

## FROM THE LANDGRAVE IN KASSEL TO ISAAC NEWTON

E. Høg<sup>1</sup>

Landgrave Wilhelm IV established in 1560 the first permanent astronomical observatory in Europe. When he met the young Tycho Brahe in 1575 he recognized the genius and recommended him warmly to the Danish king Frederik II. Wilhelm and Tycho must share the credit for renewing astronomy with very accurate observations of positions of stars by new instrumentation and new methods. Tycho's observations of planets during 20 years enabled Johannes Kepler to derive the laws of planetary motion. These laws set Isaac Newton in a position to publish the laws of physical motion and universal gravitation in 1687 - the basis for the technical revolution.

This contribution is a supplement to Høg (2018a) and it is also related to the subject of evolution of astrometric accuracy during 2000 years, shown in Høg (2018b).

Figure 1 shows the instruments used by Wilhelm for observations 1560–67 resulting in the first Kassel Catalogue of 58 stars. He did not make further observations before Tycho Brahe's visit in 1575.

Figure 2 with instrument details. Especially panel c showing the divided arc, visualizing the wonderful fine mechanics produced in Kassel by the ingenious Jost Bürgi. Bürgi commuted between Kassel and Prague from 1592 and he moved to Prague in 1604 to become Kepler's friend and collaborator for many years building instruments and observing.

Figure 3 shows a Kepler ellipse. Kepler derived the law of equal areas partly by application of the wrong, as we now know, Aristotelian dynamics where the speed is proportional to the force. When the force is inversely proportional to the distance to the Sun and it acts perpendicular to the radius vector, the law of equal areas in equal times results – sic! (Helge Kragh 1978 priv. comm.)

### REFERENCES

- Høg, E. 2018a, RMxAC, 50, 1  
 Høg, E. 2018b, RMxAC, 50, 41

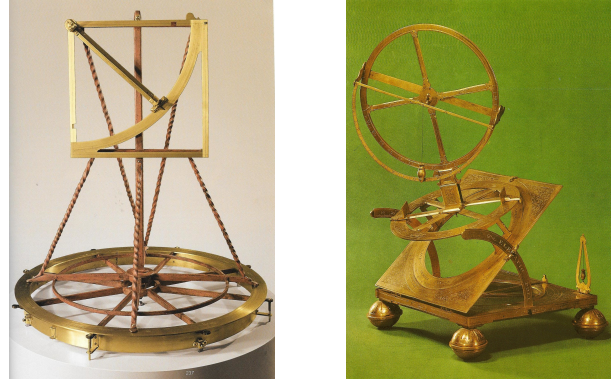


Fig. 1. Left: The original horizontal quadrant from 1560 with 40 cm radius. Right: Modern model of a torquetum.

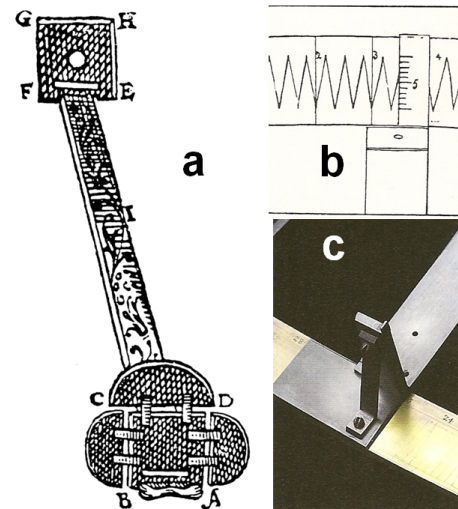


Fig. 2. At left, Tycho's sighting device. At right, instrument details used in Kassel after 1585 following ideas from Hven brought to Kassel by Paul Wittich. b: Scale with transversal divisions. c: Divided arc on a sextant from 1593.

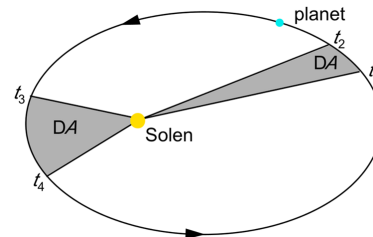


Fig. 3. Kepler's second law, the law of areas.

<sup>1</sup>Niels Bohr Institute, Copenhagen University, Juliane Maries Vej 30, 2100 Copenhagen Ø, Denmark (ehoeg@hotmail.dk).