

# MICROSCOPICAL ADVANCES: THE POSTERITY OF HUYGENS' SIMPLE MICROSCOPE OF 1678

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ABSTRACT: From an examination of recently rediscovered examples of the simple microscope with spherical lens and specimen revolver, originally developed by Christiaan Huygens, the paper seeks to illustrate how the combined study of texts and objects is essential to establishing the evolution of an instrument. Some of the newly discovered instruments are described and comment is made on the commercial forces which acted in parallel with scientific ones on the development of this particular form of microscope

'In their beginning the most beautiful inventions are always imperfect, which is why suddenly several different ways of constructing this new type of microscope were seen, before it was brought to the final perfection in which it is sold by Butterfield at Paris, in the Faubourg St. Germain'.<sup>1</sup> The form of simple microscope (figure 1) concerning which the expatriate English instrument-maker in Paris, Michael Butterfield (1635-1724) published a description which opens with the quotation above had indeed been the subject of intensive, though rapid, development. It was a development which did not end with the model that Butterfield published, but this second stage of development is one which it has only recently become possible to trace as a sufficient number of examples of the instrument have come to light to allow comparison to be made between textual sources (manuscript and printed) with the instruments manufactured and distributed commercially in France, Germany, Italy and

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<sup>1</sup> *L'Usage du nouveau microscope fait avec une seule et très petite boule de verre*, n.p. [Paris], 1679. 'Les plus belles inventions sont toujours imparfaites dans leur commencement, c'est pourquoy on a veu tout à coup plusieurs differentes manieres de construire ce nouveau genre de MICROSCOPE, auparavant qu'il ait esté mis dans la dernière perfection que les vend le sieur BUTTERFIELD, au Faux-bourg S. Germain'.

England. In historical accounts of the development of instruments, texts and objects need always to be studied together for each casts light on the other. Examination of an object may modify the conclusions drawn from a study only of the texts concerning it, but texts can often throw light on evolutionary stages in the design of the instrument, and the ideas behind them which are normally undetectable from an examination simply of the instrument, or even of a series of instruments.

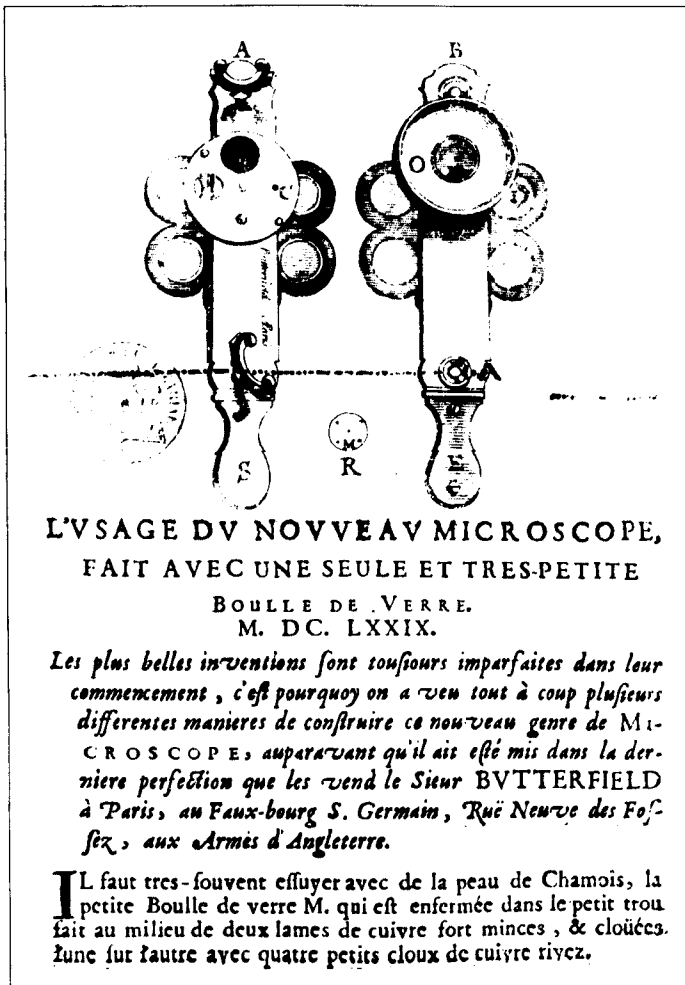


Fig. 1 Prospectus by Michael Butterfield for the form of Huygens simple microscope that he made, 1679. Bibliothèque Mazarine, Paris.

In a recent exemplary study, Marian Fournier,<sup>2</sup> has displayed the earliest stages of development of the simple microscope with spherical lens and specimen revolver. It was devised and developed by Christiaan Huygens (1629-1695) between the spring of 1678 and early 1679, for the study of infusoria, with which he became seized with enthusiasm after a visit to Antoni van Leeuwenhoek in 1677. Although Huygens was acquainted with the simple microscopes of Musschenbroek and Leeuwenhoek, his basic starting point was two simple microscopes sent to him by Nicolas Hartsoeker (1656-1725)<sup>3</sup> in March 1678. Certainly original to Huygens was the idea of enclosing the liquid specimen between a disk of glass and another of mica, but other developments stemmed from suggestions made by his brother Constantijn, Ole Romer and Hartsoeker himself. 'Essentially', Fournier writes, 'the variant versions of Huygens' single lens microscope all consisted of a double frame of some 8 to 12 cms height ... The front half of the frame contained the lens and the back half was originally designed to hold the specimen but came to accommodate the diaphragm. The twin parts of the frame were clamped together at one end, while the other end was held together with a screw. By turning the screw the distance between the two parts of the frame varied and thus the specimen was brought into focus in front of the lens'.<sup>4</sup> Of the six versions that Huygens developed Fournier argues that at least two were made and used and shows that the instrument quickly became known in Paris and was manufactured there, as it was in the Hague by Severijn van Oosterwyck.

The first maker of Huygens' simple microscope in Paris was quite probably Michael Butterfield. He in November 1687 had sent an infusion of coriander water to Huygens, presumably for use in his experiments, and the unusual remark, quoted above, about the various forms of the instrument during its development before it attained that which Butterfield made and sold, may well have been based on personal knowledge, a supposition that is supported by the fact that Butterfield and Hartsoeker were also well acquainted with each other.

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<sup>2</sup> Marian FOURNIER, 'Huygens' Designs for a Simple Microscope', *Annals of Science*, xlvii 1989, 575-596.

<sup>3</sup> For whom see Alice STROUP, 'Science, politique et conscience aux débuts de l'Académie Royale des Sciences', *Revue de Synthèse* 4th ser., 3-4 1993, 423-53 and références there cited on pages 438 and 442.

<sup>4</sup> FOURNIER (n 2), 581.

Already by the time Butterfield published his pamphlet,<sup>5</sup> the design had changed a little, for as Fournier points out although the model there illustrated and described corresponds in form with Huygens' third design, the optical layout is closer to that of the fourth version<sup>6</sup>. It is a salutary reminder of the fragility of knowledge, even for such a late period in the history of instruments as the 17<sup>th</sup> century, that although Butterfield's pamphlet had some influence and he had several models of the instrument in stock, today only one example of the description is known,<sup>7</sup> and no examples of the instrument signed by Butterfield. A form of simple microscope made in silver by Butterfield which may be related to Huygens second design has however survived.<sup>8</sup>

Nonetheless the model did become quite widely known. Even so, in tracing it knowledge depends as much on extant examples as it does upon texts. An instrument signed 'Chapotot AParis', which may be by either Jean or Louis Chapotot,<sup>9</sup> is close to Huygens' design as shown in Butterfield's pamphlet, but cannot be closely dated.<sup>10</sup> In 1709 Butterfield's composite version was described by Nicolas Bion,<sup>11</sup> which meant that the design was available in one of the most complete and popular treatises on instruments current throughout the 18<sup>th</sup> century.<sup>12</sup> Already however by the 1680s a further variant form of the instrument was available. In this the front and back plates were extended to

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<sup>5</sup> Note. 1. Given that Butterfield sent a letter to the Royal Society of London describing the new microscope (published in the *Philosophical Transactions* xii 1678, 1026-7) where he claims that a notice of a new level of his construction published in the *Journal des Sçavans* 15 November 1677 had been written by himself, it is not unlikely that he was also the author of the description of Huygens' microscope.

<sup>6</sup> *Op. Cit* (n. 2), 593.

<sup>7</sup> Bibliothèque Mazarine, Paris, 10371 V/pièce 39.

<sup>8</sup> Fournier (n2) 583-4 ; Butterfield's version (Science Museum, London inv 1954-289, ex Gabb collection), is described by Brian BRACEGIRDLE, 'Seventeenth Century simple Microscopes' in R.G.W. ANDERSON, J.A. BENNETT & W.F. RYAN (eds), *Making Instruments Count. Essays on Historical Scientific Instruments presented to Gerard l'Estrange Turner*, Aldershot, 1993, 295-305 (302-3).

<sup>9</sup> Despite the common assumption that these two makers were father (Louis) and son (Jean), no evidence has yet been found to establish their relationship.

<sup>10</sup> The instrument is now in the Museum of the History of Science, Florence. For a description see GERARD L'E. TURNER, *Museo di Storia della Scienza: Catalogue of Microscopes*, Florence, 1991, no 8, 31-2.

<sup>11</sup> Nicolas BION, *Traité de la construction et des principaux usages des instrumens de mathématique...*, Paris, 1709.

<sup>12</sup> French editions of Bion's work appeared in 1723, 1725 and 1752, with an English translation in 1723 (2nd edition 1752) and a German translation in 17126.

cover entirely the specimen revolver.<sup>13</sup> They thus give the revolver and its specimens complete protection and also offer a broad open surface ideal for decorative engraving. Surviving examples are far more elegant than Huygens' model, a matter of importance in the commercialisation of the instrument.

Several of the surviving examples of this new 'full-plate' model of the instrument as it may be called, are signed by the Paris maker J. Pouilly or de Pouilly whose name has in consequence come to be attached to it. Insofar as this may lead to paternity of this rather minor innovation being attributed to him it is unfortunate as no evidence whatever is known on the point. The development does however seem to have been made quite quickly as a full-plate instrument is shown in a portrait, supposed to be of Nicolas Hartsoecker, by Caspar Netscher which is dated 1682.<sup>14</sup> It is fortunate that it is, for only one surviving example of the type is dated.

Table 1. Full plate Huygens-type simple microscopes known in May 2003

1	Depouilly à Paris	fully engraved	Museum Boerhaave, Leiden <sup>15</sup>
2	Depouilly à Paris	engraved	Science Museum, London 1925-126 ex Crisp coll.
3	Depouilly à Paris	engraved	Billings Coll. Washington DC.
4	Pouilly à Paris		fully engraved Sotheby's 30.10.97 lot 10
5	De Pouilly à Paris	engraved	Sotheby's 9.11.99 lot 435
6	Pouilly à Paris	fully engraved	Private collection <sup>16</sup>
7	Not signed	fully engraved	Nachet 2
8	Not signed, in case	plain	Nachet 3
9	Not signed	plain, incomplete	Nosch coll. Sotheby's 30.10. 02 lot 34
10	'16.C.C.C.A.V.F.92' <sup>17</sup>	lime-wood & ivory	Christie's 30.5.96 lot 222
11	Gregoire à Paris	fully engraved	Christie's 8.7.99 lot 155
12	John Marshall fecit	fully engraved	Sotheby's 30.5.02 lot 11
13	Petrus Galland fecit Romae	plain	Victoria & Albert Museum, London <sup>18</sup>
14	G.F. Brander, Regensburg	plain	Nosch coll. Sotheby's 30.10. 02 lot 27.

<sup>13</sup> FOURNIER (n 2), 593.

<sup>14</sup> *Ibid* 594 where the portrait, which is in the Kupfälzisches Museum, Heidelberg, is reproduced.

<sup>15</sup> Acquired from Tesseract, see their catalogue 46, 1994 no 8. For a description see Marion FOURNIER, *Early Microscopes, a descriptive catalogue*, Leiden, 2003 no 10.

<sup>16</sup> This example is complete with its original black fish skin case.

<sup>17</sup> = Cosmus Conrad Cuno Auguste Vindellicorum fecit 1692.

<sup>18</sup> Contained in a case of drawing instruments some of which are signed by Galland, although the microscope itself is not signed.

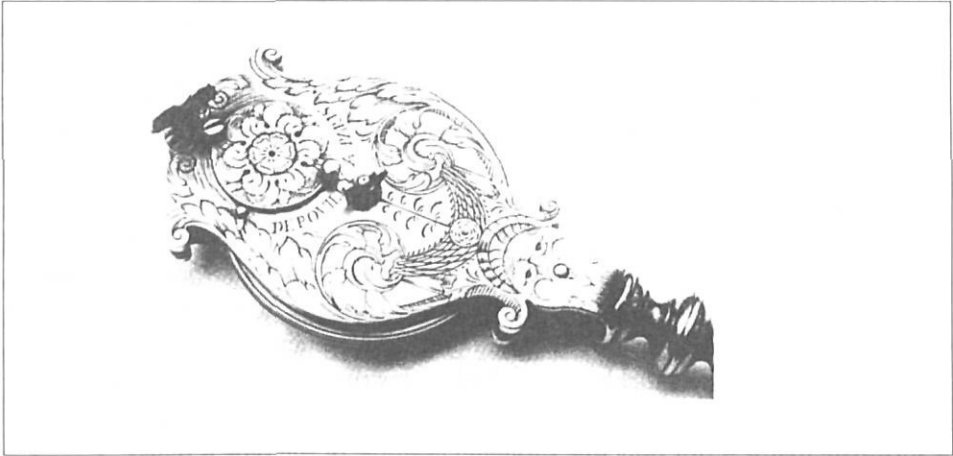


Fig I.1. Full plate Huygens-type simple microscope by Depovilly, Paris. Courtesy of Jesseract

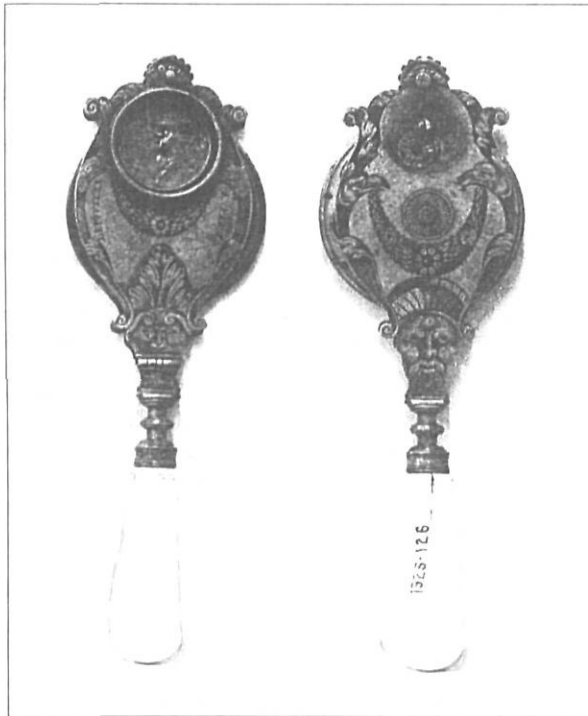


Fig. I.2 Full plate Huygens-type simple microscope by Depovilly, Paris. The Science Museum, London, Inv. 1925-126

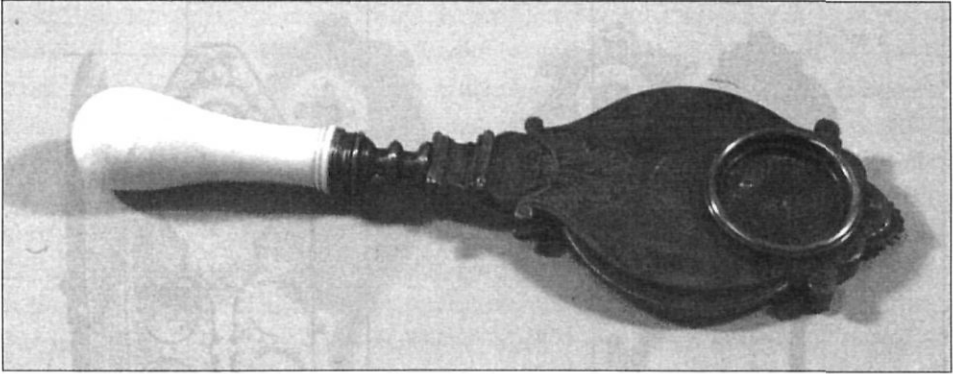


Fig. I.3 Full plate Huygens-type simple microscope by Depovilly, Paris. The Billings Collection of the Medical Museum of the Armed Forces Institute of Pathology, Washington DC.

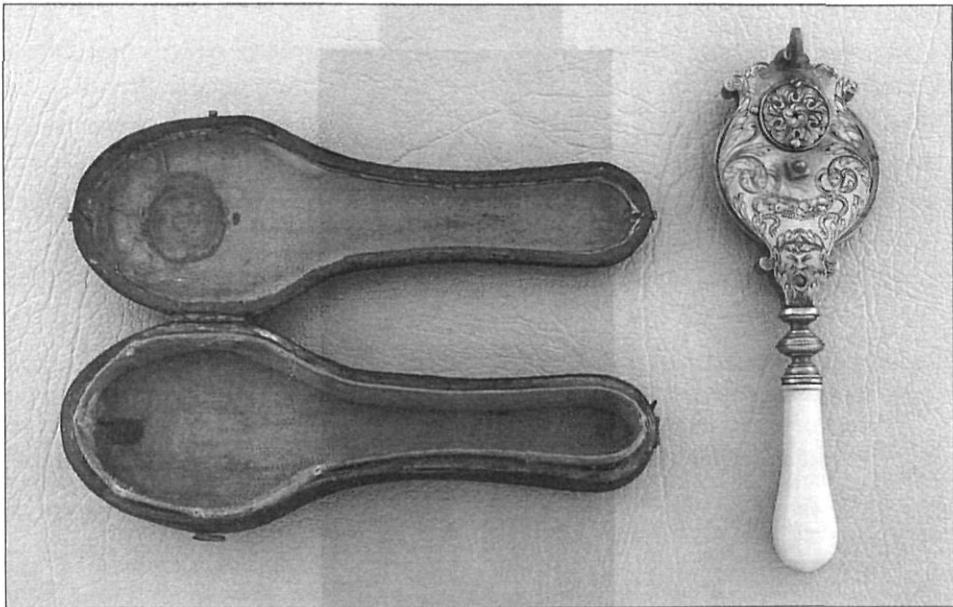


Fig. I.6. Full plate Huygens-type simple microscope by Povilli, Paris. Private collection

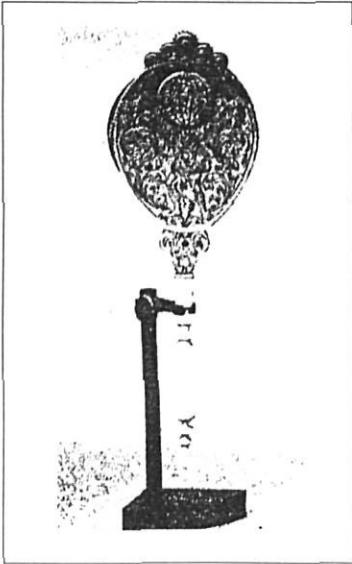


Fig I.7 Full plate Huygens-type simple microscope not signed once in the Nachet collection

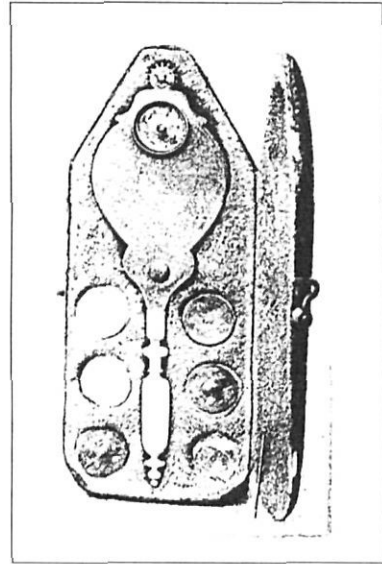


Fig I.8 Full plate Huygens-type simple microscope not signed once in the Nachet collection.



Fig I.9 Full plate Huygens-type simple microscope not signed.  
Courtesy of Sotheby's London



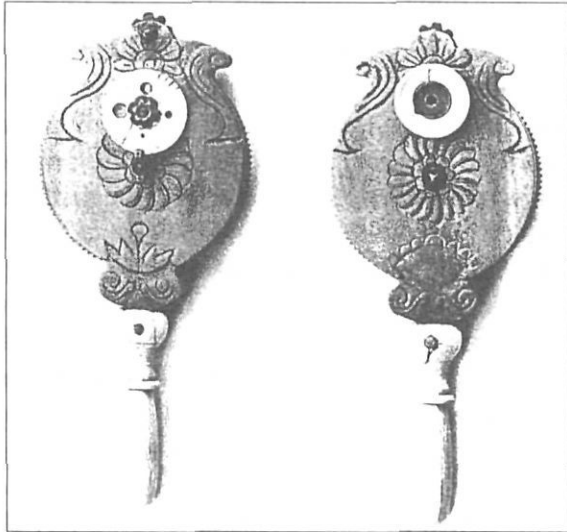


Fig I.10 Full plate Huygens-type simple microscope by C.C. Cuno 1692. Courtesy of Christie's London



Fig I.11 Full plate Huygens-type simple microscope by Grégoire Paris. Courtesy of Christie's London

Certainly in production by 1682, it seems probable that the 'full-plate' model of Huygens' simple microscope was developed in Paris a year or so earlier. From there it spread to Italy probably, as Fournier has suggested<sup>19</sup>, with Wilhelm Homberg (1652-1715) who had settled in Paris in search of a place in the Académie Royale des Sciences in 1680. As part of his campaign to be elected he 'ostentatiously visited the laboratories and workshops of Parisian artisans to offer scientific help',<sup>20</sup> but his hopes being dashed by the death of Colbert in 1683, he returned to Rome where he remained until 1691. In Rome Homberg frequented the private *Accademia fisico-matematica* which met in the palace of Giovanni Giustini Ciampini (1633-1698), and there he showed the new Parisian simple microscope<sup>21</sup>. As a result it was fully described and illustrated in a brief description of recent innovations in optical instruments published by the secretary of the society Carlo di Napoli<sup>22</sup>. When the illustration in di Napoli's book is compared with the example of the instrument contained in the case of drawing instruments signed by Petrus Galland (I.12), a very close resemblance is seen in form and both instruments are undecorated. The Galland example may indeed date from exactly this period for he is known to have been working in Rome by at least 1691.<sup>23</sup>

In the same way as the full-plate version of Huygens' simple microscope travelled to Italy, so it did also to Germany. Here again Fournier has sketched out the route,<sup>24</sup> noting that the earliest account is an undated, but pre-1700, pamphlet by Cosmus Conrad Cuno (1652-1745) in Augsburg. Since she wrote an example of the instrument by Cuno (I.10) which

<sup>19</sup> *Op. cit.* (n2) 593.

<sup>20</sup> David J. STURDY, *Science and Social Status, the Members of the Académie des Sciences, 1666-1750*, Woodbridge, 1995, 228.

<sup>21</sup> For this society see W. E. K. KNOWLES MIDDLETON, 'Science in Rome, 1675-1700, and the *Accademia Fisicomatematica* of Giovanni Giustini Ciampini', *The British Journal for the History of Science*, viii 1975, 138-54. Homberg made other innovations concerning microscopes known to this body. See Silvio A. BEDINI, 'Seventeenth Century Italian Compound Microscopes', *Physis*. iv 1963, 383-422 (398-400).

<sup>22</sup> *Nuove invenzioni di tubi ottici dimostrati nell'Accademia fisicomatematica romana nell'anno 1686*, Rome 1686. According to Middleton (n 19) 146 but without références, 'several authorities mention that the book was written by Ciampini himself'.

<sup>23</sup> Alberto LUALDI, 'Repertorio dei costruttori Italiani di Strumenti scientifici, secoli XVI-XVIII', *Nunciu. Annali di Storia della Scienza*, xv fasc. 1, 2000, 169-234 (195).

<sup>24</sup> *Op. Cit* (n 2), 594-5.

probably belonged to Ehrenfried Walter von Tschirnhaus (1651-1708), dated 1692 has surfaced. Although it is made of ( ?) lime-wood and ivory rather than brass and ivory, it is so close in form to the Pouilly examples (I.1-4) that it may be considered a calque upon them. The rather later German example by G.F. Brander (I.14) however has a less bulbous, more oval form closer to the Italian model. This example published in 1932<sup>25</sup> from the Deutsches Museum, Munich but lost from there during the 1940s has also recently reappeared, in the optical collection of Rolf Nosch<sup>26</sup>. It is the only known instrument of this type made by Brander (1713-1783) and, since it is signed from Regensburg whence he removed to Augsburg in 1734, must be very early in his production.



Fig I.12 Full plate Huygens-type simple microscope by John Marshall, London.  
Courtesy of Sotheby's London

<sup>25</sup> By Reginald S. Clay & Thomas H. Court, *The History of the Microscope...*, London, 1932, 33 & 38.

<sup>26</sup> Sotheby's, *Instruments of Science and Technology*, 30 October 2002, lot 27.

Recent discoveries of examples of the Huygens' full-plate simple microscope then enable us to fill out, make richer, the story of its transmission to Italy and Germany that was already known. The appearance of an example by John Marshall (I.12) however enables an entirely new chapter to be added. Before the appearance of this instrument it was quite unknown that any examples of the instrument had been made in England. Until then the earliest trace of it, apart from Butterfield's letter about his version published in the *Philosophical Transactions*, was the translation of Bion's account, also of Butterfield's model, in Edmund Stone's English version of Bion's treatise on instruments which did not appear until 1723. This is a brief two paragraphs in a book of some 300 pages. It did however make the purpose of the instrument very clear.

The Use of this instrument is very easy; if the objects are transparent, as the Feet of a Flea, or of Flies, their Wings, the Mites in Cheese, or other minute Animals ; as likewise Hairs of the Head, their Roots &c. they are put upon the Glass Plates on the Wheel, and are held fast with a little Gum-water : and to see the little Animals in stale Urine, Vinegar, in Water where there has been infused Pepper, Coriander, Straw, Hay, or almost any kind of Herbs ; little Drops thereof must be taken up with the End of a little Glass Pipe, and laid upon the aforesaid Glasses : then the Wheel must be turned and raised, or depressed by means of the Screws, and a Spring between the Plates, which serves to keep the Wheel in any Situation required, in such manner that a little Drop may be exactly under the Lens. Things being thus ordered, take the Microscope in your Hand, and having placed your Eye to the Concave over the Lens, look steadily at the Drop in broad Day-light, or at Night by the Light of a Wax-Candle ; at the same time turn the Screw at the End by little and little, to bring the Drop nigher, or make it further from the Lens, until the Point be found where the Object will be transparent, or the Animals swimming in the Drop of Liquor, appear very large and distinct'.<sup>27</sup>

Since John Marshall, the maker of the newly discovered English full-plate Huygens microscope died in 1723 he is unlikely to have used Stone's translation

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<sup>27</sup> Edmund STONE, *The Construction and principal Uses of Mathematical Instruments*, London, 1723, Bk. III.2

of Bion as a source of information about the instrument. He is also unlikely to have used Butterfield's description in the *Philosophical Transactions* for this is not a full-plate version. Marshall's however is, indeed, very similar to some of the known examples made by Pouilly. Presumably, like Galland in Rome and Cuno in Augsburg, he saw an example of Pouilly's instrument and copied it. Such instruments were indeed available in London at least by 1710, and probably nearly a decade earlier. In 1710, the Silesian Baron Nimptsch, who by then had lived in London for some seven or nine years, having previously been in the Low Countries and Italy, showed to the brothers Von Uffenbach then visiting London 'a fine microscope made by Boilly [sic = Pouilly] in Paris, such as Zahn describes in the appendix of his *Oculi ...*'<sup>28</sup>. Zahn did indeed describe the full-plate Huygens microscope in his *Oculus artificialis...* (1702), and it was exactly the kind of object that Nimptsch, gambler, chemist and *virtuoso*, was likely to have acquired in Paris or in Rome whence he had carried to London a spy-glass by Campani which he also showed to the Von Uffenbachs.<sup>29</sup>

Marshall's instrument is composed of two parallel mounted plates. The central portion of each of these plates, bounded by two pairs of points on the circumference, is circular each plate being extended downwards from one pair of points to form the handle attachment, and upwards to the clamping screw block. The two plates are rigidly mounted on a turned baluster pillar terminating in a screw to which the lignum vitae handle is attached. Each of the plates is fully engraved with symmetrical foliate decoration carried on flowing stems. At the top of the instrument immediately below the signature both plates have a circular aperture in which a lens-cell may be set. Through the lens thus mounted any one of six specimens presented on the circular specimen plate (the

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<sup>28</sup> W. H. QUARRELL & Margaret MARE (tr. & eds.) *London in 1710 from the travels of Zacharias Conrad von Uffenbach*, London 1934, 97.

<sup>29</sup> *Ibid.* 80. That Marshall had begun making the full-plate Huygens' simple microscope as early as the first years of the 1690s is also however possible. An advertisement in John HOUGHTON'S *A Collection for the Improvement of Husbandry and Trade* 2<sup>nd</sup> series, London 1692-1703 no 61 29 September 1693 mentions 'A Pocket *Microscope* and a wheel *Perspective Glass* with three *Concavqész* in the *Eye Glass* fir for allk weathers'. Since the latter sounds as if it had a rotating eye-piece similar to the revolving aperture plakte of the Huygens-type microscope, and is juxtaposed with 'a pocket *Microscope*', one wonders if the pocket *Microscope* mentioned was not Marshall's form of Huygens' design from which the London maker had adapted the revolving plate to the eye-end of a spy-glass. The advertsiement from Houghton his cited here from D.J. BRYDEN & D. L. SIMMS, 'Spectacles Improved to Perfection and Approved by the Royal Society', *Annals of Science* 1 1993, 1-32 n. 81.

specimen revolver) attached by a central gilt-brass bolt and nut between the two outer plates and free to be rotated, may be examined. This revolver is itself composed of two brass discs, pierced with six apertures and the central mounting hole held within an outer ring. One of the discs is permanently fixed in the ring with a piece of mica over it. The second disc is removable so that specimens may be placed in position, and has a locating pin for repositioning it. Focusing is effected by means of a wing-headed screw which when turned presses the two plates apart thus changing the optical distance between the lens-plate and the specimens. When the central screw is undone, the specimen plate may be slid out of the instrument. The lower end of the handle unscrews to allow access to a storage compartment which in this example contained two lignum mounted lenses and an unmounted lens element.

From this description, as from the illustration, the close general similarity of Marshall's instrument with those of Pouilly should be clear. Even Pouilly's instruments however were not identical. Examining the six signed instruments, the unsigned one in the Nacet collection which may be assimilated to them (I.7) and the instrument by Gregoire (I.11) allows modifications introduced in the course of making to be detected. The fundamental differences with Huygens' original designs are of course that the Pouilly-type instruments are more practical since the specimen-revolver is fully protected, and that the instruments are far more elegant and decorative. Marian Fournier has argued that Huygens original modifications to existing simple microscopes, and to the designs of Hartsoeker, were motivated by his interest in fusoria. 'It is obvious', she writes, 'that the design of the microscope was adapted towards the requirements of a specific line of biological research'<sup>30</sup>. The subsequent differences between the Huygens-Butterfield model and the full plate instruments seem however to have occurred in response to a different motivation - that of giving commercial appeal to the instrument. Such a purpose, like the changes that it provoked may, from a strictly scientific standpoint, seem trivial, but historically it is not so. The growth of interest and attention being brought to study of the natural world, the development of experiment as both a method of investigation and of instruction in the sciences, and the need of demonstration models to explain new cosmological concepts in the late 17<sup>th</sup> and early 18<sup>th</sup> centuries, created a greater demand for instruments

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<sup>30</sup> *Op. cit.* (n 2), 596.

and apparatus and so stimulated an increase in the number of makers of such devices. At this particular period however demand from within the sciences themselves was still insufficient to support more than a very few instrument-makers, and these few would probably have been insufficient to produce the wide variety of instruments and apparatus now required. It was only because many of the new instruments could be presented elegantly to appeal to a new, non-professional, indeed often rather uninformed, clientele eager to acquire pleasing, expensive and unusual luxury goods, that viable, commercial instrument-making could develop. Fifty years ago in his pioneering history of French scientific instrument-making, Maurice Daumas introduced the idea that the commercial structures of the instrument-making trade, in particular the workshops, were in themselves a factor which needed to be assessed and taken into account even in narratives of the internal historical development of the sciences.<sup>31</sup> The development of the Huygens' simple microscope design illustrates how the sciences themselves could also be the source of a new luxury good. It also shows how the two functions combined, the optical capacity or the precision of an instrument validating it, and adding to, its appeal as a luxury object. To draw a parallel with modern complicated wrist-watches developed exclusively for the luxury market, is perhaps not far-fetched. Such watches (like personal computers) incorporate complex functions and levels of precision which far exceed the needs of their putative purchasers. But such functions and precision guarantee the quality of the product and justify, or at least help reconcile the purchaser to, the high price which makes it a luxury item.

The elegant full-plate Huygens' simple microscope as produced by Pouilly and Gregoire appealed to the fashionable world of their time in exactly this way. One of them (I.5) carries a personal blason and motto, that by Gregoire<sup>32</sup> a

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<sup>31</sup> Maurice DAUMAS, *Les Instruments scientifiques aux XVIIe et XVIIIe siècles*, Paris 1953. Cf. Anthony J. TURNER, 'Maurice Daumas: les instruments scientifiques', *Musée des Arts et Métiers, La Revue*, 32 2001, 22-31.

<sup>32</sup> Gregoire is a maker unknown except by his signature on this instrument. He is likely to have been a member of the clockmaking family of Blois, perhaps the younger son of Jean I Grégoire, Antoine (b. 1635) and working at Blois from 1662, or a member of the following generation who had moved to Paris. The Grégoire family had commercial connections in Paris from at least 1649 when Jean I Grégoire distributed his products through his brother-in-law, Auger who was also a clock-maker. See E. DEVELLE, *Les Horlogers blésois au XVIe et au XVIIe siècle*, 2nd edition, Blois, 1917, 371. Thibaud FOURRIER, *Dictionnaire des horlogers de Blois*, La Garmonière, 2000, 33.

crowned CD monogram adapted from a jewellers' pattern book..<sup>33</sup> All of them use rich materials, brass, gilt-brass, ivory, lignum vitae, and all but one are richly engraved. There are however some differences within the group. Numbers I.1, I.4, I.5 are fitted with a wing-nut to adjust the focus. I.2, I.3, I.7, I.8, and I.9 however are all fitted with a knurled wheel placed at the top of the instrument in the plane of the plates which alters the distance between them by acting on a screw. A second important difference shown by numbers I.2, I.3 and I.9 is that the front plate (that carrying the lens), is hinged to the base block rather than being rigidly screwed to it. The plate is therefore under less tension when focusing is carried out. This mechanical advantage, together with the greater commodity of the gnurled screw suggests that the latter three instruments represent a slightly later design stage than those with wing nuts. Unfortunately this hypothesis is called into question by I.7 & I.8 which have knurled wheels but are screwed to their base blocks. I.5 is for the moment unique for here there is no base block at all, the plates being extended downwards in two single shaped pieces to form a handle through which they are screwed together.

If it is not yet clear whether the constructional differences of the extant Huygens' full-plate simple microscopes offer any dating indications or not, they do show that at the same time as Huygens' instrument was adapted to become a luxury good, it was also improved in its mechanical construction. At present little more can be said about this group of instruments nor very much about the maker of most of them, J. Pouilly. J.-D. Augarde<sup>34</sup> records a Jean Pouilly 'au Compas marin' in 1650, but if this is not a simple misprint for 1680, what his relationship with the maker of the microscopes may be is unknown. The earliest dated instrument by the latter is an mounted lode-stone signed 'De Pouilly à Paris 1680'<sup>35</sup>. This is an instrument of particular interest as Pouilly's new method of arming lodestones so that they were able to lift up to 200 times their own weight was mentioned in the *Journal des Sçavans* on 12

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<sup>33</sup> Nicolas VERIEN, *Recueil d'emblèmes, devises, médailles et figures hieroglyphiques... avec leurs explications. Accompagnés de plus de deux mille Chiffres fleuronez, simples, doubles & triples...*, Paris 1724

<sup>34</sup> Jean-Dominique AUGARDE, 'La Fabrication des instruments scientifiques du XVIIIe siècle et la corporation des fondeurs', in Christine BLONDEL, Françoise PAROT, Anthony TURNER & Mari WILLIAMS (eds), *Studies in the History of Scientific Instruments*, London & Paris 1989, 52-72 (72).

<sup>35</sup> Sotheby's, *Important Watches, Clocks, Barometers, Mechanical Music and Scientific Instruments*, London, 9 November 1999, lot 591.



May 1682. The following year a geometrical rod of his invention was mentioned, and in 1684 there was a report on a multiple drawing and topographical instrument by him. Yet another new instrument by him was described on the 19 March 1685. In 1692 he is listed in the *Livre commode...* where his method of arming lodestones and his microscopes are singled out for mention<sup>36</sup>. Pouilly was clearly an innovative maker, capable of original ideas, the design modifications found in the Huygens-type microscopes that he signed may therefore be attributable to him. That he was a specialist maker of lodestones may be no more than a reflection of the fascination that lodestones exerted, and of their fashionability, in late 17<sup>th</sup> century Paris, but if it implies that he was therefore in contact with another leading moulder of them, who had an extensive private collection —Michael Butterfield<sup>37</sup>— then the coincidence that both the best known makers of Huygens' microscopes were also adepts of lodestones, and that the originator of Huygens' design, Nicolas Hartsoeker acknowledged Butterfield as the source of most of the magnetic experiments that he included in his *Principes de physique*<sup>38</sup>, becomes interesting.

More than this cannot, at present, be advanced. A decade ago however it would have been impossible to advance even this much for in 1994 only five of the microscopes listed in Table 1 were known, and virtually nothing was known of Pouilly. The discovery of new instruments has been essential to the increase of understanding, but it is one which comes about through study of the instruments as a group, not as individual specimens, in association with all such textual sources as are available. It is a study also that has to be approached from outside the history of science strictly defined. Instruments in the late 17<sup>th</sup> century, as for all the Early Modern period and even later, belonged equally to the worlds of learning and of commerce. It is only by giving full weight to the exigencies of both that a truly scientific history of scientific instruments can be written.

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<sup>36</sup> Apart from his microscopes and the lodestone mentioned above, relatively few instruments by Pouilly are known. A sector dated 1681 was sold at Sotheby's 7 October 1994 lot 83, a recipiangle in the National Maritime Museum, Greenwich is dated 1686. Besides two undated graphometers known in private hands, there is a plotting instrument in the State Library of New South Wales, Sydney, Australia dated 1684.

<sup>37</sup> For a description of this 'mighty collection of loadstones to the value of several hundred Pounds Sterling', see Martin LISTER, *Paris in the year 1698*, edited by Raymond Phineas Stearns, Urbana, Chicago & London 1967, 82-93

<sup>38</sup> Paris 1696, 205-6.