Collectio mineralium. Leopold's II mineralogical catalog between history, science and collecting

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1. Leopold II (1747–1792). An Emperor and a Man of Science

In his review of Wandruska's first volume on Leopold II's biography (1963), Del Pane (1964) stated that historiography had left the figure of Leopold II in the shade. According to the author, the fact that

> he ruled a little country for twenty-five years and then appeared just like a meteor on the scene of the Holy Roman Empire, [...] has been distracting scholars from investigating an extremely suggestive theme for those who study the problems of the Modern era.

However, even if Leopold II held the title of Holy Roman Emperor for only two years (1790–1792), his reign is regarded as one of the greatest eras of consistent and committed reform in the four-hundred-year history of the Habsburg monarchy (Szabo 2018). Furthermore, the historiographical gap pointed out by Del Pane (1964) appears all the more surprising if we consider that the first historical accounts on Leopold's II life were published at the end of the 18th-century (e.g., Rastrelli 1792; Becattini 1797), and at the beginning of the 19th-century, the historian and statesman Gino Capponi (1792–1876) collected documents and oral testimonies to write a "History of Peter Leopold." Sestan (1951) found that Capponi's project impressed various Italian 19th-century scholars such as Pietro Colletta (1775–1831), who strongly encouraged Capponi to complete Leopold's II biography.[1] Unfortunately, Capponi never finished his book, whose drafts are now preserved at the Central National Library of Firenze. Since then,

[1] Sestan (1951, 195) quoted a passage of the letter Colletta sent to Capponi on 19 December 1828: "Sii tu lo storico della Toscana novella; ma per amore di tutti i santi [...] oggi solo Leopoldo deve farti buco nella mente. Scrivi e scrivi. Ti dirò cosa impertinente, ma soffrila [...] riempi questo vuoto con un bel libro. O foss'io giovine quanto te! Quali speranze vorrei nutrire! E tu puoi più di quel che io potrei, sol che vorrai: e vuoi."

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Figure 1 – Martin van Meytens (1695–1770), Franz I. Stephan und Maria Theresia mit elf Kindern. Vienna, 1764–1765. Kunsthistorisches Museum Wien, Gemäldegalerie 3149.

numerous biographies on Leopold II have been printed, but a complete survey is beyond the scope of this study. However, it is worth mentioning Wandruska's (1963) classical critique, and Leopold's II biographical profile edited by Pasta (2015).

A search of the literature revealed that there is a large volume of published studies describing Leopold's II political, economic, administrative, and religious reforms as the Grand Duke of Tuscany (1765–1790) (e.g., Bellatalla 1984; Mangio 1988; La Rosa 1997; Rosa 1999; Capra 2005). Most of these works focus on his criminal justice reform, which made Tuscany the first country to abolish capital punishment (1786) in modern history (Berlinguer and Colao 1989; Edigati 2011; Dezza 2017). It has to be noted that diverse studies then examine the cultural background in which these reforms were carried out (e.g., Tacchi 1992; Contini 2002; Tazzara *et al.* 2020). However, few studies have investigated Leopold's scientific interests. This research topic can represent one of "those suggestive themes" that Del Pane (1964) hoped would be further explored in future studies on Leopold's II life.

This work is based on the investigation of primary sources along with museum objects (both artifacts and naturalistic specimens) that are currently preserved in diverse Italian and foreign institutions. Analyzing the link between these two different typologies of mute evidence (Hodder 2012) will help to unearth new facts about Leopold's scientific activities, as well as to understand their values and meanings in a broader transnational and cultural context. The findings shown in this study thus represent a relevant contribution to research on Leopold's II scientific biography, providing new insights into his interest in geo-mineralogical collecting. So far, very little attention has been paid to this aspect, although mineral collecting was definitely a relevant cultural and scientific practice in Europe between the late 18th and early 19th-century (e.g., Wilson 1994). The improvement of scientific mineralogy went hand-in-hand with the economic development of individual territories to the point that mineral collections, as outlined by Vogel (2015), became public pictures of a country's natural resources. Although mining and geo-mineralogical collecting represent well-established research themes in the history of the Habsburg monarchy (e.g., Mattes in this volume), these topics have not been adequately examined with reference to Leopold's biography, thus leaving in a "space of invisibility"[2] the interesting and fascinating catalog of his mineralogical collection.

Quoting the famous David Copperfield's incipit, "to begin my life with the beginning of my life, I record that I was born", Peter Leopold was born on 5 May 1747 at the Schönbrunn Palace. The story of his birth is reported in the *Diary* of the chamberlain Johann Joseph von Khevenhüller-Metsch (1706–1776), who recorded that the newborn was named Peter, after Peter the Great (1682–1725), and Leopold in accordance with the traditional Habsburg and Lorraine name (Khevenhüller-Metsch 1908). Leopold's mother, Maria Theresa of Habsburg (1717–1780) was the only female ruler in the history of the Habsburg dominions and under her reign the monarchy underwent a series of important institutional, financial, medical, and educational reforms.[3] Yonan (2011) argued that Maria Theresa has been styled by the literature

[2] Monti and Ratcliff (2004) described as "space of invisibility" ("spazio di invisibilità", in the original text) the conceptual category aiming to provide a critical revision of the lesser-known aspects, which underlaid the social and intellectual dynamics of scientific discoveries as well as the progress of empirical sciences (see also Long 2011 and 2017).

[3] Among them, the codification of the traditional criminal justice system (the *Constitutio Criminalis Theresiana*) in 1769, the establishment of new educational institutions (e.g., the *Theresarium* in 1746), and the promotion of a variolation campaign in 1767 (Byrne 1997; Beller 2006; Vocelka 2009; Weiss and Esparza 2015).

as the *Landesmutter* (the mother of her country), while Aliprantis (2019) stated that her reign greatly influenced the liberal reforms in 19th-century imperial Austria. Maria Theresa was then fond of science, whose practical importance she recognized for the government of the Habsburg territories. Mineralogy was one of her interests due to its importance for the development of mining science and the exploitation of raw materials. In 1776, she called Ignaz Edler von Born (1742–1791) to Vienna to manage the naturalistic collections belonging to her late husband, Holy Roman Emperor Francis I (1708–1765), who was passionate about chemistry, mechanics, and mineralogical collecting (Lhotsky 1941, 1945; Riedl-Dorn 1996; Zedinger 2008; Hassmann 2015). In this regard, Fischer *et al.* (1976), along with Mattes in this volume, reported that in 1748 Francis I acquired and transferred to the Hofburg Palace the naturalistic collection belonging to the Florentine scholar Ritter Johann von Baillou (1684–1758), which encompassed more than 30,000 minerals, fossils, shells, and snails. This collection, of which Baillou was in charge as Director for Life, became the basis of the emperor's private *Naturalien-Cabinet* together with the pre-existing Physical Cabinet and the Coin and Antique collection. Following Francis' death, Maria Theresa presented his collections to the Austrian state so they could be accessible to everyone interested in the natural sciences. They were open to visitors twice a week and can be considered as the founding of today's Naturhistorisches Museum. These collections also had the role of making familiar to the public the geo-mineralogical resources (and their economic value) available in the Habsburg dominions. Von Born thus organized the collections according to the latest scientific standards and checked that the most representative specimens of all the imperial mines were present (Koeberl *et al.* 2018). Therefore, mineralogy was not strange to Leopold's familiar, cultural and political environment.

The education of the young archduke was entrusted to counts Franz (1718–1766) and Anton (1723–1806) Thurn-Valsassina-Como-Vercelli, two educated officials attracted by the intellectual currents of the Enlightenment and whose family was passionate about mineral collecting (Meixner 1960). Leopold's portrait as a young student is given by Maria Theresa, who wrote an *Instruction* to Franz von Thurn to be sure of his son's proper education. Leopold had a sensitive nature, a generous heart, and was good in studies—wrote Maria Theresa—but he was also a rude lazy guy full of himself, and a gossip lover. On 15 May 1762, Franz von Thurn sent to the Maria Theresa a report entitled *Fidèle tableau de S. A. R. l'archiduc Léopold dans le temps qu'on me charge de la direction de sa conduite*, a document in which his pupil was described as a rebel teenager, but very fond of science and technology (von Arneth 1881). In this regard, the correspondence between Leopold and the Thurn brothers highlighted how he was particularly interested in chemistry and in visiting mines, factories, agricultural land reclamations, and port facilities (Wandruska 1963).

On 18 August 1765, after the sudden death of his father, Leopold was appointed as Grand Duke of Tuscany and on 13 September he arrived in Firenze along with his wife Maria Luisa of Spain (1745–1792). The literature on the cultural and scientific aspects of his governorship (e.g., Bellinazzi and Contini 2002; Bertelli and Pasta 2003) has revealed that Leopold was a patron of various scholars such as the botanist Giorgio Santi (1746–1822) (Bindi 2014) and an active supporter of the 'useful' sciences. In her analysis on this subject, Klein (2016) used the sciences of mining (*Bergwerkskunde*) and salts (*Salzwerkskunde*) as two examples to illuminate the concept of *nützliche Wissenschaften* (useful sciences), i.e., the knowledge generated by the sciences, which might improve a country's education, progress, and civilization. So, it was not by chance that Leopold financed the Livorno edition of the *Encyclopédie* (1770–1779)

Figure 2 – Magnifying glass belonging to Archduke Leopold. It is contained in a leather case that bears the initials "A. L. " (Archduke Leopold) and consists of two biconvex lenses, which are set in a short ivory tube. Museo Galileo, Imss n. 3561.

and the Italian translation of William Bailey's *Advancement of Arts Manufactures and Commerce* (1773) (Pacini Fazzi 2008); established a thermal center in Montecatini, which was open to the public and where hydrothermal treatments based on the chemical analysis of both thermal and mineral water were prescribed (Becagli 1985);[4] promoted the establishment of the Florentine *Specola Astronomica e Meteorologica* (Astronomical and Meteorological Observatory) with the assistance of Leonardo Ximenes (1716–1786) (Triarico 2000); built and maintained strong relationships with the natural philosophers belonging to the *Accademia delle Scienze di Siena detta de' Fisiocritici* (Manganelli and Benocci 2013). In this regard, between 1776 and 1777, Leopold along with the psychist Domenico Bartaloni (1750–1798) promoted the installation of two lightning rods in Siena, which were part of a network that the Grand Duke made installed in the major city centers. Bertucci (2009) found that the cultural debate on lightning rods was deeply connected to the 18th-century scientific investigations into the electricity's nature. This view is supported by Abbri (1987) who pointed out that lightning rods soon became a symbol of Leopold's enlightened politics.

McClellan (1985) outlined that the expression 'useful science' also included the establishment of institutions and university chairs to promote scientific research and new communication networks. As an example, Leopold instituted the first chair of chemis-

[4] In this regard, Vaccari (1996) pointed out that Giovanni Targioni Tozzetti (1712–1783) and Giovanni Arduino (1714–1795) made several journeys to detect the presence of mineral deposits in the Grand Duchy of Tuscany. Likewise, Burgassi (2012) described the discovery of boric acid made by Hubert Franz Hoefer (1728–1795) in both Lagone Cerchiaio and in the fumaroles near Pomarance.

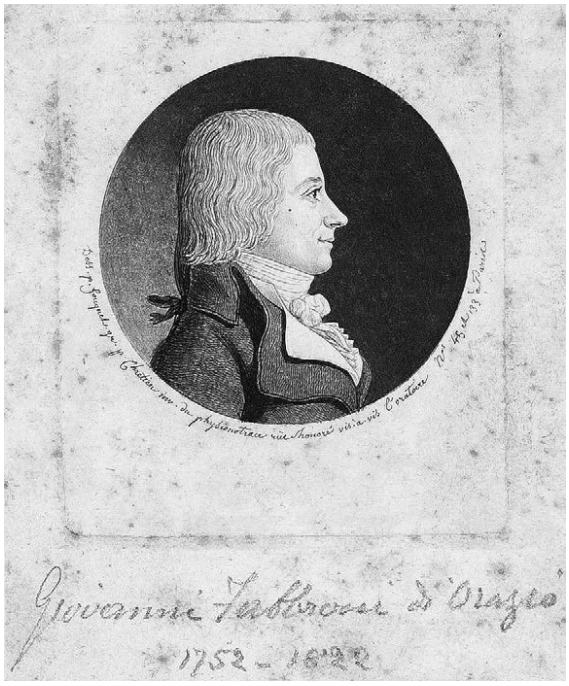

Figure 3 – Portrait of Giovanni Fabbroni (1752–1822). Courtesy of Fototeca-Accademia dei Georgofili.

try at the University of Pisa in 1757 and established the *Imperiale e Reale Museo di Fisica e Storia Naturale* (the Imperial and Royal Museum of Physics and Natural History) in Firenze on 22 February 1775. The latter should also include a scientific academy that he would have personally financed.[5] Almost every paper that has been written on the Imperial and Royal Museum of Natural history discusses its importance within Leopold's reforms to enhance science institutionalization and cultural renewal for the public good. Here, it will be discussed the role played by this institution within Leopold's scientific activities.

As stated before, Leopold was fond of science and grew up in an environment that seemed to be permeated by natural sciences and geo-mineralogical collecting. But did these solicitations turn into personal interests beyond the socio-political choices inspired by the Enlightenment? First response can be found in Leopold's private library held in the grand-ducal residence at Pitti Palace. In her interesting analysis, Knieling (2016) showed that Leopold preferred the purchase of contemporary books rather than rarities. Most of the volumes were acquired in France and concerned the topics of his administrative and political reforms. However, Franza *et al.* (2019) have found that natural sciences were also represented. The study of the library's catalog (*Catalogue des livres du Cabinet particulier,* 1771)[6] has revealed the presence of a section named *Sciences et Art*, which encompassed 876 volumes. Among these books, it is worth mentioning the *Dictionnaire universel des fossils* by Elie Bertrand (1793), the *De la fonte, des mines, des fonderies* by Christoph Andreas Schlüter (1750), and the *Lettre du duc de Noya Carafa sur la tourmaline* (1759).[7] But the catalogue also included the *Traites des pétrifications* by Louis Bourguet (1742), the *Oryctologie* and the *Conchyliologie* by Antoine Joseph Dezallier d'Argenville (1755 and 1757).

[5] Archivio Museo Galileo (AMG), Fab. 01, c. 147.

[6] The catalog is currently preserved at the Central National Library of Firenze, Manuscript and Rare Books Section (Rari Post. 153). A catalog's second copy that belonged to Maria Luisa of Spain is kept at the Newberry Library in Chicago (Z491.C277).

[7] The presence of this book within Leopold's library, along with Nollet's *Lettres sur l'électricité* (1753) and Franklin's *Expériences et observations sur l'électricité* (1751), provide information about his interest in the study of electrical phenomena. This finding is confirmed not only by the establishment of a Tuscan network of lightning rods but also by the scientific instruments he acquired for the Imperial and Royal Museums of Physics and Natural History. Most of these instruments are electrostatic, pneumatic, and mechanical devices that are now preserved at the Galileo Museum in Firenze. Among them, there is a device for demonstrating the properties of lightning rods (Inv. 2693), an ampoule to electrically simulate the northern lights (Inv. 423), and a Nairne cylinder electrical machine (Inv. 2736). The latter was custom-made for Leopold by Edward Nairne (1726–1806) in 1773. The following year, the Grand Duke awarded Nairne with a gold medal and a prize of 1,415 Tuscan lire. Cf. AMG, ARMU 001, aff. 153–154, cc. 114, 126. Further information about these electrical instruments can be found in Hackmann (1995). For an overview of the scientific collections present in the Imperial and Royal Museum of Physics and Natural History at the time of Leopold's rule see Contardi (2009).

Leopold's studies on the physics and chemistry of minerals found practical application in the research and experiments he performed at the Imperial and Royal Museum of Physics and Natural History. For instance, the investigation on the combustibility of gems (i.e., diamond, ruby, spinel, orient sapphire, water sapphire,[8] emerald, hyacinth, garnet, chrysolite, turquoise, rock crystal, orient amethyst, water topaz, opal, and pearls) through a concave mirror that he had been carrying out at the Physics Cabinet since 1773.[9] Here Leopold was assisted by the chemist Hubert Franz Hoefer (1728–1795), who was the administrator of the Court pharmacy from 1767 to 1790. Drawing on an extensive range of sources, Piccardi (2004) provided an in-depth analysis of Hoefer's scientific work showing its relevance to the chemical knowledge of the time. In particular, the author analyzed the *Tabula affinitatum* (1766), i.e., a table showing chemical affinities between substances modeled on both Étienne-François Geoffroy's *Table des differents Rapports observés entre differentes substances* (1718) and Anton Rüdiger's *Systematische Anleitung zur reinen und überhaupt applizierten oder allgemeinen Chymie* (1756), that Hoefer commissioned in 1766 for the grand-ducal apothecary's shop. The table is now preserved at the Galileo Museum in Firenze together with Leopold's chemistry workbench. Scorrano *et al.* (2002) described its complex arrangements outlined that it was openable and presented, on the lower part, a cupboard fitted with pedal-driven bellows for improving the substances' combustion. On both sides, there were drawers and shelves for the storage of scientific instruments and chemical preparations. Some of these compounds were prepared by the Grand Duke himself under the supervision of Felice Fontana (1730–1805) and Giovanni Fabbroni (1752–1822), who were the director and vice-director of the Imperial and Royal Museum of Physics and Natural History (Pasta 1989; Knoefel 1990). Leopold was therefore a regular visitor[10] to the museum's laboratories and established with Fabbroni a fruitful scientific collaboration.[11] Fabbroni was a go-between Leopold and various French chemists such as Antoine Baumé (1728–1804) and Jean Antoine Claude Chaptal (1756–1832) (Horn and Jacob 1998; Barnard and Fones 2012). For example, Leopold asked for the catalog of the chemical preparations sold by Baumé in 1787[12] and ordered Fabbroni to make several purchases the following year.[13] On 4 November 1788[14] Fabbroni asked Chaptal to send to the Grand Duke from his apothecary shop in Montpellier[15] 63 pounds of

[8] Water sapphire is a deep blue variety of the mineral cordierite.

[9] AMG, Fab. 14, 14 cc.

[10] As an example, Giovanni Tommaso Mannucci (1750–1814) sent a letter to Fabbroni on 3 September 1789 to inform him of the Grand Duke's visit the next day. Mannucci wrote that the Grand Duke would have arrived half past two in the afternoon, passing through the door that faced the street. Cf. AMG, Fab. 04, c. 3.

[11] Besides assisting in his chemical experiments, Fabbroni was also a key figure for Leopold's mining interests. For instance, he supervised, on behalf of the Grand Duke, the excavation and polishing of some crystals from the mountains in the surroundings of Pistoia. Leopold was so pleased with his scientific relationship with Fabbroni that he instructed his personal secretary, Ranieri Fulger (dates uncertain), to send to Fabbroni a letter (4 December 1789) in which he thanked the Florentine scholar for his services. Fabbroni replied with a heartfelt letter for Leopold's commendation the following day. Cf. AMG, Fab. 04, cc. 2–4 and c. 113.

[12] AMG, Fab. 04, c. 71.

[13] AMG, Fab. 04, cc. 20, 25, 28–29, 56.

[14] AMG, Fab. 04, c. 2.

[15] AMG, Fab. 04, c. 49.

Figure 4 – Leopold's chemistry cabinet. Museo Galileo, Room X.

diverse compounds, among these 5 pounds of spirit of hartshorn (ammonium carbonate), and 3 ounces of hellstone (silver nitrate) (Testi 1980). Fabbroni's letters to Chaptal, formed a part of a very interesting correspondence that highlighted how Leopold was interested not only in buying compounds for his experiments, but also in keeping posted on the last advancements in chemistry in France,[16] such as the vitriol oil (sulfuric acid, according to Testi 1980) crystallization process. On 17 June 1788 Fabbroni handled the shipment of 17 pounds and 2 ounces of Venus' crystals (copper acetate) from Lyon by the chemist François Bonafous (dates uncertain). A good example of Leopold's direct involvement in the preparation and execution of chemical experiments is the purchase of a supply of lute in late December 1786. On this occasion, Leopold was not in Firenze and thus asked Fabbroni to put the compound in a box and sent it to Pisa where he was at that time.[17] The lute was a compound of clay mixed with oil, which was used in chemical distillation to seal vessels to prevent the dispersion of steam and to protect the surfaces from the heat (e.g., Linden 2003). The fact that Leopold asked for a quantity of lute while he was away from the Imperial and Royal Museum of Physics and Natural History shows that he continued to carry out experiments even outside of his chemical cabinet.

On 1 March 1790 Leopold came back to Vienna to be crowned as Holy Roman Emperor. His chemical cabinet was therefore transferred to the museum on 27 July, and then arranged in three purpose-built rooms on 30 November of the same year.[18] Its contents were detailed in *Laboratorio di chimica* (Chemical Laboratory), i.e., a catalog of more than 100 pages collecting all the preparations, books, and scientific instruments that were present in Leopold's cabinet.[19] In the first room were placed the chemical compounds for a total of ca. 1013 preparations displayed on 13 shelves. In the second room were stored the samples that—as noted by the anonymous cataloguer—"were obtained analyzing the three kingdoms of nature." The writer also pointed out that most of these preparations needed to be renovated because they were evaporated or altered. In the closet on the left were kept the 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 ca. 130 specimens. Subsequently, substances of vegetal origin (i.e., ca. 299 samples among which various essential oils) were listed. The closet on the left preserved the chemical preparations of mineralogical origin (e.g., diverse samples of sulfur alum, mercury, arsenic, and realgar) for a total of ca. 440 specimens. In the closet, there were also kept ca. 106 books about chemistry, most of them in German or French. At the end of this list, a note outlined that both the side and the floor shelves contained the reagents and substances useful for experiments, which were not part of the general catalog. Various utensils, tools, and scientific instruments were then stored in all the three rooms devoted to the cabinet's exhibition.

Considering all this evidence, it seems that Leopold felt a genuine interest in chemistry and its relations with mineralogy, as the analysis of the catalog of his mineralogical collection seems to confirm.

[16] AMG, Fab. 04, cc. 80, 83.

[17] AMG, Fab. 04, cc. 126, 131.

[18] AMG, ARMU 004, aff. 73, c. 307. The document also reported the economic estimate made by Fabbroni of Leopold's chemical cabinet for a total of 7217 lire.

[19] AMG, Fab. 10, cc. 1–99.

2. Unpacking Leopold's mineralogical catalog

As stated by Swinney (2011, 31), catalogs are themselves museum objects, more precisely "meta-objects, collections of records about collections, an archive of an archive." Swinney (2011) also noticed, quoting Latour (1987, 2), that catalogs are usually perceived as "working tools" whose reliability is usually unquestioned and taken for granted. On the contrary, the author suggested critically examining these sources to investigate what kind of knowledge can be acquired and reconstituted through their analysis. Catalogs are indeed both material objects and media throughout a collection is constructed and constituted, and the specimens encompassing it are arrayed. Furthermore, catalogs recorded the existence of those samples that are no longer available for a variety of reasons (i.e., lost, decay, damage, theft and so on).

The catalog of Leopold's mineralogical collection, which is preserved at the Historical Archive of the Natural History Museum of the University of Firenze,[20] has been transcribed and translated in this volume. Latour (1987) and Spivak (2000) remarked how both transcription and translation are not simply copying processes, but they involve the creation of new meanings[21] in changing language, temporary perspective, and cultural backgrounds. By drawing on the concept, Lynch (1999) stated that catalogs present the documentary representation of a specimen as the results of a selection of diverse information identifying and describing that object. As an example, catalogs contain data about hierarchical relations such as who oversaw compiling them. In this regard, the genesis of the catalog of Leopold's mineralogical collection bearing the title *Collection Mineralium or Collection of domestic and foreign ore metals – semi-metals – mountain juices – native mountain colors. Ores and mountain kinds*[22] was analyzed in Mattes (this volume), who highlighted the presence of three handwritings.

It is interesting to note that the writers used distinct styles that revealed a diverse mineralogical knowledge as well as a different awareness about mineral collecting. For instance, Samples Nos. 186–187 present interesting gemological considerations regarding the possibility to use these specimens as polished stones. Whilst the vagueness of other accounts (e.g., Samples Nos. 218, 220, and 227) seems to coexist with the notes on minerogenetic processes shown in Sample No. 232. These findings indicate the last author was a more skilled expert than the previous ones. He knew how to identify minerals, assess their quality, and spot their differences. What has just been stated is proven by the description of Samples Nos. 197–200 in which the min-

[20] Archivio Storico del Sistema Museale di Ateneo, Università degli Studi di Firenze (AS-SMA), *Collectio Mineralium oder Sammlung in- und aus-Ländischer Erzte Metallen – Halb-Metallen – Berg-Säfften – Nativ-Berg-Farben. Erzt- und Berg-Arten.*

[21] The catalog of Leopold's mineralogical collection was migrated from a paper- and manuscript-based medium to digital media by its digitalization. Subsequently, its text was transcribed, translated, and then printed into hard copy. At each stage, the catalog is re-materialized. As DeSilvey stated (2007, 41) these stages constitute "a moment of mimetic labour [which] opened up a channel of communication that tracked along former networks of relation and resonance."

[22] The catalog's original title is *Collectio Mineralium oder Sammlung in- und aus-Ländischer Erzte Metallen – Halb-Metallen – Berg-Säfften – Nativ-Berg-Farben. Erzt- und Berg-Arten. Mit einen beygefügten Inhalts-Verzeichnis Für Ihro königl. Hochheit dem Durchleuchtigsten Erz-Herzog PETRO LEOPOLDO Erz-Herzog von Oesterreich etc. etc. Auf Hohen Befehl verfasset, und in die Ordnung gesetzet von Joanne Francisco Pirkhert Im Jahr 1765. PRAESIDE Camerae Caesareae & Caesareo Regiae Aulicae Comite Seifrido ab HERBERSTEIN Erklärung nachfolgender Mineralien und Berg-Arten.*

Figure 5 – Pompeo Batoni (1708–1797), Kaiser Joseph II und Großherzog Pietro Leopoldo von Toskana. Rome, 1769. Kunsthistorisches Museum Wien, Gemäldegalerie 1628.

Figure 6 – The mining overcoat Leopold wore on the occasion of his visit to the Banská Štiavnica mines in 1764. Slovenské Banské Múzeum, SH 926, 1968/00922, Fárací plášť Leopolda II, 1764. Photo by B. Babiaková.

eralogical and economic considerations are supported by reflections on the collecting value of the specimens. Furthermore, it should be noted the use of new terms to define some minerals such as *greis*, *roßzahn*, and *plinz*. The latter replaced the term *Eysen Spath* (e.g., Sample No. 129) and it was used to indicate siderite.[23] The same goes for the identification of cinnabar, which was indicated as *zinopel* (Sample No. 148), *zinopl* (Sample No. 149), *zinober* (Sample No. 155), and at last with the term still in use of *zinnober* (Sample No. 201).

Since *Collectio Mineralium* is not mentioned in any bibliography or library indexes,[24] it is useful to provide its physical description, following the standards proposed by the International Federation of Library Associations and Institutions (2011). The catalog, consisting of 110 pages, contains a case-by-case list of Leopold's mineral collection for a total of 242 specimens. The volume size is 33 cm tall by 21.5 cm wide by 1.5 cm thick. The binding is a full blinded-tooled calf with border decoration formed of golden fleurons. In the center, there is the golden engraving of the House of Habsburg's emblem (Kusler 2017). The text was written on a watermarked paper, which was produced by the Dutch paper company founded by Cornelis (1683–1755) and Jan (1688–1757) van Honig in 1738.[25] The page layout is in two columns and the manuscript's language is a variant of the Early New High German (Steger 2019), while the calligraphic style is Fraktur (Baltolu 2018). The title page, which is the only catalog's page printed in full, shows the title and the year of issue (1765). It should also be noted the presence of three stamps that can help in the reconstruction of the volume's collecting history. The first stamp on the frontispiece—which is also the oldest—reports the wording "Museo di Fisica e Storia Naturale Firenze." The second stamp is only partially decipherable and bears the word "Instituto" together with a label showing the date 1889. The last one says "Istituto di Studi" and "Gabinetto di Geologia." These findings suggest that *Collectio Mineralium* was first deposited at the Imperial and Royal Museum of Physics and Natural History. The deposit reasonably occurred in 1771 when Leopold gave all the literary books and oriental manuscripts preserved at the Pitti's Palace respectively to the Magliabechiana and Laurenziana libraries. The scientific volumes were donated to the brand-new established Academy of Philosophical Sciences and to other scientific institutions. The catalog of Leopold's mineralogical collection was thus presumably transferred from the Grand Duke's personal library to the Imperial and Royal Museum of Physics and Natural History's archive on this occasion. Later, the catalog was acquired by the Institute of Advanced Practical Studies and Specialization in Firenze (*Istituto di Studi Superiori Pratici e di Perfezionamento*), which was founded in 1807. The Institute consisted of three main sections: Medicine and Surgery, Natural Sciences, Philosophy and Philology (Rogari 2005). The catalog of Leopold's mineralogical collection thus became part of the library of the Natural Sciences Section and more precisely it was preserved in the Geology Cabinet.

Within the catalog there is only one engraving representing the Lower Hungarian mining town of Kremnica (Kremnitz).[26] At the end of the volume, an index[27] groups the

[23] See endnote to Sample No. 217.

[24] The only studies to date that have investigated the catalog of Leopold's mineralogical collection are Fabozzi (2019) and Franza *et al.* (2019).

[25] Further information on the Honig paper company can be found in Beals (1995, 51).

[26] See Mattes in this volume and his note 7. See also Štefánik (2016) and Cembrzyński (2017).

[27] It is interesting to note that each section of the index shows diverse blank pages. This finding may indicate an interest in adding new specimens to Leopold's collections.

samples according to their nature[28] and extraction site.[29] The page number of the relative catalog description is also reported. It should be noted the presence of a second index showing the "chemical signs", i.e., the alchemical symbols[30] that are present in the catalog.[31] To each cataloged mineral was assigned a progressive number providing a link between a single specimen and its documentary representation. Unfortunately, Leopold's collection has not been located yet and therefore this relation cannot be reconstructed.[32]

As mentioned before (Mattes, this volume), the genesis of Leopold's catalog is related to the journey he made, together with his brother Joseph (1741–1790) and his future brother-in-law Albert Kasimir von Sachsen-Teschen (1738–1822),[33] to visit the mining districts in Lower Hungary in 1764. Before their departure, Leopold and Albert Kasimir received diverse gifts[34] coming from the Vienna Court Chamber of Coin-

[28] The specimens were divided into *Gold-Erzt* (i.e., samples containing gold), *Electrum oder Göldisches Silber-Erzt* (i.e., specimens containing golden silver), *Silber-Erzte* (i.e., samples containing silver), *Kupfer-Erzte* (i.e., specimens containing copper), *Bley-Erzte* (i.e., samples containing lead), *Zinn-Erzte oder Zwitter* (literally, tin-ores or hybrids), *Eißen Erzte oder Stein* (literally, iron-ores or rocks), *Queck-Silber* (i.e., samples containing mercury), *Zinober* (i.e., samples containing cinnabar), *Küeß* (pyrite specimens), *Marcasiten* (marcasite samples), *Schwefel* (i.e., specimens containing sulfur), *Antimonium* (i.e., samples containing antimony), *Wißmuth* (i.e., specimens containing bismuth), *Zink oder Spiauter* (i.e., samples containing zinc), *Kobold* (i.e., samples containing cobalt), *Arsenicum* (i.e., samples containing arsenic), *Saltz* (salt), *Vitriol* (i.e., specimens containing vitriol), *Alaun* (i.e., specimens containing alum), *Stein-Kohlen* (stone coals), *Brennende Materien* (literally, burning matters), *Berg-Arten* (literally, mountain kinds), *Nativ-Berg-Farben* (literally, Native-Mountain-Colors), *Aus unbekanten Orten* (i.e., specimens whose provenance is unknown).

[29] The greater part of the specimens came from the Carpathians area with a few exceptions such as Sample No. 63, which came from Bohemia, and Sample No. 164 coming from America. The latter was described as a fine gold specimen from Potosí, which can be identified with the state of San Luis Potosí in Mexico, where gold and silver deposits were discovered starting from the 16th-century (e.g., Brown 2012).

[30] A complete survey of the use of alchemical symbols in the 18th-century is beyond the scope of this work (see Crosland 2004 for an overview). However, it is worth noting that the presence of alchemical symbols to indicate metals and metallic compounds in Leopold's catalog are evidence of the analytical definition of simple substances, and thus of the determination of mineral composition by analytically determining procedures. The latter derived, as Porter has shown in his seminal work (1981), from both the practical activities of mineral assayers and the theoretical analysis of chemically literate scholars who were involved in mining industries. On both alchemy and the knowledge of minerals and metals at the Habsburg court see Smith (1994).

[31] For instance, alchemical symbols are present in Samples Nos. 60 and 64.

[32] Cipriani *et al.* (2011), Mottana *et al.* (2012, 105) and Fabozzi (2019) assume that Leopold's collection may have merged into the mineralogical collections preserved at the Florentine Natural History Museum. Fabozzi (2019) hypothesizes that Samples Nos. 3, 9, 12, 58, and 64 can be identified with the minerals bearing the inventory numbers 498, 1037, 114, 1031, 1044. This assumption is based on the similarity of the specimens' cataloging descriptions reported in both *Collectio Mineralium* and *Inventario del Reale Gabinetto di Fisica e Storia Naturale* (1793). However, no document explicitly mentions these samples as belonging to Leopold's mineralogical collection. Further research has been carried out within the *Mineraliensammlung* at the Naturhistorisches Museum in Vienna, where the Habsburg mineralogical collections are preserved. Even in this case, ancient catalogs and museum inventories have shown no reference to Leopold's collections. The same holds for the investigations performed at the Institute of Mineralogy and Petrography of the University of Innsbruck. However, the current exhibition does not preserve any specimens that can be identified as part of Leopold's mineralogical collection.

[33] Albert Kasimir von Sachsen-Teschen was Leopold's brother-in-law since he married Maria Christina (1742–1798), who was Maria Theresa's fifth daughter, on 8 April 1766. Albert Kasimir was a keen collector of works of art and part of his graphics collection is now preserved at the Albertina Museum in Vienna (e.g., Koschatzky and Krasa 1982).

[34] In her interesting article, Čelková (2004) described the items that are now preserved in the *Kammerhof* of the Slovak Mining Museum and have been collected on the various visits of the Habsburg family to Banská Štiavnica. The items belonging to Francis I, Leopold, Joseph, and Albert Kasimir are listed on pages 55–60.

Figures 7–8 – Details of the hammer Leopold used to mine some silver ores in Banská Štiavnica (1764). Slovenské Banské Múzeum, UH 2338, 1968/03508, Kladivko Leopolda II, 1764. Photo by K. Patschová.

age and Mining in Banská Štiavnica (Schemnitz, Slovakia). Among these items, there were three copies of the *Goldenes Bergbuch* (Golden Book),[35] which contained the descriptions of Lower Hungarian mining districts together with 16 models of mining, metallurgical and minting machines (Vozár 1983, Janetschek 1998). The first stage of the journey (20 July 1764) was in Siglisberg, near Banská Štiavnica. Here the princes received some gold and silver ores together with medals and commemorative coins minted in the Kremnica Mint. Subsequently, they arrived in Windschacht and, even on this occasion, they were greeted by the local authorities with fine silver and gold specimens, while the mining officers instructed the princes in reading mining maps. In Banská Štiavnica, they received gold and silver ores as a present and, after being equipped like miners,[36] they spent most of the day visiting mining tunnels.[37] They even knocked off[38] some silver ore specimens. In the afternoon, they visited Nicolaus Joseph von Jacquin's (1727–1817) chemical laboratory (Klemun and Hühnel 2017) where he carried out chemical experiments for more than three hours using local ores. The next day, the princes visited the *Kaiser-Franz-Erbstollen*, i.e., a mining tunnel that opened on the occasion of Francis' I visit in 1751. On Tuesday, they made a tour of the above ground works and learned about the different technologies of ore processing and smelting.[39] Subsequently they were instructed on administrative and economic man-

[35] Leopold's copy is preserved at the Central National Library of Firenze (Palatino 1094). The volume counts 235 pages, among these 78 plates concern city views (e.g., at cc. 3–4 is a Banská Štiavnica's view depicted by Carlo Giovanni Della Martina in 1764, while at c. 161 is a Kremnica's view), maps, prospects, ink drawings, and watercolors relative to the mines described in the text. Some plates are on two pages, whilst the larger are folded within the volume. The most important plates are then signed by their respective authors, who were also mining technicians such as Carl Ployer, Joachim Miller, Gottfried Deschau, Andreas Marini, Johann Göllner, and Benedict Feil. The volume is bound in crimson velvet, with paperback covers engraved in gold and gilt cut. It is written in German and different handwritings are easily recognizable throughout the manuscript. On the first page is visible the stamp of the Museum of Physics and Natural History in Firenze, which is also present on the fifth page together with Leopold's stamp.

[36] In her review of Schemnitz's renewed visitors, Kasiarová (2000) reported some of the events surrounding the royal journey. Among these, there was Leopold's and Joseph's visit to the Glanzenberg mine that was documented, in addition to archival records, by the stone plaque walled in this gallery. Kasiarová (2000) pointed out how the custom of displaying these celebratory plaques was reserved for the rulers that had visited the mines. There are various maps showing the places where these plates were located with their original inscriptions. During their visits to the underground mines, important guests used to wear mining dresses that were sewn in the local villages. The Slovak Mining Museum still preserves Leopold's overcoat (i.e., a pink-gold brocade overcoat with damask plant decoration in green silk, Inv. No. SH 926).

[37] In this regard, the catalog description of Sample No. 150 reported that "His Majesty, the Roman King himself, even worked in these chams", mentioning the Joanni Chasms in the Pacher Gallery. This is a reference to Francis' I visit in 1751 during which (just as Leopold, Joseph, and Albert Kasimir) he visited the tunnels and knocked off an ore. Kasiarová (2000) noticed that the shafts in which the rulers had worked were named after them. On this basis, the Leopold Gallery, which was mentioned in the catalog description of Sample No. 253, can be potentially identified as the shaft he visited in 1764.

[38] Kasiarová (2000) noticed that important visitors used beautifully decorated irons and mallets, which were either made by local craftsmen or brought by guests from Vienna. Leopold and Albert Kasimir's hammers are preserved at the Slovak Mining Museum (Inv. Nos. UH 2337, UH 2338).

[39] In the underground, Joseph, Leopold, and Albert Kasimir were shown different types of mining activities. They were acquainted with the production processes as well as with the resulting mineralogical products. A reference to these techniques is given in the description of Sample No. 154, in which the processing of the mineralogical specimen was carried out according to the "usual techniques." Probably the author did not detail the method that was used to determine the various metal

Figure 9 – The handstein that was given to Archduke Joseph on the occasion of his visit to Kremnica in 1764. Kunsthistorisches Museum Wien, Handstein mit Bergwerk, Kremnica, 1764, Kunstkammer 4146.

Figure 10 – The handstein Leopold received as a gift during his visit to Kremnica in 1764. Matthias Scarwuth, Franz Xaver Glantz (attributed to), Handstein aus den mittelslowakischen Bergbaustädten, 1764. Magyar Nemzeti Múzeum, Budapest.

agement of a mining site. Banská Štiavnica seemed to be the most important part of the royal journey consisting of big representation events, factory and mine visits, and a torchlight procession with up to 1200 miners. On Thursday, the whole entourage went to Kremnica where they visited the Royal Mint. According to the *Wienerisches Diarium* of 29 August 1764, each prince received a "costly and beautiful" handstone (*Handstein*) representing the Kremnitz mine that contained different kinds of ore.[40] However, Balážová (2017) pointed out that only two handstones were made: one for Joseph, the other for his brother Leopold. The first was donated to the imperial treasury on 14 March 1765, and it is preserved at Kunsthistorisches Museum (Inv. No. KK_4146). As stated by Balážová (2017), the identification of the handstone given to Leopold is still open, even if the author assumed that a *Handstein* was kept in the Magyar Nemzeti Múzeum (Budapest) (Inv. No. D 3154) could be the one he received in Kremnica. The next day, the princes set off for Banská Bystrica where they visited diverse metallurgical facilities. On 31 July 1764 Joseph, Leopold, and Albert Kasimir came back to Vienna. The visit to the Hungarian mines was a formative experience, especially for Leopold who had the possibility to acquire on-site new knowledge on mineralogy, chemistry, and mining sciences. While Joseph was portrayed as the ambitious heir to the throne, Leopold—as stated by Konečný (2017, 362) —"was shown as an inquisitive young man who knew how to handle minerals."

A closer investigation of Leopold's catalog reveals other interesting insights.[41] As mentioned earlier and in Mattes (this volume), the specimens were grouped according to their nature, which represented the amount of valuable minerals potentially extractable from a mining deposit.[42] For instance, skeletal galena from the Transylvania area weighing 20 pounds in pure lead was valued at 134 scruples in fine gold (No. 11). Whilst a specimen of azurite extracted from the mines of St. Philip and Jacob (No. 12) was cataloged as representative of the copper's good quality that could be mined in the Romanian mountains of Oravița (i.e., 6 pounds of copper were estimated at 4 lots in fine silver). A sample of chalcopyrite with a mixed schist and quartz matrix then represented with its 10 pounds of copper, the valuable mineral that was present in the St. Ferdinand mine in Upper Hungary (No. 16). This approach showed how the practice of mineral collecting in Leopold's catalog combined scientific and utilitarian goals. The mineral descriptions are evidence not only of the scientific knowledge of the time, but also of the economic and political power of the House of Habsburg through the exploitation of the natural resources that were present in its dominions (Wakefield 2009).

contents since it had already been shown to Leopold during his visit. In the same vein, the author did not illustrate either the brass-manufacture processing that was mentioned at Sample No. 156 or the construction of a gateway reported in the description of Sample No. 158. Other references to mining equipment and practices can be found at Sample No. 49 where a mining compass was described. Interesting hints on extractive metallurgy are then mentioned in Samples Nos. 193, 194, 198, and in the *Notandum* at the end of the main text.

40 Balážová (2017) described the *handstein* as a selected piece of ore the size of a human hand, that was valued for its rarity based on its appearance and high-quality composition. From the end of the 17th-century, these kinds of objects were modified into more fashionable works of art (*Tafelaufsatz*) representing motifs of the Central Slovak mining towns.

41 A more comprehensive analysis of the mineralogical samples listed in the *Collectio Mineralium* is given in the catalog's endnotes.

42 As an example, Sample No. 127 represented a specimen of pyrargyrite, and marcasite evaluated up to 500 lots in fine silver and 6 pounds in refined copper.

Another interesting aspect of Leopold's catalog is the investigation of the terms used for describing the specimens. The transcription and translation of the text reported the word-for-word translation, while the endnotes presented a historical and scientific analysis aiming to characterize the specimens according to the contemporary mineralogical terminology. As an example, and according to Haditsch and Maus (1974), the term *Eisenblüte* meant aragonite, even if in the early 19th-century literature it was used to indicate the crystal growth in caves (i.e., stalactites and stalagmites). *Röschgewächs* usually identified a sample of stephanite, but it could also mean argentite and acanthite. *Gelf* referred to marcasite, even if this species is described with both the term *malachitische* (Sample No. 10), and the expression *grün und braun Kupfer* (Sample No. 38). Another term frequently used is *glanz*, which means 'shining'. So, the term *Bleiglanz*, literally "shining lead", indicated galena. This mineral could also be identified through the exclusive use of *Glanz*. *Glanze* was then used as a descriptive term for all sulfur minerals, relatively soft, dark-colored, with a metallic luster. *Glanzerz* identified argentite or sillimanite. To distinguish between the different mineralogical species, it was necessary to compare the definition given in the text with other information reported in the catalog such as the locality where a sample was mined. Subsequently, these data were compared with the information present in both the IMA database—which includes information on more than 5400 approved mineral species and their properties—and the Mindat.org data source containing more than 1 million species/locality information on minerals found at more than 300.000 localities (Hazen *et al.* 2019). However, the absence from Mindat.org database of a species presented in the Collectio Mineralium Leopold's catalog, may have two different meanings: (1) the species may have been reanalyzed in the following centuries and thus ascribed to a different mineralogical species; (2) some areas (e.g. gossan cap, leached zone, oxidized zone, enriched zone) of the historical mines where the specimens were collected in the mid-1700s could now be exhausted.

Finally, another intriguing aspect of Leopold's catalog is the presence of 4 specimens (Samples Nos. 140–144), whose description could indicate the discovery of meteorite fragments. These specimens were recovered in Hronec, which is a village now located in the Banská Bystrica Region. Sample No. 143 was described as an "ironstone of a rare kind, striking in clay-like sediments", while Sample No. 144 as a "very compact ironstone." All the samples contained a high quantity of pure iron. However, the Meteoritical Bulletin Database, which is the official database—managed by the Meteoritical Society—gathering information for all the meteorites known, does not show any specimens that have been found in Hronec so far.

3. The Vienna-Firenze connection: rocks and minerals between science and art

In the previous section, the catalog of Leopold's mineralogical collection has been investigated from different points of view. The analysis has revealed an unknown page of Leopold's scientific biography, i.e., his interest in mineralogy, mining science and mineralogical collecting. However, some might say that *Collectio Mineralium* just represents the natural progression of a 'family passion'. Therefore, it remains to be investigated whether Leopold expressed an interest in these subjects other than the catalog of his mineral collection. The analysis of the period that he spent in Firenze is a privileged viewpoint to answer this question. As mentioned above, Leopold established the Imperial and Royal Museum of Physics and Natural History in 1775 and worked in the chemistry cabinet, while building a positive scientific relationship with Fabbroni. However, it is still to be investigated whether Leopold had a concrete inter-

Figure 11 – Il trionfo d'Europa e le Quattro Stagioni, Firenze, 1771. Palazzo Pitti, Appartamento degli Arazzi, Inv. O.d.A. 1911, 835.

est in the museum's administration,[43] especially in the management of the geo-mineralogical collections.[44]

For instance, it was found that Leopold acquired on 12 November 1771 the naturalistic collection belonging to the late merchant Peter von Spreckelsen (d. 1771) (Schröder 1851), which has been described in Benvenuti *et al.* (this volume). In this regard, it has to be noted that the acquisitions promoted by Leopold continued in the years to come. As an example, on 14 October 1780 he donated to the museum a collection of "microscopic" fossil shells, which were preserved in tiny glass jars within a wooden box. This collection was gifted to him by the abbot Ambrogio Soldani (1736–1808), who is primarily known for his studies on the meteorite shower that fell on Si-

[43] As the Grand Duke of Tuscany, Leopold was directly involved in the museum administration. For instance, on 14 April 1777, he approved a new regulation regarding the museum's janitor based on the suggestions proposed by the director's assistant Giuseppe Pigri (d. 1804). Whilst from August to November 1789 he dedicated himself to improving the museum management from an economic and organizational perspective. These reports followed the museum rules Leopold issued on 9 March 1782 to complete the general regulation dated 1775. Cf. AMG, ARMU 002, aff. 2, c. 5; aff. 7, c. 84; Fab. 01, cc. 393, 398, 415; ARMU 001, aff. 1, c. 3.

[44] In this regard, it has to be noted that Leopold dealt with mineralogical collections also besides the acquisitions he patronized for the Imperial and Royal Museum of Physics and Natural History. As an example, he deposited in the Royal Cabinet the catalog about the geo-mineralogical specimens and fossils collected in the Volterra area that was written by Abbot Giuseppe Gherardini (1713–1786) from the Abbey of St. Giusto. The specimens are divided into five groups (e.g., Soils, Stones, Metals, Concretions, and Petrifications). The volume is accompanied by a rich set of notes concerning the diverse kind of specimens, among which there are various samples of alabaster, quartz, diasper, cinnabar, antimonium, sulfur, saltpeter, pumice stone, corals, and various animal fossils. It is interesting to note that the group named as Metals in the catalog's index is then titled as Minerals in the main text. Cf. BNCF, Palatino 1121.

ena in 1794 (Marvin 1998; De Gregorio 2008). On the same day, Leopold sent to the museum 57 "pieces of natural history" ("pezzi di storia naturale") that he received from "Lagusius"[45] on behalf of the naturalist Francesco Bartolozzi (1750–1817).[46] The von Spreckelsen's collection and the acquisitions made in 1780 showed Leopold's interest into the enrichment of the geo-mineralogical collections since the early days of the Imperial and Royal Museum of Physics and Natural History's foundation.

As discussed in Benvenuti *et al.* (this volume), the Habsburg dominions represented the main areas from which the new museum acquisitions were coming.[47] For instance, on 6 December 1784 a mineral dealer known as Epstein (dates uncertain) informed Leopold on the shipment from Vienna of the mineral collection he sold to the museum.[48] The next year, more precisely on 10 February 1785, Leopold paid 300 "zecchini" (pure gold coins) for a mineralogical collection to Johann Weiss (dates uncertain),[49] who was both a mineral dealer operating in Vienna and the owner of a rich collection of gems that included, according to Wilson (1994, 103), some really fine specimens such as 46-cm green beryl from Siberia.

After his return to Firenze from a long stay in Vienna (1778–1779), during which he had the opportunity to visit some iron deposits in Carinthia, Leopold found out that the iron mines[50] present in the Grand Duchy of Tuscany were not adequately exploited. So, he invited some Habsburg mining experts, such as Thaddeus Rauscher (dates uncertain), to visit the local iron mines on 7 October 1779. In this project, Leopold was helped by Fabbroni.[51] In a first report[52] Fabbroni recorded, without mentioning any name, how one of those experts went back to Carinthia and another, who stayed in Firenze seemed unable to continue with the work. So Baron Ecker, who was the owner of extensive foundries in Carinthia and had also escorted Leopold in his visit abroad, came to Firenze along with his most experienced colleagues. After receiving Rauscher's report in 1780, Fabbroni wrote to Leopold stating that Rauscher was not aware of the

[45] Lagusius is the translation into Hellenizing Latin of Johann Georg Hasenöhrl's (1729–1796) surname. He was the Viennese physician who vaccinated Leopold's family against smallpox in 1769 (Contini 2003).

[46] AMG, ARMU 001, aff. 3, c. 338. In the Imperial and Royal Museum of Physics and Natural History's history, Francesco Bartolozzi hit the headlines because he was banned from entering the museum by Grand Ducal order, after Luigi Gagli (dates uncertain), who was the museum's cashier and guardian, sued him for slander in 1782. Bartolozzi asked for the revocation of this measure in both 1791 and in 1792 without succeeding. Fontana readmitted him only in 1799. Cf. AMG, Fab. 01, cc. 338–341, c. 556; ARMU 006, aff. 54, cc. 206–209; ARMU 003, aff. 6, cc. 29–32.

[47] In this regard, it should be noted that also renewed collectors, who came to visit the Florentine mineralogical collections, were from the Habsburg territories. For instance, on 16 February 1784 the Prince of Liechtenstein visited the Imperial and Royal Museum of Physics and Natural History. He was welcomed by Gagli replacing Fontana, who was absent due to illness. Gagli wrote to Leopold that the Prince of Liechtenstein was so satisfied with the tour that he gave him a medal as a present. Gagli hoped that the prince's kindness did not contravene the Grand Ducal provisions that prohibited the museum staff from accepting gratuities from visitors. Cf. AMG, Fab. 01, c. 546; ARMU 001, aff. 26, c. 458. Wilson (1994, 102) included the two Princes of Liechtenstein—Johann (1760–1836) and Louis (1780–1833)—among the most well-known Austrian aristocrats who were also mineral collectors. Unfortunately, the documents do not report the Prince of Liechtenstein's name in full.

[48] AMG, ARMU 002, aff. 23, c. 124.

[49] AMG, ARMU 001, aff. 174, c. 174.

[50] On the history of Tuscan mines in the 18th-century see Mori (1958), Arrigoni (1984, 1985, 1989), Vitali (1992), Nesti (2006).

[51] AMG, Fab. 02, c. 1. On 27 June 1777, Fabbroni ordered the manufacturing of some metal rods to Giorgio Holzer (dates uncertain), who worked for the Reale Magona (i.e., the Royal Mines). Cf. AMG, ARMU 002, aff. 47, c. 208.

[52] AMG, Fab. 02, cc. 9–11.

Figure 12 – L'Allegoria dell'Acqua. Firenze, 1765.a The State Hermitage Museum, St. Petersburg Inv. n. Epr-5318. Photograph © The State Hermitage Museum. Photo by Vladimir Terebenin.

advancements in iron-making processes outside his homeland.[53] As an example, Rauscher criticized the use of three fires to produce iron in the Mammiano mines without reflecting, according to Fabbroni, on the fact that the local iron ores are bigger than those extracted in Carinthia. And again, Rauscher stated that the quality of the iron produced in Livorno was too malleable and therefore unsuitable for the manufacture of nails and plowshares. Conversely, Fabbroni considered this defect easily fixable. Fabbroni agreed with Rauscher on the necessity to reorganize the wood production for supplying the furnaces in Val di Cecina. Both then acknowledged the excellent quality of the local coal deposits, a finding that encouraged the search for new mining veins. In the years to come, Fabbroni studied the coal deposits in Val di Cecina on Leopold's request. For instance, on 26 December 1788[54] he received from the Secretary of the State Council Alessandro Pontenani (dates uncertain), two boxes encompassing 20 presumed coal samples found by Francesco Henrion (dates uncertain) in the northern and southern surroundings of Cecina to verify their nature and, in case of positive findings, whether the quarries deserved to be excavated. Leopold was so interested in this research that on 21 January 1789 he ordered Fabbroni to go to Montecatini Val di Cecina to examine the local coal deposits.[55] On 14 May 1789 Leopold asked Fabbroni to write a book that reported the quarries' exact location, data about their quality, the excavation methods, together with all the information Fabbroni considered useful to promote the coal extraction in the Grand Duchy of Tuscany. Fabbroni was also asked to analyze some ores mined from the Lagoni of Monte Cerboli to ascertain the presence of borax.[56] Leopold then suggested that Francesco Giovannini (dates uncertain), who was a mineral prospector known as Il Pollacco, should also participate to the field research.[57] On 12 November 1789, Fabbroni sent to Francesco Grobert (dates uncertain) his instructions for starting the excavation of the coal deposits in Val di Cecina.[58] At the beginning of the new year, on 30 January 1790, Fabbroni informed Pontenani to have finished writing the book Leopold requested, which he entitled *Dell'antracite o carbon di cava detto volgarmente carbon fossile* (On anthracite or quarry coal, commonly called hard coal).[59] However, coal was not the only mineral species that aroused Leopold's interest. As an example, he sent to Fabbroni a silver ore from Anghiari, a parish near Arezzo, so he could characterize the specimen in the museum laboratories.[60]

[53] AMG, Fab. 02, cc. 3–8.

[54] AMG, Fab. 03, cc. 8–9.

[55] AMG, Fab. 03, c. 21–25. The instructions Leopold sent to Fabbroni were to analyze the quality of the soil on the hill where the quarry was located. Subsequently, he had to investigate the deposit's size, its features and ascertain the presence of other quarries. Leopold recommended that Fabbroni repeat his instructions for all the discovered deposits. Fabbroni had then to send a detailed report to the Grand Duke stating whether it was convenient to start the excavation works. Leopold granted in advance Fabbroni the amount of 12 pure gold coins to cover his travel expenses. See also AMG, ARMU 002, aff. 90, c. 368.

[56] AMG, Fab. 03, c. 6.

[57] In 1789, Il Pollacco personally sent a letter to Leopold to inform him about his findings. Fabbroni cherished this prospector, who had found several local specimens (e.g., diverse minerals coming from Volterra) for the enrichment of the museum collections, to the point of asking Leopold to give him extra money for his services. Il Pollacco was hired as the museum's first outside employee, as shown in Cipriani *et al.* (2011, 52), in December 1790. Cf. AMG, Fab. 002, cc. 250–253 and 255; ARMU 004, aff. 71, c. 299.

[58] AMG, Fab. 03, cc. 2–3.

[59] AMG, Fab. 03, cc. 7, 11–13, 23–28. Fabbroni sent a heartfelt letter to thank Leopold for the generous reward he was given for the writing of the volume on 12 February 1790. Fabbroni's book was printed in 250 copies by Gaetano Cambiagi (dates uncertain).

[60] AMG, ARMU 004, aff. 15–16, c. 112.

Leopold was also interested in the use of minerals in artworks. To investigate this further aspect, we need to virtually move to the Galleria dei Lavori, the Florentine hardstone and semiprecious stone workshop that was founded by Ferdinando de' Medici (1549–1609) in 1558 (Giusti 2005). When Francis I was crowned Grand Duke of Tuscany in 1737, it was feared that the Galleria dei Lavori would have closed its doors: the royal court would have not left Vienna, the grand-ducal finances were going through a moment of crisis, and Giovanni Battista Foggini (1652–1725), who was the Galleria's headmaster, had died without leaving an 'heir' up to his skill and inventiveness (e.g., Spinelli 2019). However, as stated by Giusti (2006), everything was about to change when Louis Siries (1686–1754), i.e., the *orfèvre du roi* at the court of Louis XV (1710–1774) (Avisseau-Broustet 1996), was hired as a goldsmith and engraver in 1732. Brini and Pioppi (2010) noticed that Siries was a fine and polyhedric craftsman as demonstrated by his huge collections of more than 2000 chisel punches.[61] Siries also worked on glyptic and in 1746 he realized a lapis lazuli and gold cameo, based on a drawing of Giuseppe Zocchi (1711–1767) (Tosi 1997), showing Empress Maria Theresa as protector of art, science, and craft (Vienna, Kunsthistorisches Museum, Inv. n. XII 695). From that moment on, a strong relationship was established between the Galleria dei Lavori and the House of Habsburg-Lorraine, which would last over time.[62] In 1759, Cosimo Siries (died 1789) succeeded his father Louis in the direction of the Galleria dei Lavori. Like his father, Cosimo was a medalist, an engraver and a skillful bronzesmith. He established a positive relationship with Leopold and realized for the Grand Duke, as pointed out by Masala (1997, 57), various trinkets, snuffboxes, tabletops in hardstones and even diamond rings between 1766 and 1782. Among the works he made it has to be noted a ciborium (1782) with pillars and frames in lapis lazuli, friezes in Spanish coralline, agata bezels, and a jasper small door. The host was realized using pure oriental chalcedony (Giusti *et al.* 1978, 443). Unlike is father regency, Leopold commissioned diverse works also for the Pitti Palace's grand-ducal residency such as gold cutlery, soup tureens and bowls (Gonzales-Palacios 1986, 109), and a hardstone *commode* (1769–1771) showing the *Trionfo di Europa* and the *Quattro Stagioni* as auspicious subjects for his rule (Firenze, Palazzo Pitti, Appartamento degli Arazzi, Inv. n. O.d.A. 1911, 835). Leopold was also fond of hardstone artworks illustrating allegories and marine subjects such as the two tabletops that represented the allegories of water and air realized in 1765 and in 1766. Both the works were stolen by the Napoleonic troops and are currently preserved respectively at the Musée du Louvre (Inv. n. MR. 407) and at the Hermitage Museum (Inv. n. 5318). Leopold was then interested in

[61] The chisel-punches represented diverse subjects such as architectural vedutas (Firenze, Museo dell'Opificio delle Pietre Dure, depositi).

[62] This is exemplified by the white and brown onyx plate that Maria Theresa sent to Siries from Vienna in 1755 to make a cameo portraying the royal family (Vienna, Kunsthistorisches Museum, Inv. n. XII, 74). It should also be mentioned the catalog encompassed 168 engravings Siries released in 1759 and that were acquired by Maria Theresa (Giusti 1992, 113). Among these, there were diverse cameos realized in carnelian and gold (e.g., Vienna Kunsthistorisches Museum, Inv. n. XII, 556, 564, 566, and 619). A copy of Siries'catalog is preserved at BNCF, *Catalog des pierres gravées, par Louis Siriès, orfèvre du roi de France, présentement directeur des ouvrages en pierre dure de la galerie de S. M. impériale à Florence*. Florence: chez André Bonducci, 1757. Misc. Magl. 1103.1. Francis I was also interested in Siries' works and during his visit to Firenze purchased a painting of semi-precious stones with a marine subject for his father-in-law Charles VI (1685–1740), a tray, and a table with the top in semi-precious stones with a gilded bronze frame. Siries realized for Francis I a series of more than 60 paintings in semi-precious stones, which were adorned with a gilded bronze frame, illustrating countries architecture and human figures. All the paintings were sent to Vienna and they are still preserved at the Hofburg Palace (Giusti 2006).

Figure 13 – L'Allegoria dell'Aria. Firenze, 1765. Musée du Louvre, Inv. MR 407.

the use of scagliola to illustrate neoclassical subjects such as the tabletop representing the Titus' quadriga (1768, Firenze, Palazzo Pitti, Galleria Palatina, Inv. n. MPP 1911, 19443, 19483), and the two panels showing the Dance of the Hours and the Maidens that adorned a candelabra (1772, Firenze, Palazzo Pitti, Galleria d'arte moderna, Inv. n. 827, 828). These works were made by Lamberto Cristiano Gori (1727–1801), who was appointed by Leopold as the court's "scagliolista" (i.e., scagliola artist). Gori held this position until 1795 (Bono 2004; Colle 2004).

The Galleria dei Lavori had professional connections with the Imperial and Royal Museum of Physics and Natural History. For instance, the artisans of the Grand Ducal mint were involved in the restoration and manufacturing of both instruments and furniture for the museum.[63] And again, the offcuts from the working of semi-precious stones should be sent to Fontana by order of Leopold's secretariat.[64] Between the two institutions was also evidenced by the exchange of craftsmen specialized in the processing of mineralogical specimens. For instance, Cristofano Perini (dates uncertain), who was a lapidarist, was transferred on Cosimo Siries' suggestion to the museum in June 1787.[65] Leopold's interest in the use of hard stones, precious and semi-precious stones in art works was not limited to the Galleria dei Lavori but also included several items[66] stored in the Treasury of the General Wardrobe (*Stanza del Tesoro della Guardaroba Generale*).

[63] AMG, ARMU 001, aff. 10, c. 412.

[64] AMG, ARMU 002, aff. 107, c. 409.

[65] AMG, ARMU 002, aff. 49, c. 212.

[66] From the reading of the general inventory of Leopold's Treasury General Wardrobe is learned that he had a huge box inlaid with semi-precious stones (Wardrobe 1); a hardstone snuffbox along with tiny boxes for an apothecary use (Wardrobe 2); various hardstones painting to be kept next to the bed, a small gold crucifix with semiprecious stones that has been described as "bello assai" (very beautiful), tiny hard stones paintings to be kept next to the bed showing the Madonna of the Ss. Annunziata; other paintings and some small piles of hard stones, and a lapis lazuli chessboard (Wardrobe 3). In the second part of the same wardrobe, there was a touchstone painting to be kept

Figure 14 – *Ciborium* with flower decoration in bas-relief of semi-precious stones and gilded copper canopy, ca. 1782. Courtesy of Ministero per i beni e le attività culturali e per il turismo - Museo dell'Opificio delle Pietre Dure di Firenze, Inv. n. 345.

After leaving Firenze in 1790, Leopold did not give up his interest in mineralogy and mineralogical collecting. According to Fitzinger (1856 and 1868), he dedicated himself to the valorization and enrichment of the Habsburg mineralogical collections. For instance, he acquired from Andreas Graf von Hadik (1710–1790) (von Arneth 1877) a mineral collection encompassing gold, amethyst, jasper, opal specimens in addition to silicified wood samples and diverse fossils. Leopold II also donated to the imperial cabinet the mineralogical collection he received from Friedrich Samuel von Rossan Schmidt (1737–1794)[67] for his crowning ceremony. This collection was transferred to Vienna by Federico Manfredini (1743–1829).[68] Afterwards, he ordered to move the Habsburg mineralogical collections in the larger Hofburg's rooms and to reorganize the entire exhibition. The collection was open to the general public every day of the week except on Tuesdays. Unfortunately, Leopold II never got to see the new exhibition because he suddenly died on 1 March 1792.

4. Conclusions

Behind the curtains of naturalistic museums worldwide are a great number of historical catalogs. These volumes describe the specimens and the processes through which the collections were established (e.g., Alberti 2005). These data often remain unknown to the public because catalogs are rarely part of museum exhibitions. However, they represent unique sources of information, whose study shows how collections are the results of complex cultural, social, and scientific practices within networks of varied persons, places, and things (e.g., Byrne *et al.* 2011). Furthermore, as shown in this paper, their analysis problematizes the act of collecting through the investigation on how a collection developed, the impact it has had during the centuries and the roles it continues to play in both historical and scientific research.

next to the bed showing a golden-silver Madonna, an urn to be used during the Holy Week made of gold leaf and precious stones, a tray realized with precious stones, diverse crowns in hardstones, a cup inlaid with semi-precious stones, some "modern" hardstones. This last type of stone material was also used to make some "beautiful" tiny cups that were kept in Wardrobe 5. In Wardrobe 6 there was a tiny cup that was described as "beautiful and modern" ("bella e moderna") and it was used to preserve a set of crystal balls and buds ("bocciuoli") made in golden silver. Other two similar cups were stored in Wardrobe 8. 207 pounds of silver in bars and 85 pounds of golden silver were then preserved in the room downstairs. Národní Archiv (Prague National Archive), Inventario delle robe esistenti nella stanza del tesoro detta della Guardaroba Generale, cc. 199–202. For an overview of Leopold's archive, a part of which is currently stored at the Prague National Archive, while the other one at the Firenze State Archive see Gori and Toccafondi (2013).

[67] Friedrich Samuel von Rossan Schmidt held commercial relationships with the Imperial and Royal Museum of Physics and Natural History. Between 9 January and 6 March 1793, when Ferdinand III (1769–1824) was the Grand Duke of Tuscany, Rossan sold to the museum a collection encompassing minerals, fossils, and other natural specimens. The negotiation was supervised by Fabbroni and the acquisition seemed to be a great one since it counted three boxes of minerals and books, for the settlement of which Fabbroni is forced to ask Luigi Bartolini (1745–1800) for an advanced payment of 7000 lire. Another mineral collection provided by Rossan was acquired in 1794. Cf. AMG, ARMU 007, aff. 5, c. 30; Fab. 05, c. 210, 212, 216; ARMU 009, aff. 6, c. 13.

[68] Like Schmidt von Rossan, Manfredini was among the providers of the Imperial and Royal Museum of Physics and Natural History. For instance, he was involved in the so-called "agata affair", concerning a specimen of agata that Carl Fredrik Fredenheim (1748–1803), director of the Swedish Natural History Museum, sent to Felice Fontana. The latter assumed that the sample had been sent to him as a purchase proposal and, considering it to be a fake, he proposed to Fredenheim a very low economic valuation. At the end, the Swedish minister Johan Claes Lagersvärd (1756–1836) was forced to request the formal restitution of the specimen. Cf. AMG, ARMU 005, aff. 48, c. 142.

This paper has shown that the investigation of historical catalogs provides useful information not only for understanding the formation of naturalistic collections in the past, but also to acknowledge they are relevant to contemporary museum studies, thus promoting a more meaningful historical approach to both geosciences and geo-heritage.

Archives

Archivio di Stato di Firenze (ASF), Segreteria di Finanze, f. 480.
Archivio Museo Galileo (AMG), ARMU 001, aff. 1, c. 3; aff. 3, c. 338; aff. 10, c. 412; aff. 26, c. 458; aff. 147, c. 97; aff. 153–154, cc. 114, 126; aff. 168, c. 150; aff. 174, c. 174.
AMG, ARMU 002, aff. 2, c. 5; aff. 7, c. 84; aff. 23, c. 124; aff. 47, c. 208; aff. 49, c. 212; aff. 90, c. 368; aff. 107, c. 409.
AMG, ARMU 003, aff. 6, cc. 29–32.
AMG, ARMU 004, aff. 15–16, c. 112; aff. 71, c. 299; aff. 73, c. 307.
AMG, ARMU 005, aff. 48, c. 142.
AMG, ARMU 006, aff. 54, cc. 206–209.
AMG, ARMU 007, aff. 5, c. 30.
AMG, ARMU 009, aff. 6, c. 13.
AMG, Fab. 01, cc. 147, 338–341, 393, 398, 415, 546, 556.
AMG, Fab. 02, cc. 1, 3–8, 9–11, 250–253, 255.
AMG, Fab. 03, cc. 2–3; 6–7, 8–9, 11–13, 21–28.
AMG, Fab. 04, cc. 2–4, 9, 20, 25, 28–29,49, 56, 71, 80, 83, 101, 113, 126, 131.
AMG, Fab. 05, c. 210, 212, 216.
AMG, Fab. 10, cc. 1–99.
AMG, Fab. 14, 14 cc.
Archivio Storico del Sistema Museale di Ateneo, Università degli Studi di Firenze (AS-SMA), *Collectio Mineralium oder Sammlung in- und aus-Ländischer Erzte Metallen – Halb-Metallen – Berg-Säfften – Nativ-Berg-Farben. Erzt- und Berg-Arten*.
AS-SMA, Catalogo delle produzioni naturali passate al Real Museo di Firenze prima dell'anno 1792, cc. 7–11, 25–27; 30–213; 223–631; 643–701; 705–731.
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BNCF, Palatino 1094.
BNCF, Palatino 1121.
BNCF, Pelli Bencivenni, Effemeridi, ms. N.A. 1050 prima serie.
BNCF, Catalog des pierres gravées, par Louis Siriès, orfèvre du roi de France, présentement directeur des ouvrages en pierre dure de la galerie de S. M. impériale à Florence. Florence : chez André Bonducci, 1757. Misc. Magl. 11 03.1.
Národní Archiv (Prague National Archive), Inventario delle robe esistenti nella stanza del tesoro detta della Guardaroba Generale, cc. 199–202.

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