Henry Sully's Life Story - Chapter 8 Quest for Longitude Timekeeper

QUEST FOR LONGITUDE TIMEKEEPER - *Draft*

This is the eight and penultimate chapter in the story of Henry Sully. Following a short stay in London, he returned to Versailles, where for some time he was obliged to make a living repairing watches. Sully picked up tools and drawings again, and with the help of some select workers assisting him in this complex task, he continued on the work he had started twenty years before, and had recently taken up again while in London: to design and construct a novel and functional clock allowing the determination of longitude at sea. This chapter will attempt to document Sully's arduous progress on this ambitious project, over a period exceeding twenty years.

INTRODUCTION

In the previous chapter, we learned about Sully's regretful return to London following the failure of the two horological factories he had led in Versailles and Saint Germain en Laye. While in London, he attempted to reinvigorate his long term design to develop a working longitude timekeeper, but was unable to obtain sufficient interest and funding, so decided to return to the Continent, to rejoin with his family, and pursue horological opportunities there.

This chapter is not an easy one to write, for several reasons. Firstly, the time scale is very long: Sully's trajectory on this longitude quest originated in London before 1703, and ended after 1726 in Bordeaux and Paris. His work in this area has been alluded to in previous chapters, but never told in depth, because it always appeared to simmer behind whatever other priorities were occupying his life (family, travels, writing, factories, etc.).

Secondly, his work in this area is the most complex horological initiative he undertook, very much at the leading edge of what was possible at that time: producing a timekeeper not only more precise than almost anything else, but also most reliable in being able to withstand the rigours of lengthy voyages at sea. The description he wrote in 1726 (see Recommended Reading section below) is a most fascinating but complex book of many facets, which is difficult to adequately convey, requiring a significant investment of time and space.

Thirdly, understanding Sully's role and importance in the long story of the development of a working marine timekeeper requires telling at least succinctly the achievements of his predecessors (notably Huygens and Hooke) as well as his successors (in France, this being Pierre Le Roy and Ferdinand Berthoud). Since this has already been told quite well in some books listed below, only a very cursory overview of this will be provided here, and readers are urged to read those additional sources for more in-depth explanations.

Finally, there is some poignancy in describing the episode of his final attempts to develop and test his marine timekeepers; it represented the last opportunity he was to have to finally attain the

fame and financial success he had long felt he deserved, after all the hard work he had invested into this enterprise, and that he needed to provide for his family after some years of financial hardship. As we shall see, Sully eventually came up short in reaching his goals, but it was not because he did not give it all he could. The reality is that some of the necessary technical elements that went into finally arriving at a successful marine chronometer in the later decades of the century (both in France and England), were not yet available to Sully during the mid 1720's.

Only a short introduction will be given about the historical search for a horological solution to the determination of longitude, because this subject has been covered in great depths by many authors, a summary list of key books being presented and described below for further reading. Likewise, these authors have well described Sully's own attempts at designing and constructing such a timekeeper, so this chapter will not delve into the technical details of his works to any great depth.

Rather, this chapter will try to untangle and document the long journey that Sully took to finally be in a position to test his timekeeper at sea, in 1726. All this had started over twenty years before, in 1703, when as a young man just completing his apprenticeship in Charles Gretton's shop in London, he had approached Christopher Wren and Isaac Newton with his ideas, and obtained some encouragement from them to persevere.

Throughout all the years of Sully's life since those early meetings, he pursued his desire to solve the longitude problem, even though for most of that time, that long-term project would need to take a backseat to other professional obligations, or family responsibilities requiring him to find sources of income, whether by repairing timepieces, writing and publishing books, or starting up horological factories.

QUEST FOR LONGITUDE – BRIEF HISTORICAL REVIEW

Non-horological means for determining longitude had been devised and attempted ever since European men set off on sea-going ships to explore the seas, seeking to find a different route to the Indies, and finally stumbling upon the Americas. As summarized by Stephen Inwood, writing about the late seventeenth century[1]:

> *The measurement of longitude at sea was one of the great scientific and practical problems of the age. Until sailors could do this, navigation would remain a hit or miss affair, and long distance sailing for commercial or military purposes, upon which England's [and France's] prosperity and power increasingly depended, would be unsafe and uncertain.*

The satellites of Jupiter had been discovered by Galileo around 1610, using telescopes recently made by improved lens-crafting techniques. Although the observation of Jupiter's moons proved extremely successful on land to determine longitude, it was simply not practical to do so on a moving ship at sea. And yet, this (and observations of the moon) continued to be sought as a

[1] Stephen Inwood, *The Man who Knew Too Much*, Pan-Macmillan, 2002.

solution to the problem, until the marine timekeepers of the late eighteenth century proved to be the best solution.

Horological means to determine longitude go back a long way, to Gemma Frisius (1508 – 1555) who first came up with the idea around 1530. After all, it was natural to think of clocks since their time representation (24 hours) matched the rotation of the earth, and therefore, the time distance from a clock set at current time on a ship, compared to another one set at the known longitude of the departing location, would quite readily indicate the location of the vessel according to the meridian lines. But, this could only happen if the clock set at the departure, could tell time very accurately through long months of voyage at sea, subjected to the rocking of the waves and storms, and to varying temperature and humidity at different points along the itinerary. From Frisius's original idea, it took almost 250 years for horological science to mature enough to provide that stable, reliable marine timekeeper.

The man who almost single-handedly advanced horology to a point where it could at least hope to solve the longitude problem was the mathematician, physicist and astronomer Christiaan Huygens (1629 – 1695). At Christmas in 1656, he came up with the idea of mating a pendulum (whose properties had been described by Galileo) to a clock, greatly improving the consistency of timekeepers. Twenty years later, his invention of the spiral balance spring allowed a similar leap of accuracy in watches. Although he also strove for many years to perfect a marine timekeeper, this work is not nearly as well known as that which resulted in the pendulum clock and spiral balance spring.

In 1662-3, Huygens carried out some experiments on a marine clock with Scottish nobleman Alexander Bruce, the two having met in The Hague a few years before. In his groundbreaking book *Horologium Oscillatorium*, published in 1673, Huygens described the use of cycloids and a triangular pendulum for use at sea. Between 1682 and his death in 1695, Huygens experimented considerably with longitude timekeepers of various designs, aided by able clockmakers in the Netherlands. Some of these clocks were even tested on ships, with less than satisfactory results.

Horological historians have been researching and documenting Huygens's work in the determination of longitude, and an excellent overview is John Leopold's article in The Quest for Longitude (1993 – see Recommended Reading below). In it, Leopold writes: "*What* [Huygens] *achieved has often been under-estimated. There is no doubt, however, that* [he] *cleared a lot of the initial problems. (...) His timekeepers demonstrated that the solution for the longitude problem was not entirely out of reach, even though his machines failed to yield consistently reliable results. And most importantly, his theoretical work was the basis for all subsequent work and resulted, for example, in the construction that was ultimately to provide the solution: the balance with balance spring.*"

Leopold went on to write that "*the longitude machine of Henry Sully shows too many points of similarity with Huygens's Balancier Marin Parfait to deny a direct connection. (...) Huygens left his scholarly papers, including his notes on the last experiments in horology, to the library of Leiden University, where they could be consulted. Henry Sully, who lived in Leiden for some years [see earlier chapter in the story of Henry Sully, on this site], may well have seen those notes; in addition, he may have talked to the maker of the last clock, van der Cloese, who was*

still active in The Hague. Furthermore, a marine timekeeper (most likely that of 1694) remained in the Huygens family until 1754, when it was auctioned and disappeared."

Around the same time that Huygens was making significant progress in horological inventions that would encourage him to try to solve the longitude problem by horological means, an Englishman was not only contesting some of Huygens's inventions, but also making bold attempts to allow measurement of longitude at sea using a clock. This was Robert Hooke (1635 – 1703), a complex, prolific and talented inventor and explorer of many aspects of science – or "natural philosophy" as it was referred to at the time: motion, light, gravity, magnetism, astronomy, horology, optics, various engines and instruments, etc. Hooke had been granted the role of "curator of experiments" at the Royal Society when he was only twenty-seven. He was given residency at Gresham College, where he was to live the rest of his life, and where he was able to carry out experiments on various scientific problems of the day. He was called "an eminent mechanic genius" by the author of the notice on him in *Biographia Britannica* (1747-1766).

Hooke had early decided (like Henry Sully also did, forty years later) that he would try to make his name and fortune by finding a horological solution for the problem of longitude at sea. An original spring-driven clock he designed for this purpose, which he presented to King Charles II in 1664, did not yield the results that would give him the notoriety of success he was seeking. As we just saw, Huygens was able to proceed further, using different designs, but neither man quite tackled the horological problem by the end of the seventeenth century.

In the letter accompanying his presentation of his longitude timekeeper to Charles II, Hooke had written:

> *This is that Invention which has been soe long and by soe many sought, though to the best of my knowledge not found or known to any yet by my self and my two friends* [Sir Robert Moray and Lord Brouncker, of the Royal Society] *to whom I very lately Reveald it, which I have had perfect as it now is, by me these three yeares ... I doe humbly therefore throw both my self & it at Your M feet."*[2]

It is quite probable that Hooke's work on longitude clocks may have inspired Sully, as this would have been well known and discussed around London, during the time he was apprenticed with Charles Gretton. Hooke was a contemporary of Christopher Wren, and both had spent years working alongside each other in and out of the Royal Society, so Wren was very well aware of Hooke's work, his positive contributions as well as the shortcomings in his designs. Likely, he would have imparted some of this knowledge to young Sully, when the two met in 1703 – the year that Hooke died - to discuss the young clockmaker's aim to solve the longitude problem.

(Author's note: Include story of the Sully-Huygens marine clock, attributed to Sully at the Time Museum, then sold off and later resurfacing at Antiquarium auction, attributed to Huygens)

[2]M. Wright "Robert Hooke's Longitude Timekeeper", in "Robert Hooke, New Studies", Woodbridge 1989.

SULLY's QUEST FOR LONGITUDE

Sully could well have heard of Huygens's work on a marine clock, through the horological circles in London that he was a part of, while he was apprenticed and later journeyman in the shop of Charles Gretton (see Chapter 2 of this story). It is known[3] that Huygens's brother Constantyn had told the great London horologist Thomas Tompion about Huygens's Perfect Marine Balance. Word about this would certainly have circulated among London clockmakers like Tompion, Gretton, Quare, etc. So this may have been the genesis of Henry Sully's early intent to develop a marine timekeeper himself. Also, Wren and/or Newton could likely have known about it and this may have resulted in them possibly steering Sully to the Netherlands (see Chapter 3 of this story).

At this time, before we take up the story of Sully's life upon his return to Paris in 1721, it may be useful to offer the following summary table to key dates and events in Sully's life, related to his quest for developing a longitude timekeeper.

Chronology of Henry Sully's Development of a Longitude Timekeeper (1703-1726)

Date	Age	Location	Event or development	Source
1689		London	Constantyn Huygens tells Tompion of his brother's Perfect Marine Balance	1
1694	15	London	Sully starts apprenticeship with Charles Gretton	
1703	23	London	Meets Wren who encourages him in his goals and provides him with a recommendation	2
1703	23	London	Meets Duke of Somerset who directs him to Newton	2
1704	24	London	Meets Newton who shows him Debaufre escapement in a watch, and encourages him in his goals	2
1704	24	London	Meets Lords Summers and Hallifax, Mr. Flamsted and Mr. Hudson, unsuccessful in obtaining funding	2
1706-7	26	The Hague	Arrives in The Hague, starts a family, befriends Nicholas Massy Possibly meets Huygens collaborator Bernard van der Cloesen	3 4
1708-10	29	Leiden	Relocates to Leiden, possibly researches Huygens papers at university Discusses marine clock with Boerhaave and city magistrates	4,5 2
1711	32	Frankfurt on Main	Publishes dissertation discussing use of horology for navigation	2
1714	34	London	British Parliament Act of Longitude, which offered 20,000 pounds to whoever would develop a method to determine longitude accurate to within half of a degree of a great circle	
1714	35	Vienna	Accompanies his benefactor Duke of Aremberg, who supports him in his work Discusses marine clock with Leibniz, Prince Eugene and several dignitaries	2,5 2
1716	37	Paris	Follows Aremberg, meets Julien le Roy, who sees marine clock parts in	5

[3]From Huygens's last surviving letter written in March 1695.

			Sully's dwellings Presents memoir on his marine timekeeper (*Montre pour la mer*) to *Académie Royale des Sciences*, discusses with several academics	5
1720	41	Paris	Discovers "the curve, compensation for action of weight, use of rollers, and the lever", resulting in his "*Pendule à levier*" (lever clock)	2
1721	42	London	Builds his escapement (deadbeat pinwheel type), discusses clock with dignitaries and several horologists, but does not secure funding to continue his research and development	2
1722	43	Paris	Shows his lever clock "A" to Joseph Saurin (member of the *Académie*)	2
1723	44	Versailles Paris	Shows his lever clock to many noblemen at Court Tests his clock suspended in a carriage on streets of Versailles and Paris April: first presentation of his clock at the *Académie* Considerable interest leads to many orders of his lever clock, which he is unable to fulfill due to persistent problems with the escapement	2 6 6 5,7
1724	45	Paris	January: second presentation of (revised) clock "B" at the *Académie*, then clock tested 8 days by Cassini at the observatory March: second test at the observatory of revised clock	6,7
1724-5	46	Versailles	July 1724-Nov 1725: corresponds with Graham (4 letters) about his clock Sends a clock "C" to Graham (now on display at Science Museum in London)	6,7
1725	47	Bordeaux	Arrangements made with Académie des sciences de Bordeaux and Montesquieu (1689-1755). Test his clock "B" on land then on a couple of boats in the Gironde estuary. His unreliable escapement had been replaced with a verge. Returns to Paris where his furniture and tools had been sold to pay the rent	6 6,7 5
1726	48	Paris	Publishes a book describing his long development of a marine clock, containing various information, letters, memoirs, measurement data, and various other writings.	6

Sources:
1.*Oeuvres Complètes de Christiian Huygens* (O.C). vol 10, pp. 709-710
2. 1726, Henry Sully, Paris: *Description abrégée d'une horloge de nouvelle invention..., Éclaircissemens* section (starting on page 254
3. Genealogical church records, Netherlands
4. The Quest for Longitude (1993), Leopold article, pp.102-113
5. Sully, *Règle artificielle du temps* (1737 ed.), Mémoire par Julien le Roy, pp. 381-412
6. 1726, Henry Sully, Paris: *Description abrégée d'une horloge de nouvelle invention.*
7. Betts, Marine Chronometers at Greenwich (2017), pp. 120-128

SULLY RETURNS TO FRANCE (1721)

After leaving London (as explained in the previous chapter), Sully eventually settled into a horological repair practice in Versailles. This was necessary as, finding himself without other means to earn a living, he needed to provide for his wife and several children. While in Versailles, Sully picked up tools and drawings again, and with the help of some select workers

assisting him in this complex task[4], pursued the work he had started twenty years before, and had recently taken up again while in London: to design and construct a novel and functional clock allowing the determination of longitude at sea.

Sully was to ultimately come up short, as we shall see, but after giving it a valiant try. As his friend Julien Le Roy wrote[5]: "*to have courageously attempted an undertaking even more praiseworthy, in that its success would prevent thousands of men from perishing in the sea.*"

As the summary table above indicated, Sully went through three iterations of his marine clock (referred to as "A", "B", and "C") in the ensuing years, which he presented to noblemen at Court, and members of the *Académie des Sciences de Paris*, both to inform them of his progress in this area, and to solicit funding and support in continuing his work, which he saw as having a national importance. After all, this initiative would address a dire maritime traffic need for seagoing nations like France and England. But also important to Sully (as in the case of Huygens and Hooke decades before), it held the promise of great fame, and considerable monetary rewards, should he be the first to come up with a viable solution.

Unfortunately, the marine clock he had presented with some success to the Académie in 1723, featuring the escapement he had designed (inspired by the one by Debaufre he had remembered from his meeting with Newton twenty years before) proved unreliable after a certain period of time. He doggedly tried to make it work, in part because he was desperately trying to fulfill several orders from interested parties, but ultimately had to resign himself to replacing it with the time-proven verge escapement, which did not have the necessary advantages to work as a reliable and sufficiently accurate marine timekeeper. Julien Le Roy recalled this story in some detail, which is worth reproducing here[6]:

> *The new lever clock was so well received, that each ambassador wanted one to bring to his sovereign: the Parisian collectors and amateurs ordered some as well; in order to make arrangements with all those who wanted one, he registered those who came to subscribe and provided a certain amount in advance.[7] With the funds generated by the subscriptions, he increased the number of his workers, and got them to work on marine clocks; but in the interval it took to make a few clocks, he noticed that his original one was losing accuracy, and he suspected correctly that the reason was his new escapement, of which the frictions became variable after some time; he thereby realized that the nice properties that had seduced him were obliterated by this only fault, and that he had been wrong in the positive judgment that he made about it; but at that time, when this subject was new and little known, anyone could have made the same mistake; and how could he not? the experiments themselves led him to error, he had seen his clock run so well for a month; so it was natural for him to conclude that it continue to run well, but that was not the case, it lost its consistency, and because the source was the escapement to which he was so attached, because of the love that one naturally has for one's inventions, especially those that one has flaunted in public, he had a very hard time deciding to*

[4] One of whom being Englishman William Halstead (who appears to have married Sully's sister-in-law)
[5] Règle artificielle du temps (1737) p. 409
[6] Règle artificielle du temps (1737) pp. 402-405
[7] Breguet would use the same approach when he returned to Paris after the Revolution, in his "Montres à souscription".

abandon it, and only did so after many modifications that delayed him and made him very uncertain about how he would go about finishing the clocks; not being able to deliver any, and everyone asking him for them, he became very embarrassed, either to deliver them with imperfections, or to continue to have them screaming at him, until he had made the last efforts to perfect them as much as possible.

This would be the place to demonstrate why the escapement we are talking about produced such great variations, after having originally been so precise; but I reserve this subject for another memoir[8], I will limit myself to say here only that the variations came solely from the friction that increased or diminished to various degrees in short and equal amounts of time, and that the best escapements are those that are exempt from these defects; for example, in the memoir I am thinking about, I hope to demonstrate with the most recent evidence, that the amount of friction of the escapement from a second pendulum clock, perfected as much as it could be, and compared to Mr. Sully's, would vary less and be more constant during 50 or 60 years, than his own, as it was at the time of his death, for 50 or 60 days. I say 'at the time of his death', because I have since perfected his escapement, and I feel it would have been comforting for him to come up with this idea at a time when it could have been useful to him; however, most inventions depend on those that came before them, and the idea for mine only came to me after seeing another escapement that had been invented based on his.

After Mr. Sully had abandoned the new escapement, after many modifications, and applied the verge escapement one to his clocks, he was able to adjust them more easily, and their accuracy was much more sustainable; this progress toward their perfection, led him to try further, and it was in order to make experiments at sea, that he traveled to Bordeaux in 1726, where he arrived with referral letters from the Académie: one can see in the same book[9], on pages 225 and 233, the results of the experiences that he made; he was extremely well received in this town by academics and other people of merit.

Although different iterations of his marine clocks were tested on land (carriages drawn over rough roads) and in buildings like the Paris observatory, by impartial observers like Cassini, Sully desired to have an opportunity to have his longitude timepieces tested on sea-going vessels. It took him a few years to finally obtain some support to carry out these tests, through generous support provided to him by the *Académie des Sciences de Bordeaux*, under the leadership of Montesquieu[10]. These sea trials (actually, restricted to the estuary of the Garonne river), Sully's clocks indicated promise but even he had to admit that they were not quite ready to be used in long ocean-crossing voyages.

With hindsight, one realizes that some of the basic technological elements needed to produce a reliable marine clock, just were not yet available in Sully's time. The three principal missing elements were: (1) a detached escapement, allowing the balance to swing freely, (2) a means of correcting for the effect of heat and cold on the balance and balance springs, and (3) ensuring

[8] Unfortunately this memoir either was not written or is not available to research.
[9] 1726?
[10] Charles Louis de Secondat, Baron de La Brède et de Montesquieu (1689 - 1755), generally referred to as simply Montesquieu, was a French judge, man of letters, historian, and political philosopher (Wikipedia). He was also President of the Académie des Sciences de Bordeaux.

isochronism of the balance or balance spring. Solutions to these fundamental requirements were only attained by John Harrison in England, and Pierre Le Roy in France, almost at the same time (1765-66) but from completely independent development paths.

Some authors have pointed out that Sully's "marine watch" (*montre marine*) may have led to the solution for longitude determination at sea, had he realized it at the time. This watch (shown on the lower left in Figure 1 of Appendix IV below), even though he claimed was significantly more accurate than other watches of the day, was designed by Sully as a back-up solution to his ceiling-mounted lever marine clock. The watch would be used to reset the clock if it ceased working due to the movement of the ship. Harrison was to discover the benefits of using a watch 40 years later, having first come out with a marine clock in 1735 (H1), followed by two other sophisticated clock designs, until he came up, twenty-five years later, with the large marine watch (H4) which was successfully tested at sea by his son, and ultimately won him the English longitude prize.

Sully's use of rollers to support and steady the balance pivots on his clocks, may well have inspired Harrison and certainly Pierre Le Roy to apply in their design. It is not certain whether Harrison knew explicitly of Sully's efforts and of the good and bad aspects of his marine clock, but certainly Pierre Le Roy would have been well aware of the efforts of his father's long time friend. Pierre no doubt met Sully several times as a boy, when the Englishman would visit his father's shop or home. And his father would undoubtedly have shared with him all he knew of Sully's lengthy and ultimately unsuccessful attempts to develop a working marine clock. As was pointed out earlier, Le Roy stated that he had perfected Sully's escapement, and his son would have had this knowledge when he later designed his own, even though it bears no resemblance.

It cannot be known whether Julien Le Roy encouraged his son to pursue his friend's elusive goal of a longitude timekeeper, but Pierre certainly took up the mantle himself after he established himself as worthy inheritor of his father's name and workshop. One thing is certain: while Sully constantly made people aware of his progress (whether by personal conversation, correspondence, presentations or some of his published writings) in developing a working marine clock (see Appendix II), Pierre Le Roy preferred a more discreet path, as he himself described:

> *While my works did not satisfy me, instead of lavishly announcing some minor attempts, I felt it wiser to perfect them in silence: it's the conduct that I maintained for 25 years. Not to mention the efforts by which I tried to perfect the different parts of our Art, and about which one can consult the history of the Académie des Sciences for the years 1752, 1755, 1763, etc. To demonstrate this, I had constructed in 1748 the escapement whose principle is the basis for those in my marine watches.*[11]

Certainly, in the book he published in 1726, Sully showed no discretion in revealing the history of his development of marine timekeepers, describing his current design, sharing correspondences between him and various people expressing opinions on his marine clocks, and summarizing the observations of the sea trials in Bordeaux. He put everything he could into that

[11]Le Roy, Pierre, *Exposé succint [sic] des travaux de MM. Harrison et Le Roy dans la recherche des longitudes en mer et des épreuves faites de leurs ouvrages*, Paris, 1768.

book, both the good and the not-so-good. Clearly, he stressed the positive aspects of his timepieces and their sea trials, and minimized the shortcomings, but did acknowledge that his design was not yet ready enough and that much work was still needed to perfect various of its aspects.

Sully may have felt that his time was running short, and that he would not be able to bring his long goal to fruition. So he may have been sharing everything he could to those who would follow him on this quest for longitude determination. Also, indications are that coming back from Bordeaux, he found himself quite impoverished (notwithstanding the 600 livres annual pension he had been awarded in 1723), his furniture and tools having been sold by his wife while he was away, to pay the rent. So he may have desperately needed some income resulting from the publication of this work. His friend Julien Le Roy described this period such:

> *The considerable time taken with his research, to perfect his clocks as much as possible, the money it cost him to travel to Bordeaux, his furniture and best tools sold for the rent, in his absence, all contributed to upset him; he fell ill of sadness, and his health was so affected that it took him a long time to recover, and regain his strength.*[12]

On page 24 of his 1726 book, Sully reflected on the recognition obtained, and sacrifices incurred, on his long journey to develop a marine timekeeper:

> *I have had the honour of being recognized on the occasion of this Work, and have been assisted in an uncommon way, in the sole goal of finding myself in a better position to perfect my invention, that all learned men who know about it have given their approval, and hope for its useful success for the public. This is why in spite of the sacrifices I have made until now for a good part of my past life, and of advantages that fortune could have given me, in order to make something for the public good; I neither regret the past, nor am I overly worried about the future; in this way I will not be totally unrewarded, for all the pains I have given to this; because other than the honours and advantages I have stated above, and others which I do not renounce, I have had a great deal of pleasure in pursuing my ideas, that always seemed to me that they would succeed; and this pleasure is increased in each step in which success is developed and demonstrated. And even if [this work] can never be as perfect as I would wish, I will always have the satisfaction of having contributed a little something to the perfection of an Art, which is one of the most ingenious and useful.*
>
> *Allow me now to speak more particularly about this invention, and of the uses that can be made of it, until it can be perfected enough, if possible, to measure time in as accurate and universal a manner as we would wish.*

By indicating “if possible”, Sully seemed to suggest that there still remained a considerable amount of work to perfect this kind of marine timekeeper, and that he may not be the person to bring it to its final result.

[12]Règle artificielle du temps (1737), pp. 406-407

A particular moving story revolves around Sully's relationship with Montesquieu, who presided over the Bordeaux Science Academy. Sully had approached him to help him carrying out sea trials of his marine timekeeper in the estuary of Bordeaux. Montesquieu had graciously agreed, he and the Academy had given Sully a fond welcome upon his arrival in Bordeaux in August, and provided the necessary logistical support and measurement oversight on the performance of the timekeeper. Appendix III has a translation of a correspondence in July 1726, where Sully thanked Montesquieu for his support.

Some previously unpublished correspondence of Montesquieu was presented in *Le Correspondant* (tome 106) on 10 and 25 February 1877. The text reads (author's translation):

> Another reason prolonged [Montesquieu]'s stay in the province. Henry Sully, an Englishman who had been esteemed in his country by Newton for his astronomical research [somewhat incorrectly stated], and whom the Duke of Orléans had tasked to create the Versailles horological factory, had just arrived with a new scientific invention. It was a lever-based pendulum clock to measure time at sea: which allowed to arrive at the exact determination of longitude. The only way to measure this instrument was to carry out experiments on a ship. Sully had chosen Bordeaux because of its marine port and above all because of its Academy, where sciences were better known and appreciated than in any other provincial city. The company welcomed him to the proceedings, delegated some of its members to assist him with his trials, and report back. Montesquieu, who was president as we have seen, treated Sully with the most cordial kindness.
>
> One day, this great "horologist", having suffered considerable financial losses as happens to all inventors, wrote this letter to Montesquieu which is both very English and very naive: "*I feel like hanging myself, but feel I wouldn't do so if I had one hundred écus*." "*I am sending you a hundred écus*[13]*", replied the correspondent immediately. "Don't hang yourself, my dear Sully, and come to see me.*"
>
> This good action, which honors so much its author, was only revealed after his death, by his daughter. Do you wonder where such discreetness from Montesquieu originates from? The answer may be in this observation from him: "*Timidity has been the scourge of my life.*"
>
> We would like to know that this generosity in fact did save Sully, but nothing prevents an inventor from his fate; this one died two years later, in misery, as is common.

Recall that while he was running the trials of his clock in Bordeaux, as Julien Le Roy recalled[14], Sully's furniture and best tools had been sold (by his wife presumably) to cover his debts. It may well have been after coming to terms with the sobering personal situation upon his return to Paris, that Sully wrote that letter to Montesquieu. Was he seriously contemplating suicide at that

[13] One écu (or livre tournois) was worth at that time about three dozen eggs, four bottles of common red wine, or a pound of butter. 100 écus was not a fortune, but represented an amount necessary to feed, clothe and house Sully's family for two or three months, at the most.
[14] Règle artificielle du temps (1737) p. 407

time, or was it just a play of words in a backhanded request for subsistence money from someone he saw as a possible benefactor?

To have fallen from the heights of leading a revolutionary new horological factory eight years before and living the affluent lifestyle that came with that position, to now having to beg for money to feed his family, must have been very difficult for Sully to bear. He had known low points before in his personal and professional life (the death of his first wife, the loss of his lucrative positions leading the Versailles and Saint Germain factories), but this may have been a final blow to his hope of finding fame and fortune. His twenty-three year old dream of producing a viable longitude timepiece (as Huygens, Hooke and others had unsuccessfully tried before him) came to a sudden and definite end.

Sully would pick himself up and continue trying to find ways to earn an income for him and his family, during the two years following the failure to successfully prove his marine timekeeper in Bordeaux. But in the end, he nevertheless died destitute and according to a contemporary commentator, left a family in great need. The final dénouement of his life story will be told in the next and final chapter.

APPENDIX I - RECOMMENDED READING

Anyone interested in the fascinating story of determination of longitude, whether by horological, astronomical and other means, is strongly urged to read the descriptions contained in these fine books, some of which cover the various technical challenges and solutions to developing a longitude timekeeper, in much greater and accurate detail than this author could ever be able to do in this limited space.

Longitude, by Dava Sobel, 1995, London.

Sobel is described on the back cover as “an award-winning former science reporter for the New York Times, and writes frequently about science for several magazines”. Her book is written for the lay reader with an interest in this story, particularly the long and arduous attempts by Englishman John Harrison (1693 - 1766), who was finally awarded the totality of the British Parliament’s Longitude Prize of 1714, a few years before his death. A gentle and limited introduction to the subject, Sobel does not even mention Sully in her text.

Revolution in Time, by David Landes, 1983, Harvard, Massachusetts.

This is one of the great general books on horology of the late twentieth century. The author, an academic, described the evolution of horology and its various dimensions in interesting ways, focusing on many of the illustrious names that have dotted its long history. The development of marine chronometers is described in some detail in this highly readable book. Sully is mentioned a few times, though not necessarily on the subject of longitude measurement.

The Marine Chronometer, by Rupert T. Gould, 1923, London. (New edition by Jonathan Betts, 2013, ACC Books, Suffold.)

This work by polymath and ex-Royal Navy officer Lt. Cdr. Gould is one of the classic texts on this subject. It stems from painstaking restoration work that the author carried out on the much neglected chronometers of John Harrison. Gould also studied the development of longitude timekeepers over the years (notably in Holland, France and England) and his book, with many illustrations, is the first to delve into the subject in such an in-depth manner, right up to the development of the modern marine chronometer in the nineteenth century.

Sully's work is described on pages 35-39, where Gould concludes that "*At the time of his death he was working on a new design of marine timekeeper, and if his life had been prolonged (...) it is quite probable that he would have triumphed over both his mechanical and financial difficulties. His clock, although impracticable, is evidence of his great abilities. It is to be regretted that he devoted so much of his time to improving it, and neglected his marine watch, which was far the more promising design of the two.*"

The Quest for Longitude, William Andrewes ed., 1996, Harvard.

In November 1993 in Massachusetts, a symposium on the history of determination of longitude at sea was attended by five hundred participants from seventeen countries. This book in large part consists of the scholarly articles that were presented during the symposium, covering all aspects of the subject. It is very information rich and strongly recommended to anyone with more than a casual interest in this fascinating story of scientific discovery.

The work of John Harrison, and the English horologists who followed him, is predominant in these proceedings, but considerable space is also given to early continental European pioneers like Christiaan Huygens, Henry Sully, Pierre le Roy and Ferdinand Berthoud. Other articles describe non-horological means to determine longitude, as well as "nutty" solutions to the Longitude problem, encouraged by the generous English prize announced in 1714.

Henry Sully's attempts are described in some detail, in particular highlighting the influence that Huygen's earlier attempts had on Sully's own lengthy path to try to find a viable solution.

Various books, by Pierre le Roy and Ferdinand Berthoud, 1760's-1780's, Paris

Le Roy (son of Julien) and Berthoud (of Swiss nationality but who worked in France most of his adult life) were competitors for the development of a longitude timekeeper on French soil. They were working on different designs around the same period (and at the same time that Harrison was finally achieving success in England). Both horologists, especially Berthoud, were prolific writers on the subject, praising their own timepieces and finding faults in their competitor's. At stake was the favour of the State (which was conferred on Berthoud in the end, much to the chagrin of Le Roy), to become the provider of marine chronometers for the French Navy.

A good number of these books (and other contemporary French horological titles) can be downloaded from the French National Library in PDF format (https://gallica.bnf.fr/).

Both Pierre le Roy and Ferdinand Berthoud are discussed at length in the books on longitude presented in this section. The book by Andrewes in particular, features a very informative article by Catherine Cardinal on the rivalry between the two renowned horologists.

Marine Chronometers at Greenwich, Jonathan Betts, 2017, Oxford University Press.

Betts is a recognized horological scholar and author, who for over twenty years was curator of horology at the National Maritime Museum in Greenwich, London. In this capacity, he became very intimate with the many marine chronometers preserved at the Museum, which are described in this lavish catalogue.

In the book, several pages are devoted to Sully and his efforts to develop a longitude timekeeper, and Betts describes the different iterations of Sully's marine clocks (named A, B, C). The museum at Greenwich features an Experimental Marine Chronometer by Sully, of the type C, dated 1724, though not on display. Betts provides a very detailed description of all aspects of this marine timekeeper (museum catalogue number ZBA2248), which is inscribed "HENRY SULLY A VERSAILLES INVENIT 1721 ET FECIT 1724". In his writings, Sully had indicated the design to date from the time he was briefly in London (1721), and that it had actually been manufactured when he had re-established himself in Versailles.

Description d'une horloge d'une nouvelle invention pour la juste mesure du temps sur mer, Henry Sully, 1726, Paris.

Certainly, no discussion about Sully's journey to develop a longitude timekeeper would be complete without referencing the original source, Sully's own words written around the time of the sea trials of his marine clock (and watch) in 1726, in Bordeaux. This book, in Sully's own words, is used often in recounting the story in this chapter of Sully's life.

The book was printed in two parts: in January 1726 in Paris, and in December 1726 in Bordeaux. The first part provides the context on the subject of longitude measurement at sea, and a description of Sully's timekeeper. The second and lengthier part follows attempts to test Sully's marine timekeepers in the estuary of Bordeaux, and describes some of the mitigated successes that were obtained.

Also contained in the second part of the book are copies of memoirs presented by Sully at the *Académie royale des sciences* in Paris, in 1723 and 1724. It also reproduces correspondence he had, between 1724 and 1726, with various people about his marine clock, most notably with Englishman George Graham (1673 – 1751), Swiss mathematician and physicist Daniel Bernouilli (1700 – 1782), and others.

The book also contains other texts by Sully, including a section entitled *Eclaircissemens* (see Appendix II below) which contains the closest we will ever have of an autobiographical text by Sully. Also included is a text in which he outlines his ambitious plan to write a comprehensive six-volume treatise on horology. Sully also included his translation of the British Parliament Act of 1713 which established the lucrative longitude prize (20,000 pounds), eventually won by John Harrison.

APPENDIX II – ECLAIRCISSEMENS (1726)

From: 1726, Henry Sully, Paris: *Description abrégée d'une horloge de nouvelle invention pour la juste mesure du temps en mer avec le jugement de l'Académie des Sciences sur cette invention et une dissertation sur la nature des tentatives pour la découverte des Longitudes dans la navigation et sur l'usage des horloges pour la mesure du temps en mer.* 290 pages.

Starting on page 254, in a section entitled "*ECLAIRCISSEMENS*" [Clarifications], Sully provides insights on the invention of his "lever pendulum clock", which is the subject of the book, and the judgment that others have offered about it.

Sully starts the section on a philosophical note:

> *Men create nothing; they gather ideas by using their senses and their mind; of themselves there is only the arrangement of these that they know to put in their works, and this arrangement, when it is particular and distinguished from others, is called invention.*
>
> *An invention consists of knowing how to equally choose, reject, combine, separate, elevate and destroy; it only has merit from the utility of the object, or from the knowledge and skill that the invention requires, and that the inventor can bring to bear.*
>
> *At the root of all talents is a certain aptitude which is constantly a gift of nature; the one who possesses these talents only adds the manner in which they are utilized, cultivated, enhanced: perhaps in this there is little that is actually ours; self-esteem enlarges the object. But if enough remains to encourage men to do well, little remains to inspire their humility.*
>
> *Based on these principles, there is nothing that men can legitimately draw from vanity; it follows that one should be quite indifferent as to the property of those goods that we call inventions; goods very prone to appropriation, that one never possesses without exciting envy, and that one can hardly preserve without very good titles.*
>
> *However, we see little of this philosophical indifference, when it comes time to dispute one's titles against those who have stolen them, or to defend them against all that tends to rob them from the legitimate owner. Sometimes the interest that one has of being recognized as the inventor of useful things, is joined to the honour of being such; this circumstance change the thing's nature: it becomes a treasure that one finds while searching through one's lands, and it is permitted to push away those who come to take it away.*
>
> *All honest people agree that plagiarism, even of the dead, is loathsome; and to want to appropriate the fruits, genius, and works of contemporaries, is insolent and odious. One is more tolerant of certain passe-droits of little consequence, and one prefers sometimes to endure small thefts, than to dispute with one's friends.*

Since I oppose these indignant practices, and would be mortified to just be suspected of such, I take the liberty to declare that I don't wish to rob the goods of anyone, nor to beautify myself with their feathers; that I will preserve as best I can what remains of mine, and what I could lose in the future, and that I will take back what belongs to me, wherever I find it.

It's not that I am so eager to have the name inventor, I don't dwell on it as long as the thing invented has some utility; and in order not to err I expose my ideas to wise experts so they can offer their judgment; they can criticize or condemn these things: I defend them only when I feel that truth is on my side; and I am the first to get back up from my errors, as soon as I realize them.

Following this approach, I could not appropriate what does not belong to me: it would be telling those who have the right to claim them back, and not allow me to keep it from them. If I wish to preserve what remains of mine, it's that I believe that what came from me, could belong to me as much as to someone else who would want to take it. And if I want to take back something of this kind that has been taken from me, I would produce such good titles, and behave so honestly that that people I would oblige to give back my property, would find nothing to criticize about my actions.

This lengthy preamble seems to result from Sully's sensitivity toward some opinions offered by others [Graham, for one] about his clock, in which it was directly or indirectly suggested that he had used aspects of clocks from other makers, and passed them off as his own inventions.

Sully goes on to say about his clock (page 261):

To prove without a doubt that I am the author of this clock, and that it is different from any other, I don't feel I need any better title than the pages of the registers of the Académie Royale des Sciences de Paris. In all the works that appeared there, either in physics, or mathematics, or mechanics, nothing indicates, even in the remotest manner, a clock construction that would have the least resemblance to this one, or that suggests that someone had tried to do something similar. If I needed other proof, it would be very easy for me to produce some. I have for witnesses (b) many of the most illustrious persons in England, Holland, Germany, and France, and who know about the beginning of this endeavour, and of the progress that I have made from time to time, since the year 1703. That this design had been suggested to me by the late Sir Wren (able mathematician and great architect) whose name and merit are known in the entire learned world.

In the footnote (b), Sully launches into an interesting and detailed chronological overview of his work in the areas of marine clocks, and the many people that he met and discussed the subject with along his lengthy project, culminating in the clock he was describing in the book written in 1726. This chronological, almost biographical note [which starts on page 261 and completes on page 264], is worthy of translation and inclusion here, since it has not been available in English before, and will assist in writing this chapter on Henry Sully's life. The translation follows.

(Translation by Robert St-Louis, 2020)
(b) I wouldn't have intended to bring forward these proofs, were it not that some people have tried in many ways to do me harm and to deprive me, if they could have, of all the fruits of my applied work during so many years. I therefore felt that I needed to demonstrate their imposture, make them ashamed of their arrogance, and silence them forever.

In the year 1703, the late Sir [Christopher] Wren, judging me worthy of making a useful attempt toward the measurement of time at sea, gave me a fine recommendation to this effect. I asked to see the Duke of Somerset [Charles Seymour, the 6th Duke][15], who received me very graciously, and instructed me to address myself on his behalf to Sir Newton[16], to explain my views to him, which gave me the great honour of being known by this great man, who gave me insights that I needed, being at the time just a young man of 23 years; he encouraged me in my plan [to develop a marine clock], and gave me a favourable testimony. Following this, the Duke of Somerset tried to engage Lords Sommers[17] and Hallifax and others to join him, to create a fund, which would engage me to apply myself entirely to this research, which was at that time my one and only goal, but this attempt did not succeed. I nevertheless applied myself to it using my own resources, which became known in London among ingenious persons: the late Mr. Flamsted[18] and Mr. Hudson, who assisted the wise astronomer in his observations, and who is presently Professor of Mathematics in the School of Christ [Christ College] in London, and of the Royal Society, were among those people.

The learned and famous Professor Dr. Boerhave[19] will well remember the discussions I had the honour of having with him on this subject when I was in Leyde [Leiden, Holland] during the years 1708, 1709 and 1710, and with several magistrates of that city.

Being in Franckfort on Meyhe [Frankfurt on Main] in the year 1711, I published a small brochure in French, entitled "Méthode pour régler les montres" [Method to regulate watches], with a dissertation on "l'excellence de l'horlogerie" [the excellence of horology]; in which I insinuated what could be expected of this Art for use in navigation; one can still find copies of it among the learned people of that country. The Reverend Jesuit Father Des Bosses[20], then living

[15] It is interesting that after seeing Wren, Sully went to see the Duke of the county of his birth, Somerset. Sully was born from parents who resided in Bicknoller Somerset.
[16] Sir Isaac Newton (1643-1727) English mathematician, physicist, astronomer, theologian, and author, was President of the Royal Society of London in 1703. He became a Commissioner of Longitude under the Act of 1714, and corresponded widely on proposals for finding longitude at sea. (Wikipedia)
[17] Lord John Somers (1651-1716) was Lord High Chancellor of England under King William III and was a chief architect of the union between England and Scotland achieved in 1707 and the Protestant succession achieved in 1714. He was President of the Royal Society from 1698 to 1703. (W)
[18] John Flamsteed (1646-1719) was an English astronomer and the first Astronomer Royal, at the newly created Greenwich Observatory. He spent almost 40 years observing stars and producing a catalogue of almost 3,000, published after his death. (W)
[19] Dr. Hermann Boerhaave (1668-1738) was a Dutch botanist, chemist, Christian humanist, and physician of European fame, who taught at the University of Leiden. He introduced the quantitative approach to medicine and was the first physician to use thermometer measurements in clinical practice. His motto was Simplex sigillum veri: 'Simplicity is the sign of the truth'. He is often hailed as the "Dutch Hippocrates". (W)
[20] Barthélemy Des Bosses (1668-1738) was a Jesuit priest who taught philosophy and mathematics in Germany. He translated a work by Leibniz into latin, and the two exchanged a voluminous correspondence from 1705 until Leibniz's death in 1716. (W)

in Cologne, communicated this brochure to the journalists of Trévoux[21]; they speak of it in one of their journals in October 1712 or 1713, as I recall; I've seen this little brochure translated into German.

But no one has been more informed, either of my goals or of the progress I had accomplished, than my illustrious benefactor my lord the Duke of Aremberg[22], who gave me the honour of keeping me at his side, solely to better allow me to carry out my views on how to perfect my Art. It was under the guise of this generous Prince that I enjoyed all the advantages that I could hope for during the years 1714 and 1715, that I had the honour of following him in his travels to Vienna and Paris. In this way I met and adopted the ways of the learned elite of the countries where I found myself. While in Vienna I knew the famous Mister Leibnitz[23]: he perfectly understood my views, continually urged me to pursue them and provided me with news; and he honoured me with his friendship and his correspondence by his letters until his death. If the mention of my name, that he gave me the honour of including in his letters that were printed, and in the hands of learned people, was not sufficient to prove it, I have as witnesses that I dare name, my lord the Prince Eugene of Savoye[24], my lord the Duke of Arenberg, my lord the Count of Koningseck [Koenigsegg][25], then ambassador in France and now in Spain, my lord the Count of Mattuof, ambassador in Moscovie [Moscow], the Baron of Huldenberg, envoy of Hannover, Mr. Brunix, envoy of Holland, Mr. Clement, resident of the late Queen of Great Britain, and many other persons of the utmost distinction that I had the honour of knowing at the Court in Vienna in 1714, who also knew about my work.

As early as 1716, being in Paris, I declared to the learned members of the Académie Royale des Sciences, by whom I had the honour of being known, how far ahead I was in this work, and that I anticipated the way to overcome difficulties, that were well known to me: I can claim here the testimonies of the illustrious Abbé Bignon[26], Mr. de Fontenelle[27], Mr. Saurin[28], and many other fellows of the Académie; and since I had reason to believe that almost the entire Académie had a general notion of what I was working on, I concluded in these terms a memoir that I had the honour to read in this illustrious assembly that same year. "The indulgence that you will show for this little essay may incite me to one day produce some fruit of my work which will be more

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[21] The Journal de Trévoux, often called the Mémoires de Trévoux, was an influential academic journal that appeared monthly in France between January 1701 and December 1782. It published critical reviews of contemporary books and papers on a broad range of subjects, mostly non-fiction, and most of the authors were members of the Society of Jesus (Jesuits). (W)

[22] Leopold Philippe of Arenberg (1690-1754) was the 4th Duke of Arenberg, an aristocrat and military officer. He fought in the War of Spanish Succession in 1706, and was a field commander on several other European conflicts. He moved to Paris in 1716, and Sully followed him there.

[23] Gottfried Wilhelm Leibniz (1646-1716) was a prominent German polymath and one of the most important logicians, mathematicians and natural philosophers of the Enlightenment. He made major contributions to physics and technology, and anticipated notions that surfaced much later in philosophy, probability theory, biology, medicine, geology, psychology, linguistics, and computer science. (W)

[24] Prince Eugene Francis of Savoy–Carignano (1663-1736) was a Paris-born field marshal in the army of the Holy Roman Empire and of the Austrian Habsburg dynasty during the 17th and 18th centuries. He was one of the most successful military commanders of his time, and rose to the highest offices of state at the Imperial court in Vienna. (W)

[25] Count Koenigsegg, an Imperialist ambassador, became ambassador to France and later, to Spain.

[26] The Abbé Jean-Paul Bignon (1662-1743) was a French ecclesiastic, statesman, writer and preacher and librarian to Louis XIV of France. From 1706 to 1714, he presided over the committee of men of letters who edited the Journal des sçavans, which position he took again in 1724. (W)

worthy of your attention". And it was this very work [i.e. marine clock] that I was designating in these terms.

It was only in the year 1720 that I discovered, almost at the same time, the curve (Courbe) which I use; the compensation for the action of weight, which I only before saw the possibility, and which had stopped me during 12 years; and the use of rollers (rouleaux) and the lever (levier). In the year 1721, in London[29], I found myself with the leisure to execute everything I had been mulling over previously; I started with the escapement. A diamond watch that Sir Newton had shown me in 1704, and of which I will speak later, gave me the first idea[30]: as early as 1712, I had imagined the necessary changes to be made, without having completed their execution. I built a watch with this escapement, and showed its construction to Lord Parker[31], at the time Chancellor of Great Britain, and Lord Islay[32], and demonstrated its workings in the Academic assembly of Mrs. Watts and Worster, and many other knowledgeable and interested people of London, and among other able craftsmen [artistes], to Mr. Vick, watchmaker to the King. I also showed my "pendule à levier" [lever clock], and I announced its properties to all my friends, but showing its construction to only one London clockmaker, who was Mr. Reith[33]. I then wrote about it to Mr. Le Roy[34], watchmaker of Paris, whose ability is now deservedly well known by the public.

Having arrived in Paris in 1722, I showed my lever clock uncovered, first of all to Mr. Saurin, and then in 1723 at Versailles to the Duke of Chaulnes, his Eminency l'Abbé de Livri, now ambassador for the King in Poland; Mr. le Chevalier de Luines [Luynes][35] and Mr. le Chevalier de Bethune[36]; then to the late Mylord Duke of Orleans, at the Académie, and to the King, Mylord

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[27] Bernard Le Bovier de Fontenelle (1657-1757) was a French author and an influential member of three of the academies of the Institut de France, noted especially for his accessible treatment of scientific topics during the unfolding of the Age of Enlightenment. He is noted for the accessibility of his work – particularly its novelistic style. This allowed non-scientists to appreciate scientific development in a time where this was unusual, and scientists to benefit from the thoughts of the greater society. (W)

[28] Joseph Saurin (1659-1737) was a French mathematician and a converted Protestant minister. He was the first to show how the tangents at the multiple points of curves could be determined by mathematical analysis. (W)

[29] After the unsuccessful attempts to maintain watch-making factories that he had created in Versailles (under John Law) and later in Saint Germain (under the Duke of Noailles), Sully had been forced to return to London, along with most of the English workers he had convinced to go to France to work with him. The lack of income caused Sully to ponder on his next venture, and he found the time to devote efforts to his interrupted marine clock project.

[30] This watch had an escapement made by DeBaufre. (expand)

[31] Thomas Parker, 1st Earl of Macclesfield (1666-1732) was an English Whig politician who was Lord Chief Justice from 1710 to 1718 and acted briefly as one of the regents before the arrival of King George I in Britain. (W)

[32] Archibald Campbell, 3rd Duke of Argyll, 1st Earl of Ilay (1682-1761) was a Scottish nobleman, politician, lawyer, businessman, and soldier. He was known as the Earl of Ilay from 1706 until 1743, when he succeeded to the dukedom. He was the dominant political leader in Scotland in his day, and was involved in many civic projects. (W)

[33] ?? Reith was the assistant director under Sully of the Versailles watchmaking factory. When Sully was removed by John Law, Reith became the director until the factory closed down. Both later returned to London along with the other English watchmakers who had been enticed to go work in those factories, accompanied by their families.

[34] Julien Le Roy (1686-1759) was a major early-mid-18th-century Parisian clockmaker and watchmaker. He and Sully knew each other and often exchanged horological ideas while the latter lived in Paris. They were also founding members of the Société des Arts. In 1737, LeRoy worked with the publisher to edit and augment Sully's 1717 book, in a revised and final edition.

[35] Charles-Hercule d'Albert de Luynes, entitled Chevalier de Luynes (1674-1734) was a marine officer and French aristocrat descendant from two noble families. He served in the Royal Marine under Louis XIV and XV.

[36] François-Annibal de Béthune (1642-1732) was also a French aristocrat and marine officer.

the Cardinal of Fleury, then bishop of Frejus, being present, and many of the principal noblemen of the Court; and from that time to all the interested people who came to see it at my home, among whom were found most of the ministers of foreign Courts.

It's not strange that people seeking applause that they have not worked to deserve, have tried to make a name for themselves at my expense; an attempt that has however not met with success: but it would be very surprising if someone in the future tried to do the same, after all the proof that I have just presented.

APPENDIX III – Correspondence with Montesquieu

129. -SULLY' A MONTESQUIEU.
I. Henri Sully, horloger du duc d'Orléans, mort en 1728.
Autographe. Arch. de La Brède.
De Paris, ce 3o° juillet 1726.
Vous jugerez bien, Monsieur, du plaisir que m'a dû faire une lettre de votre part; une lettre surtout aussi gracieuse que celle que vous m'avez fait l'honneur de m'écrire. Il n'est point de récompense du prix des approbations comme la vôtre; ce sont, du moins, celles principalement que j'ambitionne.
Dans la supposition d'une dette aussi générale que celle que vous insinuez, vous aurez déjà, Monsieur, payé le contingent de votre ville et de tous les pays au delà de la Loire, et, moyennant deux ou trois voix comme la vôtre, s'il s'en pouvait trouver, la France, pour sa part, serait bientôt quitte avec moi. Je suis tout préparé. Monsieur, à suivre les conseils que vous me faites l'honneur de me donner; je pour- suivrai courageusement mes vues sans me laisser rebuter par aucune difficulté, et je travaillerai tant que je pourrai me remuer pour les intérêts de la société dont je n'ai pas, au reste, à répondre des mœurs. Je connais un peu les hommes et je ne m'étonne de rien. Vraiment, je compte fort sur la postérité, et je souhaiterais beaucoup plus que je ne l'espère voir sortir de mes jours mes contemporains de l'enfance.
Vous aurez déjà appris. Monsieur, par M. de Loubes, qui est parti il y a quinze jours, le dessein que j'ai formé de me rendre à Bordeaux pour faire mes premières expériences du vaisseau, sous les yeux de votre Académie', et vous saurez en même temps que vous seul. Monsieur, êtes cause de cette résolution que j'ai prise. Cela est vrai à la lettre. C'est pourtant fâcheux qu'il faut aller à cent cinquante lieues de la Cour et de la capitale pour trouver des personnes de discernement. Heureux cependant qu'il s'en trouve quelque part dans le royaume !
Je compte partir au premier jour, et je n'ai jamais eu d'impatience si grande que celle que j'ai d'avoir l'honneur de vous rendre mes devoirs en personne et d'exposer mon ouvrage dans toute son étendue au jugement de votre Académie.
Je suis, avec un respect et un attachement que je ne saurais assez dignement exprimer. Monsieur, votre très humble et très obéissant serviteur.
Sully.
I. Il s'agit des expériences sur le bon fonctionnement d'une horloge marine que Sully venait d'inventer. II fut présenté à l'académie de Bordeaux le 18 août 1726 et les expériences commencèrent peu après {Reg. mss de l'Académie, III, p. 408 et suiv.).

APPENDIX IV – FIGURES

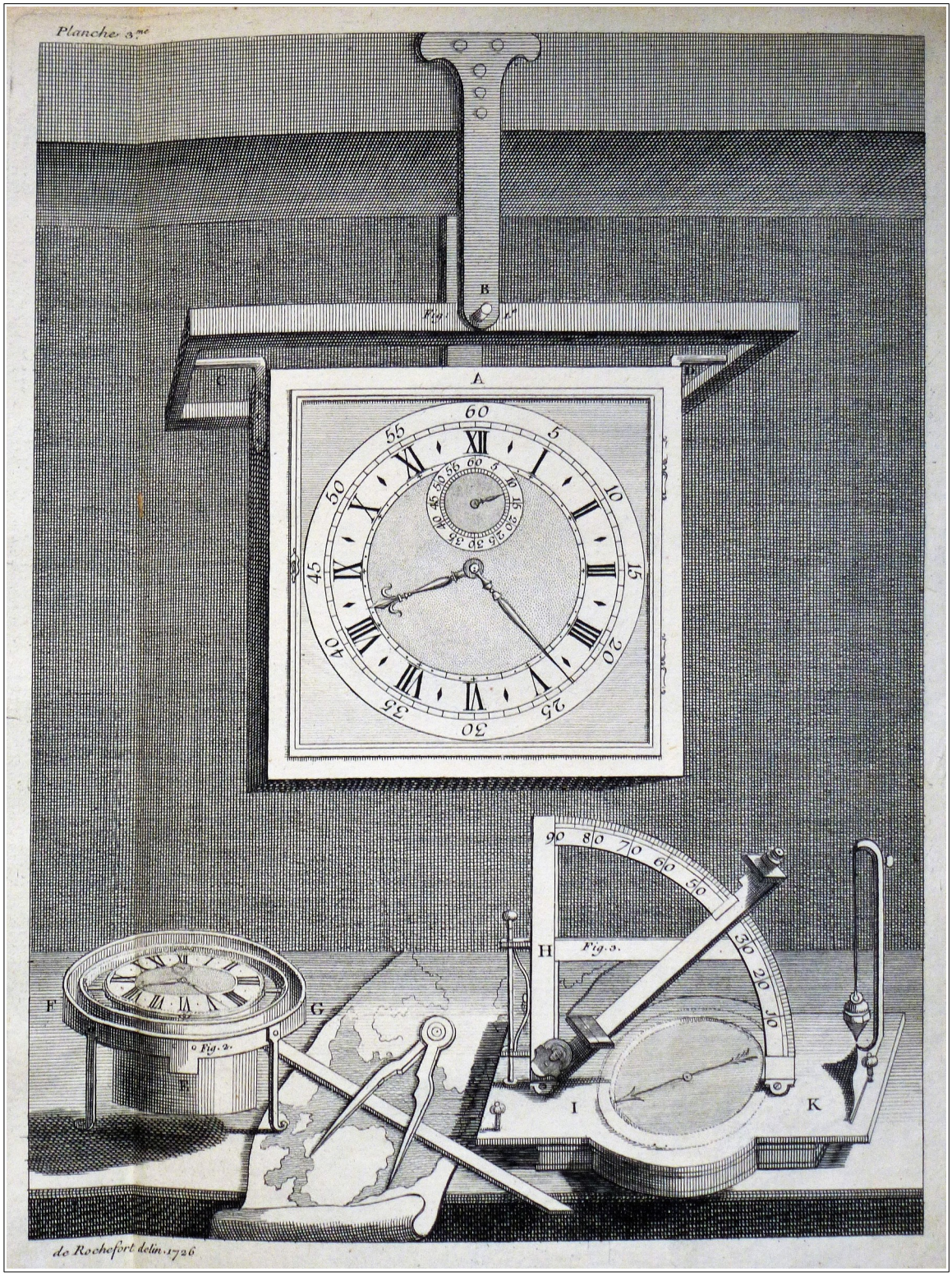

Figure 1: Sully's longitude clock and watch, and other related tools (1726)

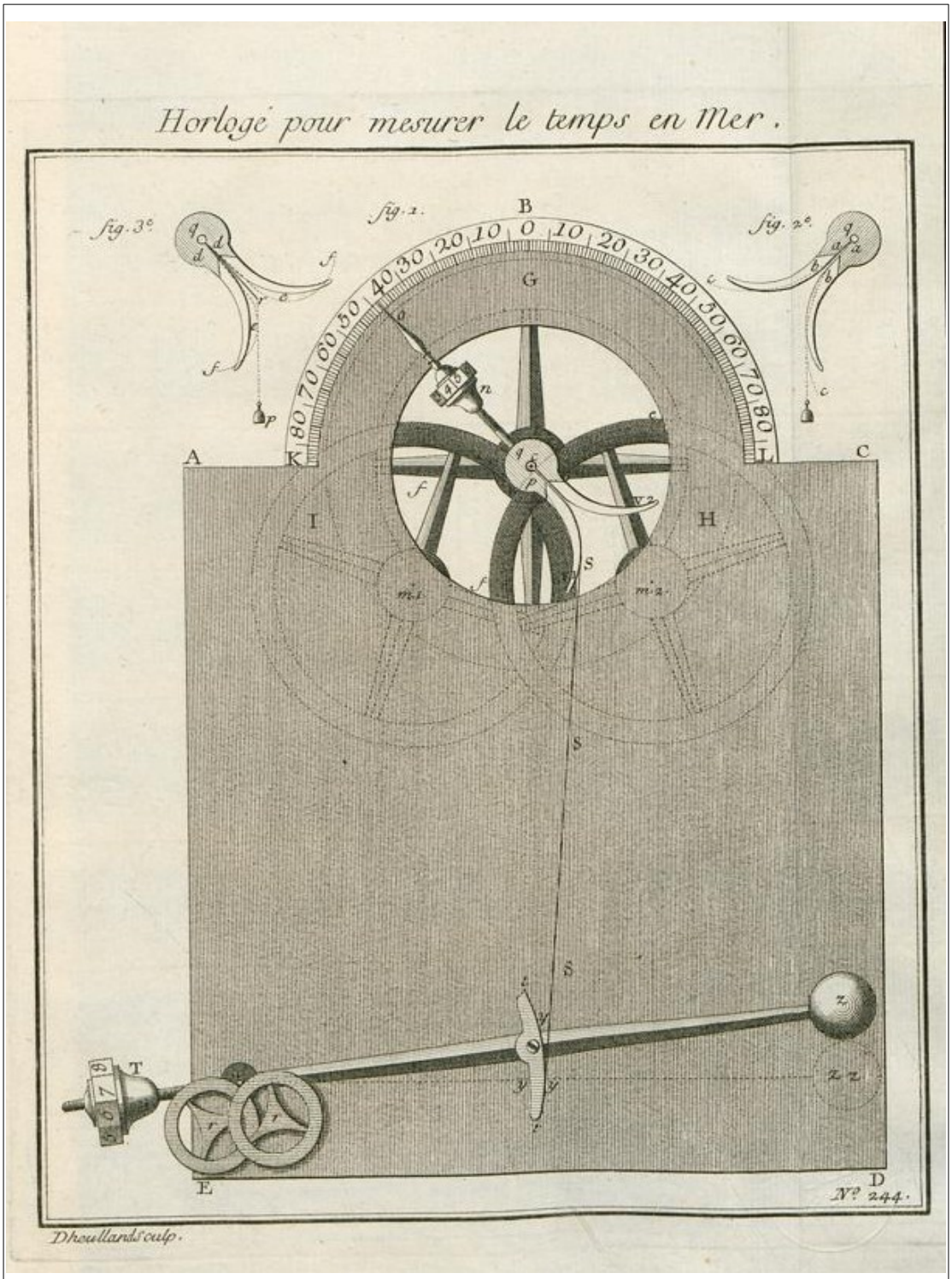

Figure 2: View of Sully's longitude timekeeper clock movement (1724)