Bartolomé Sureda: Mechanic, Inventor and Artist. A Character of Enlightened Knowledge

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Abstract. The main objective of this work is to present the figure of Bartolomé Sureda y Miserol (1769–1851), a mechanic, inventor and illustrated artist, in relation to his contribution to scientific progress. The next goal is to demonstrate the extent to which graphic representation techniques were decisive during the aforementioned process, techniques that the enlightened scientists of Spain, the so-called "experimental natural philosophers" among whom was Sureda, used masterfully to develop their plans and drawings of machines. The scientists of Las Luces constituted a circle of technology professionals whose training came from various fields: artistic, analytical and technical. In the absence of specific educational centres, academies were created during the 18th century that were conceived to promote knowledge and were born from private gatherings. Bartolomé Sureda was trained in these centres and took an interest in both technique and art, and although he applied great geometric rigour in the representation of machines, his artistic will was never absent.

Keywords: Bartolomé Sureda · Engineering-Illustration in Spain · Graphic representation · Aquatint · Lithography

1 Introduction

At the beginning of the eighteenth century, scientific activity had very little social influence and practically no institutional support, and thus, research activity was almost nonexistent.

During the first half of the century, a period prior to the Enlightenment, Spain was immersed in changing historical situations that represented clear disagreements with the Old Regime. With the establishment of the Bourbon dynasty in Spain, voices began to be heard that, in addition to criticism, demanded the search for solutions to catch up with the intellectual activities that were being conducted in Europe.

Decades later, towards the middle of the century, within the intentions of progress advocated by enlightened reformists, scientific advancement and teaching of the sciences were predominant, and both were considered essential elements for facilitating the development of industry and commerce. Within those intentions of prosperity was

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also the manual or servile arts, i.e., arts or mechanical trades excluded from the set of the seven noble or liberal arts that made up the Trivium –grammar, rhetoric and dialectic – and Quadrivium – arithmetic, geometry, astronomy and music. The social attitude began to change as a result of the publication of the French Encyclopaedia, which included equality among the sciences, arts and crafts.

Spanish Enlightenment constituted a unique stage that generated fundamental events in Spanish history in its attempt to transform the world. In addition, established a line of thought that introduced the foundations of modernity and that led to a structure of relationships between scientific knowledge and technique. In many parts of Europe, scientific and technical progress was conceived as something intimately linked to political and social progress, and faith in science and technology was a basic element in the fight against superstition and irrationality.

In eighteenth-century Spain, one of the most characteristic events that occurred was the attempt, carried out by a small section of the population - the enlightened minority - to place Spain at the same level as the rest of Europe. With this objective, science and technology were promoted, and a series of urgent measures were adopted aimed at training new scientists. Among these measures was the hiring of foreign experts and the granting of scholarships to study outside of Spain, resulting in great achievements for our cultural landscape. Trips to Europe and expeditions to America were also promoted, and fundamentally, specialized institutions that promoted scientific research were founded. However, of all the measures described, the main mechanism of creating innovation in Spain during the Enlightenment was scientific missions. Thus, instead of prohibiting studies abroad, as had been done since the Counter-Reformation, scholarships were granted to expand training in other countries. This measure, which began at the beginning of the century, became common during the second half of the century [16]. The measure was strengthened by the monarch Carlos III (1716–1788), with regard to the training of experts abroad, turned out to be of more importance than the hiring of foreign specialists. First-hand learning was much more effective than imported knowledge [25].

Regarding the field of engineering, one of the primary objectives of the Spanish Enlightenment was the implementation of teaching and research in the new disciplines of hydraulics and mechanics to facilitate the development of future public works. To achieve these goals, individuals such as José Moñino (1728–1808), Count of Floridablanca, provided the necessary impetus so that in the spring of 1784, the Canarian engineer Agustín de Betancourt (1758–1824), a paradigm of Spanish enlightened scientists, was graced by the Secretariat of Indias with a pension to settle in Paris, an offer that was endorsed by the Royal Academy of Fine Arts of San Fernando, of which he was an honorary member. At first, his learning was directed to the study of underground architecture, but due to vocational inclination, he subsequently went to *École des Ponts et Chausseés*, a school of civil engineering in Paris and at that time the most prestigious in the world. With Betancourt at the helm, playing a managerial role, the “Hydraulic Team” was established in Paris in 1785, a compact group of Spanish pensioners from different branches of science among whom Bartolomé Sureda would be part of a few years later. The studies in the aforementioned school and the relationship with scholars, including Gaspard Monge (1746–1818), gave rise to a series of fundamental events associated with the subsequent development of Spanish engineering. In this context, various devices and machines were conceived, the steam engine was reinvented, and the optical telegraph was perfected.

During this stay in Paris, there was an event of great relevance, i.e., the continuation -by Betancourt and the distinguished scientist José María de Lanz (1764–1839)- of the unfinished work of Gaspard Monge, creator of descriptive geometry, materialized in a curricular treatise entitled *Essai sur le composition des machines*. The work, from 1808, was pioneering in industrial kinematics, and in its pages, the authors assured, based on certain scientific principles, that "form" and "function" are two directly related concepts [13].

Regarding the founding of scientific institutions, one decisively influenced the development of engineering in our country because of its origins and the group of people and series of events that made its founding possible. The Royal Cabinet of Machines opened its doors in Madrid in 1791 under the direction of Betancourt and the subsequent incorporation, in 1793, of Juan López de Peñalver (1764–1834). During their stay in the French capital, the members of the Hydraulic Team developed and compiled plans, models, and scientific reports representative of the avant-garde engineering in Europe [2]. The complete collection, i.e., 359 plans, 270 models and 99 memoirs, arrived from Paris to Madrid in the summer of 1791 and was installed in the rooms of Buen Retiro Palace. The Royal Cabinet opened its doors on April 1, 1792; however, it took until 1802, the year in which a new educational centre, i.e., the General Inspection of Roads and Canals, was created, for Betancourt to transform the Royal Cabinet into the School of Hydraulic Studies, acquiring notable importance as an educational centre considered among the best European scientific centres.

Following the French occupation in 1808, the pilgrimage of the machine collection of the Royal Cabinet to various points of Madrid began, from the drawing rooms of the Royal Academy of Fine Arts of San Fernando to Buen Retiro Palace. After the assault on this palace by Napoleonic troops, what remained of the collection was sent to Buenavista Palace, where it remained in obscurity until 1815. In that same year, the Royal Matritense Economic Society of Friends of the Country carried out an inventory, the results of which revealed the irreparable losses suffered. The collection remained there until 1824, when the Royal Conservatory of Arts was founded; it was then, after the last transfer to this institution, when the remaining machine collection of the Royal Cabinet almost completely disappeared. These documents undoubtedly constitute one of the most important and best testimonies of Spanish engineering during the Enlightenment [21].

The Royal Conservatory of Arts became the Royal Industrial Institute in 1850, a centre in which a new type of civil engineer began to germinate, i.e., industrial engineers [20].

2 Biographical Notes: Training, Professional Activity, and Inventions

Bartolomé Sureda was born in Palma de Mallorca in 1769 into a family of carpenters. When he was a child, he demonstrated an inclination for the arts and skill in drawing, entering the School of Noble Arts of the Royal Mallorcan Economic Society of Friends of

Fig. 1. Francisco de Goya. Portrait of Bartolomé Sureda (fragment). 1803–1804. National gallery, Washington

the Country at the age of 16, where he earned awards on two occasions [5]. The classes taught by Juan Muntaner (1744–1802), engraver, teacher, and director of the school allowed the young Sureda to recognize the importance of instruction in the technique of engraving, which was one of his contributions to scientific dissemination during the Enlightenment [24]. His education was nourished by writing books and treatises in addition to other texts that contributed to his technical training; however, his training also focused on the application of new techniques, including the then emerging intaglio engraving and lithography.

In 1791, with the help of the Mallorcan Tomás de Verí (1763–1838), a pensioner in Paris and a member of the Hydraulic Team, he moved to Madrid and entered the Royal Academy of Fine Arts of San Fernando, which then had a pedagogical facet, the following year. Through Verí, he came into contact with Betancourt, who, in view of his artistic gifts, incorporated him into his work team and invited him to make a to England on a scientific mission associated with industrial espionage. The main objective of the trip was to learn about the "hydraulic press," a new invention by the English engineer Joseph Bramah (1748–1814). Sureda remained in England between 1793 and 1796, and as Betancourt's right hand, he took trips and conducted industrial and engineering studies on the design and construction of machines, perfecting his knowledge of drawing and engraving and undergoing training in the manufacture of English pottery. Among the chalcographic engraving techniques he learned were the "aquatint" and "aguada" varieties of etching; thee techniques consisted of generating various shades on a copper plate, giving it a certain pictorial character.

In March 1797, the year they returned to Spain, at the Royal Academy of Fine Arts of San Fernando, both scientists presented the new hollow engraving technique learned by Sureda in England, a technique that he later showed to Francisco de Goya (1746–1828), who used the technique in his *Caprichos* collection made between 1798 and 1799 [6, 10]. Pedro García-Ormaechea write about the presentation of these techniques before the Board of Academics, among whom was Goya:

"… a new method of painting on glass, executed in England, a picture engraved by Don Bartolomé Sureda in a way that imitates the washing of Chinese ink, another engraved by a method that imitates a pencil and is executed on the sheet as soon as it is drawn on the paper, and another engraved on a board; all of these were presented by the Honorary Academician Agustín de Betancourt as evidence of what is being advanced in the arts in that part of Europe" [9].

Apparently, in gratitude for the teaching received, between 1803 and 1804, Goya painted portraits of Bartolomé Sureda (Fig. 1) and his wife Thérèse Louise Chapronde Saint Armand; these paintings are displayed in the National Gallery of Washington.

On the other hand, the Valencian artist José Antonio Jimeno y Carrera (1757–1818) was one of the first cultivators of aquatint engraving in Spain. Thus, the possibility has raised that Jimeno initially showed Goya the new technique [6, 12].

In August 1796, a scientific expedition left for Cuba with the objective of building a canal from the Güines Mountains to Guantánamo Bay [11]. The Cuban authorities requested the presence of Betancourt, Lanz and Sureda to execute this project and direct the construction of machines for sugar mills, which had operated until then by oxen and slaves. Sureda would have been responsible for creating plans and levelling. However, the aforementioned mission was never carried out because the ship in which they were travelling was seized, on June 9, 1797, by the British frigate Boston, and the surveying instruments were seized. The construction of the canal was replaced with the construction of a railroad that linked Havana with Güines, the first railroad to be built in the Spanish-American world. Subsequently, Sureda joined the Royal Cabinet and dedicated himself to engraving representative plates of machines for informative purposes under the direction of the engineer López de Peñalver (Fig. 2).

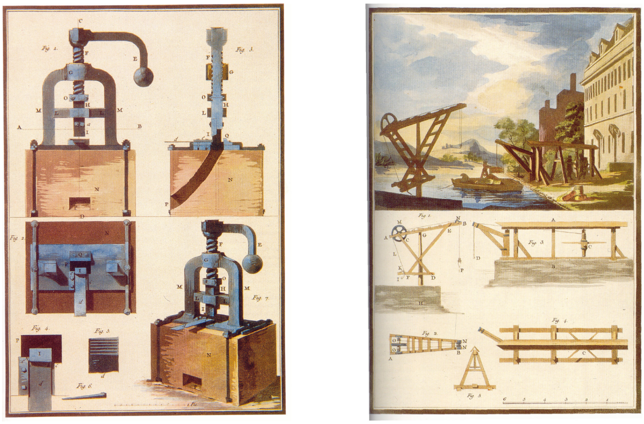

Fig. 2. B. Sureda. (a) Nail making machine. (b) Crane for the port of Mahón. Descripción de las máquinas… 1798 [15]

In 1800 and with the constant support of Betancourt, Sureda travelled again to France to undergo training in the construction and handling of textile machines under the guidance of the machinists Charles Albert and James Collier, who spun cotton, wool, linen and hemp in Coye-la-Fôret (Oise). The purpose of this apprenticeship was to take charge of the Royal Cotton Factory of Ávila, which had been managed and operated by Betancourt since 1799. From France, the Mallorcan sent detailed plans of the structure and operation of the new machinery; Betancourt, based on the plans, was having the machines built with support from the Madrid Cabinet.

In 1802, he moved to Paris to learn porcelain manufacturing techniques at Manufactory Nacional de Sèvres, whose industrial secret had not been revealed. Upon the death of Felipe Gricci, director of the Royal Porcelain Factory of Buen Retiro, and at the express request of the Spanish crown, Sureda returned to Madrid in 1803 to take over the company.

In the history of Spanish porcelain, Bartolomé Sureda will always remain linked to Buen Retiro Manufacturing, the company founded by Carlos III in 1760 and in operation for almost half a century. The discovery of the first Spanish hard porcelain during Sureda's mandate marked the beginning of a process of technology transfer in Spain in the early nineteenth century [22]. Chemical and mineralogical analyses of a selection of fragments of crockery, tiles and sculptures that were found during the archaeological excavation of the factory in 1996, confirmed the production of a new type of hard porcelain in which a magnesium clay, sepiolite, was used instead of kaolin. The steps that he had to take before being able to manufacture hard-paste porcelain are recounted in a report that he wrote in November 1808, when he was about to leave the factory [18]. During the five years of his tenure, he developed a porcelain different from other European productions, i.e., "Porcelanas de Madrid," even producing pieces of a higher quality than that manufactured in Sèvres. The Royal Factory, known as the China Factory, was occupied as a barrack by the French in 1808 and burned by the English in 1812, apparently with more commercial than political interests.

In the middle of 1809, Sureda travelled again to the French capital, now with the objective of following Betancourt, who had been in Russia. However, Napoleon (1769–1821) did not allow him to continue his journey and ordered him to remain in France, where he dedicated his time to improving his knowledge in the field of porcelain and the textile industry. During this stay, he began to develop his skills as an inventor, patenting, together with the mechanic Etienne Calla (1760–1835), a machine for spinning all types of filamentous materials (Fig. 3).

After five years, he returned to Palma de Mallorca, where he collaborated in several projects supported by the Mallorcan Society of Friends of the Country, for example, the mechanization of wool weaving in workshops associated with the hospital. However, his stay there was brief; a few years after his arrival, he was assigned as a technical director to the Royal Cloth Factory of Guadalajara, again under the command of López de Peñalver. He was entrusted with the establishment of workshops to spin wool using machines; he was able to accomplish this because of the knowledge acquired in his previous stays in France.

In *Essai sur le composition des machines* by Lanz and Betancourt [13], Sureda is again described as the inventor of some mechanisms: an improved textile machine (Fig. 4), a machine for polishing windows (Fig. 5), a machine that applies continuous circular motion at a uniform velocity that can be changed to an alternative rectilinear motion (Fig. 6) and a machine for mincing leather to make cards (based on the motion of the previous invention) (Fig. 7), among others.

In 1820, he was assigned to the Royal Porcelain Factory of La Moncloa, which was created to replace the former Buen Retiro factory.

A few years later, in 1824, he was appointed director of the Royal Glass Factories of San Ildefonso, undertaking its renovation with the construction of new mills and the

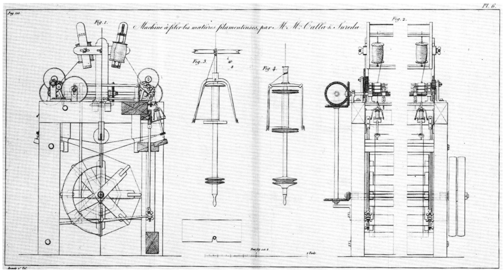

Fig. 3. B. Sureda and E. Calla. Patent: machine à filer les filamenteuses. 1812 [5]

restoration of the manufacturing and polishing of large mirrors using the aforementioned machines he invented (Fig. 5). In that same year, he was appointed director of the construction and repair of machines of the Royal Conservatory of Arts. Subsequently, Sureda was part of the jury for the first public exhibition of Spanish Industry products held in Madrid in 1827.

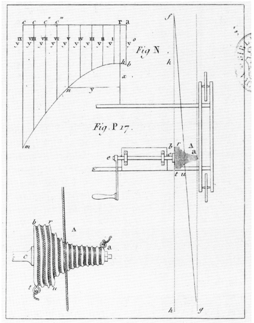

Fig. 4. B. Sureda. Invention: Improved mule-jenny spinning machine. Essay sur … (Mechanical description and application of the invention in facsimile of the first English edition of 1820, P17, p.149) [13]

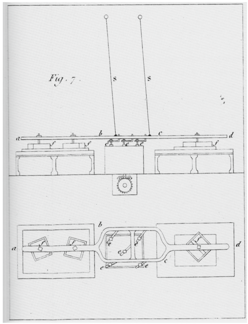

Fig. 5. B. Sureda. Invention: glass polishing machine. Essay sur… (mechanical description and application of the invention in facsimile of the first French edition of 1808, F.7., p.30) [13]

Around 1829, he returned to Mallorca. In recognition of an artistic career that he had never abandoned, he was appointed director of the Academy of Noble Arts by the Mallorcan Society of Friends of the Country, a position he held from 1837 to 1849, taking charge of the remodelling of the drawing and sculpture studios. In those years, he travelled with his followers to Barcelona to participate in the preparation of the plates for the *Historical-artistic Panorama of the Balearic Islands,* the work of Antonio Furió (1798–1853), a lithographic instalment by the painter and engraver Francisco Muntaner (1743–1805). The presence of Sureda in the Academy was an impetus for the application of new artistic techniques, i.e., daguerreotype and lithography.

Bartolomé Sureda died in Palma de Mallorca in 1851.

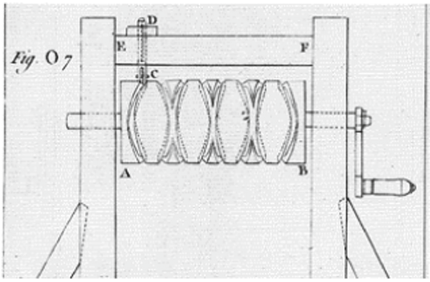

Fig. 6. B. Sureda. Invention: transformation of circular motion into rectilinear motion. Essay sur… (mechanical description and application of the invention in facsimile of the first French edition of 1808, O.7., p.36) [13]

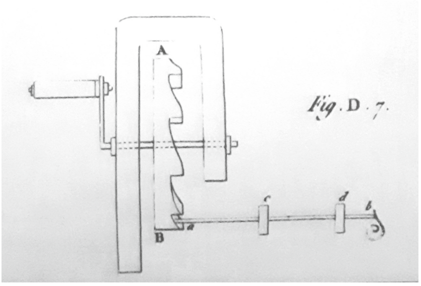

Fig. 7. B. Sureda. Invention: application of motion transformation to a leather chopping machine to make cards. essay sur… (Mechanical description and application of the invention in facsimile of the first French edition of 1808, D.7, p.29) [13]

3 Bartolomé Sureda, an Encounter Among Science, Technique and Art

In the extensive entry dedicated to Sureda in the Historical Dictionary of Illustrious Professors of Fine Arts in Mallorca, the first reference makes mention of his training in drawing, which together with mathematics constituted the pillars of the thought of Las Luces [7].

Bartolomé Sureda, as an enlightened person, was immersed in the great changes that occurred during the Enlightenment in conjunction with various technological and sociocultural phenomena that changed the character of life in the last decades of the eighteenth century. However, in his role as an architect of the graphic representation of machines, he actively participated in a fundamental moment, a before and after, marked by the historical significance of the Age of Reason and the incipient postulates of descriptive geometry. In this way, this period became an essential stage between the real and figurative staging that had begun in the medieval era and the normalized schematization of the contemporary age.

The drawing of machines in the 18th century contributed, to a great extent, to the characteristics of drawing in general. Enlightened scientists used a certain coding in their graphs that was accompanied by figuration and artistic rendering of the objects represented. It was then, in the late eighteenth century and as an innovative resource, when technical records were becoming popularized. The staged reading typical of previous moments was maintained, but gradually, a more technical definition was incorporated into the available graphic space, in such a way that the drawing of machines was progressively losing its plastic quality for the sake of industrial production in the eighteen hundreds. The new geometric postulates, together with serial manufacturing and the birth of the principle of interchangeability—direct antecedents of standardization in industry—contributed decisively to the creation of a graphic language of engineering that, as such, was acquiring a set of characters and symbols—a syntax—incomprehensible to unqualified readers [26].

Technological development has been greatly influenced at all times by the different techniques of graphic representation. From the Middle Ages to the Renaissance, the drawing of machines was based mainly on the staged representation of the object; the graphic samples of this period, usually embedded in technical texts, generally consisted of models of the mechanism as a whole with a merely illustrative function and sometimes presented some hints of conventionalism. However, in the Renaissance, technical representations began to exhibit certain recurring graphic aspects, and together with the theatrical rendering of machines and their environments, typical of the artists, other types of drawings were developed in which mechanical objects were shown with a more precise description, through some schematization and attenuation of the surrounding space. Later, in the eighteenth century, the transformation of social relations was decisive and of great depth, making it necessary to meet the demands of a new social system by resorting to inventing unprecedented technical procedures. A more intense relationship among science, technology and industry was established, leading to the birth of a true machine cult that led to a transfer of the craft to the industrial plane. In the 1700s, the production of images related to machines acquired a particular purpose that responded to the demands emanating from modifications in the social structure. During that century, technical records became popularized in the graphic space, which until then had only been artisanal; factories and workshops were shown as theatres in which activities were conducted. In this first phase of machinery, mechanical designs materialized in plans and drawings, in which washing or intaglio engraving was masterfully expressed in the communication of a certain type of information destined for technological development and formed the basis of an ideology of technicality. In short, beginning in the seventeenth century, and more formally in the eighteenth century, the same demands of the social system that had led to the division of labour were seen in the drawings of machines that sought decomposition in phases of the artisanal manufacturing processes [27].

In the first attempts to rationalize information and as an innovative fact of great importance – although with roots in some Renaissance machine theatres – the compilation of analytical and descriptive methods was linked, in the late eighteenth century, with a bipartition in the images of machines superimposed in the same work with comparative figuration of the whole and specifications of the compositional parts. The staged representation of previous moments was maintained, but gradually, technical records were becoming popular in the figurative representation of objects, and a more technical definition was incorporated into the available graphic space, with which the compositional parts of contraptions began to be exhaustively described. Finally, with the progressive arrival of industrialization at the beginning of the nineteenth century, the samples described above did not coexist in the same graphic space and continued, from that moment, as well differentiated currents. Bartolomé Sureda, along with other illustrious figures, were the last Spanish scientists interested in both technique and art. This affirmation is evident in the plates, drawn and engraved on paper by himself with the new chalcographic techniques learned in England, for the already named work directed by José López de Peñalver in 1798, *Description of the machines of more general utility that are in the Royal Cabinet, established in Buen Retiro* [15] (Fig. 8).

The century par excellence in terms of intaglio printing was the Enlightenment. The reforms undertaken during this period resulted in engraving being one of the most effective ways of disseminating ideas; engraving was conceived, mainly, as a means to create illustrations in scientific books. In Spain, all the technicians of the time were trained in hollow engraving in the recently founded Royal Academy of Fine Arts of San Fernando. Through this academy, technical advances and machines facilitated the progression of art, linking scientific studies to artistic development. In this way, the Academy played a fundamental role in scientific development by promoting decisive techniques for the dissemination of science: drawing and engraving [1].

During the seventeenth century, copper plates with engravings displaced wood blocks engraved with fibre, thus transitioning from relief techniques to hollow engraving to represent machines. One of these techniques, "aquatint," is a chalcographic method derived from etching in which resin is used in addition to varnish and acid.

Another new technique that Sureda learned in England was "gouache", "lavis" or "brush bite," which imitated the pictorial effect of an ink wash due to the direct application of water with a brush.

The aforementioned work by López de Peñalver, *Description of the most useful machines in the Royal Cabinet,* was developed with the active participation of Sureda and can be considered the first edition of a Spanish technical collection in which the modernizing of industry is illustrated. The prints, engraved with etching, gouache and burin, were made by Sureda and by the engraver Vicente Mariani (1765–1819) In the prints prior to the 19th century, the engraver included a series of Latin words that helped the reader understand the mechanism [19]. In the illustrations elaborated in gouache and illuminated later, as explained in the book itself, the following phrase is shown at the bottom of the sheet "Sureda drew it and engraved it" or *"Sureda lo dibuxó y gravó*," which indicates that he was the only artist who worked on the plate. However, if we analyse the prints made by Mariani, created with burin, the caption that appears is *"Mariani sculp"* or *"Mariani sc,"* which means that he only engraved the plate and was not the creator of the original drawing (see the signature in Fig. 8 b).

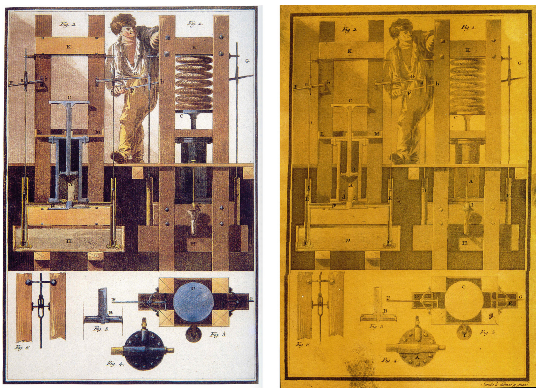

Fig. 8. B. Sureda. Hydraulic press of Mr. Bramah. (a) Stamp. (b) Copper plate. Descripción de las máquinas… [15]

During his stay in England, Sureda also learned about and trained in a new method of wood engraving that had been developed by Thomas Bewick (1753–1828) in 1775. Given the limitations of wood fibre carving, this new method involved engraving in relief. The process consisted of cutting the wood perpendicular to the axis of the trunk, countergrain, counterthread or testa, as it was called in Spanish, or gravure sur bois debout or wood engraving in French or English, respectively. This technique allowed working in a similar way to that of burin on metal.

Some years later, in the first decades of the eighteen hundreds, there was discussion in Spain about a recently invented image reproduction technique. It was an additive technique for planographic printing in which the matrix was obtained by adding material and not subtracting it, as in previous engraving processes. Lithography, given its name because it involves stones, gave rise to a matrix without incisions; therefore, it should not be included as an engraving technique, as it is sometimes designated [3]. The inventor of the aforementioned technique was the German Alöis Senefelder (1771–1834), author of plays, who, in 1796, in an attempt to print his own works and not having sufficient economic means to use copper, resorted to the use of stones from the quarries of Solnhofen (Bavaria), which led to the discovery of lithography. It was a flat printing technique that allowed stamping of an image drawn on a stone with ink or a grease pencil. Senefelder patented his invention in London in 1800.

The first report of lithography in Spain was the translation of the writings of Marcel de Serres (1783–1862) "News on lithography or the art of printing with stone moulds" included in the *Memory of Agriculture and Arts* published by order of the Royal National Board of Government of Commerce of Catalonia, Barcelona, by Antonio Brusi (1775–1821), in 1815–1816. Regarding its impact in Spain, lithography revolutionized graphic techniques used until then, primarily because of its ability to reproduce originals [23]. After a period of training in Munich, Bartolomé Sureda, Carlos Gimbernat (1768–1834) and José María Cardano (1782–1843) were the pioneers of lithography in Spain, with the intention of using the new technique as a means of scientific reproduction. In 1818, under the direction of Cardano, the first lithographic establishment was inaugurated in Spain and created for the management and processing of maps, charts and plans. Cardano himself showed Francisco de Goya the new technique [4]. Some years later, in 1825, Sureda assumed the task of advising José Madrazo (1781–1859), in charge of the Royal Lithographic Establishment, on the use of the lithographic presses in the Hydrographic Depository [17].

To conclude, with the newly implemented graphic techniques, Bartolomé Sureda was one of the first to learn and use daguerreotype. In the aforementioned work *Optical-historical-artistic panorama of the Balearic Islands* of 1840, Francisco Muntaner makes careful use of the lithographic press and the machine invented by Daguerre that ensured the reality of the representations of subjects [8] (Fig. 9).

4 Final Considerations

The extensive specialized training and the extensive and fruitful professional life of Bartolomé Sureda, a figure of knowledge and representative of the ideals of the Enlightenment, has barely been detailed in this work. Among the numerous facets of his activity,

Fig. 9. B. Sureda. Optical-historical-artistic panorama of the Balearic Islands. Molino de la Beata. Lithography, 1840 [8]

we wanted to note, specifically, his formidable contribution to the graphic representation of machines in their interaction among science, technique and art.

It is necessary to remember that, during the Enlightenment, due to new scientific postulates, fundamental changes occurred in the industry and originated the progress of modern engineering. In this sense, the similarities with the current moment in which a new industrial revolution is taking place are evident, now due to profound and emerging technological and methodological changes.

Engraving and lithography techniques played a fundamental role in the diffusion of technology; industrial advances have always been linked, in each stage or historical period, to graphic representations through these artistic techniques. War machines, hydraulics and a multitude of devices and machines, culminating with the steam engine in the nineteenth century, have been carefully drawn and reproduced, contributing to the dissemination of knowledge. Engraving, although initially considered a minor art, experienced a notable boom in Spain during the seventeenth century. As art at the service of the Enlightenment, engraving contributed to demonstrating the achievements made in areas as diverse as art, literature and science [14]. The most widespread reproduction engravings drew the eyes of Europe towards its own cultural assets. This technique was widely used in scientific dissemination, and it is an indisputable fact that one of its most notable creators was our character.

Through the graphic representation of machines across the centuries as an active subject of technicality, it seems evident that images themselves have held a preponderant position within the complex framework of machinery. It would not be possible to think of the industrial advances of the nineteenth century without the application of descriptive geometry to the science of machines, unifying the criteria in regard to capturing the achievements of the century.

Therefore, understanding and identifying the procedures by which these images were obtained is relevant because when thinking about their iconographic analysis, prior knowledge of the sources and familiarity with specific topics and concepts is required. To achieve this understanding, investigate the cultural tradition and scientific knowledge of the drawing of machines and, finally, pause and examine the essential work of Bartolomé Sureda y Miserol.

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