicke, FRAS

V Aql is an extremely red star of about 7 mag, located in the southern part of Aquila between  $\lambda$  Aql (3.4 mag) and 12 Aql (4.0 mag), the head of the Eagle (Fig. 1). Though the colour is already visible in a small telescope, a larger magnification is recommended, especially when the variable object is at minimum. Here a detailed presentation of the historic background is given, not yet available in the literature. Perhaps this gives an appetite to look up the remarkable star in the summer sky. V Aql is one of my favourite targets, using apertures up to 20-inch. Visitors are always astonished when gazing this strange orange-red spot on a dark background.

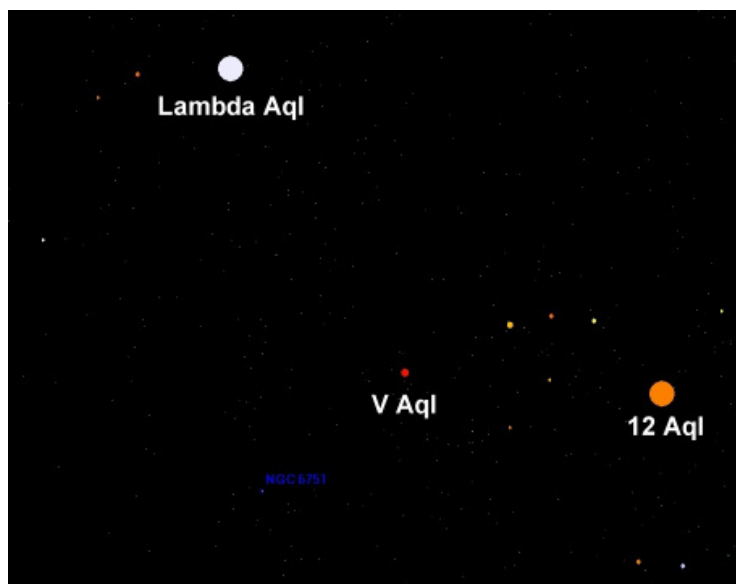


Fig. 1: Location of V Aquilae

### Discovery and early observations

Often Julius Schmidt, Director of Athens Observatory, is mentioned as the discoverer of V Aql. He found it on 18 July 1872 with the 6.2" Plössl refractor. The observation was announced in *Astronomische Nachrichten* (AN) 80, 81 (1872). The article contains Schmidt's list of red stars, where the object is no. 126, described as "extraordinary glowing fiery-red". It is noted that Lalande and Bessel had measured its position, but without mentioning the colour, which is "even more strongly marked than in  $\mu$  Cephei or R Leporis" (Herschel's Garnet Star and Hind's Crimson Star, respectively). Schmidt identifies the object as "Lal. 35611, Weisse 1367". Curiously, Jérôme de Lalande ignored the colour of the star, though he was the first to publish a list of 'Étoiles Rouges' in 1804. The latter designation refers to a new reduction of Bessel's zone observations by Maximilian v. Weisse (Krakow, 1846). The Athens astronomer observed the star from July 1872 to December 1883, recording a slow brightness decrease (see the report of B. Sticker, AN 231, 369 (1928)).

Obviously, Schmidt was not aware of a note given in the second edition of Webb's 'Celestial Objects for Common Telescopes', published in 1868. On p. 189 the red star is described as "truly striking and wonderful [...] fine specimen of a remarkable and beautiful class". Moreover, George Knott is mentioned as discoverer! Knott, owner of the Woodcraft Observatory in Cuckfield, Sussex, found the object in October 1861. For this was not published until 1871 (see below), there must have been a private communication with Webb. The discovery note for V Aql is contained in Knott's paper on the variable star U Cygni, dated 16 September 1871 (about a year earlier than Schmidt's report); see AN 78, 219 (1871). He wrote: "I came across this star accidentally in sweeping in October 1861, when its fine colour, which so far as I am aware had not been previously noticed, struck my eye. Its magnitude is certainly slightly variable." It is unknown whether Knott used a small sweeper or the main instrument, a 7.3" Clark refractor.

The next to pipe up was Eduard Schönfeld, Director of Mannheim Observatory and a distinguished variable star observer. In a letter to the AN, dated 17 September 1872 (see AN 80, 137 (1872)), he criticised Schmidt's list of red stars and noted that no. 126 was already seen by Knott. Moreover, Schönfeld mentions that the star appears in Bessel's zone 187, observed on 18 September 1823 and described as "very red". Bessel's important remark was omitted in the catalogue of Weisse, consulted by Schmidt ('Weisse 1367' is corrected to 'Weisse XVIII 1442'). This implies that Friedrich Wilhelm Bessel is the very discoverer of V Aql! Schönfeld writes that he has observed the star several times since 1863, but without detecting any brightness change. It was later included in his monumental 'Südliche Bonner Durchmusterung' as BD  $-5^{\circ}$  4858 (7.0 mag).

Triggered by Schmidt's publication, three letters on the 'New Red Star' appeared in the *Astronomical Register* (AR). The first was written on 23 September 1872 by W. G. Lettsom of Lower Norwood; see: AR 10, 264 (1873). It is a mere translation of Schmidt's note and, obviously, should introduce the star to UK astronomers (also reminding of Webb's book). One of them – George Knott – reacted on 19 November, writing that he had observed the star already in October 1861: "like Schmidt, I had the idea that it had not been noticed previously [...] however Schönfeld states that the star was observed by Bessel" (AR 11, 19 (1873)). In the following letter, T. Wilson (Thornton in Craven) remarked on 11 December 1872 that, by Lettsom's hint, he looked up the star with his equatorial and found it "a more brilliant scarlet than R Leporis; but could not observe both simultaneously for comparison, without being up inconveniently late". The object is not listed in Frederik Schjellerup's 'Catalog der rothen, isolirten Sterne' of 1866, but appears as no. 222c in the second edition (*Vierteljahrsschrift der Astronomischen Gesellschaft* 9, 252 (1874)). Two years later, John Birmingham included it in his 'Catalogue of Red Stars' as no. 483, noting 'variable (?)'; see: *Mem. Roy. Irish Acad.* 24, 249 (1876).

A debate came up about the question, who detected the variability of the red star. Though Knott and Schmidt already noticed it, the quantitative confirmation is due to Vojtěch Šafařík (Prague), finding a slow variation between 6.7 and 7.2 mag in 1884-85; see: AN 120, 277 (1889). The further story is contained in Vol. 13 of the *Astronomical Journal* (1893). On p. 13 Edwin Sawyer (Brighton, Mass.) claimed to be the discoverer in his paper 'On a new Variable in Aquila'. Based on observations in 1890-92, he derived a range of 7.6 – 8.0 mag and a period of "moderate length if regular" (obviously, the brightness scale was not unique at that time). His claim was rejected by Heinrich Kreutz (Kiel), summarising the issue on p. 76. Sawyer replied (p. 77), doubting the reliability of earlier results: "many announcements of the kind are passed by as being either very doubtful or worthless". Šafařík reacted too (p. 85), stating that the variability of 'Birm. 483' was "discovered by me many years ago, and duly announced". Finally, we find on p. 89 Seth Chandler's 'Second catalogue of Variable Stars', listing the star as '6834' (not a running number). In the notes Knott, Schmidt, Šafařík and Sawyer are mentioned. Moreover, the official designation 'V Aquilae' is introduced here (following U Aquilae, discovered 1886 by Sawyer). It was used, for instance, by Ellard Gore in his book 'The Stellar Heavens' (1903, p. 63), in Thomas Espin's (fourth) list of red stars (*MNRAS* 58, 443 (1898); entry no. 167) and, particularly, in the standard work on variable stars: 'Die Geschichte und Literatur der Veränderlichen Sterne' by Müller and Hartwig (1918).

The first photographic images of V Aql were taken by Williamina Flemming in 1890, using the 8" Draper refractor at Cambridge (Mass.). They confirmed the variability of the red star; see: AN 126, 163 (1891). The term 'carbon star' – influenced by spectroscopy – was popularised by Agnes Clerke in her book 'Problems in Astrophysics' (1903), which contains a chapter on the matter (p. 215).

### Physical nature and data

V Aql is a carbon star, which means a late-type giant, similar to a red giant whose atmosphere contains more carbon than oxygen. Due to the low temperature, the two elements combine in its upper layers, forming carbon monoxide, which consumes all the oxygen, leaving carbon atoms free to form other carbon compounds. This gives the star a 'sooty' atmosphere and a strikingly red appearance. The spectrum is dominated by strong absorption lines of the molecules C2 and CN. V Aql is a semiregular variable of type SRb with a period of about 335 days (the main data are given in the table). Other bright examples of carbon stars are R Lep, T Lyr, V Hya, S Cep, 19 Psc and Y CVn (Secchi's 'La Superba').

Tab. 1: Data of V Aql

Position (2000):	19 04 24.2 –05 41 05 (Aql)
Visual magnitude:	6.6 – 8.4 mag
B–V color index:	+4.32
Spectral type:	C5 (Np)
Temperature:	2611 K
Distance:	1210 ± 420 ly
Other designations:	Lalande 35611, BD –5° 4858, Birmingham 483, HD 177336, SAO 142985