

**Just a Grand Duke who Loves Chemistry. Peter Leopold of Habsburg-Lorraine (1747–1792) and his Chemical Cabinet at the Imperial and Royal Museum of Physics and Natural History**

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**Abstract**

This article dealt with the history of the chemical cabinet established by the Grand Duke of Tuscany, Peter Leopold of Habsburg-Lorraine (1747–1792), at the Imperial and Royal Museum of Physics and Natural History in Firenze during his regency. To achieve this goal, it investigated untapped archival sources (e.g., administrative and commercial documents, minutes, correspondences, inventories) concerning the museum management from its foundation in 1775 to the departure of the Grand Duke for Vienna to be crowned as Holy Roman Emperor Leopold II in 1790. The article analyzed the

chemical cabinet's manuscript catalog, whose entire transcription is presented in the Supplementary Information Files. The work then examined the connections between the activities performed at the chemical laboratory and Peter Leopold's interests in experimental chemistry. Concerning this research question, the scientific relationship he held with the naturalist Giovanni Valentino Mattia Fabbroni (1752–1822) – Vice-director and then Director of the Imperial and Royal Museum of Physics and Natural History – who helped the Grand Duke navigate all aspects of his interests in chemistry and natural sciences, was also discussed.

## **Keywords**

Peter Leopold, history of chemistry, Giovanni Fabbroni, catalog, museum

## **Introduction**

Writing about a notable historical figure such as Peter Leopold of Habsburg-Lorraine (1747–1792) is not an easy task. So, it is not by chance that Soll stated that “there is no single way to characterize Peter Leopold. His approach to intellectual life, philosophy, and governing were pragmatic, eclectic, and a mix of his various influences”.<sup>1</sup> In fact, it is difficult to account for the life<sup>2</sup> of a man who was the ninth son of Francis I (1708–1755) and Maria Theresa of Austria (1717–1780), brother of Joseph II (1741–1790) and Marie Antoinette (1755–1763),<sup>3</sup> Grand Duke of Tuscany from 1755 to 1790, and the next-to-last Holy Roman Emperor (Leopold II) from 1790 to 1792, year in which he suddenly died from pleurisy at the age of 44 years.<sup>4</sup> But that is not all. Peter Leopold was a Jansenist and an enlightened despot,<sup>5</sup> whose concrete projects – as stated by Maran, Castellini, and Bisan—<sup>6</sup> reformed the administrative, managerial, organizational, judicial,<sup>7</sup> and economic aspects of social and cultural life in the Grand Duchy of Tuscany. In this regard, Sarti found that these amendments “transformed Tuscany into a model state”,<sup>8</sup> while Maran et al. underlined how the analysis of the municipalities' reform contributed to a better understanding of today's decentralization by governments in the context

of the new public management.<sup>9</sup> However, a complete survey of Peter Leopold's reforms of Tuscany is out of scope here, and the reader is referred to the literature for further details.<sup>10</sup>

The principal aim of this study is to detail and analyze the history of the chemical cabinet Peter Leopold established at the Imperial and Royal Museum of Physics and Natural History through the investigation of the scientific relationship the Grand Duke held with the naturalist and Museum's vice director Giovanni Valentino Mattia Fabbroni (1752–1822)<sup>11</sup> together with the examination of the laboratory's catalog.<sup>12</sup> The latter unpublished source is preserved at the Museo Galileo's library, whose archival fund on the history of the Imperial and Royal Museum of Physics and Natural History<sup>13</sup> holds various documents that were investigated to achieve the goals of the present paper.

The existing literature on the Imperial and Royal Museum of Physics and Natural History is extensive and focuses mainly on its collections and history.<sup>14</sup> The Museum, established by Peter Leopold's *motu proprio* on 22 February 1775, was not only a place to gather and preserve the naturalistic and scientific collections inherited by the Medici family<sup>15</sup> and the Accademia del Cimento<sup>16</sup> but also acted as a research center to promote useful knowledge in the service of the public good.<sup>17</sup> In this regard, Contardi underlined how the museum collections were open to all and organized to encourage a visitor's self-instruction through the display of explanatory labels.<sup>18</sup> However, the collections did not comprise only the specimens and instruments belonging to the Medici family and the Accademia del Cimento. Still, they were constantly enriched by new acquisitions<sup>19</sup> promoted by Peter Leopold, together with the instruments, preparations, and objects<sup>20</sup> realized at the various museum workshops.<sup>21</sup> Among these, there was the chemistry cabinet that was established to represent, according to both Felice Fontana (1730–1805) and Giovanni Fabbroni, one of the most advanced research centers at an international level. It encompassed, in addition to the standard equipment like flasks and bell-jars, diverse pneumatic pumps<sup>22</sup> together with a workbench –realized by the woodcutter Francesco Schmidt (dates uncertain)–<sup>23</sup> belonging to Peter Leopold. It was openable with a slate working surface for experiments. One of the three cavities in the workbench is linked to a

bellow operated by pedals useful for calcination and combustion operations. Various shelves allowed to store glassware, tiny bottles, and chemical compounds (Fig. 1).



**Fig. 1:** Leopold's chemistry cabinet. Museo Galileo, Room X.

In this regard, Scorrano et al. analyzed 38 samples using X-ray fluorescence, X-ray diffraction, gas chromatography-mass spectrometry, IR spectroscopy, thermal analysis, and chemical tests. According to the authors, most of the compounds were employed in textile manufacturing, while the remaining represented both chemicals helpful in improving wine production and substances of apothecary interest.<sup>24</sup> Many historians have connected the investigation on the workbench to the work of Huber Franz Hoefer (1728–1795) at the court apothecary, as well as to the research the Grand Duke patronized on water<sup>25</sup> and hot springs<sup>26</sup>. While recent studies have linked Peter Leopold's interest in

chemistry to mineralogy, mining science, and mineral collecting.<sup>27</sup> However, so far, there has been little discussion about the involvement of Peter Leopold in the experiments being conducted at the chemistry cabinet and the organization of the chemical laboratory. In the following pages, the analysis of untapped archival documentation will generate fresh insights into these subjects.

## Materials and Methods

As mentioned in the Introduction Section, this study investigated the historical documentation that described both Peter Leopold's interest in chemistry and the chemical cabinet he established at the Imperial and Royal Museum of Physics and Natural History. The documentation covers a period from the museum's foundation in 1775 until the end of Peter Leopold's regency as Grand Duke of Tuscany in 1790. Exceptions were documents about the chemical cabinet covering a period up to 1807. The materials were analyzed according to the standard archival research methods illustrated, for example, in Ventresca and Mohr.<sup>28</sup> The benefit of this approach is providing access to data that would not otherwise be known. Furthermore, the presentation of the archival documents according to a schematic organization facilitates their use as a resource for scholars interested in the history of chemistry in 18<sup>th</sup>-century Italy.

### *Bonding in chemistry: Peter Leopold and Giovanni Fabbroni*

One of the first research questions that come to mind is: did Peter Leopold attend the Imperial and Royal Museum of Physics and Natural History? Or the museum's establishment was, as stated by Solomon,<sup>29</sup> just a result of the European Enlightenment ideas? If, on the one hand, it is beyond dispute that the museum foundation was a consequence of Peter Leopold's reformism, i.e., the promotion of science as an instrument of public utility,<sup>30</sup> on the other hand, it represented a place that the Grand Duke used to attend in person as shown by a *billet* his Intimate Secretary, Giovanni Tommaso Mannucci (1750–1814), sent to Fabbroni on 3 September 1789 forewarning his visit for the following day.<sup>31</sup>

At the Imperial and Royal Museum of Physics and Natural History, Peter Leopold established a close scientific relationship with Giovanni Fabbroni. The latter also assisted him in handling the contacts with various foreign chemists and apothecaries, such as Antoine Baumé (1728–1804).<sup>32</sup> Through the mediation of Francesco Favi (1749–1823)<sup>33</sup> –who was the Secretary of the Tuscan Legation in Paris deputed to purchase and ship diverse kinds of scientific products to Firenze via Marseille, Livorno, and Pisa–<sup>34</sup> Fabbroni got in contact with Baumé and received a copy of the catalog of his preparations in July 1787. The *Genres du Catalogue de M. de Baumé* encompassed 40 items, among which there were cobalt crystals useful for both nitrous and vitriolic acids, flowers of benzoin (benzoic acid), fusible salts of urine (i.e., the complex of salts present in human urine, which may indicate ammonium sodium phosphate or sodium ammonium chloride) and diverse essential oils (e.g., chamomile and cardamon).<sup>35</sup> Since then, Fabbroni bought various boxes of Baumé’s preparations until 1788.<sup>36</sup> One of the last products Fabbroni purchased from Baumé at Peter Leopold’s request was a supply of *pâte de guimauve*, i.e., a demulcent lozenge prepared from the root of *Althea officinalis*.<sup>37</sup> On Tuesday 19 May 1788, Mannucci advised that “His Royal Highness ordered Fabbroni to write to Monsieur Baumé to send him, as soon as possible, 12 pounds of *pâte de guimauve* within a small cup, so that it would not be broken”. The order had to be of particular urgency since Mannucci sent the same note twice on Friday 22 May 1788.<sup>38</sup> At the end of June, Fabbroni noticed that the box was just arrived in Firenze, hoping that it would be delivered at the Royal Chamber soon.<sup>39</sup> Unlike the previous shipments, the *pâte de guimauve* was transported from Paris to Firenze via Genova, and its delivery was in the care of the courier Francesco Maria Vignolo (dates uncertain).<sup>40</sup>

On the same note, Fabbroni gave positive news about sending 17 pounds and 2 ounces of Venus crystals (copper acetate) that had been bought from Bertrand Pelletier’s (1761–1767) laboratory.<sup>41</sup> The products sold by Pelletier had already aroused the Grand Duke’s interest in the past. As an example, on 6 April 1787, during one of his stays in Pisa, Peter Leopold charged his Intimate Secretary Ranieri Fulger (dates uncertain) writing Fabbroni to inquire about the essences and essential oils sold by the Parisian apothecary.<sup>42</sup>

Peter Leopold was then very interested in the work of another French chemist, Jean Antoine Claude Chaptal (1756–1832).<sup>43</sup> In an undated document, Mannucci referred to Fabbroni that the Grand Duke had heard the news about a “Monsieur Chaptal who has a big store in Montpellier selling all kinds of chemicals, acids, and drugs of excellent quality at a meager price”. Mannucci then said that “His Royal Highness will appreciate Fabbroni writing to some of his correspondents to know whether this is true or not. In case of a positive response, His Royal Highness will be pleased to receive a note on all the products he sells with their respective prices”.<sup>44</sup> Fabbroni wrote to Chaptal<sup>45</sup> and the latter sent back a descriptive letter<sup>46</sup> on both the compounds he produced and the procedures he followed for realizing the crystallization of vitriol oil. In this regard, it has to be said that Chaptal sent Fabbroni letters like this more than once. For example, he illustrated the products he sold in Montpellier and his research methods in a missive dating 24 December 1786. This document shows on the top right of its first page a Fabbroni’s brief remark in which he noted that the response was sent on 15 January 1787. He also noticed to have rewritten to the French chemist on 22 February 1787 because he was waiting for a box of chemicals that was not delivered yet. Later, Chaptal would have informed Fabbroni about his chemical products and his upcoming scientific publications. This is the case of a letter, partially gone missing, in which he noticed the forthcoming release of a treatise in two volumes on modern chemistry (i.e., *Elements de Chemie*, 1790).<sup>47</sup>

On 10 November 1786, Fabbroni sent a request for chemicals to Chaptal following a detailed list Peter Leopold had sent to him some days earlier.<sup>48</sup> The content of the list is reported in Table 1. It is interesting to note that, on 27 November 1786, the Grand Duke required that the products, once in Firenze, be delivered to him in Pisa. They had to be shipped via river using Monti’s boat that sailed every Friday with the groceries for the Royal Pantry.<sup>49</sup>

Substances	Weight
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Vitriol oil	10 pounds
Alkali Volatile Fluor	6 pounds
Alkali Volatile Concrete	6 pounds
Alkali Volatile Caustic	6 pounds
Salt of Tartar	8 pounds
Volatile Salt of Hart's Horn	2 pounds
Cinchona Essential Oil	1 pounds
Butyric Antimony	1 pounds
Volatile Salt of Hart's Horn	3 pounds
Oil of Tartar per Deliquium	4 pounds
Diaphoretic Antimony	1 pounds
Flowers of Benzoin	1 pounds
Emetic Tartar	1 pounds
Infernal Stone	3 ounces
Marine Ether	1 pounds
Acetic Ether	1 pounds
Sugar-cane Acid	1 pounds
Regulus of Cobalt	10 ounces

**Table 1:** Peter Leopold's order of chemicals purchased from Jean Antoine Claude Chaptal. 4 November 1786.

A second list, containing the request for other three chemicals (e.g., six ounces of phosphor, six ounces of pyrophorus,<sup>50</sup> and one pounds of tartar acid) to buy from Pelletier's laboratory, was attached in a letter Peter Leopold sent to Fabbroni from Pisa on 17 January 1787.<sup>51</sup>

The delivery of the products coming from Chaptal's store in Montpellier was late, so the company Durand Martin et C.ie wrote to Fabbroni to apologize for any inconvenience it might have caused on 3 March 1787.<sup>52</sup> When the shipment finally arrived in Pisa on 26 March, Peter Leopold personally



opened the three boxes and checked their content. After separating what he would have kept for himself from what would have been sent to the chemistry cabinet, the Grand Duke noted that three chemicals were missing (e.g., the essential oil of cinchona, the flowers of benzoin, and the marine ether), so he asked Fabbroni to contact Chaptal to send them as soon as possible. He was also informed that an unusual quantity of vitriol oil had been delivered to the Imperial and Royal Museum of Physics and Natural History and asked to set aside a bottle he would have used for his experiments when back in Firenze. In this regard, it has to be noted that Peter Leopold carried out chemical experiences outside the Royal Cabinet.<sup>53</sup> For instance, on 18 December 1786, he gave instructions to the chancellor Gaetano Stefani (dates uncertain) to contact Fabbroni asking for a supply of lute<sup>54</sup> to be sent to Pisa. The compound, mixed with boiled oil and clay, had to be like the one previously prepared by Fabbroni for the experiments he conducted in the chemistry cabinet. Peter Leopold's request was quite urgent. Fabbroni had to prepare and deliver the lute in a day to the grand-ducal Intimate Secretary, so it could be placed in a suitcase that was ready to be shipped to Pisa.<sup>55</sup>

Coming back to the order of chemicals delivered by the French apothecary Chaptal in March 1787, Peter Leopold gave away the butyric antimony to the chemistry cabinet. He advised Fabbroni that the products' jars were extremely fragile and had to be handled with highly caring.<sup>56</sup> One of the last orders Fabbroni commissioned to Chaptal dated to mid-January mid-March 1788.<sup>57</sup>

As mentioned before, Fabbroni was not only an agent for purchasing chemicals but also a mentor who guided the Grand Duke through the path of chemistry. For example, while he was experiencing cinchona, Peter Leopold asked Fabbroni if its extract could be reverted to gel in a brass pot, in a copper and silver evaporator, or if it was necessary to store the compound in an earthenware evaporator.<sup>58</sup> Fabbroni was also Peter Leopold's mentor for mineral chemistry and its application to mining science. In this regard, after visiting the Habsburg iron mines in 1779, Peter Leopold realized that the Tuscan iron deposits were not adequately exploited. Therefore, he asked Thaddeus Rauscher (dates uncertain), a mining expert in Carinthia, to come to the Grand Duchy of Tuscany to evaluate the ore processing.

Fabbroni discussed the results of Rauscher's investigations in two reports in 1780. In the first document, the events concerning these inspections were summarized. Fabbroni stated that two experts from Carinthia arrived in September to check the quality of the iron ores and any abuses committed by the local mining administrations. However, one of the two men left the country promising to return after a few days, while the other remained in Firenze without continuing the work. New mining experts arrived from Carinthia, and after analyzing some ores extracted in Maremma, they came to different conclusions about the iron processing systems in use. The first one stated that the defects in ironworking originated from the small amount of coal used in processing the raw materials. The second expert thought that they were caused by an insufficient quantity of iron ores being processed.<sup>59</sup> So ends the first document. In the following *Report on the iron mines in the Grand Duchy of Tuscany and the sampling made by Taddeo Glauscher of Carinthia in 1780*,<sup>60</sup> Fabbroni disagreed with the opinions of the foreign mining experts, saying that "they were not aware of the progress in iron processing made outside their homeland". As an example, he stated that the three furnaces employed in the smelting were necessary because of the samples' size, while the iron produced in Livorno, whose excessive malleability could be easily corrected, could also be used to manufacture nails and plowshares. However, at the end of his second report, Fabbroni agreed with Rauscher about the necessity to reorganize the wood supply for the furnaces in Val di Cecina. Moreover, the excellent quality of the coal deposits in those areas was worthwhile for further analysis.

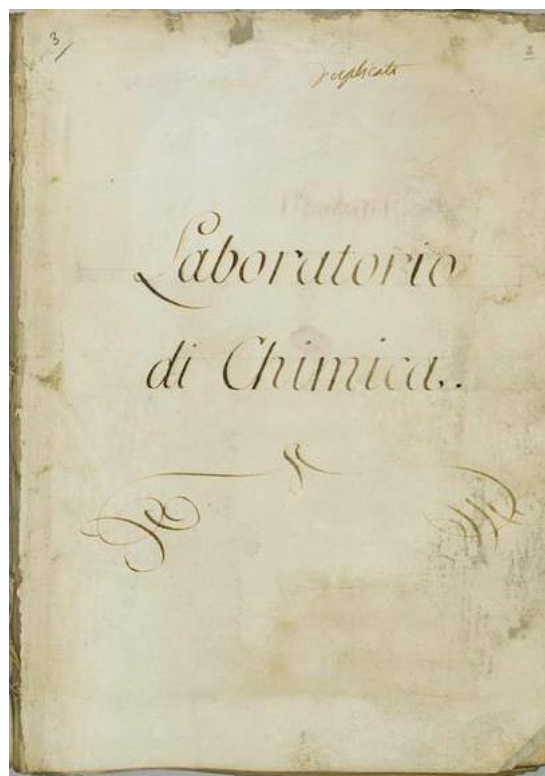
Peter Leopold was no stranger to this dispute. He was pleased with the results shown in Fabbroni's reports to the point that he supported the research of new ore deposits in Val di Cecina in the years to come. Starting from January 1789, Fabbroni investigated the quality of the soil near the coal mines, their extent, and the possibility of finding other deposits nearby. The Grand Duke also ordered that an essay on coal mining and its processing methods be written to improve and promote this activity in the Grand Duchy of Tuscany. One year later, Fabbroni informed Alessandro Pontani (dates uncertain), the Secretary of the State Council, to have finished the book the Grand Duke requested. The volume was *Dell'antracite o carbon di cava detto volgarmente carbon fossile* (On anthracite or

quarry coal, commonly called hard coal) and was printed in 250 copies by Gaetano Cambiagi (1725–1795), who was a typographer and the owner of the grand-ducal printing house.<sup>61</sup> Besides the investigations he carried out in Val di Cecina, Fabbroni was also deputed to the characterization of presumed coal samples. These analyses were performed in the chemistry cabinet. For example, on 26 December 1788, he examined 20 coal samples brought to the museum by Francesco Henrion (dates uncertain), an archivist at the Archives of the Tithes of the Grand Duchy of Tuscany.<sup>62</sup> On Peter Leopold's request, Fabbroni also examined ores coming from Montecerboli to ascertain the presence of borax<sup>63</sup> and copper specimens to verify the possibility of opening a new mine near Arcidosso, a project carried out some years later under the grand-ducal regency of Ferdinand III (1769–1824).<sup>64</sup>

In the following sub-section, the organization of the chemistry cabinet is described through the examination of its catalog –comprising instruments, books, and compounds, some of which belonged to and were made by Peter Leopold– and information is also given on the destiny of the cabinet after the Grand Duke left Firenze in the summer of 1790 to be crowned as Holy Roman Emperor Leopold II.

#### *A Grand Duke at Work: Peter Leopold's Chemistry Cabinet*

The organization of the chemistry cabinet is illustrated in a 100-pages manuscript entitled *Laboratorio di Chimica* (Chemistry Laboratory), which is preserved at the Museo Galileo's Library.<sup>65</sup>



**Fig. 3:** Frontispiece chemistry cabinet's catalog. Biblioteca del Museo Galileo, Firenze.

The volume covers a period from 1780 to 1807. It is divided into four sections, the first of which is represented by the *Indice delle droghe e preparazioni chimiche lasciate al Reale Museo da S.M.I. e collocate nella prima nuova stanza del Laboratorio chimico* (Index of the drugs and chemical preparations left to the Royal Museum by H.R.H. and placed in the first new room of the Chemical Laboratory). On the first page was reported, in red ink, the location (Room II) where the preparations were kept, and each compound was preceded by the symbols “●” or “x”, which probably indicated its presence or lack ascertained during an inventory. The chemicals were then grouped according to the shelves where they were stored, as shown in Table 2. The Results and Discussions section will analyze this part of the chemistry cabinet's catalog.

Shelf	Drugs and Preparations Nos.
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I	81
II	45
III	79
IV	63
VIII	92
IX	89
X	36
V	40
VI	145
VII	85
IX	54
XII	51
XIII	75
Above the shelves	15

**Table 2:** Numbers of shelves and preparations as listed in *Index of the drugs and chemical preparations left to the Royal Museum by H.R.H. and placed in the first new room of the Chemical Laboratory.*

The following catalog's section concerned the chemicals obtained by processing the "three Kingdoms of Natures" (i.e., animals, plants, and minerals), which were housed in the second of the three rooms designed to accommodate the chemical cabinet within the Imperial and Royal Museum of Physics and Natural History.<sup>66</sup> In this regard, it has to be noted that most of these compounds were in poor conservative conditions since they were evaporated or altered and need to be restored. The preparations' list has been transcribed in Supplementary Information Files I–IV, while some information of potential interest resulting from the transcription activity is reported below.

In a closet on the left of the room were substances of animal and/or human origin (e.g., cow's milk serum, gelatinous part of dried human blood, urine salts) for a total of 129 preparations. Some of

these compounds' descriptions are followed by the letters "MB" in red ink, while the red-ink string "O-KI-AO-" is placed before the "donkey glue as prepared by Chinese people" (*Colla d'Asino come preparate dai Cinesi*). Subsequently, there were the plant chemicals comprising 295 preparations. Among them, seven samples were preserved without their containers.<sup>67</sup> It is then interesting to note that diverse samples of honey were listed as preparations of vegetable origin, and one of these varieties (e.g., honey without phlegm, *Miele sflennato* in the original text) was marked with the red-ink letters "MB". It is also noteworthy to highlight the presence of two kinds of milk sugars (e.g., impure sugar milk, *Zucchero di Latte impuro*; white sugar milk, *Zucchero di Latte bianco*) as well as the numbers "II" and "III" to indicate two different samples of rectified ether. Numbers "2", "2.3", and "3" were used to show respectively a sample of turpentine essential oil (*Olio essenziale di Terebentina*), and two samples of turpentine oil (*Olio di Terebentina*). The only compound that was cataloged as a poison was a sample of Ticunas, i.e., an American poisonous substance whose effects were studied by Felice Fontana in an essay published in 1780.<sup>68</sup> On the right side of the room, a closed kept the compounds that were realized by processing minerals for a total amount of 436 samples. Two preparations (e.g., Earth-based Sea salt, *Sale marino a base terrosa*; Homberg's sedative salt, *Sale sedativo d'Hombergio*) were inventoried without containers (vase missing, *manca il vaso*). The red-ink numbers "I", "II", "III", and "IV" indicated four samples of blue enamel (*Azzurro di smalto*), while the string "100.6" and "8.00" was reported on a cobalt sample (*Cobalto reputato fattizio con 100.6. e 8.00. di Vienna*). The number "2" showed that a sample of Berlin-blue was prepared using Sheele's method (*Azzurro di Berlino privato della parte colorita col metodo 2: di Sheele*). The letters "A.B." were then present in the description of a crystallized fusible alloy (*Lega fusibile dell'A. B. cristallizzata*). The cabinet also preserved 104 chemistry and natural sciences books constituting the third catalog's section.<sup>69</sup> Many of these volumes were written in German and French, while only two editions in Italian were present.<sup>70</sup> The inventory did not provide information about the books' publishing house or their year of publication with the exception of *Taschenbuch für Scheidekünstler und Apotheker auf das Jahr* (1789) and Götting's *Almanach* (1780). The books' titles were usually

shortened as well as the names of their authors. The number of tomes in a single work followed the title. At the end of the section, a brief note remarked that all the compounds and preparations are usually used in experiments and other investi. For this reason, they were not included in the general catalog. The transcription<sup>71</sup> of the entire inventory is provided in the Supplementary Information Files.

The fourth and last catalog section described 56 scientific instruments (e.g., balances, mortars, boilers). The transcription of this section is also presented in the Supplementary Information Files. It is interesting to note that the title of this section referred to the objects stored in all three cabinet rooms (*Utensili e arnesi che si conservano nelle tre stanze del Laboratorio*). Nevertheless, ten instruments kept in a fourth room, i.e., the cabinet's obscure hallway (*androne oscuro*), were also inventoried. It is then worth of mention that the descriptions presented in this section are more detailed than those given in its previous catalog parts, providing accurate data about the instruments' physical and external characteristics, the materials they were made from, and whether accessories were present or not. By analyzing this descriptive model, it was discovered that two anvils showed the emblem of the Medici family.<sup>72</sup>

After Peter Leopold returned to Vienna to be crowned Holy Roman Emperor Leopold II, he donated the workbench and all the objects preserved in the chemistry cabinet to the Imperial and Royal Museum of Physics and Natural history. The donation happened on 27 July 1790 when all the preparations belonging to the Grand Duke were transferred to the porpoise-built room with "various tools, housewares, earthenware, and crystal vases". Fabbroni's economic evaluation estimated the cabinet's value at 7217 Tuscan lire. In detail, the chemical preparations and the instruments were evaluated at 6235 Tuscan lire; the housewares, the furniture, and the tools at 952 Tuscan lire; the books at 30 Tuscan lire.<sup>73</sup>

## Results and Discussions

This study aimed to assess the history of the chemical cabinet at the Florentine Imperial and Royal Museum of Physics and Natural History during the Grand Duke Peter Leopold's regency. To achieve this goal, the catalog of the chemical cabinet was analyzed, and the entire manuscript text was transcribed in the Supplementary Information Files. The investigation showed that 1534 items were kept in the cabinet between 1780 and 1807. Among them, there were 1374 chemicals. What is interesting about the data is that 950 compounds belonged to Peter Leopold and therefore, they were inventoried and described altogether in the first part of the catalog. A closer inspection of their list transcribed in the Supplementary Information File I revealed as some of these preparations might have been prepared by the Grand Duke himself. For instance, a sample of *Lac Martin* – i.e., a mastic-based varnish used in the restoration of paintings – was described as “made by His Royal Highness [on] 29 December 1780”.<sup>74</sup> One of the most intriguing aspects, besides the sample evidence of Peter Leopold's genuine interest in chemistry, is that it was still preserved in the early 20<sup>th</sup> century when Ugo Schiff (1834–1915) noted its presence among the compounds kept in the chemical cabinet. Schiff also outlined that Jakob Philipp Hackert (1737–1807), a painter working for Ferdinand I of the Two Sicilies (1751–1825) in Napoli, had probably illustrated the method for preparing the *Lac Martin* to Peter Leopold during the meeting he had with the Grand Duke at the end of 1778.<sup>75</sup> In this regard, it has to be noted that the sample made by Peter Leopold was stored on Shelf no. VIII, which was entirely devoted to the preservation of dyes and varnishes for painting, coating wood, gilded brass, and other minerals. Among the 92 preparations, there were two samples of *Lac Martin*: the one prepared by Peter Leopold and a second one briefly described as “Bechi's *Lac Martin*”.<sup>76</sup> Unfortunately, the catalog provided neither further information on Peter Leopold's preparation nor on the Bechi's one.

Nevertheless, the latter could be possibly identified with Antonio Bechi (dates uncertain), a member of the Florentine Confraternity of the Misericordia and an impresario who established a theater in Via di Porta Rossa in 1760.<sup>77</sup> In the current state of research; it is neither possible to affirm nor deny that the Bechi who prepared the second *Lac Martin* sample was Antonio Bechi. And if this was the case,



neither had he ever met Peter Leopold to explain the varnish preparation. However, this is a hypothesis valuable to be explored in further studies.

Another striking observation emerging from comparing the chemicals' inventory belonging to Peter Leopold is that various preparations were comprised in the orders the Grand Duke received by the diverse French apothecaries in the 1780s. As expected, not all the compounds bought through the years have been cataloged (e.g., the *pâte guimauve*) because they were used to perform experiments or make other preparations, such as the radical vinegar of Venus, which was based on Venus crystals. However, Table 1 showed that most of the chemicals ordered to Chaptal on 4 November 1786 (excepting the essential oil of cinchona) were cataloged in pure form (i.e., flowers of Benzoin, emetic tartar, infernal stone, and sugar-cane acid) or in combination with other compounds. This is the case of the marine ether, which was used to make four different preparations (i.e., manganese marine ether with vitriolic oil, marine salt, and wine spirit; marine ether with Libavio's liqueur; nitrous and vitriolic marine ether).

It is then worth of mention that Peter Leopold's interest in mineral chemistry outlined in the previous Section was confirmed by the catalog's analysis of his preparations preserved in the chemical cabinet at the Imperial and Royal Museum of Physics and Natural History. For example, diverse compounds were utilized in mineral processing, such as vitriolic oil, which was used in the distillation of manganese and the extraction of lead in association with cobalt and zinc. In this regard, it is interesting to note the presence of many preparations constituted by minerals such as ruby-Sulphur (realgar)<sup>78</sup> and various copper-, antimony-, and manganese-based compounds. About this topic, it is worth mentioning that on Shelf No. V was kept 30 cobalt preparations, such as a cobalt specimen from Vienna melted with nitrous acid and prepared with tartar oil, and four compounds made with zaffre (*zaffra*), which indicated impure cobalt arsenate.<sup>79</sup> Among them, one was used for realizing a sample of sympathetic green ink mixed with royal water (*aqua regia*), i.e., a 3:1 mixture of hydrochloric acid and nitric acid. In this regard, it is important to note that 13 different sympathetic cobalt-based inks were preserved, including five green and one rose samples. It can be assumed that Peter Leopold was

genuinely interested in sympathetic inks and their chemical principles, a fondness he shared with the cultural milieu of his time. On this, Macrakis highlighted that sympathetic inks gained the interest of the intellectual community at the end of the 18<sup>th</sup> century. In particular, the progress in knowing the properties of cobalt (e.g., the changing of colors from rose to green and blue when heated) in the early 1700s and the research of chemists such as Jean Hellot (1685–1766) and Pierre Joseph Macquer (1718–1784) allowed the use of these writing tools to become much more advanced and fashionable throughout Europe.<sup>80</sup>

The remaining parts of the catalog gathering the chemical preparations belonging to Peter Leopold present various compounds that could be utilized in precious metal refining as a mixture of Salpeter and ammonia salt to refine gold. These preparations may help us understand the research on mineralogy, chemistry, and mining activities the Grand Duke performed with Giovanni Fabbroni's assistance.

The present results are significant in at least two major respects. Broadly speaking, the compounds belonging to Peter Leopold that were listed in the first part of the chemical cabinet's catalog reflected the institutional reforms he undertook to promote the development of chemical knowledge through the establishment of new research centers as the chemical cabinet at the Royal Museum of Physics and Natural History. The latter soon became a center of great importance from a European perspective, as shown by the French apothecaries with whom Fabbroni was in contact. The cabinet was then equipped with the most up-to-date instruments and tools to perform experiments in pneumatic chemistry, as revealed by the analysis of its catalog. Furthermore, the investigations carried out at the chemistry cabinet, such as those to improve iron processing in Maremma or the research on the characterization of valuable minerals, were aimed, as stated by Mokyr, at expanding the set of useful knowledge and applying natural sciences to solve technological problems and bring about economic growth.<sup>81</sup> To this theoretical framework has to be referred to Fabbroni's publication on the coal deposits, which represented a means to promote mining sciences and activities within the Grand Duchy of Tuscany. In this regard, it is noteworthy that the typologies of the preparations listed

in the chemistry cabinet's catalog showed how chemistry was an applied science in 18<sup>th</sup>-century Italy, closely linked on the one hand with medicine and pharmacopeia and on the other hand with mineralogy and mining processes. On this subject, it is interesting to outline that Peter Leopold asked Thaddeus Rauscher to improve the working methods used in Tuscan iron deposits and ordered Fabbroni to observe the mining and mineral processing techniques utilized in the Habsburg mines. This action followed similar resolutions taken by the rulers of other Italian states that supported the educational travels to the mines of Central and Northern Europe (e.g., to the renewed Chemnitz mining school) for their naturalists, as happened to Marco Carburi (1731–1808) and Matteo Tondi (1762–1835).<sup>82</sup> So, it was not by chance that Fabbroni, after the Restoration, left his position as Director of the Imperial and Royal Museum of Physics and Natural History to be responsible for the mint and the mines of the Grand Duchy of Tuscany. It should then be noted that the measures Peter Leopold implemented to improve chemical knowledge, such as the establishment of a chemistry chair at the University of Siena in 1771, continued the actions carried on by his father, Francis I, who instituted the first Tuscan chair of chemistry at the University of Pisa in 1757.<sup>83</sup>

Subsequently, the combination of the findings presented in this study raises the possibility that Peter Leopold's interest in chemistry, although influenced by the cultural context in which he lived, could be genuine. For example, he carried out experiments on the diverse phases of matter and performed personal investigations outside the chemistry cabinet, as shown by the orders of chemical products he asked to be delivered in Pisa with urgency at the end of 1786.

About the remaining parts that constituted the catalog of the chemical cabinet, it was considered not to explore them further than the materials presented in the previous section since these inventories are linked neither to Peter Leopold nor to the activities he carried out at the chemical cabinet, covering the volume a period up to 1807. Regarding the inventory of the books kept in the chemistry cabinet, it is interesting to outline that on 14 May 1789, Francesco Favi informed Fabbroni of the publication of Lavoisier's *Traité élémentaire de Chimie* and of the first volume of the *Annales de Chimie*. Favi then advertised to have shipped the books by courier to Fontana's address and asked whether he was

to send the ongoing annals or not.<sup>84</sup> According to inventory, the museum acquired for the library of the chemical cabinet both the volumes of Lavoisier's *Traité élémentaire de Chimie* and the first ten issues of the *Annales de Chimie*.

## Conclusions

The present study aimed to examine the history of the chemical cabinet at the Imperial and Royal Museum of Physics and Natural History up to 1790, when Grand Duke Peter Leopold, who founded the museum in 1775, returned to Vienna as Holy Roman Emperor Leopold II. The second goal of this work was to analyze Peter Leopold's interest in chemistry to investigate whether he had a sincere fondness for this branch of science. Thanks to the examination of the chemical cabinet's catalog, whose transcription is presented in the Supplementary Information Files, and the data comparison with other archival sources relative to the Imperial and Royal Museum of Physics and Natural History, this study has found that the establishment of the chemical cabinet fell under the policies for promoting scientific culture Peter Leopold implemented in the Grand Duchy of Tuscany under his regency. However, one of the more significant findings to emerge from this work is that the establishment of the cabinet and its management also suited the Grand Duke's interests in natural and experimental sciences, disciplines that experienced remarkable advancements in the second half of the 18<sup>th</sup> century. Peter Leopold's fascination with analytical chemistry is evidenced by the collection of preparations he owned within the chemical cabinet –some of which he made– that were inventoried in the first part of the cabinet's catalog. Their analysis, together with the reconstruction of the activities he carried out with the help of Giovanni Fabbroni, showed the scientific and experimental interest in the chemistry of an Enlightened ruler, who was fully aware of the economic, social, and cultural benefits that would result from the development of chemical knowledge for the territories under his governance.

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## References

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3. An investigation of the relationship between Peter Leopold, Joseph II and Marie Antoinette is included in A. Ritter von Arneth, *Marie Antoinette: Joseph II Und Leopold Ii: Ihr Briefwechsel: Joseph II Und Leopold II: Ihr Briefwechsel*, K.F. Köhler, Leipzig, **1866**.
4. A. Wandruszka, *Physis* **1962**, 4(2), 116–124.
5. L. Bellatalla, *Pietro Leopoldo di Toscana granduca-educatore: Teoria e pratica di un despota illuminato*, Pacini Fazzi Editore, Lucca, **1984**.
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7. As an example of Peter Leopold's judicial reforms, it is worth mentioning that the Grand Duchy of Tuscany was the first country to abolish torture and the death penalty on 30 November 1786. More details on this topic can be found in: L. Berlinguer, F. Colao, *La leopoldina nel diritto e nella giustizia in Toscana*, Giuffrè, Milano, **1989**; D. Edigati, *Prima della Leopoldina: la giustizia criminale toscana*

*tra prassi e riforme legislative nel XVIII secolo*, Jovene, Napoli, **2011**; C.E. Tavilla in *Il diritto come forza, la forza del diritto. Le fonti in azione nel diritto europeo tra medioevo ed età contemporanea* (Eds.: R. Braccia, A. Carrera, A.A. Cassi, E. Fusar Poli, A. Marchisello, G. Rossi, C.E. Tavilla, A. Sciumè), Giappichelli, Torino, **2012**, pp. 151–185.

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10. For a more extensive survey of Peter Leopold's reforms see: C. Mangio, *La polizia toscana: organizzazione e criterio d'intervento 1765–1808*, Giuffrè, Milano, **1988**; A. Tacchi, *Medioevo e Rinascimento*, **1992**, 6, 361–373; G. La Rosa, *Il sigillo delle riforme. La costituzione di Pietro Leopoldo di Toscana*, Vita e Pensiero, Firenze, **1997**; M. Rosa, *Settecento religioso. Politica della ragione e religione del cuore*, Marsilio, Venezia, **1999**; V. Baldacci, *Le riforme di Pietro Leopoldo e la nascita della Toscana moderna*, Regione Toscana Press, Firenze, **2000**; A. Contini in *La corte di Toscana dai Medici ai Lorena* (Eds.: A. Bellinazzi, A. Contini) Ministero per i Beni e le Attività Culturali, Direzione Generale per gli Archivi, Roma, **2002**, pp. 129–220; V. Perlatto, *Studi Urbinati, A - Scienze Giuridiche, Politiche ed Economiche*, DOI: 10.14276/1825-1676.1070; R. Messbarger in *Florence after the Medici*, (Eds.: C. Tazzara, P. Findlen, J. Soll), Routledge, New York, **2020**, pp. 116–154.

11. Giovanni Valentino Mattia Fabbroni was one of the most renewed intellectuals in the Tuscan cultural circles of the late 18<sup>th</sup> century. In their review of the history of analytical chemistry in Italy, Burns et al. stated that Fabbroni's research interests encompassed natural sciences, mineralogical and agricultural chemistry, electrochemistry, and political economy. Fabbroni was also involved in managing the Imperial and Royal Museum of Physics and Natural History, where he worked since he was sixteen years old as an assistant to the director Felice Fontana (1730–1805). In 1780 Fabbroni was appointed as Museum's Vice Director. He became Museum Director in 1825. See: T. Burns, G. Piccardi, L. Sabbatini, *Microchim Acta*, DOI: 10.1007/s00604-007-0769-0. For a more exhaustive

Fabbroni's scientific biography see: R. Pasta, *Scienza, Politica e Rivoluzione. L'opera di Giovanni Fabbroni (1752–1822) intellettuale e funzionario al servizio dei Lorena*, L.S. Olschki, Firenze, **1989**; S. Contardi in *Linnaeus in Italy: the spread of a revolution in science* (Eds: M. Beretta, A. Tosi), Science history publications, Sagamore Beach, **2007**, pp. 113–128.

12. Archivio Museo Galileo (AMG), Fabbroni 10, cc. 1–99.

13. The Archive of the Royal Museum of Physics and Natural History preserves more than 5700 records about the administration, organization, and management of the Museum from 1775 to 1872. This archival fund represents one of the most important sources of information to investigate the fascinating and complex history of this institution.

14. On the history of the collections housed at Imperial and Royal Museum of Physics and Natural History see: G. Barsanti, G. Chelazzi (Eds.), *Il Museo di Storia Naturale dell'Università degli Studi di Firenze. Le Collezioni della Specola*, Firenze University Press, Firenze, **2009**; M. Raffaelli (Ed.), *Il Museo di Storia Naturale dell'Università di Firenze – Le collezioni botaniche*, Firenze University Press, Firenze, **2009**; S. Monechi, L. Rook (Eds.), *Il Museo di Storia Naturale dell'Università degli Studi di Firenze. Le collezioni geologiche e paleontologiche*, Firenze University Press, Firenze, **2010**; G. Pratesi (Ed.), *Il Museo di Storia Naturale dell'Università degli Studi di Firenze. Le collezioni mineralogiche e litologiche*, Firenze University Press, Firenze, **2012**; J. Moggi Cecchi, R. Stanyon (Eds.), *Il Museo di Storia Naturale dell'Università degli Studi di Firenze. Le collezioni antropologiche ed etnologiche*, Firenze University Press, Firenze, **2014**; M. Borgheresi, F. Di Benedetto, A. Caneschi, G. Pratesi, M. Romanelli, L. Sorace, *Phys. Chem. Miner.*, DOI: 10.1007/s00269-007-0175-5; G. Pratesi, A. Franza, E. Lascialfari, L. Fantoni, F. Malesani, A. Hirata, *Geoheritage*, DOI: 10.1007/s12371-021-00624-1.

15. On 18 October 1771, Felice Fontana (1730–1805), who was the first director of the Imperial and Royal Museum of Physics and Natural History, received the inventory concerning the scientific instruments and the naturalistic specimens kept in the Royal Gallery (today Uffizi Gallery) that had belonged to the Medici family. AMG, ARMU 001, aff. 1, cc. 331–380. On the scientific Medicean

collecting see: F. Camerota, M. Miniati, *I Medici e le scienze: strumenti e macchine nelle collezioni granducali*, Giunti, Firenze, **2008**. For an investigation of the Medici collections that are still preserved at the Florentine Natural History Museum see: A. Re, D. Angelici, A. Lo Giudice, J. Corsi, S. Allegretti, A.F. Biondi, G. Gariani, S. Calusi, N. Gelli, L. Giuntini, M. Massi, F. Taccetti, L. La Torre, V. Rigato, G. Pratesi, *Nucl. Instrum. Methods Phys. Res. B: Beam Interact. Mater. At.*, DOI: 10.1016/j.nimb.2014.11.060.

16. The Accademia del Cimento, founded by Leopold I de Medici (1617–1675) and Ferdinand II de Medici (1610–1670) in 1657, was the first scientific society in Europe. It remained active until 1667 and was devoted to studying the natural philosophy's principles in the light of the experimental method. During the Accademia's meetings, usually held at Pitti Palace, the participants –among which there were Francesco Redi (1626–1697) and Giovanni Alfonso Borelli (1608–1679)– performed experiments on thermometry, barometry, and pneumatics using the purpose-built instruments that were stored in the grand-ducal residence, until Peter Leopold transferred them to the Imperial and Royal Museum of Physics and Natural History at Torrigiani Palace. See: P. Findlen, Academies, networks, and projects: the Accademia del Cimento and its legacy, *Galilaeana*, 7, **2010**, 277–298.

17. In the spirit of Enlightenment, useful knowledge covered many disciplines (from today's hard sciences to humanities) that could improve a country's education, progress, and civilization. See: T. Morel, G. Parolini, C. Pastorino (Eds.), *The making of useful knowledge*, Max Planck Institut für Wissenschaftsgeschichte, Berlin, **2016**. In this scientific, social, and cultural *milieu*, the establishment of the Imperial and Royal Museum of Physics and Natural History can be included among the policies – such as the reforms of hospitals and libraries – Peter Leopold implemented for the public good. See: M.M. Goggioli, *La Biblioteca Magliabechiana. Libri, uomini, idee per la prima biblioteca pubblica a Firenze*, L.S. Olschki, Firenze, **2000**; E. Chapron, *Il patrimonio ricomposto. Biblioteche e soppressioni ecclesiastiche in Toscana da Pietro Leopoldo a Napoleone*, *Archivio Storico Italiano*, **2009**, 167, 299–346; E. Diana, M. Geddes de Filicaia, *Regolamento dei regi spedali di Santa Maria*



*Nuova e di Bonifazio*, Polistampa, Firenze, **2010**; S. Barchielli, L'Istituto vaccinogeno all'Ospedale di Santa Maria degli Innocenti di Firenze nel XVIII secolo, *Nuncius*, **1998**, 13(1), 247–263.

18. S. Contardi, *La casa di Salomone a Firenze: l'Imperiale e reale museo di fisica e storia naturale, 1775–1801*, L.S. Olschki, Firenze, **2002**.

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20. A classic example of the objects realized at the museum laboratories is the anatomical models produced at the La Specola wax workshop. See: A. Maerker, *Model experts: wax anatomies and Enlightenment in Florence and Vienna, 1775-1815*, Manchester University Press, Manchester, **2011**.

21. Among the museum workshops, Contardi highlighted how the physics cabinet represented one of the most renewed research centers on electrical phenomena at that time and was attended by various scholars such as Angelo Querini (1721–1796), Antonio Vallisnieri junior (1707–1777), and Carlo Barletti (1735–1800). The latter studied the machines that were built there. Furthermore, the physics cabinet also realized mechanical and pneumatic equipment and various optical instruments. See S. Contardi in *Il Museo di Storia Naturale dell'Università degli Studi di Firenze. Le collezioni della Specola* (Eds.: G. Barsanti, G. Chelazzi), Firenze University Press, Firenze, pp. 18–25.

22. The surviving pneumatic pumps (ca. 13 instruments) are now preserved at the Museo Galileo (Inventory nos. 358–359, 423, 831, 1530–1537, 3777). Among these, it is worth mentioning a pear-shaped glass ampoule that was used to simulate the aurora borealis phenomenon (Inv. no. 423), two vitreous globes for experiments with a bladder in a vacuum (Inv. nos. 358–359), and an air pump that resembles the device described by Jean Antoine Nollet (1770–1770) in his *Leçons de physique expérimentale* (1743–1748) (Inv. no. 1534). On the latter instrument, see: P. Brenni in *The art of teaching physics: the eighteenth century demonstration apparatus of Jean Antoine Nollet* (Eds.: L. Pyenson, J.F. Gauvin), Septentrion, Sillery, **2002**, pp. 11–27.

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24. See: G. Scorrano, N. Nicolini, I.M. Masoner, *J. Chem. Ed.*, DOI: 10.1021/ed079p47. Peter Leopold's workbench is now displayed in Room X of the Museo Galileo's permanent exhibition.

25. Hubert Franz Hoefler was born in Colonia in 1728. There was no news about him until 1765 when he arrived in Firenze along with Peter Leopold's retinue. He remained in Firenze for 25 years and was appointed director of the court's pharmacy. In 1766 he commissioned the *Tabula Affinitatum*, i.e., a table of the chemical affinities between different substances based on Étienne-François Geoffroy's *Table des différents Rapports observés entre différentes substances* (1718), for the apothecary's shop. The *Tabula Affinitatum* is now preserved at the Museo Galileo (Inv. no. 1899). From the early 1780s, Hoefler analyzed the Tuscan springs of Rapolano, San Quirico d'Orcia, and Rio nell'Elba. Still, his most renewed investigation was the water analysis of Lagone Cerchiaio in Monterotondo Marittimo, during which he discovered the natural boric acid (1778). When Peter Leopold was crowned as Holy Roman Emperor in 1790, Hoefler returned to Vienna, where he died as a court chamberlain five years later. See: G. Piccardi, *La Farmacia granducale di Firenze*, L.S. Olschki, Firenze, **2018**; G. Piccardi, *Nuncius*, **2004**, 19(2), 545–568.

26. After the renovation of Bagni di Pisa and Bagni di Lucca, Peter Leopold oversaw the establishment of a new thermal center near Montecatini. Following the works of David Becher (1725–1791), who was a physician and a balneologist also known as the “Hippocrates of Karlovy Vary”, the Grand Duke ordered chemical analyses on both cold- and hot-water springs to formulate individual hydrothermal treatments. Similar investigations were performed in the Siena area by Giuseppe Baldassarri (1705–1785). See: V. Becagli in *Una politica per le terme: Montecatini e la Val di Nievole nelle riforme di Pietro Leopoldo. Atti del Convegno di studi: Montecatini Terme, 25-26-27 ottobre 1984*, Periccioli, Siena, **1985**, pp. 174–210; G.L. Corinto, *Geotema*, **2019**, 60, 44–52; A. Guarducci in *Chiare, fresche e dolci acque. Le sorgenti nell'esperienza odepolica e nella storia del territorio* (Ed.: C. Masetti), Cisge, Roma, **2020**, pp. 355–370.

27. A. Franza, R. Fabozzi, L. Vezzosi, L. Fantoni, G. Pratesi, *Earth Sci. Hist.*, DOI: 10.17704/1944-6178-38.2.173; A. Franza, J. Mattes, G. Pratesi, *Collectio mineralium. The Catalog of Holy Roman Emperor Leopold's II Mineralogical Collection*, Firenze University Press, Firenze, **2022**.
28. M.J. Ventresca, J.W. Mohr in *The Blackwell Companion to Organizations* (Ed.: J.A.C. Baum), Blackwell, Maiden, **2002**, pp. 805–828.
29. E. Solomon, *Reference/Representation*, 105–108, **2011**.
30. S. Contardi in *Il Museo di Storia Naturale dell'Università degli Studi di Firenze. Le collezioni mineralogiche e litologiche* (Ed. G. Pratesi), Firenze University Press, Firenze, p. 17.
31. “Sua Altezza Reale fa sapere all’Aiuto del Direttore del Real Museo Gio: Fabbroni che domane verrà al d. Museo alle ore  $2\frac{1}{2}$  pomeridiane scendendo alla porta della strada. 3 Settembre 1789.” See: AMG, Fabbroni 04, c. 3.
32. According to Simon, although he did not enjoy the same historical recognition as other pharmacists due to his opposition to Antoine Lavoisier’s oxygen theory, Baumé was a qualified chemist. He wrote several works on the crystallization of salts, the phenomena of freezing and fermentation, and the properties of boric acid, Sulphur, and opium. Baumé’s research also dealt with the practical use of chemistry. For example, he studied the characteristics of clays and other building materials and created a system for fabric dyeing and silk bleaching. Baumé then proposed a new method for the purification of saltpeter and established the first ammonium salt factory in France. He also perfected the empirical hydrometer that today is named after him. On Antoine Baumé see: J. Simon, *Osiris*, DOI: 10.1086/678108; C. Barnard, A. Fones, *Platin. Met. Rev.*, DOI: 10.1595/147106712X650811. With regards to his studies on fermentation producers, on 9 November 1787, Baumé complimented Fabbroni for the essay about wine fermentation written by his brother Adamo. AMG, Fabbroni 04, c. 34. The work *Dell’arte di fare il vino* (1787) dealt with producing and conserving wines to be exported. On Adamo Fabbroni (1748–1816) see: R. Pasta in *Dizionario Biografico degli Italiani*, Istituto della Enciclopedia Italiana, Roma, **1993**, vol. 43, pp. 669–673.

33. Francesco Raimondo Favi was a well-known diplomat in the Parisian political, economic, and cultural *milieu*. Thanks to his intermediation, new scientific publications as well as diverse mechanical drawings, botanical specimens, and scientific instruments reached Firenze in the last decades of the 1700s. See: Z. Ciuffoletti, *Parigi-Firenze 1789-1794. Dispacci del residente toscano nella capitale francese al governo granducale*, L.S. Olschki, Firenze, **1994**.
34. Francesco Favi, Joseph Latour (dates uncertain), and David Durand (dates uncertain) oversaw the shipments on the French front, while Rocco Bacigalupo (dates uncertain) was responsible for deliveries from Livorno to Pisa and Firenze.
35. AMG, Fabbroni 04, cc. 69–72. Another list of chemicals Fabbroni asked Baumé for is given in AMG, Fabbroni 04, c. 57.
36. AMG, Fabbroni 04, cc. 30–32, c. 52.
37. R.D. Hoblyn, *Dictionary of terms used in medicine*, printed for Sherwood, Gilbert, & Piper, London, **1844**, p. 228.
38. AMG, Fabbroni 04, c. 16.
39. AMG, Fabbroni 04, c. 11.
40. AMG, Fabbroni 04, c. 12.
41. Bertrand Pelletier was an apothecary conducting diverse investigations into mineral chemistry at his Parisian laboratory in Rue Jacob 48. Following Jean Baptiste Romé de L'Isle's (1736–1790) studies, he realized salt crystals that were soluble at very slow evaporation. In 1785, he confirmed Carl Scheele's (1742–1786) discovery that chlorine could be produced from hydrochloric acid and manganese. See: W.A. Smeaton, *Platinum Metals Rev.*, **1997**, 41, 86–88.
42. AMG, Fabbroni 04, c. 77.
43. Jean Antoine Chaptal, Count of Chanteloup, was a chemist and a statesman. His studies dealt with the industrial manufacture of soda ash and sodium nitrate. With Louis Nicolas Vauquelin (1763–1829), he determined the alum composition, promoting its industrial production by synthetic means. See: J. Hoff, *Technology and culture*, **1998**, 39, 671–698.

44. AMG, Fabbroni 04, c. 43. This document is related to a brief note, showing no signature or date, partially written in French, reporting general information about Chaptal and his well-stocked store in Montpellier. A closing remark in Italian says, “I would write for the prices and the kinds of products he sells”. See: AMG, Fabbroni 04, c. 48.
45. AMG, Fabbroni 04, c. 50.
46. AMG, Fabbroni 04, cc. 101 and 108.
47. AMG, Fabbroni 04, cc. 80–81.
48. AMG, Fabbroni 04, c. 2. The document heading reported that if Fabbroni did not need to file the order note, this would be sent back to His Royal Highness.
49. AMG, Fabbroni 04, c. 104.
50. The *Pyrophorus Hombergii* was a flammable compound realized from human fecal matter created by the Dutch chemistry and physician Wilhelm Homberg (1652–1715) in the early 18<sup>th</sup> century. See: L. Principe, *The Transmutations of Chymistry. Wilhelm Homberg and the Académie Royale Des Sciences*, University of Chicago Press, Chicago, **2020**.
51. AMG, Fabbroni 04, cc. 89–90.
52. AMG, Fabbroni 04, c. 86.
53. AMG, Fabbroni 04, c. 84.
54. The lute was usually used in chemical distillation processes to seal a vessel and prevent the dispersion of the stem while protecting its surface from heat. See: S.J. Linden, *The alchemy reader: from Hermes Trismegistus to Isaac Newton*, Cambridge University Press, Cambridge, **2003**.
55. AMG, Fabbroni 04, c. 126.
56. AMG, Fabbroni 04, cc. 96 and 98.
57. AMG, Affari 002, c. 355.
58. AMG, Fabbroni 04, c. 30.
59. AMG, Fabbroni 02, cc. 9–12.

60. AMG, Fabbroni 02, cc. 2–8. The original title was *Relazione sopra le miniere di ferro nel Granducato di Toscana e saggi sopra le medesime fatte da Taddeo Glauscher di Carintia nel 1780*. Taddeo Glauscher can be identified with the mining expert Taddeus Rauscher, since the correct spelling of his name is mentioned in the opening of Fabbroni's report.
61. AMG, Fabbroni 03, cc. 268–271.
62. AMG, Fabbroni 03, c. 253.
63. AMG, Fabbroni 03, c. 251.
64. AMG, Fabbroni 03, c. 275 and 404.
65. AMG, Fabbroni 10, cc. 1–99.
66. The full title of the second catalog's section is *Serie di preparazioni chimiche risultanti dall'analisi dei tre regni della natura e che si conservano in piccoli saggi nella seconda stanza del Laboratorio* (Series of chemical preparations resulting from the analysis of the three kingdoms of nature and stored in small samples in the second room of the Laboratory).
67. Acid and light cacao butter oil (*Acido e Olio leggero del Burro di Cacao*), precipitated copal of the Spirit of Wine with the effusion of water (*Coppale precipitata dello Spirito di Vino con l'effusione dell'acqua*), cherry-laurel spirit (*Spirito di Lauro-ceraso*), essential oil and resinous part of laurel berries separated from its fixed oil by means of wine spirit (*Olio essenziale e parte resinosa delle Bacche di Alloro separati dal suo Olio fisso col mezzo dello Spirito di Vino*), aromatic part of wine dissolved in wine spirit (*Parte odorante del Vino disciolta nello Spirito di Vino*), litmus tincture (*Tintura di Tornasole*), litmus starch or mold laquer (*Fecula del Tornasole ò Lacca muffa*).
68. In his essay on Ticunas, Fontana stated that he had the opportunity to study this vegetable-origin poison at the beginning of his stay in London (approximately in the summer of 1778). The English version of the essay's title reported the compound as belonging to the Grand Duke of Tuscany. Since no other mention of this fact was written neither in Fontana's text nor in the chemistry cabinet's catalog, it is impossible to include this sample within the preparations Peter Leopold owned. See: F. Fontana, *Philosophical Transactions of the Royal Society of London*, **1780**, 70:163–220, ix–xlv.

69. The third catalog's section was entitled *Libri d'arte che si conservano nel Laboratorio* (Arts books kept in the Laboratory).

70. They were Scopoli's *Materie spettanti alla chimica* and the Italian edition of Macquer's *Dizionario di chimica*.

71. The transcription reports as precisely as possible how the books have been inventoried; therefore, possible spelling errors have not been corrected unless they made the text unintelligible.

72. Here is the original text: *un Tasso ed una Bicornia sul medesimo Coppo lustri e intagliati a bulino con vari fregi e coll'Arme de Medici*.

73. AMG, ARMU Affari 004, c. 307.

74. "Lac Martin fatta da S.A.R. 29 dicembre 1780" in the original text.

75. U. Schiff, M. Betti, *Archeion*, **1928**, 9:290–324.

76. "Lac Martin del Bechi" in the text.

77. See: *Tomo Settimo delle Gazzette Toscane uscite settimana per settimana nell'anno 1772*, Appresso Anton Giuseppe Pagani Stampatore e Librajolo delle Scalere di Badia, Firenze, **1772**, No. 12, unnumbered page; P. Landini, *Istoria della venerabile Compagnia di Santa Maria della Misericordia della città di Firenze con i capitoli, riforme, e catalogo di tutti i capi di guardia dal suo primo principio*, nella stamperia di Pietro Allegrini alla Croce Rossa, Firenze, **1786**, p. CXVII;

78. T. Wright, *The Universal Pronouncing Dictionary, and General Expositor of the English Language*, the London and New York Printing and Publishing Company, London and New York, vol. 5, p. 267.

79. F. Flügel, J.G. Flügel, *A practical Dictionary of the English and German Languages: Deutsch-Englisch*, Julius Richter, Leipzig, **1861**, p. 1128.

80. On the history of sympathetic inks, their usage in the late 18<sup>th</sup> century, and chemical research about their composition, see: J. Wisniak, *Revista CENIC Ciencias Químicas*, **2009**, 40(2): 111–121;

C. Lehman, *Ambix*, DOI: 10.1179/174582310X12629173849881; K. Macrakis, *Prisoners, Lovers*,

*and Spies: The Story of Invisible Ink from Herodotus to al-Qaeda*, Yale University Press, New Haven, **2014**.

81. J. Mokyr, *The Journal of Economic History*, **2005**, 65(2):285–351.

82. R. Vergani, *Quaderni Storici*, **1989**, 24: 123–141; C. Guerra, *Lavoisier e Partenope: contributo ad una storia della chimica del regno di Napoli*, Società Napoletana di Storia Patria, Napoli, **2017**.

83. G. Fochi, *Annali di Storia delle Università Italiane*, **2010**, 14: 207–216.

84. AMG, ARMU Affari 002, aff. 94, c. 374.

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