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Obtaining a Royal Privilege in France for the Watt Engine (1776–1786)

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Based on unpublished correspondence and legal acts, the article tells an unknown episode of Boulton and Watt's entrepreneurial saga in eighteenth-century Europe. While the Watt engine had been patented in 1769 in Britain, the two associates sought to protect their invention across the Channel in the 1770s. They coordinated a pragmatic strategy to enrol native allies who helped them to obtain in 1778 an exclusive privilege from the King's Council to exploit their engine but this had the express condition of its superiority being proven before experts of the Royal Academy of Science. As comparative trials could never take place, the privilege proved useless. The French adventure was all the more a failure because two former allies, the Périer brothers, misused Boulton and Watt's trust and used their know-how and connections to sell counterfeits of the Watt engine. This unfortunate episode contrasts with Boulton and Watt's well-known success story in England and suggests the redrawing of the general picture of technology transfer from Britain to France in the Age of Enlightenment.

KEYWORDS Watt engine, royal privilege, patent, technology transfer, eighteenth-century Europe

Introduction

The Watt engine represents one of the central technological items of the modern era on account of the role it has played in the 'industrial revolution' in Europe.¹ James Watt (1736–1819) has thus become the archetypal inventor of the Enlightenment, integrated into popular mythology.² Since the technical innovation, patented in 1769 in Britain for a period of twenty-five years, only met with commercial success after Watt's association in 1775³ with Matthew Boulton (1728–1809), an entrepreneur from Birmingham, it is regarded as a textbook case for the historiography of technology.⁴ The steam engine market was previously dominated by the Newcomen engines which were developed in the early eighteenth century by the Devon ironmonger Thomas Newcomen (1664–1729). These were primarily used to drive water pumps draining coal and metal mines. Boulton and Watt's first prototype functioned in 1775 in the

region of Birmingham. The two partners then implemented a commercial strategy of charging not for the sale of the engines, but for the coal they were saving in the process. Backed by their ownership of invention, they granted licences in Great Britain in exchange for their technical expertise. In other countries, the strategy of licensing was ineffective in the absence of patents effective in those countries. There was, nevertheless, a potential market on the continent as evidenced by the flow of requests for information. It was from France that the greatest number of approaches to Boulton and Watt were sent.⁵ These requests sometimes concealed dishonest intentions. Indeed, the ‘pirates’ were trying to gather information in order to build Watt engines and then to sell them without a licence.⁶

The story that follows gives an account of Boulton and Watt’s attempts to secure a right of invention in France for their engine in the late 1770s. After recalling the situation of steam engines in Great Britain around 1775, it sets forth Boulton and Watt’s strategy to obtain, with help from the ‘allies’ of circumstance, an ‘exclusive privilege’ from the crown of the kingdom of France. A judgment of the King’s Council was handed down to that effect on 14 April 1778, but it included a proviso which would make it impossible to exploit. Due to its historic importance and novelty, we shall dwell for a longer while on the text of this judgment before proceeding to emphasize the consequences it has had for the market of the Watt steam engines in France.

This episode is important for several reasons. First and foremost, it is a highly documented empirical case, which cites a number of new or little-known sources. It provides a rebalancing in relation to more general studies of international comparison, which, despite their undeniable value, lack that ‘human flesh’ that is the delight of the historian who resembles the ogre portrayed by Marc Bloch.⁷ The story particularly shows how the interests of different protagonists varied with the circumstances and how today’s allies, after being apprenticed, become tomorrow’s competitors. Such a story in which Boulton and Watt appear ill-at-ease on French soil also allows us to reconsider the *success story*, as well as the foresight of the Boulton-Watt pair, in context. It supplies this way the general comparative studies with information on the French and British systems in the Age of Enlightenment⁸ by highlighting the cultural grey areas that the two Britons crossed in moving from the system of patents, which they knew well, to the system of royal privileges, which they understood only in approximate terms. Finally, this ceaseless circulation of letters, of knowledge, of building parts and of people across the Channel emphasizes the complexity of the innovation process and the fragmentation of the objects and the know-how involved.

The ‘Fire Engines’ in Great Britain around 1715

The Newcomen ‘atmospheric engines’

Around 1775, there were already between five and six hundred ‘fire engines’ in Great Britain.⁹ The majority consisted of engines of the Newcomen type.¹⁰ Drawing on the ideas of Denis Papin (1647–1712) and Thomas Savery (1645–1715), Thomas Newcomen manufactured around 1710–12 the prototype of a ‘fire pump’ using atmospheric pressure to raise the pump rod.

In the rest position as illustrated in Figure 1, the counterweight (K) acts through the beam to put the piston (D) in the raised position. The coal- or wood-fired water boiler produces water vapour (A) to fill the cylinder (B). When a jet of cold water is injected into the cylinder, the water vapour condenses, the pressure within the cylinder drastically decreases and the external atmospheric pressure pushes the piston downwards — hence the term ‘atmospheric engine’. The branch (F) of the beam is then in the lower position. This cycle produced mechanical energy which operates a water pump connected to the chain (I).

The first Newcomen engine was operated in Staffordshire, either in Tipton¹¹ or two kilometres away in Dudley,¹² driving a water pump to drain water from a coal mine. It seems that, starting from 1717, the Fire Engine Proprietors Company exploited the patent obtained by Newcomen in 1712.¹³ When the patent expired in 1733, at the end of the twenty-year legal period, ninety engines of this type had already been built¹⁴ and their number rose to a few hundreds in the 1760s.

The ‘new invented fire engines’ and the association with Boulton

During the winter of 1763–64, the professor of natural philosophy at the University of Glasgow, John Anderson (1726–96), bought a small Newcomen engine, which

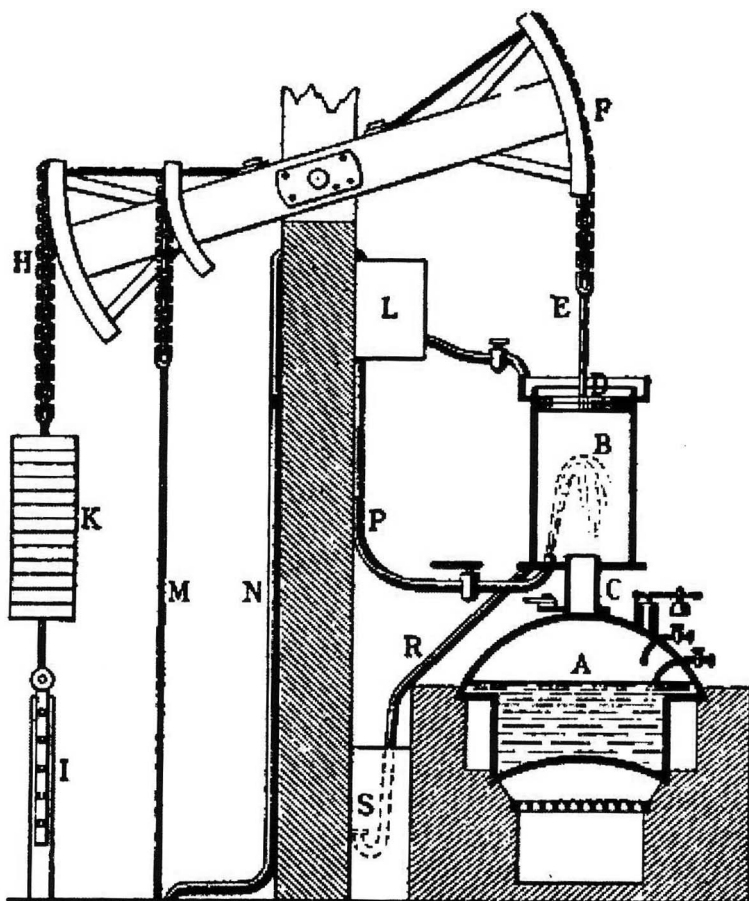


FIGURE 1 A schematic of a Newcomen engine (Meyers *Encyclopedia*, 1890).

proved defective. He commissioned a young independent instrument maker, James Watt (1736–1819), to repair it. It was probably at that time that Watt had the idea of improving the Newcomen engine by equipping it with a ‘separate condenser’ below the piston, on the left in Figure 2.¹⁵

Condensing the water vapour outside the cylinder had the advantage that the cylinder walls are not cooled and then reheated with each cycle. Watt introduced a second modification to the Newcomen engine: instead of having the piston pushed by the external atmospheric pressure, he suggested using the power of the steam under pressure inside the cylinder. It seems that conclusive trials were carried out in 1765.¹⁶ The young Scottish inventor obtained a patent in early January 1769 for the ‘separate

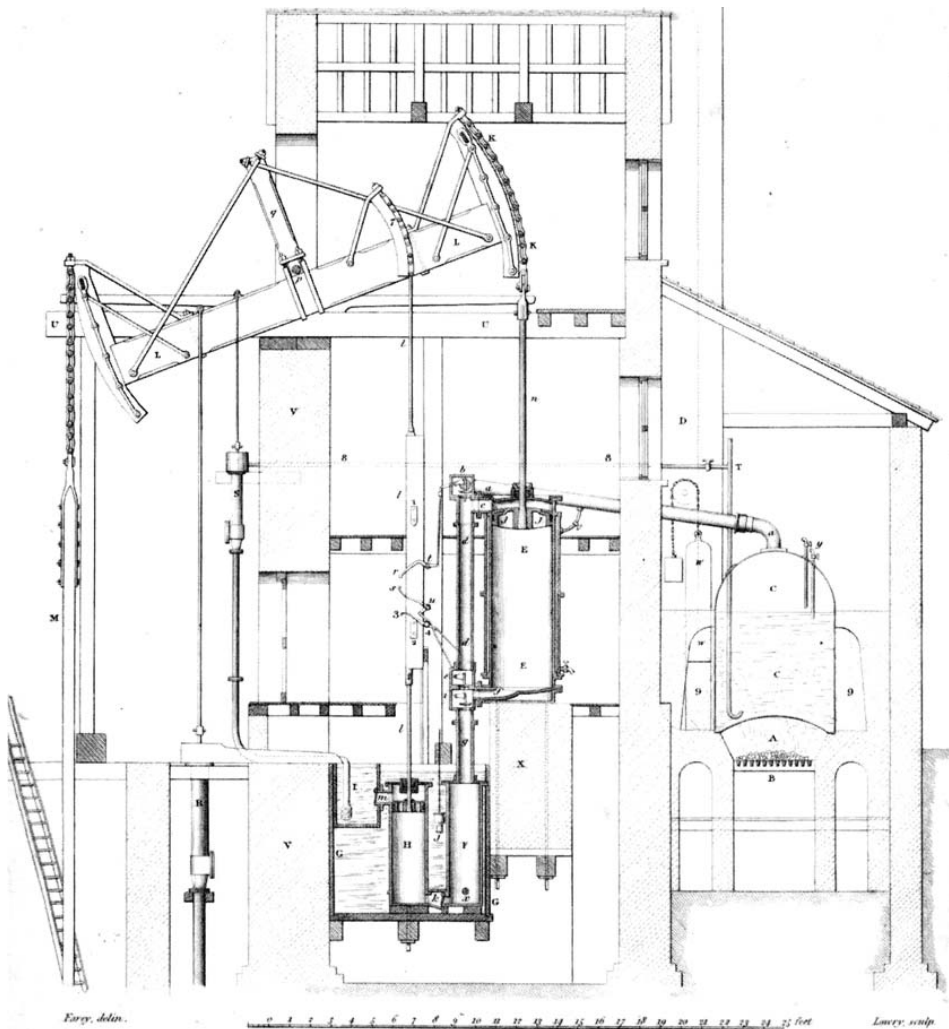


FIGURE 2 Watt's single engine alternative around 1788 from Farey, *A Treatise on the Steam Engine*, pl. X.

condenser',¹⁷ *by simply describing the engine*. Without any personal wealth and already in debt, he could not exploit it alone; therefore he sold two-thirds of the rights in the patent to the entrepreneur John Roebuck (1718–94), who was exploiting a coal mine in Carron, on the north-east of Glasgow, with atmospheric engines. Watt and Roebuck manufactured and perfected step-by-step a small experimental single-acting engine at Kinneil House. However, Roebuck's company went bankrupt in 1773 and he sold his rights in Watt's patent in 1774 to Matthew Boulton.

Boulton and his partner, John Fothergill (1730–82), had established in the early 1760s a factory in Soho, two miles north-west of Birmingham. This factory, which Watt had visited in 1767,¹⁸ was producing by stamping a wide variety of metal objects in large quantities.¹⁹ It would serve as the basis for further work on the Watt engine. Watt then left Glasgow to settle permanently in Birmingham and brought with him the engine he had made with Roebuck. The engine, which had been repaired by skilled workmen trained by Boulton, quickly functioned in a satisfactory manner.²⁰ It allowed a substantial — probably a third — saving in fuel consumption compared with conventional engines. Boulton was able to obtain an extension of the patent in 1775, which ensured a monopoly in Great Britain for Boulton and Watt for the next twenty-five years, until 1800.²¹

The two partners divided up the workload: Watt made the calculations, drew up the plans for the engines and wrote the instructions for their installation, working alone and hard, usually from home, as he feared delegating to others;²² Boulton for his part managed the financial aspects, met clients and consequently travelled widely, to London and Cornwall.²³ Only a part of the necessary pieces for manufacturing each engine were made in Soho, the rest were subcontracted, the centrepiece in particular, which was the heaviest of all: the cast iron cylinder. This cylinder was cast and bored by the metallurgist and inventor John Wilkinson (1728–1808), at his factory in Bersham, near Chester. Wilkinson, who had just filed a patent in 1774 for a boring mill,²⁴ was at the time the only person capable of boring the cylinders of a metre in diameter with sufficient accuracy.²⁵ Other suppliers manufactured the pistons and the pumps for discharging the steam from the central cylinder to the condenser.²⁶

The first two engines sold by Boulton and Watt functioned from May 1776 in the Midlands: in Bloomfield, in a coalmine, and in Broseley, on the River Severn, in Wilkinson's foundry.²⁷ In fact, the two partners did not sell turnkey engines, but granted operating licences and provided customers with all the building components in unassembled form. The licence fees were calculated according to the fuel saved by reference to the engines of 'old construction'. In addition to the licence and the unassembled components, Boulton and Watt also provided the construction plans of the engine, a user guide, as well as assistance if needed. Early customers of Boulton and Watt were the owners of copper mines in Cornwall where the fire engines connected to pumps were used to drain underground galleries. Since the coal had to be bought in, fuel saving represented a significant gain, contrary to a coal mine where the cost of fuel was not accounted for. With their early success in Cornwall, the two partners set their sights abroad, and more specifically on the kingdom of France.

Boulton and Watt's strategy for obtaining an 'Exclusive Privilege' in France

A limited market in search of novelties, 1773–77

In France, the fire engine market was quite limited compared with England and was supplied from outside France.²⁸ In the mid-1770s, only a few dozen 'atmospheric engines' were operating in France, mostly in Brittany, Hainaut, and Nord.²⁹ The first engines had been introduced in the 1720s by British manufacturers.³⁰ Over the following decades, installed engines came from Britain, as well as from manufacturers in Liege and Amsterdam. A few engines of French manufacture appeared at the beginning of the 1770s.³¹

Information concerning the existence and operation of the Watt engine circulated at that time in France through personal networks, both scientific and commercial.³² The first Frenchman to obtain first-hand information was probably Le Camus de Limare (born in 1736) in 1773. He heard about the new invented fire engine from Boulton when he visited Boulton's factory in Soho.³³ He probably relayed the information on his return to Paris, especially to the two people who had recommended him to Boulton: the Swiss banker Isaac Panchaud (1738–82)³⁴ and an English merchant who did business in France, John Motteux.³⁵ The first foreign letters enquiring about the new engines reached Boulton and Watt in 1777. The very first came from France.³⁶ Boulton already knew the Parisian milieu of the ironmongers with whom he had been trading for a decade,³⁷ but did not know the steam engine market there. He showed interest in the matter as 'pirates' had already sought to introduce the Watt engine in France without a licence.³⁸

An obvious case of 'piracy' occurred in June 1777 when the academician Jean-Charles-Philibert Trudaine de Montigny (1733–77), sent Joseph Alcock (born after 1739, died after 1800) to England. He was the son of a wealthy ironmonger of Irish origin who had settled in France.³⁹ Alcock had to draw up a report on the state of the art of fire engines⁴⁰ and to find engineers capable of repairing the engine from Marly that fed the fountains of the palace of Versailles with water from the Seine.⁴¹ Directly instructed by Boulton and Watt, on his return from Birmingham he promoted this engine that '[Boulton] brought to perfection'.⁴² In a letter from January 1778, Alcock proposed the purchase by the French crown of a few Watt engines since they have 'too big a price for a private individual'. Besides the replacement of the Marly engine, a purchased new engine 'would serve as a Model to exercise at leisure the industry of French artists to imitate it, which is not easy [...] for even the smelting of tubes and pistons is utterly unknown and without example among us'. The contents of Alcock's letter suggested pirating the Watt engine were promptly brought before the Royal Academy of Sciences by the chemist Pierre Joseph Macquer (1718–84) and the engineer-geometrician Etienne Mignot de Montigny (1714–82).

The request for a right of invention

The signs of interest received from France — visits, letters, piracy — meant two things for Boulton and Watt. First, there was definitely a market in France for their engine. Second, this market would be filled by others if they did not react quickly enough to protect their commercial interests. As before, it was Boulton who conducted the business strategy. With a wealth of domestic experience, he considered

that the best protection overseas would be of legal order.⁴³ He feared, probably with good reasons, that only a very small number of new engines would be supplied to French manufacturers before they would throw cease importing and manufacture themselves. He therefore wanted, before selling a single engine, to be guaranteed a right of invention in France.⁴⁴ However, the legal systems were very different from those on the other side of the Channel; there were patents on one side, and ‘royal privileges’ on the other.⁴⁵ To bridge the cultural gap, Boulton counted on the network of influence established in trading with ironmongers in Paris, as well as on his support from the British nobility.⁴⁶

Boulton had first written to the banker Panchaud in April 1777 but his request went unheeded. Instead, he received a request from Antoine de Ricouart, Count d’Hérouville (1713–82). This entrepreneur of Flanders’ nobility had been using fire engines over the past couple of decades. He had installed an atmospheric engine in 1758 near Dunkirk to drain the marshes of the Moeres, which he owned, sufficiently to allow growing of tobacco. The draining required ‘an ordinary fire engine’ and ‘fourteen large windmills’ to activate the pumps.⁴⁷ It was made more difficult following the peace treaty of the Seven Years’ War (1756–63), which filled drainage ditches in the marshes. To improve the irrigation, d’Hérouville envisaged replacing the atmospheric engine by ‘the new engine of Sr Bolton’ and contacted Boulton for this purpose. The two men corresponded through a bilingual intermediary, Jean Hyacinthe de Magellan (1723–90), who was a correspondent of the Royal Academy of Sciences in London.⁴⁸ Boulton placed his hopes in this count, providential both through his relations in the world and in trade and through his military background as ‘Lieutenant of the King’s Armies’. He advised him to issue in his and Watt’s names a request for a ‘royal privilege’ for their invention before the crown of France.

D’Hérouville spared no effort. He involved his relations, Jean-François Tolozan (1722–1802) in particular, then a high-ranking civil servant (intendant) dealing with commerce, who forwarded the request to the minister of finance, Necker (1732–1804).⁴⁹ The count supplemented the request with a technical essay that he had written himself in January 1778, in which he argued the originality and superiority of the Watt engine.⁵⁰ De Magellan wrote a note going along the same lines.⁵¹ In return, d’Hérouville received a letter addressed to ‘count de Rouville’,⁵² dated 23 February 1778 and signed by the minister. Necker stated that he ‘would gladly grant him for fifteen years the favour that [Mr Bolton] requests [in order to] establish his engine in France’. Boulton therefore obtained for himself and Watt, through d’Hérouville and de Magellan, a royal privilege, the judgment of which was adopted in the King’s Council on 14 April 1778.

The judgment of 14 April 1778 or the conditional granting of an ‘exclusive privilege’

The text of the judgment (*arrêt* — see Appendix) from 14 April 1778⁵³ consists of two parts: the first specifies the request and the second grants an exclusive but conditional privilege. The judgment begins with the description of the invention for which Messrs Boulton and Watt filed a ‘Request presented to the King’. It concerns ‘a new fire engine, different and of superior power to the old ones’. The judgment specifies three major developments of the new engine: ‘the action of the steam’ rather

than ‘the weight of the atmosphere’ to activate the piston, the constant ‘degree of temperature’ inside the cylinder made possible by ‘the condensation of the steam’ in a ‘separated condenser’; the circulation of the steam in a ‘wheel [in] circular motion’. Two ‘effects’ of interest for the engine result from these technical characteristics, namely, an increased reliability (‘less precarious’, ‘more suitable to transport’) and an increased efficiency (‘an infinitely lower expense’ of coal). These ‘effects were seen in England’ where the ‘supplicants’ had already won an ‘Exclusive Privilege’ from the ‘English Government’.

The judgment goes on to list the rights of invention ‘if it pleases His Majesty to grant them the same privilege in France’. The supplicants would have ‘the exclusive privilege to make, sell, and retail in the entire Kingdom the fire engines of their invention’, which would ‘prevent anyone from counterfeiting, selling, and retailing them and from hindering the supplicants from exercising their privilege’. Then the text introduces a provision: before the request is granted, the applicants promised to come and ‘establish similar engines and observe their superiority to the former ones from the Moeres from Dunkirk belonging to Sr. Count de Rouville or at such other place as will be indicated in the presence of such commissioners as are to be appointed’. For there to be a privilege, there must be an invention, and for there to be an invention, it must be certified by commissioners in a specified place.

The first part ends with a sentence which takes note of the request, following the notice provided by de Montigny and Macquer from the Royal Academy and the report of Moreau de Beaumont, ‘councillor ordinary and member of the Royal Council of Finances’, in charge of the judgment.

The second part contains the grant by ‘The King in his Council’ of the exclusive privilege of Boulton and Watt for the construction, sale and distribution of their engines ‘for a period of fifteen years’. The privilege does not apply to ‘the old pumps and fire engines’. It contains, however, an extremely important proviso: ‘the said engine [must] be recognized as superior in effect and in saving to the old fire engines’. The privilege would therefore not take effect until ‘the trial will have been taken by the aforementioned, either in the city of Paris or in the Moères near Dunkirk in the presence of such commissioners as are to be appointed by the Council’. The granting of the privilege depended therefore on the ability to prove to the royal authority the superiority of the invention. If proof was not made, ‘in the case of failure on the part of said Boulton and Watt’, the judgment stated that they ‘can [not] claim any form of compensation directly or indirectly’. If proof was made, the offenders would be required to pay ‘a penalty fine of five hundred *livres* [*tournois*] and for all costs and damages’.

Finally, the judgment, signed by Moreau de Beaumont, was followed by the dispatch of ‘letters patent’.

Implementing the privilege through comparative trials

The utopian application of the privilege

In 1769, the British Parliament had granted a patent to Watt on the simple description of an original design of a steam engine. A decade later, in France, the King’s Council

demanded the British associates to prove that their invention deserves a royal privilege through comparative trials between old and new engines. In addition, the trials were restricted to only two specified sites: the Moeres or Paris. D'Herouville received a letter from his friend de Magellan dated 17 April mentioning the possible passage of Boulton through the Moeres during a trip nearby to Flanders.⁵⁴ Soon after, Boulton and Watt contradictorily claimed to be too busy to travel.⁵⁵ Thus, on 22 April, they put de Magellan in charge of conducting the case for them.

The letters patent were probably addressed to the holder of the request on the promulgation of the judgment. Upon receipt, d'Hérouville undertook the writing of an essay to his allies, in which he analysed the situation as regards the privilege.⁵⁶ He stressed the urgency to conduct comparative trials because, he wrote, 'envious and greedy people [...] having, as Messrs Boulton and Watt, knowledge of such engines, and the talent to build them' could obtain 'a similar privilege' to theirs. He then considered the need for a second judgment which would grant an unconditional privilege. This judgment should 'mention the trial which had been carried out' proving the superiority of the invention as well as 'a more exact specification of the engines'. However, the memoir nonetheless contained a great surprise. D'Herouville, who had worked a few months before for the inclusion of the Moeres in the judgment as a trial site, announced that he was about to sell them to the Dutch.⁵⁷ He no longer had enough money to maintain them. Therefore, the count no longer had 'any interest today to increase, change or improve the effect of the fire engine'. The option for the Moeres thus became unavailable in May.

To make his turnaround more acceptable, d'Hérouville proposed to de Magellan and 'to the Intendant of Commerce for this case [Tolozan] to take this trial in Paris'.⁵⁸ He suggested installing two engines in existing buildings 'to save time'.⁵⁹ What d'Hérouville did not mention was that in Paris there was no atmospheric engine in operation. The Parisian solution would thus have brought about additional financial costs and a delay in schedule given the time needed to install two engines, one of old design, one of new design.⁶⁰ It became clear at the beginning of summer that neither the Moeres nor Paris would be appropriate for the comparative trials. With the disappearance of the two specified sites, the direct application of the judgment of 14 April literally became utopian, not being 'in any place'.

The Breton alternative with the Jary brothers

In June 1778, a new war broke out between the French and British crowns due to the support from the French for the American War of Independence. The epistolary exchanges across the Channel, however, remained possible. During the summer, de Magellan sent a copy of letters patent to Boulton and Watt.⁶¹ They understood then that the judgment was not exploitable in that situation and that they had to adopt a new strategy.

The text of the judgment itself suggested a possible alternative. If the second part of the text granting the privilege specified the Moeres or Paris as the trial site, the first part describing the request stated that the trials could take place in 'such other place as will be indicated', that is to say anywhere in the Kingdom. Boulton suggested to de Magellan to change the trial site in a letter from 22 August. After thanking d'Hérouville for his efforts, the letter explained that a third trial location had been found: 'Mr Joseph Jary, dealer to the King for the Northern⁶² mines near

Nantes in Brittany, has contacted us to engage us to erect one of our engines at his coal mine near Nantes, in the place of an existing old one'. The construction of a Watt engine next to an existing Newcomen engine would facilitate carrying out the comparative trials.

Even though it was written to de Magellan, it was to d'Hérrouville that the letter was particularly addressed. Boulton asked the count explicitly to obtain permission from the King's Council to perform these trials in Brittany and, in case of favourable results, to register a second royal judgment. This judgment, which would change the trial locations, should also restrict the privilege only to 'new beam or reciprocal engines' because, Boulton wrote, the 'rotary or circular engine' was not yet completed.⁶³ After reading the judgment in detail, Boulton and Watt had to admit that *the engine for which they had obtained a privilege in April did not exist*.⁶⁴ D'Hérrouville had already pointed it out to them during the spring, in his 'Observations', and consequently thought of a second judgment to register the 'beam engine', which was the only Watt engine that existed. It was the need for a second judgment regarding the existing engine and specifying a new trial location that caused Boulton and Watt to negotiate with François Joseph Jary (1739–1805).

Jary was the son of a merchant from Nantes, Simon Toussaint Jary (1704–68), who had obtained in 1746 a thirty-year concession to exploit the coal mine from Languin in the parish of Nort-sur-Erdre.⁶⁵ He and his older brother, Simon Basile (1738–1801), had taken over the business from their father and obtained the renewal of the concession for thirty years starting from 1776. An atmospheric engine was installed in Languin in 1766 to pump water from the mine, the extraction shaft of which could go deep down to up to 300 feet,⁶⁶ but it did not come up to expectation.⁶⁷

Between the summer of 1777 and the spring of 1778, the Jary brothers heard about a more efficient engine using the 'steam of boiling water' from Wilkinson's younger brother, William (1744–1808). He was then the superintendent of the cannon foundry and boring factory at Indret, downstream of Nantes.⁶⁸ He met the Jary brothers, either in Languin while he was in search of coal,⁶⁹ or in Nantes where Joseph was trading.⁷⁰ Joseph then began a tour in Shropshire and South Staffordshire in April 1778.⁷¹ That was when he met the elder Wilkinson brother, John, in Broseley⁷² and asked Boulton and Watt for an estimate for their steam engine.⁷³ Wilkinson was enthusiastic but Boulton and Watt were initially distrustful.⁷⁴ Joseph came back to England during the summer 1778. This second trip coincided with Boulton and Watt's search for a fall-back site for the comparative trials. The two partners thus agreed to deal with Jary and gave him, on 19 August 1778, a descriptive note on the 'new invented fire engines'.⁷⁵ After a trip to Cornwall to observe the steam engines in operation, Joseph visited the Soho foundry, on 10 October 1778.⁷⁶ It was during this period that Jary tried to bypass Boulton and Watt and obtain from Wilkinson manufactured pieces to build the Watt engine.⁷⁷ In spite of this misdemeanour, he obtained a written undertaking from Boulton to provide him with a 'licence for the use of the [fire] engine of our construction' as well as the materials, the plans and the instructions necessary for its installation no later than January 1779.⁷⁸ In turn, Boulton and Watt wanted £150⁷⁹ and 'all the assistance necessary to perform the [comparative] trial in the mines from Nord'. The engine, which was to be assembled in Nort-sur-Erdre, would require the importation of certain copper components for the boiler.⁸⁰

It was thus expected for the beginning of 1779 that two steam engines would be in operation in Nort-sur-Erdre: the atmospheric engine, already there; and the scheduled Watt engine. This made possible the comparative trials. Boulton and Watt had then to convince the royal authorities to accept the Breton site for trials. In addition to a request in their own name, they charged d'Hérouville⁸¹ and Jary independently to file a request with the King's Council to amend the judgment of 14 April 1778 in favour of Nort-sur-Erdre.⁸² From August to October 1778, Jary had an increasingly important role in the theatre imagined by Boulton and Watt for obtaining a privilege in France. He took over the leading role from d'Hérouville. Other than the fact that there was an atmospheric engine operating in Languin, three other reasons explained his central role: his interests were intertwined with those of the two Britons since he needed the Watt engine; he had an undeniable technical expertise; and he knew how to appear decided and convincing.⁸³ Jary left Birmingham on 8 November 1778 with gifts and letters for the Count d'Hérouville and for the academician Macquer.⁸⁴

D'Hérouville, who had lost the importance he had had the previous winter, remained 'the generous patron of the useful arts'.⁸⁵ Boulton and Watt went easy on the count, assured him they would do nothing without his consent and downplayed their commitments with the Jary brothers,⁸⁶ because they still needed him to obtain a revision of the judgment on two issues that presented problems: the location for the comparative trials; the type of engine had in view by the privilege — not the 'annular engine', but the 'beam Engine'.⁸⁷ In return, d'Hérouville was faithful to the two partners and presented their request to the intendant of commerce, Tolozan, on 16 November 1778. Less than a month later, on 13 December, Tolozan replied favourably with two letters addressed to de Magellan and to Jary, authorizing the comparative trials in Brittany.⁸⁸

Boulton knew nothing of these advancements at the beginning of January 1779.⁸⁹ The construction of the engine of the Jary brothers was delayed. Watt, who had been working on plans for the engine, did not finish them until the end of the month⁹⁰ even though he had ordered components for the engine from his usual suppliers: a cylinder from Wilkinson,⁹¹ a piston from Spedding Hicks & Company,⁹² and various other pistons from Daermon.⁹³ As for their British customers, Boulton and Watt asked the Jary brothers to pay for the orders directly to the suppliers.⁹⁴ In mid-January, it was estimated that the engine would be finished in March.⁹⁵ Despite this delay, everything seemed favourable for the comparative trials to be held in the near future in Languin. Boulton and Watt felt confident enough to decline Camus de Limare's offer, then the 'receiver general for Bugey', who offered to take care of their business.⁹⁶ As for Jary, he was so confident of the superiority of Boulton and Watt's engines that he considered to present with d'Hérouville a project to pump water from the Seine in Paris which would win the market against a certain Mr 'P. . r'.⁹⁷

I

The circumvention of the privilege by Périér

In the 1770s there had been several competing projects to pump water from the Seine.⁹⁸ Among them, Jacques-Constantin Périér (1742–1818), and his younger brother, Auguste Charles, proposed a project to the Royal Academy of Sciences in February 1776.⁹⁹ Jacques-Constantin — hereafter simply referred as Périér — a

mechanical engineer, who had been recommended to the Academy by Malesherbes, was supported by the Duke of Orleans.¹⁰⁰ In October 1776, his project was chosen by the Office of the City of Paris and, on 7 February 1777, the Périer brothers obtained the ‘letters patent’ from Louis XVI allowing them to establish and build fire engines intended for raising water from the Seine and bring it to the different districts of the City and its suburbs. The letters patent, which granted a fifty-year privilege, were finally registered by the Parliament on 16 July 1778.¹⁰¹ A month later, the Périer brothers had collected sufficient investor associates and founded the Water Company of Paris, on 28 August.¹⁰² This joint stock company had a large capital, close to one and half million *livres tournois*.¹⁰³ It was thus able to buy its main competitor, the company of the Vachette brothers, which distributed water to Parisians from the Seine drawn from boats moored in the quays. With this acquisition, the Water Company of Paris secured a monopoly¹⁰⁴ of water distribution in Paris.¹⁰⁵

What remained to do was a huge task however: to build the water distribution network throughout the city, to settle the ‘force pumps’¹⁰⁶ near the Seine to carry the water to the tanks at the top of the hill of Chaillot,¹⁰⁷ and to build the fire engines to activate the pumps. Being experienced in such matters, Périer was appointed by the Company on 19 October 1778 to negotiate the purchase of ‘cast iron’ pipes and of fire engines in England.¹⁰⁸ As Périer had been on good terms with the Wilkinson brothers for one and half year,¹⁰⁹ he left Paris for Birmingham in November.

The negotiations between Périer and Boulton during the winter of 1778–79

Wilkinson gave Périer a warm welcome. He took him to visit his factory in Bersham where the cylinders for the steam engine were cast, as well as the factory in Broseley where the iron pipes were cast. Last time they met, in April 1777, Périer was attracted by the Watt engine he discovered in Wilkinson’s foundry¹¹⁰ and insisted on having the centrepiece of the device, the cast iron cylinder, which the foundryman refused.¹¹¹ This time, Wilkinson sent Périer directly to Boulton in London for negotiations on the steam engines.¹¹² Périer wrote to Boulton on 24 November 1778 to ask him about ‘the acquisition of two fire engines for [his] water company from Paris the [building] work of which has already begun’.¹¹³ For the most part, the negotiations between Boulton and Périer took place in London during the winter.

In early January 1779, negotiations proceeded slowly. Périer did not want to go along with Boulton and Watt’s usual conditions: purchasing a licence in exchange for instructions, plans and component parts. The two partners usually demanded the payment of ‘one third of economy’ made on the consumption of coal. As Périer refused this condition, they agreed on ‘a fee in proportion to the number of piston strokes’. They temporarily agreed the remuneration at about twenty Company’s shares, worth 24,000 *livres tournois*.¹¹⁴ While still dealing with Périer during the winter of 1778–79, Boulton and Watt kept their allies in France informed, particularly d’Hérouville.¹¹⁵ They hoped to win on both sides: to have the privilege revised with help from the pair d’Hérouville-Jary in Languin, and to sell a licence to Périer in Paris. The fact was that Boulton, being financially pushed, needed money.¹¹⁶

But Périer stalled and sought to reduce the number of shares to be paid.¹¹⁷ This made Boulton all the more nervous since Périer had already tried the previous year to bribe Wilkinson. The British entrepreneur suspected his Parisian client of wanting

to invalidate the royal privilege.¹¹⁸ He kept Watt informed regularly, while he was working in Birmingham, and warned Watt ‘against foreigners who have come over to steal his ideas’.¹¹⁹ In mid-January, Watt had not lost hope of seeing the transaction succeed and believed P erier gentleman enough to keep his commitments.¹²⁰ Despite their suspicions, Boulton and Watt remained confident since the comparative trials from Languin were near, just two months away, which allowed the revision of the privilege and the legal protection of their interests in France.

The negotiations between Boulton and P erier continued until late January in London, using P erier’s agent, the merchant John Motteux, in the presence of McDermott, chaplain to the ambassador of France, who acted as interpreter.¹²¹ Motteux sought to persuade Boulton to agree with P erier.¹²² An oral agreement was finally reached on 29 January in the presence of Motteux, McDermott and Wilkinson: twenty shares immediately and another twenty at the next capital increase by issuing shares.¹²³ At the last minute, the Company sought to reduce this number to fifteen plus fifteen but they failed.¹²⁴ An appointment was made to sign a written agreement at Motteux’s on Tuesday, 2 February.¹²⁵ The day before, Boulton and P erier had gone together to Shadwell to see a Watt machine, newly put in operation.¹²⁶ The following day, on Wednesday, they took the coach to Coventry en route to Birmingham, where they had to be present on Friday morning.¹²⁷ Boulton had in fact proposed to P erier to come and work with Watt to finish the plans for the engine. They were all to dine together on Friday night at Boulton’s.¹²⁸

The London Notarial Act of 12 February 1779

In spite of having invited P erier to Birmingham, the two associates mistrusted him more than ever. They feared that he had acquired from his travels to England and his visits to factories¹²⁹ sufficient contacts and expertise to make counterfeits without their consent. They therefore wanted to bring the P erier brothers and the Water Company of Paris before a British notary to specify the limits of the licence granted. For this purpose, on 12 February 1779, they signed a notarial act in London, the clause 10 of which specified that the licence granted only concerned the engines to be used in water pumping and distribution in Paris:

James Watt and Matthew Boulton do hereby grant unto the said P erier Fr eres and Company their license and liberty for erecting and using so many of their [...] new invented fire engines [...] as shall be necessary for the purpose of raising water for the supply of the said City of Paris, but for no other use or purpose whatsoever.¹³⁰

The act also gave the two Britons the opportunity to request payment in cash instead of in shares.¹³¹ It is probable that, with the 12 February 1779 notarial act, Boulton and Watt looked more at the moral commitment of P erier — a gentlemen’s agreement — than at a formal legal protection. They believed that this notarial act would be enough to ensure their protection against the P erier brothers until such time when the royal privilege was revised.

Commercial dispute and P erier’s counterfeits

Eight months later, the promised engine for the Water Company of Paris was unloaded in Honfleur in November 1779. It was then transported to Paris under

Périer's care.¹³² Boulton and Watt respected the terms of the notarial act. However, Périer did not keep his side of the bargain. He refused to pay the sum equivalent to twenty shares. In a letter which he wrote to Boulton in December 1781, he explained that 'some of the new shareholders say that Boulton and Watt did not obtain a privilege to build the steam engine in France; the General Assembly takes this into consideration and asks if Boulton and Watt could send a copy of the documents with regard to their privilege'.¹³³ After several years of epistolary dispute, Boulton and Watt had to threaten Périer that they would address themselves directly to the board of directors of the Water Company of Paris for the balance of 27,668 *livres tournois*. This balance was finally paid by the Company, on 22 August 1786.¹³⁴

While delaying payment of his debts, Périer further wronged the two associates by starting to make counterfeits of their engine without a licence. He had indeed gained sufficient expertise and could manufacture some of the necessary parts, with the exception of the cylinders. He had acquired the expertise from Boulton and Watt during his trips across the Channel. As for the cylinder, Périer became a good customer of Wilkinson's. He ordered, from his foundry from Bersham, a large cylinder for the Watt engine. The item was ready for delivery in February 1783 when Watt discovered the foundryman's betrayal. This cylinder allowed Périer to assemble a first Watt engine in 1784, which he sold in Santo Domingo for the irrigation necessary to the harvest of sugarcane.¹³⁵ In 1786, Périer obtained another large cylinder from Wilkinson for the cannon-foundry from Indret.¹³⁶ Afterward, Périer supplied the workshops at Chaillot with reverberatory furnaces for casting large-diameter cylinders, and with various machines allowing their boring.¹³⁷

Epilogue: the moral of the French adventure

Why did Boulton and Watt not sue the Water Company of Paris for payment for the Watt engine that remained outstanding for seven years after its delivery? Much more, why did they not sue Périer for the counterfeit he sold to Santo Domingo? Simply because Boulton and Watt had no right in France for the construction, sale and distribution of the Watt engine. Indeed, the 14 April 1778 privilege was never made effective. The engine from Languin was not operational in March 1779 as expected. Because of the war between France and Britain, the shipment of component parts to Nantes took two years instead of the usual few weeks.¹³⁸ The Watt engine was not installed in Languin until February 1781. At that time, the Jary brothers had pulled down their Newcomen engine almost a year before.¹³⁹ The comparative trials could therefore no longer take place in Nort-sur-Erdre. They did not take place anywhere in France, for that matter. No representative of royal power could certify the superiority of the new invented engine to the former. Thus, the exclusive privilege of 14 April 1778 remained conditional and was of no use.

Strangely, Boulton and Watt never relied on the notarial act of 12 February 1779 against Périer, which gave him only a limited licence to pump water from the Seine in Paris. Had the two associates understood that this act signed in London had no value whatsoever in France in the absence of international law? Did they finally admit that the conditionality of the privilege made invalidated their industrial property claims in the kingdom of France, including the 12 February 1779 notarial act? Or,

more simply, had they not other concerns than to apply again for a royal privilege for building and selling their engines in France? They had low expectations across the Channel since they understood how long and insecure was the process of obtaining an exclusive privilege. On the contrary, their business flourished in Britain: they built and sold around twenty engines for the domestic market in 1778.

Conclusion

Boulton and Watt's attempt to have the right of invention granted by patent from the British Parliament in 1769 recognized in France was a failure. The royal privilege of 14 April 1778 seemed to clear the path to an effective legal protection for fifteen years; however, with its condition unfulfilled, it had no actual value. The economic interests of the two associates were therefore not protected in France. While the kingdom of France formed the second largest market after the British Isles, only four steam engines were commissioned by the French from Boulton and Watt before the end of the century: those of Jary and Périer in 1779 and two other engines a decade later.¹⁴⁰

This unfortunate episode contrasts with the *success story* in Britain and Boulton's management of the market. The methods that functioned so well at home were ineffective in France. The cultural, linguistic, legal and commercial backgrounds being very different, the partners needed native allies. One reason for their failure lies in the choice of these allies who proved to be inconsistent at best and dishonest at worst. The first, d'Hérouville, put his effective outreach at their service but sold his marshlands from the Moeres just when they had become needed for the comparative trials. The second, the Jary brothers, offered their atmospheric engine at Languin in 1778 but took it down a year later without even waiting for the construction of the Watt engine, despite their promise to do everything in their power to make the comparative trials possible. The third, the Périer brothers, were without question the worst possible allies, whose only object was to acquire the know-how necessary for manufacturing counterfeits. The Périer brothers also benefited from the greed of Boulton and Watt's main supplier, Wilkinson. The technology transfer occurred discreetly through Jacques-Constantin Périer, to whom the historiography traditionally attributes the merit of introducing the Watt engines in France.¹⁴¹ Yet, if not an outlaw, Périer was certainly a crook. A few years later, when Watt improved the beam engine with the 'sun and planet' gear which allowed a double-acting and rotary motion that operated in May 1786 at the Albion Flour Mills by Blackfriars Bridge in London.¹⁴² The same Périer summoned the Franco-Spaniard engineer and spy Augustin de Betancourt to obtain the design details.¹⁴³

This empirical case highlights the differences between the legal systems in Britain and France at the end of the Age of Enlightenment. Even if Boulton and Watt had had more effective allies in France and had been more familiar with the legal procedure there so as to use their British patent to obtain an effective Privilege in France, the protection that would have been afforded was minimal. Potential offenders would have been charged the ridiculous fine of 'five hundreds *livres*' *tournois*, which was equivalent to two per cent of the price of Boulton and Watt's licence sold to Périer in 1779. If offenders would have to pay 'costs and damages' too, there was no clear

specification of these retributory damages. The King's Council, which was the judge of the seriousness of the contravention, fixed low penalty fines, which sounded like an invitation to fraud.

However, we think that an additional reason why Boulton and Watt failed was that they wanted to strike all the deals instantly (with d'Hérouville, Périer and Jary at the same time) instead of first converting the conditional privilege into an actual right by conducting the comparative trials ('le beurre, l'argent du beurre et le sourire de la crémière' as a French phrase puts it).

Appendix: Arrêt pris en Conseil du Roi le 14 février 1778 [King's Council, Judgment of 14 April 1778. AN E 1548]

vu bon
d'aguesseau
exptn gratis

« Versailles, le 14 avril 1778

Sur La Requete présentée au Roy En Son Conseil par les Srs Boulton et Watt, contenant qu'ils seraient parvenus après plusieurs expériences réitérées à inventer une nouvelle machine à feu différente et d'une force supérieure aux anciennes sans que le poids de l'atmosphère soit l'agent qui donne le mouvement au piston sur lequel l'action seule de la vapeur agit, que le cylindre de vapeur est toujours au même degré de chaleur que la vapeur même, sans qu'il arrive que l'injection de l'eau froide refroidisse en aucune façon le cylindre. Que la condensation de la vapeur se fait dans un vaisseau différent du cylindre appelé condenseur. Que la vapeur étant introduite dans la cavité d'une Rouë contenant une matière fluide elle donne à cette Rouë un mouvement circulaire avec une force proportionnée à la capacité de la Roue et de la quantité de vapeur qu'elle peut recevoir. Que l'effet de cette Machine à l'avantage sur celles dont on s'est servi d'être moins preciaire et mieux proportionné à la consommation du charbon qui sy employe, et qu'elle en dépense infiniment moins, enfin que cette machine est tres propre pour faire mouvoir des marteaux ou des soufflets de forge à rouler le cuivre ou autres métaux et à tous les effets que les moulins à Eaux peuvent produire. Qu'on peut aussi l'employer avec succes pour le dessechement des Marais, que ses effets ont été constatés en Angleterre et qu'ils ont mérité que le Gouvernement Anglais accordat aux suppliants un Privilege exclusif. Que s'il plaisoit à sa majesté leur accorder le même privilege en france ils offraient de venir y établir de semblables machines et d'en constater la supériorité sur les anciennes [p.1] dans les moeres de Dunkerque appartenantes au Sr Comte de Rouville ou dans tel autre endroit qui sera indiqué et sous les yeux de tels commissaires qui seront nommés Requeroient à ces causes les suppliants qu'il plut à sa Majesté leur accorder le privilege exclusif de construire, vendre, et debiter dans toute l'étendue du Royaume les machines à feu de leur invention faire défense à toutes personnes de les contrefaire, vendre, et débiter et de troubler les suppliants dans l'exercice de leur privilege sous telles peines qu'il appartiendr appartiendra vu la dite Requete, ensemble l'Avis des Srs de Montigni et Macquer membres de l'académie Royale des sciences sur le raport du Sieur Moreau de Beaumont Conseiller ordinaire et au Conseil Royal des finances.

Le Roy en Son Conseil à permis et permet au S^{rs} Boulton et Watt de construire vendre et débiter dans toute l'étendue du Royaume pendant l'Espace de quinze années exclusivement à tous autres les nouvelles machines à feu de leur invention après neanmoins qu'essay aura été fait d'ycelles, soit dans la ville de Paris, soit dans les moères de Dunkerque en presence de tels

commissaires qui seront nommés par le Conseil et apres que la dite Machine aura été reconnue supérieure pour l'effet et pour l'économie aux anciennes machines à feu. fait deffenses à toutes personnes de quelque qualité et condition qu'elles soyent de troubler les dits Boulton et Watt dans [p.2] l'exercice du dit privilège, apeine de cinq cent livres d'amende et de tous dépens dommages et intérêts sans néanmoins que ceux qui fabriquent ou employent les anciennes pompes et machines à feu, soyent privés du droit de les faire, vendre et débiter, ni que dans le cas de non succès de la part des dits Boulton et Watt, ils puissent prétendre directement ni indirectement aucun dedomagement, et seront toutes lettres patentes expédiées sur le present arrêté.

gribouillis Moreau de Beaumont »

Notes

- 1 Robert C. Allen, *The British Industrial Revolution in Global Perspective* (Cambridge: Cambridge University Press, 2009).
- 2 Eric Robinson and Albert E. Musson, *James Watt and the Steam Revolution* (A. M. Kelley, 1969).
- 3 John Lord, *Capital and Steam Power, 1750–1800* (London: P. S. King & Son, Orchard House, Westminster, 1923), p. 97.
- 4 Jennifer Tann, 'Marketing Methods in the International Steam Engine Market: The Case of Boulton and Watt', *Journal of Economic History*, 38.2 (1978), 363–91.
- 5 Jennifer Tann and Michael J. Breckin, 'The International Diffusion of the Watt Engine, 1775–1825', *The Economic History Review*, new series, 31.4 (1978), 544, table 3. Some fifty requests were sent to Boulton and Watt from France between 1775 and 1825.
- 6 *Ibid.*, p. 542.
- 7 Marc Bloch, *Apologie pour l'histoire ou Métier d'historien*, 3rd edn (Paris: Armand Colin, 2002), p. 51.
- 8 François Crouzet, 'Angleterre et France au XVIIIe siècle: essai d'analyse comparée de deux croissances économiques' [England and France in the Eighteenth Century: A Comparative Analysis of Two Economic Growths], *Annales. Économies, Sociétés, Civilisations*, 21.2 (1966) for example.
- 9 John Kanefsky and John Robey, 'Steam Engines in 18th-Century Britain: A Quantitative Assessment', *Technology and Culture*, 21.2 (1980), 170.
- 10 Donald S. L. Cardwell, 'Power Technologies and the Advance of Science, 1700–1825', *Technology and Culture*, 6.2 (1965), 189–90. No fewer than eight types of different steam engines are listed for the eighteenth century.
- 11 John R. Harris, *Industrial Espionage and Technology Transfer — Britain and France in the Eighteenth Century* (Aldershot: Ashgate 1998), p. 288.
- 12 Allen, p. 156.
- 13 *Ibid.*, p. 161. In fact, Thomas Savery patented his engine in 1698, shortly before Newcomen's. The latter, encumbered by that prior patent, arranged with Savery to share with him the licensing rights for his engines.
- 14 Harris, p. 288.
- 15 Frederic M. Scherer, 'Invention and Innovation in the Watt-Boulton Steam-Engine Venture', *Technology and Culture*, 6.2 (1965), 166–68.
- 16 James P. Muirhead, *The life of James Watt*, 2nd edn (London: John Murray, 1859), p. 161. Watt wrote to John Roebuck on 23 August 1765: 'I have tried my new engine with good success'.
- 17 Patent number 913 of 1769. Secondary sources disagree on the date of the patent: 5 January in Paul Mantoux, *La révolution industrielle au XVIIIe siècle, Essai sur les commencements de la grande industrie moderne en Angleterre* [The Industrial Revolution in the Eighteenth Century: An Outline of the Beginnings of the Modern Factory System in England] (Paris: Génin, 1959), p. 332, n. 2; 9 January in Jacques Payen, *Capital et machines à vapeur au XVIIIe siècle — Les frères Périer et l'introduction en France de la machine à vapeur de Watt* (Paris: Mouton, 1969), p. 31.

- 18 Muirhead, p. 168. Watt had not met Boulton then, but Fothergill.
- 19 Mantoux, p. 339.
- 20 Ibid., p. 340. Watt announces in a letter to his father: 'The matter that has brought me here is turning out to be good rather than bad: the engine I have built works now, and the results are more superior than those of any other that has been invented before mine. I expect this invention will be very profitable'.
- 21 Ibid., pp. 332, 340–41. A petition for the extension of the patent was addressed by Watt to the House of Commons on 23 February 1775. It was examined with the utmost care thanks to Boulton's relations in the scientific world, and on 22 May 1775, the patent from 1769 was extended for a period of twenty-five years through a 'special law'.
- 22 Scherer, p. 173.
- 23 Muirhead. This division of tasks appears in the partnership agreement signed between Boulton and Watt.
- 24 The date of 27 January 1774 for Wilkinson's patent was given in 2000 on Georges Vanderquand's personal website, which is no longer available.
- 25 Peter M. Jones, *Industrial Enlightenment: Science, Technology and Culture in Birmingham and the West Midlands, 1760–1820* (Manchester: Manchester University Press, 2008), p. 55. It was not until 1795 that Boulton and Watt established their own foundry in Soho, which allowed them to make cylinders of sufficient size without Wilkinson's help.
- 26 Jennifer Tann, 'Suppliers of Parts: The Relationship between Boulton and Watt and the Suppliers of Engine Components, 1775–1795', *Birmingham and Warwickshire Archaeological Society Transactions*, 86 (1974), 167–77.
- 27 Harris, p. 300.
- 28 D'Hérouville, 'Mémoire sur une nouvelle machine à feu' [Essay on a New Fire Engine], Unpublished essay dated from 15 January 1778 and signed Hérouville — AN F12 2205. 'Very few fire engines are used in France, and when they are used, they are taken from abroad'.
- 29 Tann and Breckin, p. 548. 'There were probably about 14 engines in French Hainaut besides others on the Nord Coalfield and in Brittany'. If we consider that there were around twenty fire engines in France, then there was a ratio of one to thirty between the two countries.
- 30 Harris.
- 31 Tann and Breckin, p. 548. It 'is presumed that an indigenous French atmospheric engine industry had developed by about the 1770s, if not before'.
- 32 Ibid., p. 550.
- 33 John R. Harris, 'Matthew Boulton: A Slight Adjustment of the Halo', in *Les entreprises et leurs réseaux: Hommes, capitaux, techniques et pouvoirs, XIXe–XXe siècles: mélanges en l'honneur de François Caron*, ed. M. Merger and D. Barjot (Paris, La Sorbonne, 1998), p. 358. Le Camus de Limare was one of the first Frenchmen aware of the Watt engine.
- 34 Denise Ozanam, *Claude Baudard de Sainte-James, trésorier général de la Marine et brasseur d'affaires (1738–1787)* (Geneva-Paris, Librairie Droz, 1969), p. 43.
- 35 Camus de Limare to Boulton, 28 December 1778: 'Thanks Matthew Boulton for his hospitality when he met him, John Wilkinson and Mr Coulson in 1773, at the recommendation of Messrs. Motteux & Pancharde [sic]'.
- 36 Tann and Breckin, p. 544.
- 37 Lord, p. 208. In 1768, Boulton was asked to sell counterfeit coins of 'deux sous' in France but he refused. From that time, it seems that Boulton was in contact with Panchaud.
- 38 Albert E. Musson and Eric Robinson, *Science and Technology in the Industrial Revolution* (Manchester, 1968).
- 39 John R. Harris, *Essays in Industry and Technology in the Eighteenth Century: England and France* (Aldershot: Ashgate, 1992), ch. 4: 'Michael Alcock and the transfer of Birmingham technology to France before the Revolution'.
- 40 Payen, p. 104.
- 41 Harris, *Essays*, p. 300.
- 42 Joseph Alcock, Roanne, 10 January 1778, signed 'Alcock, entrepreneur de la Maison de quincaillerie anglaise' [Entrepreneur of the English ironmongery] AN F12 2205. The recipient of the letter is not mentioned (it might have been Trudaine first but he died just before) but the letter in itself can

- be taken for an unofficial report to the sponsor of the mission: the Royal Academy. The following quotations of the paragraph are translated from the letter.
- 43 Jennifer Tann, 'Marketing Methods', p. 366. 'The early overseas marketing strategies of Boulton and Watt were Boulton-inspired. [...] Protection was thus a central issue in the formulation of their domestic business policy-and no arguments were advanced for modifying this policy in overseas markets'.
- 44 Tann and Breckin, p. 551.
- 45 Liliane Hilaire-Perez, *L'invention technique au siècle des Lumières* [Technical Invention During the Enlightenment] (Paris, Albin Michel, 2000), in particular ch. 3: 'Privilèges français et *patents* anglais'.
- 46 Tann and Breckin, pp. 550-51.
- 47 D'Hérouville, n. 28. 'The Count d'Hérouville was obliged for fifteen to sixteen years to supplement the natural flow of waters from the Moères, which had been removed by the destruction of the cunette [channel for draining water from a fortification] from Dunkirk, enforced under the peace treaty of 1763, to establish in the Moères an ordinary fire engine and since then fourteen large windmills to raise the waters and discharge them away from the Moères'.
- 48 Harris, *Essays*, p. 304.
- 49 Necker to d'Hérouville, Paris, 23 February 1778. AN Marine — G110 — F 147.
- 50 D'Hérouville, n. 28. 'The Count d'Hérouville [...] had opportunity to verify, through the examination and report of several learned men or connoisseurs, that this engine was absolutely of a different construction from the previous ones, that the air pressure is much better and more usefully employed than in the others, that its effect is less precarious and more proportional to the consumption of coal used; and that it expends considerably less coal, all other conditions being equal, but that Nobody until now has known its true construction'.
- 51 D'Hérouville, *Observations du Comte d'Hérouville pour les Srs Boulton et Watt*, undated (after the judgment of 14 April, probably in May). AN Marine — G 110 — F 160.
- 52 It may be a spelling error. The same spelling can be found in the text of the judgment.
- 53 King's Council, Judgment of 14 April 1778. AN E 1548. The original text of the judgment is transcribed in Annex I. To date, it is not published in its entirety.
- 54 De Magellan to d'Hérouville, 17 April 1778, AN Marine — G110 — F°151. 4 'I would like to be able to announce hereby the day in which Mr Boulton was due to leave for Flanders, but he has not yet arrived, as he had promised, to London, and I have just written to him about it again'.
- 55 Boulton to de Magellan, 22 April 1778. AN Marine — G110 — F°190. 'We are, Mr Watt and myself, so overworked that it would be a great inconvenience for either of us to go at present to Paris'.
- 56 D'Hérouville, *Observations*, n. 51.
- 57 This sale is attested by a letter of d'Hérouville to d'Angivillers (Director-General of the royal buildings), 14 June 1778, with Necker's consent. AN Marine — G 110 — F 170.
- 58 D'Hérouville, *Observations*, n. 51.
- 59 D'Hérouville to the director of the royal buildings, 14 June 1778, AN Marine — G110 — F°170.
- 60 Boulton to de Magellan, 16 October 1778, BCL — MS 3147/3/81/134. Boulton mentioned 'the great expense of erecting an engine at Paris'.
- 61 Boulton to de Magellan, 22 August 1778. AN Marine — G110 — F°172.
- 62 Boulton confused the spelling of Nort-sur-Erdre with the north region (*Nord*) but he probably understood where Nantes was situated.
- 63 Boulton to de Magellan, 22 August 1778. AN Marine — G110 — F°172. 'I would also ask you to inform Mr count d'Hérouville that, having been exceedingly busy this year with erecting more than twenty of our new beam or reciprocal engines (all very large), we never had the time to complete our rotary or circular engine, and we consequently wish that our privilege was restricted to the other kind [...] the beam engine which will be the only one put to the trial, at least some time from now'.
- 64 Watt had certainly had the idea of a 'circular motion' but he had not filed a patent before 1782. John Farey, Jr, *A treatise on the steam engine, historical, practical, and descriptive* (London: Longman, Rees, Orme,

- Brown and Green, 1827), pl. 15 exemplified a drawing of the circular engine. Reference communicated by Marc Thomas (Centre François Viète).
- 65 Languin Confirmatory judgment, 21 May 1746, ADLA — 8 S 21.
- 66 Joseph Jary, *Mémoire de S.J. Jary*, 6 October 1783, AD35 — C1473.
- 67 Ibid. 'It did not have great success, we were mistaken; in 1778, it had to be restored and carried 400 *toises* more to Levant, we were preparing for it when the Englishman Mr Wilkenson arrived on the scene and during conversation gave us the idea of a new engine whose power came from the steam of boiling water'.
- 68 Paul Naegel, 'Marchand de la Houlière et la création de la fonderie de canons d'Indret (1775-1778)', *Annales de Bretagne et des Pays de l'Ouest*, 115.4 (2008), 55-79.
- 69 Jary.
- 70 Jary to d'Hérouville, Note, AN Marine — G110 — F°186. Jary signs 'Jary, Tradesman, Quai Flesselles at Nantes'.
- 71 William H. Chaloner, *Industry and Innovation — Selected Essays* (London: Frank Cass and Company Limited, 1990), p. 61.
- 72 Ibid., p. 19.
- 73 Boulton to a 'Lord' (probably Macquer), 16 October 1778, BCL — MS 3147/3/81/135.
- 74 Chaloner, pp. 61 and 78 (n. 18). Relying on a letter from Boulton to Wilkinson, 16 April 1778 (AN Marine G 110 — 172 F for the English version, 174 F for the French version), Chaloner wrote: 'John Wilkinson took up Jary's cause with considerable enthusiasm and suggested to Soho that he should get the casting ready to ship immediately news of the arrêt was received. Boulton and Watt remained more cautious'.
- 75 This unpublished note from 19 August 1778 was entitled 'État des machines à feu de la nouvelle construction établies en Angleterre par les Srs. Boulton et Watt et dont une partie a été vue par le Sr. Jary' [State of new invented fire engines established in England by Messrs Boulton and Watt, part of which was seen by Mr Jary]. There is a copy of this document, certified as a true copy, held in the Archives Nationales: AN Marine — G110 — F°179.
- 76 Peter Jones, personal communication to one author, 2009.
- 77 Wilkinson to Watt, 1 November 1778, cited by Chaloner, pp. 61 and 72 (note 20). This is confirmed by a letter from Boulton and Watt to d'Hérouville, 16 October 1778, AN Marine — G110 — F°180 and 181: 'We are not ignorant that Mr Jary has endeavored to obtain an engine without our permission'.
- 78 Boulton to Jary, 12 October 1778, BCL — MS 147/3/81/133. The information is confirmed by Chaloner, p. 72 (n. 8).
- 79 This sum represents about 3000 *livres tournois*, which was six times the amount of the fine provided for by the privilege of 14 April 1778. It was therefore Boulton and Watt's expertise that the customer purchased rather than the law.
- 80 AN Marine — G110 — F°187.
- 81 Boulton and Watt to d'Hérouville, 16 October 1778, AN Marine — G110 — F° 180 and 181.
- 82 Boulton to de Magellan, 16 October 1778. BCL — MS 3147/3/81/134. 'I have therefore drawn a request in our name & Mr Jary hath drawn another in his own name to the conseil d'état praying that the trial indicated in the judgment of 14 April is made on the fire engine which will be erected on the coal mines from Nort in Brittany'. This is confirmed by the letter of Boulton to a 'Lord' (probably Macquer), 16 October 1778, BCL — MS 3147/3/81/135.
- 83 Jary's technical mastery is mentioned in the three letters written by Boulton on 16 October 1778. He is also described as 'a man of character and abilities' to d'Hérouville in the letter that Boulton and Watt addressed to him on the same day.
- 84 James Keir to Boulton, 11 November 1778, BCL-Inventory file REEL 11 according to <http://www.ampltd.co.uk/digital_guides/industrial_revolution/detailed%20listing%20%20part%201.aspx> but the exact classification number is not revealed.
- 85 Boulton and Watt to d'Hérouville, 16 October 1778, AN Marine — G110 — F° 180 and 181.
- 86 Boulton to de Magellan, 1 January 1779, BCL (Register of correspondence issued by Watt) F°97 et 98 — letter no. 152. 'If the Count d'Hérouville could obtain permission for us to make this trial in Bretagne, and if the trial so made would be effectual

- towards the obtaining the second Arret de Conseil we would without loss of time proceed to erect an Engine for Mr Jary. We have not thought proper to make Mr Jary acquainted with any of the measures that have been taken towards obtaining an exclusive privilege — but we have delayed giving him a decisive answer to his propositions till we knew whether his Engine can be made the subject of the trial required by the Arret de Conseil'. At that moment, the installation of the engine in Languin was finalized and Jary had also submitted a request to the King's Council on behalf of Boulton and Watt.
- 87 Ibid. 'I beg also you will acquaint the Count d'Herouville that we have never had yet the time to complete the Annular Engine from our being so much engaged in the erection of Beam Engines, and therefore which our exclusive privilege to be confined to the other sort of which alone we shall made the proposed trial at least for some time'.
- 88 Tolozan to Jary, 13 December 1778, AN Marine G110 — F192 and Tolozan to de Magellan, 13 December 1778, AN Marine G110 — F193.
- 89 Boulton to de Magellan, 1 January 1779, BCL (Register of correspondence issued by Watt) F° 97 et 98 — letter no. 152. Through this letter, Boulton asked de Magellan to inform d'Hérouville that they would try with Jary to hold the comparative trials in Brittany. In the event that they would not obtain the necessary authorization, he proposed to send a 'model' of a Watt engine to Paris. Clearly, Boulton was not informed at that time of the authorization from Tolozan given via d'Hérouville on 13 December 1778. This can be put down either to negligence, or to the difficulties in mail delivery due to the war between France and England from 10 July 1778.
- 90 Watt to Jary, 27 January 1779, BCL — F° 120, letter no. 172.
- 91 File of Jary's engine containing documents and plans dated from January 1779 to October 1780, including a document entitled 'Mr Jary's Engine — January 1779'. Birmingham City Archives. The existence of the file and copies of several documents have been kindly communicated to us by Professor Peter Jones (University of Birmingham).
- 92 Watt to Spedding Hicks & Company, 20 January 1779, BCL — F° 114, letter no. 164.
- 93 BCL — F120 — letter no. 174.
- 94 Watt to Jary, 26 March 1781. Subsequent correspondence — after the arrival of the boat to Nantes. Also contains the instructions for the installation of the engine. BCL (undisclosed shelf mark), as indicated by Chaloner, pp. 69 and 74 (n. 72): 'concerning the payment of supplies, asked Jary to pay Wilkinson directly'.
- 95 De Magellan to d'Hérouville, 19 January 1779, AN Marine — G110 — F° 199.
- 96 Camus de Limare to Boulton, 28 December 1778, BCL. In addition, Camus of Limare requested an estimate regarding the cost of a steam engine for a blast furnace. Watt sent him in a letter dated 26 January 1779 an estimate amounting to £2000, excluding the cylinder to be bought from Wilkinson.
- 97 Jary to d'Hérouville, Note, 30 November 1778, AN Marine — G110 — F° 186. 'We could establish a project with the city of Paris to supply it with water against Mr P. . r'. Speculations follow on how to proceed in this case.
- 98 Jean Bouchary, *L'eau à Paris à la fin du XVIII^e siècle: la Compagnie des Eaux et l'entreprise de l'Yvette* (Paris: Rivière, 1946).
- 99 Minutes of the Academy of Sciences, meeting of 3 February 1776.
- 100 Payen, pp. 32 and 102.
- 101 Richard A. Baker, 'John Wilkinson and the Paris Water Pipes', *Wilkinson Studies*, II, ed. R. A. Baker (Merton Priory Press, 1992), 59.
- 102 Ozanam, p. 36. Banker Panchaud was one of the main associates of this Compagnie des Eaux de Paris.
- 103 Ibid., p. 33. The initial capital consisted of 1200 shares, each worth 1200 *livres tournois*, i.e. 1.44 million *livres tournois*.
- 104 Baker.
- 105 Payen, p. 34 (chronology). The Compagnie des Eaux de Paris actually delivered water in Paris from July 1782 to April 1788, when it was dissolved because of financial difficulties due to stock market speculation, and turned into Royal Administration.
- 106 'Recommendations from Academicians at the start of the project'. Minutes of meetings of the Academy of Science, Vol. 95, meeting of 9 March 1776.

- 107 Jacques Seebacher, 'Autour de "Figaro": Beaumarchais, la famille de Choiseul et le financier Clavière', *Revue d'histoire littéraire de la France*, 62.2 (1962), 209. The land was bought to the comtesse de Boufflers on 4 September 1778.
- 108 The analysis which follows is based on Payen; the archives that he cited: AN, Minutier Central, Study XXX, bundle 460, Minute of 19 October 1778.
- 109 Chaloner, pp. 60 and 71 (n. 7), citing a letter from Boulton to an unknown addressee, 2 May 1777: 'The sum of intelligence concerning Perrier is [...] that W. Wilkinson went over to solicit orders for the pipes &c'. Payen, p. 32. In April 1777, Périer went to England and met the older brother, John Wilkinson, in Broseley. He then allegedly promised him a large order — of over forty miles of pipes — in return for Wilkinson's promise to buy shares in the company which he was building.
- 110 Chaloner, p. 60. 'Perrier, when he went to Broseley, was resolved to have common engines; that afterwards he was convinced that ours were much superior'.
- 111 Boulton expressed this distrust of Wilkinson in a letter dated 3 May 1777. He brought it up again in a letter from 22 May 1777 stating that Wilkinson was building a cylinder for an unknown client (who was most probably Périer). BCL — MS 3147/3/1/11.
- 112 This attitude may be dictated by Boulton's warnings. Indeed, Boulton expressed his distrust of Wilkinson in a letter dated 3 May 1777. He brought it up again in a letter from 22 May 1777 stating that Wilkinson was building a cylinder for an unknown client (who was most probably Périer). BCL — MS 3147/3/1/11.
- 113 Payen, p. 106, with a correction of the date of the letter.
- 114 Payen, p. 114. Twenty shares represent one-sixtieth of the initial share capital of the Water Company of Paris (1200 shares).
- 115 De Magellan to d'Hérouville, 13 January 1779, AN Marine — G110 — F° 197. 'I have just received from them, that is to say from the first two (Boulton and Watt), a letter, about the matters that they have arranged with Mr Périer, who came here expressly to have two of the New engines, and they refused to act without your approval. I told them that surely you would approve which would tend to the common good of France and at the same time to the interests of individuals, for we must always combine the individual good with the common good to make it long-lasting'.
- 116 Lord, pp. 90ff.
- 117 Périer to Boulton and Watt, 7 January 1779, BCL — MS 3147/3/156.
- 118 De Magellan to d'Hérouville, 19 January 1779, AN Marine — G110 — F° 199.
- 119 Boulton to Watt, 20 January 1779 from <www.ampltd.co.uk/digital_guides/industrial_revolution_series_one_parts_12_and_13/documents/Reel198.pdf> — Items 3/3/2.
- 120 Watt to Wilkinson, 15 January 1779, BCL F° 111, letter no. 160. Watt wrote: 'Mr Perier has communicated to his Company our proposal and stays answer in London. He seems disposed to give up something. Mr Boulton is now in London and I shall go if necessary. In case of our agreeing with Mr Périer, hope you will guard against making him any cylinders which may be altered so as to elude our privilege, though I should expect him to be more of a gentlemen than to do such a thing'.
- 121 Chaloner, p. 20.
- 122 Boulton to Watt, 27 January 1779, BCL MS 3147/3/3/7. 'We were right in our conjectures about Périer wishing to get from us some exorbitant proposals in writing to injure us at Paris; I have seen Wilkinson, McDermott and Motteux today, who advises us by all means to agree with Périer'.
- 123 Boulton to Watt, 30 January 1779, BCL MS 3147/3/3/9.
- 124 Ibid. 'If I had not closed yesterday it would never had been done as he [Périer] last night received a letter from his Company proposing at their ultimatum 15 shares now and 15 at next creation'.
- 125 Boulton to Watt, 30 January 1779, BCL MS 3147/3/3/9. 'Adjourned till Tuesday and them to meet at Mr Motteux and there finally sign deal'. No track of the signed agreement from 2 February 1778 has been found so far, so it is not clear whether the deal was signed.
- 126 Payen, p. 113.

- 127 Boulton to Watt, 30 January 1779, BCL — MS 3147/3/3/9.
- 128 Boulton to Watt, 2 February 1779, BCL MS 3147/3/3/10. Boulton announced his associate: 'I shall attend Mr Perrier tomorrow night in the Coach to Coventry, and come Birmingham on Friday morning. Pray tell my wife we shall dine her on Friday'.
- 129 Muirhead, p. 260. Muirhead suggests that Périer may have had the opportunity to visit the factory in Soho but is unsure whether Périer and Watt actually worked together.
- 130 Payen, p. 254.
- 131 *Ibid.*, p. 254, clause 12.
- 132 Payen, p. 32 (chronology). 6 November 1779: 'Périer falls into the water during the disembarkment of the engine'.
- 133 Périer to Boulton and Watt, 7 December 1781, cited in Payen, p. 125.
- 134 Payen, p. 126. 'In August 1786, in fact, Boulton and Watt complained that they had written several times without receiving an answer, "but in consequence of a conversation that Mr St James held with our friend Mr Argand, we have been flattered that it will be agreeable to your Company to pay the bill of our account". It is specified that the total sum is 27,668 livres [tournois], "which includes the interest on the first sums on the time they were due to this time. We have not charges any interest on the 24,000 livres agreed to be paid at the augmentation of the original number of 1,200 shares."'
- 135 Boulton to Watt, 14 February 1783, BCL, MS 3147/3/1-79. 'Received Perrier's account. Wilkinson has engine lying at Bersham for Perrier to be erected at St Domingo. Put not your trust in founders'.
- 136 ADLA — Cote C 1063 — INDRET.
- 137 *Compte rendu de la visite des ateliers de Chaillot, en 1786, par une commission de l'Académie des sciences* [Report of the visits to the workshops from Chaillot in 1786 by a committee of the Academy of Sciences]. *Minutes of meetings of the Academy of Science*, Vol. 105.
- 138 The letters and people thus travelled in time of war more easily than the supplies. Obtaining the necessary English and French passports was indeed less difficult for people than for boats. In addition, 'ad valorem' insurances had to be signed for the transported goods, which were very costly in time of war due to frequent piracy.
- 139 Duhamel, *Rapport d'inspection de septembre 1781* [Inspection report of September 1781], AN F14 — 7777.
- 140 Tann and Breckin, pp. 544, 561. The two other orders came from Beconnais and Company (flourmill) in 1789 and Beguyères and Company in 1791. In both cases, the intermediary had been a certain Levêque.
- 141 In Payen the author honours Périer with the best laurels. None of the following authors discard this praise.
- 142 Lord, p. 165.
- 143 Harris, *Industrial Espionage*, pp. 317-18. For a biography of Betancourt, see Irina Gouzevitch, *Augustin Bétancourt (1758-1824): le parangon de l'ingénieur européen* (Rennes, Rennes University Press, 2006).

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