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# THE STRASBOURG CATHEDRAL CLOCK

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Before taking up my studies in art history and the history of science in Tübingen and Hamburg I served my apprenticeship with a clockmaker for three years. After finishing my courses in 1990 I decided to write a PhD thesis on one or even a group of astronomical clocks of the Renaissance. As it is expected from a PhD candidate I first tried to get an idea about the state of research and coming about to examine the vast literature on the Strasbourg clock I did not expect any exciting results. It seemed to be a routine check, a mere matter of diligence. Already in 1922 Alfred and Théodore Ungerer had published a monograph on the three astronomical clocks erected in the course of the centuries in Strasbourg Cathedral – the first one built in 1352/54, the second clock completed in 1574 and, finally, the third clock constructed by Jean-Baptiste Schwilgué in the first half of the nineteenth century, which still can be admired today.[1] The Ungerers were aptly fitted to this task, because they were the successors of Schwilgué's workshop, consulted the archival sources thoroughly and prepared a valuable bibliography. The removal of the old clock after the last inspection by Schwilgué in 1836, who did his best to emphasize its ruinous condition to get through his plan for an entirely new construction is a rather sad story, because neither a thorough documentation of the old clock was made nor great care was taken of its remnants in the 19th century. It may be noted, that only the objection of the Strasbourg Magistrate who insisted on the preservation of the original case prevented Schwilgué to erect a gigantic french marble clock with glazed apertures in the southern transept. However, this is not meant to belittle Schwilgué's work, which is a masterpiece of its own class. After a period

[1] Alfred and Théodore Ungerer, *L'horloge astronomique de la Cathédrale de Strasbourg,* Strasbourg 1922. There is also a modern, lavishly illustrated work by Henri Bach, Jean-Pierre Rieb and Robert Wilhelm: *Les trois horloges de la Cathédrale de Strasbourg*, Strasbourg 1992.

of neglect in the Age of Enlightenment almost every monumental clock suffered substantial alteration, if not total demolition. Especially in the course of the 19th century, which saw the establishment of factories producing turret-clocks the old movements were simply scrapped for modern replacements.

When consulting Schwilgué's account on the state of the second clock in the Municipal Archive in Strasbourg I wondered not only about the rich adornment and extravagance of the clock case, but also of the complicated wheelwork. Was there any connecting, coherent idea behind it? That paintings and ornaments on a Renaissance clock symbolize the transitoriness of human life, the Last Judgement, Virtues and Vices and so on seems natural and these features have been already treated at length. But what did it meant to its constructor, to the contemporary spectator?

After some days of work in the Municipal Archive of Strasbourg it soon turned out, that not only the correspondance of Conrad Dasypodius had been overlooked, but also his *Heron mechanicus*, a programmatic description of the clock published in 1578 had to be interpreted once again. Finally, one crucial piece of evidence seemed to be missing. After having examined all archival records I finally found the „missing link" in the library of Göttingen University.

First let us get familiar with the history of the clock and its design. Soon after the introduction of the reformation in Strasbourg the now protestant magistrate set out to build a new clock opposite the old astronomical clock erected in 1352/54 in the southern transept of Strasbourg Cathedral. About 1531 Michael Herr, a physician, and the astronomer Nicolaus Prugner were commissioned to construct the clock. A clocktower was erected by Bernhard Nonnenmacher, master builder of Strasbourg Cathedral, and Herr made drawings of a huge astrolabe. Caspar Engel, a goldsmith, beat copper discs with depictions of the twelve signs of the zodiac and the painter Nikolaus Kremer, a pupil of Hans Baldung Grien, constructed two sundials („Zeiger"). Unfortunately no clear idea of the progress of the work being undertaken can be gained from the archival records, because the accounts for the expenses are very incomplete in these years.[2] At any rate, all activities came to an end, when Emperor Charles V. in 1548 decreed the so-called Interim. Two years later the Cathedral was restituted

[2] For details and the relevant sources see Günther Oestmann, *Die Straßburger Münsteruhr: Funktion und Bedeutung eines Kosmos-Modells des 16. Jahrhunderts*, Stuttgart 1993, p. 29–35.

to the old faith. Notwithstanding catholic protests the Strasbourg magistrate did away with the Interim in 1559, but it lasted until 1571, when a new attempt to replace the old clock was made. Now Conrad Dasypodius (1531–1601), a Swiss mathematician teaching at the Academic Gymnasium of Strasbourg, was entrusted with the construction.[3] His collaborators were his colleague David Wolckenstein, Isaac and Josias Habrecht (1544–1620; 1552–1572?)[4] from Schaffhausen as clockmakers and Tobias Stimmer, who was commissioned to paint the panels of the case. Stimmer (1539–1584) was trained in his native town Schaffhausen and was one of the most eminent painters in the region of the Upper Rhine.[5] In 1571 Dasypodius made a „first concept" and then engaged Tobias Stimmer to paint a ground plan and the elevation of the clock. After it was shown to Dasypodius's colleagues at Strasbourg Academy and to Oswald Schreckenfuchs, professor of astronomy and Hebrew language at Freiburg, the craftsmen were hired. The work started in the same year and three years afterwards, in 1574, it was completed. No preparatory sketches and plans are extant, however. Most likely they perished together with the estate of Dasypodius and all the catalogues of the Municipal Library and Archive of Strasbourg in the fire caused by the bombardment of German troops on August 24th, 1870.

*Modesty is fine but it doesn't get you very far*. According to this proverb Dasypodius claimed no less than to give a „universal description of time" (*absoluta descriptio temporis*):

*„In this work we represent the orbits of the heavenly bodies, we mark out the divisions of time (these motions are the measurement).* [...] *And on this clock we exhibit eternity, the century, the orbits of the planets, the yearly and monthly revolutions of the sun and the moon, the divisions of the week, days, hours, parts of hours, minutes. We have added also, for the sake of adornment,*

3 Apart from several dictionary entries there is only an old short bibliography by Johann G. L. Blumhof available (*Vom alten Mathematiker Conrad Dasypodius*, Göttingen 1796). See Oestmann (n. 2), p. 37sq.

4 On the Habrecht family see Théodore Ungerer, „Les Habrecht: Une dynastie d'horlogers strasbourgeois au XVIe et au XVIIe siècle", *Archives alsaciennes d'histoire de l'art,* 4, 1925, p. 95–146.

5 August Stolberg, *Tobias Stimmer: Sein Leben und seine Werke. Mit Beiträgen zur Geschichte der deutschen Glasmalerei im sechzehnten Jahrhundert* (= Studien zur deutschen Kunstgeschichte, 31), Strasbourg 1901; Friedrich Thöne, *Tobias Stimmer: Handzeichnungen. Mit einem Überblick über sein Leben und sein gesamtes Schaffen,* Freiburg i.Br. 1936; Max Bendel, *Tobias Stimmer: Leben und Werke,* Zürich/Berlin 1940.

*splendor, and admiration, various contrivances, pneumatic, sphaeropoetic, and automatic, everything from history and the tales of the poets, and also from sacred and profane writings in which there is or can be some delineation of time. And we show these things by paintings, pictures, statues, and other works similar to these. For all and individual details were so ordered and arranged that they have a definite meaning and one worthy of note, taken either from things sacred to the pagans, or the stories of the poets, or writings of the historians and annalists.“*[6]

Before the clock stood a celestial globe with constellations painted by Stimmer, a sort of astronomical instrument Dasypodius held in high esteem:

„[…] *there is none which, by virtue of its form and use, is more fitting for these daily true and definite observations of heavenly appearances than the astronomical globe. Such a globe is formed after the shape of the universe. To this we have added several other things: such as the true place of the comet which appeared in the year 1572* [the Supernova observed by Tycho Brahe and numerous other astronomers]*; such as the concentric circles, the climes, zones, descriptions of the shadows, the qualities and names of the winds, and many other things of this sort which are traditional in the science of spherics. We also gave it a daily motion, in imitation of the primum mobile, of which this globe completes its course in 24 hours. Also at the same time there appear the paths of the sun and moon which they follow with their own mean movements in longitude. I had kept it to myself for astronomical observations; but, to adorn this astronomical work of ours and to gratify our eminent Senate, I gladly joined this globe to the work. We have attached a Pelican beneath so that it should be in place of Atlas and represent a symbol of eternity, or even of our Redeemer and Saviour.“*[7]

Dasypodius's pride is quite justified, because the construction of the wheelwork is a masterpiece.[8] The difference between mean solar and sidereal day is realized very precisely with a deviation of about only 2 seconds a year – at least in theory, because the mechanism expects far too much of the movement with its verge escapement. The moon's pointer will be off one day in 2,64 years.

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6 Conrad Dasypodius, *Heron Mechanicus: Seu De Mechanicis artibus, atque disciplinis. Eiusdem Horologij astronomici, Argentorati in summo Templo erecti, descriptio,* Straßburg 1580, fol. FIIIv, FIVr, GIIr. I have quoted from an english translation by the late Bernard Aratowsky which is going to be published facing a facsimile of the latin text. [The book has appeared in the meantime as issue no. 68 in the series *Algorismus: Studien zur Geschichte der Mathematik und der Naturwissenschaften* (ed. Menso Folkerts), Augsburg 2008].

7 Ibid., fol. GIr/v.

8 For a detailed study of the globe see Victor Beyer, Henri Bach and Ernest Muller, „Le globe céleste de Dasypodius: I. Étude historique par V. Beyer, II. Étude astronomique et horlogère par Henri Bach, III. Étude hymnologique par E. Muller“, *Bulletin de la Société des Amis de la Cathédrale de Strasbourg,* Sér. II, No. 7, 1960, p. 103–139.

In the lower storey of the clock three distinct tables are seen, of which the two side ones contain on them diagrams and data of the eclipses of the sun and moon for 32 years following (1573–1605). These panels have not survived in their original condition, however. They were painted over, when in 1609 Matthias Bernegger (1582–1640), professor of mathematics at Strasbourg Academy and close friend of the astronomer Johannes Kepler, calculated the data of eclipses for the period of 1613 to 1649.[9] The middle table contains a perpetual calendar, movable holidays, dominical letters, and leap years for 100 years in advance, but the original data are no longer extant (the disk shows calendrical data for the years 1670–1769). According to a description of the cathedral from the 18th century, the death of Luther (February 18th, 1546) was marked among the Saint's names.[10] The calendar disk is adorned in the four angles with four pictures of monarchies, also with two statues. For one, of Apollo, marks out the individual current days on the calendar with a spear; the other, of Diana, exactly opposite shows the day opposite to the current one. Finally in the center of the disk a geographical description of Germany, particularly of the provinces adjacent to the Rhine, and also a topography of the city of Strasbourg is added. Above the calendar disk appear statues of the seven planets; of these each one comes forth on its own day. Through these automata weekly time is represented. On the right and left side the principal chapters of the Christian religion are depicted, from the creation of the universe, original sin, redemption, resurrection, and the last judgment. *„For in these"* says Dasypodius, *„the entire delineation of time is consumed."*[11] In the middle of these paintings, above the circle of planets, a little dial showing quarter-hours and the minutes can be seen. Two angels are sitting alongside; after the sound of the hourly signal bells one of these with a sceptre numbers the hours, and the other turns the sand clock which he holds in his hand.

In the middle storey of the clock an astrolabe constructed for the latitude of Strasbourg (48,5°) is placed. Conspicuously the lines of the tympanum, which is

9 The original data were published by Dasypodius in his Heron mechanicus (n. 6), fol. Ir–Kr and in the *Warhafftige Außlegung vnd Beschreybung des Astronomischen Vhrwercks zu Straßburg / welches er Anfaenglichs Erfunden vnnd angeben hat* […], Strasbourg 1580, p. 33–45.

10 Philippe André Grandidier, *Essais historiques et topographiques sur l'église cathédrale de Strasbourg,* Straßburg 1782, p. 291.

11 Dasypodius, *Heron mechanicus* (n. 6), fol. GIVr.

a huge painted stone disk of about 2 metres in diameter, have disappeared on the margin. After removing the clock in the 19th century it was used as a base for the globe in the museum and was worn by visitors walking around – incredible, but true fact.[12] Pointers of the sun and moon, Saturn, Jupiter, Mars, Venus, and Mercury show the mean places of the planets in the Zodiac. The construction of the epicyclic wheelwork is quite clever; it shows mean synodic periods. The wheels for each planet are carried around by the wheel for the sun's movement. For the sake of simplicity, Mercury and Venus are fixed to the sun on movable arms. The construction to achieve the difference between solar and sidereal time is identical to the one Dasypodius employed in the celestial globe.

Schwilgué and the late Henri Bach made contradictory statements on some details of construction.[13] Thanks to the benevolence of the former Director of the Musée des Beaux-Arts, Dr. Jean-Daniel Ludmann, in October 1989 I obtained permission to dismantle and measure the wheelwork, which is in good condition. There is a fatal error in the construction: The wheel for Mars possesses 129 teeth instead of the necessary 136, thus giving a considerable deviating period of rotation. Whether this flaw can be ascribed to Dasypodius or the Habrecht brothers is not clear.[14]

In the angles of the huge stone disk with a diameter of about two metres Stimmer painted allegories of the four seasons, which also depict the four ages and temperaments. Above the astrolabe, the monthly phases of the moon can be seen. These correspond to the movement of the moon appearing on the astrolabe. On one side the church triumphant, on the other the snake, or the serpent of perdition is painted.

In the upper storey the quarter hours are indicated by the sound of bells chimed by statues of the four ages, a boy by one stroke, a youth by two, a man by three, and an old man by four strokes. Finally, the statue of death comes forward, striking the hour. At last the statue of the Saviour meets the individual statues of the ages, going out to signify redemption. But death's statue, depicted gruesome by the unknown sculptor of the cathedral clock, gives forth the last sound with its own bell.

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12 Ungerer, „Les Habrecht" (n. 4), p. 110, n. 44.

13 Oestmann, *Die astronomische Uhr* (n. 2), p. 113.

14 For an analysis and calculation of the astrolabe gearing: Ibid., p. 113–121.

The tower on the right side housed the weights and was topped by an iron cock, the only remnant of the first clock of the fourteenth century. Since at that time it was customary to commemorate the Passion of Christ in the Christian church, this cock by its crowing warned men of the denial of Peter.[15] On the tower paintings of Urania, a Colossus, a portrait of Nicholas Copernicus, a panel depicting the three fates and an emblematical painting showing architectural and mathematical symbols can be seen. Because of the existence of the Copernicus portrait – by the way the earliest depiction of the great astronomer –[16] it has been frequently claimed, that Dasypodius adhered to the heliocentric system, which is far from truth. Like several astronomers of his day especially from the reformed camp under the influence of Philip Melanchthon he admired the mathematical genius of Copernicus excluding his extravagant cosmological ideas.[17] The celestial globe, cone and pair of dividers in the foreground refer to the astronomical work of Copernicus, but the lily of the valley he holds in his left hand alludes to his activities as a physician. After completing his studies of canon law in 1501 Copernicus was given permission to study also medicine in Ferrara for two years.[18]

On the outside of the southern transept a dial is mounted with the twelve signs of the zodiac and two pointers indicating the motions of the sun and moon and the moon's phases. Three sundials on the gable wall provided Strasbourg Standard Time for the clockmaker in charge to regulate the clock after winding up the weights each day.[19]

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15 As stated by Dasypodius (*Heron mechanicus* (n. 6), fol. HIIr).

16 On the portraits of Nicholas Copernicus see Zygmunt Batowski, *Coppernicusbildnisse*, Transl. Alfons Triller, Berlin 1942 (Typoscript of the original Polish edition *Wizerunki Kopernika,* Torun 1933); Friedrich Schwarz, „Kopernikus-Bildnisse", in: Johannes Papritz and Hans Schmauch (Eds.), *Kopernikus-Forschungen* (= Deutschland und der Osten: Quellen und Forschungen zur Geschichte ihrer Beziehungen, 22), Leipzig 1943, p. 143–171.

17 Robert S. Westman, „The Melanchthon Circle, Rheticus, and the Wittenberg Interpretation of the Copernican Theory". *Isis: An International Review Devoted to the History of Science and its Cultural Influences,* 66, 1975, p. 165–193.

18 Alexander Berg, „Der Arzt Nikolaus Kopernikus und die Medizin des ausgehenden Mittelalters", *Kopernikus-Forschungen* (n. 16), p. 172–201; Bernhard-Maria Rosenberg, „Das ärztliche Wirken des Frauenburger Domherrn Nicolaus Copernicus", in: Friedrich Kaulbach, Udo Wilhelm Bargenda and Jürgen Blühdorn (Eds.), *Nicolaus Copernicus zum 500. Geburtstag,* Köln/Wien 1973, p. 97–137.

19 On the sundials see René R.J. Rohr, *Les cadrans solaires anciens d'Alsace,* Colmar 1971, p. 110–114; P. Werkmeister, „Über die Zeitmesser des Straßburger Münsters insbesondere die Sonnenuhren am Giebel der Südseite", *Strassburger Münsterblatt: Organ des Strassburger Münsterbauvereins,* 6, 1912, p. 62–74.

As a humanist Dasypodius admired the technology of the ancients and in 1578 he published a kind of programmatic treatise entitled *Heron mechanicus* in combination with a description of his clock. By the time of construction of the clock he had already acquired a sound first-hand knowledge of the contents of major treatises of Euclid, Pappus, Heron of Alexandria and Proclus, to name only a few. Hugo Blotius (1533–1608), Imperial Librarian in Vienna, stood in close contact to Dasypodius and bought several manuscripts for the Strasbourg scholar when travelling in Italy. Dasypodius amassed a fine collection mainly of greek authors in the mathematical disciplines (e.g. arithmetic, geometry, astronomy and astrology) and several technological treatises from hellenic times. Some time before the first edition of the works of Heron of Alexandria, which appeared in 1575 in Italy, Dasypodius already studied his manuscripts which gave a stimulus for the construction of the Strasbourg clock and its automata.[20] He planned to edit the entire collection as a sort of „Mathematical Compendium", an ambitious plan, of which only a short introduction and a schematic layout were completed. In 1613 his collection passed into the hands of Matthias Bernegger. About 1625 Bernegger got into financial troubles in the course of the Thirty Years War and he was forced to offer the manuscripts to Daniel Heinsius, a colleague in Leiden. The draft of his letter comprising a list of Dasypodius's manuscripts fortunately survived in the Uffenbach collection now preserved in Hamburg.[21] It is an important, hitherto neglected source for the range of this remarkable 16th century collection of manuscripts, of which virtually nothing is handed down to us, because the entire collection perished in 1870 when German troops attacked Strasbourg and the municipal library burst into flames.

Referring to Pappus, Heron and Proclus Dasypodius distinguished the universal mechanical science in logical and cheirurgical.[22] Logical mechanic takes from the mathematical disciplines and from natural science itself the plans for

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[20] Johan Ludvig Heiberg, „Nogle Eftervirkninger af graesk Mechanik", *Det Kongelige Danske Videnskabernes Selskab: Oversigt over det Kongelige Danske Selskabs Forhandlinger og dets Medlemmers Arbejder,* 1886, p. 1–14; Wilhelm Schmidt, „Heron von Alexandria, Konrad Dasypodius und die Straßburger Astronomische Münsteruhr", *Abhandlungen zur Geschichte der Mathematik,* H. 8, (= XIIIth Suppl. to *Zeitschrift für Mathematik und Physik*, 42, 1898), p. 177–194.

[21] Hamburg, Staats- und Univ.bibl.: Supellex epistolica Uffenbachii et Wolfiorum, 4°, 31, p. 169–173. For a transcription see Oestmann, *Die astronomische Uhr* (n. 2), p. 249–251.

[22] Dasypodius, *Heron mechanicus* (n. 6), fol. Br.

constructing machines. Cheirurgica comprises under itself the manual skills and the results of the work of the hands. These do not require the comprehension of disciplines, but are accomplished only by talent and industry. The logical mechanician first consults the writings and teachings of the philosophers and mathematicians before he applies his hand to the works. As Vitruvius points out, an architect should be of encyclopedic knowledge and only with condescension Dasypodius mentions the work of the artisans:

„[...] *we sweated much in instructing untutored craftsmen and illiterate workers. Not that I wish to take away any praise from anyone, but although each in his own art and craft was indeed excellent, all were ignorant of matters astronomical, historic, legendary, and also of the remainder of the arts from which the automata, gnomonica, pneumatica, and sphaerica have been taken.*"[23]

Dasypodius frequently refers to the pneumatic, sphaeropoetic and automatic art. By *Sphaeropoetica* he means a famous, but no longer extant treatise by Archimedes on the construction of a sphere – probably the ancestor of the planetarium. His references to Heron's treatise on automata driven by air pressure and weights and his automatic theatre indicate Dasypodius's manuscript studies, from which he gained inspiration for his constructions.
Finally some threads of architectural theory are worked in. It would take another lecture to elucidate the difficult and sometimes obscure terminology used by Vitruvius[24] but here it may be enough to say, that the basis of establishing harmonical proportions of buildings is the determination of a basic unit, called module. This module can be derived for instance from the available plot of land for building or the distance between the columns. Multiplying the module according to certain rules based on the different orders of columns, symmetry and beauty (*Eurythmia*) of the building is achieved by the recurring module. Exactly these thoughts were in Dasypodius's mind when he made out his plan for the clock:

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23 Ibid., fol. HIIv.

24 For this problem see Heiner Knell, *Vitruvs Architekturtheorie: Versuch einer Interpretation,* Darmstadt 1985; Johannes André Jolles, *Vitruvs Aesthetik,* PhD thesis Freiburg i. Br. 1906, p. 9–39 and Peter Hugh Scholfield, *The Theory of Proportions in Architecture*, Cambridge 1958.

*„And all these things are worthy of mention, since there are in all the parts of the whole work eurythmia and symmetry, and the upper parts correspond to the lower and the lower to the upper; also a neat arrangement and agreement is seen in individual items, so that, as it were, one seems not to be able to exist without the other. For through the Pelican eternity is shown, a century through the wheel of 100 years, a year through the calendar, the seasons of the year by paintings, the months by the movement and phases of the moon, the weeks by statues of the planets, the hours and half-hours by the outer margin of the astrolabe, the quarter-hours and the minutes are shown by a tiny little painting."*[25]

This is a really witty interpretation of the architectural theory of Vitruvius, because Dasypodius took the module not as a unit of measurement to establish harmonious proportions in architecture. For him the module of his plan is the minute, which is the least common multiple of time perceptible on the Strasbourg Clock. Every part of the clock either mechanical or in artistic furnishing shows a multiple of this unit up to eternity which is (somewhat contradictory) the greatest conceivable period of time.

This is all very well but I was still somewhat uneasy about what Dasypodius called his „first concept" or „first invention". In his descriptions of the clock – the German one, first published in 1574 (enlarged edition: 1578) as well as in his *Heron mechanicus* – Dasypodius occasionally dropped veiled hints on some meaning of the clock. Thus, for example, the moving statues of the four ages were added *„for the sake of delight and wonderment, not however without a certain particular significance."*[26]

I looked up all publications of Dasypodius in vain, but finally I found a short remark on another description of the clock in an old history of astronomy, published 1741 by Johann Friedrich Weidler (1691–1755) in Wittenberg.[27] In 1578 a voluminous commentary written by Girolamo Cardano on Ptolemy's *Tetrabiblos*, the „Bible of Astrology" left the presses of Heinrich Petri in Basle to which Dasypodius added a short commentary by himself.[28] But already in the

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25 Dasypodius, *Heron mechanicus* (n. 6), fol. Hr.

26 Ibid., fol. Hv.

27 *Historia astronomiae, sive De ortu et progressu astronomiae liber singularis,* Wittenberg 1741, p. 380sq.

28 *Hieronymi Cardani, In Cl. Ptolemaei De astrorvm ivdiciis, avt (vt vvlgo appellant) Qvadripartitae Constructionis Lib. IIII. Commentaria, ab Avtore postremùm castigata, & locupletata.* [...] *Item, Cvnradi Dasypodii, Mathematici Argent. Scholia et Resolvtiones sev Tabvlae in Lib. IIII. Apotelesmaticos Cl. Ptolemaei: Vnà cum Aphorismis eorundem*

end of the 18th century the author of a still valuable mathematical and astronomical bibliography, Johann Ephraim Scheibel, remarked: *„The description of the famous clock at Strasbourg which Dasypodius gave, to which is referred in the general title and on a separate title, I was not able to find in my copy* [of the book]."[29] Obviously nobody had inspected the rare book thoroughly and it took some time, after I found a description of the clock which is a digression of Dasypodius's commentary on the 3rd book of the *Tetrabiblos*. Here Ptolemy describes four methods to determine the ascendant, i. e. the degree of the ecliptic rising at the eastern horizon for a specific time, usually the time of birth: „Difficulty often arises with regard to the first and most important fact, that is, the fraction of the hour of birth; for in general only observation by means of horoscopic astrolabes at the time of birth can for scientific observers give the minute of the hour, while practically all other horoscopic instruments on which the majority of the more careful practicioners rely are frequently capable of error, the solar instruments by the occasional shifting of their positions or of their gnomons, and the water clocks by stoppages and irregularities in the flow of the water from different causes and by mere chance. It would therefore be necessary that an account first be given how one might, by natural and consistent reasoning, discover the degree of the known hour nearest the event, which is discovered by the method of ascensions."[30]

In the first place an astrolabe can be used to measure time quite precisely. Most likely Ptolemy here thought of an observational armillary sphere (as described by him in book V of the *Almagest*), but his commentators usually interpreted it as the common planispheric astrolabe. Sundials are less secure because they may be incorrectly aligned or their construction is false. Even less reliable are sand- and waterclocks. Once the time is accurately known, the most certain way to determine the ascendant is by calculation according to the rising times of the signs (the method of ascensions) explained by Ptolemy in book II, chapter 8, 9

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*librorum. Denique breuis explicatio Astronomici Horologii Argentoratensis, ad ueri & exacti temporis inuestigationem extructi*, Basle 1578, p. 723–758.

29 *„Die auf dem allgemeinen Titel und auf einem besondern angezeigte Beschreibung der berühmten Uhr zu Strasburg, welche Dasypodius angegeben hat, finde ich meinem Exemplar nicht, sondern nach dessen Aphorismis astrologicis, nach welchen sie stehen sollte, folgt das letzte Blatt mit der Anzeige des Jahres.*" (*Einleitung zur mathematischen Bücherkenntniß*, Breslau 1769/87, vol. III, XV./XVI. Stück, p. 99sq.).

30 Claudius Ptolemy, *Tetrabiblos*, Ed. and Transl. Frank Egleston Robbins (= Loeb Classical Library, vol. 435), 7th ed. Cambridge (Mass.)/London 1994, p. 229/231.

of the *Almagest*. After paraphrasing Ptolemy's text, Dasypodius starts a remarkable digression:

„[...] *With benevolent consent, without envy and suspicion of thirst of glory, I now may explain my thoughts, when the renowned Senate of the City of Strasbourg entrusted me with the invention and design of an astronomical clock in the main church of the city.* [...] *If somebody looks at it with learned eyes, he certainly will notice that I envisaged in my thoughts these four subjects Ptolemy presented here. Since a true and well-chosen description of time is to be done by instruments or calculation, I imitated exactly these subjects and if you look for the instruments in our work, you will find the astrolabe skilfully executed, with the mean motions of the planets. You also have three sundials [on the outside of the Cathedral] constructed with great zeal, effort and diligence by me and my colleague David Wolckenstein. In the third position, instead of waterclocks which are no longer used, you have pictures of the seven planets, which put on show the seven days of the week, the indication of the moon's phases, statues of the four ages of man and a statue of death, which concludes the hours. Also many hands indicating the movements of the planets, the hours, fractions of hours and fractions of the first order* [i. e. minutes]. *All these are being taken instead of waterclocks. Of all these investigations of time the theory of rising times by Ptolemy is most certain. For this I made use of a celestial globe, because it is the most exquisite instrument and appropriate for astronomical calculation beyond all measure.* [...] *Thanks to the diligence and effort of David Wolckenstein we adorned it with pictures of the constellations, meridians, parallels, declinations and magnitudes and all the other things which are explained in spherical astronomy. Finally we gave a soul to this exquisite and astounding globe, a daily movement in imitation of the primum mobile* [the starry vault]. *Therefore you have, my dear reader, the theory of rising time in the globe, and I may say, so exceptionally as you could get it through calculation, if it is permitted to imitate astronomical calculation with instruments. The regularity of these four components can easily be perceived. The sundials guide the other instruments. When the true moment of time is deduced from the shadow of a gnomon you can determine true or approximate time with different instruments of the work belonging to different parts of time.* [...] *But it was not sufficient for a carefully considered representation of time to observe only the rules set up by Ptolemy: It was necessary to add other things, so that the description of time would be complete and absolute. Everything which cannot be achieved by wheels, hands and statues, such as Eternity, Creation and the end of the world, the principal kingdoms and alike, which is of significance for time, we showed in pictures, a calendar disk for hundred years* [...] *and tables of eclipses skilfully executed by the most eminent painter of Germany, Tobias Stimmer.* [...] *From this short outline everybody will easily recognize, that the astronomical work made out by the Senate of Strasbourg for posterity, is unique and worthy of glorification. To him and my highly loved native country I, Conrad*

*Dasypodius,* [...] *dedicate the invention, design, and completion of the entire work to eternal commemoration.“*[31]

Obviously Dasypodius was an ardent believer in astrology and constructed an astrological computer for Strasbourg Cathedral. But the subtleties of underlying various levels of meaning seemed to be properly understood only by its constructor. Shortly after the completion of the clock severe quarrels on the invention and construction between Dasypodius and the Habrecht brothers were fought out, so that the responsibles of the Cathedral Chapter had to mediate between the squabblers. Finally they drew up a lenghthy report on the matter, confessing, *„that they did not understand the astronomical art Dasypodius made use of properly.“*[32] Like it is still today, the ordinary public was delighted by moving statues and the crowing of the iron cock. An astronomical clock was just another marvel of the Cathedral*, „the real museum of the Middle Ages“*[33] among such rarities as whalebones, stuffed crocodiles, meteorites and ostrich eggs. Certainly only very few people cared about symmetry, eurythmia and interpretations of Ptolemy. These intricacies were reserved for the learned spectator, but it is the historian's duty to excavate these layers of thought and knowledge sometimes quite strange to us. Dasypodius's concept is a striking example for the overall importance of astrology in the sixteenth century.[34]

The Strasbourg clock is a brilliant, alas one of the last examples of monumental clocks with complex indications and an almost overwhelmingly variety of meanings. It was a model of the cosmos, and the stars were thought to govern earth right down to the smallest detail. These proportions were soon to be reverted in the course of the seventeenth century, when the cosmos itself became a huge clockwork and time turned into a linear and neutral continuum.

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31 This is a rather free, partial translation by the author of the latin text in Dasypodius's *Scholias et resolvtiones* (n. 27), p. 748–750. A facsimile accompanied by a complete German translation can be found in Oestmann, *Die astronomische Uhr* (n. 2), p. 252–260.

32 Strasbourg, Archives Municipales, Sér. II, 46, No. 35, fol. 5v.

33 Joseph Sauer, *Symbolik des Kirchengebäudes und seiner Ausstattung in der Auffassung des Mittelalters: Mit Berücksichtigung von Honorius Augustodunensis, Sicardus und Durandus*, 2nd ed. Freiburg i. Br. 1924, p. 217.

34 Despite all efforts of Lynn Thorndike and Otto Neugebauer a certain reserve to research astrological concepts internally can still be detected among historians of science. Thus in a review of the author's book by Owen Gingerich (*Isis*, 87, 1996, p. 348sq.) the astrological significance of the Strasbourg clock is not even mentioned.