Bürgi, Jost

Born **Lichtensteig, St. Gallen, Switzerland, 28 February 1552**
Died **Kassel, Germany, 31 January 1632**

Jost Bürgi was a clock maker, astronomer, and applied mathematician. His father was probably a fitter. Very little seems to be known about his life before 1579. It is probable that Bürgi obtained much of his knowledge in Strassburg, one of his teachers being the Swiss mathematician Konrad Dasypodius. An indication that he did not get a systematic education is the fact that Bürgi did not know Latin, the scientific language of his time. Nevertheless, he made lasting scientific contributions that prompted some biographers to call him the "Swiss Archimedes." Bürgi was married first to the daughter of David Bramer, then in 1611, married Catharina Braun.

Bürgi developed a theory of logarithms independently of his Scottish contemporary **John Napier**. Napier's logarithms were published in 1614; Burgi' s were published in 1620. The objective of both approaches was to simplify mathematical calculations. While Napier's approach was algebraic, Bürgi's point of view was geometric. It is believed that Bürgi created a table of logarithms before Napier by several years, but did not publish it until later in his book *Tafeln arithmetischer und geometrischer Zahlenfolgen mit einer gründlichen Erlüterungen, wie sie zu verstehen sind und gebraucht werden können.* Indications that Bürgi knew about logarithms earlier in 1588 can be obtained from a letter of the astronomer **Nicholaus Bär** (Raimarus Ursus), who explains that Bürgi had a method to simplify his calculations using logarithms.

Logarithms paved the way for slide rules because the identity $\log(a \cdot b) = \log(a) + \log(b)$ allows one to compute the product of two numbers a and b as an addition. Bürgi also computed sintables. These tables, called *Canon Sinuum*, seem however to have been lost. The sintables were used in a method called *prosthaphaeresis*, known to many astronomers in the 16th century. In this method, trigonometric formulas like $\sin(x)\sin(y) = [\cos(x-y) - \cos(x+y)]/2$ are used to reduce multiplication to addition. Bürgi is considered as one of the inventors of that method; other identities were used by Ursus, **Johannes Werner**, and **Paul Wittich**.

Another indication that Bürgi's discovery of logarithms was independent of Napier's is the fact that **Johannes Kepler**, who admired Bürgi as a mathematician, states in the introduction to his *Rudolphine Tables* (1627): "… the accents in calculation led Justus Byrgius on the way to these very logarithms many years before Napier's system appeared; but being an indolent man, and very uncommunicative, instead of rearing up his child for the public benefit he deserted it in the birth." Although the two discoveries are today believed to be independent, Napier definitely enjoyed the right of priority in publication. Both methods were mainly computational. It seems that the first clear and theoretical exposition of the equation $\log(x\,y) = \log(x) + \log(y)$ can be found in Kepler's *Chilias logarithmorum*.

In 1579, Bürgi entered the employ of Landgrave **Wilhelm IV** of Hesse-Kassel, observing with the court-mathematician **Christoph Rothmann** at the excellent Kassel observatory. Some denote it as the first stationary observatory in Europe. Bürgi, who also knew **Tyge Brahe** and who was a friend of Kepler, made many instruments for the observatory. One of the instruments was the "reduction compass," another being the "triangularization instrument," both of which had military applications. Bürgi's famous celestial globe from 1594 can be seen on some Swiss stamps.

Bürgi is attributed to the invention of the minute hand on clocks in 1577. His invention was part of a clock he constructed for Brache, who needed precise time for observing. Bürgi is also known in the history of time measurement for a clock he made in 1585 that would run for 3 months. He introduced the idea of adding an independent system to the traditional wheel-train, which was wound in short periods by the mainspring, giving a more constant flow to the escapement. This was later perfected, leading eventually to an autonomy of several months. In 1604, Bürgi became court watchmaker to Emperor Rudolf II. He returned to Kassel the year before his death.

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Selected References

Gingerich, Owen (1980). "Jost Bürgi at Kassel." *Journal for the History of Astronomy* 11: 212–213.

Gronau, D. (1987). "Johannes Kepler und die Logarithmen." *Reports of the Mathematical Statistical Section of the Research Society Joanneum*: 284.

Nový, Luboš (1970). "Bürgi, Joost." In *Dictionary of Scientific Biography*, edited by Charles Coulston Gillispie. Vol. 2, pp. 602–603. New York: Charles Scribner's Sons.

Thoren, Victor E. (1988). "Prosthaphaeresis Revisited." *Historia Mathematica* 15: 32–39.

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