A famous astronomer, a full bladder, and the heavens revealed

Our modern conception of the universe largely resulted from a famous astronomer's inability to urinate. On Saturday, October 13, 1601, the celebrated Danish scientist Tycho Brahe went to a dinner party, drank too much, and returned home with a very full bladder. No one could catheterize him, and he died within two weeks at the age of 54 from uremic poisoning. As a result, his young assistant Johannes Kepler (1571-1630) inherited all of the observational data that his mentor had been reluctant to share with him.

Fig. 1. Uraniborg contained a fine scientific library, astronomical instruments, print shop, pharmacy, and living quarters for Tycho, his family, and a bevy of apprentices.

With this information, Kepler eventually discovered the elliptical nature of the planets' orbits, as well as the mathematical relationships that govern them, and subsequently published his findings simply and elegantly as Three Laws of Planetary Motion, which became the foundation of modern physics, and within a generation led Isaac Newton to his theory of universal gravitation.

What, though, caused Tycho's sudden demise? He was not known to have been ill – the last entry in his observing log was dated October 11, 1601 – just two days before the party! He could have had an enlarged prostate gland, but this is unusual in a middle-aged man. One of Tycho's physicians thought that he had a bladder stone and had ruptured his bladder, but a 2010 examination of Tycho's exhumed body showed no stone. Radiological analysis of the skeletal

remains, including computed tomography, showed no evidence of cancer metastatic to his bones, although it is possible that he may have had localized prostate cancer which had not yet spread. A popular theory through the years, however, has been that someone poisoned Tycho, but autopsy measurements of mercury levels in Tycho's moustache hairs were consistent with non-toxic exposure: most likely, Tycho had taken mercurial diuretics in a futile attempt to make urine.

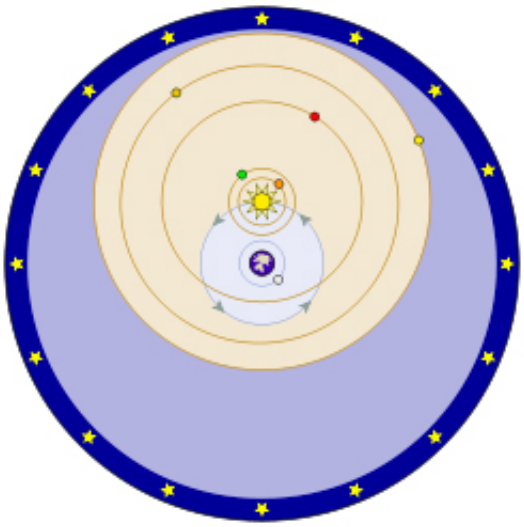

Fig. 2. The Tychonic system was developed out of meticulous observations which suggested flaws in the Copernican model of the universe.

Reportedly, on his deathbed, he held Kepler by the arm, exhorting "Please, let me not have lived in vain." He certainly lived a full and colorful life, suffering a nasal wound in a duel while still a university student, marrying and having eight children, adopting a moose for a pet, and training dozens of future astronomers at Uraniborg (Fig. 1.), his island observatory near Copenhagen. Rumor has it that Tycho eventually became a little too friendly with the Queen, and therefore got himself kicked out of Denmark late in his career; fortunately, his genius was recognized by the Holy Roman Emperor, Rudolph II of Bohemia, so he relocated to Prague in the late 1590s, where he became acquainted with Kepler's early writings and invited his protégé to join him in Prague to help promote a new theory of the universe.

Tycho believed that the Earth lies at the center of the universe, orbited by the sun and moon; however, he postulated that the other planets orbit the sun as it in turn orbits the Earth. (Fig. 2.) Tycho believed that his theory was scientifically verifiable, in addition to being biblically accurate during the Counter-Reformation, a period of intense religious upheaval in Europe. He based his theory upon two key findings: first, he was unable to measure any shift, or parallax, in star positions that would indicate that the Earth was moving in space, and second, the retrograde motion of Mars as Earth passed by it varied from year to year, indicating that the planets did not follow perfectly

circular orbits. We now know that the nearer stars do show some parallax, but this is slight enough that only a powerful telescope will pick it up. However, after Tycho's precipitous demise, Kepler used his mentor's comprehensive observing log to discover the true design of the near universe.

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