

# Applications of archeometry in eighteenth century São Paulo furniture: indicative analysis and historical contextualization

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**ABSTRACT:** This article presents the results of applied Physics archeometric measurements on two pieces of furniture from the Museu Paulista collection, a chest-safe and a tanned leather chair, both made around the eighteenth century. The analysis techniques used were ED-XRF and imaging with ultraviolet light fluorescence. The interdisciplinary analyses sought to identify the materials with which the pieces were composed, thus presenting historical information about furniture production in the city of São Paulo in the eighteenth century. The obtained results allowed the identification of some of the materials used in the painting of the chestsafe – white lead and vermilion (or cinnabar) – and in the tanned leather and metal parts of the chair – iron and brass in both parts –, although additional procedures still need to be applied for obtaining results on other materials. To allow the contextualization of the material and economy life of São Paulo, the information obtained from material sources were confronted with broader textual documentation data such as paint commission lists, travel reports and artistic manuals of the time, thus revealing the city's dynamism and its intricate commercial networks.

**KEYWORDS:** History of São Paulo. Material Culture. Archeometry. Energy-Dispersive X-ray Fluorescence (ED-XRF). Furniture.

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RESUMO: Neste artigo, são apresentados os resultados dos exames arqueométricos de Física aplicada sobre duas peças de mobiliário do acervo do Museu Paulista, uma arca-cofre e uma cadeira de couro de sola feitas por volta do século XVIII. As técnicas de análise utilizadas foram o ED-XRF e o imageamento com fluorescência de luz ultravioleta. As análises interdisciplinares tiveram por objetivo identificar os materiais com os quais as peças foram compostas, evidenciando informações históricas sobre a produção moveleira na cidade de São Paulo no século XVIII e princípios do XIX. Os resultados obtidos permitiram identificar parte dos materiais usados na pintura da arca-cofre, como o branco de chumbo e o vermelhão (ou Cinabre), no couro curtido da cadeira e nas partes metálicas de ferro e latão de ambas as peças, ainda que outros procedimentos ainda necessitem ser aplicados para a obtenção de resultados sobre outros materiais. As informações obtidas com as fontes materiais foram confrontadas com dados de documentação textual mais abrangente, como listas de compras de tintas, relatos de viagem e manuais artísticos da época, de maneira a permitir a contextualização da vida material e econômica da cidade, revelando sua dinamicidade e as intrincadas redes comerciais em que estava imbricada.

PALAVRAS-CHAVE: História de São Paulo. Cultura Material. Arqueometria. Espectroscopia de Fluorescência de Raios X por Dispersão de Energia (ED-XRF). Mobiliário.

## INTRODUCTION

Seeking to emphasize the importance of historical research through musealized artifacts and to explore their potential, this article seeks to understand the socioeconomic dynamics of the city of São Paulo between the eighteenth century and the first decades of the nineteenth century via the analysis of the remnants of home furniture that were manufactured and used in São Paulo, and that are preserved today in the collection of Museu Paulista of Universidade de São Paulo.

Based on material culture,<sup>3</sup> we seek to explore to the maximum the information we could extract from two furniture pieces, the RG55 tanned leather chair (Figure 1) and the RG3242 chest-safe (Figure 2), both manufactured in São Paulo between the seventeenth and eighteenth centuries.

These two pieces – as well as similar ones present in the Museu Paulista collection – have already been analyzed by several authors, considering not only their rarity for São Paulo's context but also their artistic and formal idiosyncrasies, and both pieces reveal the adaptation of Portuguese styles in the colonial environment, bringing – later – reminiscences of the Portuguese national style.<sup>4</sup> Revealing great richness of information, several study approaches have been made, whether on the meticulous aesthetic and typological bias of José Wasth Rodrigues,<sup>5</sup> whether on their iconographic elements, as scholarly examined by Jaelson Bitran Trindade,<sup>6</sup> in the symbology of the Fifth Empire represented by the bicephalous eagle wrought in the backrest of the chair, or also on the contextualization of its social use in the São Paulo domestic space, studied by Maria Aparecida Borrego.<sup>7</sup>

Considering these studies, we adjust the scales of our thorough observation to the microscopic clues and even to those unobservable under visible light, using techniques and methodologies from the applied Nature Sciences to the study and conservation of heritage, within the field of Archeometry.<sup>8</sup> For such, we use Carlo Ginzburg's evidential paradigm, having the sensitivity to note that the most banal or obvious elements can be exceptionally revealing.<sup>9</sup>

From the vast universe of archeometric techniques, we will use those derived from Applied Physics to specify which pigments were used in the painting and which chemical elements constitute the leather parts, and even what is the composition of the metal parts. Considering the statement by Ulpiano Bezerra de Meneses that "the only intrinsic possessions of an object are its physical and chemical characteristics, everything else is attributed to them",<sup>10</sup> we seek to show that the constituent materials of the pieces also have historicity, that is, the choice for certain and specific portions of the physical environment for manufacturing is not natural, nor automatic or

3. Our guiding the perspective about material culture is the one predicated by Ulpiano Bezerra de Meneses (1994, p. 17), because, according to his definition, material culture is every "segment of the physical environment socially appropriated by man"; thus, including furniture as artifacts, products and vectors of social relationships of complex mental depth, technique and use – dimensions which we will not address here, but can be found in authors such as Auslander (1996), Hellman (2005), Canti (1980), Flexor (2008), Santi (2013), Borrego (2010b) and Borrego & Félix (2016).

4. Cf. Moutinho et al. (2011) and Rodrigues (1968).

5. Id.

6. Cf. Trindade (2010).

7. Cf. Borrego (2010b) and Borrego & Félix (2016).

8. Regarding physical and chemical methods for the study of cultural goods, cf. Rizzutto (2015).

9. Ginzburg (2012, p. 178.)

10. Cf. Meneses (1994).

11. Online collection of Museu Paulista. Available from: <<https://bit.ly/2Nuz5xg>>. Access on: Aug. 10, 2018.



Figure 1 – Frontal view of the RG55 tanned leather chair. Museu Paulista collection.<sup>11</sup>



Figure 2 – Frontal view of the RG3242 chest-safes. Museu Paulista collection.<sup>12</sup>

restricted to what a certain community has available in its most immediate environment.

Starting from the final product, our effort will thus be “bringing things back to life”, as Tim Ingold proposes,<sup>13</sup> seeking to understand the social dynamics interrelated to the production chain, focusing mainly on the raw materials that constitute the pieces, and then, with broader documentation, to contextualize the chains and spaces for material supply and production technologies.

We link the notion of “social life” to this understanding, or rather, the notion of the social trajectory of objects as proposed by Arjun Appadurai. The manufacture and possession – even if elementary and transient – of any kind of object by a given person or group in a given period is filled by history, having cultural and even *political* meanings, following the vectorization of sociabilities and economic relations that are enabled and propelled by objects.<sup>14</sup>

The propelling impetus for the use of Archeometry in this study was the scarcity of textual information available about the trajectory of the pieces we seek to analyze. We thus use these interdisciplinary methodologies not only so their evidentiary character can corroborate information already written, but to bring to light unpublished data about the materiality of the Brazilian colonial period. The use of methodologies of these other fields of knowledge for history allows us to discover information that

12. Online collection of Museu Paulista. Available from: <<https://bit.ly/2Nuz5xg>>. Access on: Aug. 10, 2018.

13. Cf. Ingold (2012).

14. Cf. Appadurai (2008).

15. Cf. Taunay (1920).
16. Cf. Ellis Jr; Ellis (1950).
17. Cf. Machado (1980).
18. Cf. Bruno (1991).
19. Taunay (1931a, p. 139).
20. Taunay (1931b, p. 74).
21. This historiographical reevaluation movement must be understood within the international historiographical context, given that Fernand Braudel had already considered “distinguishing between luxury and misery is only an initial and monotonous classification, as well as little precise in itself”, Braudel (1995, p. 300). The productive capacities of each material civilization must be understood according to specific contexts. For example, prior to the Industrial Revolution, Europe was a “scarcity economy”, and household interiors were much, for the most part, leaner than current ones, except for the households of the small rich stratum and yet unmatched to the productive volume achieved after the mechanization of production. Cf. Braudel (1998); as well as considerations by Roche (2000, p. 17ss.).
22. Cf. Holanda (2014).
23. Cf. Blaj (2002).
24. Cf. Borrego (2010a).
25. Cf. Carvalho (1994).
26. Cf. Maranhão (1999).
27. Cf. Pereira (2017).

could not be obtained only with written sources or by naked eye and visible light observations. Such procedures will help to rethink our historical approach to these pieces, providing new information about the Portuguese and Brazilian societies in the eighteenth and nineteenth centuries. These will also help to complement the knowledge about the collection of Museu Paulista, rescuing its institutional history, the trajectory of its pieces and helping in the preservation of its heritage.

Regarding this theme, we will seek to reveal the commercial connections underlying the materials used in these two artifacts, evidentially revealing the dynamicity of the economic and social life of São Paulo that, for a long time, was neglected by the historiography about the city.

Examples of such historiography are the works of Afonso Taunay,<sup>15</sup> Alfredo Ellis,<sup>16</sup> Alcântara Machado<sup>17</sup> and Ernani da Silva Bruno,<sup>18</sup> whom, despite having conducted extensive studies on colonial São Paulo, often ended up replicating the narratives from biased administrative sources and making – at times – tautologic comparisons with other colonial environments without due consideration for the specificities of São Paulo. Such authors formed a true research line with interpretations and narratives that became traditional, sketching the city of clay in a gray manner; one that would be poor, isolated and empty, where public resources were scarce<sup>19</sup> and aesthetic expressions were rustic and limited<sup>20</sup> and where trade had no conditions to flourish, emptied by the economic cycle of Minas Gerais, and by the peripheral position among the coastal captaincies.

However, these conceptions were revised<sup>21</sup> by several authors who studied different aspects of life in São Paulo during this period such as – to name only a few examples – the dynamics of the population and the boundaries of expansion of the colony, as approached by Sérgio Buarque de Holanda;<sup>22</sup> the commercial integration of the captaincy and the social dynamics of its commercial agents, as approached by Ilana Blaj<sup>23</sup> and Maria Aparecida de Menezes Borrego;<sup>24</sup> the logic of urban life and the reproduction of the forms of distinction and exercise of symbolic power in social structuring, studied by Mônica Muniz Carvalho;<sup>25</sup> the composition of fortunes and the historiographical problematization itself made by Milena Maranhão,<sup>26</sup> and in the scope of commissions of sacred arts, the study of the performance of artists made by Danielle Manoel dos Santos Oliveira.<sup>27</sup>

The limited dimension of this case study is always considered by us, despite its importance in deepening the ranks of studies that follow in the same interpretative framework, albeit with different themes, focuses and methodologies. We thus seek to contribute to the studies on the old São Paulo following the interdisciplinarity path provided by the joining of knowledge from Social History and Archeometry, thereby adding new methodologies and problems to this line.

## ANALYSIS OF MATERIALS BY APPLIED PHYSICS

In a very general way, archeometry – as defined by Artioli<sup>28</sup> – is the application of scientific principles and methods of characterization of materials related to cultural heritage. The term was created in 1958 with the journal *Archaeometry*, Oxford,<sup>29</sup> related mainly to the quantitative characterization of the raw materials of archeological objects and processes. However, techniques such as X-ray were used since the 1930s to radiograph paintings and pieces from artistic collections, thus evidencing the parallelism of intentions that ended up converging two fields of research, each with their own methodologies and using increasingly novel techniques for examining the pieces.

What unites the wide range of professionals – be they physicists, engineers, biologists, chemists, or historians, archaeologists, conservators and museologists – is the search for capturing the greatest amount of possible information on the most varied traces of material culture using the greatest amount of techniques and methodologies available. Thus, it is possible to historically understand what materials and techniques were employed, the age of materials and production, as well as, targeting the future, to know how to conserve them for as long as possible and what techniques and instruments should be developed or improved to provide more accurate analysis and capture new data.<sup>30</sup>

We will provide an overview of what are and how the physical analyses are performed on the objects, and which components are used. The experiments conducted on the furniture occurred in the museum itself with portable equipment. All radiation techniques used were non-destructive, that is, they did not require the removal of fragments from the pieces and caused no damage to their surface or structure. For example, imaging with infrared reflectography and ultraviolet (UV) fluorescence, Raman and energy-dispersive X-ray fluorescence (ED-XRF) spectrograph among others.

Energy-dispersive X-Ray fluorescence (ED-XRF) is used to investigate the elemental composition of the materials present in art, archaeological and cultural heritage objects.

A portable system (Figure 3) was used for the analyses in this study, consisting of an Amptek X-ray Tube<sup>®</sup> with silver anode, and a Si-Drift detector also from Amptek<sup>®</sup>. During measurements, the ED-XRF system is positioned near the sample without touching it or causing any damage (Figure 4). Since each chemical element emits a specific characteristic X-rays, it is possible to detect the elements present in the artifacts. The analysis can be done “in situ” without the need of sample fragmentation. Thus, it is possible to identify which elements present in the pigments were used in the paints or that are present in the metals.

28. Cf. Angelini; Artioli (2010).

29. Castellano; Martini; Sibia (2007, p. 4; p. 9).

30. Angelini; Artioli (2010, p. 15).

31. Mayer (1999, p. 42).

32. Cf. Appoloni; Silva (2009).

33. Cf. Pouliot; Mass; Kaplan (2015).



Figure 3 – Photograph of the portable ED-XRF system: A) Detector; B) X-ray tube with silver anode (Amptek®). Photo by the authors.



Figure 4 – Photograph at the time of measurement of point P4 of the chest-safe, focusing on the red ink of the chest's coat of arms. Photo by the authors.

Pigments have components that serve as historical daters, e.g., white lead, a widely used paint until the twentieth century and then abandoned<sup>31</sup> given the emergence of zinc white, popularized around 1834, and followed by titanium white around 1918.<sup>32</sup> Substances used in precise historical moments can also be identified, such as wet blue leather – resulting of the hydration of the skins with chromium salts –, which came to be manufactured only after 1890.<sup>33</sup>

Ultraviolet (UV) imaging was also used to identify possible signs of intervention in the pieces, such as restorations and the existence of varnishes and paintings made



at different times (Figure 5). Interweaving the information of each of these techniques is crucial, since they only allow fractions of understanding when isolated, often leading to errors. For example, imaging with ultraviolet light enables the identification of signs of restoration via the various colorations that take on the different layers of paints and disparate pigments.



Figure 5 – Photograph with UV light fluorescence on chest RG3242, where signs of restoration are shown, such as the three vertical lines on the inner part of the cover. ED-XRF revealed other types of paints used in the restoration. Museu Paulista collection. Photo: José Rosael.

We will now present the steps taken during the examination of the two pieces and the analysis of the raw data obtained; following, we shall perform the historical problematization of such data.<sup>34</sup>

## EXAMINATION OF THE TANNED LEATHER CHAIR

The study began with the consultation of the index card for the RG55 chair, as found in the Images and Database of Museu Paulista. On it, we find the following description, which we partially reproduce:<sup>35</sup>

Period: 17<sup>th</sup> century (colony)

Mat./Technique: leather – wood – metal

Origin: Brazil (Probable)

34. We emphasize the importance of presenting these data from the analysis report so as to bring to the public not only the steps of the examination – which are usually unclear to non-specialists –, but also to disclose these data which should still be more broad and densely analyzed – not only in continuity of our studies but also in contact and comparison with the research projects of other professionals. The consolidation of archeometric databases for Brazilian heritage is fundamental. The importance of this record is reinforced when considering the need for the continuous preservation of the pieces, thus assuring the knowledge we have of them and their maximum description, seeking future historical studies and even the possibility of losses of irreparable assets – such as the terrible fire of the National Museum of Brazil, where among the thousands of lost items that were part of its collection, there were rare furniture pieces that could be studied in a comparative manner to furniture from São Paulo.

35. Cf. Rodrigues (1948). Typed and initialled. Online collection of Museu Paulista. Available from: <<https://bit.ly/2Nuz5xg>>. Access on: Aug. 10, 2018.

Description: Ornament: eagle. Ornament: crown. Ornament: initials. Ornament: heart. Seventeenth century rosewood chair, in straight lines, rustic construction, with raw leather seat in bad condition, and backrest with a leather piece wrought with ornaments and branches, having a crowned bicephalous eagle in the center, with a banner in which you see a heart in flames crossed by two arrows and the writing *ímdr*. In the corners of the backrest wooden trim in octahedron. Straight legs, rectangular section, with simple crosspieces. Measurements: backrest height 0.92 m.; seat height 0.51 m.; backrest leather piece 0.51 x 0.31 m.; seat leather piece 0.51 x 0.40 m.

This piece was initially analyzed by visible fluorescence image with ultraviolet light. Using ultraviolet lamps, it is possible to identify the fluorescence of materials in the backrest region. The images obtained show the points of damage and interventions when subjected to the lighter or darker violet tones. In the following figures (Figures 6, 7 and 8), spots where material loss and restoration interventions occurred can be observed through the image of the possible tear that was restored again in a lighter tone.

The analysis with the ED-XRF system could be performed at different points in the piece since the equipment can be placed close to the studied point without damaging the object. Several points were measured at different positions in the object to better characterize the various existing materials (Figure 9).

The characteristic X-ray fluorescence of each element is recorded by specific detectors that generate spectra, which are graphs that show in the y-axes the number of X-rays measured according to their energy (in the x-axes) in the analyzed points. The XRF measurements were performed at 30 kV voltage, 20  $\mu$ A current, 100 seconds in time. The results provide important data that can enable the comprehension of the materials present in the objects and of the production process of the pieces.

**Table 1 – Nomenclature and specification of the points measured by ED-XRF – RG55 Chair.**

REFERENCE	Name	SPECIFICATION V = 30kV, i = 20 $\mu$ A, t = 100 s
160824ac	P1	Seat leather, upper side
160824ad	P2	Nail on the seat, upper side
160824ae	P3	Seat leather, smooth, light color
160824af	P4	Wood on top of the front leg
160824ag	P5	Seat leather, upper side
160824ah	P6	Seat leather, top side, dark color

160824aj	P7	Large upholstery nails on the backrest, front part
160824ak	P8	Small upholstery nails on the backrest, front part
160824al	P9	Backrest leather, front part, smooth
160824am	P10	Backrest leather, front part, wrought
160824an	P11	Large upholstery nails on the high part of the backrest, front piece
160824ao	P12	Nail on backrest, front part
160824ap	P13	Backrest leather, back part
160824aq	P14	Cut with glue of the backrest leather, central back part
160824ap	P15	Wood of the right front foot (side)
160824aq	P16	Left side nail

We conducted several stages of analysis and discussion of the data obtained by the ED-XRF exams. First, the data collected by the detector were recorded by a specific Amptek® program and data analysis was performed by the WinQxas program.<sup>36</sup> An example of the graph obtained by the ED-XRF technique for point P1 (seat leather, upper side) measured in the chair and displayed by the analysis program is shown in Figure 10:

From the height of the peaks in the graph we can identify a striking presence of iron (Fe), potassium (K), calcium (Ca), zinc (Zn). Other elements such as titanium (Ti), manganese (Mn), copper (Cu) and lead (Pb) are minority. Argon (Ar) and silver (Ag) are elements that do not belong to the object and are related to argon found in the air and the silver X-ray tube used.

The analysis of the different spectra obtained enables comparisons between specific points, such as the comparison between two metal parts in Figure 11 – the large upholstery nails on the backrest (P7) and small upholstery nails on the backrest (P8). It can be observed that the large upholstery nails of P7 present a greater amount of Cu and Zn (constituent materials of brass), whereas P8 presents a greater amount of Fe.



Figures 6 and 7 – Image of UV reflectance of the RG55 chair of the Museu Paulista collection. Backrest seen from the front and back, evidencing the restoration mark on the leather. Photo: José Rosael.

Figures 8 – Image of UV reflectance of the RG55 chair of the Museu Paulista collection. View from the top of the seat, where the damage on the leather and its rough spots are highlighted. Photo: José Rosael.



Figure 9 – Picture of visible light of the RG55 chair of the Museu Paulista collection with the identification of the different points measured by ED-XRF. Photo by the authors.

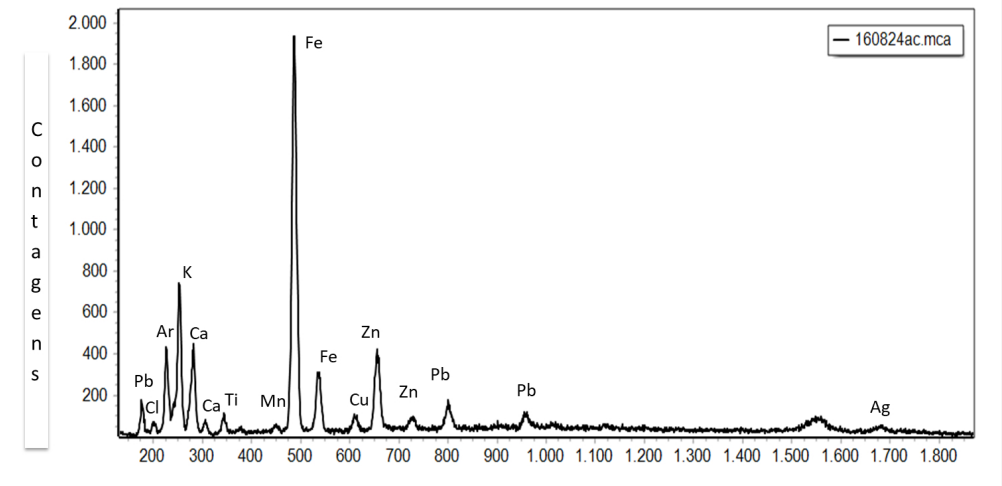


Figure 10 – ED-XRF spectrum measured in the seat leather on the upper side, P1 (160824AC), with the respective identifications of the chemical elements present in the piece RG55 chair, belonging to the Museu Paulista collection.

In the black line of the graph in Figure 12, the presence of Cu and Zn can be noted, which compose brass. Iron is predominant in P8, corresponding to the small upholstery nail and represented by the red line.

With the processing of the collected data – that is, the determination of the areas of peaks obtained in each spectrum by the WinQxas analysis program – we were able to make graphs with bars for the quantities (peak areas) of each chemical element present in each of the measured points, and thus check the correlation between the amounts present at each measure point of the furniture piece (Figure 13).

From the joint analysis of the data obtained with the examination of the points, we came to some conclusions, described below:



Figure 11 – Detail of the incidence of measurements in points P7 and P8, large and small upholstery nails, respectively, of the piece RG55 chair, belonging to the Museu Paulista collection. Photo by the authors.

1) We can note that the points related to leathers have high Ca content (brown peaks – P1, P3, P5, P6, P9, P10 and P13). Ca is also present in the wood of the point at the top of the front leg (beige peaks – P4 and P15) of the front foot. Given the fact that it is a point at the top of the front leg, where the leather that originally covered it is absent, it is possible that Ca from the leather went to the wood over time, or that the wood also has a large amount of Ca.

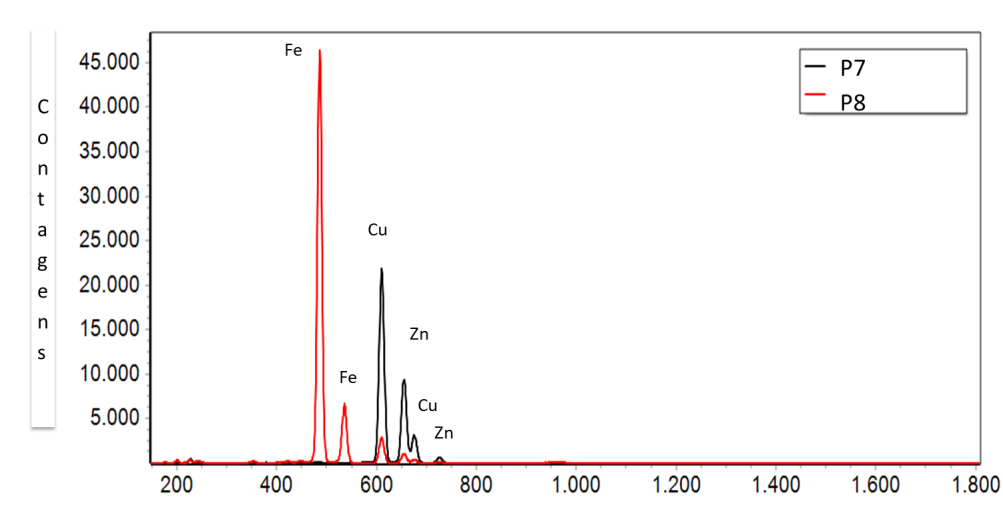


Figure 12 – Comparative ED-XRF spectra for the P7 and P8 points measured in the large and small upholstery nails, respectively, of the RG55 chair. Museu Paulista collection.a.

2) Strontium is mainly present in backrest leathers (P9 and P10) and in lower amount in the seat. P9 and P10 also have a greater amount of Ca, Pb, Mn and Ti, which can reveal different manufacturing processes or wear, as well as restorations and applications of cleaning products.<sup>37</sup> These elements could be present in the leather, but due to use would have their quantities diminished in the seat and would have been more preserved in the backrest. The leather points also present great amounts of Br, suggesting an element added to such skin. Other elements present in the leather in varied and unclear amounts are: sulfur (S), K, Ti, Pb, Mn and Cl.

3) The presence of Fe in P9 and P10 – backrest leather – may reveal that this leather was tanned with salts of this metal or may have received a layer of varnish or another type of substance with such element. The smallest amount of leather in the seat (P3) – which is leather with fur (Figure 14) – shows that the processes of tanning or finishing with paint and varnish were different. We cannot present a precise statement on how the leather tanning process occurred; however, given the low Fe concentration – or of other metals – in the raw leather with fur, we

37. Surely all the layers of products and weathering that these chairs underwent should be considered when analyzing the chemical elements of their surfaces. For example, we found in an index card of the Laboratory of Conservation and Restoration of the Museu Paulista, kindly provided by Ms. Fabiola Zambrano, which records the cleaning and treatment of the RG553 chair in November 21, 1994, with the application of wax and *mocotó* oil to prevent the leather from cracking. Thus, chemical components not used in the eighteenth century could appear in these objects due to the industrialized cleaning and conservation products applied during the family and museum trajectory of these objects.

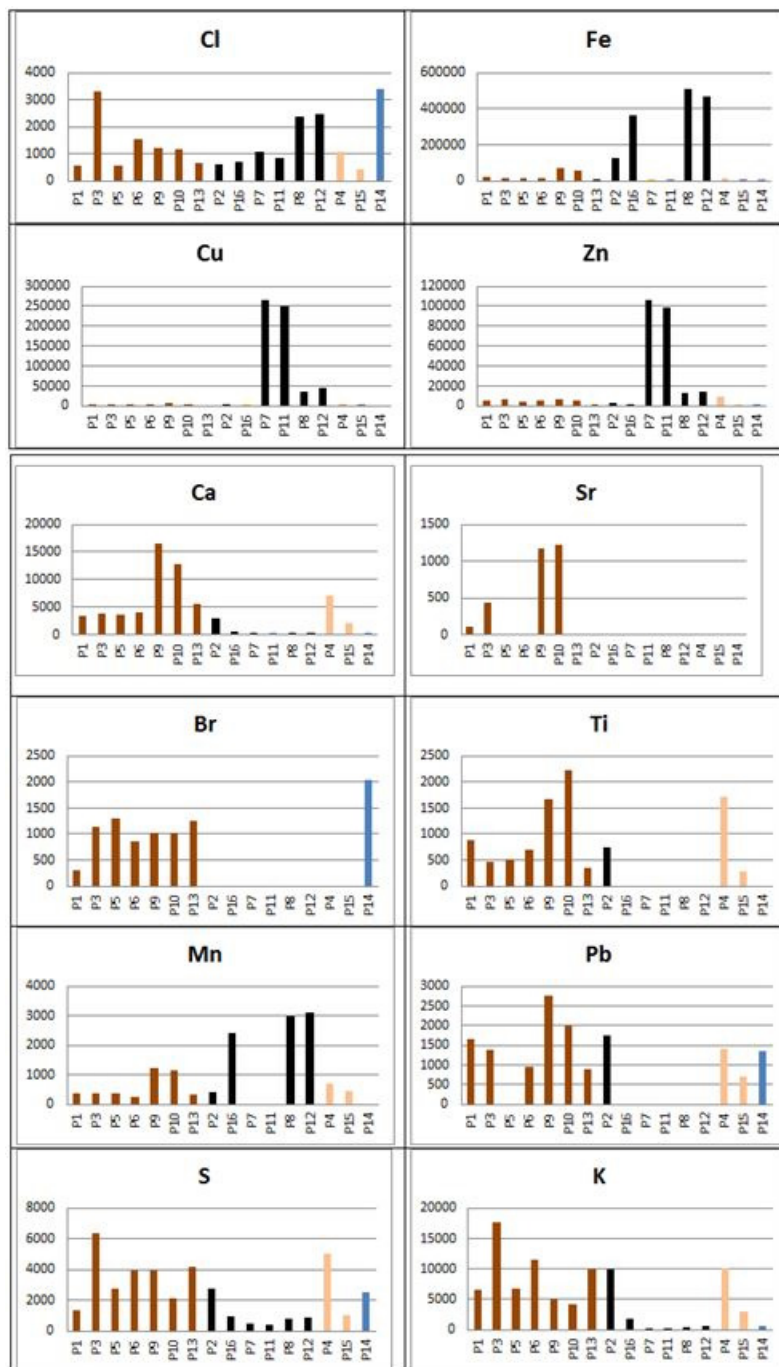


Figure 13 a-l – Bar charts of the areas obtained in the peaks of the different spectra and systematization and correlation between these points. By the color scheme, we correlated to the measuring point: brown bars refer to leathers, black bars to metals, beige bars to wood, and blue bars to the glue used in the restoration of the backrest. Data referring to the RG55 chair belonging to the Museu Paulista collection.



can consider that its tanning was not performed with immersion in metallic salts. This would be evidence of the tanning process using the tannin of plant species.

4) P4 and P15 – wood points – present Ca, Ti, Mn, Pb, S, K and Cl. P4 usually presents a greater amount of these elements in relation to P15, suggesting that it had extended contact with the leather and, over the years, it may have been contaminated with these elements from the leather. It was impossible to detect or correlate any surface treatment element that could have occurred on P15.

5) We observed different constitutions for the metals of nails (black dots – P2 and P16), large upholstery nails (P7 and P11) and small upholstery nails (P8 and P12).

6) Iron is present in P2 and P16, and in greater amount in P8 and P12 (small upholstery nails) since these are nails or upholstery nails without brass coating. Only P2 has Pb and Ti, indicating that it is different from P16. Upholstery nails present lower amounts of potassium, which is more intense in P2 and P16. Chlorine (Cl) and sulfur (S) are also present in metals – Cl is more present in small upholstery nails (P8 and P12), and S is more intense in the P2 nail, suggesting their contamination.



Figure 14 – Photograph of the lower part of the seat of the RG55 chair, belonging to the Museu Paulista collection, where animal fur is still present. Photo by the authors.

7) P7 and P11 present a great amount of Cu and Zn, proving that these are “large” or “thick” upholstery nails made of the alloy of these two metal components of brass. P8 and P12 also present small amounts of Cu and Zn, suggesting a different alloy for the “small upholstery nail” when compared to the brass upholstery nails (large). This means that the “small upholstery nails” are possibly not constituted exclusively of brass due to presenting much greater Fe amounts. We note that these were originally brass-plated; however, only traces of its presence remain.

38 Although it was not possible – nor was our focus on this study – to identify which type of glue was used, we considered that characterizing such restoration point with ED-XRF was important to keep in mind whether glue elements could have impregnated other parts of the chair, which could generate dating problems. We must also stress the importance of collecting and disseminating such data on the successive interventions on the pieces to provide the basis for future studies on restoration materials and practices over time.

8) The measurements at the point of glue used for restoration reveal the presence of bromine (Br), Pb, S and Cl.<sup>38</sup> Through the ultraviolet photograph made by José Rosael – a photographer of Museu Paulista – we were able to observe the incidence of the glue used in the restoration of the piece with greater detail and precision.

9) The intensities of the peaks of the ED-XRF spectra of metals are correlated to the concentrations according to the following table:

Table 2 – Concentrations of metals identified by the ED-XRF measurements – RG55 Chair.

Element	Nail P2 %	Nail P16 %	L Upholstery Nails P7 %	L Upholstery Nails P11 %	S Upholstery Nails P8 %	S Upholstery Nails P12 %
Ti	0.56					
Mn	0.30	0.66			0.53	0.58
Fe	95.28	98.14	0.14	0.11	90.92	88.11
Cu	0.30	0.71	71.47	71.44	6.22	8.64
Zn	2.23	0.49	28.39	28.44	2.32	2.66
Pb	1.32					

## EXAMINATION OF THE CHEST-SAFE

Despite having been a public furniture piece belonging to the court of orphans of the City Council of São Paulo, this piece interested us due to allowing comparisons with domestic furniture and indicating its provenance from São Paulo through a written record present on its lid, as well as a very rare date.

The index card for the piece is reproduced, as consulted in the database of Museu Paulista:<sup>39</sup>

Period: 1738

Mat./Technique: Wood (Argentine Cedar) – Metal (Iron)

Origin: Brazil/São Paulo/São Paulo

History: It belonged to the old City Council of São Paulo, used as a safe and file. Commissioned by the court of orphans in São Paulo, Clemente Carlos Cotrim, in 1738, as inscribed in the inner part of the lid [...] in uppercase, golden and shaded letters:

CLEMENTE CARLOS === DE AZEVEDO COTRIM / MANDOU FAZER ESTE === COFRE SENDO IUIS / DE ORFÃOS TRIANA === L NESTA CIDADE EM / O ANNO + D E 738+'. [...] the coat of arms of Portugal, from the John V period, that were painted in the inner part of the lid were used on the flag of the City Council of São Paulo. Measurements: length 1.87 m.; height 0.70 m.; width 0.735 m.

39. Rodrigues (1948, f.2). Typed and initialled. Online collection of Museu Paulista. Available from: <<https://bit.ly/2Nuz5xg>>. Access on: Aug. 10, 2018.

The chest-safe was also subjected to UV fluorescence analysis to identify signs of restoration. Restoration points in the chest can be identified in the photograph with UV light, especially in a vertical band to the center of the coat of arms, with more intense blurred blue shades (Figure 15). This image also presents small dots scattered across the surface.

In the analyzed RG3242 chest, the ED-XRF technique was used again (30kV voltage, 20  $\mu$ A current, and 100 seconds time) and the different measured points are identified in Figure 16. The details describing each point measured in the piece is present in the table below.

Table 3 – Nomenclature and specification of the points measured by ED-XRF – RG3242 Chest.

REFERENCE	Name	SPECIFICATION V = 30kV, i = 20 $\mu$ A, t = 100 s
160824ca	P1	White pigmentation point
160824cb	P2	White pigmentation point
160824cc	P3	Light green pigmentation point
160824cd	P4	Red pigmentation point
160824ce	P5	Golden castle point
160824cf	P6	Black pigmentation point
160824cg	P7	Beige pigmentation point
160824ch	P8	Red pigmentation point (light brown)
160824ci	P9	Dark green pigmentation point
160824cj	P10	Black pigmentation point
160824ck	P11	Red pigmentation point
160824cl	P12	Letter E point (bottom right line)
160824cm	P13	Red pigmentation point on letter C for "Cofre"
160824cn	P14	Bottom pink pigmentation point

160824co	P15	Golden crown point
160824cp	P16	Internal white pigmentation point
160824cq	P17	Iron part point – inner nail
160824cr	P18	Iron part point – strikeplate hole
160824cs	P19	Iron part point – central ornament

The peaks of the spectra (Figure 17) indicate the greatest number of counts of the elements that are present on each specific point, thus allowing the comparison of different chemical elements found on the surface of the studied object. For example, in this spectrum we identified: K, Ca, Fe, Zn and Pb, the latter in very high concentration.

We observe in Figure 18 the areas obtained in the peaks of different chemical elements in the various spectra, and the systematization and correlation between these points. From the color scheme correlated to the measuring point we can observe the amount of each element composing the respective pigments used



Figure 15 – Photograph with UV light of the RG3242 chest-vault, belonging to the Museu Paulista collection, where the restoration points can be identified on the chest, especially in a vertical line in the center of the coat of arms with a blue shade. Small dots scattered across the surface can also be observed. Photo: José Rosael.

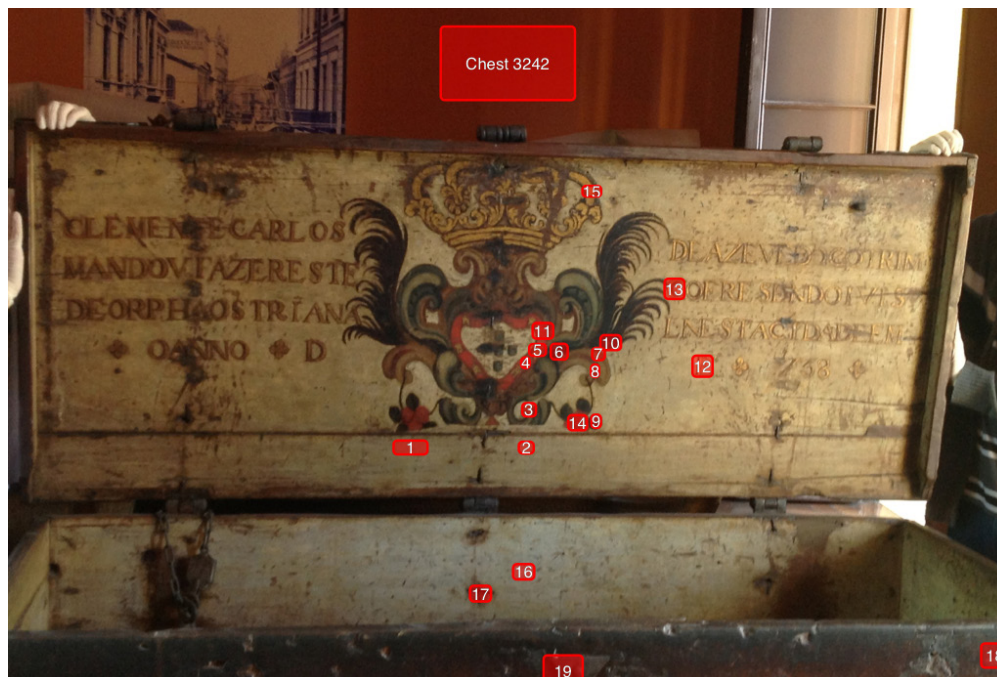


Figure 16 – Photograph with visible light of the RG3242 chest, belonging to the Museu Paulista collection, with the points of the ED-XRF measurements identified. Photo by the authors

in the painting: whites, greens, blacks, gold (in yellow), beige (which was found to have the same composition of whites), red and metal components (in brown).

The graphs of elements show that several points – such as P13 and P15 – were on restoration zones, given the anachronic presence of Ti, a component that

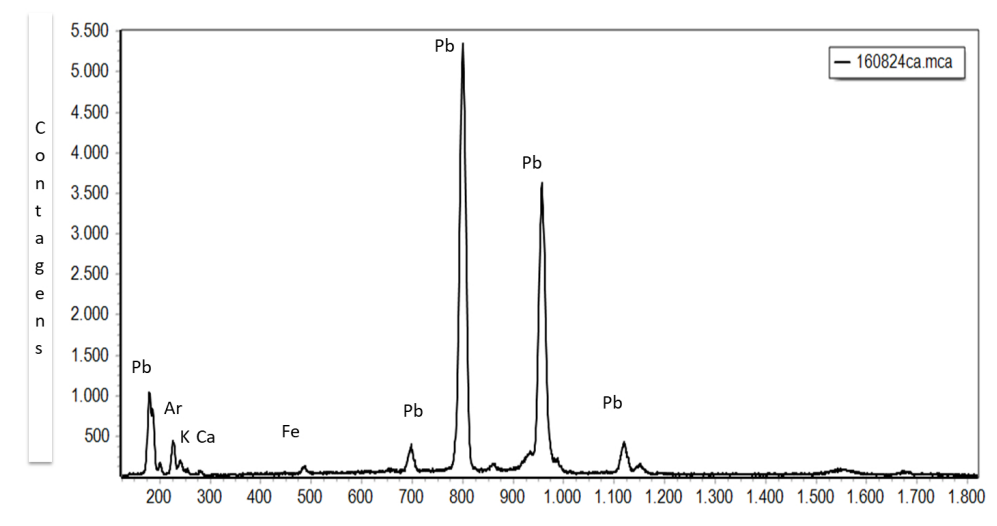


Figure 17 – Example of the ED-XRF spectrum obtained for P1 (160824CA) of white pigmentation measured in the RG3242 chest. Museu Paulista collection.

only appears in paints of the twentieth century.<sup>40</sup> The summarized conclusions are as follows:

1) The golden points – P5, P12 and P15 – have a large amount of gold – P5 is the figure of the castle, P12 is the letter “E”, and P15 is part of the crown. Thus, it is confirmed the use of gold (Au) leaves to make the adornment of the letters in the inner part of the lid, as well as the iconography that makes up the imperial coat of arms of Portugal, either in the castles or in the crown. These same points – P5, P12 and P15 – present spurious peaks of Cr and Ti due to possible restoration procedures.

2) Mercury-based red pigments were identified on P8, P4, P11, P14. In this case, the pigment used is probably vermilion, given the marked presence of mercury (Hg) and sulfur (S). Only on P13 (red of the letter “C” for “cofre”) we do not have Hg; however, high peaks of Pb, Fe, Ca and Ti are present, which may indicate that red lead or iron oxide were used on this point, and perhaps also a restoration given the presence of Ti.

3) White points present a high amount of lead – P1, P2 and P16 –, suggesting the white lead pigment. This is consistent with the dating that the furniture piece itself presents, from the eighteenth century, given that this was the main white pigment to be used in painting before the nineteenth century.

4) The dark green (P9) and black (P6 and P10) points present a high amount of Cu; however, we cannot accurately determine which pigment is present. The hypothesis is that tenorite was used, a Cu oxide. There may have been the use of mixing with blue azurite pigment. Given that there is a high presence of Pb in these points, the use of black pigments based on lead can also be suggested: galena (PbS) or plattnerite (PbO<sub>2</sub>).

5) The point with light green pigment presents high Ca and Pb amounts, possibly from white pigments used to attenuate the tone. Ca is also very present in P17 (beige color), suggesting the use of this element in the pigment mixed with lead.

6) The points of the measured metals – P17, P18 and P19 – presented different chemical elements. P18 – strikeplate hole – presents elements such as Pb, Zn, Cu, Cr, Fe. P18 also presents Ca, Ba and Sr, which may be linked to contamination when it was applied in a mold – since it is made of cast iron –, possibly made of plaster or clay since these are alkaline-earth metals. P17 – inner nail – is basically composed of Fe and a little lead. The presence of Pb in Fe alloys is possibly to enable more malleability to the metal for the craftsman, especially in the strikeplate hole P19 – referring to the central ornament – is composed of iron with Mn, Zn and Pb traces.

7) The incidence of Pb, Cr, As, Sr, Ba and Ca peaks P18 – corresponding to the lock of the chest-safe – serves as an indicative that such a metal part is a different alloy from the other metal parts – especially Sr, Ba and Ca, which are not found in other analyzed points.

8) The intensities of the peak areas of the ED-XRF spectra of metals show concentrations as shown in Table 4:

41. For a dialogue between the pure ancient visual analysis of works of art as methodified by Giovanni Morelli, cited by Ginzburg as one of the precursors of the evidential method, and the most recent technological applications in these fields of study, refer to Rosado (2011, p.36).

Table 4 – Concentrations of metals identified by the ED-XRF measurements – RG55 Chest.

Element	Nail P17 160824cq %	Lock P18 160824cr %	Ornament Metal P19 160824cs %
Cr		0.29	
Mn	0.71	0.00	0.69
Fe	92.69	78.03	98.40
Cu	0.38	1.80	0.00
Zn	1.34	6.81	0.62
Pb	4.88	13.08	0.28

## HISTORICAL CONTEXTUALIZATION OF OBTAINED DATA

Analyzing the data collected in the examinations of the furniture pieces, we used other sources to comprehend and attribute historical density to such pieces. Inspired by Carlo Ginzburg’s methodological comprehension,<sup>41</sup> we shall focus on the littlest evidential signs present in the furniture pieces, its structural materials and the colors of the pigments used in the internal painting of the chest-safe. The clues to a historical evaluation that enables – in a game of analyzed scales between social microevents and microphenomena – the understanding of the conditions under which these pieces were produced and, by extension, of this fraction of the material and economic life of the Portuguese Empire in America.

Unfortunately, even the great precision achieved by cutting-edge technologies of applied physics cannot provide all the answers about the history and trajectories of the historical pieces to historians. However, it is up to historians to make use of the collected data and, instead of limiting themselves to these two objects, weave further parallel and perpendicular points with specific research lines, as phenomena

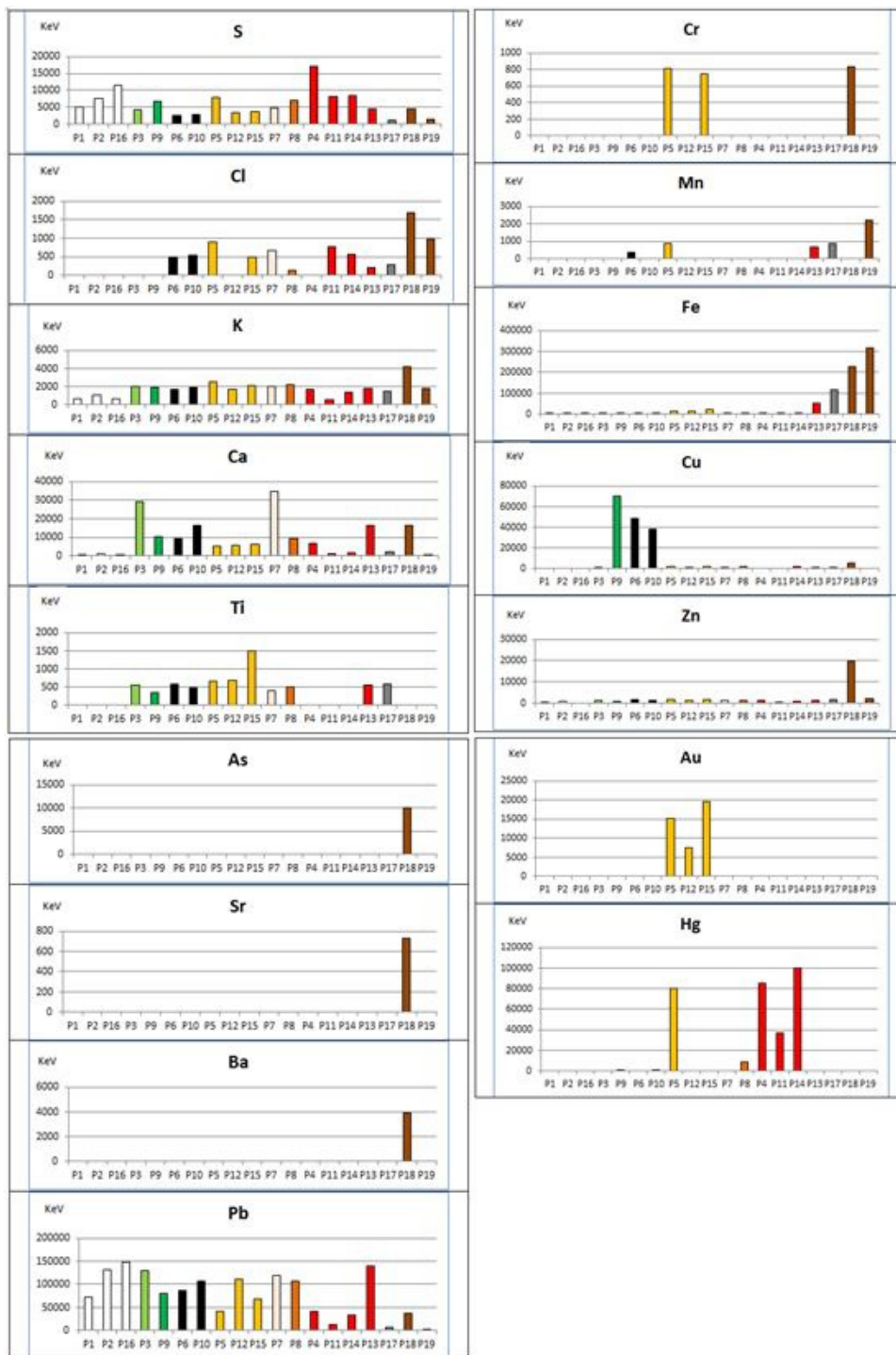


Figure 18 a-p – Bar charts of the areas obtained in the ED-XRF spectra for the different chemical elements determined in the measurements of the points in the RG3242 chest, belonging to the Museu Paulista collection.



that surpass these temporalities and also take place in other spaces; thus, connecting them to the greater social whole that they were a part of.

Several questions remain from the results of the analyses to be better determined by crossing information that can be obtained by using multiple joint techniques. Nevertheless, we needed many elements that provided us with valuable clues to comprehend the *social life* of these objects. For example, we observed parts that were restored over time in the leather of the chair's backrest, which was shown by the fluorescence analysis with UV light. This preliminary analysis sought to guide the choice of the ED-XRF points for the characterization, given that we would have considerable doubts about a possible dating and the determination of the material in points "blindly" analyze, that is, without the disclosure of alterations and restorations – such as the leather with glue on the chair or the layers of restoration paint on the chest.

Firstly, we obtained interesting data about the two different types of leather, not only visually – one is smooth and received treatment with irons, being called the sole, and the other still presents animal fur, named raw – but also by the presence of different chemical elements, thus indicating different tanning processes. From the results we could observe that metallic salts were used in the leather of the wrought backrest, as indicated by the volume of iron found. However, in the haired leather of the seat we noticed the incidence of another tanning method, in which the salts would be absent.

It is known that in addition to the use of metals, the tannins of trees were used for the tanning hides in Europe.<sup>42</sup> Researching in textual sources, we find that it was also practiced in the colony and that the Brazilian production of tanned leather was quite strong given the large volume of cattle that existed in the captaincies of the northeast and the south regions.

From the correspondences of the captain-generals we can observe the importance of the production of tanned leather given their concern with extraction in mangrove forests,<sup>43</sup> especially of the São Paulo coastline:<sup>44</sup>

The men who, in this country, extract the bark of the trees called Mangrove, which serve for tanning at the leather manufacture area of this city, extract it with such disorder that they cut the trunk of all around them, seeking to gather the most with least amount of work. The very contractors are interested in this since it is of their interest buying it this way due to being cheaper, thus leaving the trees stripped of all the sustenance that gives them life, which then become completely dry and perish. Such excess has reached a point in which the innumerable amount of mangrove trees that once existed in this district are now totally extinct, forcing these men to fetch them around Cubatão because they cannot find them in these neigh-

42. Riba; Miró (2007, p. 23); and Pereira, (2000, p. 162).

43. Cabral (2014) showed the formation of one of the first environmental legislations in Brazil given excessive and disorderly extraction.

44. Refer to *Ofício do Morgado de Mateus on Documentos Interessantes para a História e Costumes de São Paulo* located at Arquivo Público do Estado de São Paulo (1952, p.25).

45. Arquivo Nacional da Torre do Tombo. Coleção Papéis do Brasil. Cleto, Marcelino Pereira. "Dicionário da capitania de São Paulo", vol. I. [microfilmed]. PT/TT/PBR/11.

46. Cf. Cleto et al. (1977).

47. Ibid.

borhoods anymore. This abuse shall cause the infallible coming certainty that this tree will be completely missing and with it, soon [...] the very production of leather shall end.

Such leather production should certainly be sufficiently profitable to the point that it faced one of the royal taxes for the reconstruction of Lisbon after the 1755 earthquake, as Pereira Cleto recalls in the *Dicionário da Capitania de São Paulo* (Dictionary of the Captaincy of São Paulo).<sup>45</sup>

In his *Dissertação sobre a Capitania de São Paulo* (Dissertation on the Captaincy of São Paulo), from 1782, the same author provides more accurate information, providing a list of the goods that paid the new tax:<sup>46</sup>

For each arroba of the Bark of Mangrove trees that is moved outside the Village, one hundred réis;

For every hundred sticks of Mangrove trees, one hundred réis;

For each dozen rafters made of Mangrove trees, eighty réis;

We note that it was a high value for this specific wood type when compared to others:<sup>47</sup>

For each large [wooden] joist, eighty réis;

If small, forty réis;

For every dozen wooden tiles, one hundred and twenty réis.

We do not know which plant species could be used in the city of São Paulo for the tanning of hides, but we do note that there were individuals who performed such process. A record states that, in 1825, Francisco Pereira da Silva from the Boaçava neighborhood was an ordinance official in addition to "making a living from his leather". Moreover, Joaquim Aranha and Mariano Gomes de Andrade, both black individuals and the latter a soldier, lived from the same craft in that same year in the Pinheiros neighborhood.<sup>48</sup> We must note that these two neighborhoods are close to the Pinheiros river, possibly where they could use the waters for tannery.

The pieces of furniture with wrought leather lead us to conjecture on the breeding of livestock to produce furniture, on the supply of hide by cattle farms closer or distant from the São Paulo – especially farms from Rio Grande.<sup>49</sup>

Considering the information found on eighteenth century documentation from the City Council – until 1765 –, the passage of livestock was constant in São Paulo, especially heading towards Minas Gerais, Rio de Janeiro and Goiás, as well as to other areas of the captaincy that could consume such cattle or serve as warehouses given their strategic location – Guaratinguetá, Santos, Piedade, Parnaíba, Mogi Guaçu.<sup>50</sup>

With the opening of the Viamão path in the 1730s, the troops of mules coming from the Río de la Plata, from Curitiba and from the very fields of Viamão began to head to the Sorocaba animal fair in greater numbers and more often. From there, the cattle purchased by traders were taken to several regions, having the city of São Paulo as a destination or support area.<sup>51</sup> The implementation of the Sorocaba registry, still in 1750, proves that the volume of heads brought to this village was attractive from a fiscal point of view.<sup>52</sup>

Regarding the intense trade between the south and southeast of Portuguese America in the eighteenth century, Renato Leite Marcondes comments that, parallel to the conduction of troops via land to meet the demand for transportation, clothing and food; leather, tallow and dried meat were transported by sea.<sup>53</sup> However, the studies of specialists are not conclusive with regard to the extraction of leather for furniture, neither in Rio Grande do Sul, or in São Paulo, nor on the cabotage path traveled by the material.<sup>54</sup>

Gold – another product of paramount importance in the colonial economy – was found in the chest-safe in the representations of the royal crown and the castles of the imperial coat of arms of Portugal. The use of gold could perhaps be evident in a first observation of the piece, and the archeometric investigation of such points could even be unnecessary; however, we must be cautious: we know that the manufacture of pigments that imitated gold was recurrent in the European and Colonial American world, as Bernardo Montón's *Secretos de Artes Liberales y Mecánicas* (The Secrets of Liberal and Mechanical Arts) manual published in 1734 attests. The manual taught the "*Secreto para hacer oro de la China para dorar*" (Secret to make Chinese gold for decoration), which consisted of amalgam of mercury and sulfur, passed by filtered lime water. After being burnt, reduced to dust and detempered with Armenian bole and fish glue, then being used for painting or even honing. The so-called gold of Germany was another process practiced at the time, which consisted of an amalgam of silver with turmeric, prepared in infusion of water and yolk, which generated the appearance of fine gold – such as veneer – and of even easier application with a brush.<sup>55</sup> Thus, the rigor of the archeometric examination is crucial for the determination of which techniques were used in the manufacture of the artifacts and to allow their discussion.

48. Refer to *Maços de População de 1825* located at Arquivo Público do Estado de São Paulo.

49. Observations that have already been made in Borrego; Felix (2016).

50. Heads of cattle were taxed during this period to contribute to the voluntary donation for the reconstruction of Lisbon due to the 1755 earthquake. The fact that livestock is at the top of the list of the taxed goods in São Paulo reveals its importance in the set of goods traded in the city. Cf. Borrego (2010a).

51. Reis (2014, p. 30-1).

52. According to Bacellar (2001, p. 101), "unfortunately, no fiscal documents of this Registry for the eighteenth century have survived. Functioning from the moment of its creation until 1825, under the leasing system for private individuals, the eventual control books of animal passage also remained under the possession of these subjects."

53. Marcondes (2001, pp. 41-71).

54. Regarding cattle breeding in southern Portuguese America, cf. Osorio (2007) and Hameister (2002).

55. Apud. Sandão (1966, p. 40).

56. Sarmiento (1969, p. 47).

57. Sarmiento (1969, p. 49).

We can also apprehend its time of manufacture and even the economic conjuncture experienced in the colony in relation to the policies of the metropolis simply due to the presence of such rare element in the chest. In a study about a couch part of the collection of the National Historical Museum of Brazil, Therezinha de Moraes Sarmiento contextualizes its production conditions and its artistic style to the period of Joseph I of Portugal. This monarch, who faced the terrible earthquake of Lisbon (1755), established as a rule to his subjects the modesty in customs and furniture so the nation could return to its former simplicity.<sup>56</sup> His father, John V, in turn, had previously commanded in the May 24, 1749 *Pragmática* (Law):

Cap. V – From this day on, I forbid the manufacturing of new household furniture in silver, neither in fine or false gold or lace of any kind or material [...]

Cap. VII – due the loss they cause to many parts of my domains, the carriages, tables, sideboards, dressing tables, desks, chairs, stools, trumeaux and other utensils that come from foreign places, I order [...] that the entry of such goods is prohibited in Portuguese customs [...]<sup>57</sup>

Therezinha Sarmiento concludes that such measures greatly altered the production of Portuguese furniture since manufacturers were forced to employ other methods to decorate their pieces given the prohibition to the use of noble materials. This would be the reason why woodcarving works took prominence in the Portuguese material culture of the eighteenth century. In the aforementioned case, we see that these policies restricted the resources to be employed in the microeconomy of furniture, thus affecting the technologies of the productive structure. We thus reinforce: the political-economic dimension also presents itself on the very material culture produced by the population.

In addition to the message written in the chest – informing who commissioned it, where it was made and the date, thus conferring it legal legitimacy –, the presence of lead white as the main pigment composing the white base of the painting works as an important dater, affirming the eighteenth-century origin of the piece. This is one of the most thoroughly recorded pigments by historical sources regarding the extent of its use and substitution, given that it was the main white pigment used in painting until the beginning of the nineteenth century, when zinc white was popularized (ZnO) in 1834.<sup>58</sup> The very danger of the use of white lead – which poisoned many painters and artists – led to the search for a white pigment that would replace it and reduce its application. Zinc white also fell in disuse by the twentieth century with the advent of titanium white in 1918, an element used in several synthetic pigments.<sup>59</sup>

Regarding the pigments used in the green and black colors, we noticed that even if the use of ED-XRF allowed us to specify the chemical elements present, it was not sufficient to accurately identify what compound of which elements were used. Both colors present component similarities, and given the striking presence of copper, its oxide (CuO) may have been used is suggested; the oxide is also called tenorite,<sup>60</sup> from which *verdete* is made, also called copper green, its acetate.<sup>61</sup> There is also the possibility of such a green spectrum, certainly dimmed by time and the successive layers of varnishes applied on the piece over the years, to be from the mixture of the copper green with blue pigments, such as azurite (Cu<sub>3</sub>(CO<sub>3</sub>)<sub>2</sub>(OH)<sub>2</sub>).<sup>62</sup> Noting the strong presence of lead in black paints, an element that appears in practically all points, given the impregnation of the white base, we argue that this paint is derived from lead, perhaps its oxide (PbO<sub>2</sub>) or its sulfide (PbS), also called galena.

The red pigments indicate two types of paint: red lead (Pb<sub>3</sub>O<sub>4</sub>) and vermilion (HgS), both widely used since Ancient times until the eighteenth century.<sup>63</sup> Vermilion was certainly the most important pigment for our investigation since it provided us with an important clue about the origin and the production chain of pigments used in São Paulo.

This occurred because Alberto Jacqueri de Sales wrote in the *Diccionario do Commercio* (Dictionary of Trade), from 1760, that vermilion “comes mostly from Holland”; something that historian António Cruz<sup>64</sup> confirms with statistics data on importation between 1777 and 1797, noting that this was the only country supplying Portugal. In fact, the Dutch were the great world producer of vermilion, the name attributed to the traditional way of obtaining such pigment – the “Dutch process” – was not an accident.<sup>65</sup> A broader study on the production of pigments or their importation in Brazil is required; however, considering the fact that even Portugal imported such compound from the Netherlands, it is reasonable to believe that the one used in Brazil was foreign, travelling the profitable trade routes of European artistic materials, as well as the mercantilist logic of supplying manufactured goods to the colony. Even with the abundance of elements used in vermilion in American lands, the obstacles imposed by the know-how made it more feasible to buy it than attempting to produce it locally. Also in Portugal, António Cruz notes that even with mentions of the extraction of cinnabar – natural equivalent of vermilion –, when considering the technical dimension of the pigment production, it is not likely that such a natural variant was used in painting after the Middle Ages.<sup>66</sup>

In our research, so far, we have found only a single inventory of purchase of paints, among other items, commissioned by the City Council of São Paulo to Rio de Janeiro, which provides an additional evidence that such products still went through the port of Santos to then be sent up the hills:<sup>67</sup>

58. Cf. Appoloni; Silva (2009).

59. Ibid.

60. Ibid.

61. Ibid.

62. Ibid.

63. Ibid.

64. Cruz (2013, p. 303).

65. Ibid.

66. Ibid.

67. See the register in Box 41 of *Fundo Câmara*, in the *Série Documentos Avulsos* of the *Arquivo Histórico Municipal de São Paulo*. Given that some documents were unreadable, we were unable to transcribe some of the lines, possibly containing more pigment names.

Rio de Janeiro 22 de abril de 1789

O Snr. Capitão Antônio da Cunha Lobo

Fazendas que pediu para o Senado da Câmara de São Paulo, e remeto para a Vila de Santos a entregar ao Alf.es João Xavier da Costa Aguiar, marca a Mg.e.

A granel 80 quintas de ferro, a 5.000, 400.000

[...]

76 libras de Olio de linhaça, 160, 12.160

Custo das ancoretas 800, 1.600

[...]

soma 13900

1 cunhete

4\ \ pregos caibreres – 5.600 – 22.400

4\ \ ditos pau a pique 3.800 – 15.200

Custo do cunhete – 240

Soma 3.784..

1 cunhete

2 @ e 8 lbs. Alvaiade ... 2.800, 6.550

Custo do Supra vae 160

[...]

1 lba. de fezes 180

16 lbs. de Verdete a 800 – ..800

1 lb.a de Sinopla fina 1.600

1\2 lb.a de Vermilhão f.o 1000. 22.830

soma 474.570

carreta do ferro .480 [...]

If we compare the archeometric data of the chest from the beginning of the eighteenth century with this inventory made by end of that century, we notice how the pigments that we found in the chest were still being imported – at least from other

captaincies, if not from Europe itself –, namely: *alvaiade*, which is white lead; *verdete*, another name for copper green; vermilion, whose high value (22\$830 réis) for the small amount (half a pound) could indicate its foreign origin; and the “golden feces”, another name of litharge, lead oxide (PbO) extracted from galena deposits, which was also used for the separation of gold and silver in mining. The inventory also contains sinopla, a red-brown pigment also called sienna<sup>68</sup> (clayey iron oxide); and finally, the inventory provides us with this rich listing of data that was used linseed oil as the basis for paintings.<sup>69</sup>

Antônio Cruz also prepares a table with the values of the pigments imported via Portuguese ports in 1777, which draws attention due to the high values even in the metropolis, thus proving the importance of these elements to the artists and patrons of the time:

Tabela 5 – values of the pigments imported via Portuguese ports in 1777.

Pigmentos	Arrobas	Réis
<i>Alvaiade</i>	2366	2012\$265
<i>Fezes de ouro</i>	354	290\$280
<i>Sinopla</i>	4	29\$120
<i>Verdete</i>	249	1248\$645
<i>Vermelhão</i>	43	1027\$820

We thus note how the production of furniture serves as an example of the complex forms of production that occurred in the colonial space, having the case of the chest-safe as one of the possible configurations of what could be considered the furniture of Brazil in the eighteenth century – according to the investigation of Angela Brandão<sup>70</sup> –, that is, a furniture piece manufactured in São Paulo with Portuguese-based style, made under the local productive capacities, and with materials imported from Europe.

We also observe the high value of paints when compared to the other raw materials used in the manufacture of furniture in São Paulo. The expenses recorded by the City Council with the construction of the Church of Saint Ephigenia in 1815, reveals to us:<sup>71</sup>

[...] to have imported the wood that was bought for the making of the coffin of the Sacristy for the amount of 3\$600 réis;

68. Cf. Appoloni; Silva (2009).

69. Cruz (2013, p. 299).

70. According to Brandão (2010, p. 44.), “The classification of the furniture set in Brazil for the colonial period is still precarious, and often a furniture piece is considered as a Brazilian colonial piece – with difficult differentiations – despite being a Portuguese piece brought to the colony; the furniture made in Portugal with Brazilian wood; the furniture made in Brazil by Portuguese craftsmen; furniture made in Brazil by local craftsmen, apprentices of Portuguese craftsmen or with models of Portuguese furniture; the furniture made in Brazil by local craftsmen in a rustic manner [...]; finally, the furniture made in Brazil by local craftsmen or not, but with decorative themes inspired by the native flora and fauna.”

71. Livro 286, Fl. 10v, from Fundo Câmara, of Série Assunto Diversos of the Arquivo Histórico Municipal de São Paulo.

72. Apud Pereira (2012. p. 121).

Found more... have imported 4 locks and 4 rings for the coffin... 5\$120 réis;

The minister also spent with payed two carpenters for 10 days to craft said coffin, to one \$400 réis and to the other \$320 réis the amount of 7\$200 réis.

He also paid painter to paint the sacristy and the coffin, paying for all paints an amount of 6\$000 réis

We thus see how the paints used in São Paulo possibly travelled a large commercial route, at least from what we can infer about vermilion: from the Netherlands to Lisbon, from Lisbon to Rio de Janeiro, then to Santos, until finally travelling up the mountains – possibly along the indigenous peoples' shores – and reaching São Paulo; however, the ships could have also performed additional cabotage paths at other ports to trade additional goods.

Danielle dos Santos also found similar paint order list made by the painter José Soares de Araújo for painting the main chapel of Saint Francis of Assisi in Diamantina, Minas Gerais, which occurred around 1782. We reproduced it below to show that Minas also used imported pigments:<sup>72</sup>

Rol das tintas q. se carecem p. a a pintura da Capela de N. P. e S. Fran co .

10 ' ' Milheiros d'Ouro

5 ' ' C a d'geço grosso

4 ' ' d as d'geço Mate

5 ' ' L as de bolo (?)

1/4 ' ' de pinta unha (?)

3 . ' ' L as de maquim (?)

1/2 ' ' d a de rom (?)

1 ' ' d a . de flor d'Anil

1 ' ' d a de Vermilhão

2 ' ' d as de Sinõpla (?)

1/4 ' ' d'Verde Eszilado (estilado)



- 1/2 '' (cx ou lata?) de jalde lino (Amarelo)  
 1/4 '' d'Flor d'jalde (lalde)  
 1/2 '' l a de lacara  
 2 '' C a de Alvayade  
 12 '' l aS do d a fino  
 1/4 '' d'preto de roma  
 1/4 '' de gomas graxas  
 1/4 '' d a detromentina fina  
 1 '' pele d'lixa fina de pintor grande ou duas piquenas  
 4 '' broxas grandes  
 2 '' duzias d'broxas piquenas surzidas co algumas de ponta  
 4 '' d as d'pinceis d'cabra surzidas  
 3 '' C a de retalho de luva  
 1 '' barril de olio d'linhaça  
 2 '' l aS d'Sombra d'Colonia.

Pedece venha tudo bem acondicionado e no melhor comedo que puder ser 1 '' l a de fezes de ouro

(the following is written on the back of this list:)

"Rol das tintas pa Dourar e pintar a capela mor da ordem 3. a de S. Franc.o" s/ data.

The same author informs us that paints were commissioned from Bahia for the painting of the tomb of the church of the Third Carmelite Order of São Paulo in 1801,<sup>73</sup> thus reinforcing our data on the importance of the pigments used in painting, which are shown to be important not only due to the artistic executions but due to the very quality of their imported materials.

Despite these data that indicating the import of paints and the continuity of the European standard of painting, we know that the most varied adaptations occurred in the colonial space, as well as innovative perspectives from artists to perform such adaptations.

74. Cf. Cianciarulo (2014).
75. Cf. Moresi (2007).
76. Cianciarulo (2014, p. 81).
77. Cf. Appoloni; Silva (2009).
78. Sinkankas (1974, p. 204, apud MORESI, 2007, p. 79-82).
79. Cianciarulo (2014, p. 18).
80. *Ibid.*, p. 19.
81. Cf. Andrada (1803) in: Cleto (1977, p. 191).

Such statement is based on what we find from other examples of archeometric studies, as described by Adriana Cianciarulo.<sup>74</sup> Claudina Moresi,<sup>75</sup> examined sacred art from Minas Gerais and found that a substance called gold-pigment (arsenic sulfide) was used to represent the wounds and blood drops of images of Christ – called “rubies”; this substance however is not found in European sacred sculptures. Adriana Cianciarulo<sup>76</sup> notes that the composition of this pigment also took local contours, since despite being traditional in Europe,<sup>77</sup> colonial artists mixed it with resins, which, upon drying, assign a bright red aspect to the blood drops. Moreover, the preparation itself was the secret that conferred such unique quality: the gold-pigment – which was yellow – would acquire the red and bright coloration when warmed to the point of sublimation and then cooled.<sup>78</sup>

This preparation procedure shows that the colonial painters certainly empirically developed the quality of their materials because, despite the gold-pigment already appearing in Portuguese manuals – such as those by Cennino Cennini (1398), Felipe Nunes (1615) and in the *Segredos necessários para os officios, artes e manufacturas, e para muitos objetos sobre a economia doméstica* (Necessary secrets for the crafts, arts and artifacts, and for many objects on the domestic economy) (1794) –, it did not undergo such preparation and coloration in European and even Hispanic-American sculptures.<sup>79</sup> Another local adaptation was the use of kaolinite – a white clay found in Minas Gerais – as a surface preparation basis to receive the paint and used in substitution to plaster, which had to be imported from Europe.<sup>80</sup>

We see how the interest in replacing European productive components by local ones was in vogue in the colonial period when, in 1803, in *Viagem pela Capitania de São Paulo* (A Travel by the Captaincy of São Paulo), Martim Francisco Ribeiro Andrada noted the quality of soils of the Cananeia region:<sup>81</sup>

Continuing from south to north, behind the village, the Upiranga, on the left, and Arariaiçu, on the right, rivers reach the sea in a single line; the formation of the margins is the same and in its banks a painfully white clay is found, of yellow, pink, red and lead-colored mud, very good for paints.

Such minerological attention to the possibility of stimulating the production of paints – although in a very brief part in Andrada’s report – was linked to other efforts to investigate the economic potential of the São Paulo and the Portuguese colony as a whole, considering that during the eighteenth century – and especially in the next century – the Portuguese Crown strengthened its efforts in exploring new income sources in its colonies, as well as diversifying agricultural production; an effort continued by the enlightened Brazilians after the Independence.<sup>82</sup> Such studies

on chemistry and botany performed by other researchers and naturalists can be exemplified by his brother's work – José Bonifácio de Andrada e Silva – on quinine production (*Cinchona officinalis*) in Rio de Janeiro, seeking to replace importation from Peru.<sup>83</sup>

Since the Pombaline Reforms, the metropolis already defended reducing imports, especially of luxury goods, which, as we could see by these punctual examples of the prohibition of the use of gold on the couch and vermilion in the chest-safe, were exceptionally expensive and caused foreign currency evasion from the Lisbon and colonial accounts.<sup>84</sup>

## CONCLUSION

Given these analyses, albeit very brief given the density of the theme, we were able to notice how the very furniture materials provide clues of their importance to the society of the time, as well as carry clues from their past trajectories. These are further material indications that allow us to dispute the narrative of São Paulo's isolation and poverty, as well as the rusticity attributed to its production conditions. We note how the city council, despite the recurrent rhetoric of the absence of funds that permeates its correspondence with the metropolitan government, possessed resources to order the necessary apparatus to its governance such as this monumental chest for the purpose of granting security to its official documents.

In addition to the more practical function of archiving, the materials of the ornaments are revealing of the symbolic weight of this piece.<sup>85</sup> Although an object of restricted use, it is not difficult to retroactively image everyday scenes of its use. For example, when *escravos de ganho*,<sup>86</sup> wage laborers or the poorer mechanical officers went to collect licenses and records,<sup>87</sup> they would be admired by such large safe displaying the golden flush of the Royal Crown and its multicolored crest; thus, reinforcing the power of the set of objects of the government headquarters within an internal space, which was exteriorized by the city council building, the pillory and the organization of parades in public festivals.<sup>88</sup>

Further studies must be conducted on the meanings of the possession and use of furniture with these identified components – such as the costly vermilion and gold, the white lead, the leathers with their different tanning procedures and metals with varied alloys, as well as other pigments that we were unable to identify via ED-XRF or the imaging with UV fluorescence.

82. Patrocínio (2015, p. 70ss).

83. Patrocínio (2015, p. 43).

84. Lustosa (2013, p. 163).

85. Cf. Lisboa; Gonçalves (2011).

86. *Escravos de ganho* were enslaved individuals who performed certain activities for their owners and were allowed to keep part of the payment for such activity – e.g., selling goods. This type of slavery was more common in urban areas.

87. We believe that the staff of the City Council received visitors in the very Senate meeting room, since a division with the secretariat was only made in 1830. "Year of 1830 [...] August [...] 30<sup>th</sup> [...] by the past July 20<sup>th</sup>, Nicolau the Mason was paid to build the new Secretariat wall, and [...] the door that goes to [...] the Session Hall. These works were evaluated in 10\$560, and that were made paid since no one accepted 7360." Cf. Livro 1656, fl. 127, of the Fundo Câmara Municipal, of Série Receita e Despesa of the Arquivo Histórico Municipal de São Paulo.

88. Cf. Carvalho (1994).

89. Cf. Ingold (2012).

90. Cf. Appadurai (2008).

Such material findings – certainly still preliminary – will allow the thorough determination of the intricacies of their acquisition and use in the colonial era. Bringing the multiplicity of sources we use – e.g., payment records, period manuals and traveler reports –, we use Tim Ingold's<sup>89</sup> reflection of not limiting ourselves to the final and "dead" form of things, objectified, but seeking to understand each of its elements – starting from the atomic level – in its *coming* to be in the past, by the various hands through which it went through in its "social lives".<sup>90</sup>

Regarding the gray shades used by many historians to compose the understanding of eighteenth-century São Paulo, we seek to give it some more colorful brushstrokes about its economic conditions and material life, precisely using the pigments, leather, metals and wood of some artifacts of the time. More than bringing final answers on the production of these pieces – answers that have already been obliterated by time –, we seek to show that we can obtain a great volume of contextual information even with a small number of artifacts, and how the interrelationship of sources attributes density to historical analyses that start from the most microscopic evidential pieces.

Even such punctual signals provided us with limited scope of analysis – some of which unfortunately inconclusive via the used technologies –, and we were able to join our assessments to those of several other researchers – each in their specific area – to create bridges for the understanding of the social dynamics of São Paulo's population in their spatial and economic procedures, their forms of distinction and symbols of opulence, their daily scenarios of power and the propellants, as well as the contradictions of their local developments and development related to larger world-economies of the Portuguese Empire.

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