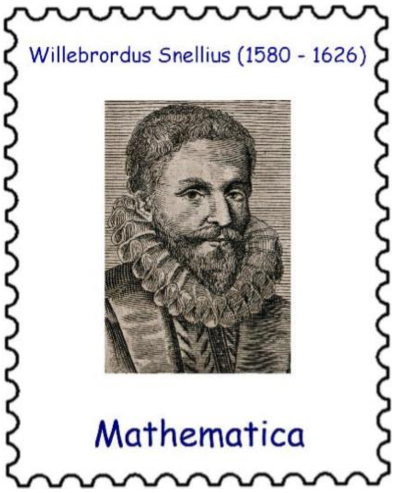
WILLEBRORD SNELL (June 13, 1580 – October 30, 1626)

by HEINZ KLAUS STRICK, Germany



WILLEBRORD SNEL VAN ROYEN, also known by the Latinised name WILLEBRORDUS SNELLIUS, was born in Leiden as the eldest son of RUDOLPH SNELL VAN ROYEN and MACHTELD CORNELISDOCHTER.

Both parents were from Oudewater and they were among the few survivors of the massacre carried out by Spanish troops in 1578 when they conquered the city after the citizens had joined the rebellious *Geuzen* ('The Beggars') as part of the Dutch struggle for freedom.

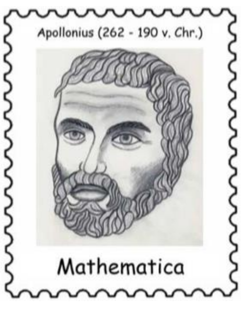
RUDOLPH SNELL, a student of the philosopher and logician PETRUS RAMUS, was appointed professor of mathematics at Leiden University (founded in 1575) in 1581. In addition to this activity, SNELL ran a well-attended public school in his house, where WILLEBRORD also received his schooling.

His father had intended his son to study law, but WILLEBRORD was more interested in mathematics. Privately he took lessons from LUDOLPH VAN CEULEN, a professor of arithmetic, surveying and fortification at the Leiden School of Engineering. Occasionally the gifted son took over his father's lectures in his absence.

From 1600 onwards WILLEBRORD travelled through several European countries. In Würzburg he visited ADRIAAN VAN ROOMEN, in Prague he carried out celestial observations under the guidance of TYCHO BRAHE.

After BRAHE's unexpected death in October 1601, he continued to JOHANNES PRAETORIUS in Altdorf (near Nuremberg) and to MICHAEL MAESTLIN in Tübingen. SNELL then travelled to Paris to complete his law studies. There, however, he finally decided against the subject given to him by his father – and for mathematics.

After returning to Leiden, WILLEBRORD SNELL took on more and more of his father's teaching duties, finally also officially in return for payment.



He used the rest of his time to translate works by SIMON STEVIN (1448-1520) and LUDOLPH VAN CEULEN from Dutch into Latin, so that they could be read by other scientists.

He also wrote commentaries on writings by PETRUS RAMUS (1515-1572) and attempted to reconstruct two lost books by APOLLONIUS OF PERGA (265-190 BC).

After examinations in grammar, rhetoric, logic, arithmetic, geometry, algebra, physics, optics, astronomy, geography, *gnomonica* (construction of sundials), statics and ethics, SNELL obtained the title of *Magister artium* in 1608.

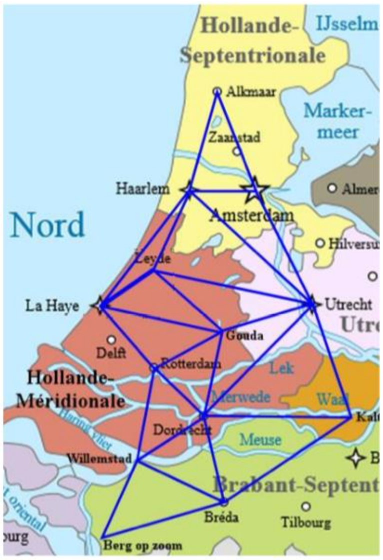
In the same year he married Maria De Langhe, with whom he had at least seven children (only three of whom survived childhood).

After his father's death in 1613, he officially became his father's successor in the chair of mathematics. However, he did not receive his full salary until 1618.

In 1626, Willebrord Snell died at the age of 46 after suffering from colic.

In his main work *Eratosthenes Batavus de terrae ambitus vera quantitate*, published in 1617, he referrred to himself as the *Dutch Eratosthenes* – in allusion to the first attempt to determine the circumference of the earth.

Inspired by the ideas of Gemma Frisius on how surveys could be performed by triangulation, he was the first to carry out such a survey. Starting from multiple surveyed baselines lying between his house and a church in the neighbouring town of Zoeterwoude, he built a network of triangles between church towers in 14 towns (cf. the Wikimedia map Triangulation Pays-Bas Snellius), from which he was able to determine the distances between these towns, especially between Alkmaar and Bergen-op-Zoom, on the basis of only 54 angular measurements (approx. 130 km).



Since both places lay on meridians of longitude that differ by only 27', this resulted in a value for the circumference of the earth of 38,653 km (with a deviation from today's value of 40,075 km of approximately 3.5 %).

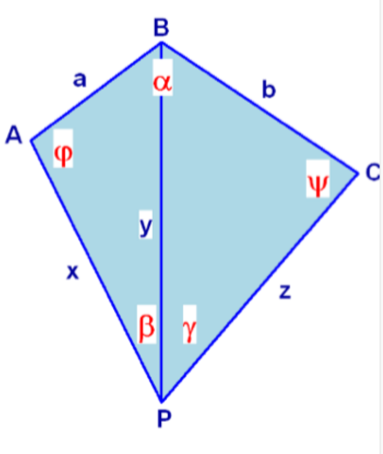
For the angular measurements he used a quadrant constructed of iron by the instrument maker Willem Jansz Blaeu (radius approximately 1.75 m with divisions of two angular minutes, cf. Wikimedia photo on the right by Prof. Jos van den Broek).

He dedicated his work to the governor of the Netherlands – a clever idea that earned him half a year's salary as a reward.

In order to be able to carry out the extremely complex calculations (without aids – logarithms were not yet known to Snell), Snell developed the method of so-called *backward cutting*.

75 years after Snell, the French mathematician Laurent Pothenot also described this procedure; hence one often finds the designation Snell-Pothenot procedure.

A quadrilateral *ABCP* is considered, of which the lengths of the lines $a = |AB|$ and $b = |BC|$ and the angles α, β, γ are known.



The lengths of the lines x, y, z, i.e. the distances of a point *P* from *A, B, C*, are sought.

According to the sine theorem:

$$y = \frac{a \cdot \sin(\varphi)}{\sin(\beta)} = \frac{b \cdot \sin(\psi)}{\sin(\gamma)}, \text{ so } \frac{\sin(\varphi)}{\sin(\psi)} = \frac{b \cdot \sin(\beta)}{a \cdot \sin(\gamma)} = k.$$

This results in $\varphi = 360° - (\psi + \sigma)$ with $\sigma = \alpha + \beta + \gamma$ and then

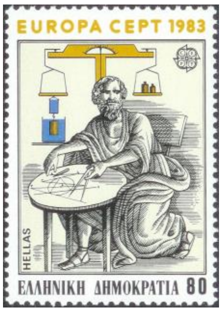
$$\sin(\varphi) = -\sin(\psi + \sigma) = -\sin(\psi) \cdot \cos(\sigma) - \sin(\sigma) \cdot \cos(\psi) = k \cdot \sin(\psi)$$

and $\tan(\psi) = -\dfrac{\sin(\sigma)}{k + \cos(\sigma)}$,

with which one can calculate the angle ψ, then the angle φ and finally the side lengths x, y, z.

SNELL also published several writings on astronomy, in which he used his own measurement data (*Descriptio Cometae*, 1619), but also data from TYCHO BRAHE and JOST BÜRGI (*Observationes Hassiacae* – the Star Catalogue of Landgrave WILHELM IV OF HESSE, 1618).

In both works, he proved to be a follower of the PTOLEMIC world view with the earth as the centre.



Like ARCHIMEDES, but with more precise intermediate values than the latter, SNELL determined the side lengths of a regular 96-gon inscribed or superscribed and obtained the value of π to 6 digits.

In his work *Cyclometricus* (1621), he also applied this method to a regular 2^{30}-gon, and even calculated π with 34-digit accuracy, while his teacher LUDOLPH VAN CEULEN, through years of calculations on a regular 2^{62}-gon using the original ARCHIMEDEAN method, only achieved an accuracy of 35 digits.

In 1621 he discovered the law according to which light rays are refracted when passing from one medium to another:

The constant *refractive index*, which depends on the optical media in question, results from the ratio of the sines of the angles of incidence and refraction measured to the perpendicular (*SNELL's law of refraction*) – but it was not published until 1703 by CHRISTIAAN HUYGENS, who rejected a claim of priority by RENÉ DESCARTES (*Dioptrique*, 1637).

Among the manuscripts of SNELL left behind was a draft of a work entitled *Dioptrica* – with hints that SNELL may have been inspired to his discovery by the writing *Treasure of Optics* by the Persian scholar IBN AL HAITHAM (965-1039).

Twenty years before SNELL, THOMAS HARRIOT had already found the rule; though the very first discoverer, however, was probably the Persian scholar IBN SAHL in 984.

In 1624 SNELL published his lectures on navigation. In doing so, he also examined the *curvas dos rumos* of PEDRO NUNES and introduced the term *loxodrome* for them, and this has been in general use ever since.

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https://www.spektrum.de/wissen/willebrordus-snellius-mehr-als-nur-lichtbrechung/1959523

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