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Cross-trade skills and business strategies: personal itineraries between medicine and metallurgy in Middle Ages and early modern Europe

L. Hilaire-Pérez & C. Verna

Although technology has long been reduced to the application of science to industry, long term studies of cultural practices in the worlds of production have expressed another meaning for useful knowledge. Whereas scientific and analytical knowledge might have been used by practitioners, like industrialists during the Enlightenment, the distinctive feature of innovative technical culture relied rather on growing capacities to mobilize available knowledge, organised in a way to achieve projects, to overwhelm constraints, to gain profit and to spare expenses.

In parallel, technology gradually emerged as a science of the project, as an epistemology of purposive action, of intentionality and design, whereas scientific knowledge was concerned with objects (a definition of science that constructivist historians of science would refute). Useful knowledge as knowledge in action was grounded on abilities to collect, to compare, to combine and to substitute, in a synthetic science.

The theorisation of technology as an "adaptation of means to some preconceived ends" (E. Layton), as an intentional rationality and a science of doing, has already received attention from historians and philosophers. The efforts of contemporaries to foster the autonomy of technology since the Renaissance under the term of science of genius, later evolving into "engineering science" has been studied by several historical "schools", in America, England, and France in the wake of G. Canguilhem's seminars. New research like that of Joost Mertens' and Lissa Roberts' in Netherlands are improving our understanding (like the comparative history of *technologie* "technology").

Nevertheless, one question has been left aside: what part did practical men play in the emergence of this new science of action? The historiography presents "technologists", from Diderot to Beckmann, Ure or Lenormand, as stemming from scientific and enlightened circles of civil servants, from cameralism, from economists' *milieux*. The practical roots of the emergence of technology have seldom been studied. We would like to show that the theorisation of technology as a science of purposive action was fostered by growing abilities to understand technique as a synthetic and projective activity in the long term.

The question asked at several levels. The basic (but difficult) one is the field of practices, of day-to-day work in shops, factories and yards. The spread of synthetic practices

of doing, not at all codified, but daily experienced, was massive, especially as sub-contracting became the main system of production and fostered complementarities, combinations, division of labour into operations and gestures, into transversal units of actions, far from guild ethos and from the “myth of the maker”.

Another level is that of mediators who belonged to worlds of practice (like entrepreneurs and businessmen) and to worlds of theory (because they were learned, or members of societies, or writers of treatises etc.). This will be the focus of our present study, through the biographies of two individuals. Why a biographical approach? Such intermediaries were not numerous. They belonged to small groups of inventive and dynamic entrepreneurs whose cultural itineraries ran across social and economic boundaries, from workshops and business networks to universities, academies and court circles. Such individuals were also used to breaking trade boundaries, to mobilize diverse skills, to develop “technical interrelatedness” and “technological convergences”, i.e. to compare and adapt devices, to assemble and combine pieces and materials, to transpose and substitute designs, mechanisms, tools etc. It is impossible to observe such hybrids without focusing on singular lives, on the originality of personal cultural itineraries.

I . Metallurgy meets pharmacy : Urba Aygabella’s Renaissance

Biography is a difficult practice, particularly in the field of the history of medieval techniques. It is nevertheless a means of questioning, on the individual level, combinations of technical knowledge. In our case, the discovery of written sources of a rare quality allowed us to examine the question across two separate and hierarchically different levels of knowledge and practice: pharmacy and the metal industry. These two areas of knowledge coexisted in the life of notable, living in a mountain village in the south of France, at the beginning of the fifteenth century.

These written sources are notaries' registers kept at the Archives of the city of Perpignan. They correspond documentation relating to the high valley of Tech in Catalonia, a territory today French but which depended in the fifteenth century on the Crown of Aragon. For the rural village of Arles upon Tech alone, 10 notaries’ registers are preserved, recording several thousand acts from 1402 to 1446. These registers represent only a part of the activity of three notary offices among the eight that the village had at this time. But the quality of these sources is not reduced by their quantity. In this case, the hand of the notary is not that of a mere writer. Indeed, the notaries in question are, for the great majority of them, personally involved in the metallurgical industry of their time and held shares in the mining societies, forging watermills and furnaces set up near Arles. The writing of the notary is that of a man immersed in metallurgical production because of his financial interests, and whose knowledge

is reflected in his writing. The vocabulary he uses allows us to reconstitute techniques located in the Catalan mountains, much more exactly than usual. He also reveals the activity of an area with a “technical culture of the territory” (P. Galluzi). Since Antiquity, the Catalan mountains and particularly the Vallespir, the high valley of Tech, have sheltered iron, lead and silver-bearing copper metal industries.

From the thousands of acts recorded in these registers, a particular life stands out: that of Urba Aygabella. He is not the individual upon which the texts shed most light. If we count the acts in which he is mentioned as an actor and not a mere witness, we come to a total of 102 for the period from 1412 to 1446. This is not impressive when compared with some active merchants of the village during the same period, who appear in up to 150 acts. He is not special either because of the diversity of his activities [the practice of several activities is very frequent in the Middle Ages], but he is the only one for whom the texts testify to the variety of his interrelated activities and concerns.

The inquiry into Urba Aygabella allows us to notice the difference between the public denomination of an individual’s professional occupation and the actual range of his activities. From there, we can investigate the reasons for this difference in the light of his knowledge. The life of Urba Aygabella stands out as a concrete example of this difference: he is a declared apothecary in Arles upon Tech in the fifteenth century and was also deeply involved in the dissemination and the implementation of innovative technical knowledge in the metal industry.

So Urba Aygabella is an apothecary. He is not the only one in this mountain village. It is doubtless necessary to recall that in Catalonia, villages enjoyed an exceptional medical fame in the medieval era. Thus, during the 34 years of Urba Aygabella's appearance in the texts, the village has not only another apothecary but also several physicians, surgeons and barbers. His official occupation of apothecary that is indicated in the acts, implies that Urba Aygabella had a formal training that we know was available in Southern Europe from either the University of Montpellier or the University of Barcelona. However it remains unproven that Urba Aygabella actually had this formal training.

Among the 102 acts that survive about this man, none related to his public profession of apothecary: no indication of the sale of ointments, or professional contact with the physicians, barbers or the other apothecary of the village. So the man appears as an apothecary but this activity is not recorded in the texts about him. The acts show an individual involved in the village community: he is a consul. They show a man whose money circulates but in the same way as that of all the other members of the village notability, and the sums he lends are not among the most important. Of course he is not isolated. Besides other members

of the Aygabella family among whom Bartolome, who is an important merchant and has shares in a dyeing company, Urba also works closely with Pierre Comelles, a merchant of the village of Arles, with Pere de Candello, a notary of the city of Perpignan and with other notables of that same city.

What does Urba Aygabella do? He manages his “molina”, that is an hydraulic forge and he actively takes part in prospecting for silver ore in connection with the installation of a “fusina” a furnace, on the territory of Arles. He never invests in the textile activity that is so important in Arles. His domain is that of metallurgical production and even innovative metallurgical production. Indeed the “molina” of Leca (a hamlet near Arles) whose shares he owns together with a notary, is not any common workshop. It is necessary to remember that a “molina” is a direct reduction water-powered iron mill, in which the hydraulic force is used to move hammer and bellows and which produces iron and steel bars directly from iron ore and charcoal and not through the intermediary making of pig-iron. This type of ironworks first appears in the western South of France at the end of the thirteenth century and makes long term roots in the area from Périgord to the Pyrenees. The important innovation of a water-powered blowing system appears for the first time in the texts in 1416, for this “molina” of Leca, where Urba Aygabella is involved. This is related to an important technical detail, that in the direct reduction process, blowing must be controlled very precisely so that the melting point is not reached. This innovative hydraulic ironworks is well known within metal working circles. When the Basque iron makers, who were very active in the XVth century ironworks of Catalonia, looked for a “molina” to rent, they got in touch with their local correspondent and asked specifically if the “molina” of Leca would be free. The texts show~~n~~ that Urba Aygabella did indeed rent his “molina” to Basque iron makers. So, the use of the water-powered blower in the field of iron production is doubtless related to Urba Aygabella's activity in silver production.

In 1425 a silver mine was discovered in Arles. Some months after, a company was created involving Urba Aygabella and Pierre Comelles, the owner of the land on which the mine had been found. Urba Aygabella also took part in other silver-mining companies, but that of “En Comelles” (on his land) is the most interesting for our subject. Indeed, its ore was processed in a furnace which appears in the acts under the precise name of “fusina”. This word was used in Lombardy and Venetia when referring to a silver processing furnace. The philological investigation ~~on~~ of this term is rather complex and I have presented it in another work [“The notary as a witness: techniques and the dissemination of tacit knowledge (Catalonia, XIIIth-XVth centuries) “]. In silver making in Venetia at the end of the Middle Ages, the presence of the word ‘fusina’ specifically indicates a furnace processing both lead and silver-bearing copper using a water-powered bellows. But the “fusina” was a quite new type of workshop in Catalonia. At the beginning of fifteenth century, it was part of the many

attempts, researches and inventions, whether successful or not, that finally gave birth to the "Saiger" process (*Saigerprozess* or cofusion-liquation-ressuage). Now was Urba Aygabella, whether, in the field of silver or that of iron, present at the time of implementation of the innovation? It is possible that he had taken part in the spread of the water-powered bellows from one field of metallurgy to another. So this man is not only interesting at the level of his village but also at a European level because he actively took part in technical mutations that cross the fifteenth century: the water-powered bellows in direct-reduction iron making and researches on silver-bearing copper that ultimately culminated in the "Saiger" process.

Urba Aygabella, who was ~~is~~ publicly known as an apothecary, was certainly able to apply his knowledge as an apothecary to the field of metallurgy. His knowledge of minerals, a necessity for the preparation of remedies and especially his knowledge of metals (lead, gold, silver, copper) may have been useful for his other field of activity. Besides, this use of abilities was rather common at this time: to have silver ore valued, the King of Aragon called for apothecaries and physicians. Of course, for the smelting of polymetallic ore, the "argentarii" (silversmiths) of the city of Perpignan were called for. But even if the scale is different, the weighing of ingredients, the search for their purity, the techniques to separate ingredients by heat are known to an apothecary by training who could apply them to the processing of polymetallic ore. Likewise, the knowledge of heat control is crucial to the production of steel. On a more theoretical level, we must remember the case of Agricola, doctor and apothecary in the city of Jarimov in German Saxe, and author of *De re metallica*. Thus, from pharmacy to metallurgy, and possibly even from metallurgy to pharmacy, Urba Aygabella was able to adapt and combine his knowledge. In any case, his success in the field of metallurgy proves that his position of apothecary allowed him to improve ordinary workshop practices and to create and innovate. His success was born of this technical interrelatedness.

But Urba Aygabella's success was outside the field of his public profession, in discrepancy with his social position. When he announced himself as an apothecary, he conformed to a social model that followed a strong hierarchy and by which a little medieval entrepreneur was a "man without qualities". A large entrepreneur was often referred to as merchant or banker. For Urba Aygabella, who was neither an iron maker nor a silversmith, it was better for his social standing, to keep his status of apothecary. We will come back to this point in the conclusion.

II – Siderurgy meets surgery : William Blakey's Enlightenment

We will again focus on one individual, William Blakey, a perfect hybrid with respects to his identity (Anglo-French), his skills, his enterprises and his social and cultural worlds. We will

concentrate on his business, crossing expertises in watchmaking, steelworking and surgery. As a surgeon, Blakey transmitted technical skills to an audience of consumers to whom he was selling products of his manufacture, steel trusses for hernias, in the 1750s-1770s. We have deliberately chosen micro-history the best scale on which to observe how crafts skills were rearranged into technical knowledge and how the figure of the technician emerged during the Enlightenment.

We will first study Blakey's metallurgical business and then his involvement in surgery, remembering that both activities were closely interrelated. We will try to understand the connexions Blakey created between these two trades.

William Blakey's position as a metallurgist is a good example of the part played by migrations and new sociabilities in the eighteenth century. Blakey was the son of an English watchmaker, also called William Blakey, who came over to France in 1718, as one of the main protagonists of the massive transfer of skills organised ~~run~~ by John Law. This transfer was part of Law's innovative schemes to reform finance and state income by enhancing trade, growth and consumption. Blakey senior was in charge of steelworks in Normandy (Harfleur) to provide springs for a watchmaking factory run in Versailles by another watchmaker, Henry Sully. One hundred English workers were enticed to work at both sites.

Blakey senior and Sully were Catholic and Jacobite, although Sully was of Huguenot extraction. Hybrid identities characterised these highly skilled artisan-entrepreneurs. Blakey junior who was born in London in 1711 (Saint Martin in the Fields) and was naturalised in France in 1758. Meanwhile, as a Catholic, he was able to enter the Parisian guild of surgeons in 1742 and then the guild of watchmakers in 1750. These cosmopolitan characters easily acquired academic, state, court and guild connections and did not oppose public utility and private profit.

Blakey senior and Sully were the main protagonists of the creation of the Paris Society of Arts circa 1718. This society of arts, one of the first in Europe, originated from the academic project of a *Description des Arts et Métiers* but it soon evolved toward a non-academic institution, open to artisans and artists, mixing scientific and technical cultures in order to develop synthetic understanding of facts and processes and improve technical devices. In this pre-Encyclopedic society, tools, instruments, manual skills were praised. Surgeons who could not find their place in traditional medicine because they practised with hands and tools, were welcomed. Some of them were highly innovative such as François Quesnay, who was closely linked to the watchmaker and automata maker Jacques Vaucanson, and the future theoretician of physiocracy (understanding economy as a clock-work organism). The Society of Arts promoted technology as a transversal science of operations devised by practitioners in tune with scientists. But the Paris Academy did not tolerate this 'openess', which competed with it for official credit, and it dismantled the Society of Arts in

1736. Although surgeons had gained an Academy of surgery in 1731, the emergence of technology in the public space developed out of reach of academicians, in other sites and through other media. Business practices and public culture played a major part. Blakey junior became an mediator for technology because of his practice, more than via his involvement with any learned societies.

Blakey was first of all a metallurgist and his guild membership did not mean that he was labelled an artisan. He rather was a manufacturer, taking over his father's business in steelworking mills. It is difficult to follow the relationship between father' and son's businesses in the 1730's, but private ledgers and state correspondence reveal that, at least in 1744, probably before, Blakey junior ran a mill for steel wire drawing to make watch pinion wires and springs. The mill was set up near Paris, at Crécy en Brie (east of Paris), on a river called the Morin (also Villers sur Morin). Blakey's wire mill was considered as an invention by the Paris Academy of science which approved it and allowed it to be printed on its official publications. Not surprisingly, Blakey got an exclusive privilege (patent) for his invention in 1744 ; he was said to have the secret for making steel wire for pinions and ~~to~~ improving such steel, but there is no clue to understanding which steel he worked with and how he treated it in order to be drawn. We only know it was good quality steel, ductile, able to pass 5 times through the draw bench and that it was one third cheaper than English steel.

The steelwork mill might have been quite large. A notary private act gives us information on the mill he used (formerly one for oil) and on the riverside transformations he realised when ~~as~~ he became proprietor of the 7/11th of the river site in 1750. The mill was called a "*fabrique d'acier*", a steelwork. In 1755, he acquired a second mill and requested the use of other sides of, and islands on, the river Morin.

Blakey provided watch and clockmakers with pinions and springs, he also produced steel reeds for looms, a new product in textile manufacture, and he launched "elastic steel trusses" with steel springs. Thanks to his wife, Margaret Elisabeth Aumerle, alias Mrs. Blakey, he set up a shop in Paris, right in the centre, on the "rue de l'Eperon" (parish of St André des Arts) and used prints intensively to advertise his shop and factory. The Blakeys were famous as steelwork specialists and as businessmen.

In 1759, William Blakey junior was called upon to take the lead of the great manufacture of Essonnes, on the river Etampes, not far from the Morin. Essonnes was one of the first sites in France where iron was rolled, although no coal was used at any stage of the production. The production was mainly of iron plates (*plates-bandes*) and rods (*tringle*s). It also was one main centre for making files ~~by~~ with the help of machines ; one of them could cut eight files at a time. The market for files was clock and watchmakers, and production

relied on the use of homogeneous steel. The demand for springs, wires and files was the main impulse behind eighteenth century research into steel in France, which explains why artisans played a main major role in these steelworks, although scientists and academicians more often deserve the attention of historians. The first promoters of Essonnes were Parisians locksmiths, supported by state financers and court mercers. These elite artisans were encouraged thanks to several exclusive privileges, which were seldom granted at that period.

The 1759 act of cession of Essonnes to the Blakeys allowed them to become managers without bringing any assets, only their skills and their equipment from Crécy. According to their ledgers, it seems that the Blakeys mainly worked for the clock and watch making trade, providing wire and springs and also repairing and mending clocks and watches, chains, boxes and all kind of toyware. Their business was supported by the dynamism of Mrs. Blakey's shop which moved from the centre of Paris to a street close to the fashionable street Saint-Honoré (*rue* des Prouvaires). The shop, which opened in 1763, was called "*Le Magasin anglais*". Mrs. Blakey (who was a privileged mercer, appointed to the court) developed a wide commerce ~~of~~ in fashionable toyware trinkets and of tools and machines for the Parisian artisanal market. The Essonnes mill was not sufficient to support this "toys and tools" business. The Blakeys were closely connected to English producers and traders in London, Birmingham and Sheffield where they frequently travelled.

The Blakeys set up an exclusive contract with Benjamin Huntsman in 1765, and then with his successors, William Huntsman & Robert Asline. The Blakeys had the exclusivity to retail Huntsman's cast steel in France (a very strict clause for Huntsman who feared counterfeiters). What did this contract actually involve? The Blakey's bought all kinds of steels Huntsman could deliver them : "German steel", "common blister steel", "best blister"; "shear steel", "double shear", "superfine cast steel" etc. These different qualities of steel referred either to "*lames*" (strips), to "steel in bars" or to tools and files, which mainly came from Lancashire sub-contracted workers supplying Huntsman's firm. The range of tools for trades was wide, it not only included numerous hand tools but also equipment, especially bench vices and sliding tongs. What matters here is that the Blakey's dealt with a multiplicity of materials and products in a long distance trade, so that they had to develop a precise technical language to order specific sizes (especially the thickness and width of foils to be worked in Essonnes), specific qualities of steels for the uses they planned, specific patterns of tools and files according to the needs of Parisian artisans. Although the Blakeys, Huntsman and Aline and the Lancashre workers sometimes failed to understand each other, they tried to set up a codified language, based on prescriptions, measures, drawings and wooden patterns which circulated with the letters. This seems to have been Mrs. Blakey's part. At the same time, Mr. Blakey was developing quite a similar language for the commercial appeal of their steel spring trusses.

Although trusses never counted greatly in the Blakeys' business, these articles were continuously produced in Essonnes. They fostered a trade outside Paris, reaching the provinces and even the colonies, and they were supported by state orders for military hospitals. As we have seen ~~saw~~, William Blakey was a member on the guild of surgeons where he belonged to the (lower) class of truss maker surgeons ("*chirurgiens badangistes*"). He actually visited patients and he "examined" them. Some of his customers called him "operator" or "expert of St Côme". It is difficult to precisely say what were Blakey's knowledge and skills as a surgeon but we must remember that surgeons and watchmakers were closely connected in the Paris Society of Arts and that they both represented an elite of crafts, for whom tools, instruments, gestures and manual skills were emblematic. They were at the fore-front of technology as a science of "operation". It might even be possible that the title of surgeon was more distinguished than that of watchmaker. The surgeons had ~~got~~ an academy since 1731. Blakey advertised his business as a as surgeon or as the author of elastic trusses, not as a steel mill manufacturer.

Why trusses? Trusses were used by surgeons to cure hernias of different sorts and more generally, to reshape bodies when interior disorders created external deformations. Such a remedy was in tune with a conception of the body as soft, weak and unable to produce tension by itself, to accumulate and develop energy through exercises. There was a whole range of pathologies covered by trusses, including deformation after giving birth or ombilic problems for children ; some diseases were not advertised by retailers of trusses like Blakey, for instance anus pathologies which nevertheless seemed quite common according to private correspondence. Actually, in Blakey's case, besides a practical treatise on trusses written in 1758, and his numerous ledgers indicating materials and markets for trusses, the most original archives are his letters to the buyers of steel trusses. Historians of consumption often complain of the lack of evidence of consumers' practices. Blakey's archives allow us to access just such information.

This is why we propose a double-sided explanation to understand Blakey's involvement in truss making. On one hand, he realized a "technological convergence" between watchmaking and surgery, that is between two trades; on the other hand, he set up a wider connection based on a common technical language and on the diffusion of operative skills among specific audiences. Whereas open technic and technical interrelatedness were based on economic logics, we can distinguish two processes, inside trades and outside trades, in the public space.

Technical connection within a trade meant that Blakey transposed resources from one type of production to another. Blakey's former speciality was steel wires and springs, ie the

ductility of steel, the capacity to be shaped, drawn, bent and rolled, and the capacity of the material to store energy and give it back gradually. It seems quite evident that Blakey applied his skills for watch springs making to contrive steel spring trusses. It is possible to understand what his trusses were thanks to the treatise, the ledger and the letters. The main belt was made of iron or steel, the pad (*pelote*) was in cotton or cork, braces were in leather, coverings were in textile or skin, and the main part of it, the springs, were in steel (probably shear or blister).

The quest for elasticity was a major research field in the Enlightenment, not only in steel making but also in gum, textiles and varnishes like those for the building up of balloons. The interest ~~for~~ in elasticity belonged to ~~a~~ transversal technical thought; the materials and their properties were isolated from the products and the objects, they were approached through their behaviour under specific actions and forces like expansion, draught, compression.

Cross-skilling in Blakey's case was not only based on the transposition of watch springs for steel trusses; but it also relied on the transversal understanding of material properties and of concepts of forces and energy. This was in common use in watchmaking as springs had to store energy. But this was also the case for Blakey's trusses. Both the treatise and the letters between Blakey and the purchasers reveal a conception of the body as energetic, as producing effort, as when riding a horse, working for navy and artillery, or weighing charges in building trades. The imbalance created by effort tensions needed compensation from trusses. The constraint on the body by the trusses did not mean any static posture; Blakey recommended exercise and gave advice to ensure some movement. The body itself was considered as elastic; Blakey precisely described the gesture of the surgeon examining the tension of the organs by pressing his hands on bellies. A new balance of forces had to take place between the tension offered by the truss and the lack of tension in the patient's body. Food and the whole environment were considered in respect to the creation of strains in the body which may disrupt its elasticity. In some way, the body was considered as a material. It was also a sort of machine, or rather a component to be adjusted to the trusses. Through the letters a dialogue took place between Blakey and the consumers, who became users of the trusses and technicians of their own bodies.

So, technology also developed outside trade, in the sphere of the public space opened-up by commercial practices. The letters reveal Blakey's exchanges with customers who ordered trusses and had to know how to fit them up. We can make two remarks based on the evidence of the letters. First, the language was similar to the one developed at the same time between Mrs. Blakey and Hunstman & Asline. The problem for ordering trusses was to specify sizes and also pathologies, so that Blakey could contrive "*sur mesure*" trusses. Actually Blakey created two kinds of trusses (with one or two pads), that is ready-to-wear

trusses and custom-made, but the multiplicity of the diseases and the peculiarities of each body obliged him to adapt the models. At least, customers' requirements obliged him to do so. Measurements, descriptions, comparisons and "paper technologies" (designs, indexed straps) circulated. One lady sent a round piece of paper representing her tumour so that Blakey could adjust the shape and size of the pad to her pathology. Some attempt to codify heterogeneous information was created by commercial practice. Blakey and his customers had to adopt a standard technical language.

Second, purchasers also had to learn gestures and technical skills to fit on the trusses, to adjust them to their bodies and eventually to repair them. One specific problem was to fasten the trusses tightly; consumers compared different fitting systems like buttons or staples. Another problem was that the different parts of the truss were assembled by hinges ("*charnières*") which might not fit the shapes of the bodies well. Contact with the skin, and perspiration caused corrosion of the metal fitments, and lead to breakage, which required repairs. Blakey adapted trusses but consumers also tried to do so. In his treatise, Blakey also advised how to make trusses by one self in case of urgency. He described the available materials (cork, leather, linen), the operations and the technical movements required As a result consumers were confronted with forms of technological reasoning and had to become technical actors. This was all part of commercial strategies to attract consumers by reducing the assymetry of information. As a result, a public audience was developing for technical knowledge, ready to learn how to contrive, adapt, repair, combine and assemble materials, pieces, springs, staples etc. Whereas historians of consumption have focussed on the diffusion of taste, of literacy and design, the commercial strategies of artisans and entrepreneurs also helped to develop a taste for doing and aptitudes to project, organize and contrive amongst the public. Through the commercialization of surgery and of body technologies, useful knowledge as a synthetic science of action was diffusing outside crafts and trades, into wider audiences, reshaping the cultural space of technology. Consumers were becoming their own "operators". The ideal of the Paris Society of Arts, the creation of an audience for technology, was realized in an unexpected way, in the market place. By building up a market for steel trusses, Blakey set up an audience for technology, and contributed to the wider dissemination of technological knowledge.

But who comprised this audience? Letters mainly came from men, largely drawn from the ranks of clergymen, military officers and state servants, that is traditional social groups. This public was in tune with Blakey's circles of sociability and with his quest for fame and recognition. His trusses were also expensive items (24 *livres* and 48 *livres*). This audience revealed that technology was spreading through society unevenly, into differentiated publics, built up by practices, and not via a linear process. Technologies associated with the body,

however, might have followed peculiar patterns, in a society based on the "culture of showing". Traditional elites were at the cross-roads of the publicization of the self and of the privatization of intimate activities (like shaving). Blakey advertised "hidden trusses" for people changing clothes in public ("*devant le monde*"). He also explained how to fit them without any help. This privatisation was supported by the commercialization of instruments (notably in steel), the adoption of activities and technical intellection to make use of them. The popularity of these activities in the private sphere went hand in hand with the multiplication of instruments, devices and techniques (as it was the case for design too).

Conclusion

We have presented two case studies which illustrate, through their individual itineraries, what might have been the practical roots of technology understood as the science of purposive action. Because, as metallurgist and apothecary or surgeon, they daily experienced "technical interrelatedness",they became used to comparisons, analogies, substitutions, combinations, that is to the principle of useful knowledge : a synthetic activity of the mind.

If the sciences of conception could be theorised at the beginning of the nineteenth century, it is because some practitioners, for centuries, through their daily practices and their original cultural itineraries had experienced such rationality and even, had understood the singularity of their science of doing. In Blakey's case we must remember that he was the son of a founding father of the Paris Society of Arts. These men were cultural hybrids because their skills crossed-over trade boundaries and because they mingled practices and theoretical tools, eventually leading them (at least Blakey) to formalize and transmit their skills. But what was coherent and rational for them, did not necessarily fit with the classifications in use in their time.

This last point is an issue we would like to raise now. It relates to the social status of the "technologists" in periods when transversal skills and abilities to project were not recognised, except for engineers. Although Aygabella and Blakey were notables and ran wealthy enterprises, they lived in worlds where they were marginal. Neither of them benefited from any status enhancing the originality of their skills. They did not fit with the traditional social and economic classifications of trades and knowledge. Moreover, for Middle Ages, the status of small entrepreneurs (neither merchants nor artisans) did not have any specific appellation. So in Aygbella's case, there was a discrepancy between the public denomination of his professional occupation and the actual range of his activities. The title of "apothecary" might have been a means to gain fame and recognition, especially in the market place. This might also have been the case for Blakey as technicians had lost any institutional place of symbolic credit since the suppression of the Paris Society of Arts in 1736. In both cases, useful knowledge, that is specific skills to combine and to project, did not fit with the

intellectual frame of societies from the Middle Ages to the Ancien Regime. Their sole recognition came from the economic success of their enterprises. Business and commercial practices were more powerful than any scientific impulse to foster the emergence of technology and allowed such technicians to live from their skills, to gain connections with other elites and, eventually, to reach wider audiences.

Until technology gained an autonomy as a specific academic discipline in the nineteenth century, the practices of projects, based on the capacity to rearrange diverse skills to fulfil productive intentions, remained at best in an intermediary state (as an application of science), at worst in a no man's land. Except in places like societies of arts, or in the treatises aiming to reduce practices to principles (arts), technique as a purposive action could not be recognized, or understood.

Bibliography

Georgius Agricola, *De re metallica* (1556), H. C. Hoover, New York, 1950.

Robert G. W. Anderson," ' What is technology ?' : education through museums in the mid-nineteenth century", *British journal for the history of science*, XXXV (1992), 169-184

Enzo Baraldi, « Ordigni e parole dei maestri da forno bresciani e bergamaschi : lessico della siderurgia indiretta in Italia fra XII e XVII secolo », in *La sidérurgie alpine en Italie (XII*e-XVII*e* siècle), études réunies par Philippe Braunstein, Rome, 2001, 163-213.

Guy Beaujouan, « Réflexions sur les rapports entre théorie et pratique au Moyen Âge », in *Par raisons de nombres. L'art du calcul et les savoirs scientifiques médiévaux, XVI,* Aldershot, Variorum, 1991.

Jean-Pierre Benezet, *Pharmacie et médicaments en Méditerranée occidentale (XII*e-XVI*e* siècles), Paris, 1999.

Maxine Berg, "From imitation to invention. Creating commodities in the eighteenth century", *Economic history review*, LX (2002), 1-30

Helen Clifford, " The myth of the maker : manufacturing networks in the London goldsmiths trade 1750-1790 ", in Kenneth Quickenden and Neal A. Quickenden ed., *Silver and jewellery. Production and consumption since 1750*, Birmingham, 1995, 5-12

William Eamon, *Science and the secrets of nature. Books of secrets in medieval and early modern culture*, Princeton, 1994

Paolo Galluzi, « Les machines siennoises. Recherche archéologique, esprit d'innovation et culture du territoire », in *Avant Léonard. La science des machines à Sienne à la renaissance*, Avignon, 1992, 15-83.

Jacques Guillerme and Jan Sebestick, "Les commencements de la technologie", *Thalès*, XII (1968), 1-72, reprint in *Documents pour l'histoire des techniques*, new serie, I (2006)

Liliane Hilaire-Pérez, *L'invention technique au siècle des Lumières*, Paris, 2000

Liliane Hilaire-Pérez and Marie Thébaud-Sorger, « Les techniques dans l'espace public. Publicités d'inventions et littérature d'usage en France et en Angleterre au XVIIIe siècle », *Revue de synthèse*, II (2006)

Danielle Jacquart, « La scolastique médicale » in M. D. Grmek dir. *Histoire de la pensée médicale en Occident, 1. Antiquité et Moyen Âge*, Paris, 1995, 175-210.

Catherine Lanoë, *La poudre et le fard. Une histoire des cosmétiques de la Renaissance aux Lumières* (Seyssel, forthcoming)

Edwin T. Layton, "Technology as knowledge", *Technology and culture*, XV (1974), 31-41

Ben Marsden, "Engineering science in Glasgow : economy, efficiency and measurement as prime movers in the differentiation of an academic discipline", *British journal for the history of science*, XXXV (1992), 319-346.

Joost Mertens,"Technology as the science of the industrial arts: Louis-Sébastien Lenormand (1757-1837) and the popularization of technology", *History and technology*, XVIII (2002), 203 – 231.

Jean-Louis Le Moigne and Hélène Vérin, " Sur le processus d'autonomisation des sciences du génie ", in *De la technique à la technologie, Cahiers science-technologie-société* (Paris, 1984), 42-55.

Joel Mokyr, *The Gifts of Athena. Historical Origins of the Knowledge Economy*, Princeton, 2002.

Antoine Picon, “Towards a history of technological thought”, in Robert Fox ed., *Technological methods and terms in the history of technology* (Amsterdam, 1996), 37-49.

Giorgio Riello, « Strategies and boundaries. Subcontracting and the London trades in the long eighteenth century », *Enterprise & society* (forthcoming).

Lissa Roberts, « A world of wonders, a world of one”, in Pamela H. Smith and Paula Findlen eds.,
Merchants and marvels. Commerce, science, and art in early modern Europe, New York, 2002, 309-411.

Marie Thébaud-Sorger, *L’air du temps. L’aérostation : savoirs et pratiques à la fin du XVIIIe siècle*, Rennes, forthcoming

Raffaello Vergani, *Miniere e società nella montagna del passato, Alpi veneti, secoli XIII-XIX*, Vérone, 2003.

Hélène Vérin, *La gloire des ingénieurs. L’intelligence technique du XVI* e *au XVIII* e *siècle*, Paris, 1993.

Catherine Verna, *Le temps des moulines. Fer, technique et société dans les Pyrénées centrales (XIV*e-XVIe siècles), Paris, 2001.

Catherine Verna, « The notary as a witness : techniques and the dissemination of tacit knowledge (Catalonia, XIIIth-XVth centuries) », in *International Symposium, Craft Treatises and Handbooks : the Dissemination of Technical Knowledge in the Middles Ages, University of Cordoba*, (Cordoba, forthcoming).

Nicolas Weill-Parot, « La rationalité médicale à l’épreuve de la peste : médecine, astrologie et magie (1348-1500) », *Médievales* n°46, 73-87.