Bookreview

Jost Bürgi by Ludwig Oechslin

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Jost Bürgi (1552-1631), the Swiss-born mechanical and mathematical genius, is best known to horologists as the creator of the cross-beat escapement and the inventor of the remontoire, and thereby of the most precise mechanical timekeepers of his time. Bürgi is further known as the inventor of novel mechanical models of the universe of unprecedented accuracy. One of his best known masterpieces is his small mechanized celestial globe of 1594, which he made for Landgraf Willhelm IV of Kassel, while Bürgi was in charge of the star charting project at the Kassel court. That globe is currently in the Swiss National Museum in Zurich.

A few years ago Dr. Ludwig Oechslin, the well known scholar of the modelling of celestial mechanics - and recently appointed Director of the Musée International d'Horlogerie in La Chaux-de-Fonds - was asked to write a monograph describing the historic, artistic, mechanical, and cultural significance of this unique piece. The resulting, lavishly illustrated book ("Der Bürgi Globus, Technik und Kultur," Schweizerisches Landesmuseum Zurich, 2000, ISBN 3-980025-27-3) explains several of the breakthrough innovations incorporated in that globe, including epicyclical gearing, and separate mechanical corrections for the various components of the equation of time through the use of eccentric wheels, and of gears with unevenly spaced teeth.

Work on that descriptive book led Oechslin to undertake additional research on Jost Bürgi and his unique role of innovator and scholar bridging the disciplines of horology, astronomy and mathematics in an era when these fields were closely linked. The resulting text would have exceeded the scope of the first book, which is intended for the general public. The more in depth examination of Bürgis' scholarly achievements has now been published as a separate volume (unfortunately only in German), which is the subject of this review.

In comparision to the amount of information available on Bürgi's contemporaries like Tyco Brahe, Raimarus Ursus, Christoph Rothman, and Johannes Keppler (with whom Bürgi worked closely in Prague) relatively little is known about Bürgi. Oechslin hypothesizes that this is primarily the result of Bürgi's roots as a craftsman/clockmaker and that he was never an academically trained scholar. Bürgi was a self-taught pragmatist, who never published (in the conventional sense of the word) his discoveries or his insights. Oechslin's core hypothesis is that Bürgis' scholarlarly contribution to the state of understanding the universe at his time is not any less valuable than that many of his better known fellow astronomers. Bürgi's scholarship found expression in material models rather than the printed word.

Following a biography of Bürgi, the three core chapters of this book deal with: 1. the role of the Bürgi celestial globes, 2. the Bürgi way of communicating/transmitting scientific knowledge, and 3. the significance of the role of the mathematical techniques and concepts first used by Bürgi (including his "invention" of logarithms) in future astronomical discovery.

Because Bürgi had never formally studied Latin, the language of all formal scholarly publications of his time, his discoveries and theories were "published" in the form of gear ratios and mechanical innovations, i.e. as a part of physical artifacts, rather than as words on paper. It is no coincidence that Bürgi was one of the prime movers behind the creation of the Kassel master celestial globe, one of the most complete and most precise physical star chart existing at the time, rather than any of the competing -but arguably less comprehensive - ink and paper star charts

published in the same era. Precisely because Bürgi was preoccupied with searching for a mechanical way to accurately model the movements within the solar system he contributed breakthrough analytical insights into the exact nature of the irregularities in the apparent movement of sun and moon around the earth (e.g. in his lunar anomalies clock).

There are written records describing an early planetarium by Bürgi, and there exists a later clock including a planetary model (now in Vienna), which reflect Bürgi's original contribution to the then ongoing -and then still unsettled - debate about competing models of the solar system. Bürgi's hypothesis (where both the sun and the earth are stationary, but the earth rotates around its' axis) was a result of his need to find a mechanically simple way to build a model conforming to the celestial observations.

In his mathematical discoveries Bürgi followed a similar pragmatic path. His aim was not to seek new theoretical mathematical insights, but to fill he very practical need for accurate sine tables for spherical geometry to plot and double-check the many stars marked on his globes. Needing sine tables in 2" increments, he was faced with the prospect of having to calculate 81'000 sine values, a near impossibility with the labor-intensive methods of his time. Finding simplified calculating methods (that still yielded a satisfactory precision) became a necessity. Purely practical, pragmatic needs led to his invention of the first useful logarithms, allowing the substitution of simple addition/subtraction for tedious multiplication/division.

Given the scarcity of printed records on Bürgi and his work, Oechslin's research methodology of analyzing highly complex mechanisms and artifacts for their "implied knowledge" content is unlikely to be replicated soon, because there are hardly any potential authors out there combining Oechslin's in-depth knowledge of mechanics, astronomy and history of science. Oechslin's argument in support of the high scholarly merit of Bürgi's work is compelling. However the very complex nature of the subject matter at times makes for tedious reading, which -in the opinion of this reviewer- comes very close to the limits of what is easily digestible for an interested reader without formal training in mathematics or astronomy. The Bürgi book is most appreciated if read in conjunction with Oechslin's guide to the globe mentioned earlier. It is unfortunate that no English translation of either book seems to be planned. The hypothesis and conclusion of these books, as well as Bürgi's contribution to the history of science (and horology) in general, deserve to be debated more broadly and more thoroughly. Hopefully, this book review is a small contribution in this direction.

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