A new discovery in watchmaking history

by Joseph Flores
All pictures are from the author

Introduction

In order to be as close as possible to what was the truth, history must be based on proven facts. Authenticated documents dated from the studied period are generally solid proofs, as they recall what happens, sometimes with a lot of details. The historian classifies the facts and introduces some personal interpretation to fill the missing gaps if any. However, when it concerns a technical invention, there is no place for interpretation, if written documents exist.

All the books relative to horology, and generally qualified as "reference books", indicate that **Abraham Louis Perrelet** invented the so-called "automatic watch" (or self winding watch). This has been transmitted by the famous book of Alfred Chapuis and Eugène Jaquet "La montre automatique ancienne" published in 1952. These gentlemen have presented a watch (picture 1), which is today in the Patek-Philippe museum in Geneva. They have indicated, with the description, that it was built and invented by Abraham Louis Perrelet in Switzerland.

In contradiction with this statement is a report from the French Science Academy (recently discovered) which describes an item (watch) designed by **Hubert Sarton** (from Belgium) and dated 1778. This report, written by Le Roy and de Fouchy, then registered and copied in the minutes of the French science Academy[1], describes a self-winding watch designed by Sarton, with so many details that it is impossible to think it be anything but the watch formerly attributed to Perrelet.
This watch is examined in detail and presented hereafter.

Picture 1: Self-winding watch attributed to Perrelet in 1952, which shall be reattributed to Hubert Sarton.
(Patek Philippe Museum Collection).

[1] Refer to these two documents presented in annex

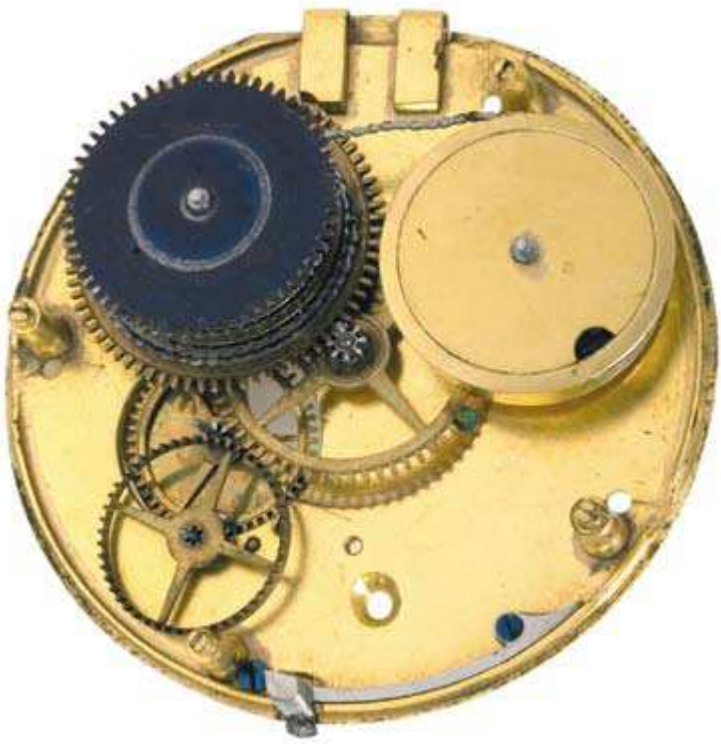
Since 1993, (the date at which I discovered the 1778 report) while searching for more official documents, it appeared to me that the Perrelet attribution relied on successive misinterpretations. With time, the invention of self-winding watches seems to slip inexorably from Switzerland (Perrelet) toward Belgium (Sarton) while still some historians seem to support the old legend, but whose motivations are not historical. Self-winding watches (or automatic watches) using today the rotor system, represent a large industrial and commercial activity and Swiss manufacturers have adopted Perrelet or his image like a trade mark.

Study of the report dated 1778

In the following report, the text will be translated into English and placed in front of a corresponding picture of a watch in the Patek-Philippe museum, formerly attributed to Perrelet.

The movement

1) The first sentence outlined in the 1778 report indicates: *"... this watch is built like ordinary watches, and has also a fusee and a barrel ..;"*
Picture 2 shows the gear train layout where fusee and barrel can be observed. The only difference with classical watches from the same period is the additional steel wheel on top of the fusee, which will be used as a ratchet.



Picture 2: The gear train

The fusee

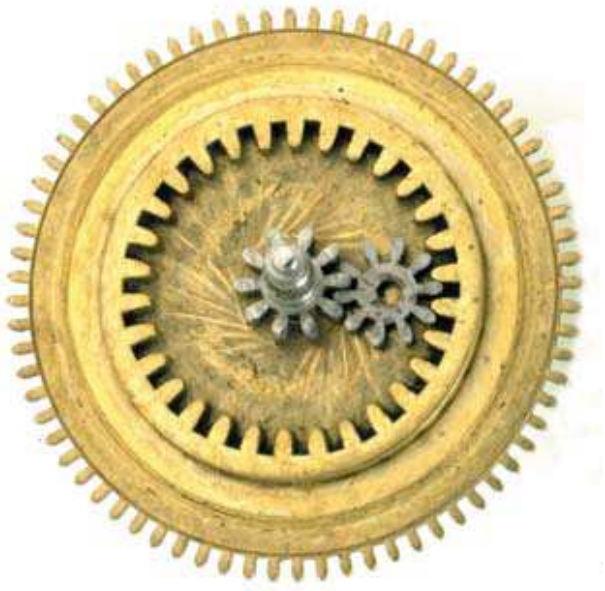
2) Then comes this sentence: *"this fusee is turning around its axle, instead of being attached to it as usual"*
This means that the body of the fusee is separated from its arbor, which is absolutely unusual. This arbour can be seen alone in picture 3 where one extremity is threaded while the other one bears a pinion, which is also unusual.

Picture 3: The fusee arbor

3) This sentence can be underlined: *"below, it has (the fusee) a pinion of 10 at its base"*. The full body of this fusee is shown in picture 4. On the left, we can see the head of a long screw, which maintains the pinion of 10 on the opposite side, as described in the French Academy report.

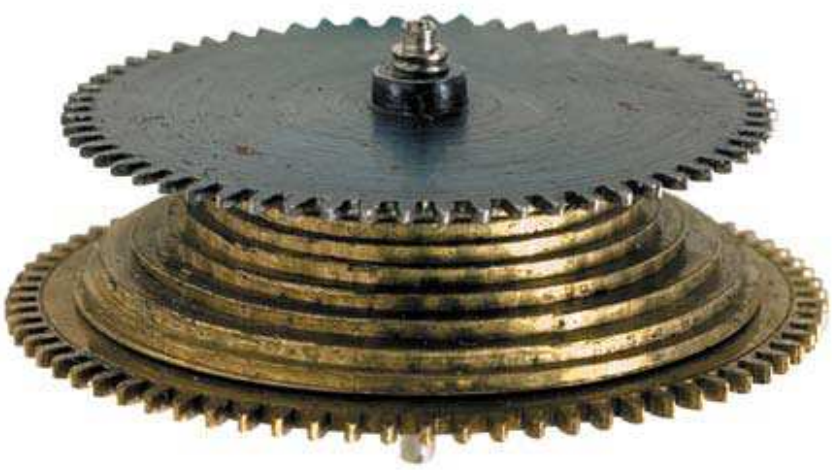
Picture 4: Both sides of the fusee

4) Next sentence: *"connected with a pinion of same number fitted on this arbor"* On picture 5, the fusee arbor has been put in place, and the gears are as shown in the picture, i.e. in accordance with the text of the report.



Picture 5: The gear inside the fusee

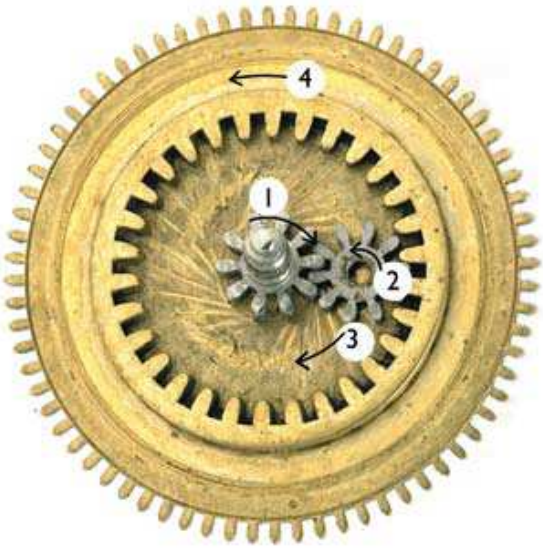
5) Again picture 5: *"The great wheel bearing the fusee, instead of having a pawl (or a click) in its recessed part, has a wheel whose teeth are directed towards the centre"* This element, a differential gear, is the key element for self-winding watches; otherwise they stop working during the winding up operation.



Picture 6: The fusee including all what has been seen above

A sentence from the report, gives the reason for the differential gear: *"Two features are necessary for such a watch to work as needed. It shall be wound up by the effect of the beating mass described here, but it shall also continue to work during this operation; otherwise it will go too slowly"*. This last feature was overlooked by A. Chapuis and his friends. A classical fusee watch stops working during the wind-up operation, as the main spring force is counterbalanced by the action on the fusee. This is not the case of self-winding watches, and this detail has been designed by Sarton, which is witnessed by the report text.

The following explanation and picture 7 show how the maintaining force is achieved using differential gear:
The main spring force comes from the fusee on which a screw is used as a satellite pinion axle (2). This pinion and centre axle being stopped (or moving slowly), the force is applied to the fusee wheel like an arrow (4), making the movement work.
The winding force comes through the central arbor (1) always in the direction indicated by the arrow (1). It is transmitted to the fusee wheel through the satellite pinion (indicated by the arrow 4)_and not only generates the movement but also goes directly to the fusee through the same satellite pinion axle, which winds up the main spring.



Picture 7: How the maintaining force is applied during winding up

6) Another sentence examined: *"This beating mass situated on the back plate like a pendulum, has a small pinion and a small ratchet wheel below it."* The described mechanisms are clearly shown in picture 8 and separated in picture 9. This system, called "inverter", makes the winding axle turn in one direction only, and has no action in the reverse direction.

Picture 8 and 9: ratchet wheel and winding mass

7) Then follows: *"a wheel placed on the same plate, which has a pinion in such a way that it is inside the train frame."* Picture 10 shows how this wheel is mounted and how its pinion has been placed inside through a small hole.

Picture 10: Wheel with pinion inside the train frame

We noticed that this pinion has a hole in its centre, in order to keep it free on its axle (the arrow shows the axle). The pictures are clear enough to understand how it is mounted as indicated in the report.

8) Again, comparing the explanations, it is said: *"finally, this last pinion drives a wheel placed on top of the fuse."* We can refer to picture 6 and also to picture 11 for details, which show the mounting. The winding mass placed on top of the movement drives the inverter system, which itself drives the wheel on top of the fusee (i.e. the fusee arbor) through the gear train.

Picture 11: Details of the automatic winding gears

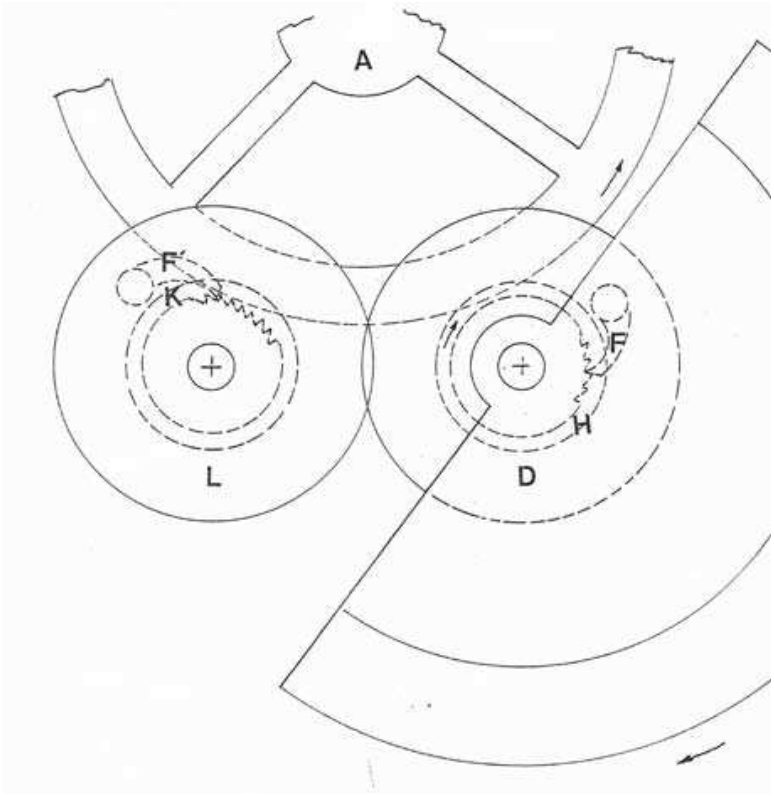
Comparison with up-to-date design

The text of the report, from Hubert Sarton design, indicates two other important features, which still exist in self-winding watches today. These details indicate how developed was his design as no evolution was needed. It was made by a clever horologist from Liege, not enough known:

- The winding of the watch occurs, whatever the rotation of the mass is
- The operation is blocked when winding up is completed

9) A second inverter is implemented as the text indicates: *"We have supposed that this beating mass was going in only one way, but it could go the other way, which could produce an opposite effect destroying all."* The following text clarifies the presence of the second inverter: *"The author (Hubert Sarton) has placed a second small ratchet wheel, in fact similar to the one which is attached to the beating mass, in such a way that it is driven by the mass and drives itself the wheel on top of the fusee;"* When examining picture 10 and 11, we noticed a small wheel in touch with the so-called relay wheel. It is the second inverter built like the first one, which can be seen in picture 10.

The drawing in picture 12 is probably clearer than any explanation. The two inverters are shown driving the relay wheel A. We can follow the movement of the wheels and arrive at the conclusion that both ways of the rotating mass drive the relay wheel always in the same direction (as shown by the arrow).

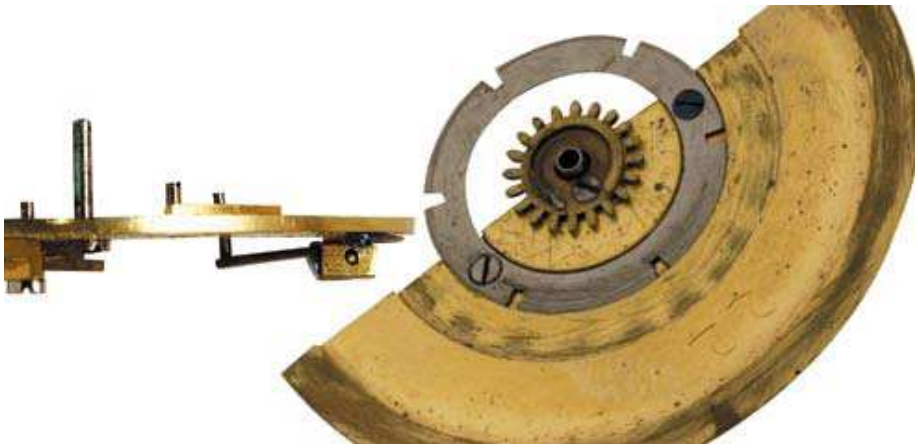


Picture 12: Drawing showing the two inverters driving the relay wheel A

Rotating mass blocking

10) In order to prevent main spring breakage, we know that it is necessary to stop the winding up operation when the main spring is completely wound up. This is still true for self-winding watches, and modern movements still have this feature. However, the system invented by Sarton is slightly different from those used today. Presentlly, this effect is produced by sliding braces, which force the main spring to slide inside its barrel. This invention dates from the middle of the 19th century.

Sarton had chosen a different solution, which was used for all similar watches prior to this modern design. When the main spring is completely wound up, a small device blocks the rotating mass, in the Sarton type watches as well as those from Breguet. The report says: *"Finally, for avoiding the main spring to be wound up any more, because already at its maximum, the chain guide bears a small pin which falls through the plate, inside the slots of a ring attached below the rotating mass."* Therefore, when the main spring is completely wound up, the rotating mass is blocked and cannot move any more. This system is shown in picture 13 and corresponds to the watch wrongly attributed to Perrelet.
The blocking is released as soon as the watch is running for a while, turning down the fusee and main spring, and then liberating the blocking pin.



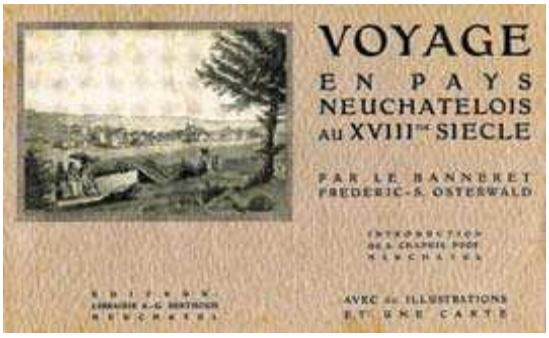
Picture 13: System for blocking the rotating mass

What about Perrelet?

After this detailed study of the 1778 text devoted to a self winding watch designed by Hubert Sarton, at least one correction should be made to the historical facts of horology, and it becomes necessary to look towards Perrelet in order to understand why such a mistake was made and propagated.

Let us examine the documents on which Chapuis et al. have based their statements. It seems today that these have been read too rapidly and misinterpreted unless otherwise proved.

The first author who talked about a certain Abraham Louis Perrelet was, as far as I know, Osterwald (picture 14) who wrote the following in 1776 in "Voyage en pays neuchatellois" (journey to the Neuchatel region):
"Sir Abraham Robert and Daniel Perrelet are the main workers in the Locle for manufacturing tools. The first one, a skilled clockmaker has invented a machine for (manufacturing) the wheels of small size (watches). The second is an excellent "cadraturier" (maker of cadratures i.e. mechanisms located under the dial) and invented the uprighting-tool. His son Abraham Louis is producing ratchet and cylinder watches.
We notice that the son of Daniel Perrelet was making ratchet and cylinder watches and no indication is made of self winding watches.



Picture 14

The second author is de Saussure who made a trip to the Locle in 1777 and who met a certain Perlet (not Perrelet). His log book relates:
"From there to Mr Perlet, the inventor of watches which wind up themselves by the movement of the man who wears them; they are going height days without being agitated. He was obliged to rebuilt the first one because he did not placed a blocking device and the winding mechanism broke the watch of a man running to the post office. At the moment he placed a good blocking system that was difficult to adjust, but is enough, there is a second ordinary mechanism and he sells it 15 to 20 Louis.
It seems that de Saussure effectively saw a self-inding watch at Mr Perlet's house which had a specific winding system based on shakes. Which Perlet he was, (as several Perrelet were working at the same time in this region of the Locle) we do not know. Neither do we see any detail indicating that he was Abraham Louis Perrelet.

Another question is raised as to which winding system it was. Only a detailed technical description can be taken as real proof.

Then Abbot Jeanneret is cited as an important reference in the Chapuis' book. Abbot Jeanneret says, page 41 in the "Étrennes Neuchatelloises" published in 1862, that Mr Houriet is the inventor of the watches which wind up themselves when carried.
One year later in 1863, the same abbot Jeanneret in "Biographie Neuchâteloise" allocates the self-winding watch to Abraham Louis Perrelet , the son of David:
"Abraham Louis Perrelet was born in the Locle in January 1729 his father David Perrelet, was at the same time carpenter and farmer."
For Abbot Jeanneret, the inventor of the self winding watch is the son of David (and not the son of Daniel). This is confirmed by Alfred Chapuis who seems to mix up all the Perrelets in 1957 in a small booklet from the Dubois factory (picture 15) and indicates the son of Daniel as the author of ratchet and cylinder watches, quoting the Osterwald reference.

Picture 15

Some other indications are given by Chapuis to support his theory: the three letters AFV on the main spring and the case, hallmarks from Neuchâtel, with letters ALR, but nothing in these details is in relation with any Perrelet.

We know that 63 persons named Perrelet were involved in horology in the town of Le Locle, according to Jean-Paul Bourdin in his book "Répertoire des horlogers loclois, XVII^{e} XX^{e} siècle". He says that during the second half of the 18th century, at least three Abraham-Louis Perrelets are registered, and several others with different first names. In this book, Abraham Louis Perrelet is the son of Daniel, but in a previous publication, "Les fabricants d'horlogerie loclois 1785-1985" the same author indicates that he is the son of David Perrelet and Jeanne-Marie Robert. Here again some confusion seems prevalent.

Several errors circulate around Abraham Louis Perrelet who is said to have formed several apprentices like Japy, Houriet or Breguet. A document dated 24 December 1770 in the archives of the town of Neuchatel indicates that Japy was apprenticed to Jean-Jacques Perrelet. Frederic Houriet cited by J.C. Sabrier in his book on this horologist, was supposed to be apprenticed to Perrelet, but was in fact to Abraham Louis Perret-Jeanneret according to a similar document from the same archives and dated 20 March 1771.

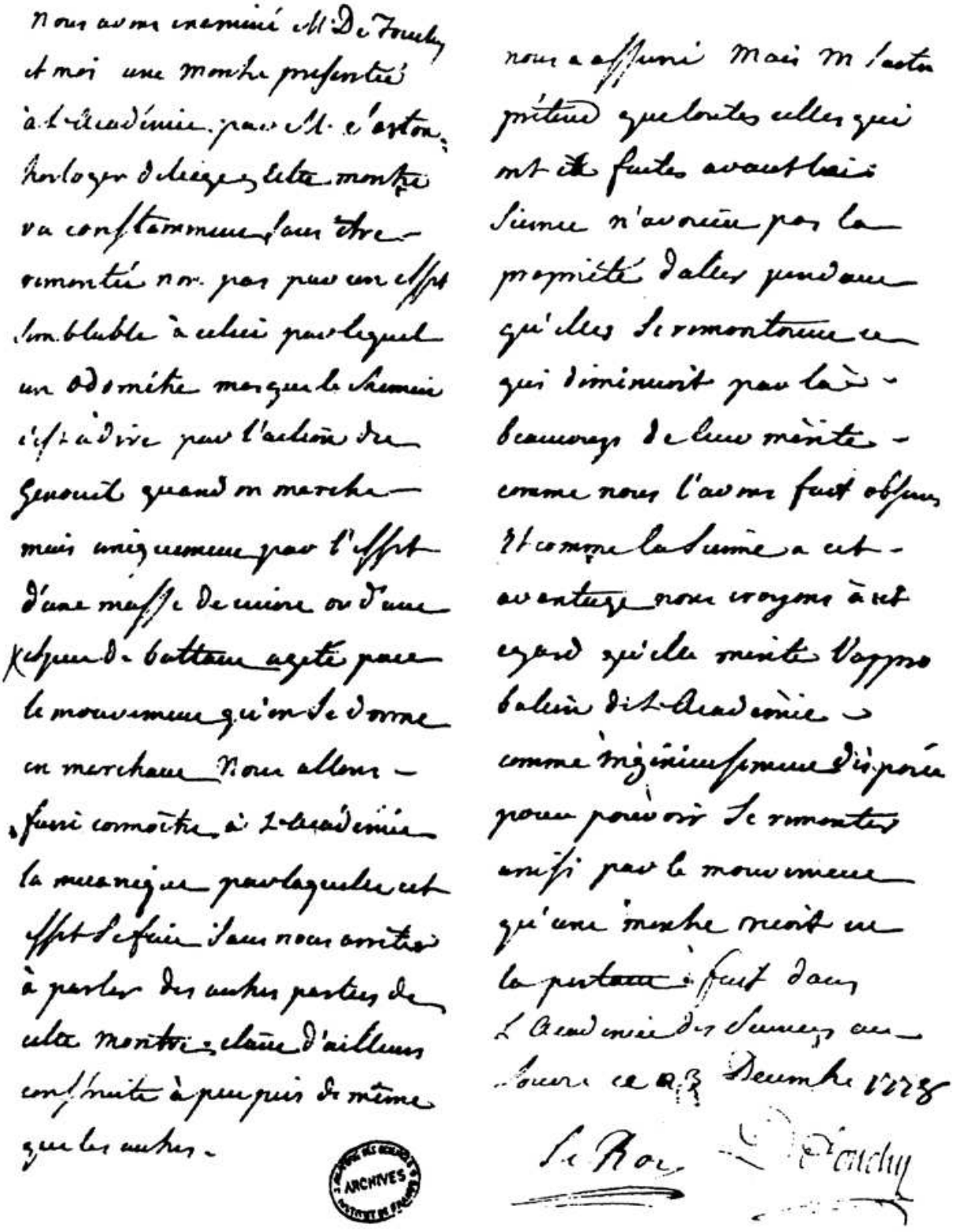
Conclusions

It appears that no certainty can be established in favour of Abraham Louis Perrelet for inventing the self winding watch as confusion is likely to occur. Furthermore, there is neither a dated report nor any clear indication of the first name of Perrelet. It is easy to suppose (without proof) that Sarton came to Switzerland and copied the idea from Perrelet in a last attempt for avoiding the destruction of a legend on which interests are built. However the other way round could be more probable, especially considering that at this time (second half of 18th century) the Swiss horologist and manufacturers are providing watch movements in quantity, sometimes with copied signatures.

Opposite to this attributed invention, there is a registered and dated report from the French science Academy, naming Sarton as the inventor.

Annexes

The first report is made by Fouchy and is reproduced below (Picture 16). This text is then copied and incorporated in the French Science Academy report dated 1778. This final report can be seen in picture 17 and on Internet at the following address:
http://visualiseur.bnf.fr/ark:/12148/bpt6k55773b
The relevant description starts at page 332 of this visualisation.



Picture 16: Extract from the report by Fouchy (December 1778)

Complete text:

"Nous avons examiné M. de Fouchy et moi une montre présentée à l'Académie par Monsieur Sarton, horloger de Liège.
Cette montre va constamment sans être remontée, non pas par un effet semblable à celui par lequel un odomètre marque le chemin, c'est-à-dire par l'action du genou quand on marche, mais uniquement par l'effet d'une masse de cuivre ou d'une espèce de battant, agité par le mouvement qu'on se donne en marchant. Nous allons faire connaître à l'Académie la mécanique par laquelle cet effet se fait, sans nous arrêter à parler des autres parties de cette montre, d'ailleurs construite à peu près de même que les autres. Deux choses sont nécessaires pour qu'une montre de cette espèce remplisse bien son objet. Il faut non seulement qu'elle se remonte par l'effet du battant dont nous venons de parler, mais encore qu'en se remontant la montre continue d'aller, sans quoi il y aurait trop de retard dans la marche. Voici comment pour remplir ces deux conditions, les choses sont disposées. Mais auparavant il est nécessaire de se rappeler que nous avons dit que cette montre est construite comme les montres ordinaires, et aussi qu'il y a une fusée et un barillet comme dans ces montres. Cette fusée tourne sur son arbre au lieu défaire corps avec lui comme à l'ordinaire, et elle a dessous, à sa base un pignon de 10 placé de manière qu'il engrène dans un pignon de même nombre, porté par cet arbre Par-là, quand l'arbre tourne, il fait tourner

ce pignon. La grande roue qui porte cette fusée au lieu d'avoir dans sa creusure un cliquet porte une petite roue dont les dents, au nombre de 30, ont leurs pointes dirigées vers le centre. La fusée placée sur la grande roue, son pignon engrène dans cette petite roue intérieure. Par cette disposition l'arbre de la fusée ne peut tourner sans que son pignon ne fasse tourner en même temps le pignon de cette fusée qui, étant entraîné lui-même du même sens pousse en sens contraire la grande roue. Par-là si on suppose que l'on tourne l'arbre de la fusée dans le sens où on le tourne pour monter la montre ça fera tourner cette fusée et par conséquence on remontera la chaîne ou la montre, en même temps que la grande roue sera poussée en sens contraire pour faire marcher la montre, comme lorsqu'elle est tirée par la chaîne. Cet effet bien entendu, voici comme il est produit par le mouvement du battant dont nous avons parlé. Ce battant situé sur la platine de dessus et mobile comme un pendule, porte par-dessous un pignon et une petite roue avec un encliquetage dont nous dirons la nécessité dans un moment. Le pignon engrène dans une roue portée sur la même platine qui a un pignon en dessous en sorte qu'il se trouve dans l'intérieur de la cage. Enfin ce dernier pignon engrène dans une roue placée au sommet de la fusée, et qui fait corps avec son arbre, à la place du crochet des montres ordinaires. Il est très facile maintenant de concevoir le jeu de ces différentes parties. On voit que le battant, suivant un mouvement de balancement, par exemple dans le sens où on remonte la montre, fera tourner la roue dans laquelle son pignon engrène et, que cela faisant tourner, par le moyen de son pignon, celle qui est portée par l'arbre de la fusée, la fera tourner en même temps du même sens et par-là remontera la chaîne comme nous l'avons dit. Car on imaginera bien, quoique nous ne l'ayons pas dit, que le mouvement de ce battant est assez grand pour surmonter l'action du ressort sur la fusée, et par conséquence pour la faire tourner Nous avons supposé que ce battant allait dans un sens, mais il pourrait aller dans le sens contraire, ce qui produirait précisément un effet opposé, qui dérangerait tout. Pour mettre donc tous les divers mouvements à profit, l'Auteur a placé une seconde petite roue avec un pignon et un encliquetage, en fait semblable à celle qui fait corps avec le battant, de manière qu'elle engrène avec celui-ci, et que son pignon engrène avec la roue qui mène celle de la fusée. Il est clair ainsi que par ce double engrenage, les différents mouvements contraires du battant, produisent toujours un mouvement dans le même sens sur la roue qui mène celle de la fusée. On sent bien que les encliquetages ne sont ici nécessaires, que pour que les pignons puissent tourner indépendamment des roues, et vice versa. Enfin pour que la montre montée tout en haut ne puisse pas l'être davantage, le guide chaîne porte une cheville qui traverse la platine, et va s'engager dans les entailles d'une plaque qui est au-dessous du battant, en sorte qu'arrêté par cette cheville il demeure immobile et la chaîne n'est plus remontée. Pour faire l'expérience de cette montre l'un de nous l'a fait porter par son domestique pendant l'espace de deux mille ou à peu près, elle (la chaîne) étant au bas auparavant elles trouva remontée de deux tours. Il résulte de tous ce que nous venons d'expliquer, que cette montre est bien imaginée pour produire son effet, mais que la nécessité de loger toutes les pièces qu'il demande, donne lieu à un inconvénient qui n'est pas compensé par le petit avantage de n'avoir pas la peine de la remonter. Cet inconvénient, est toute la place que demandent ces pièces, qui retranche beaucoup de celle qui est nécessaire à d'autres plus importantes comme la roue de rencontre et le balancier. Cette montre n'est pas absolument nouvelle, feu M. le Prince de Conti [Mort en 1776] qui était curieux d'horlogerie, en avait une dans ce genre à ce que l'on nous a affirme. Mais M. Sarton, prétend que toutes celles qui ont été faites avant la sienne, n'avaient pas la propriété d'aller pendant qu'elles se remontent, ce qui diminuait par là beaucoup de leur mérite. Comme nous l'avons fait observer, et comme la sienne à cet avantage, nous croyons à cet égard qu'elle mérite l'approbation de l'Académie, comme ingénieusement disposée pour pouvoir se remonter aussi par le mouvement qu'une montre reçoit en la portant.
Fait dans l'Académie des Sciences au Louvre ce 23 décembre 1778.
LE ROY
DE FOUCHY »