



Figure 4 — A quadrant ambiguity in the solution of the equations gives rise to two possible ellipses. The ambiguity is immediately resolved by inspection of the velocity vector.

The time of the encounter was 2008 October 7.9000, so that the time of perihelion passage was 44.4 days before this, which was

$$T = 2008 \text{ August } 26.5, \quad (18)$$

and the calculation is complete.

The following table summarizes the above discussion and gives three additional data sets for practice.

| Time of event (day of year) | Speed km s <sup>-1</sup> | $\psi$ deg | $a$ AU | $e$   | $\omega$ deg | $T$ (day of year) |
|-----------------------------|--------------------------|------------|--------|-------|--------------|-------------------|
| 281.9                       | 38.0                     | 75         | 2.686  | 0.739 | 302.4        | 239.5             |
| 302.6                       | 24.0                     | 186        | 0.740  | 0.888 | 197.2        | 259.6             |
| 329.1                       | 19.2                     | 205        | 0.631  | 0.876 | 228.4        | 281.0             |
| 304.5                       | 31.2                     | 142        | 1.108  | 0.264 | 121.7        | 240.1             |

The reader may notice that, in each case, we have been able to determine the four elements,  $a$ ,  $e$ ,  $\omega$ , and  $T$  from apparently only three data, namely the velocity (speed  $V$  and direction  $\psi$ ) and date of the occurrence. But, in fact, a fourth datum is given, namely the distance from the Sun, which was 1 AU.

Next time, in the second part of this article, we shall try the calculation in three dimensions. ●

### Reference

Van de Kamp, P. 1960, JRASC, 54, 167

Previously, we had calculated that the period  $P$  is 1608.1 days, so that  $MP/360 = 42.4$  days.

# Daniel Knode Winder (1828-97)

## the First President of the Toronto Astronomical Club

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**ABSTRACT** D.K. Winder was born and died in the U.S.A., but he lived in Canada for about fifteen years. During his time here, he became the first president of the Toronto Astronomical Club (1868) and a founder of the Toronto Entomological Association (1877). He wrote many religious articles and books and a booklet on mushrooms in which he identified a new species. Two letters to *Scientific American* in 1869 show he was a pioneer in studying the spectrum of the aurora. He was also an early “sidewalk astronomer,” taking his telescope to the people.

### Introduction

The Toronto Astronomical Club, the first of its kind in Canada, is just one year younger than our nation. After a period of doubtful existence and a number of name changes, the club evolved into the society we know today as the RASC. With the passage of 140 years, few records of the club’s beginnings remain, and references to its first president,

Daniel Knode Winder, are widely scattered. No obituary of him ever appeared in the publications of the Society — just a brief sentence about his passing. An obituary was published in a Detroit newspaper, together with his likeness (Figure 1).

Nearly everything that has been written of the earliest days of the Toronto Astronomical Club, or Society as it became in 1869, originates with Andrew Elvins (1823-1918). He was the driving force behind its creation and knew Winder well. It may

seem strange that Elvins, always considered the energizer of the astronomical society, was not the first president. In fact, he never held that office. His deference to Winder, whom he considered to have a better education, was mirrored at the time of the Society's incorporation in 1890, when he demurred in favour of Charles Carpmael, the director of the Toronto Observatory.

By the early years of the twentieth century, the Society was well established and some members began to realize even then that its history was in danger of slipping away. Perhaps on his own initiative, Elvins dictated some recollections, first in 1904 to L.H. Graham, and then in 1913 to C.A. Chant. They both took down in shorthand, and then transcribed, what Elvins told them. In 1917, A.D. Watson added his own comments in his presidential address published in the *Journal*, claiming that Winder was "a former lecturer on Astronomy in a United States College," and that he was "a kindly and sanguine person and very popular." In 1919, Chant clearly used the dictated notes in writing Elvins' obituary for the *Journal*. Here is a quote from that obituary that refers to Winder:

*During the American civil war, [Elvins] came in contact with Daniel K. Winder, who was an enthusiastic student of science. He had been a professor in an Ohio college (at or near Cleveland), but was a pacifist, being opposed to war under all circumstances, and also holding the view that the Bible tolerated slavery. Consequently, he found it very uncomfortable in Ohio and so came to Toronto, where he settled and obtained a living as a printer. He also preached for the Disciples [of Christ], but as there were very few of that religious view in Canada, they could not employ a regular preacher. Mr. Winder was a good botanist, and while on pleasant walks he made Mr. Elvins acquainted with the various species of trees, and also introduced him to the use of mushrooms. Mr. Winder was the author of a book on the mushrooms of Canada. Besides this, he was well informed in astronomy and possessed a two-inch telescope. Mr. Elvins was allowed to use this and spent many pleasant hours with it.*

Though nothing in that passage contradicts anything that Elvins said, the original transcriptions suggest that Winder had a hard time making ends meet. Elvins says the Disciples would have provided the necessities of life for Winder and gives his opinion that Mrs. Winder was a better printer than



Figure 1 — This line engraving is reproduced from a microfilm copy of Winder's obituary in *The Evening News* (Detroit) 1897 November 1, 2.

her husband. Some corroboration that his printing business was not a great success may be found in the 1876 city directory where his occupation is no longer printer but pianoforte dealer.

## Recent Biographical Research on Winder

In recent years, online genealogical records and other databases (especially [www.ancestry.com](http://www.ancestry.com)) have allowed a fuller picture of Winder to emerge. Daniel Knode Winder was born in Hagerstown, Maryland, in 1828, the son of Daniel Winder, a clergyman, and Catherine Knode. His ancestors had come to the United States from England in the early 1700s. He may have moved to the American Midwest with his parents; the 1840 census for Cambridge Township, Wayne, Indiana, lists a Daniel Winder as the head of a household with six children under the age of 15. Certainly, by the time he was in his teens, Daniel K. Winder was in New Paris, Ohio, where he published a small religious monthly, the *Reformer*, from 1843 to 1845. After marrying Mary Jane Miller in Champaign County, Ohio in 1848, they had three children — two girls, Ida May and Jennie, and a boy. Champaign County seems to have been a centre of settlement for a number of branches of the Winder family. The 1850 US Census shows Daniel K. Winder in Campbell, Kentucky; his father was in nearby Jefferson Township. By 1853, and for the next five years, he is listed as a printer in Cincinnati city directories. At about the same time, he took out six US patents, mainly for improvements to printing, but one was for a bed-bottom and another for a method to raise water. The 1860 Census puts him in Cuyahoga, Ohio, his parents now in Millcreek Township, Ohio, where they ended their days. In 1861-62, he was pastor of Franklin Circle Christian Church in Cleveland. His son Daniel Carey was born in 1863 near Urbana, Ohio.

In an article about this son in *Landmarks of Detroit*, his middle name is spelled Cory, and it is stated there that the family moved to Toronto in 1864. Otherwise, the first indication of the Winders' presence in Toronto dates to 1866 when Daniel K. Winder printed a pamphlet and appears in the city directory.

Another conscientious objector who came north during the Civil War was John Muir (1838-1914). He spent two formative years in Meaford, Ontario, from 1864 to 1866, where he joined the Disciples church. After the war ended, he moved to California, where he became a renowned conservationist. Though there is no evidence that Winder and Muir knew one another, it is not difficult to think of them as kindred spirits, seeing God's grandeur in nature and the cosmos.

## Winder's Astronomical and Technological Achievements in Toronto

As mentioned above, Winder's connections with Elvins and the astronomical society began in 1868 or perhaps earlier. There

is little note by Elvins (1868) in the *Astronomical Register*, an English periodical for amateur observers that had started up in 1863. In it, Elvins alludes to observations he and Winder made jointly of a sunspot that June. They were convinced that it was rotating — just an illusion no doubt, but indicative of the care they took in examining the detailed appearance of the spot.

For RASC members, Winder's two letters on the spectrum of the aurora in *Scientific American* of 1869 are probably his most striking contribution, since they were written when scientists were just beginning to grapple with the physical properties of the aurora. To put Winder's observations in context, note that Anders Ångström, professor of physics at the University of Uppsala in Sweden, was apparently the first person to study the auroral spectrum, when he observed a faint display of the northern lights during the winter of 1867-68. As part of his famous work *Recherches sur le spectre Solaire* published in 1868, Ångström wrote that the auroral light was almost monochromatic with a wavelength in the green part of the spectrum at  $\lambda = 5567$  [556.7 nm]. On widening the slit on his spectroscope, he found three feeble bands in the spectrum near Fraunhofer's F line [486 nm]. Ångström found it remarkable that he had observed this same auroral green line in the spectrum of zodiacal light and of sky-glow the previous year, yet it did not coincide with that of any gas, simple or compound, that he had studied. He concluded his article with a look to the future: "It follows from what I have said, that an intense auroral display ... will probably give a more complicated spectrum than the one I have observed. Supposing that to be true, there will be some hope of explaining more easily the origin of the rays found and the nature of the phenomenon itself [my approximate translation]."

Winder may not have read Ångström's own words, but he was aware of his research from reading an account of a meeting of the RAS, as reported in the *Astronomical Register* for May 1869. J.J. Plummer of Durham presented a paper based on his own observations of the auroral spectrum, and in the ensuing discussion led by William Huggins, G.B. Airy, and Warren De La Rue, Ångström's work was alluded to. Observers like Ångström, who used a grating to disperse the light into its spectrum, calculated the wavelengths of spectral lines they saw with their spectroscopes. Those using a prism, like Plummer and presumably Winder, measured the relative position of the lines, and inferred the wavelengths in relation to known lines, such as the ubiquitous D lines of sodium near 589 nm and other Fraunhofer lines.

Winder, in his first letter to *Scientific American*, published 1869 October 9, described the aurora he had seen on September 3 in terms that remind us that city residents in those days had very little light pollution to dim their fine views of the night sky. "[The] aurora borealis hung over us, waving like luminous canvas floating in the breeze, and forming a brilliant corona near the star Scheat, in Pegasus." He reported, "On this occasion I submitted the aurora to a careful spectrum analysis," a surprising accomplishment for an amateur just two years after Anders Ångström had examined the spectrum of the aurora for the first time. Winder went on to

say, "I succeeded in obtaining a distinct spectrum, consisting of one very bright line in the yellow and one faint line in the green. The bright line was close to the sodium line D, and coincident with an air line in the solar spectrum. The dim line in the green I could not identify as belonging to any known substance."

It may be that Winder even built his own spectroscope. His obituary in the Detroit *Evening News* of 1897 November 1 credits him with building "the first spectroscope in the Dominion." While that priority is probably unverifiable, it is known that in 1869 Winder spoke on "The construction and application of the spectrograph to celestial chemistry" to the Astronomical Club and to the Canadian Institute.

The same obituary also states that he built the first Edison phonograph and the first Bell telephone in the Dominion. Though these claims are dubious, it is not unreasonable that he built such devices. Instructions on how to build a telephone, for instance, appeared in *Scientific American* for September 1878. The earliest reference to the phonograph in Toronto newspapers seems to be 1878 May 11, the year before Winder left to return to the States.

By the time Winder wrote his second letter to *Scientific American*, dated 1869 November 15, and published December 25, he had studied more auroral spectra and was more confident. "The bright line seen by myself, I found to be very nearly 557 [nm]" he wrote, and went so far as to attribute it to oxygen. He based his conclusion on telluric absorption lines seen in the solar spectrum when the Sun was near the horizon. His attribution was not that surprising, considering that nitrogen and oxygen make up 99% of the Earth's atmosphere, but it is an interesting coincidence that someone in Toronto should associate the green line with oxygen, perhaps for the first time, many decades before its firm identification with that gas was established in 1925 by University of Toronto professor J.C. McLennan and his graduate student Gordon Shrum. The spectral line at wavelength 557.7 nm comes from an electron transition in oxygen that requires about 0.4 seconds to occur. Normally such a transition cannot take place, since collisions will de-excite the atom much faster, but in the rarefied upper atmosphere (100 km or higher), the transition does occur. Of course, no one in Winder's time knew anything about atomic structure and would not have understood what McLennan and Shrum proved, but his scientific contemporaries did find his letters interesting.

P.H. Vander Weyde, Chair of Industrial Science at Girard College, Philadelphia, responded to Winder's first article with a somewhat critical letter in *Scientific American* (1869 November 20). Winder's second letter, partly in reply to Vander Weyde's, was reproduced in *Scientific Opinion*, an English periodical that advertised itself as "a weekly record of scientific progress at home and abroad."

### Winder the Naturalist and Life in Canada

Sometime after 1869, Winder must have briefly returned to the States, for passenger lists show his arrival in Canada from

Cleveland in 1871, the same year that he wrote a 23-page booklet *Mushrooms in Canada*. He carefully described the various species of mushroom he had seen in his adopted land, identifying which he had eaten, and introducing the reader to a new species, *Lactarius Canadensis*. He clearly had a deep interest in the natural world and was a friend of the well-known Toronto botanist, William Brodie (1831-1909). Dentistry provides evidence of their acquaintance at this time, for Brodie became a member of the Royal College of Dental Surgeons in 1870 and Winder was a special lecturer to the Ontario Dental College 1871-2. Later, in 1877, they were founding members of the Toronto Entomological Association. Brodie was President and Winder was first Vice-President. Winder collected the society's first specimen — a larva of the common Tiger moth, *Arctia isabella*.

During the years 1872-79, Winder served as assistant chaplain of the provincial lunatic asylum in Toronto. The city directories show he lived on McGill Street (or Magill as it was spelled then) and that he was also working as a printer. He is known to have printed a 64-page sermon by the Reverend Thomas Rattray in 1878, when Winder's son, after an apprenticeship, entered the trade with him.

### Later Years in Detroit

The family moved in 1879 to Detroit, where Winder's name appears in directories as a printer. He was well known in that city as an amateur astronomer, showing the transit of Venus to throngs of people in 1882, and setting up his telescope on pleasant evenings on the city's Campus Martius (Figure 2). He would charge spectators 5 cents for a look at the Moon and planets, along with a lecture. After his wife's death in 1891, he wrote and printed three religious books between 1893 and the time of his death in 1897. Two were on the subject of *Positive Proofs of a Future Life*.

Some of these facts come from Winder's obituary in the Detroit *Evening News* of 1897 November 1, which refers to him as Professor Winder, and the "Campus Martius Astronomer." It states that he was formerly a professor of music at Hygun College, Cincinnati, but this is likely a misprint for Hygeia Female Athenaeum, part of a mid-century Utopian community near Cincinnati. No record of Hygun College, and no record of Winder at Hygeia, could be found.

In addition to his booklet on mushrooms and his letters on the aurora, Winder wrote several religious articles. There is indirect evidence that he wrote on other topics. Janet Brodie, in her book *Contraception and Abortion in Nineteenth-Century America*, mentions a pamphlet by Daniel Winder entitled *A Rational or Private Marriage Chart: For the Use of All Who Wish to Prevent an Increase of Family* (1858) and the *History of Detroit and Michigan* (1884). She states that he was the author of "a work on The Aurora Borealis." Presumably, this was not just the letters in *Scientific American*, though no trace has been found of anything more comprehensive.



Figure 2 — Daniel K. Winder with his telescope on Detroit's Campus Martius (date unknown). The sign attached to the brace on the tripod says "Sunspots Today." (Courtesy of the Burton Historical Collection, Detroit Public Library)

Winder was survived by his three children, Mrs. A.J. Roberts of Chicago, D.C. Winder and Mrs. A.W. Carkceck, of Detroit. He was buried in Woodmere Cemetery, Detroit.

### Conclusion

Winder's frequent moves and many occupations reinforce the notion that he struggled throughout his life to make ends meet. He had an active interest in the latest technological and scientific advances of his age and a commitment to popularizing astronomy. At a time when astronomy was seen by many as a part of natural theology, his deeply held religious beliefs and strong principles made him well-suited to be the first president of our Society 140 years ago.

### Notes and Acknowledgements

Rather than giving an extensive list of references, I have identified many sources within the article. Further details can be found in the "Winder" file of the RASC Archives, where I will deposit my research notes.

I am grateful to Ian Halliday, Don Lafontaine, and Hans Rollman for some expert advice. Members of the Winder family, Elna and Jay Thompson, as well as many archivists and librarians helped facilitate my research, most notably Ra Dajkovich-Graham of the Toronto Public Library. ●