

UNFREEZING TIME

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Johannes Kepler, Frontispiece of the Rudolphine Tables (*Tabulæ Rudolphinæ, quibus astronomicæ scientiæ, temporum longinquitate collapsæ restauratio continetur*) Ulm: Jonas Saur, 1627. Folio book (30.5cms x 48.3 cms)

The astronomer Johannes Kepler (1571–1630) spent several years designing and revising this elaborate frontispiece, which ended up carrying so many allegorical references that one of his friends needed 458 lines of Latin hexameters to explain it. For those who knew how to decode this complex image, it depicted a historical trajectory, a sequential journey through time that confirmed Kepler's self-appointed position as Europe's leading astronomer, the natural heir of predecessors going back several millennia.

This imaginary temple was never built, so in a sense it exists outside time, even though the people inside are real-life characters drawn from both the past and the present. The imaginary figures on top of the dome signal that the building is dedicated to Urania, the goddess of astronomy, who sits at the centre crowned with stars and surrounded by six muses holding astronomical instruments. Flying overhead, an imperial eagle drops coins from its beak in tribute to Prague's Hapsburg emperors, who patronised both Kepler and his former employer, Tycho Brahe. Inside, a placard hanging from the temple's ceiling announces the title of Kepler's book – *The Rudolphine Tables*.

That title was already out of date: this eagerly anticipated book was so long in the making that Rudolf II had been dead for fifteen years. Kepler had taken on the daunting task of using Tycho's observational data to compile mathematical tables for finding the positions of the planets relative to the stars. Tycho's measurements were far more accurate than any previous ones, and astronomers from as far away as India and China had repeatedly begged Kepler to speed up his calculations. Hindered by lack of money and the complexity of the work, Kepler procrastinated for over twenty years; he was reluctant, he wrote, to be sentenced 'entirely to the treadmill of mathematical computations.' He managed to lighten his task by taking advantage of logarithms, which were introduced by John Napier in 1614. But even after he had finalised all his tables, another three years went by before Kepler could find a suitable publisher and settle various disputes with Tycho's quarrelsome heirs.

With its scattering of small stars, the temple's twelve-sided floor represents the heavens divided into the signs of the zodiac, while the vertical columns supporting the roof

are the observations on which the science of astronomy is founded. To acknowledge the source of his data, at the very front of the base Kepler prominently featured a map of Hven, the small Danish island where Tycho had built his famous observatory, Uraniborg. Although Kepler never visited Hven, Tycho had employed him as his assistant in Prague, and it was his dying wish that Kepler should inherit his closely guarded measurements. To the map's right, two panels show the book being printed, while immediately to its left sits Kepler himself; a list of his previous publications is on display to establish his academic credentials, while the two coins on his desk are probably a strong hint that his imperial salary was in arrears.

The columns at the back of the temple are the oldest. Crudely carved from wood, they represent ancient readings made with rudimentary instruments: in the centre, a Chaldean astronomer with a Phrygian cap is using his fingers to measure the angular separation of the stars. In front of those and hence later in time, the next four columns are more solidly constructed from brick and are adorned with the names and instruments of key historical figures. The earliest, on the back right, belongs to Meton, the Athenian astronomer of the fifth century BC who became famous for introducing a nineteen-year calendrical cycle; by singling him out, Kepler neatly referred to his own work in reforming the Julian calendar. Next in sequence come first Aratus – a third century Greek poet who described the constellations – and then over a century later Hipparchus, the renowned Greek mathematician standing next to his column on the left and holding his catalogue of fixed stars. Fast forwarding into the Christian era, the Egyptian astronomer Ptolemy is seated on the right next to a diagram of planetary orbits; wearing a turban and an oriental gown, he is absorbed in his mathematical calculations.

The two nearest – and hence most recent – columns are clearly labelled Copernicus and Tycho Brahe, Kepler's most immediate and most important predecessors. Their fine stone pillars have classic Greek capitals to indicate the superior sophistication of these two modern astronomers. Copernicus is sitting next to his Doric column, and on his knee is a copy of *De Revolutionibus*, the book he published on his deathbed almost thirty years before Kepler was

born and that was still on the Vatican's banned list. According to Copernicus, the planets rotate uniformly around the sun in circles, the shape of divine perfection, but that idealised model was hard to reconcile with increasingly accurate measurements. Kepler openly admired Copernicus, although he derived his own ideas from scientific observation rather than religion to argue that the planets move in ellipses and are governed by mathematical laws.

Kepler's drawing shows Copernicus arguing with Tycho, who – on the insistence of his heirs – is shown very elegantly dressed in a fur-trimmed gown and adorned with the full regalia of nobility; one of his books sits to his left and two of his celebrated instruments are displayed overhead. With his left hand, he is pointing down to the floor, to the heavens that are the source of his observations, while his right hand directs Copernicus's attention to the diagram of his system on the ceiling. In an attempt to reconcile biblical tradition and astronomical data, Tycho insisted that the sun and the moon rotate around the earth, while the other five planets revolve around the sun. The ornateness of his column's Corinthian capital reflects the complexity of the Tychonic compromise.

The temple and its inhabitants lie in the past: Kepler portrays himself as their direct successor, the culmination of progress over many centuries. To reinforce his own significance, he has carefully omitted his most important contemporary, Galileo Galileo, whose lens-based telescopes were penetrating deeper into the cosmos than Tycho's giant quadrants. In contrast, Kepler prided himself on his mathematical approach. He never knew that before the end of the century, he would himself be relegated to a bygone era, eclipsed by a still more famous mathematician – Isaac Newton.

Main source and further reading

Stefano Gattei, 'The engraved frontispiece of Kepler's *Tabulæ Rudolphinæ* (1627): A preliminary study,' *Nuncius* 24 (2009), 341–65.

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