Mart van Duijn, Ben Hordijk, Rob Memel and Jef Schaeps

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Mart van Duijn*, Ben Hordijk**, Rob Memel***, Jef Schaeps****

After the publication of the article 'Salomon Coster, the clockmaker of Christiaan Huygens' in this journal, the authors decided to have the enigmatic Figura horologij mei edita anno 1657-drawing examined by the Leiden University Libraries. The investigation revealed that the Figura drawing had been made for the printing of the image in Huygens's Horologium, published in 1658.

Introduction (by BH and RM)

In 2018 we had planned to study the correspondence of Christiaan Huvgens at Leiden University Libraries. Already during our first visit to the reading room we came across two interesting finds, a drawing of an unknown clock dial and a drawing of the profile of a pendulum clock movement. The latter drawing is darkly coloured and drawn in ink on one side (Fig. 1) and traced in pencil on the other (Fig. 2). This drawing is now known as the Figura horologij mei edita anno 1657-drawing (hereafter Figura drawing). We immediately associated both the dial drawing and the Figura drawing with Huygens's Horologium image of 1658 (Fig. 3),¹ the first pendulum clock publication of Christiaan Huygens. After researching the Oeuvre Complètes,² and other literature and publications, we noticed that neither of the drawings had been depicted previously. Joella Yoder catalogued and briefly described both drawings in her book A Catalogue of the Manuscripts of Christiaan Huygens,³ but neither is depicted there. The Figura drawing in particular intrigued us because of its similarity to the Horologium clock, the handwritten text and the possibility of new insights into the early development of the pendulum clock.

After discovering all kinds of other documents, we decided to make a publication about the invention and manufacture of the early pendulum clock during the period 1657 – September 1658.⁴ For us it was a necessity to work as much as possible with primary sources from the seventeenth century. The use of secondary sources from the eighteenth century and later, we considered as highly undesirable because of the strongly diminishing reliability of information. The relevance of later secondary sources is in our view only suitable when it unquestionably supports an explicit primary source.

Prior to the publication, we asked Dr Mart van Duijn to carry out an initial inspection of the *Figura* drawing. The results were included in the aforementioned publication. After our publication, and the comments published in the next journal issue,⁵ we decided that the *Figura* drawing needed more and extensive in-depth study. At our request Dr Mart van Duijn and Drs Jef Schaeps agreed to perform a new extensive in-depth inspection of the *Figura* drawing. Their findings are presented in the next section.

^{*}Dr Mart van Duijn is Curator of Post-Medieval Western Manuscripts and Archives at Leiden University Libraries. **Ben Hordijk is the former chairman of the Museum and Archive of Horology and founding member of the Horological Collection Netherlands. ***Rob Memel is a restorer of early clocks and complicated pendulerie with an interest in seventeenth-century Horological archive research. **** Drs Jef Schaeps is Curator of Prints and Drawings at Leiden University Libraries. Address for correspondence: info@robmemel.nl

^{1.} Christiani Hugenii a Zulichem Const. F. Horologium (The Hague, Adriaan Vlacq, 1658).

^{2.} Oeuvres Complètes de Christiaan Huygens publiées par la Société Hollandaise des Sciences (The Hague: Martinus Nijhoff, 22 vols, 1888–1950); hereafter: OC.

^{3.} Joella Yoder, *Catalogue of the Manuscripts of Christiaan Huygens including a Concordance With His Oeuvres Complètes.* History of Science and Medicine Library, Volume 35 (Leiden-Boston: Brill, 2013).

^{4. &#}x27;Salomon Coster, the clockmaker of Christiaan Huygens. The production and development of the first pendulum clocks in the period 1657 – September 1658', *Antiquarian Horology* 42/3 (September 2021), 323-344.
5. Letters to the Editor in *Antiquarian Horology* 42/4, 576-580.



Fig. 1. The verso side of *Codices Hugeniani*, HUG 32 folio 188 (Leiden University Libraries), showing a drawing in ink of the profile of a pendulum clock with on top right the inscription *Figura horologij mei edita anno 1657* (A drawing of my clock made known in the year 1657). The dark surface is caused by the etching ground of the copperplate which was used to print the *Horologium* image.

The research of the Figura drawing

(by MvD and JS)

HUG 32, fol. 188, is part of Huygens's extensive archives kept at Leiden University Libraries, mostly containing his scientific workbooks and correspondence. HUG 32 is described by Yoder as a collection of loose sheets of various sizes and dates, called 'Portefeuille Varia [1]' by the editors of the *Oeuvres Complètes*. Most of the material was written by Christiaan's primary heir, Constantijn Huygens Lz; only ff. 168–192 are in Christiaan's hand. Unlike most of the material in Huygens's archives, which was bequeathed to the library after Huygens's



Fig. 2. The recto side of *Codices Hugeniani*, HUG 32 folio 188 (Leiden University Libraries), showing the mirrored drawing in pencil which is traced from the ink *Figura* drawing on the verso side (see Fig. 1.). On the top left the inscription *Tabula haec Aeri incisa reperitur in Hugenii Horologio* (This drawing, incised in copper, is found in Huygens's *Horologium*).

death in 1695, HUG 32 was gathered by the lawyer and collector Jean Theodore Royer (1737–1807) and willed to the library in $1809.^6$

The sheet in question measures 290 by 172 mm, with one of the lower corners torn off, and has a modern foliation in pencil. The verso side has the *Figura* drawing in ink, with letters indicating the different parts of the pendulum clock. The upper right corner has a barely legible inscription, by Huygens himself: '*Figura horologij mei edita anno* 1657' (A drawing of my clock made known in the year 1657). Yoder was unable to decipher

6. Yoder, Catalogue of the Manuscripts of Christiaan Huygens, p. 143.

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Fig. 3. Image of the *Horologium* (1658) clock from the collection of the Leiden University Libraries (539 F 29). This copy belonged to Isaac Vossius, who received *Horologium* directly from Christiaan Huygens.

the first word, but Ben Hordijk and Rob Memel managed to publish a complete and convincing transcription in their article (see note 4). The ink drawing is covered with a greyish residue of etching ground, resulting in a somewhat darkened image. This darkening is not the result of the erasure of another or earlier drawing, as has been suggested. The recto side of fol. 188, bearing the stamp of Leiden University Libraries, has the *Figura* drawing in graphite (pencil). The upper left corner has a seventeenth-century inscription: *'Tabula haec Aeri incisa reperitur in Hugenii*



Fig. 4. Detailed image of the recto *Tabula* drawing (see Fig. 2). The indentations are usually on the pencil line, which makes it difficult to show in an image. Here the indentations are just beside the pencil line. Between the yellow lines is the traced pencil line. Between the red lines the indentations to make a transfer onto the copper plate.

Horologio^{'7} (This drawing, incised in copper, is found in Huygens's *Horologium*). The drawings on both sides exactly align, probably the result of the ink drawing on the verso side being traced in pencil on the recto side. Although the modern foliation might suggest otherwise, the image in ink was done first, followed by the tracing in pencil.

The residue of etching ground seems to point to a very common technique, used for transferring images to a copper printing plate. In general this process entails placing a

7.With 'Aeri' instead of 'iteri' as transcribed by Yoder. Thanks to Jos van Heel (former curator old collection Museum Meermanno The Hague).



Fig. 5. From left to right the process of the *Figura* ink drawing, the traced mirrored *Tabula* pencil drawing to the final image in *Horologium* (1658).

drawing on a copperplate covered with etching ground (wax containing a pigment such as sooth or graphite), after which the drawing was retraced with a sharp object, indenting the etching ground. To avoid a mirrored reproduction of the design, a preceding step was necessary in which the drawing was first traced on the back of the sheet. This is what has been done with Huygens's *Figura* drawing in ink, with the back of the drawing now being identified as the recto side. The indentations are still visible (Fig. 4). After the drawing had been transferred onto the plate, this was etched in order to produce a printing matrix.⁸ A drawing by Huygens used to transfer a design to a printing plate is of

8. For a detailed description of the process see Ad Stijnman, *Engraving and etching*, 1400–2000: a history of the development of manual intaglio printmaking processes (London/Houten, 2012), pp. 155–157.

the utmost rarity. No other example is known from Huygens's archives kept in Leiden. This kind of drawings usually perished in the transfer process.

Comparing the *Figura* drawing to the image in Huygens's *Horologium*, as is suggested in the anonymous inscription on the recto side, reveals the fact that the drawing and the printed image are identical, with the exception of the letters (Latin and Greek), that were probably added to the plate separately.⁹ Yoder refers to the ink drawing as 'an exact copy of the Figure used in *Horologium*',¹⁰ while in fact the ink drawing on HUG 32, fol. 188 verso, is the original design used to create the printed image of Huygens's pendulum clock in *Horologium* (1658) (Fig. 5).

Figura and the depicted clock

(by BH and RM)

Huygens made many sketches of clocks and parts of clocks that are interesting for closer research. Unfortunately most of these sketches are undated which makes it difficult to date them in a specific year/month. Drawings by Huygens, like the Figura drawing, are extremely rare certainly when it concerns the original drawing which was used as a transfer on a copper plate for Huygens's Horologium. Because of the text Figura horologij mei edita anno 1657 on the verso side in Huygens's own handwriting, it is certain that the design of the clock, including the OP construction,¹¹ vertical escapement wheel, the absence of the arches, the Huvgens endless cord and the central seconds hand existed at the latest in December 1657. Also, the handwritten text on the pencil tracing clearly indicates that Huygens used a copper plate for his Horologium publication. Unfortunately, Huygens did not add a specific month to his text. December 1657 is therefore the most cautious estimate, but in theory it could also be January 1657. We consider the latter less likely since the first design of Huygens's clock was a pendulum linked to a vertical balance.¹² That the *Figura* movement could have been the movement from Coster's patent application is an option, but we would like to emphasize that there is no evidence for this. It is even questionable whether a drawing was included in the patent application at all, since the existence and ultimate proof of such a drawing is completely lacking.

Images in *Horologium* and *Horologium* **Oscillatorium** (by BH and RM)

It is impossible to say with certainty when Huygens made the *Figura* drawing. As the clock as such already existed in 1657, it is a promising possibility that the drawing was also made in 1657. We know that Huygens started writing *Horologium* by the end of 1657 and that the process from the delivery of a manuscript to a printed copy could take months in the seventeenth century. Nevertheless, we can establish that the *Figura* drawing is the earliest existing accurate drawing of Huygens's pendulum clock.

In 1673, Huygens published *Horologium* Oscillatorium,¹³ his second publication on clocks. This publication also contains an image of a clock (Fig. 6). The clock in this image is equipped with the cycloidal arcs that Huygens writes about extensively. Huygens invented the cycloidal arcs by the end of 1659, and clocks (almost) identical to this image were unmistakably manufactured from December 1659 onwards. Particularly in the eighteenth century, publications were issued in which the clock image from *Horologium* Oscillatorium was used as a basis, and the

^{9.} Studied copy: Leiden, University Library, 539 F 22 (copy of Isaac Vossius).

^{10.} Yoder, Catalogue of the Manuscripts of Christiaan Huygens, p. 145.

^{11.} A construction to minimize the amplitude of the pendulum by adding a pinion and a wheel, in the *Figura/Horologium* drawing marked O and P. Huygens also experimented with non-cycloid arcs in the early phase. Both the OP construction and the non-cycloid arcs no longer exist with the invention of the cycloid shape at the end of 1659.

^{12.} Codices Hugeniani, HUG 45 letter Huygens to Kechelius June 1657 (OC II, letter no. 392) and Codices Hugeniani, HUG 45 letter Huygens to Chapelain 28 March 1658 (OC II, no. 477).

^{13.} Christiani Hugenii Zulichemii Const. F., Horologium oscillatorium sive de motu pendulorum ad horologia aptato demonstrationes geometricae (Paris, F. Muguet, 1673).



Fig. 6. Image of the *Horologium Oscillatorium* (1673) clock from Huygens's own copy which is part of the collection of the Leiden University Libraries (755 A 5).

author in question produced his own woodeut or engraving etching.¹⁴ That *Horologium* and *Horologium* Oscillatorium were regarded by Huygens as his earliest two treatises on clocks is obvious. In *Horologium* Oscillatorium Huygens makes two clear references to his earlier and first publication Horologium. In his opening sentence in typical muddled seventeenth-century language, he writes: 'It is the sixteenth year since we published a pamphlet about clocks, then recently invented by us'. By 'the sixteenth year' Huygens means the year 1658, where 1658 is the first year and 1673 the sixteenth year. This translation and accompanying explanations are supported by experts of Leiden University Libraries. Some authors misinterpret this sentence and mistranslate it as 'it is sixteen years ago', resulting in the year 1657 which is clearly incorrect. In *Horologium Oscillatorium* Huygens reconfirms the year 1658 in a number of sentences after the opening sentence:

Sixteen years ago [1657, BH/RM], when neither in words nor in writings had anyone mentioned clocks of this kind, or in general any rumor was spread (I am talking about the use of the single pendulum employed in timepieces, for nobody will dispute the addition of the cycloid), I invented its construction by my own thinking and had it realized. In the following year [1658, BH/RM], which was the fifty-eighth of this century, I published the image of the automaton and the description; copies of both the movement itself and the booklet I sent in all directions.

In contrast to 'the sixteenth year' in his opening sentence, Huygens does write here 'sixteen years ago' which is 1657. In that year Huygens indeed '...invented and had the construction.... realized', in which the first clocks were manufactured by Salomon Coster.

In the year after, which was the fifty-eighth of this century, I published the image of the automaton and the description.

Here Huygens clearly refers to the *Horologium* image being the image of the automaton followed by the description being *Horologium*, Huygens's first publication in the following year 1658.

^{14.} See, among others, in La veuve Estienne & Fils, *Le Spectacle de la Nature* (1756) and Benjamin Martin, *A new and comprehensive system of mathematical institutions, agreeable to the present state of the Newtonian mathesis* (1764).