Simon Le Noir and the first pendulum clocks: a parallel story?

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Abstract

According to the commonly accepted story, the first French pendulum clocks were made in 1658 by Nicolas Hanet, agent of Salomon Coster, based on Dutch models. The recent discovery of an early pendulum clock mechanism, far from the refined Dutch style and much closer to the Renaissance style, potentially challenges this version of history by suggesting that another French clockmaker, Simon Le Noir, was the first to make pendulum clocks in France before Nicolas Hanet. The purpose of this article is to present a technical and historical analysis of the discovered mechanism and to show that it is possibly older than any other known French pendulum clock, then to perform a historical analysis to explain its anteriority. This study is a synthesis of a comprehensive memorandum available on a website created by the author[1].

Introduction

Knowing who was first to apply pendulum to clocks is ultimately a very academic problem. Generally speaking, history has shown us on many occasions that an invention, seen as a technical achievement, can be the simultaneous work of several distinct and uncoordinated people and often arises naturally as the result of innate social and technological maturity. This is how quarrels may arise between inventors from different regions or nations regarding the same invention as they may have had the same idea at similar times. Moreover, beyond the invention itself making it known can be particularly difficult if one does not have relationship with already well-known inventors. Many independant inventors could have thus escaped notoriety and have been completely forgotten a few years after their death.

As a consequence, the origin of the pendulum clock is the subject of recurrent debate. We know today that Galileo designed a pendulum clock as early as 1642, then his son Vincenzo would have built in 1649 a prototype which functioning was rather uncertain before Huygens independently applied the pendulum to a clock a few years later in December 1656: he will be the first to have it successfully manufactured for commercial purpose; even though all these elements have been known for quite some time, numerous researches have shown that other inventors may have played a role - minor or major - in this vast timeline and possibly fully functional pendulum clocks may have been built earlier than previously assumed.

It is interesting to note that most of our current knowledge on the history of early pendulum clocks comes from recent studies, mostly conducted in the twentieth century by such illustrious authors such as Reinier Plomp, Silvio Bedini, Enrico Morpurgo and of course Sebastian Whitestone whose latest articles published in *Antiquarian Horology* shed new light on Huygens' early work and show us once again that the whole story is far from being known. It is also not uncommon for the discovery of an atypical clock to call into question some facts previously established, in particular Huygens' priority concerning the application of the pen-

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[2] S. Bedini, *The pulse of time: Galileo Galilei, the determination of longitude, and the pendulum clock* (Florence: Biblioteca di Nuncius, 1991), pp.100-111

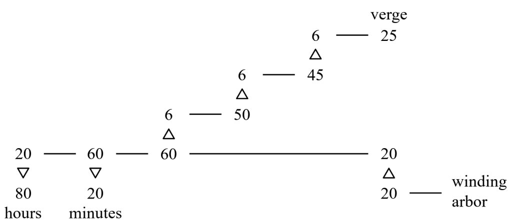
dulum to clocks - one can think of the Salem Institute clock described by Silvio Bedini[2] or of the Jan van Call regulator[3] which has been the subject of a recent controversy and which authenticity is strongly questioned.

This article will present the study of a primitive and singular pendulum mechanism rediscovered in 2020. The clockmaker who designed this mechanism is associated with a very surprising anecdote related to the origin of pendulum clocks which explicitly suggests his involvement in their development. The purpose of this article will be therefore to analyze the mechanism and the aforementioned anecdote in order to assess if this clock really is a primitive and essential witness of the history of pendulum clocks. After a general presentation of the mechanism, we will first provide a targeted analysis of its singularities; the anecdote will be analyzed in a second section, especially through its source and biographical elements. Finally, the combined synthesis of these elements will allow us to finally propose a global explanation and perhaps lift part of the veil that covers this strange affair.

This article is a synthesis of a much more complete memorandum, especially concerning the detailed analysis of the mechanism and its authenticity; this memorandum can be consulted at the following url: `http://agomand/github.io/asln/en`

1 The mechanism

The studied mechanism is shown in figures 1, 2, 3 and 4. It has a single going train without striking which reduction ratios are given below.



This 4-wheel train is composed of a fusee with its main-wheel, an "intermediate" wheel followed by a contrate wheel and a crown escape wheel. On the arbor of the fusee is mounted a "drive" wheel which allows to drive motion-work (both minute and hour wheels are driven directly by the drive wheel), held by a bridge. The winding of the mechanism is ensured by the intermediary of an arbor with a square (dial side) and at the end of which is mounted a steel wheel which drives a second identical wheel mounted on the arbor of the fusee (back-plate side); through this arrangement, the winding is thus deported on the dial side.

All brass parts are gilded with the notable exception of those mounted on the front plate (bridge, drive wheel and wheels of the motion-work), the intermediate wheel *assiette* and the escape wheel.

The verge cock is decorated with floral patterns also visible on the part holding the barrel ratchet in position. This cock is fixed to the back-plate by 2 screws which also maintain the suspension cheeks.

The fork, the pendulum and its suspension are missing. The false plate which was pinned on the front-plate remains but has unfortunately experienced damages from the previous owner and is partially covered with black painting (when recovered, the mechanism was mounted on the back of a lantern clock dial which steel support had been painted to cover rust).

The main plates measure approximately 135 mm by 56 mm with 22 mm spacing between plates. The false plate measures 113 mm by 53 mm. The theoretical length of the pendulum, calculated from the reduction ratios, is about 119 mm.

Renaissance features

Compared to the first "classical" pendulum clocks by Coster, Pascal, Hanet and others, the studied mechanism has many specificities which are related to the Renaissance style, the period

[3] See D. Thompson, *The wall clock dated 1657 signed Jan van Call* (Antiquarian Horology, vol.33, December 2012) for a detailed description of the clock. Most of the analyses follow in vol. 34 from January 2013.

Fig. 1: Front view of the mechanism

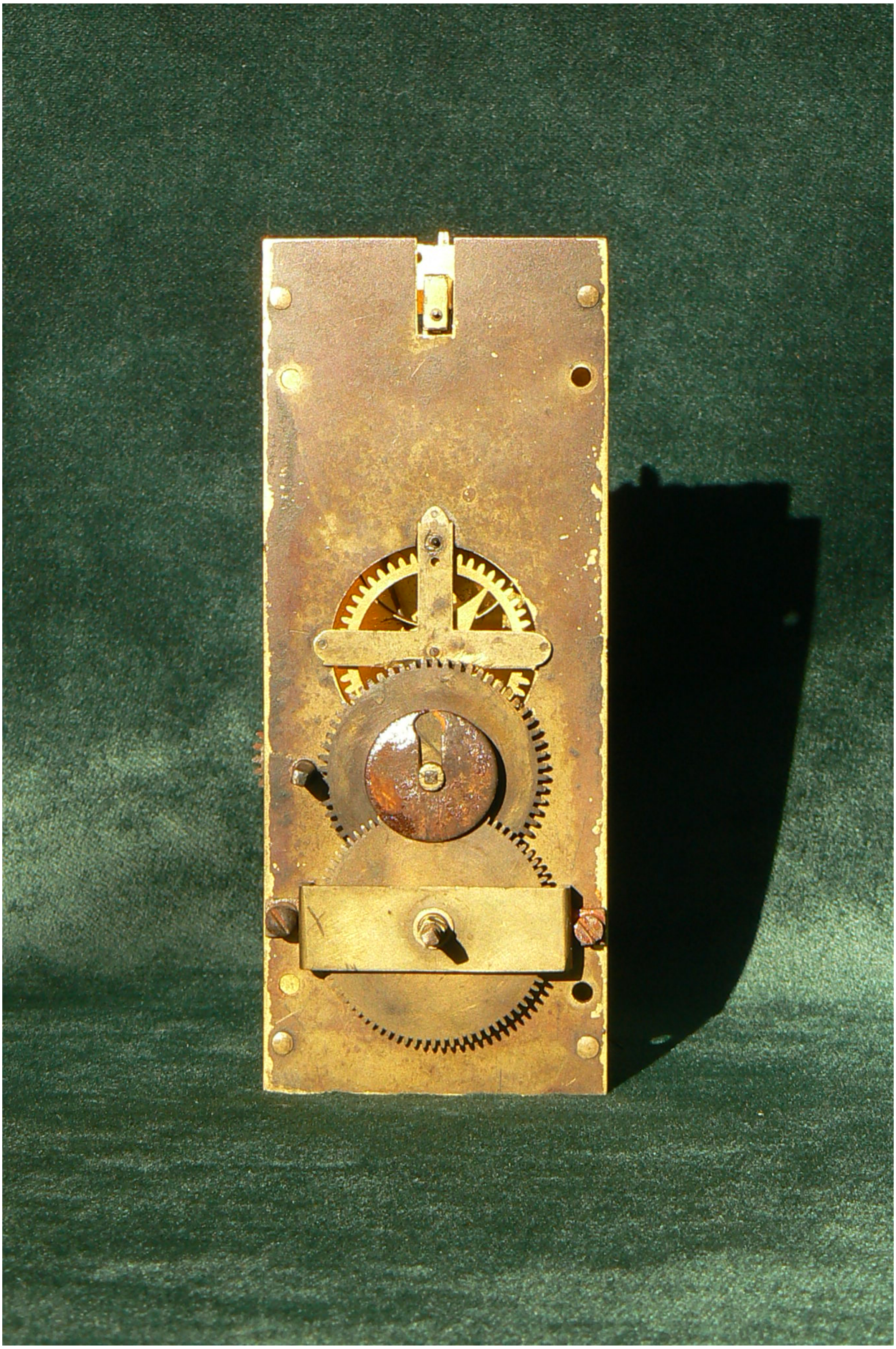


Fig. 2: Back view of the mechanism

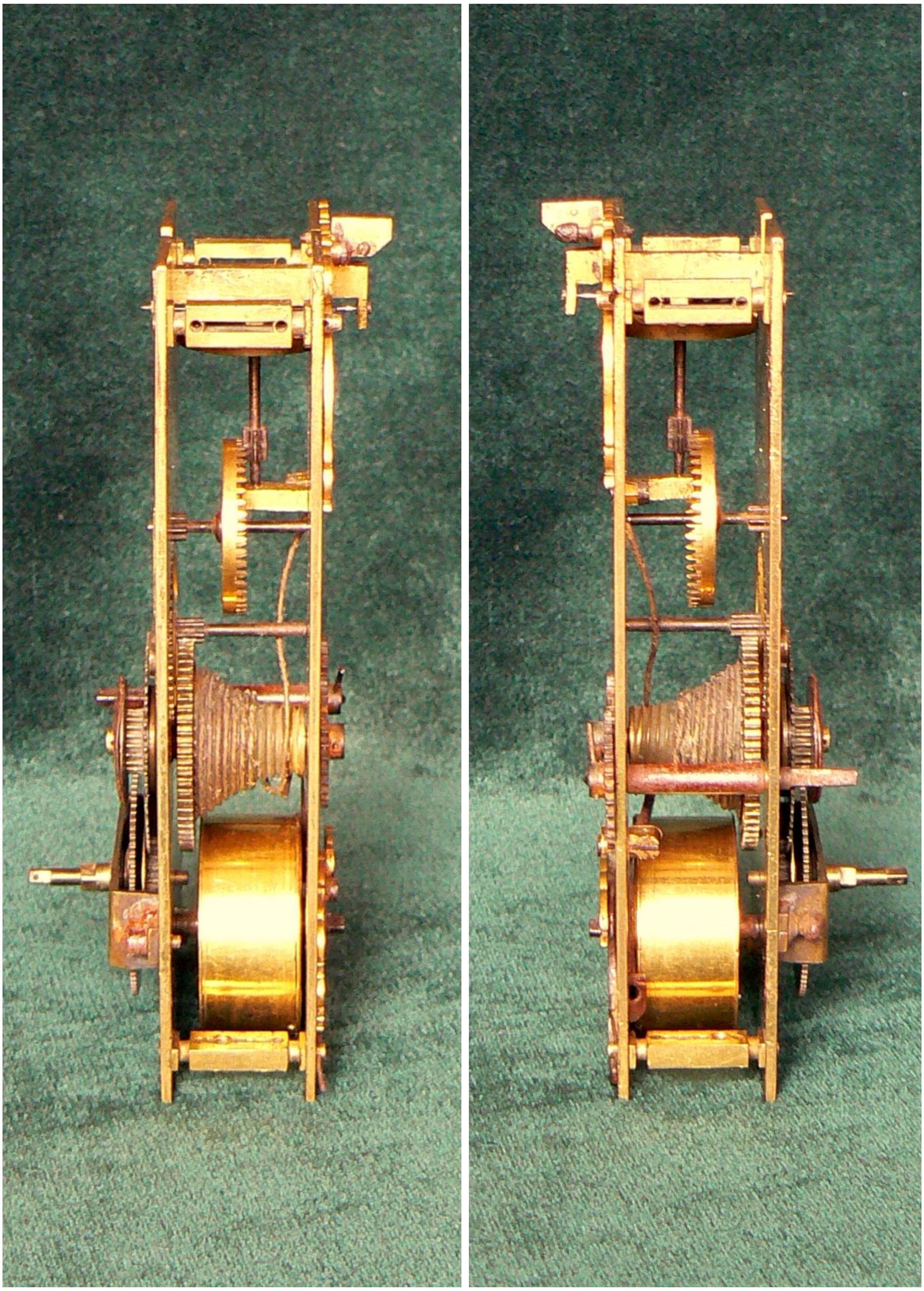


Fig. 3: Side views of the mechanism

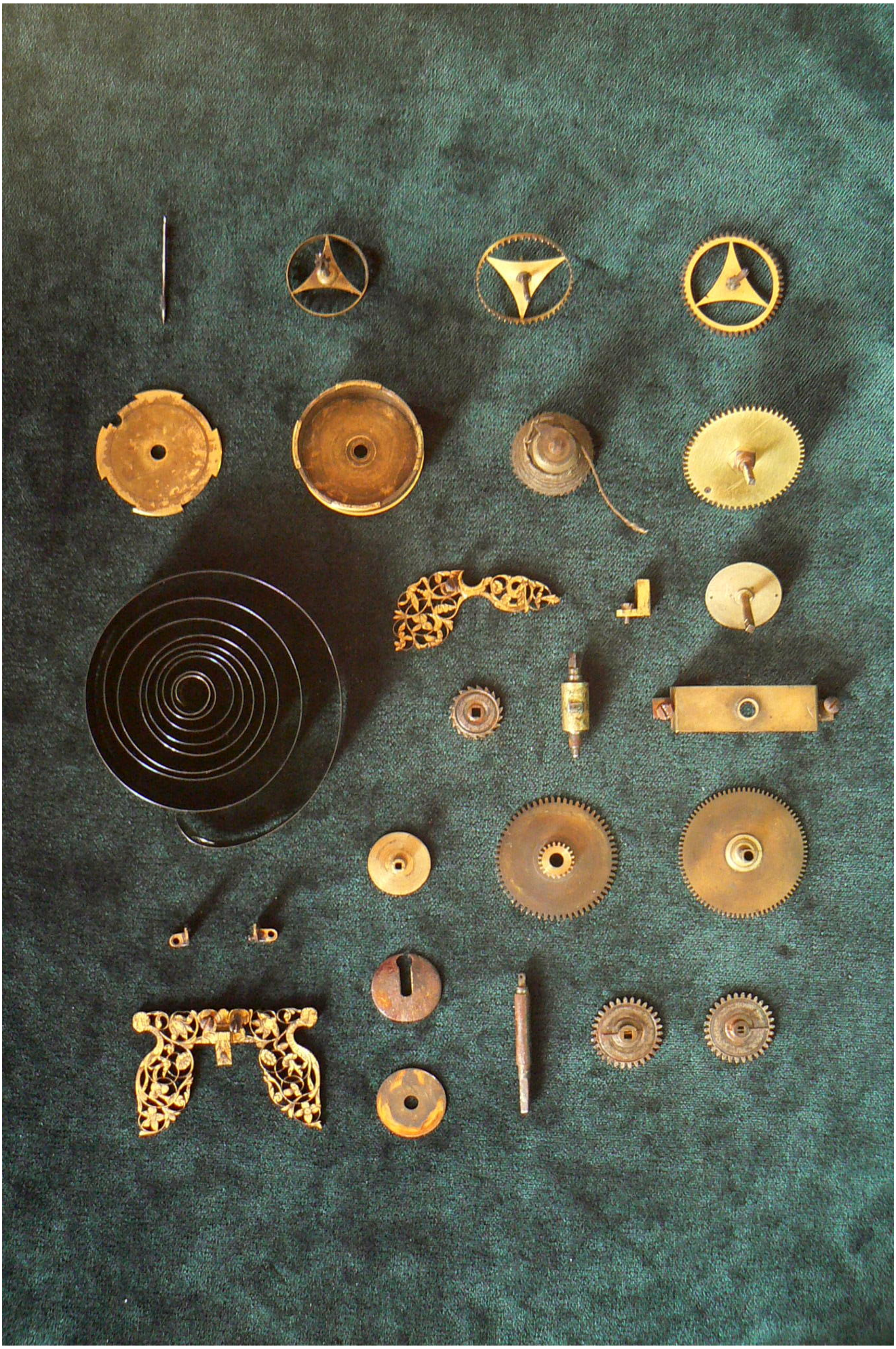


Fig. 4: Overall view of the mechanism parts

just before the application of the pendulum to clocks.

The main specificity is the presence of a fusee. It is known that the fusee has totally disappeared from French clocks with the use of the pendulum; we actually do not know any French pendulum clock from the 1658-70 era with a fusee. The very few (only 4) French pendulum clocks with a fusse we found all dated from the 1680-1700 period. On the Le Noir mechanism, the fusee may be a reminiscence of the Renaissance period when it was one of the main elements of the mechanism which was used to counter-balance the decrease of the main spring power to make the force on the escapement as constant as possible, at a time when the oscillator - the balance wheel or *foliot* - was strongly anisochronous. Only one of the earliest pendulum clocks built in Europe before 1660 known so far has a fusee. This clock, built by Treffler, has been the subject of a detailed study[4] and is currently preserved in the Galileo Museum in Florence; it may be closely related to the mechanism presented in this article as we shall see later. On the other hand it is not excluded that some of the first clocks made by Salomon Coster were equipped with a fusee, although no examples are known today.

A second rather obvious characteristic concerns the decorations of the back of the mechanism which embellish the verge cock as well as the ratchet. Such decorations are common on Renaissance clocks but also disappeared completely in France after the introduction of the pendulum; no French pendulum clocks with similar decorations are known, nor French pendulum clocks with this ratchet layout, typical of the Renaissance period with its S-shaped spring and a bridge to hold it in position. Curiously enough, later Dutch clocks (posterior to 1670) carried again this type of decorations, probably inspired from the old style.

The very special winding system is also of interest. As previously mentioned, it allows the winding to be moved to the front of the mechanism, on the dial side. Although this is not a typical Renaissance assembly, no French pendulum clock is known with a similar device; it is found on a few German clocks in the *Augsburg* tradition, some *Telleruhr* of the 1670-1680s, as well as on an astronomical altar clock - an *Altaruhr* - signed Büstman and dated from the second quarter of the seventeenth century (the wheels of this clock are by the way very similar to those of Le Noir's mechanism). Such a system is useful here because the winding square of the fusee aligns with the pendulum at rest which does not facilitate the winding (although back-winding arrangement is used on the Treffler clock mentioned above). However, Le Noir's layout appears to be quite experimental in that it partially covers his signature and overhangs the back plate - although the overhanging has been observed on other clocks with such winding system.

Among the other specificities of this clock that can be seen at first glance, the signature stands up as a noticeable characteristic. Le Noir engraved his name *and* surname, a practice that was not the more common on religious clocks where only the name is generally engraved with sometimes the surname's initial - although some well-known clockmakers sometimes choose to keep the whole surname. The calligraphy of the signature is very meticulous, curled and scrolled, quite far from the sobriety adopted in France inherited in *pendules religieuses*, inherited from Dutch pendulum clocks.

One can also notice the presence of gilding on most of the visible brass parts (excluding the wheels behind the false plate), which is quite rare on religious clocks whereas almost all Renaissance movements are gilded, as they were at that time considered both functional as well as decorative objects.

Turning now our attention to the inner parts of the mechanism, the dovetailed barrel cap is perhaps the most intriguing feature. Its cross-shape pattern, useful for mounting the cover in force, was in use on the majority of Renaissance watches and clocks in Europe and disappeared as soon as the pendulum was introduced; only one Coster clock with an almost

[4] K. Piggott, *A Royal 'Haagseklok', Appendix Three, Open-Research, Memo-Treffler: Johann Philipp Treffler's 1657/8 Pendulum Timepiece (DØcopy)*

identical barrel is known, described as a *"Renaissance" feature*[5] by one of those who examined this mechanism.

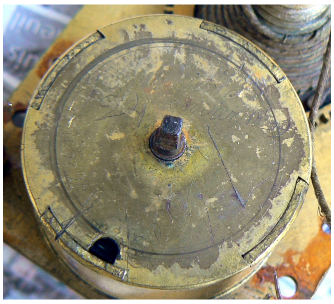


Fig. 5: Dovetailed barrel cap

On the motion-work side, we note that the hour hand was mounted on a square cannon like the minute hand (figure 6). This use of 2 squares for both hands was already seen on some Renaissance clocks, where the minute hand remained exceptional.

Fig. 6: Hand cannons

A last atypical detail is located on the side of the verge: its pivot-holders are formed by two brass cylinders whose central holes are partially "filled" by a brass rod, like a bush (figure 7). This arrangement is very common on watches of the seventeenth century, especially before the use of the balance-spring; the verge thus mounted is "trapped" between the rods and its pivots are not visible from the outside.

Fig. 7: Bushed pivot-holes of the verge

More a watch than a clock?

Amongst all elements mentioned, many of them are related to both Renaissance clocks and watches. Curiously enough, other elements suggest a stronger resemblance to watches compared to clocks.

First of all, the absence of a striking mechanism is noteworthy: only the very first *pendules religieuses* in France had a single train whereas almost all Renaissance clocks - but not watches - had a striking train. One can think that the mechanism was built based on watches', but also that it attests of a sufficiently innovative technological contribution - the use of the pendulum oscillator - to make the addition of any other functionality unnecessary, which supports Le Noir's mechanism primitive dimension.

One pivotal element is the presence of a separate bridge for the intermediate wheel and the recessed pinion of the contrate wheel (figure 8). This type of bridge was commonly used in watches from the seventeenth century but was actually still in use during the eighteenth and nineteenth century. This layout allows to increase the height of the fuseee i.e. the power reserve without increasing the distance between the main plates of the movement.

Fig. 8: "Trident" bridge on the front-plate

Finally, the pillars of the plates (figure 9) are much closer to watches' pillars than clocks'. They correspond in fact to the "primitive" Egyptian style found on a few watches and very rare clocks of the first half of the seventeenth century and then generalized by Louis XIV oignon watches. There is no French clock known with similar pillars, the most commonly used form in France being the "baluster", already in use during the Renaissance, which will

[5] K. Piggott, *A Royal 'Haagseklok', Appendix Three, Open-Research. MEMORANDUM D3: The Contentious Coster Relic Timepiece*, p.6

remain in use on most *pendules religieuses*.

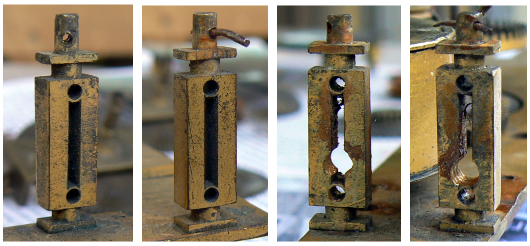


Fig. 9: Pillars of the movement

The combination of all these elements suggests that Le Noir made this mechanism as he would have made a Renaissance watch; this hypothesis is essential and will guide the following technical and historical analyses.

The suspension cheeks

It sounds appropriate to discuss here in more details about a technical feature that is not related neither to the Renaissance style nor to watches but to the use of the pendulum regulator itself: the suspension cheeks. All surviving Coster clocks have a silk suspension between two cycloidal cheeks to make the oscillations isochronous following Huygens recommandation (these cheeks seem to have been used as early as 1657, first curved empirically, then deduced from mathematical calculations after 1658). Sets combining silk chord and cycloids will be used on all pendulum clocks in Europe at least in the first years; Hooke will then introduce spring suspensions in England at the beginning of the 1660s and these will therefore be used on some British clocks from that time.

The suspension cheeks of Le Noir's mechanism have unfortunately been modified to accommodate a soldered brass rod that would have supported a new suspension silk, so as to hang a pendulum in the manner of eighteenth or nineteenth century timepieces; in addition, the lower corners of both parts have been chamfered. At first glance, one might think that these corners were extended into cycloidal cheeks but a close examination of the design of the remaining parts proves this hypothesis to be wrong. Indeed, one can notice the presence of a rectangular slot at the junction of the cheeks, intended to let the suspension pass through (cf. figure 10); such a slot however generally attests to the use of a metallic spring, a hypothesis that is all the more likely since the screw that maintains the two suspension cheeks pressed one against the other is offset upstream of this slot, whereas it is most often located between the two strands of the silk chord on traditional suspensions. The additional presence of wear centered on the slot suggests the friction of a pin used to prevent the suspension from sliding down. It can also be noted that if cycloids were used, they would not have been centered around the suspension.

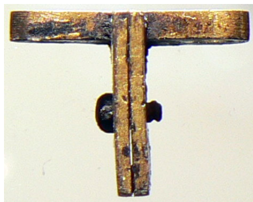


Fig. 10: Top view of the suspension cheeks

All these elements suggest on the one hand that the mechanism was never equipped with cycloids and on the other hand that its suspension was made of a metal spring (probably steel) in a similar assembly to the figure 11. This conclusion is surprising, to say the least, when we know that this type of suspension will only become widespread in the nineteenth century and was still exceptional at the end of the seventeenth century.

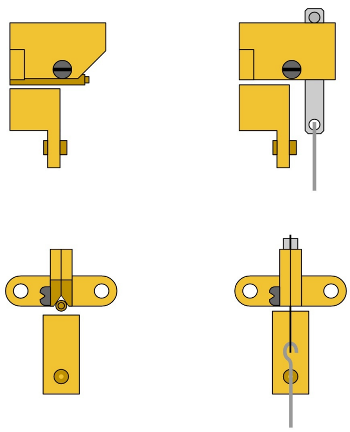


Fig. 11: Present (left) and past (right) configurations of the suspension

Comparison with known mechanisms

In previous sections we compared certain parts of the Le Noir movement with other clocks of the period. To perform a more global comparison, it is necessary to gather an exhaustive documentation on the French and European pendulum clocks of the 1660's, from reference documents such as Plomp's works[6][7] and Keith Piggott's *open-research* project[8].

It appeared that apart from certain structural aspects rather related to the standards of the time (one can think in particular of the dimensions of the plates which are consistent with the measurement in inches in use at that time or the number of wheels of the going train), the mechanism of Le Noir differs from its contemporary analogues by a very broad range of features - functional and structural - among which are the pendulum length, significantly shorter than the average, and the unconventional number of teeth of the wheels, all multiples of 5 or 10, as well as all the peculiarities we have studied above that reinforce its singularity. At this stage of our study, the movement of Le Noir remains very mysterious.

With respect to the specificities detailed above, we present below a comparative table between the clocks and watches of the seventeenth century clocks and watches and the movement of Le Noir. This summary shows well the singularity of the mechanism and its connection to the standards of the Renaissance era.

Features	**Renaissance clocks (<1657)**	**First pendulum clocks (1657-1665)**	**Watches (1600-1675)**
Gilded plates & wheels	Common	Rare	Common
Decorations on the verge cock	Common	France: not found Europe: quite rare	Common
Decoration on the ratchet	Common	Not found	Common
Fine calligraphy of the signature	Common	Quite rare	Common
First name in the signature	Common	Quite rare	Common
Use of a fusee	Always	France: not found Europe: exceptional	Always
Dovetailed barrel cap	Common	France: not found Europe: exceptional	Common
Bridge for recessed pinions	Rare	Not found	Common
Primitive egyptian pillars	Rare	Not found	Quite rare
Bushed verge pivot-holes	Quite always	Not found	Quite always
No cycloidal cheeks	N.A.	Very rare	N.A.
Spring suspension	N.A.	France: not found Europe: very rare	N.A.
Winding layout	Very rare	France: not found Europe: very rare	Not found
No striking train	Rare	Common	Common

[6] R. Plomp, *Early french pendulum clocks, 1658-1700* (Schiedam : Interbook International, 2009)
[7] R. Plomp, *Spring-driven Dutch pendulum clocks 1657-1710* (Schiedam : Interbook International, 1979)
[8] http://www.antique-horology.org/piggott/rh/openresearch.xls

Authenticity

It is understood that a piece of such unusual design must inevitably be subjected to a thorough examination as to its authenticity. This examination has been carried out in detail in the *memorandum* from which this synthetic article is derived and only the main conclusions are therefore reproduced here.

The question of authenticity was tackled by undertaking two complementary approaches: on the one hand, the *overall consistency*, which consists in questioning the consistency of the pieces with each other and identifying those that may have undergone possible modifications or are not original; on the other hand, the *temporal consistency*, which consists in examining the consistency of the mechanism with respect to the period in which it was supposed to be made.

Looking at overall consistency, no noticeable inconsistency could be found neither in the arrangement of the parts nor in their general features; for example, the wheels are all hand-cut, all have numbers of teeth multiple of 5 with pinions of 6 wings and the cutting of the spokes is the same everywhere. It has also been shown that the dimensions and overall design of the suspension holders, as well as the winding device (wheels and arbor) are consistent with those of the other parts. The only two small inconsistencies that could be noticed are the lack of gilding on the crown wheel and the lack of visible compass marks on the drive wheel; however, knowing that both of these parts have been repaired and are consistent in other respects with the rest of the mechanism, it would look like that they would be the original.

As far as temporal consistency is concerned, apart from the presence of the pendulum, the mechanism is quite consistent in terms of shapes and manufacturing methods with what could be found in the mid-seventeenth century. The mercury gilding is particularly noticeable, applied only to the visible parts of the mechanism (typically absent from the front plate on the dial side); the overall dimensions correspond to a whole number of inches and the profile of the screw heads to the one used at that time - for those that are original.

There are also several signatures of clockmakers who have made repairs. Two of these signatures on the barrel could be authentified, the oldest dating back from the mid-eighteenth century.

It can therefore be concluded at this stage of our analysis that the mechanism seems truly authentic and has only undergone relatively minor repairs and modifications, even if some have affected the integrity of certain parts and remain irreversible.

Experimental aspect

In addition to the technical and aesthetic features discussed in the previous sections, we have noted a certain number of peculiarities suggesting that Le Noir mechanism was experimental, possibly to test a new technical solution: the pendulum regulator.

First and foremost, we notice the presence of gilded bushes including two on the "trident" bridge where the intermediate wheel bearing is located (figure 12). For a number of practical reasons, it is assumed that the gilding is original and therefore these bushes were made when the mechanism was designed, probably to adjust the layout of the wheels.

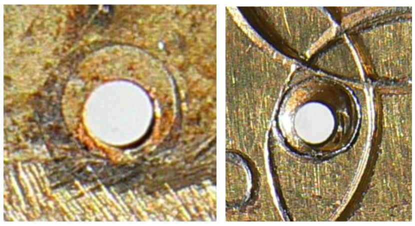


Fig. 12: Bushes for the intermediate wheel

The top of the trident shows an unused bearing, located below the crown bearing; this looks actually that it was the one that was originally intended to receive the crown wheel pivot. This hypothesis can be made by observing the cut-out that was made in the front plate around the intermediate wheel: this cut-out would have been initially of a lower diameter and was enlarged to position the new intermediate wheel; one can indeed notice a groove in the thickness of the front plate, in the extension of a "bush" on the trident which would have been in fact the former rivet fixing the cross to the plate (figure 13). Moreover, we could measure that if the crown wheel was located in the currently unused bearing, the intermediate wheel would need to have 40 teeth to mesh with it, which remains consistent with the number of teeth of the other wheels.

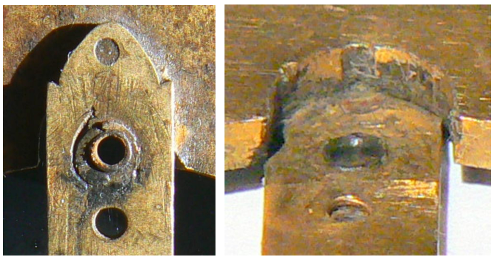


Fig. 13: Top of the cross-shaped bridge

Another detail supports this last hypothesis: the teeth of the intermediate wheel have been filed down because they were rubbing against the square at the base of the fusee and the corners of this square have also been filed down *after* gilding (figure 14); Le Noir had probably not anticipated this defect before carrying out a few tests on the mechanism once it was finished and assembled, so he was forced to make some unforeseen modifications.

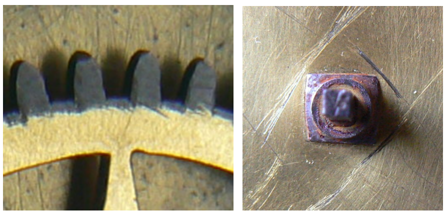


Fig. 14: Teeth and square filed down

We also noticed that the wheel on the fusee arbor that drives motion work has been filed down in the same way because it collided with the lower edge of the trident, and this edge was consequently filed down too. Closer examination lead us to the hypothesis that Le Noir aimed initially to drive the minute wheel by by the fusee wheel and thus the present wheel that drives motion work would have consisted of a single pinion to drive the hour wheel only, not colliding with the trident.

The final point of interest concerns the contrate wheel *assiette*: a circular mark is visible around the wheel like the one that would have been caused by a larger *assiette*; it is quite curious that the current *assiette* is smaller in diameter than the one of the crown wheel. At the same time, the pivot of the arbor on the dial side is cut into a point where all other pivots are upright which suggests that this arbor was initially longer and was adjusted -but what for? The false plate may give us a clue: it has a hole of medium diameter, centered in width, which seems to be original because it is the same diameter as several bearings of the mechanism. This hole may have been intended to allow the arbor of a hypothetical seconds wheel to pass through, in an arrangement similar to the Treffler mechanism's. The extrapolated reduction ratios in figure 15 are compatible with the general dimensions by taking the same gear module as the other wheels; one thus obtains a "seconds" wheel that makes one revolution in two minutes which is certainly rather atypical but not impossible.

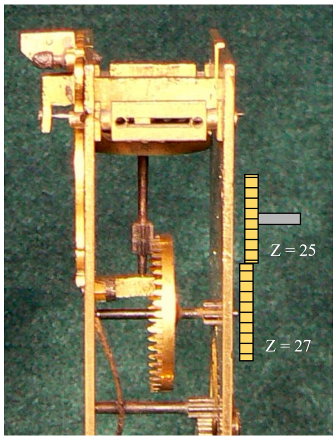


Fig. 15: Possible configuration of the hypothetical seconds wheel

There are other, more minor peculiarities that will not be discussed here; the interested reader can consult all the details in the *memorandum.*

It appears, therefore, that the mechanism was subject to numerous alterations and adjustments by Le Noir himself which highlights its experimental dimension and Le Noir's lack of experience in making such mechanisms.

2 The story behind the mechanism

The elements presented above can leave one puzzled: why make such a mechanism? How to justify this abundance of technical and stylistic choices that seem to be very different from other known pendulum clocks?

One way to answer these questions is naturally to look for information on the author of the clock, Simon Le Noir, whose name is today missing from the history of clockmaking. It appears, however, that Le Noir may have contributed significantly to the technical development of pendulum clocks, following a bibliographical source which will be detailed in the final section.

Raillard's anecdote

First looking at who Simon Le Noir was in Tardy's dictionary, it says:

> **LE NOIR** Simon.**Paris.** M. 1640. † 1680 at 60 years old. *Juré* in 1647-49-50. Pont au Change. Married to Marie **de Grand-Mesnil**. Baptizes his daughters Isabelle in 1647 and Charlotte in 1648.
>
> In 1649, Casimir, the future king of Poland, having heard of the application by Vincent Galilée of a long pendulum to a clockwork, wrote in France to some known scholars of a new clock much more accurate than all others. Some of these scholars communicated this news to a clockmaker in Paris named Simon **Le Noir**, one of the most skilled of his time. He also applied this long pendulum to a clock movement as had been done by Galileo's son. It is thus Simon **Le Noir** who made, in Paris, these clocks which one still names today "Pendulles à secondes", because the pendulum which is applied to it marks one second with each of its vibrations. **(Thiout).**[9]

We were obviously very surprised by the anecdote relayed by Tardy in these few lines which suggests the direct involvement of Le Noir in the manufacture of the very first pendulum clocks after Galileo's invention.

Since the dictionary was written largely from Paul Brateau's records, now kept at the Musée des Arts et Métiers, we were able to consult these records and learn the origin of the anecdote: it originally comes from a handwritten treatise by Claude Labey, known as Raillard, a copy of which is also available at the Musée des Arts et Métiers. The original anecdote (translated above with some differences) is displayed on page 184:

> Casimir depuis Roy de Pologne en ayant eu avis [de l'application par Vincent Galilée d'un long pendule à un mouvement d'horloge en 1649], en écrivit en France à quelques savans, comme d'une nouvelle horloge beaucoup plus juste que toutes les autres. Quelqu'uns de ces savans communiquèrent cette nouvelle invention, a un horloger de Paris nommé Simon Le Noir, un des plus habiles de son tems.
>
> Sur le récit que ces savans luy en firent, et peut-être aussi sur quelque description de la part de Casimir même, il appliqua aussi ce même Pendule a un mouvement d'horloge ainsi qu'avoit fait Galilée fils : ce fut donc Simon Le Noir, qui le premier fit a Paris de ces horloges, qu'on nomme encore aujourd'huy Pendules à Secondes, a cause que le Pendule qui y est appliqué, marque une seconde de tems a chacune de ses vibrations. Je tiens ce fait historique de J. B. Le Noir, aussi M^{e} horloger de Paris, fils de Simon Le Noir.[10]

Le Noir is mentioned a second time in the treatise a few pages later:

> Les premieres [répétitions] qui parurent, furent aportées en France

[9] Tardy, *Dictionnaire des horlogers français* (Aubenas : imprimerie Lienhart et C^{ie}, 1972), p.374

[10] C. Raillard, *Traité historique et chronologique [...] - copie de P. Brateau*, 1720, p.184

> par Casimir Roy de Pologne, après qu'il eut abdiqué la Couronne en 1669. et avoient été faites en alemagne. [...]
>
> Simon Le Noir M^{e} horloger de Paris, (duquel j'ay parlé cy devant pag. 185.) et qui le fut de Casimir Roy de Pologne, pendant le temps qu'il demeura en France, fut celui qui racomoda en ce tems ces repetitions. Feu J. B. Le Noir son fils, est celui de qui je tiens ce fait historique, et sous l'autorité duquel je l'avance.[11]

The content of these assertions can obviously have a significant influence on the analysis that can be made of the rediscovered mechanism and it therefore seems wise to seek to know more before indulging in unreasonable interpretations.

Who was Simon Le Noir?

Before going further in the analysis, it seems necessary to find other elements on this famous Simon Le Noir. Unfortunately we have found only a handful of information about him and some of it is erroneous as we will explain here.

If we start from the most reliable source, namely Raillard's treatise, we learn that Le Noir died around 1680 and had a son, Jean-Baptiste, born at Château de Vincennes in 1653. On the other hand, Brateau associates the anecdote to a certain Simon Le Noir married with Suzanne Sinot. Looking for information about his wife, a marriage contract between a certain Simon Lenoyer and Suzanne Sinot, married in 1640, was found in the Archives Nationales. The information contained in this contract clearly identifies that the groom was indeed Simon Le Noir and that he was therefore not married to Marie du Grand Mesnil contrary to what Tardy's dictionary indicates. It seems that Simon Le Noir had an homonym, father of Estienne Lenoir, and that Tardy mixed information from the two characters.

The contract of 1640 is interesting in more than one way: one learns in particular that Le Noir changed his name between 1640 and 1647, when his first daughter was born, and that he had no family in France; one knows on the other hand that he was adult at the time of his marriage and was thus at least 25 years old, thus born before 1615 which is incompatible with the date of 1620 mentioned by Tardy's dictionary. On the other hand, we found a birth certificate of a certain Simon Lenoyer dated 1607 which could very well be that of our Simon Le Noir.

This information is the only one we have today, in addition to a few other details; for example, we know that Le Noir workshop was located at the Pont au Change on the border of the Île de la Cité, where the most famous watchmakers worked according to Plomp[12]. We also have an official example of Le Noir's signature when he was a witness at a wedding in 1651 (figure 16). A consultation of the members of the AHS and the AFAHA (*Association française des amateurs d'horlogerie ancienne*) has not yet allowed us to find any other timepieces signed by Simon Le Noir.

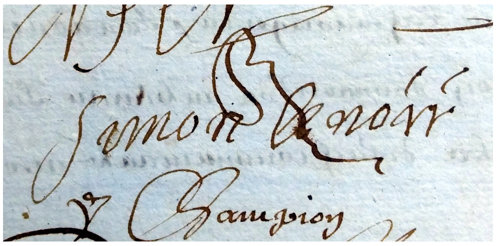


Fig. 16: Simon Le Noir signature

3 An explanation for the story

In this last section, we propose to present a technical-historical synthesis with a double objective: on the one hand, trying to explain the origin of the anecdote reported by Raillard and on the other hand, dating the mechanism and replacing it in the history of the development of pendulum clocks.

[11] Raillard, *Traité historique*, pp.206-207
[12] Plomp, *Early french pendulum clocks*

Truthfulness of the anecdote into question

It is tempting to want to take Jean-Baptiste Lenoir's anecdote as gospel, the immediate implications of which are immense; however, it is necessary to confront this anecdote with known historical facts in order to check how close to the truth it really is.

The central element of the anecdote is undeniably the mention of the king of Poland, Jean Casimir. His biography attests of a rather eventful life: son of the Polish king Sigismund III, he devoted part of his youth to military activities before joining the Jesuit order in 1643 where he remained in Rome for 5 years. He replaced his brother Ladislas IV who died in 1648 and was involved in many political and military battles. He finally abdicated the throne in 1668 and moved to France two years later, shortly before his death in 1672. During his last stay in France, he was appointed abbot of Saint-Germain-des-Prés and contributed to the development of mechanical arts and clockmaking, which he loved[13]. He was also known to be an amateur of various sciences and had a rather large collection of clocks and watches[14].

This brief biographical summary shows us that Jean Casimir may indeed have been involved in the development of pendulum clocks for several reasons: in addition to his interest in the discipline, he would have been in Italy just after the death of Galileo Galilei and just before 1649, the date of the presumed manufacture of the first pendulum clock by Vincenzio. It is therefore not impossible that he was informed of this project, especially since it is known that he maintained relations with Ferdinando II de Medici, himself close to Vincenzo Viviani, a former disciple of Galileo who wrote a memoir on his pendulum clock in 1659.

The other points of the anecdote are more open to discussion. In particular, it is not known with which French "scholars" Jean Casimir might have corresponded, nor how the information would have reached Le Noir. On the latter point, it does not seem impossible that Jean Casimir got to know Le Noir during his brief stays in France in the 1630s and 1640s, and that he therefore wished to inform him of the invention of the pendulum clock, although this is only a hypothesis that has not been confirmed today (it can however be suggested by the closeness of Le Noir to Jean Casimir presumably reported by Jean-Baptiste, Le Noir's son).

Even if the anecdote seems plausible in light of the above elements, both from a contextual and chronological point of view, it seems difficult to believe that Le Noir was informed of Galileo's invention as early as 1649 or even shortly thereafter. In particular, he would have had no reason to keep the information secret for years and not to share it quickly with the clockmaking community after having carried out a few personal tests for some months, while it sounds in practice that no French clockmaker was making pendulum clocks for sale before the arrival of Coster's models, imported from Holland by Hanet, in which case Boulliau and Chapelain would have been informed and would have communicated this information to Huygens. So in case Le Noir would have indeed experimented with such mechanisms, it may have taken place only a few months before the introduction of Dutch pendulum clocks in France so as he would have had not enough time or significant results to make his experiments known.

Moreover, from a technical point of view, Le Noir's clock has almost nothing in common with Galileo's whereas it shares many similarities with the early Dutch models. It is also strange that the anecdote mentions Galileo's clock as "much more accurate than all the others" when we know from Viviani's own confession that it did not work properly for various reasons.

Finally, we found a last element which makes the affirmation of the anecdote all the more disturbing; on August 21, 1659, Leopold de Medici will sent a letter to Boulliau in which he says:

> Your Lordships should know that His Majesty the King of Poland (in whose service is to be

[13] J.-D. Augarde, *Les ouvriers du temps* (Genève : Antiquorium éditions, 1996)

[14] P. G. Poole, *The Casimir Inventories*, Horological Journal, vol. 107, August, September and October 1964

> found Paulo del Buono, known to your Lordships), does not believe that his Serene Highness, The Grand Duke, my superior and my brother, has taken as his own that invention, persuaded by the aforementioned Paulo. His Majesty sent him a clock made in Holland and wishes to believe that it was made according to instructions of Signor Christian.[15].

The clock in question was a gift sent to Ferdinand II de Medici in September 1657 through Tito-Livio Burattini who worked for Jean Casimir. One can believe Leopold de Medici had no reason to lie in this letter as his speech is not in his favor, *i.e.* the attribution of the pendulum clock to Galileo. Jean Casimir would not believe that Galileo was the first inventor, which fundamentally questions Raillard's anecdote, unless Casimir attributed for a while the first grounds of the invention to Galileo's before stepping back to attribute them to Huygens instead. This latter hypothesis is more likely, as we will detail further in the next section.

A timepiece achieved before summer 1658

The historical approach we first chose did not allow us to discriminate the truth from the falsehood about Raillard's anecdote. The analysis of the mechanism will however strongly constrain the upper bound of its manufacturing date.

We have seen that the mechanism bears a certain number of features from the Renaissance style (decorations, fusee...) as well as others usually observed on watches (pillars). On the other hand, it is known that French clockmakers got inspiration from the Dutch pendulum clocks, imported by Hanet, to build their own pendulum clocks as explained by Plomp[16]; the French style after 1658 and until 1665-1670 is therefore almost identical to the Dutch one and is characterized by the sobriety of the mechanism with an absence of decorations and gilding, and the loss of the fusee. It is also known that domestic clocks had almost totally disappeared from the landscape of French clockmaking and watchmaking during the first half of the seventeenth century and that the French only made watches at that time, still in the Renaissance style.

All of these findings suggest that Le Noir most likely conceived his mechanism before seeing the Dutch models, thus before the summer of 1658; this justifies the use of the Renaissance style that was later abandoned, as well as the resemblance to the watches of the time. Also, as Le Noir was a renowned clockmaker, it seems impossible that he was not informed very early of the existence of new clocks brought back by Hanet and did not see them as soon as they arrived in France. If we tackle the problem the other way around, we can also say that Le Noir would have had no reason to make a mechanism such as the one studied in this article if he had already seen Coster's examples before. When the presence of an isolated atypical feature can generally be seen as a simple eccentricity of the clockmaker, the simultaneous presence of all the specificities of Le Noir's movement, consistent with each other, clearly attests that this timepiece relates to a style prior to that of the *pendules religieuses*. It would have been absurd to built such a mechanism after 1658 when all other clockmakers reproduced the models imported by Hanet without deviating from them.

Also, as the mechanism seems to have underwent numerous adjustments by the hand of Le Noir himself and looks experimental following our previous examinations, it would have been one of the very first pendulum mechanisms made by Le Noir, and by extension one of the very first pendulum clocks made in France by an independent clockmaker.

If one assumes that Le Noir did indeed make his mechanism before the summer of 1658, the main question remains to know which knowledge he based it upon: would he have been

[15] C. Huygens, *Œuvres complètes* (Société Hollandaise des Sciences, 1888-1950), letter 655a of the 21 August 1659, pp.467-69

[16] Plomp, *Early french pendulum clocks*, p.25

inspired by the work of Vincenzio Galilei that Jean Casimir told him about according to the anecdote? Or would he have been informed around 1657 of a new type of more accurate clock without knowing that it was the work of Huygens and which he would have attempted to reproduce independently on his own? This last hypothesis is attractive insofar as Le Noir's mechanism shares many features with Coster's with the pendulum being suspended to the frame by a flexible part and guided by a fork (although we do not know the exact original arrangement). Should we therefore exclude a collaboration with Jean Casimir and consider the anecdote unfounded? Not necessarily as it could actually result of a misunderstanding which origin is to be sought on the Italian side.

Misunderstanding about the invention

The scenario presented in this section sounds the most likely to us as it reconciles the content of the anecdote with Boulliau's assertion while answering almost all the questions formulated above, although it inevitably raises new ones.

It is known that Casimir offered a Coster clock to Ferdinand II de Medici in September 1657. This clock was sent to Italy by Tito Livio Burattini who worked at the Polish court and took part in several diplomatic missions for the Grand Duke; he returned from Florence in August 1657 bringing back "some mechanical niceties"[17] offered by the Grand Duke, very likely to include the Coster clock certainly presented as a technological novelty. Casimir was thus informed early enough of the existence of these clocks and could have communicated about them in France, and that is how the information could have reached Simon Le Noir. However, in that case, why does the anecdote mention Galileo as the inventor of the pendulum clock and not Huygens?

It is here that a misunderstanding arises because Boulliau writes to Huygens on January 4, 1658:

> I gave notice in Poland 3 months ago of the new invention of your clock, the queen as well as the *Secrétaire des Commandements* have given the order to buy it. If he offers something worthy of you I will not fail to inform you.[18]

The *Secrétaire des Commandements* referred to is Pierre Des Noyers. Also, according to Boulliau, Casimir would have been informed of Huygens' invention in October 1657, *i.e. after* having sent the Coster clock to Italy. It seems in fact that Boulliau's information came even later, as Des Noyers wrote to Boulliau on November 17, 1657:

> The queen, on hearing in your letter about the invention of the clock by Mr. Christian Huygens, immediately wanted one. She wants to have one, and I also want to have one, because I like to observe births, and I believe that it will be very appropriate.[19]

On January 20, 1658, he wrote again to Boulliau:

> The king and the queen are very impatient to see the clock of Mr. Christian Huygens. The Elector of Brandenburg has written to have it sent for the queen.[20]

The queen will finally get the clock in May. Its description given by Des Noyers is consistent with the known Coster clocks.

It seems, therefore, that Jean Casimir did not know that the clock he had sent to Italy was made under the direction of Huygens (one notes, moreover, that the name of Huygens is materially absent from all of Coster's known

[17] P. Des Noyers, *Lettres de Pierre Des Noyers, secrétaire de la reine de Pologne, Marie-Louise de Gonzague, pour servir à l'histoire de Pologne et de Suède de 1655 à 1659* (Berlin : E. Bock, 1859), letter CXXIII of the 19 August 1657, p.342

[18] Huygens, *Œuvres complètes*, letter 448 of the 4 January 1658, pp.117-18

[19] Des Noyers, *Lettres de Pierre Des Noyers, secrétaire de la reine de Pologne*, letter CXXIX of the 17 November 1657, p.353

[20] Des Noyers, *Lettres de Pierre Des Noyers, secrétaire de la reine de Pologne*, letter CXXXVIII of the 20 January 1657, p.376

clocks). In this context, it seems logical that Ferdinand II de Medici was not informed by Jean Casimir that the clock offered to him was made according to Huygens' work, while it is known that the Grand Duke and his brother Leopold were aware of the clock built by Vincenzio Galilei, which was also kept in their home, as reported by Guiseppe and Matteo Campani. It is therefore possible that after receiving the clock offered by the King of Poland, the Grand Duke replied to him, as Leopold would later reply to Boulliau, that this invention was due to Galileo who had put it into practice in 1649 on a clock equipped with a long pendulum. Thus Jean Casimir could have been misled into believing that the clock he offered, more accurate than its contemporaries, was a direct descendant of Galileo's invention, and could have passed on the information reported by Jean-Baptiste Lenoir to several scholars in France and elsewhere. Later, after having received the Huygens clock ordered by the Elector of Brandenburg, Casimir would have realized his mistake and would have taken a step back, which would explain why Prince Leopold would say of him that he "does not believe that his Serene Highness [...] has attributed this invention to himself".

From a chronological point of view, if Jean Casimir had received an answer from Ferdinand or Leopold after the clock arrived in Italy in October 1657, he would have had 4 months to transmit the (erroneous) information which would have reached France at the end of 1657 or beginning of 1658. Le Noir, having been informed, would have been able to build his first experimental clock mechanism in the first half of 1658 and then several "seconds clocks" before the summer.

This scenario also has the advantage of explaining the many similarities between Le Noir's mechanism and the one from Treffler in the Galileo Museum (figure 17, ©Keith Piggott & Prof. Andrea Palmieri, *Museo Galileo*). If this clock is indeed a "copy" of the Coster clock given by Casimir, as K. Piggott assumes[21], Casimir's description of the new pendulum clocks was based on this copy and it is therefore natural that Le Noir would have first complied to these indications before modifying the layout (one can think in particular of the presence of the fusee as well as of a seconds hand, although Le Noir would have finally renounced to this function).

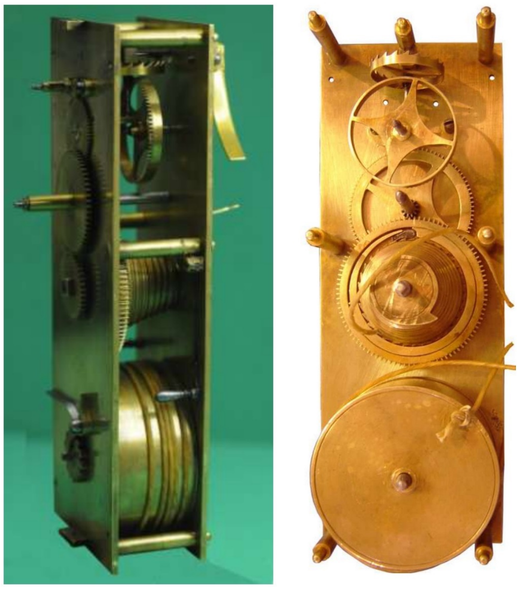


Fig. 17: Treffler clock mechanism

Conclusion

What do we finally learn from all the analyses we have conducted so far? Can we rule on certain hypotheses and which points remain to be clarified?

At this stage of our study, the main hypothesis about Le Noir's mechanism is that it was made before the summer of 1658: this hypothesis indeed justifies all the features of Renaissance clocks and watches observed on the movement and explains why it incorporates some technical solutions as well - mainly the fusee - that are not found on almost any early clock, especially early French ones.

It also seems probable that Le Noir was involved in the development of pendulum clocks in one way or another, according to the testimony of his son reported by Raillard; even assuming that the content of this anecdote was "arranged", its existence together with that of

[21] Piggott, *Memo-Treffler*, p.1. We did not succeed in finding the original source of this information.

the mechanism does not seem to be a coincidence, especially since no other French clockmaker, with the notable exception of Nicolas Hanet, has been explicitly mentioned in the known bibliography as one of the first to have applied the pendulum to clocks.

We have also proposed an explanation for the anecdote consistent with the chronology of events, which also resolves a historical inconsistency of the Coster clock sent to Italy that no historian seems to have considered until now. However, no formal proof of the proposed explanation has been found. This article therefore opens perspectives for future research which should tend to look for evidence to confirm or not this hypothesis and potentially explore relevant new ones if other discoveries are brought to light.

Future work may also dedicate to clear up some remaining questions: if Jean Casimir is indeed involved in this affair, as Jean-Baptiste Lenoir asserts, to whom would he have communicated about the invention of a new type of clock in France? and how would this information have eventually reached Simon Le Noir? Why, finally, would Le Noir have been the only clockmaker to be informed of this invention? We have not yet found any evidence to support this. Several clockmakers could very well have been informed of the invention and could have independently undertaken the construction of pendulum clocks, but only Simon Le Noir remained to posterity thanks to his son and the Raillard manuscript. It is therefore not excluded that other experimental clocks in the style of the one we have discovered will one day be found, and that they would belong to this transitional period, before the arrival of Dutch pendulum clocks in France.

This study therefore potentially opens the way to other research works and to a potential rewriting of the history of the first French pendulum clocks. I invite anyone interested or likely to have information on the subject to contact me to discuss together of possible future collaborative research on this topic which is likely to be of high interest to the horological community for quite some time.

Acknowledgements

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