

## THE LANDGRAVE IN KASSEL AND TYCHO BRAHE ON HVEN

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### RESUMEN

Tycho Brahe es conocido como el astrónomo más grande de su tiempo y sus observaciones fueron muy significativas para el desarrollo de la ciencia. En 1576 Tycho recibió la isla de Hven no lejos de Copenhague como un regalo del rey danés Federico II, donde trabajó con muchos colaboradores durante veinte años. Sin embargo, recientemente se ha reconocido que Tycho debe compartir el crédito por la renovación de la astronomía de su época con Landgrave Wilhelm IV en Kassel. Por el año de 1566 Wilhelm consiguió una mejor exactitud de las posiciones de las estrellas que cualquier otro astrónomo. Veinte años después, se obtuvo una exactitud de un minuto de arco en Kassel, y al poco tiempo por Tycho Brahe. Seguiremos esta evolución y el proceso de mutuo aprendizaje entre Kassel y Hven, los cuales no estuvieron exentos de drama.

### ABSTRACT

Tycho Brahe is known as the greatest astronomer of his time and his observations had great significance for the development of science. Tycho received in 1576 the island Hven not far from Copenhagen as a gift from the Danish king Frederik II and he worked there with many collaborators during twenty years. But Tycho must share the credit for renewing astronomy with Landgrave Wilhelm IV in Kassel as has been better recognized recently. About 1566 Wilhelm achieved a better accuracy of star positions than any astronomer before. Twenty years later, an accuracy about one minute of arc was obtained in Kassel, and soon after also by Tycho Brahe. We shall follow this evolution and the mutual process of learning between Kassel and Hven - which was not without drama.

*Key Words:* astrometry — celestial mechanics — history and philosophy of astronomy

Nicolaus Copernicus (1473-1543) presented the idea of the heliocentric system which came to revolutionize astronomy, but he emphasized that it was no new idea since it had been proposed by Aristarchus of Samos (−310 to −230).

A central person for the new astronomy is known as Landgrave Wilhelm IV of Hesse-Kassel, Figure 1. Wilhelm was from early on aware of large errors in the predicted positions of the Sun, Moon and planets with respect to the stars based on observations by Muslim astronomers. Astronomers knew of these discrepancies and had some theories for explanation, but Wilhelm was the first to tackle this problem systematically by new more accurate observations. This was a great task requiring the resources of a prince.

Wilhelm built the first observatory in Europe 1560-61 on his castle in Kassel, Figure 2. He personally observed the positions of 58 stars, the first Kassel Catalogue. The errors were about 10' up to 12' as we now know from comparison with modern observations (Schrimpf 2016, priv. comm.) i.e. a bit smaller errors than Ulugh Beg obtained a century



Fig. 1. Wilhelm IV (1532-1592), ruling as Landgrave from 1567. His first instruments, a quadrant and a torquetum, are seen at lower right. The globe behind him at left served for computing and for recording the stars.

earlier, but Ulugh Beg was unknown at the time. Tycho Brahe (1546-1601) called Wilhelm “the most important astronomer in Europe”.

Tycho Brahe had observed the new star in Cassiopeia in November 1572. During the following nights he measured the angular distance to a star eight degrees away from the new star and this allowed him to conclude that the object was further away than the Moon. It could not be an atmospheric phenomenon as changes in the heavens were commonly believed to be. This was a sensation and his

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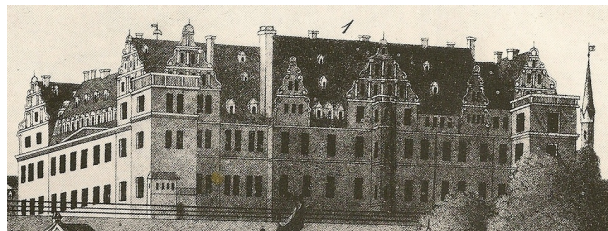


Fig. 2. Wilhelm's castle in Kassel. The balconies in the front at left and right served as observing platforms where the instruments were placed in the night, thus the first permanent observatory in Europe.



Fig. 3. Tycho Brahe's wooden sextant of 155 cm radius from about 1582.



Fig. 4. A brass sextant of 1145 mm radius as used in Kassel from 1585 for producing the catalogue of 384 stars. The elegant metal construction is quite different from the massive wooden instrument of Tycho Brahe.

book “Stella Nova” from 1573 made him famous in the astronomical world.

Tycho decided to dedicate his time to astronomy, a very unusual occupation for a nobleman as he was and therefore with obligations to serve his king. In a search for the best place in Europe to settle as astronomer Tycho went on a long journey in 1575. The first person to visit was Wilhelm in Kassel where he stayed for ten days. Wilhelm was so impressed by the young man, 29 years of age and famous for his book, that he sent message to the Danish king

Frederik II (1534-1588), urging him to support this genius. Frederik in return sent a delegation to Kassel to inquire in this matter.

At his nine months travel Tycho had decided to live and work in Basel. But when he returned to Denmark the king offered him generous support for his work. The king gave him the island Hven for life and additional income. On the island not far from Copenhagen he would be free from official obligations, free to pursue his science. Tycho accepted and worked twenty years on Hven with a large staff.

He constructed many instruments, 22 in all, in order to improve the accuracy. Some were of older type but provided with a better sighting device (telescopes were not yet known) and better scales to read the angle. He invented a new type of instrument in 1569, the sextant (Figure 3). Tycho and his staff observed the planets and 1004 stars with an accuracy about  $2'$ , sometimes even below  $1'$ .

Tycho had a fruitful correspondence with Wilhelm, published in 1596 in “*Epistolarum Astronomi- corum*”. Wilhelm had engaged in further observations after Tycho's visit and had employed two very competent men, the Swiss instrument maker Jost Bürgi (1552-1632) and the astronomer Christoph Rothmann (1561-1601). New instruments were built, a sextant as on Figure 4, a large quadrant and a good clock for timing right ascensions.

The instruments were built with important devices invented by Tycho Brahe on Hven, but the ideas reached Kassel without Tycho's knowledge from a visitor to Hven, Paul Wittich (1546-1586), as if they were Wittich's inventions. Tycho became furious when he heard that, but he could control his anger so that the good relation to Wilhelm remained.

New observations in Kassel resulted in a catalogue of 384 stars presented in manuscript in 1587, but it was not printed until much later. It therefore made no impact on the science of its time, in contrast to Tycho's observations and descriptions of instruments published in the 1590s. The errors of the second Kassel catalogue is less than  $1.1'$  as we know from studies by Hamel (1998) while previous literature gives  $6'$ ! It appears that the interaction between Wilhelm IV and Tycho Brahe was very fruitful for both and important for the advancement of astronomy. See more at Høg (2018).

## REFERENCES

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