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# “An Eye for an Optical Theory”<sup>1</sup>

## Science, trade and expertise in optical manufacture (Paris and London, c1760-c1830)

The story has been told many times<sup>2</sup>: during the second half of the 18<sup>th</sup> century, in Paris as well as in London, guilds ceased to be relevant in terms of technical knowledge and improvements (if ever were), while patent legislation gave innovators individual rights to balance costs of innovation. Christine MacLeod stressed how patenting could be part of an entrepreneurial strategy to escape from guild regulations, using Dollond’s patent for telescopes as typical<sup>3</sup>.

But if guilds lose their jurisdiction settle trade litigation, and litigation becomes public, who detain jurisdiction for litigation between tradesmen about innovation ? Do scientists, or judges have jurisdiction on inventors ? We know that trade experts appear. But how ? Asking this question also supposes to step aside from the classic account of technical progress by inventors, and to look at expertise *by the side*, and to dump the idea of inventors as trading inventions or science.

The idea is dumped because, in this paper, we consider expertise as part of a professionnalization process: within the trade of opticians some tradesmen became inventors, or improvers, while others just sold spectacles; some appear as professionals, and some have been seen as scientists. And all can pretend somehow being experts<sup>4</sup>. Beside, historians of the inventive activity have shown, the importance of inventors’ networks, linking inventors to scientists, to manufacturers and financial interests in the c1700-c1820 period. But, as well as inventions ask for expertise to determine the legitimacy of inventors’ claims, history of industrialization can use expertise on optical manufacturing as a observatory to look on technical and organizational changes. Experts and expertise are embedded in the process and networks of the inventive activity<sup>5</sup>. Of course, a capital city is a *topos* for expertise, because opportunity for such translations is only possible where technical, administrative and scientific interests can meet.

This paper examines first how a patent litigation surprisingly did arise a collective trade interest in Restauration Paris, opposing experts’ opinions. Then a parallel case, in mid-18th c. London, is reported , in order to understand what did

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<sup>1</sup> Nyman, *Draughtsman ’s*, 6

<sup>2</sup> Jackson, *Spectrum*, p. 99-108.

<sup>3</sup> MacLeod, *Inventing*, p.

<sup>4</sup> Abbot, *System*, p. 59-85. *Ibid.*, p. 98-111.

<sup>5</sup> Hilaire-Pérez, *L’invention*. Granovetter, “Economic Action”.

“decaying” guilds do. Finally we have a look on the State and scientific expertise in the improvement of Paris optical manufacture: we will see its ability to link trade to science and to state policy, and its inability to place optical manufacturing into a scientific or political "centre of calculation".

As Peter Greenaway's *Draughtsman's contract*, this paper tells stories about the power and failure of outsider's expertise, about an expert labour blurring – temporary – frontiers between trade, science and law, about the misuse of partnerships and the legitimacy of expert labourer to claim some property: opticians, manufacturer or inventors, cannot be understood without a network of contractual ties within the trade, and relationships with scientists outside the trade. This does not mean opticians are scientists or lawyers, but that some translation, ie the process of expertise – institutionalized or not – prepares and reveals the trade's evolutions.

### **Expertise in court: binocular points of view (Paris, 1824-1828).**

The starting point is the “lorgnettes-jumelles” case (i.e. binocular spyglasses), patented in 1825 by Lemière. The binoculars are inspired by those patented a few months before, in Vienna, by Voigtländer<sup>6</sup>. But the patent for importation and improvement is hardly granted that a counterfeiter is suited on May 10, 1825: the patented optician, Lemière, seizes two binoculars in the neighbouring shop of Derepas, who, following to the expertise of three opticians – chosen by the judge, Lemière and Derepas – is condemned on August 26, 1825 to the confiscation of the two *lorgnettes*, 400 francs of damages and a fine of 100<sup>7</sup>.

But selling lorgnettes-jumelles is probably very profitable: in december 1826, Lemière complains again to the Juge de Paix about Derepas<sup>8</sup>. This time the experts are not opticians but “mechanics-jewellers”: and their report is favourable to Derepas. Nevertheless, the judge again condemns Derepas, on the sole ground of the first expertise<sup>9</sup>. With much bravura in the face of grief, Derepas, this time, appeals: and for the next two years, naming “good” experts is the core of litigation between Lemière and his counterfeiters. The litigation grew even further in February 1827, with the beginning of another trial between Lemière and Bautain: Bautain was none other but the maker of the mechanic parts of the “lorgnettes-jumelles”.

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<sup>6</sup> Von Rohr, “Contributions”, p. 127

<sup>7</sup> ADP, D2U1 138 : 10th May 1825, 26th August 1825.

<sup>8</sup> ADP, D2U1 140 : 18th February 1826.

<sup>9</sup> ADP, D2U1 140 : 8th May 1826. ADP, D2U1 141 : 20th December 1826.

### **Experts before the court: a catalogue of (technical) truth-tellers.**

The 1825 expertise was made by opticians of considerable fame and experience in the trade. Two of them had been members of the *corporation des miroitiers-lunetiers* in the 1770s, and all were related to members of the guild. All were rewarded for their works by the State and acknowledged by various scientist-led institutions. And, during the French Revolution and the Napoleonic Era, they delivered telescopes and other instruments to the Army, the Navy and for the Chappe optical telegraph<sup>10</sup>.

Therefore, choosing them as experts in 1825 is far from being controversial. As prominent tradesmen, their knowledge seems sufficient to tell whether the patented improved binocular was new in trade. But do opticians really know? As a matter of fact, the second expertise of “mechanics-jewellers” shows that lorgnettes-jumelles cannot be understood as being of only one trade, as new *mechanic* parts are used by Derepas and Bautain since 1826.

The “jewellers” expert body, and the lengthy procedures opposing Lemièrre to his subcontractor Bautain, (a “jeweller-optician” as Bautain titles himself), demonstrates manufacturing binocular implies a coordination between different two trades (and different practical knowledge), as Lemièrre and Bautain do acknowledge. Most of the litigation is about finding the right experts: no less than three successive body of expertise have been named by the juge de paix of the 7<sup>th</sup> district in two years’ time.

Else is the will to find experts with a more official status: the first expertise in Lemièrre v. Bautain (1827), is that of Berthoud – chosen by Lemièrre, a scientific instrument and clockmaker as prestigious as Lerebours –, of Gambey (an instrument maker, chosen by Bautain –, and Molard – chosen by the judge, director of the Conservatoire des Arts et Métiers, a prominent figure of the French technology<sup>11</sup>.

Their expertise opposed that of 1825. It must have caused some embarrassment to the judge, who then called upon another body of experts: two scientists from the Académie des Sciences, Biot and Arago, and Lenoir, a prestigious instrument-maker<sup>12</sup> (who trained Gambey). This body of expertise could not give any useful advice: Arago refused to be expert, and Lenoir died. Therefore, in early 1828, three other experts were chosen: Gaspard Rochette, optician, Tremery, an engineer from the Corps des Mines, and Armonville,

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<sup>10</sup> Daumas, 1953, chap. 7.

<sup>11</sup> ADP D2U1 139, *op. cit.* D2U1 141, *op. cit.* BNF, *Mémoire pour M. Bautain*. BNF, *Mémoire pour M. Lemièrre*. ADP, D7U1 100 : 20th March 1827. D7U1 101 : 13th November 1827. D7U1 102 : 3rd May 1828 and reports dated 25<sup>th</sup>-28<sup>th</sup> June 1828.

<sup>12</sup> BNF, *Mémoire pour M. Bautain*.

secretary in the Conservatoire des Arts et Métiers. Rochette was chosen by Lemièrre, as it has been criticized on the behalf of Bautain... because Lemièrre was apprenticed to Gaspard Rochette. We do not know whether the judge named Trémery or Armonville, but either way this confirms the will of the judge to refer to an established authority, *out of the trade*, that authority of experts serving the State.

This “authority” would be parallel to that which delivers patents. Though the administration does not check for the novelty or reality of the invention, it carefully examines that memoirs and drawings had been deposited, so that the invention could add up to the public domain when the patent expires. For instance, Lemièrre did not obtain his patent for a lorgnette before giving drawings of his invention, joined to the specification. In early 1824, the “comité consultatif des arts et manufactures” also remarked that the invention of Bautain, submitted in november 1823, might be too close to an invention publicized in 1806 by an optician, Chevallier. As a matter of fact, academicians and “technologists” from the Ministry or the *Conservatoire des Arts et Métiers*, such as Molard himself are members of the very same *Comité consultatif*<sup>13</sup>: the second expert college in *Lemièrre v. Bautain* mirrors the *Comité consultatif* by its composition. Therefore, the experts “off the trade” are not only “neutral” or “objective” because they cannot gain profit the judgement: but also because, as civil servant, professor or scientist, they belong to the authority who did not reject Lemièrre’s application for a patent.

Such expertise also mirrors the importance of “savants” in the French Administration since Turgot, and further magnified during the Revolution. But, before a civil court, the strategy of the patentee and of the counterfeiter is more important than naming the “best” experts. And mobilizing scientists and opticians as his allies is a key to understand Bautain's success. Looking up (politics, science) is not enough, the expertise makes really sense in the tradesmen’s own context.

### **A trade of innovators ? From friendship to litigation *via* partnership**

Bautain, appealing after the 1827 judgement, has a two-fold strategy. First he improves the binoculars to escape Lemièrre accusation of being a counterfeiter<sup>14</sup>. In the other hand he bonds himself to other opticians: he provides them with jumelles and guarantees to support any legal cost; in doing so, he stands, at least legally for the whole trade. And, before the courts most of his efforts is about finding expertise that would oppose the first expertise (opticians’) and support the second expertise.

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<sup>13</sup> INPI, Patent file n°2341.

<sup>14</sup> BNF, *Mémoire pour M. Bautain*. BNF, *Mémoire pour M. Lemièrre*.

Before the judge, Bautain's lawyer also brings home-made expertises: about the relationship with Lemièrè, and about the trade of lorgnettes. Bautain's lawyer insist on what his client really is to Lemièrè, a former partner in innovation: Bautain reminds the judge he was patented in 1824 for a screw used in the binocular (but is the screw new to the trade?). In this prospect, it is very important to Bautain not to be seen as a worker, as Lemièrè tries to describe him ("son ouvrier"). As a former partner, Bautain claims some rights over the patent. To oppose this, Lemièrè displays his accountancy to demonstrate how much he paid for the work of his "worker": but are these sums – dozens of annual average worker's revenue – wages ? Even if the partnership cannot be proved, Lemièrè's pleading confirm the patent was the work of at least three people : Lemièrè himself, Bautain who obtained the patent on the behalf of Lemièrè, using his own experience from his 1824 patent, and an "ingénieur-opticien", Magnien who made the drawings joined to the specification.

To describe the trade of lorgnettes, Bautain pays a few visits to astronomers of the Royal Observatory to produce a counter-expertise. Mathieu and Arago sign two certificates which admit that Lemièrè's lorgnettes are not new in the trade. In fact, they just compare the *jumelles* to the content of 17<sup>th</sup> century treaty, already used by Derepas in 1825 without success<sup>15</sup>.

Bautain also uses other opticians' opinion. First, he obtains a certificate from the self-named "ingénieur Chevallier", optician and prominent scientific instrument makes. This certificate says that a similar binocular "lorgnettes" was described in a booklet published in 1806 by Chevallier<sup>16</sup>.

More important is that Bautain also obtains certificates from the 1825 expert opticians. One is pretty vague... but signing a certificate in favor of Bautain is already a move away from "expert" neutrality. But the certificate of Cauchoix is boldly pro-Bautain: Cauchoix suddently reminds the shop of his father-in-law, after his death (in 1797)... and affirms there was a binocular in the shop, even though, as an expert, he agreed in 1825 to say it did not exist before Lemièrè<sup>17</sup>.

In February and August 1828 Derepas and Bautain eventually succeed and Lemièrè's patent is vacated, for having used a part described in Bautain's 1824 patent. The striking importance of relationships between opticians and other manufacturers ("jewellers", "mechanics"), of specialization and subcontract (such as between Lemièrè and Bautain) is not antagonistic to some common interest. Of course, one can stress material interests: vacating the patent cut the price of "jumelles" fivefold. But we can also take into account these expertises brought before the court, and the fact that tradesmen have not been excluded from expertise on the ground of "objectivity"; Bautain and Derepas were even

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<sup>15</sup> P. Chérubin d'Orléans, 1671.

<sup>16</sup> BNF, *Mémoire pour M. Bautain*.

<sup>17</sup> Ibid.

supported by the *Procureur du Roi*<sup>18</sup>. Bautain's victory means tradesmen still held much of the legitimate technical knowledge. And the many relationships between tradesmen that are revealed during the case, between opticians, is also to be taken account to understand the patentee's weakness.

One general explanation could be that, twenty-five years after the abolition of guilds, there is still some cohesiveness between men of the same trade, inherited from the Old Régime, or caused by the decentralized organization of the trade<sup>19</sup>. The vacating of the patent helps to regulate, equalize intra-industry transaction costs, prices and confidence between opticians; it denies a monopolistic rent to only one tradesman. All that looks much as a success of a guild (a *rent-seeking* or *cost-cutting* body ?) against the so-called innovator<sup>20</sup>. An interesting comparison could be made by expertising the Dollond's case in 18<sup>th</sup> century London, a capital city with a decaying guild system.

### **Expertise, Invention and Guild (London, 1763-1819).**

Dollond's trials are a *topos* of history of science and of legal history<sup>21</sup>. But the issue we focus on here is how guild and patent can both live along, and survive their apparent conflicts.

Peter Dollond opposed the major part of London opticians to establish his monopoly on the sale of achromatic object-glasses – a true revolutionary progress in scientific instrumentation. Dollond's case is usually understood as “another sign of decay” of the London guild organization thus linking scientific progress to new legal environment (patent law). The Spectacle Makers Company (SMC), in mid-18<sup>th</sup> c. London, was the most important – though not holding a monopoly – company producing scientific instruments (for navigation, scientific activity or amusement) as well as spectacles and optical toys.

Peter Dollond defeated it thanks to his father's patent. But if so, how to account for the Dollond family rule over the Spectacle Makers' Company many decades *after* the patent expired ?

### **Inventor and guild beyond legal case report**

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<sup>18</sup> « Procès Lemièrre c. Derepas ... », *Gaz. Trib.*, 17th January 1828. « Procès Lemièrre c. Bautain... », *Gaz. Trib.*, 14th August 1828.

<sup>19</sup> Sonenscher, *Work and Wages*.

<sup>20</sup> S. R. Epstein, « Craft Guilds... », p. 705-707.

<sup>21</sup> King, *History*, p. 144-155, from Court and von Rohr, *Transactions of the Optical Society*, 30, 1929, p. 207-260. The recent Sorrenson, 2001, 31-55 must be taken cautiously, as it refuses to consider the trial being himself part of the lengthy evolution of the patent law.

Like Lemière's case in 1825 Paris, Dollond's troubles in mid-18<sup>th</sup> century London are not solely about suing counterfeiters. Again, litigation starts with the break of a partnership. So it is helpful to try to understand its organizational consequences, and then the "decay" of the SMC will be discussed. The story is not that of a progressive individual against an archaic and anti-capitalistic institution: for instance, while preparing to oppose Dollond's patent in the Privy Council, the SMC, led by Dollond's opponents, decided to allow its members to take as many apprentices as they want.

The litigation begins in 1763, five years after his father's patent being granted with the ending of a partnership between Peter Dollond, foreign brother of the SMC, and Francis Watkins, free of the same Company. The articles of copartnership provided Watkins would support the financial cost of the administrative procedure, and then would be allowed to sell the object-glasses patented in the name of John Dollond<sup>22</sup>. The partnership broke up in 1763, two years after the death of John Dollond, because Peter Dollond – foreign brother of the Spectacle Maker Company since 1755<sup>23</sup> – wanted another way of dividing profits. He paid Watkins £200 for his share of the partnership<sup>24</sup>.

But Watkins continued to sell achromatic object-glasses, and was sued by Peter Dollond. Two other spectacle-makers, Henry Pyefinch and Addison Smith, were sued, who were none other but former apprentices to Francis Watkins. Addison Smith was in a partnership with Watkins, a partnership that seems to have succeed Watkins' and Dollond's.

In autumn 1763, Watkins, formerly warden of the company, a rarely presents as an assistant, was elected Master of the Company though being far from a regular guild *cursus honorum*<sup>25</sup>. At that moment, Watkins was already sued by Dollond.

Watkins being Master, the Company ordered a petition to the Privy Council, to be written in order to vacate Dollond's patent<sup>26</sup>. The SMC paid an attorney to submit the petition, signed by members of SMC, and also by non-members. Thus the SMC admitted not to have, *by itself*, jurisdiction over litigation between members of the Company, even if the patent was a blow to many of its members. Besides, the petition is signed by instrument makers belonging to other companies. *But* the petition argues on the ground of the interest and expertises of

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<sup>22</sup> GL, Ms 14805.

<sup>23</sup> GL, Ms 5213, vol. 3, f°207.

<sup>24</sup> PRO C12/1956/12, "Bill of Complaint of Peter Dollond".

<sup>25</sup> GL, Ms 5213, vol. 3, "At a Court of Election... held on Wednesday the 5<sup>th</sup> day of October 1763"

<sup>26</sup> *Ibid.*, "At a General Quarter Court held... on the Thursday 28<sup>th</sup> June 1764"

a trade (i.e. scientific instrument making) rather than on the behalf of the sole company, an interest acknowledged the 1623 Statute of Monopolies<sup>27</sup>.

Two signatures are specially interesting: that of George Bass, a prominent assistant (formerly warden and master in the 1750s) of the SMC Court, said to be “the maker of the aforesaid [i.e., achromatic] glass in the year 1733”, and that of “Robert Rew who in 1755 in-formed Mr John Dollond of the construction of the compound object glass”, also a almost-always-present assistant to the Court<sup>28</sup>.

The text itself tells much about the invention, manufacture achromatic glasses before Dollond. The argument – parallel to the pleadings of individual defendants sued by Dollond – is four-fold: 1° John Dollond was not the first inventor, 2° as a public trade of achromatic telescopes existed before him, 3° the patent had to be vacated because Dollond was endangering a whole trade, and 4° because of the vagueness of the specification. Was “the principle reduced into form and practice”<sup>29</sup> in the specification? Though it has been argued that principles were legally patented during the 18<sup>th</sup> century, one can observe Dollond did argue the patent was not only about a vague principle but a about a manufacture. Here, it suffices to be said that a few years later Lord Mansfield’s jurisprudence in *Liardet’s case* (1778) was that an patentee “must specify upon record [his] invention in such a way as shall teach an artist, when you term is out to make it – and to make it as well as [the patentee] by [the patentee’s] directions”<sup>30</sup>.

In autumn [Trinity Term] 1764, an order of court is issued to decide the case *Dollond vs. Watkins & Smith* by arbitration of James Short, a telescope-maker, FRS, who did not belong to any guild. Short decided that Dollond had to pay to Watkins for the object-glass he still possessed “at the price that prevailed when they were made”<sup>31</sup>. This is a recognition that Dollond, acting as a monopolist, had already raised dramatically his prices: as a matter of fact, from 12 sh. according to the partnership for a 2ft-telescope, it soared to £2 and 2 shillings in 1765<sup>32</sup>.

According to Lord Mansfield, Chief Justice of the King’s Bench, the patentee was the first to sell achromatic glass to the Public – while the first inventor, a lawyer, just kept it “in his closet”<sup>33</sup>. Lord Mansfield seemingly considered the specification to be sufficient to prove the patent to be well-founded<sup>34</sup>. However, if

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<sup>27</sup> PRO PC 1/7/37

<sup>28</sup> *Ibid.*

<sup>29</sup> Robinson, “James Watt”, p. 118-125, *pro* patented principles. *Contra*: Chief Justice Eyre, quoted in Hayward, p. 172. The legality of Dollond’s patent as patent for a principle is still a matter of discussion during Watt and Boulton’s case. Mossof, 2001, p. 1311-1312.

<sup>30</sup> Hulme, “Patent Law”, p. 285

<sup>31</sup> PRO C12/1956/12, “Answer of Addison Smith”.

<sup>32</sup> PRO C12/1956/12, “Answer of James Champneys”

<sup>33</sup> Mr Justice Buller, quoted in Hayward, p. 172.

<sup>34</sup> PRO KB 122/321, roll 109-111.

Watkins and Smith (his partner) were found guilty by the jury in 1764, they were condemned to pay only 1 shilling for damages, rather than £500 asked by Dollond: a very light condemnation, probably inspired by James Short arbitration. Pyefinch was not condemned as he reached an agreement with Peter Dollond<sup>35</sup>.

In 1765, Dollond issued a new bill of complaint before the Court of Chancery against five opticians who signed the petition (among them, of course, Watkins and Smith). The defendants argued again that John Dollond's object glass was nothing but that invented by the optician George Bass (following a lawyer's instructions), and sold by William Eastland since 1762 (one defendant, petitioner and assistant to the court of the SMC). They explain that John Dollond heard about achromatic object-glasses in a discussion in James Ayscough's shop<sup>36</sup>. There is no report of these trials, except that one optician was forced to bankrupt after a condemnation to £500 for damage.

In 1767, Dollond sued Pyefinch, in spite of their prior agreement<sup>37</sup>. Pyefinch was condemned, and, in the same way that *lorgnettes* counterfeiters (Bautain in 1827)<sup>38</sup>, he was granted a patent a few years later for a "refractive telescope" – for which Dollond's patented object glasses had been designed : a reminder that patent law is not only for the sake of inventors, but also for "improvers" that might be also imitators<sup>39</sup>.

### **Spectacle Makers: a company without jurisdiction ?**

Dollond's legal success may be explained by his institutional position. Even before taking his patent, John Dollond's work had been acknowledged by the Royal Society as early as 1753. In June 1758, just after the granting of the patent in, he showed his achromatic object-glass before the Royal Society and obtained its most prestigious award, the Copley Medal. He was then made a FRS in February 1761. Therefore, it cannot be said that Dollond did not reveal into the public sphere his achromatic telescopes: a scientific examination, a scientific expertise of his telescope acclaimed his work – though, after the 1760s trials scientists had more than doubts about Dollond's priority in achromatic glasses.

The expert discourse the SMC tells another story about achromatism. The petition and "answers" of defendants to Dollond's complaint, are much about the

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<sup>35</sup> PRO C12/2071/11. "The further answer of Peter Dollond to the Bill of Complaint of Henry Pyefinch, 17<sup>th</sup> November 1768"

<sup>36</sup> Ibid.

<sup>37</sup> PRO C12/2071/11. "The further answer of Peter Dollond"

<sup>38</sup> INPI, file n°3197, [Bautain's] *Brevet d'invention et de perfectionnement pour un binocle à tirage simultané* [26th march 1827-18th may 1827].

<sup>39</sup> *Chronological*: "Constructing and making refracting telescope with object-glasses, n°976, 28<sup>th</sup> December 1770".

cooperation between opticians and an “amateur de sciences”, about subcontracting and minute specialization within the optician’s trade. Every optician cited in the petition or the defendants’ answers are assistants to the Company’s court, former Warden or Master. They meet each other in one’s shop and talk about technical issues. The petition conveys a collective, insiders’ knowledge of a very different nature.

While Dollond’s object-glass belongs to an institutionalized “open knowledge” such as the *public* demonstration or the *legal* patent specification attached to the only name of Dollond, the achromatic object-glass made in 1733 belongs to a different universe: that world of subcontracting and cooperative artisans whose shop was not only a place to display objects more or less standardized, but also a place for teaching each other and a place for meeting needs & ideas of amateurs and scientists, or even colleagues<sup>40</sup>.

Dollond’s business plan is quite different: it supposes the exclusion of others optician: one shop, one business, one optician. In the 1760s, his business rely on the reputation of *one* specialized and patented invention. Though Dollond’s success rest on the international circulation of scientific knowledge (i.e., Dollond know how to make the best telescope), is not mirrored by a circulation of Dollond knowledge and production between opticians. James Short is an exemple of a similar business organization: though being a FRS, and part of philosophers’ society, he refused to reveal his grinding methods until his death (described in a sealed envelope given to the Royal Society)<sup>41</sup>.

Conversely, the defeated opticians’ petition express a collective knowledge of *prior ars*, of the previous invention of achromatic object-glass, through a collective “open knowledge” ...open only to spectacle makers. And though we cannot account pleadings for plain truth, we might parallel Watkins’ strategy to Bautain’s, appealing to the opinion of a community of tradesmen.

Nevertheless, the patentee is not to oppose the trade company forever. From 1769 “he started to attend guild meeting regularly, became a member of the court of assistants [...] rarely missed a meeting for the rest of his life”<sup>42</sup>, and was elected warden. The 1759 patent expired (in 1773), he is elected master of the SMC in 1774, 1778 and 1779. As a matter of fact, the Dollond family continued to play a leading role in the SMC for the next century.

It was not completely disinterested. For example, his influence over the Company is quite obvious when, Dollond being master in 1774, Watkins and Scarlett were sent accounting of their overdue quarterage since their last

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<sup>40</sup> Bennett, “Shopping”

<sup>41</sup> Short, “A Method”

<sup>42</sup> Robischon, *Scientific*, p. 282 ?

attendance in 1764. In 1781, Dollond serving again as master, the Court decided to pay a solicitor in order to sue Watkins<sup>43</sup>.

But does it mean the SMC became a purely “decorative” body of Dollond’s economic power? A petition to the Parliament prepared in 1817-1818, against a bill that would give to clockmakers a monopoly on some scientific instruments reveals that the SMC was still an institution interested in the optical trade. The litigation originates in 1812, by the refusal of an instrument maker to join the Clockmakers’ company. But the Spectacle Makers’ petitioning, the lengthy litigations and discussions within the Company’s court, prove that it still had some credit to produce jurisdictional claims, in technical and organizational issues<sup>44</sup>.

So, if it is obvious the guild system did not survive the 18<sup>th</sup> century as monopolistic, the transition from guild to capitalistic organization was not completely over by the 1810s. And the SMC’s 1764 “expertise” must not be looked up only as the disguised wording of Watkins’ interests, but rather understood as mirroring a collective knowledge and interest, as opticians from Paris expressed against Lemièrre in the 1820s.

## **Experts, Science and Improvers in Optics (Paris, 1795-1811).**

The *Manufacture nationale des lunettes achromatiques* and the many incentives to the optical manufacture during the French Revolution and the Napoleonic era illustrates a technological policy rooted in the last decades of the Ancien Régime<sup>45</sup>. Acting as experts, scientists were regularly commissioned to review inventions or new manufactures, representing literally *la Raison d’Etat*. The optical industry, like the gun industry which technical and organizational story has been explored seems to have escaped away from a scientific project of a national, rational and centralized manufacture<sup>46</sup>. One must not be blind to the efforts of opticians themselves by an intense, and polymorphic expertise activity.

### **Engineering the french revolution... in optics**

The French Revolution accelerated the changes in relationships between men of practice and institutional knowledge: the Royal *Académie* was suppressed, and

<sup>43</sup> GL, Ms 5213, vol. 3, “At a Court of Assistants of the Worshipful Company of Spectacle Makers held... on Thursday the 30<sup>th</sup> June 1774”. Ibid., “At a general court holden ... on Thursday the 29<sup>th</sup> day of March 1781”.

<sup>44</sup> McConnell, *Bate of the Poultry*. GL, Ms 5213, vol. 4.

<sup>45</sup> Gillispie, 1980. Brian, 1994.

<sup>46</sup> Alder, *Engineering*.

artisans, promoted to the name of “artists”, received a benevolent attention from the administration. One obvious example is Carochet, “artiste” to the Bureau des Longitudes. His role was not only to repair and make instruments for the Bureau, in the Observatory, but also to give his point of view on instruments to be purchased, as a man of practice.

Others, like Gaspard Rochette or Putois, were rewarded for masterpieces submitted to a specialized committee<sup>47</sup>: a rewarding procedure than can be compared to some late Old Regime procedures within the Academy. Its aim was to enhance the merit of artisans or manufacturers, improvers or innovators. It was not to look after the trade organization. The selected elite, beside, was also similar to that of the *Ingénieurs du roi pour les instruments d’optique, de mathématique et de physique*, a company created in 1787 against the guild system, only to help the scientific community to obtain better instruments more easily. Conversely, Putois, optician, hoped in Lavoisier or Fourcroy, and expected “géomètres” to calculate appropriate curves for grinding lenses to be used in achromatic object-glasses<sup>48</sup>.

But the military needs and the Chappe telegraph paved the way for another relationship between the State, science and tradesmen. In vendémiaire An III, a *Ponts-et-Chaussées* engineer, self-trained in optics, Fréminville submitted to the Comité de Salut Public his project to create a national manufacture of achromatic telescopes. At this moment, not only was France in war with Britain, where had been produced almost every achromatic telescope since 1758, but the production of the necessary flint-glass had completely ceased in Britain. So Fréminville planned to manufacture flint-glass and achromatic telescopes from the grinding of the many *cristaux* the State seized from *émigrés* belongings. Also he proposed to experiment new methods for making flint-glass: the aim of the manufacture was to produce achromatic telescope for the navy, the army and the new Chappe telescope<sup>49</sup>.

The project was supported by the *Comité de Salut Public* (CSP). The workshops were regularly scrutinized by experts on the behalf of the CSP or other specialized committees. The astronomer Delambre, former member of the Académie, was always a leading member of these expert bodies. As the workshop suffered from labor shortage – Fréminville needed some help from the Comité de Salut Public to get two of his workers *requisitionnés* back in – and raw materials shortages, this supportive monitoring was more than necessary<sup>50</sup>. In Year IV, it

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<sup>47</sup> AMAM, P 45, Rochette. Ibid., P 197, Putois.

<sup>48</sup> *Ibid.* : « Les CC Lavoisier et fourcroy sont bien en état de Résoudre cet intéressant problème ; Et les Géomètres s’empresseront Sans doute, de donner une formule simple et à la portée de tous les Artistes pour exécuter des objectifs de tous les foyers possibles ».

<sup>49</sup> AN, F<sup>12</sup> 2425

<sup>50</sup> AN, F<sup>12</sup> 1534

seems the manufacture of glass had been separated from the instruments workshop, and directed by Besson and Catoire: Besson was a former member of the Convention, and twice a member of monitoring committees<sup>51</sup>.

In 1797, the manufacture of flint-glass, submitted a piece of flint-glass that Carochet, optician from the Board of Longitudes, tried and found it able to make good achromatic lenses: therefore, acting as an expertise body, the Board gave a favourable report<sup>52</sup>. In the same time, Fréminville had been charged by the Navy to improve every telescope from the “dépôt de la Marine”, and worked also for the Chappe telegraph, and possibly for the Army<sup>53</sup>. But did the success of the expert manufacture of Fréminville, constantly scrutinized by expert savants made men of the optical trade, “opticiens” or “lunetiers”, completely useless? that Parisian trade that Cassini described as so miserable compared to the Londonian instrument makers?

### **Hands-on, hands-in and hands-off expertise**

Of course, the answer of experts committed by the Navy in Messidor, Year IX, to compare telescopes of Fréminville and those of Lerebours is not straightforward. Comparing two telescopes of each optician, they concluded Lerebours produced sometimes a better objective lens than Fréminville's, but Fréminville's oculars were always better than Lerebours'. Therefore, if Fréminville seemingly produces the best telescopes,

« ...néanmoins pour les progrès de l'art, la Commission pense qu'il serait avantageux d'établir pendant quelques temps une espèce de concurrence entre ces deux artistes, en accordant à chacun une fourniture proportionnée aux besoins du service et à leurs talents réciproques. La Commission se chargera volontiers de rendre compte au Ministre, d'après la vérification et l'examen qu'elle fera de chaque lunette, du mérite des fournitures qui seront faites. Elle entretiendra par ce moyen entre ces deux artistes une émulation qui ne peut tendre qu'au bien du service, et aux progrès de l'optique »<sup>54</sup>

The advice can be read in two ways: first, the expert committee, made of scientists who made a career in the various Revolutionary expert committees, see itself has a tool for improvement of industry: this is hardly surprising after years

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<sup>51</sup> AN, F<sup>12</sup> 2435

<sup>52</sup> Feurtet, *Bureau des Longitudes*, p.

<sup>53</sup> AN G 96, « Lettre du citoyen Fréminville, directeur de la manufacture de lunettes marines au Ministre de la Marine, 21 brumaire an 6 » [November 11<sup>th</sup>, 1797].

<sup>54</sup> Ibid., « Rapport de la commission chargée par le Ministre de la Marine et des Colonies de l'examen des lunettes acromatiques proposées par le C<sup>em</sup> Fréminville et Lerebours pour le service des signaux ».

of a government that had been much that of specialized committees. The fact the report goes way beyond a simple choice between two makers reveals the experts' consciousness of their role in governmental action: they suggest a policy, not only a price-quality ratio<sup>55</sup>.

Secondly, as those experts do not want to reduce the optical industry to one expert manufacturer (a *ingénieur des Ponts et Chaussée*, and Prony's brother-in-law), whose efforts has been supported and monitored for years by the State and members the Institut National. The Fréminville manufacture, whatever its merits and the State support, do not produce something that will remain out of reach of private industry. And of course, the advice suppose to maintain a monitoring the expert body.

Fréminville's role as expert did evolve from that of expert manufacturer to that of an expert adviser. Besides, he was also a regular *ingénieur des Ponts-et-Chaussée*, being in charge of street paving ["le pavé"] in Paris, as a chief-engineer<sup>56</sup>. It may be that, after c1800, Fréminville merely cooperated with the existing trade: the to-be famous Louis-Vincent Chevalier is known to have been one of his subcontractor, working as a *chambrelan*<sup>57</sup>. Therefore, the production of Fréminville "manufacture" was not as centralized as his first memoir and the experts' accounting reports did suggest.

This is obvious in 1809-1811, when for a couple of years, Le Creusot glassworks eventually delivered flint-glass, after academic expertise, to Paris opticians. Fréminville is part of the academic process of monitoring<sup>58</sup>. But as a manufacturer he is just one of the five opticians who bought more than 10 kg. But while Lerebours bought more than 82 kg, and Jecker over 50 kg, Fréminville bought a little more than 22 kg<sup>59</sup>. This is a hint that optical trade in Paris mainly relied on the private industry.

An example of the persistence of a private, innovative industry is Jecker's manufacture: probably the biggest works in French scientific instrumentation, and also important because it appeared to members of the Académie des Sciences to be a paramount of rational organization of production through the division of labour<sup>60</sup>. Two comments must be made : first, the technical knowledge of Jecker was partly the result of his own training (which started in his uncle's shop in Besançon) and journeys to two major capital cities: Paris, where his talent brought him into the King's locksmith shop, and London, from 1784 to 1794. It is there that Jecker learned from working in Ramsden's workshop – Dollond's brother-in-

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<sup>55</sup> Bret, *L'Etat*.

<sup>56</sup> AN, F14 2228, Elisabeth-Théodore Fréminville's personal file.

<sup>57</sup> Chevalier, *Étude*.

<sup>58</sup> *Procès-Verbaux*, vol. IV (1808-1811), p. 188-190

<sup>59</sup> AN, F12 2425, f° 157, f° 176, f° 192-196, f° 207.

<sup>60</sup> L'Evêque, « Rapport... », p. 263.

law and most famous scientific instrument maker in his generation – much of what made him able to construct his dividing engine in Paris, and may be also to organize his manufacture according to division of labor<sup>61</sup>. How could scientific expertise be useful to him ? It was not about a scientific advice nor collecting any shop-floor innovation, as it can be read in the report of the academic committee visiting Jecker's manufacture and his new dividing engine:

« Aucune machine connue ne présente autant de difficultés d'exécution, et n'exige plus de soin et plus d'adresse. Vos commissaires n'ont pas jugé nécessaire de prendre connaissance du procédé employé par l'artiste, [...] et encore moins de le discuter. »<sup>62</sup>

In fact, Members of the *Académie*, in this report, promote a manufacturer's talent, and do not try to understand, that is, to publicize, any technical knowledge. Trade and technical secrets are kept within the realm of workmanship; the scientific instrument industrialist has his own expertise, and his *secrets* can be kept secret by the public authority of science.

The limits of philosophers' expertise are also self-evident in flint-glass manufacturing. While in the late 1820s, flint-glass could be produced near Paris (Choisy-le-Roy) only because Guinand, son of the glassworker who worked under Fraunhofer in Bavaria, in London, the scientific committee in charge of experimentations (led by Faraday) on flint-glass completely failed<sup>63</sup>. Conversely, in Paris, opticians continue to present their production, even non-scientific, such as spyglasses, to gain a commercial advantage<sup>64</sup>.

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In Paris and London, expertise, though having a role in major evolutions within the optical trade, is not synonymous with a growing power of scientist over manufacturing: “chasing sheep is best left to shepherds”<sup>65</sup>.

Obviously centres for optical innovation between 1750 and 1830, Paris and London are such because of existing scientific and trade networks, rather than because of scientists' calculations<sup>66</sup>. Patent law and scientists' involvement have

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<sup>61</sup> Daumas, *Les instruments*, chap. 7.

<sup>62</sup> L'Evêque, p. 272.

<sup>63</sup> Jackson, *Spectrum*, p. 143-177.

<sup>64</sup> On Cauchoix's and Lerebours' *lunettes de spectacle*, resp. : *Procès-Verbaux*, vol. VI (1816-1819), p. 6-8. Ibid, p. 131.

<sup>65</sup> Nyman, *Draughtsman's*, 1.

<sup>66</sup> Latour, *Science*, « Action at a distance ».

not yet reduced manufacturing's principles into form and practice, into calculations enrolled in scientific periodicals, or, in patents, in spite of philosophers' demand, in spite of scientists' involvement. And the expertise, like professionalization process moves along these networks, rather than across them, as well as reason in tribunals eventually did rest its case mainly thanks to practical men<sup>67</sup>.

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<sup>67</sup> Ibid., « Insiders Out ».

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