The use of 19th - century Cartography Printing Processes in Contemporary Printmaking

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SYNOPSIS

In the 19th century, the field of cartography grew exponentially when photomechanical printing became a stabilised procedure for the graphic arts industry. With the introduction of photomechanical processes, in the early developments of chromolithography, maps not only became a widespread product in Europe and the United States but they were also refined and became increasingly visually complex.

The interaction between scientists and printmakers also changed. As photomechanical processes allowed cartographers to autonomously transfer, reduce or enlarge maps, scientists and military personnel took over the task of translating images onto the wood or copper plates - a job traditionally assigned to a skilled engraver (Cook, 2002) This has also shifted the authorship of printmaking literature to scientists and military personnel, such as captains or colonels (Twyman, 1990).

Early printing techniques - such as woodcut or intaglio - are practised today within a very specific setting for particular needs. In the framework of contemporary art, design, or illustration, aspects such as the materiality of images are discussed, visually experimented with, and exhibited. While some industrial printing techniques have gained artistic standing - serigraphy, for example - a wider range of processes are hidden in the past (R. Williams and D. Williams, 1986). Cook (2002) argues that both cartography and printmaking owe each other a great deal for their progress. In the history books, however, one rarely recognises the other. We argue this is because printmaking as a profession has been split between art and science.

Based on our research centre in Portugal, we discuss the technical innovations of the Photography and Artistic Section in Lisbon, under the supervision of José Júlio Rodrigues (1843-1923). As the head of this Institute, Rodrigues (1876) was a renowned scientist at the time, awarded at the famous Expositions Universelles de Paris in the middle of the 19th century (Grandidier, 1882).
We show how this case study is a cornerstone to discussing map printing using photomechanical processes, as the Portuguese institution was one of the first within the Iberian Peninsula to focus on developing new methods for printing using photography.
From a printmaker's perspective, we aim to show how such techniques can be reenacted for a print studio. This is accomplished by applying a

Figure 1

Figure 2

Figure 1. 19th - century map reduction of Goa, India.Book of Specimens "Estanhos: Spécimens Relativos ao processo -Photolithographico da Secção Photographica. Direcção-Geral do Território, Lisbon, PT (Photography: David Lopes, i2ADS)
Figure 2. 19th-century tools for producing cartography,books of tinfoils, drawers with glass and cooper.Secção Photographica e Artística. Direcção-Geral do Território, Lisbon, PT (Photography: David Lopes, i2ADS)

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methodology we call "technological archaeology", looking into pioneer sources to replicate or reconstruct past methods using today's manual setting of a printmaking workshop. Specifically, we focus on Rodrigues's (1) use of thin metal plates for transferring or printing map images, and (2) his halftones colour printing using copper, a process referred to as "chromocuprographie" (Peres, 2013). Our presentation intends to show the results of our practical research.

In the first part of this paper, we analyse the convergence and the split between printmakers and cartographers, and how both differed when they communicated printing processes. In the second part, we discuss the technical processes of the Portuguese Photographic and Artistic Section. Finally, we present a brief critical position on how cartography can be explored by artists today, underlying possible material metaphors between printmaking and map-making in artworks of modern and contemporary art (Reddleman, 2018).

Figure 3

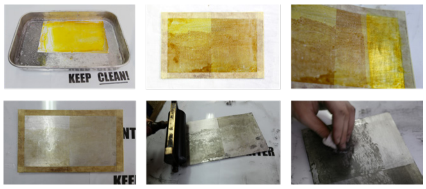

Figure 4

PRINTMAKING AND CARTOGRAPHY

The printing of cartography saw great improvements in the 19th century, mostly because of two technological innovations. First, Senefelder's invention of lithography and its later combination with photography prompted the printing industry with several photomechanical processes.

Centuries ago, the first printed maps would have been printed with woodcuts. Then, up to the turn of the 19th century, maps and atlases were mostly printed with intaglio techniques, drawn with a burin or etched (Woodward, 1975; Wood, 1985, p. 78). Both techniques demanded the labour of skilful engravers and a great amount of time, which made map printing very expensive. As Twyman (1990, p. 18) explained, lithography was not initially used in printing the written word, but in reproducing music sheets, maps, and artists' drawings. He also analysed how early advertisements for lithography printer studios displayed their capacity for printing maps (Twyman, 1999, p. 127). The main reason why lithography gained so much attention is that the technique enabled map printing to be cheaper and faster. Litography's later combination with photography accounts for the subsequent growth in the circulation of maps and commercial success (Brotton, 2012/2019, pp. 395 and 400).

The developments of lithography and transfer papers permitted maps from the previous centuries—printed with woodcut or intaglio techniques—to be re-edited, thanks to Senefelder's extensive instructions for transferring images to the stone matrixes (Holden, 1984). In essence, the technique could make widely accessible what would otherwise be very rare objects. Holden (1984) argued that Senefelder's biggest contribution to map printing was the invention of transferring, specifically the material developments of transferring inks and transfer papers. Another advantage of using paper was that the drawing and the writing of maps could be transferred without mirroring the information. With lithography, texts could also be

Figure 3. 19th-century tinfoil sheet with image inkedwith the purpose of lithographic reproduction. Secção Photographic eArtística. Direcção-Geral do Território, Lisbon, PT (Photography: David Lopes. FBAUP: i2ADS)
Figure 4. Reenactment of Rodrigues's technical procedure,using alternative metal aluminum sheets. (Research conducted atthe Faculty of Fine Arts of the University of Porto by David Lopes. Researcher in I2ADS)

written on the same matrix as the image of the map. Twyman (1999, p. 126) said, "...we tend to forget how much letterpress printers used to be governed by the availability of types". The advances in technical possibilities, where maps could be printed as relief types, also known as photo-zincography plates, served the printing industry fairly well. Maps could now be printed alongside types in the same printing run.

The printing of drawn images using photomechanical processes began with the development of photolithography. Twyman (1999, p. 243) credited the first methods to Lemercier, Lerebours, Barreswil, and Davanne. Lemercier improved a method first patented by Poitevin in 1855, in which the lithography stone is coated with light-sensitive substances and then exposed using a glass negative.
A variant of Senefelder's transfer paper, using dichromate potassium or ammonium, was introduced by Edward Isaac Asser (1809-1894). Asser followed the discovery of Poitevin, who had shown that gum dichromate was attracted to grease, allowing for the possibility to charge the bichromated paper with lithography ink.

Photomechanical processes were also in demand for their potential to reduce images through negatives and glass lenses (Twyman, 1999, p. 244). The reduction of printed maps was of interest in the 19th century, also in the Photographic and Artistic Section in Portugal. Maps of Portugal have been identified in the archives of DGT , Lisbon, Portugal (see Figure 1). In sum, photomechanical processes powered the printing industry to make large print runs of maps (Waterhouse, 1878, p. 70).

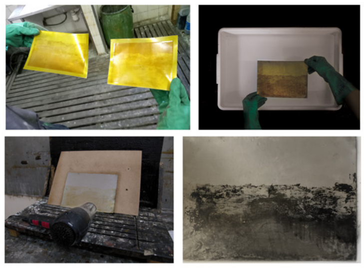

Figure 5

Figure 6

THE ROLE OF PHOTOGRAPHY IN THE EMANCIPATION OF CARTOGRAPHERS

In the 19th century, lithographers could make an impactful career by contributing technical innovations to print maps, plans, etc. One example is Joseph Netherclift, who won a silver medal given by the Society of Arts in 1828, for his method of making transfer lithographs. Netherclift was recognised as one of the "most eminent of printers working in the field of maps and circulars" in 1831 (Twyman, 1999, p. 235). There is also the example of the case study of this paper, the Portuguese chemist José Júlio Rodrigues, who also established a career as an award-winning scientist in Europe for his map printing contribution techniques at the Photographic Section in Lisbon.

Jerry Brotton (2012/2019) explained that in the 19th century, the advantages of printing lithography empowered scholars and other individuals to establish geography and cartography as a new discipline with a scientific status, which before this century had not yet existed. In Great Britain, conferences were held to argue in favour of geography and cartography as important in understanding the territory, the evolution of the landscape, climate, and the environment. As Brotton pointed out, today such ideas might be quite obvious, but up to the last decades of the 19th century, this was a pioneering understanding (2012/2019, p. 406).

Figure 5. Reenactment of Rodrigues's technical procedure,using tinfoil thick sheets. Image by Graciela Machado.(Photography by David Lopes. PhD student at FBAUP. Researcher from i2ADS)
Figure 6. Process steps in preparing transfer inksfor lithography following 19th-century recipes. (Research conducted at theFaculty of Fine Arts of the University of Porto. Photography by David Lopes. PhD student at FBAUP. Researcher from i2ADS

The armed forces took a special interest in the new technology of printing maps, and before long, lithography and the new photomechanical processes for map printing were introduced in their departments (Twyman, 1990, p. 60). According to Brotton (2012/2019, p. 397), the number of cartographic projections of the world in the 19th century was three times higher than in the previous century. The military leadership has always understood the potential for new technology in territory defence and warfare. The relationship between power and cartography is historical, as maps have always been produced for military officers and the elite for political purposes or as luxurious displays (Ristwo, 1975, p. 78)

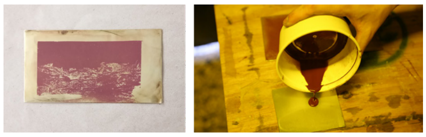

Figure 7

According to the same author, military academies started setting up their own lithography workshops. This is the case with the "École d'Application de l'Artillerie et du Genie". In this example, the establishment hired what was coined as the "artistic lithographer", which, as Twyman explained, has no "literal" translation in the English language (1990, p. 66). It merely refers to the technician who would run the printing studio. Since military maps, plans or other prints were taken to be state secrets, printmakers could not necessarily be understood as artists, but rather as employees who were hired as specialists under the service of the military. Preferably, the printmakers were members of the armed forces themselves.

Twyman (1999, p. 68) also suggested that the military workshops had in many cases produced their own transfer papers to add notes to the plans in military manuals, which clearly do not belong to the initial printed text. This indicates the military's growing intention for autonomy and independence in printing. In addition, drawing was also taught in these academies and was a part of the training of students in lithography courses (Twyman, 1999, p. 70).

The introduction of photomechanical processes meant that several tasks related to printing, such as drawing, engraving, or etching plates, could be removed from the military curricula, as well as reducing external contact or the need to hire printmakers. As the role of printmaker becomes more accessible with the use of photography, it is also more accessible for military personnel to learn these processes and to employ them in their own work environment.

The independence of this intersection between printmakers and the military forces can help us to understand how new techniques for map printing were invented by military establishments, rather than scientists or specialists related to printmaking.

The invention of photo-zincography, for example, is credited to the cartography department of the Ordnance Survey Office in the UK. The process makes use of transferring paper from metal plates back to paper again, and finishes with a zinc plate from which the image is printed. Twyman (1999, p.244) found it odd that the process was initially explored by the Ordnance, not to print maps or plans, but to

Figure 7. Matrixes and developed image on metalillustration our results on researching Rodrigues' chromocugraphy. Imageby Graciela Machado. (Photography by David Lopes. PhD student at FBAUP. Researcher from i2ADS)

make facsimiles of old documents. The facsimiles of old documents are materials identified in the Portuguese State Office for the territory, directed by the military forces, who had made proofs and small samples of their work to reproduce older books. For example, between 1877 and 1878, the Photographic Section published a small sample book of ten pages showing that edited material from previous centuries could be printed quickly, efficiently, and easily.

Photo-zincography was an alteration of Asser's process using dichromate gum, and it was undertaken by a Colonel, Sir Henry James, and his staff. Henry James understood photo-zincography to be a very efficient method to reproduce old documents, underlying its capacity for printing at a "low unit cost" (James, 1860, pp. 249-251.) Twyman also explained that photo-zincography should be credited mostly to Asser, and also to some extent to Captain A. de C. Scott (Twyman, 1999, p. 246). In essence, both are in the service of the armed forces.

RESEARCHING CARTOGRAPHY IN FINE ARTS PRINTMAKING

Our main assertion in this paper is that technology is a central and unavoidable factor in thinking about contemporary printmaking in the fine arts. As technological advances grow in a more digital and global world, they also leave us with challenges such as marginalisation, control, and power, reflected in economic dependence, warfare, political agendas, and representation in society. Since "Art and Technology" are too large a topic to tackle in a short paper, we focus our discussion on why we believe technical know-how is important to maintain in contemporary artistic practice and the hands of the artists themselves.

"TECHNOLOGICAL ARCHAEOLOGY", A METHODOLOGY

To research cartography in today's fine arts contemporary practice of printmaking, we applied a methodology which we call "technological archaeology". As a methodology, it is similar to what other projects are doing in Europe, including those at the Centre for Fine Print Research in Bristol and the organised group of conservators' "art-source technological research" (ASTR).

However, technological archaeology sets itself apart because it is a limited-scale project that aims to work with cultural heritage, making contact with small communities and small businesses to get access to local resources and traditional know-how. It also differs from the ASTR in having its outcome knowledge in the service of contemporary artists working with printmaking. Research is conducted by the artists themselves, revealing their personal set of interests, but they are encouraged to use technology with freedom. This means that the research groups are willing to transgress technological reproduction efficiency to accomplish other goals. Many of the techniques we study are now obsolete because of their initial commercial framework. Reproduction techniques with practical functions in industry are bound to disappear the moment new and cheaper technology comes on the market and gradually replaces them. Therefore, “technological archaeology” proposes to recover obsolete techniques from past centuries. Our methodology also is based on the belief that image-making in contemporary art requires a continuous practice of doing and a certain degree of specialisation. Studying methods, tools, alterations in processes, and the history of technology gives us the foundation for practical research and artistic activity.

To study Rodrigues’ 19th-century techniques, we have access to DGT in Lisbon. In brief, DGT is a unified house of several other institutions with a focus on the analysis and recollection of scientific data on the territory. In the archives of DGT, we found ourselves analysing the historical material that once belonged to the Portuguese Photographic and Artistic Section, which consists of several written bibliographies by J. J. Rodrigues (1874-1879) and museological objects – tools for drawing maps, several lithographic stones, intaglio plates, hundreds of prints and published books of integral material used in printing maps. (See Figure 2)

The preceding studies undertaken by Peres (2013) and Jardim et al. (2015) paved the way for the present study. The Portuguese researchers Peres and Jardim (2013/2015) elaborated on the necessary documentation and identification of written sources on Rodrigues and photomechanical techniques developed in 19th-century Portugal. These studies did so from the viewpoint of the history of science and chemistry. Our research focuses on the same techniques but aims to contribute from the perspective of fine arts printmakers and to demonstrate the complexity of such procedures through technological know-how.

PRESENTING THE “PHOTOGRAPHY AND ARTISTIC SECTION”

The Photographic Section was created in 1872 under the vision of military and scientist Filipe Folque, who had been trying to replace map printing intaglio processes in Portugal with photomechanical processes (Jardim, 2014, p. 44-45) The name of the section kept changing but was eventually known as the Photographic and Artistic Section, to which José Júlio Bettencourt Rodrigues (1843-1893) was appointed director. This establishment was the first of its kind in Europe to use electric light in producing photomechanical matrixes, according to Rodrigues (1876, p. 15) and Grandidier (1882, p. 361).

Jardim (2014) stated that the Portuguese Photographic Section was once one of the best cartography establishments in Europe, receiving international awards in 19th-century international exhibitions both in Europe and the United States. The focus of this paper is to present technical research undertaken today at a fine arts printmaking workshop in Portugal, where two technological innovations were developed under Rodrigues’s chief direction: tin foil metal used as transfer paper, and a photo-etching process named chromocupographie.

TIN FOIL METAL REPLACING TRANSFER PAPERS

In the 19th century, the method of coating a lithograph stone with a dichromate solution, exposing the matrix directly under the influence of light, could not suffice with stable results for printing houses. This generalised statement was made by Rodrigues (1878), who explained that the negative image glass could not be perfectly placed in contact with the "rigid" surface of the stone. The alternative was to first develop images on a prepared paper surface and then transfer them to the stone. The commonly used transfer papers also presented some difficulties, as explained by Davanne from the Société Française de la Photographie; these provided the image with imperfections from the "influence of humidity and dryness". The grain of the paper surface would stand out if the contact between the plate and the sheet were not perfectly joined. Using paper also meant that the image should be expected to expand or change size, due to the need of soaking the paper in water to make the transfer process. In the case of developing images using the gum bichromate process, the paper also undergoes dampening in water. The scale of the image was a major aspect to factor into map printing, so all of these aspects had to be solved by the printing industries related to cartography.

With these technical obstacles in mind, José J. Rodrigues devised a new process using "well-polished" sheets of metal instead of transfer paper. Metal sheets were provided with a surface in which the image could be in close contact with the negative and dichromate solution. Being metal, it also meant that the image would not contract or expand during the transfer process, which we saw above previously depended on water (Waterhouse, 1878, p. 35). Rodrigues also pointed out the commodity of using thin plates to handle and store these surfaces. As late as 1977, John Sommers wrote an article for the Tamarind Papers, pointing out the frustration of storing transfer papers improperly. The author also referred to the technical problems of transferring the image properly, since the paper adheres too much to the printing matter. To our knowledge many, including Sommers (1977), do not take into account Rodrigues's method of transferring using metal sheets, which could solve many of these obstacles, so we believe the process is widely unknown.

By 1878, Rodrigues had already published in French and Portuguese, describing the use of thin metal for the transport of images to the lithography stone. The journal Photography News is the first written source in English. The source is important, as we need to establish with greater certainty what terminology we should use in our communication.

In our technological, practical reconstruction, we are in the dark as to what kind of material the tin metal sheets were made from in the 19th century. Today, tinfoil is a common misnomer for aluminium foil. In 19th-century Europe, foliate metal plates could be made as today, from several materials, including iron, lead, tin, and zinc. According to official Portuguese documents, the prices for tin in Portugal in the year 1871 ranged between $2 and $200. One of the least expensive is the tinfoil sheets, which could cost $2.50. Tin and copper would be among the cheapest metals one could buy in Portugal in 1871. The price of tin seems to have been falling between 1844 and 1871, at least according to information taken from commercial transactions between Portugal and France. Foliated tin cost 5 francs per kilogram in 1844, being a little more expensive than zinc, which cost 4 francs. In 1871, foliated zinc seemed to cost $10, indicating a rise in zinc prices of zinc and a lowering of tin prices.

We believe Rodrigues's choice of tinfoil in his transfers is based on economic reasons, rather than related to some specific chemical quality. In this scenario, we could, in theory, replace tin with aluminium foil sheets. In our physical research at DGT, we handled an organised book of specimens, showing tinfoil with developed and charged images used in the reproduction of documents by Rodrigues. These tinfoils are as thin as the aluminium foil we find today in regular markets to wrap food. However, we understand it is important to first test the original conditions, and then later adapt to more practical solutions with our technical endeavours. Therefore, the materials for the research were gathered as closely as possible to their original sources.

We, therefore, decided to first look for material in our surroundings in the Portuguese industry. In a more industrialised economy, we chose to support local businesses, in which we set a belief system of community consciousness. To make technical reconstructions using tinfoil, one should be able to communicate with the producers, especially considering that we were dealing with a process developed in Portugal. However, we needed to take into account how the markets for materials have changed since the 19th century. With difficulty, we found both small and large companies that are still selling tinfoil. The first tests were conducted on a thick sheet of tin. During the research, we gathered alternative solutions, making use of aluminium foil, easily bought anywhere, and used for wrapping and storing food. However, our tests showed the necessity to find a material that does not tear easily (See Figure 3).

The metal plates, being so thin, should be moulded and pressed against a prepared lithograph stone to obtain a grain surface to retain the dichromate solution (Rodrigues, 1874). At this point in the process, we followed the written instructions but also experimented with different carborundum grain sizes and also with sandpaper to mould the aluminium and tin metal sheets (See Figure 4).

Applying the sensitive solution to the metal surface was not so simple. We knew that the Photographic and Artistic Section had what they called a "machine to gum the plates", which according to written information was a rotative centrifugal machine (Rodrigues, 1876). In our workshop, we adapted a process once used in an industrialised setting to the conditions of today's fine arts printmaking workshop. Therefore, the intention of technological reconstruction went through a process of improvisation as well, with means that are more suitable and accessible for artists. To coat the metal sheet, we established a manual method of applying bichromate gum, rotating our wrists, and allowing the gelatine to slowly cover the whole surface. Once the solution stabilised as it started to dry, we rapidly blew on it with a hair dryer from a distance.

Using the formulas given by Rodrigues, the solution of dichromate is often quite liquid. Following the original instructions, we degreased the metal surface to allow the foil to be coated in the most homogenous way possible. The temperature of the room had to fit some criteria to enable the layer to dry as quickly as possible. Rodrigues (1874) mentioned the use of gas to heat the plate, or to heat the plate in a small oven. In our facilities at the Faculty of Fine Arts, we made use of the UV machine and a hair dryer to dry the solution on top of the metal. At this point in the research, we found the best way was to apply a small amount in the middle of the plate, and to move it slowly in circles in order to spread it homogeneously across the plate (1). Another method, using simple resources, is to apply it with a brush in vertical or horizontal lines and immediately shake it to make the coat again homogenous (2).

At this stage in the research, we were interested in showing how the image can vary if a homogeneous coat is not successfully applied to the metal. Rodrigues's recipe for photosensitive bichromate gelatine was prepared by mixing two separate solutions and then combining them. These contained, respectively, 2 parts of gelatine for 25 parts of water, and 1 part of dichromate ammonium for 25 parts of water. We used distilled water. Following Rodrigues's recipes, we found ourselves with a tricky substance to obtain homogeneous layers at once. In our sample tests, several layers were applied in order to create a vivid yellow surface, which we found to be necessary to obtain contrasting images to which the ink would adhere easily. We also understood the need to have a more viscous substance than the one obtained following the recipe exactly as described. Therefore, we adapted the original recipe by adding a small quantity of powdered gum arabic or gelatine to thicken the solution.

TAKING A STEP BACK: MAKING THE TRANSFER INK

When following the methodology of "technological archaeology", we eventually meet an old friend, technological obsolescence. We found ourselves in the need to remake transfer inks for lithography by following older recipes, because there is no longer the option of purchasing these on the market. Technological obsolescence has moulded printmaking history from the very beginning. In a way, we can argue that technological obsolescence is what enabled printmaking to operate as a medium of artistic expression. Considering very traditional techniques such as etching, engraving, and woodcuts, such techniques can operate today in creative workshops and are mainly practised for artistic purposes. However, technological obsolescence has the power to make resources disappear, the materials, tools, machinery, providers, and businesses that are necessary to undertake certain techniques. This distance between art practice and industry is intensified, because these printing techniques once belonged to, and were mainly used by, scientists or other non-artist professionals.

Several recipes for transfer inks were found in 19th-century publications (Senefelder, Knight, 1877, Lorileux, 1898) As our case study was focused on Portugal, we tried to get information regarding what brand of material would have supplied the Photographic and Artistic Section, and selected a few dozen from the 19th century.

According to Matos (2009, p. 176), Rodrigues opened his own ink factory, which he named Rodrigues & Rodrigues. There might be a small difference, since the Photographic Section had the means to produce its own transfer inks. However, Rodrigues only opened his business in 1872 after he had left the public institution. From archived documentation, we also know that Rodrigues tried to establish his ink production as the main supplier to the Official Printing Press in Portugal. His request was, however, denied, as the ones responsible for making such decisions chose to maintain business with the French company Lorilleux & Cie in Paris.

Therefore, we chose to produce transfer ink following the recipes in a practical treatise written by Charles Lorilleux himself (see Figure 6). Using this process, images were successively developed on metal surfaces, both in aluminium and tin. The non-absorbent surface of aluminium foil and tin foil enables the image to develop more easily than on paper. Very absorbent paper, coated with gum bichromate, usually needs to be sized in order to develop the image correctly. This is not a concern when using thin metal sheets.

One very important aspect of transferring, according to Sommers (1985), is to warm the stone to room temperature. It is a common mistake to proceed to the transfer without properly considering the temperature of the matrix (Sommers, 1975, p. 84).

Proceeding to transfer to stone using metal plates also proved to be challenging. The inking of the image cannot be undertaken by a rubber roll; when doing so, one should expect a shallow layer to cover the image. The image revealed in bichromate gelatin has a visible sculptural aspect. Since the ink is attracted only to the solidified bichromate yellow areas, a coarse leather roller is best suited to inking the transfer plate. In an alternative way, using a piece of waste fabric, and rubbing it in circles to push the ink into the bichromate gelatin, has also been proven to work.

CHROMOCUPROGRAPHY AN UNKNOWN PORTUGUESE TECHNIQUE

Grandidier (1882, p. 371) stated that “chromocupography” is a variation of Eckstein’s method (Peres, 2013, p. 439-439). This is confirmed by analysing the objects in DGT in Lisbon in person, as the copper plate with rectangle charts was inscribed with a metal needle on the back, where one can read clearly “Eckstein’s modification” (see picture). We can also be sure that this copper plate is the technique in question by looking at the archives provided by the Société Photographique de Paris, in which the same rectangles appear to be printed, and are identified as written as chromocupographies by Rodrigues. Another name for Rodrigues’s process is “polychromolithographia”, as it appears in the Portuguese magazine O Ocidente. “Polychromolithographia” is attributed to Rodrigues as one of his inventions, and right in front of it is written “an addition to Eckstein’s process” (Silva, 1892, p. 218). Regardless, the process in itself does not require an established name simply because it does not seem to have been a very widely used procedure after being made public.

In the 19th century, Charles Eckstein (1876) introduced a new sophisticated method to make polychromatic prints of maps, using only five stones. Three stones inked with blue, yellow, and magenta provided the entire range of colours, the outline drawing of maps was printed in black, and the remaining stone was used for printing text, also in black. In today’s setting, thinking of contemporary art printmaking practice, four stones would probably suffice. Eckstein’s method was, according to himself, an advantage in reducing printing costs, and in solving the problem of how to get different tints and shades of colours (p. 5). This method was not entirely photomechanical, as it relied on a more experienced practitioner, specifically a lithographer with a good understanding of drawing and/or painting. (1) The photographic image was first transferred to the stone. After a long, time-consuming process, in order to stabilise the photographic image, (2) the stone was coated with a thin layer of asphaltum and other materials that would provide the stone with grease. According to Eckstein’s description, (3) the image was then etched, similar to how one etches in lithography (p. 10). From the description of the process, we understand that such a task requires a strong vision of how to separate the colours of the different images.

Maps printed with colour became an attractive goal in the 19th century. With the new methods of transferring photographic images to stone, polychromate prints with lithography could be produced cheaper than ever. Godefroy Engelmann first patented chromolithography for commercial uses, which, according to Stinjman (2012), was a breakthrough ever since Jacques Le Blond invented the thricomate process in the 16th century. The technique, however, was difficult to implement in practice because it required the use of several stones to obtain a wide range of colours. In addition, even though the use of stones in principle is related to the lithography technique, departments were interested in replacing stone matrixes with lighter materials, such as copper or zinc plates.

Going back to Rodrigues, chromocuprography was mentioned by Grandidier (1882) as an alternative method for printing chromolithographs. In his variation, Rodrigues employed copper plates instead of stones, and he etched the plates using iron perchloride, which is also typically used today to etch metal for intaglio. Grandidier also explained that Rodrigues was able to apply a fine granular photosensitive layer by adding iron oxide (III) to the gelatine, which turns it into an opaque substance (see Figure 7). He explained that “the iron oxide (III) does not attack the bichromate gelatine, nor does the iron perchloride” (Peres, 2013). What Grandidier seems to be describing is, in principle, the aquatint process, as according to him, “without the previous application of this dust, the etching of the copper does not allow the halftones to hold the ink, in order to print these” (Grandidier, 1882, p. 371). Lacan (1878, p. 8) also stated that Rodrigues prepared a mixture of gelatin and bichromate of ammonia, which he added to water with red chalk. The mixture was added to a copper plate covered with a fine resin layer. We make a supposition of an aquatint ground.

THE METAPHORICAL POTENTIAL OF TECHNOLOGICAL KNOW-HOW

With our background discussion of technological know-how, we intend to make two points. First, we believe that know-how should be researched and recovered from the past to enrich the growing debate between the material and the digital in today’s contemporary art setting. Second, we understand that know-how from the past can be used critically and introduced creatively in the subject matter of art-making for contemporary printmaking.

THE HAPTIC EYE

To account for how the know-how of map printing can approach the subject of map printing techniques and how these can migrate to art practice, one is first obliged to underline the differences between our time, which is progressively more digital, and the printed maps. Reddleman (2018) opened her book by stating that maps belong to our everyday lives. The author’s efforts go in showing how much the idea of cartographic images depends on a sort of abstraction and capacity to see space in multiple directions. Mapping and using maps take place in a complex process, and we can bring to the discussion Merleau-Ponty’s (1960) understanding of vision and movement, in which the author argued that the body follows and acts independently from the mind. (p. 162)

We should acknowledge how much the accessibility of digital technology has affected the way our bodies use maps. Maps are indeed everywhere, and we are often in contact with them through our smartphones. This cannot be anything like what our grandparents experienced. Not so long ago, the best printed maps needed careful examination of the information in small type; locations needed to be found by following the name of roads with a finger. Portable maps would unfold to unwieldy sizes, and needed to be laid down flat inside the car during road trips. Folding and unfolding would wear maps down with time; information could be lost where the paper was creased or folded. In the times we live, maps are never easier to read and preserve.

Using printmaking, we can re-enact human relationships with maps in several dimensions, but if we are doing so with the scope of technological know-how, our discussion must focus on material and physical traits. Thinking about the technological know-how of the 19th century not only takes us back to the challenges of identifying how people printed maps in the 19th century, but also how people used them.

THE IMPLICIT TERRITORY OF IDEAS AND SUBJECTS ABOUT MAP PRINTING

Reddleman (2018, p.21) proposed that cartographic images are concerned with something she called “meaning-making”, and discussed maps as complex sources of vision. A map is never neutral, as was also argued by Broton (2019). Maps crop, centre, isolate, and enhance information, depending on the intentions of those who made them. In our approach to using cartography and map printing in artistic practice, technical know-how cannot be researched without understanding their creators’ intentions, their political status, and historical contexts. If one chooses to ignore these, the printmaking techniques will merely be tools of image-making.

Developing art practice with the awareness of map printing’s close proximity to power, the geopolitical implications and their evolution as technology is to understand how the world has represented itself by the hands of subjectivity. Brotton (2019) showed how European countries were able to construct a public perception of how much of the African continent was under colonial occupation, just by making printed maps. In reality, the perception of the colonial occupation was very different in the area (p. 403). In general, cartography was perceived as a tool to visualise Europe’s possession of Africa. (Brotton, 2012/2019, p. 402). The author relates the technological innovation of lithography in the 19th century with the development of scientific cartography, under the agenda of imperialist cartography.

The images of cartography have semiotic power, or “meaning-making” as Reedleman put it, and such can and should be crossed critically with the subject of contemporary art production. To research technological know-how is ultimately to study technology in philosophical implications with history and practice. Technological know-how related to map printing can be appropriated critically if one is willing to consciously approach these topics.

FETISHISING MATRIXES OR THE NEED FOR A USELESS ARCHIVE

It is not conceivable to think that one can undertake a technical procedure in printmaking without understanding that it also works within a creative process. Technological know-how means more than following instructions; it requires the ability to solve problems. We also understand that know-how is part of bodily experience, which does more than giving form to the artwork. As Richard Serra once said, “matter always imposes form into form”.

Our research of technological know-how has compiled several instructive and technical manuals that can be used by university students. The experimentation undertaken has left us with a great deal of processual material—small sample plates, tone charts, residual images, repetitions, and variations of such images. All of this material has come together in archived folders, which will be properly edited to communicate research results. But could those also be a sort of artistic expression?

In 1993, Robert Morris introduced the idea of the artwork “making itself” through the process. In his line of argument, Morris mentioned the importance of the materials and tools in making up the form of Pollock’s paintings, for example, which is moulded from the “tendencies and properties of the matter” (p. 43). Morris understood that the physical and optical qualities of artworks co-exist. (p. 44).

As we approach the archives in DGT from the 19th century, we understand that the process materials of printmaking are perceived mostly as collateral documentation within a museological context. Following Morris’s understanding and with our contemporary eyes, one could also see these for their richness and potential to tell a story. Morris (1993) underlined that Pollock went beyond a sense of leaving traces of process as an “autobiographical presence”. However, we argue in favour of these personable traces that we find left behind in objects that were made to be tools, steps meant to make prints. The story they tell is not only the making of printed maps, but of those who made them, and how their bodies interacted with matter and process. Hidden in drawers, the matrixes, seen as steps in the process rather than as autonomous, do trigger some sort of response in us as artists.

As obsolete technological know-how still needs to be researched and systematised, the objects we can see present us with more than clues to solve them; they themselves have a potential form to be presented. The developed images on metal matrixes of our research results are being accounted for as ends in themselves and as exhibition material. Regarding such objects purely as a means to produce cheap photomechanical matrixes does not meet our contemporary needs in the same way as they would in the 19th century. In conclusion, we understand the need to change our perception of processual objects, in an ever-growing tendency to use the outcome process of printmaking as an artistic expression.

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IMAGE GALLERY

Figure 1. 19th-century map reduction of Goa, India.Book of Specimens “Estanhos: Spécimens Relativos ao processo -Photolithographico da Secção Photographica. Direcção-Geral do Território, Lisbon, PT (Photography: David Lopes, i2ADS)

Figure 2. 19th-century tools for producing cartography,books of tinfoils, drawers with glass and cooper.Secção Photographica e Artística. Direcção-Geral do Território, Lisbon, PT (Photography: David Lopes, i2ADS)

Figure 3. 19th-century tinfoil sheet with image inkedwith the purpose of lithographic reproduction. Secção Photographic eArtística. Direcção-Geral do Território, Lisbon, PT (Photography: David Lopes. FBAUP: i2ADS)

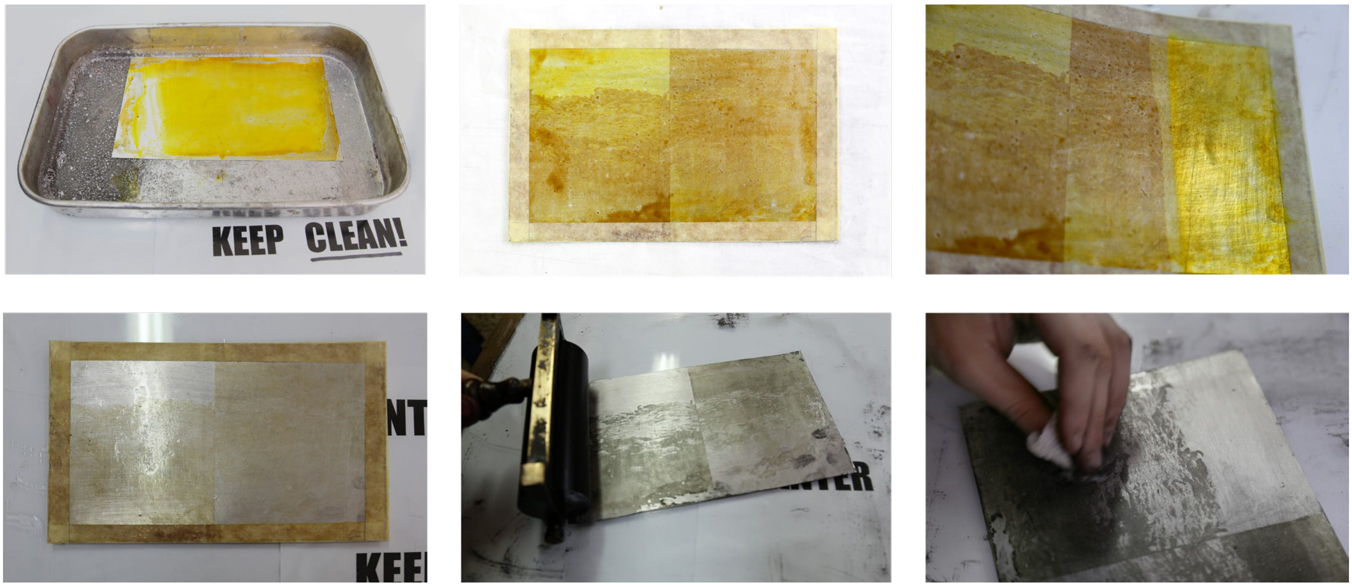

Figure 4. Reenactment of Rodrigues's technical procedure,using alternative metal aluminum sheets. (Research conducted atthe Faculty of Fine Arts of the University of Porto by David Lopes. Researcher in I2ADS)

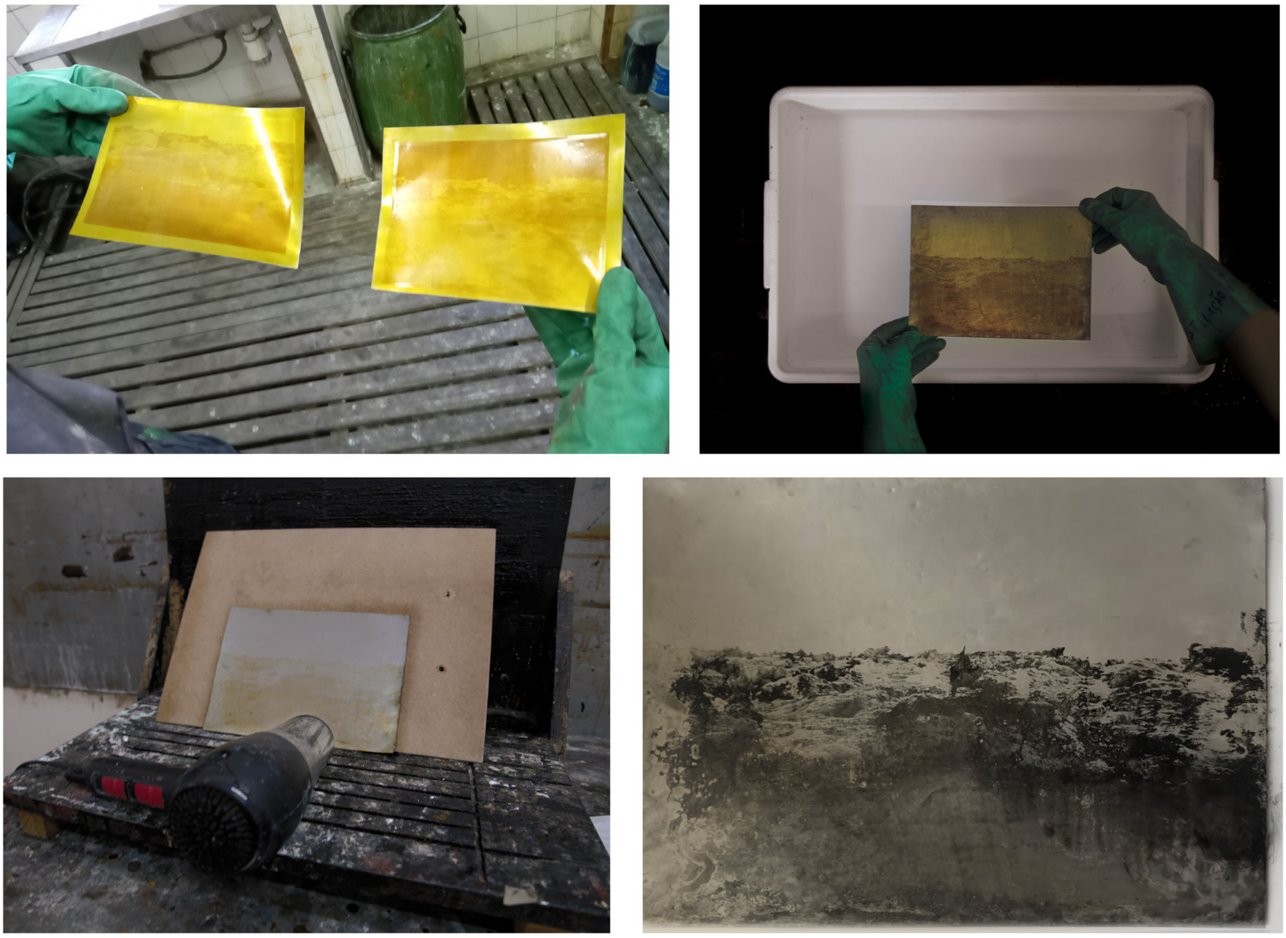

Figure 5. Reenactment of Rodrigues's technical procedure,using tinfoil thick sheets. Image by Graciela Machado.(Photography by David Lopes. PhD student at FBAUP. Researcher from i2ADS)
Figure 6. Process steps in preparing transfer inksfor lithography following 19th-century recipes. (Research conducted at theFaculty of Fine Arts of the University of Porto. Photography by David Lopes. PhD student at FBAUP. Researcher from i2ADS

Figure 7. Matrixes and developed image on metalillustration our results on researching Rodrigues' chromocugraphy. Imageby Graciela Machado. (Photography by David Lopes. PhD student at FBAUP. Researcher from i2ADS)