

# COLLECTIBLE MINERALS

*Exhibition: September 6, 2023 – March 9, 2024*

*Musée de Minéralogie  
Mines Paris - PSL  
60, Bd Saint-Michel, 75006 Paris*





## PREFACE



**Rich of 230 years of history, the Mineralogy Museum of Mines Paris – PSL is one of the most complete in the world. This reasoned collection only achieved its international ranks thanks to the contributions of many people, whose stories have been kept with the curated specimens. Thanks to the exhibit “Collectible Minerals”, some of these stories are revealed, along with hundreds of objects. Since its creation and until now, the collection of the museum has kept its main strategic purpose: to preserve and display mineral resources. Not only the museum is a repository and showcase for these resources and beauties of nature, it is also a place to discuss the strategic, economic and environmental issues around mineral mining.**

Since its creation in 1794, the *Cabinet des Mines*, later known as the *Musée de Minéralogie de l’Ecole des Mines de Paris*, has been accumulating minerals, ores, rocks, meteorites, gemstones and even art objects. Over 230 years, the different acquisitions modes enabled the collection to grow and achieve a state of completion that rivals the top worldwide institutions. If the main purpose was to reach that completeness, the museum also knew how to showcase itself by acquiring top-rank specimens. Minerals and gem crystals are nowadays considered

natural art objects that sometimes compete with the most valuable artworks. If historically a collection of minerals had to represent the entire diversity of the mineral kingdom, today it also has to be aesthetically pleasing.

It is this evolution of collecting that the exhibit “Collectible Minerals” is presenting, through the many adventures of people who contributed to the museum’s collection.

**The idea to create such an exhibition was born in 2020 in the mind of Didier Nectoux, director of the Mineralogy Museum of Mines Paris – PSL and Marie Vallanet, then Director of L’ECOLE, School of Jewelry Arts.** They both dedicated efforts to create a partnership between the two institutions. In 2021, L’ECOLE became a benefactor to the museum: a three-year engagement was created to support the museum’s effort in promoting its collections. Over that time, two projects have been completed: the publication of a book (*Le musée de Minéralogie de l’Ecole des Mines de Paris*, Gallimard & L’ECOLE editors) and this exhibition. The nominated curators of the exhibition were Maddalena Napolitani, who conducted her PhD on the historic collections of the Ecole des Mines de Paris, and myself, curator of the Mineralogy Museum. The exhibition could not have been completed without the precious help of Didier Nectoux, and our interns who worked on that project over the last three years: Aude Barthe, Carla Barreto and Clotilde Savatier (curation’s assistant).

**Eloïse Gaillou**

Curatrix

Musée de Minéralogie Mines Paris - PSL



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## PRESENTATION OF THE EXHIBIT "COLLECTIBLE MINERALS"

Whatever the object, collecting is part of the process of acquiring, accumulating, studying, inventorying and classifying objects. Minerals are no exception to the rule.

Collections of geology and mineralogy have many benefits. Firstly, they are vital tools that help us understand and learn about our planet. In essence, they are recorders of geologic events that have happened here on Earth. They provide us with the keys to understanding our planet.

Additionally, minerals by themselves are a source of acquisitive yearning. As with works of art, their beauty fascinates and attracts. Owning them becomes a mark of influence and power. However, beyond just being aesthetically pleasing, minerals are also the source of numerous of the raw materials necessary for many human activities. In that respect, one must first appropriate them in order to exploit and transform them. Through the cataloguing of species and their deposits, systematic mineral collections becomes strategic. They provide us with the keys to conquering the world.

Created in 1794, the "Cabinet des Mines", today the Mineralogy Museum of the École des Mines de Paris, is one of the world's leading mineral collections. Opening its display cabinets, drawers and cupboards unlocks a multitude of stories testifying to both the greatness and shortcomings of our societies. In this way, minerals tell us about illustrious people: emperors, inventors, explorers, conquerors or simple enthusiasts of science and technology.

From the French Revolution to the heyday of the Industrial Revolution and on to the present day, this collection continues to be a mirror of our society. It tells the stories of great explorations, discoveries, inventions and conflicts. This exhibition offers itself as an invitation to travel not only through history, geological time and even space but also down the paths of human thought.

Let yourself be carried away by what the stones have to say.

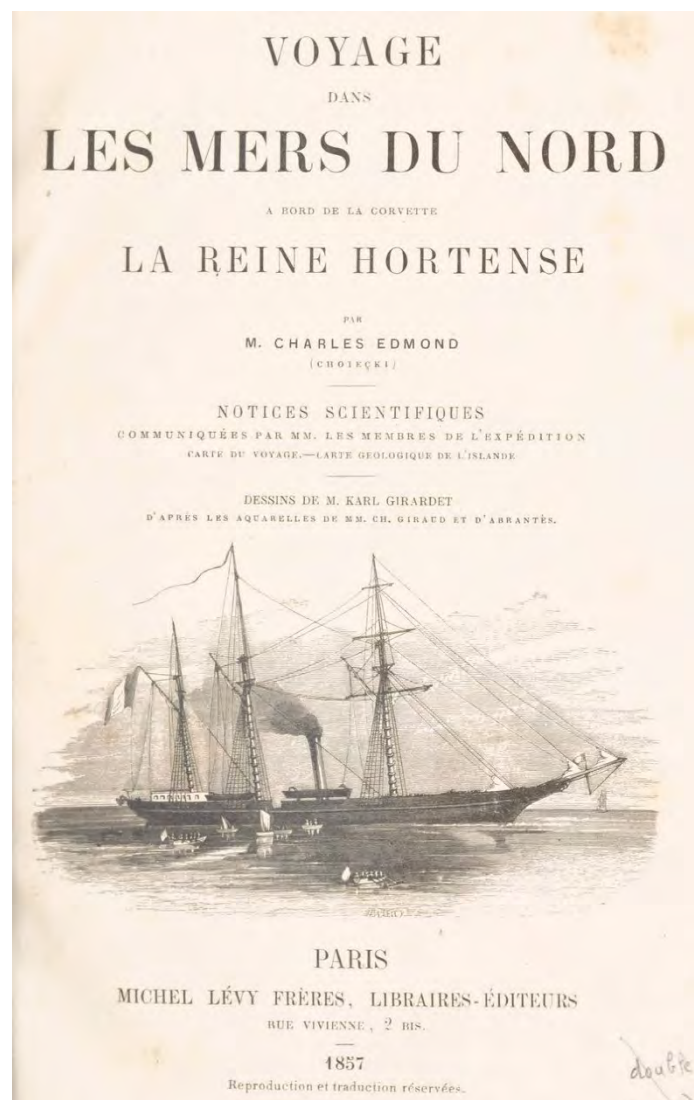
### 1- FIELD COLLECTION

Professors, students and mining engineers have the mission to collect in the field: "all the productions of the globe [...] and of the Republic, [which will be] arranged by locality", as specified in the decree of creation of the Cabinet of Mines. This clearly identifies the strategic issues of the collections. The objective is to list the mining resources in order to know them better and better exploit them. The frantic race for natural resources developed in the 19th century at the time of

the industrial revolution. This period is that of colonial expansion and exploitation of the invaded territories. It is also the golden age of the exploration of the world and its "discovery". The great expeditions, conquests and cartographic missions are an opportunity to further develop the School's missions and enrich its collections, with samples from around the world.

### Prince Napoléon's voyage to the North Seas

In 1856, Prince Napoleon led a four-month expedition to the North Seas. Aboard the ship *La Reine Hortense*, he explored the basaltic plateaus of Scotland, the geysers of Iceland, the aluminum mines of Greenland, the silver mines of Norway and the rare earth ore mines of Sweden. Alexandre de Chancourtois, curator of the collections of the École des Mines de Paris, is commissioned to collect and describe the representative samples of the territories crossed.



First page of the book "Voyage dans les mers du Nord [...], by Charles Edmond in 1857, tracing back Prince Napoleon's journey in the North Seas. Bibliothèque Mines Paris - PSL.

**The samples given by Prince Napoleon are markers of mineralogical discoveries made during the 19<sup>th</sup> century, such as berzelianite and columbite.**



A drawer showing a few of the rocks amongst the 737 collected by de Chancourtois for Prince Napoleon during the 1856 trip in the North Seas. In 1868, Prince Napoleon gave the collection to Paris School of Mines.



Map of the main dates and stops of Prince Napoleon's journey in the North Seas in 1856. Adapted from Hervé Rouèche.

## NATIONAL FIELD COLLECTION

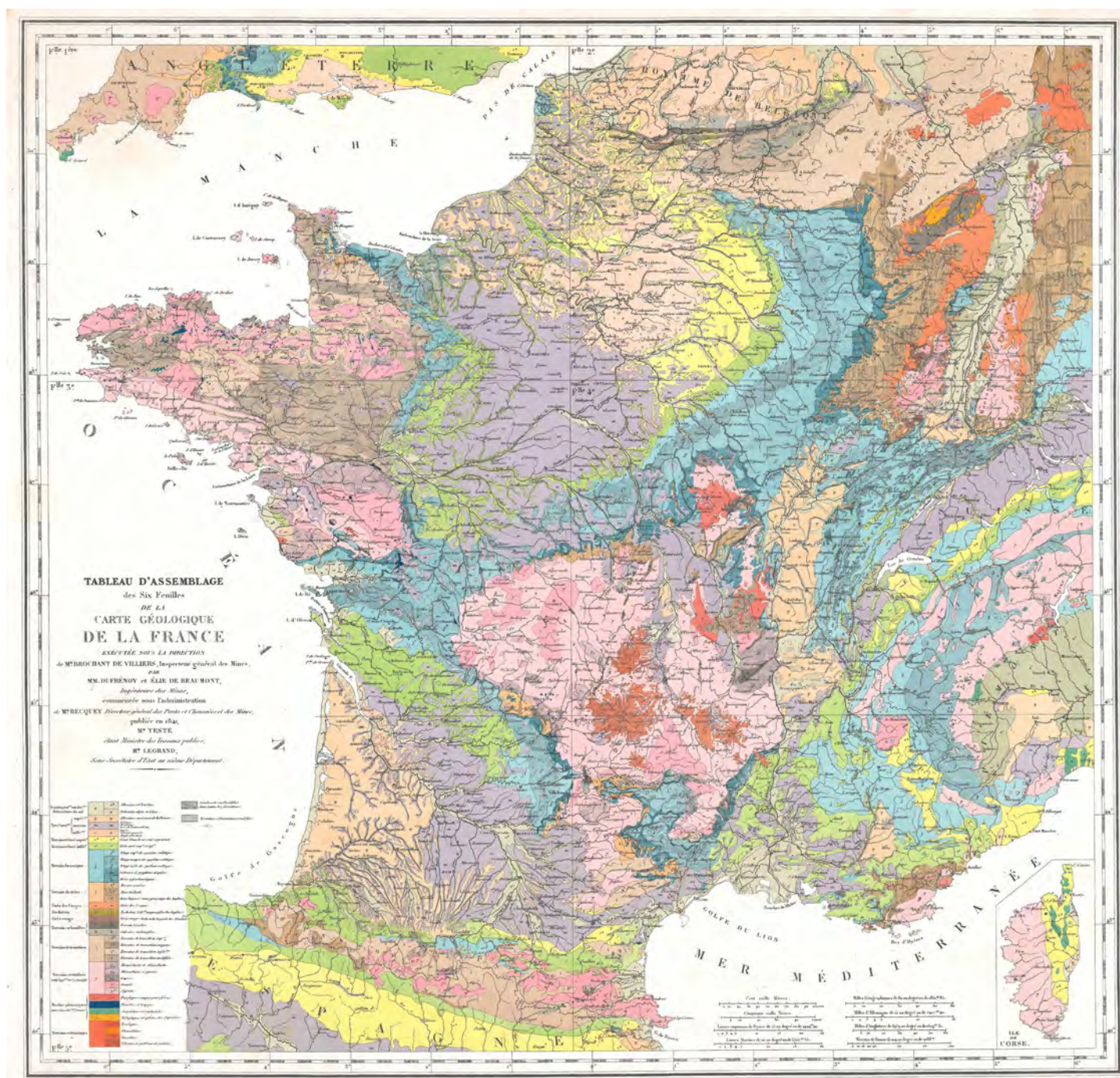
### France and the first geological map

On December 20, 1841, the first geological map of France on a scale of 1:500,000 was presented to the Academy of Sciences. Its objective is to "represent graphically, by conventional colors and by a few other signs, the distribution and relative arrangement of the large mineral masses" (*Explanation of the Geological Map of France, 1841*). It is the result of several years of work by three professors from the School: André Brochant de Villiers, Pierre-Armand Dufrénoy and Élie de Beaumont.

**It took 10 years and 80,000 km by foot for Dufrénoy and de Beaumont to create the first geological map of France.**

Traveling through France, they collected many samples, now deposited in the collections. They constituted the tangible counterpart of the card.

As a scientific and strategic tool, the map also makes it possible to identify resources. This map constitutes the reference for all geological maps drawn afterwards all around the world. The exhibit presents a typical rock of each of the 12 regions of France.



Geological map of France, at the 1 / 500,000 scale, by Pierre-Armand Dufrénoy & Elie de Beaumont, 1841. Bibliothèque Mines Paris - PSL



## COLONIAL FIELD COLLECTION

Controlling the supply of mineral resources was one of the first driving forces behind colonial conquest. These resources were identified and listed by mining engineers in the French colonies and in the territories to be conquered. Large expeditions are organized in order to identify the exploitable riches.

### Brédif (1786-1818): a one-way field trip

Charles-Marie Brédif, a mining engineer, left for Senegal in 1816. His mission was to go up the Senegal River to identify the territory's mining resources. Passenger on the ship *La Méduse*, he experienced the nightmare of the infamous shipwreck. The raft was built the day after the shipwreck, and left along with the rowboats. Brédif was in one of the rowboats and kept a daily diary of the tragic event. The raft got cut-off (voluntarily?) and drifted offshore while the rowboats eventually reached shore on the beaches of Mauritania. The passengers walked during five days in the desert before arriving in Saint-Louis.

Brédif resumed his field trip mission in 1817. The samples sent for the School of Mines' collections come from his travels to the Island of Gorée and the nearby coasts of Senegal. His mission lasted one year, as he got heavily sick of dysentery and eventually died from it.

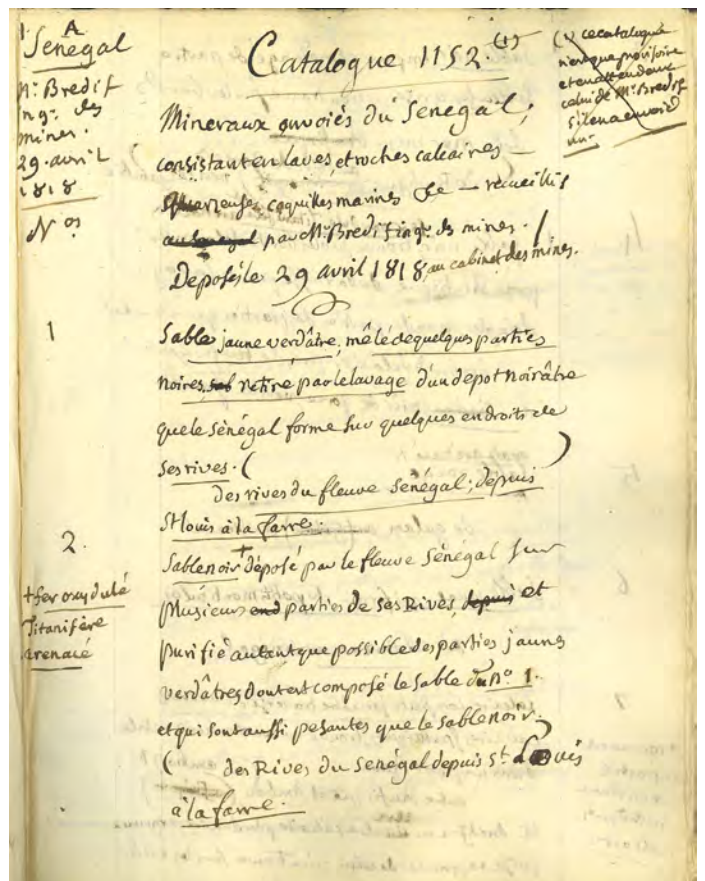


Three basaltic rocks from Senegal, most likely collected by Charles-Marie Brédif during his mission for Paris School of Mines in 1817.

**The mining engineer and employee of the Paris School of Mines Charles-Marie Brédif was one of the survivors of the Medusa shipwreck.**



Map of the sea route taken by the French frigate *La Méduse* in 1816. The ship left on June 17 and was shipwrecked on July 2, 1816. Out of the 392 people it carried, 160 died from the tragedy.



Entrance catalog 1152 of the mineralogy museum, from April 29, 1818, describing sands, minerals and rocks sent by Brédif from Senegal. In total, 36 specimens from that shipment were retrieved for the collection.

## 2- PURCHASE

The collections of the *Cabinet des Mines* began with the purchase of the collection of the French chemist Macquart. In 1793-1794 the mining engineer Alexandre-Charles Besson wrote a "State of the cabinets or collections of natural history which are in Paris and the surrounding area [...]". He indicates the collections that are put up for sale, the contribution of which can enrich those of the Cabinet. This purchasing policy continued throughout the history of the collections until 2010. The purchases are generally made to mineral dealers, in order to fill in specific gaps in the collections. In the list of merchants, the names of famous houses of the whole world are found. Occasionally, acquisitions are made from individuals. Entire collections are even sometimes acquired, such as that of Glasser, Foster, Nottin, or even that of Joséphine de Beauharnais.

### The collection of de Drée – Dolomieu

In 1845, part of the collection of the Marquis de Drée was acquired, representing 19,000 samples. This collection of major importance also included that of famous geologist and brother-in-law of the Marquis: Dieudonné de Dolomieu. His research on volcanoes and his discoveries had a great impact in the scientific world of his time. To pay homage to this scientist who participated in Napoleon Bonaparte's Egyptian expedition, dolomite (dolostone), a rock, dolomite, a mineral, the Dolomites, a mountain range, bear his name.



Posthumous portrait of Dieudonné de Dolomieu (1750 – 1801) by Nicolas Bosse in 1843. Bibliothèque Mines Paris – PSL.



Specimens from the De Drée / Dolomieu collection, presented in a drawer for the exhibition "Collectible Minerals".

## EXCEPTIONAL PURCHASE

An acquisition budget for minerals has been allocated to the collections since their creation, and this until 2010. Purchases are rarely made at the mines themselves, but rather at international fairs. The products and discoveries of the year converge at these "rock shows", the largest one being the Mineral & Gem show of Tucson, Arizona. Currently, the budget allocated to the museum no longer allows the acquisition of new specimens, only donations enrich the collections.

### Sikhote-Alin meteorite: a good deal

On February 12, 1947, a meteor shower ignited the skies of the Sikhote-Aline Mountain Range in Eastern Siberia. The explosion is felt up to 300 km from the impact, leaving a smoke trail of 30 km. Many fragments were found after the fall. This 115 kg fragment, which entered the collection in 2006, was purchased from a private collector. Rare on the market these days, its value has increased 16 times since then.



Stamp made by the Soviet Union in 1957 for the 10<sup>th</sup> anniversary of the Sikhote-Aline fall, depicting the smoke and the ball of fire, as represented in the painting by J. P. Medvedev.



115 kg-fragment of the Sikhote-Alin meteorite in the Mineralogy Museum's collection (ENSMP 83267. 36 x 35 x 29 cm).

## MERCHANTS

Field collections are not exhaustive. To fill the gaps of the collection (in mineral species and localities), purchase from dealers are made. They sometimes get their supplies directly in the field through miners, or by buying or exchanging with their peers. They sell through various means: by publishing catalogs of samples, opening a shop, participating in local or international fairs.

### Renowned merchants

Shops, "Maisons", counters designate the merchants' shops. The Krantz shop, still open today, specializes in the sale of minerals and scientific tools for geology and mineralogy. Krantz is famous in particular for its wooden crystallographic models, marketed from 1880. Among the other merchants presented, only the Deyrolle shop is still in business. Boubée, Saemann, Cahn and Foote saw their golden age from the end of the 19th century, but no longer exist today.



Azurite with chalcoalumite from Lyon Co., Nevada, USA, purchased from A.E. Foote (1846–1895) by the Mineralogy Museum. (ENSMP 2146; 14 x 10 x 7.5 cm).

### 3- SEIZURE

Since the creation of the *Cabinet des Mines* in 1794, the revolutionary confiscations enriched the collections, which were in the process of being built. Property confiscated from members of the French aristocracy and clergy became state property and was collected in depots, where it was inventoried. Henri Macquart and Jérôme Tonnelier, in charge of the *Cabinet des Mines* collections, were going to the storehouse known as the *Hôtel de Nesle* (now *Quai Voltaire*). They selected objects of interest for the collections and draw up the registers of entry to the *Cabinet* called the "inventories of cases of minerals from different emigrants deposited at the *Maison de Nesle*", as evidenced by the museum catalog 267.

#### Collection of Henri Bertin (1720-1792)

Already at the time of King Louis XV, Henri Bertin was considering the creation of a School of Mines in France. Inspector general of finances from 1759 to 1763, he was appointed in 1764 to head a ministry, on which the mines also depended. Bertin had an important natural history cabinet, enriched with minerals and works of art from Asia, especially China.

His collection, which was seized during the French Revolution, integrated the *Cabinet des Mines*. Kept in drawers, the artworks from his collection will only find its place of honor in 2019.



Representation of Lao Tseu holding an apple, made in serpentine, from the Bertin collection (Bertin catalog 271, number 31-61; ENSMP 68353; 10 x 6.5 x 3.3 cm).



Dragon-fish lithophone (qing) in aragonite from Henri Bertin's collection (Bertin catalog 271, number 28-16; ENSMP 68424; 25.5 x 18.6 x 1.4 cm).



**Henri Bertin, minister under King Louis XV, was a fine collector of Chinese art objects.**



Above: First page of the "Cabinet de Bertin" entrance catalog 271 of the mineralogy museum, dating from July 6, 1797.

Right: Sculpture in natural two-color serpentine (Bertin catalog 36-14; ENSMP 68431; 19.4 x 15 x 1.8 cm).

## SEIZURE, HERITAGE OF THE FRENCH REVOLUTION

**"But, it's a rebellion?"** Many are the samples  
**"No, sire, it's a revolution!"** coming from the  
confiscations during the  
French Revolution. In the

registers, the names of "Condé, Asnières, Kinsky, Tessé, Boutin, Clermont d'Amboise, Goupillière, Brionne de Vaudemont, Liancourt" are found. The latter is undoubtedly the Duke of Liancourt de La Rochefoucauld, an eminent emigrant, famous for the sentence addressed to King Louis XVI: "No, sire, it's a revolution! ".



Specimens from Liancourt's collection, which was seized during the French Revolution and entered the Cabinet des Mines on July 6, 1797 under catalog number 272.

### Dietrich: a national anthem

Another important figure: Baron de Dietrich, who had his collection confiscated, returned, then purchased. Of the 8,000 samples confiscated in 1795, 1,800 were purchased by the School of Mines in 1798. Today, only a hundred of them are identified in the collections. De Dietrich was not only the Mayor of Strasbourg, he was also the one who encouraged Rouget de Lisle to compose "La Marseillaise", which became the French National Anthem. Minerals and ores presented in this exhibition might have heard it sung for the first time in the baron's salon in 1792.



Specimens from de Dietrich's collection, which was seized during the French Revolution. The Paris School of Mines eventually purchased his collection, entering catalog number 400.



Yellow fluorite from Giromagny, Belfort, France, from de Dietrich's collection – catalog number 400 – A7, that he acquired through M. Tournay in 1770 (ENSMP 8931; 16 x 8.4 x 4 cm).

## 4- DONATIONS

Donations represent a substantial part of the collection: private collectors, explorers, merchants, former students or professors of the School of Mines, to which are added a multitude of generous contributors. Currently, the main donor is the ABC Mines association, which supports the museum. The methods of donation are multiple: in monetary form or in kind, on an one-off basis or by bequest of entire collections. To be accepted, specimens must have a remarkable appearance: a new mineral species, a new locality, a perfect shape, a particular color, or a scientific or historical interest. Entry into the collection by donation is therefore a guarantee of excellence. This philanthropic act is of mutual benefit, as the museum ensures the durability of the object, its conservation, its valorization and perpetuates the name of the donor.

### The systematic collection of Emile Bertrand

Mining engineer, Émile Bertrand (1844-1909) has dedicated his career to the study of minerals. His favorite tool: the polarizing microscope, which he constantly perfected by inventing new devices, such as the "Bertrand lens". Bequeathed to the School of Mines in 1910, its cataloged collection of 2021 specimens is exemplary: each sample is mounted, labelled and accompanied by a catalogue.



One of Emile Bertrand's microscopes, equipped with a "Bertrand lens". Bibliothèque Mines Paris – PSL.



A few of Bertrand's mineral samples, mounted on wooden blocks (5 x 3.7 cm each), with catalog numbers for reference. 236: labradorite (ENSMP 72688). 362: green beryl from Ilmen Mountains, Chelyabinsk, Russia (ENSMP 13395). 363: aquamarine beryl (ENSMP 72433). 443: apophyllite from Saint Andreasberg, Braunlage, Germany (ENSMP 72503). 687: red calcite from Sweden (ENSMP 71723).



One of the 32 drawers dedicated to Emile Bertrand's collection. This drawer is mostly dedicated to quartz, with rough and polished crystals of different quartz varieties. Bertrand classified all of his specimens by chemical families and by species. Each specimen of his collection is mounted on a wooden base with a dark red resin. The number on each corresponds to a catalog number. Room is left for missing specimens.



Most specimens in Emile Bertrand's collection are rough samples. However, for mineral species having a gem-quality variety, Bertrand had at least one gemstone of the variety. Here, two polished lapis lazuli specimens that are engraved with gold writings.

(ENSMP 83293, Bertrand's collection number 272; 2.2 x 1.7 x 0.2 cm each).



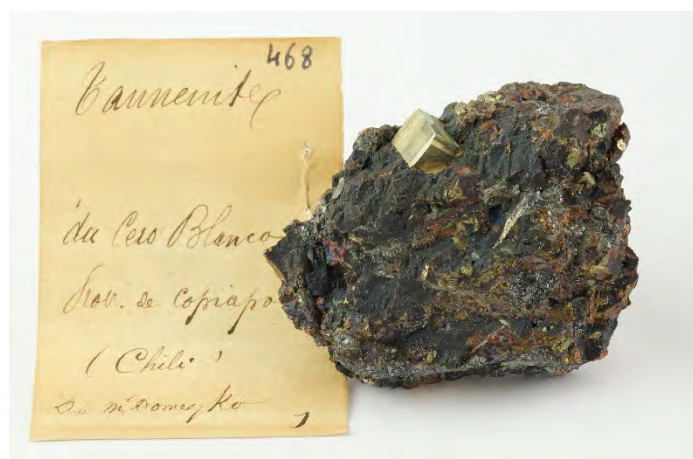
## DONATION, A TOOL FOR INTERNATIONAL INFLUENCE

There are many foreign former students of the School of Mines. Some become famous in their country and continue a relationship with the museum by donating samples from their travels, giving the collections their international dimension.

### Domeyko (1802-1889), a worldwide celebrity

Originally from a war-torn region, Ignacy Domeyko fled Russian influence and completed his studies at the School of Mines. He studied under Élie de Beaumont and graduated in 1837. In 1838, he moved to Chile and became a professor, training future engineers and helping to discover new mining deposits. He was then called upon to reform the country's university education system. He never stopped sending samples to the museum.

Countless stamps, medals and statues bear the effigy of Domeyko, now claimed by Lithuania, Poland, Belarus and Chile.



Emplectite "tannenite" sent from Chile by Domeyko (ENSMP 468; 5.3 x 4.5 x 2 cm).



Chrysocolla from Chile sent by Domeyko in 1884, with its original labels (ENSMP 4819; 9.6 x 8.4 x 3.8 cm).

## DONATION, A FINANCIAL CONTRIBUTION

Monetary donations are curators' delight. It enables them to create an acquisition policy based on the needs of their collections and the minerals available on the market.

### Egleston (1832-1900), a long-term benefactor

Thomas Egleston studied at Yale in 1854, then at Paris School of Mines. He graduated second in his class in 1860. Upon his return to the U.S., he was inspired by the model of the Parisian School of Mines to found the School of Mines at Columbia University in New York, which became Engineering's Earth and Environmental Engineering Department in 1864.

Initially wishing to bequeath his collection to the museum, he eventually donated \$10,000 between 1898 and 1899, earmarked for "the increase and embellishment of the mineral collections". For more than 50 years, the Egleston fund has considerably enriched the museum with exceptional specimens.



Pegmatite from San Piero in Campo, Elba Island, Italy, showing an association of tourmaline, orange grossular garnet, quartz and feldspar. Acquired with the Egleston funds (ENSMP 19231).

## **DONATION, A QUEST FOR ETERNITY**

Giving is not just a gratuitous act. It is part of a quest for posterity. Once in the museum, the objects perpetuate the memory of the donor and become witnesses to his consecration. This approach can sometimes take on unreasonable proportions.

### **Alibert (1820-1905), the price of recognition**

Merchant and explorer, Jean-Pierre Alibert was commissioned by Tsar Nicolas I in 1844 to guide an expedition to Siberia. There, he discovered large deposits of nephrite jade and graphite, which he went on to exploit. Despite his early success, he lost prestige following a commercial failure when manufacturer Faber-Castell first marketed their famous pencils.

Eager for recognition, he had trophies made of graphite and nephrite. He donated them to renowned scientific institutions, including the School of Mines. Only a few elements of this trophy remain today and are now again on display at the museum, including a 500-kg nephrite jade boulder by the entrance of the museum.



*Photograph from 1908 of Alibert's graphite trophy at the School of Mines, before it was dismantled for the first time. The trophy could be seen on three sides, with different graphite blocks and carvings. Bibliothèque Mines Paris – PSL.*

## 5- HERITAGE

The museum now preserves specimens that once risked dispersal or even disappearance. Their entry in the collections has enabled the preservation of this heritage. The heritage value of these objects is attested, for example, by their success at the World's Fairs. Inaugurated in London in 1851, these events marked the 19th century. They showcased the technical and artistic prowess of various nations, spectacular witnesses to the industrial revolution. Delegations from the various nations handed over numerous samples of minerals characteristic of their territories. Among these deposits is an exceptional gem, donated by an award-winning lapidary.

A few gems from the rich French Crown Jewels were also rescued and added to the collections. The loose gemstones were saved from the 1887 auction voted by the French Third Republic.



*Drawing of the interpretation of Napoleon III Coronation Crown, designed by Lemonnier in 1855. The crown is mostly made of yellow gold (crosshatched and lines), with diamonds (in white) and emeralds (in green).*

### **Emeralds from the Coronation Crown of Napoleon III**

Presented here are forty-five emeralds from the French Crown Jewels that adorned Napoleon III's coronation crown. Created by Alexandre-Gabriel Lemonnier, the Emperor's jeweler, the crown along with that of the Empress, were presented and awarded at the

Universal Exhibition of 1855. The golden imperial eagles and palms were set with diamonds and emeralds. Only the small emeralds were spared and awarded to the Paris School of Mines.



*Eight of the 45 emeralds from the Coronation Crown of Napoleon III in the Mineralogy Museum's collection. These emeralds were adorning the feet of the golden eagles.*

## THE FRENCH CROWN JEWELS: A SPARED HERITAGE

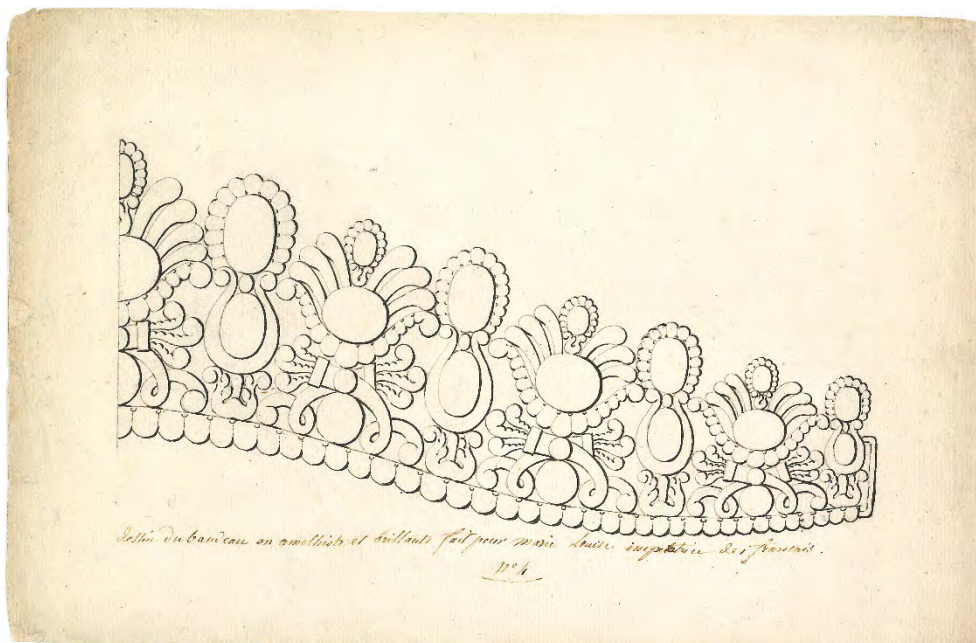
At the 1878 Universal Exhibition, France unveiled its national treasure: the French Crown Jewels. Sixteen million visitors discovered the jewels of the last empresses and emperors, as well as loose gemstones used as stock. A monarchical symbol to be destroyed, the French government decided to sell this national treasure in 1887. Only a few pieces were spared and were given to the Muséum national d'Histoire naturelle, the Louvre museum and the Paris School of Mines.



*Some of the 59 pink topazes attributed to the collections of Paris School of Mines in 1887. The pink topazes were purchased by Nitot to create a jewelry set in "Brazilian rubies" for Empress Marie-Louise.*



*Some of the 177 amethysts attributed to the collections of Paris School of Mines in 1887. The amethysts were mounted in a jewelry set in 1811 by Nitot, jeweler of the Emperor, for Empress Marie-Louise in 1811. The set was dismantled under King Louis XVIII and the amethysts were kept as loose gemstones in the French Crown Jewels.*



### Gems of the Empress Marie-Louise

Sorted by experts among the 77,486 gems, the Paris School of Mines is awarded series of emeralds, "Brazilian rubies" (pink topazes) and amethysts. These last two were acquired under Napoleon I to create ornaments for the Empress Marie-Louise. The drawn tiara is the only precise witness to the work produced by the jeweler Nitot (now Maison Chaumet) with the amethysts, as pieces of jewelry were dismantled from one king or emperor to the next, to create new ones. Marie-Louise was portrayed with her pink topaz ornament in 1812-1814 by Robert Lefèvre.

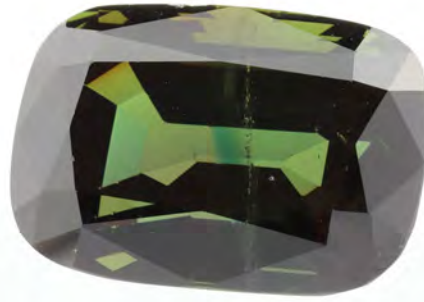
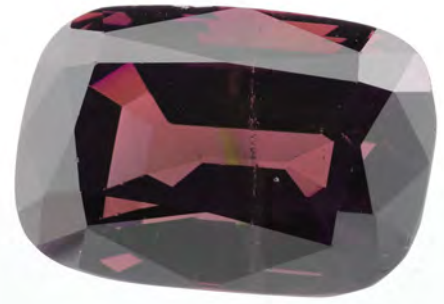
*Drawing of the profile of the amethyst tiara created by Nitot in 1811 for Empress Marie-Louise, as mentioned under the tiara. The drawing was kept in the Heritage Center of the Maison Chaumet, direct descendant of jeweler Nitot and is revealed for the first time during this exhibition. Credit: Maison Chaumet*

## Universal Exhibitions: A heritage preserved

Universal Exhibitions reveal the industrial and artistic treasures of nations. The world's best artists compete. Painters, engravers, sculptors and architects compete for the gold medal that promises fame. Once they have won, the works find their place in private collections or in museums, thus becoming heritage objects and symbols of an era.

## Alexandrite, a treasure revealed

Among the artists, lapidaries and jewelers presented their creations. At the 1878 Exhibition, Parisian lapidary Henri Garraud proposed a showcase of gems for the "Jewelry, Jewels" section, for which he received a gold medal. Garraud selected an exceptional 42.54-carat alexandrite, known for its color change, and donated it to the museum in 1882. This is the first time it has been exhibited again.



42.54-carat alexandrite, as view under incandescent light (above) and under daylight (left). The unusual stone shows a twin plane along with inclusions running through its center. The alexandrite was identified by the French Gem Lab LFG as most likely coming from Sri Lanka thanks to its inclusions and physical and chemical properties (ENSMF 69873: 2.3 x 1.6 x 1.2 cm).

RAPPORT D'ANALYSE GEMMOLOGIQUE GEMMOLOGICAL ANALYSIS REPORT		Identification   Identification	
n°396132	Paris, le 14/06/2023	<b>ALEXANDRITE ALEXANDRITE</b>	
Objet Item	Pierre isolée Loose stone	Nature minéralogique   Mineralogical nature	
Forme - Taille Shape - Cut	Coussin - Facetée Cushion - Faceted	CHRYSOBÉRYL CHRYSOBERYL	
Dimensions   Measurements	23.15 x 15.95 x 12.31 mm	Traitement   Treatment	
Masse   Mass	42.54 ct	Pas d'indication de traitement No indication of treatment	
Couleur Colour	Voir commentaires See comments	Origine géographique   Geographical origin	
Commentaires   Comments		Sri Lanka (Ceylan) Sri Lanka (Ceylon)	
Caractéristiques compatibles avec celles des gisements de Sri Lanka (anciennement Ceylan). Gemological properties consistent with those of Sri Lankan deposits (formerly Ceylon).		L'origine géographique indiquée est une opinion du Laboratoire (ou des laboratoires gemmologiques) (opinion, check, inclusion). The geographical origin indicated is an opinion of the laboratory (or the gemmological labs) (opinion, check, inclusion).	
Changement de couleur : vert profond légèrement brun à la lumière du jour / pourpre profond légèrement brun-rouge à la lumière incandescente Colour-change : deep brownish green in daylight / deep brownish reddish purple in incandescent light		Sri Lanka (Ceylan) Sri Lanka (Ceylon)	
Voir lettre annexe See appendix letter		Lumière du jour Daylight	
		Lumière incandescente Incandescent light	
		Photographie   Photography	
		La couleur et les dimensions de l'échantillon analysé ne sont pas représentatives. The color and dimensions of the object analyzed are unrepresentative.	
		Ugo Hennebois, AG DUG Gemmologue   Gemmologist	
		Dr Stefanos Karamelas, DUG Responsable laboratoire   Chief gemmologist	
Méthodes utilisées   Methods used			
* Ces analyses sont réalisées conformément à la norme ISO 18305:2022.			
<ul style="list-style-type: none"> <li>■ Observation / Observation</li> <li>■ Réfractomètre / Refractometer</li> <li>■ Colonne lumineuse polarisée / Polarized lighting</li> <li>■ Microscopie / Microscopy</li> <li>■ Tests de dureté / Hardness tests</li> <li>■ Densité / Density</li> <li>■ Analyse de spectroscopie / Spectroscopy analysis</li> </ul>	<ul style="list-style-type: none"> <li>■ Spectroscopie infrarouge / Infrared spectroscopy</li> <li>■ Spectroscopie UV-visible / UV-visible spectroscopy</li> <li>■ Spectroscopie Raman / Raman spectroscopy</li> <li>■ Spectroscopie à fluorescence / Fluorescence spectroscopy</li> <li>■ Spectroscopie FTIR / FTIR spectroscopy</li> <li>■ Microscopie à haute magnification / High magnification microscopy</li> <li>■ Tomographie / Tomography</li> <li>■ IRI*</li> </ul>	Date d'analyse / Date of analysis: 14/06/2023 L'interprétation des résultats n'est pas certifiée par l'accréditation COPRAC. Le rapport émet le constat que les données sont en accord avec les données de la base de données de la LFG. The interpretation of the results is not certified by COPRAC accreditation. The report states that the data are in accordance with the data in the LFG database.	
 LFG PARIS Laboratoire Français de Gemmologie		 Accréditation N° 1-6767 Portée disponible sur www.cofrac.fr	
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Gemmological analytical report done by the French Gem Lab LFG in 2023 on the 42.54-carat alexandrite in the museum's collection. The report comes with a letter that acknowledges the exceptional character of the stone. Credit: LFG.

## PARIS SCHOOL OF MINES AND THE UNIVERSAL EXHIBITIONS

In 1855, Napoleon III commissioned his cousin Prince Napoleon to organize the first Parisian Universal Exhibition. Paris School of Mines is immediately associated with it. The general inspectors of mines Frédéric Le Play, commissioner general, assisted by Alexandre de Chancourtois were the organizers of the two first ones in Paris.



Specimens from California exhibited during the Universal Exhibition of 1878. Left: Azurite (ENSMP 37253 to 37555). Above: Gypsum (ENSMP 38165).

### The geological heritage of Nations

Universal Exhibitions are an opportunity to showcase the mineral wealth of nations. Some rocks bear witness to geological phenomena, others to human activity. Minerals are strategic, indispensable to the

development of technical innovations and industrial progress. From a variety of mines and operations, they are sent by scientists and industrialists from all over the world. The museum holds, among others, those from California (1878) and Chile (1889).



Display case dedicated to the specimens preserved from the different Universal Exhibitions by the School of Mines.

## 6- EXCHANGE

Exchanges have always been the best way to complete collections. As early as the end of the 18th century, Paris School of Mines maintained relations with similar institutions, such as the Bergakademie in Freiberg. Exchanges with the latter were common practice. Closer to home, in the 1960s an exchange policy was put in place. The aim was to place the collection at the very top of the world rankings, according to the wishes of School's director Edmond Friedel. To achieve this, a partnership was established with the Bureau de Recherches Géologiques et Minières (B.R.G.M.). Field expeditions were set up to create stocks specifically dedicated to exchanges. The 1995 national inventory of the collections put an end to this modality, freezing the exchange collection in the heritage domain.

### Opal, an extraordinary exchange

The volcanic rock containing opal nodules of different colors was obtained by exchange with a collector, Bernard Amster, director of the *Compagnie de Madagascar* and member of the *Société Française de Minéralogie et de Cristallographie*. Six minerals were traded to obtain this world-renowned specimen.



*Opal-bearing rhyolite from Mexico, obtained by exchange and valued at 1,000 points (ENSMP 16209; 17 x 12 x 4 cm).*

### AN INTERNATIONAL EXCHANGE SYSTEM DEDICATED TO MINERALS

From 1957 onwards, the exchange system flourished for a quarter of a century. The systematic collection grew considerably. Each piece is traded for specimen(s) of equivalent value. The value is established on a point scale specifically dedicated to minerals. Curator Claude Guillemain and his team canvassed institutions, dealers and collectors. He created the Service de Conservation des Espèces Minérales (S.C.E.M.) to build up exchange stocks.

### Fluorite: its "points" scale

Rather than a price subject to international exchange rates, an internationally-recognized points system enables exchange based on a scale of values. Each mineral is assigned a number of points according to its rarity, perfection and geographical origin. To illustrate, a reference scale based on fluorite is shown here.



*A series of fluorites, valued by points. From left to right: 8, 12, 15, 25, 90 and 450 points. The fluorite on quartz on the right is the most valuable, as the pink fluorite from the Alps are extremely thought after.*



A series of tourmalines of different values: from 2 points for the smallest black ones to 700 points for the bicolor blue-pink one in the center of the photo.

### **“Blue Cap”: The Queen of Tourmaline**

The Tourmaline Queen mine in California's Pala mining district was the site of an exceptional discovery in 1972. That year, a group of miners extracted tourmalines of astonishing dimensions, color and clarity for the locality. These were pink-red tourmalines with a blue head, known as "Blue Cap". The world of collectors went wild, as only 37 specimens were extracted from the original discovery, which would remain the most exceptional. Some of these tourmalines display a beautiful mineral association with well-formed quartz and feldspars. The best piece, called *Candelabra*, entered the U.S. national collection at the Smithsonian Institution. The Museum of Paris School of Mines did not hesitate to pay the high price for one of them - 2800 points, the equivalent of several hundred ordinary tourmalines.

### **INSTITUTIONAL EXCHANGES**

Curators actively seek out their peers in museums and institutions around the world to exchange ideas. The race for new mineral species is on. Each collection aims to be the repository of the greatest number of mineral species and reference localities.

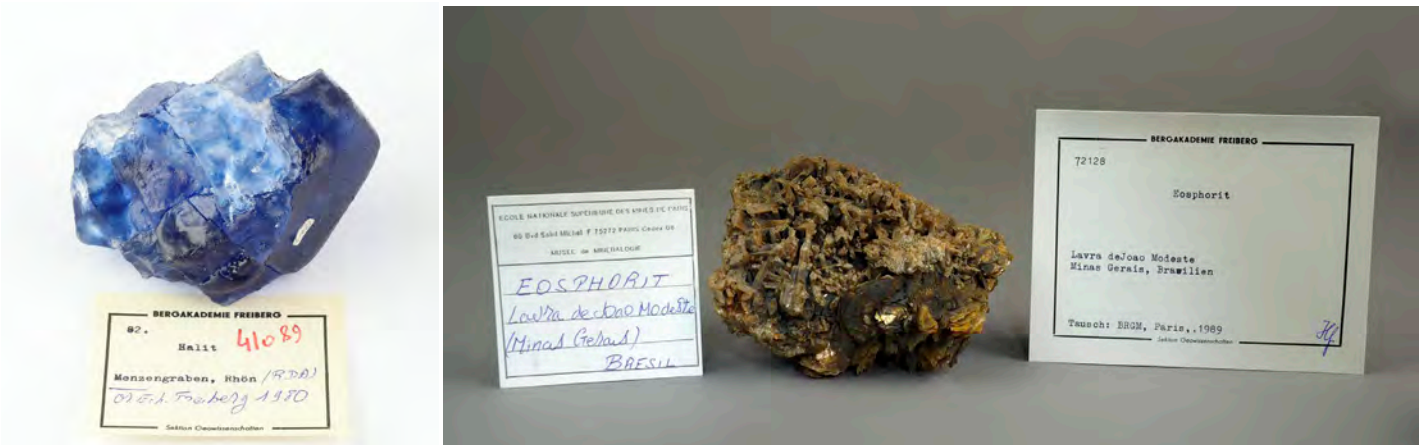
### **Freiberg: a sister School of Mines**

The Bergakademie in Freiberg was Germany's very first School of Mines, founded in 1765. The two Schools differed in their scientific vision. At the end of the 18<sup>th</sup> century, René-Just Haüy in Paris and Abraham Gottlob Werner in Freiberg each proposed their own classification system. Until the early 20<sup>th</sup> century, collections were organized following their own systems. Still, debates on ideas were welcome and the two Schools exchanged knowledge and samples.



*“Blue Cap”* tourmaline from the Tourmaline Queen Mine, Pala District, San Diego Co., California, USA, acquired by exchange in 1973 (ENSMP 16163; 26.5 x 13 x 13 cm). It was valued at 2800 points and was the source of a yearlong discussion with the dealer before the right “price” was agreed upon.

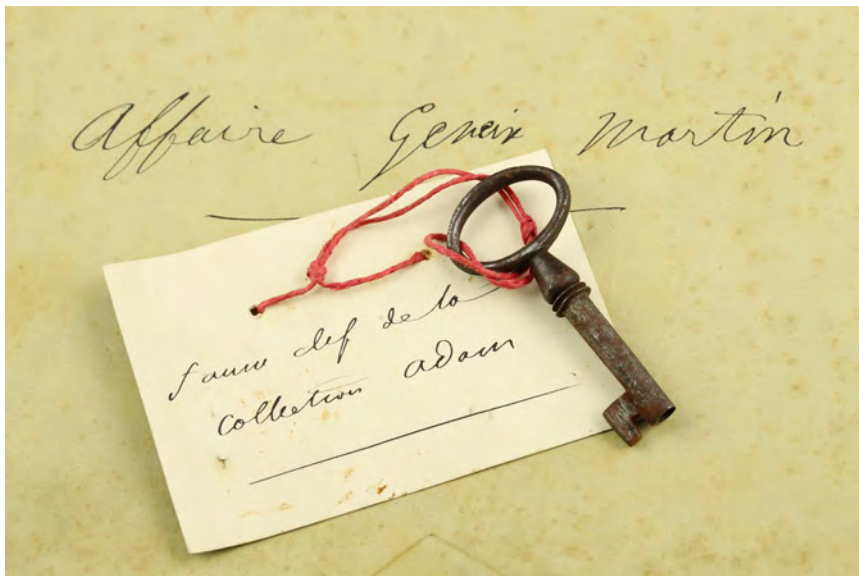




Minerals obtained by exchange, between the Paris School of Mines and the Bergakademie of Freiberg. Left: halite now in the collection of the School of Mines. Right: Eosphorite from the School of Mines now in the collection of the Bergakademie of Freiberg.

## SIDE STORY: THEFT

### THEFT BY THE ABBOT GENEIX MARTIN



Envelope containing the replicate of the key made by the Abbot Geneix Martin that opens the cabinet of the Adam collection, kept at the School of Mines. Archives of the Library of Mines Paris – PSL.

A few minerals from the extensive collection of over 1,500 specimens of M. Adam, donated to the Paris School of Mines in 1881.



It's June 14, 1892. For several months, employees in charge of the collections have been noticing the disappearance of samples. Security guards eventually drilled a hole in a partition to spy on the thief. They were surprised to find the Abbot Geneix-Martin, an auditor in a mineralogy class. He had a false key made to access the drawers of the large collection of M. Adam. After he confessed, his home was searched, and over 2,000 samples were found. When the School decided to lodge a complaint, he fled to Fécamp, in the North of France. Full of guilt, he threw himself off the cliffs on June 20 of the same year.

## CONCLUSION

### THE ADVENTURE CONTINUES

Understanding the Earth and the Solar System is still a burning scientific topic. The fields of investigation have expanded thanks to new analytical techniques, such as particle accelerators (synchrotron, for example). Technological advances allow researchers to access the mysteries of neighboring planets as well as the depths of the Earth. For both of these subjects, samples from the Mineralogy Museum's collection have been taken out of their drawers to participate in these scientific adventures.

Today, the exploitation of the planet is taking on unprecedented dimensions. Planes, cell phones, cars, wind turbines and solar panels, all require more and more raw materials for their manufacture. Rare earth elements, tantalum, lithium, copper and cobalt have become essential to our contemporary lifestyle. The complete inventory of natural resources is more necessary now than ever before to create a sustainable future. Comprehensive collections of mineral species and their deposits make up what can be called "the Great Rock Library", from which researchers and students may draw and add information.

As innovation progresses, so does the need for analysis, discussion and communication concerning the relationship between mineral resources and manufactured objects. Researchers, students, artists and the public come together at the Mineralogy Museum of the École des Mines de Paris, making it an ideal place to take this approach forward.

Mineral collections fascinate through the beauty of their specimens. In conjunction with this, minerals are critical for giving tangible form to thoughts and for reflecting on strategic, economic and environmental issues shaping both our present and our future.

### SAMPLES FOR UNDERSTANDING THE SOLAR SYSTEM

#### Diamond, witness of the deep Earth

Diamond formation conditions are extreme: it crystallizes at depths of between 150 and 800 km. Its structure and integrity remain unchanged when it travels to the Earth's surface through volcanic activity, making it a unique witness of the deep Earth. Geologists analyze its impurities and inclusions to uncover the mystery of these inaccessible environments.

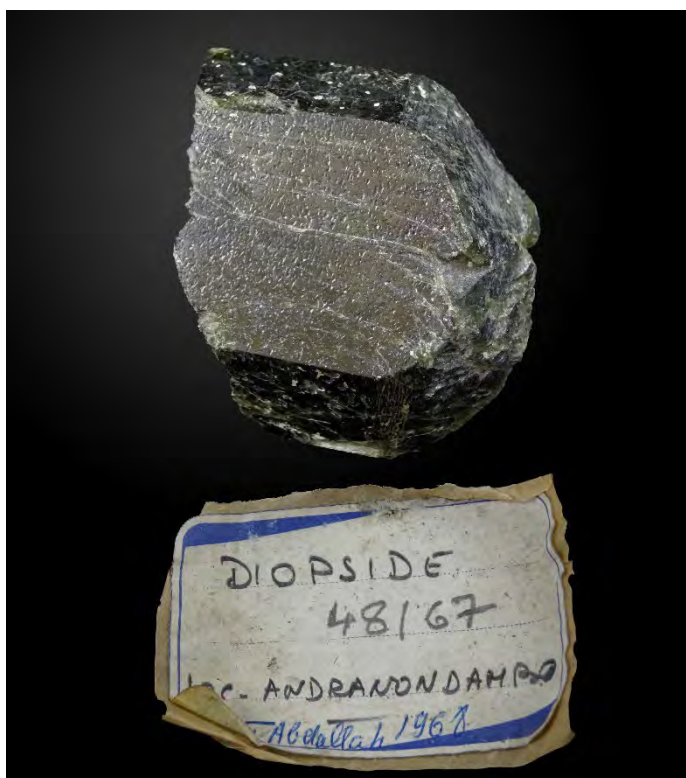
The diamonds presented here are part of a preliminary study by Dr. H el ene Bureau of Sorbonne University (IMPMC). She is interested in the water in the form of hydrogen contained in diamonds, and is studying its influence on the geodynamics of our planet.



Four colored diamonds studied by Dr. H el ene Bureau, kept in its original study box (ENSMP 101).

#### A sample of the Mineralogy Museum on Mars

This is the remaining fragment of the sample on board the Perseverance Rover, currently traveling across Mars. This diopside, a magnesium and calcium silicate, was used to complete the suite of standards for SuperCam, the instrument that measures the composition of Martian rocks. NASA's Mars2020 mission is led by a European team, including Violaine Sautter from the Mus eum d'Histoire Naturelle, who was responsible for finding some of these reference samples.



Diopside before it was cut in half. One-half was prepared and sent on Mars via the Perseverance Rover in 2019 (ENSMP 48167).

## THE COLLECTIONS FOR UNDERSTANDING THE CHALLENGES OF THE ENERGY TRANSITION

### Sovereign lithium?

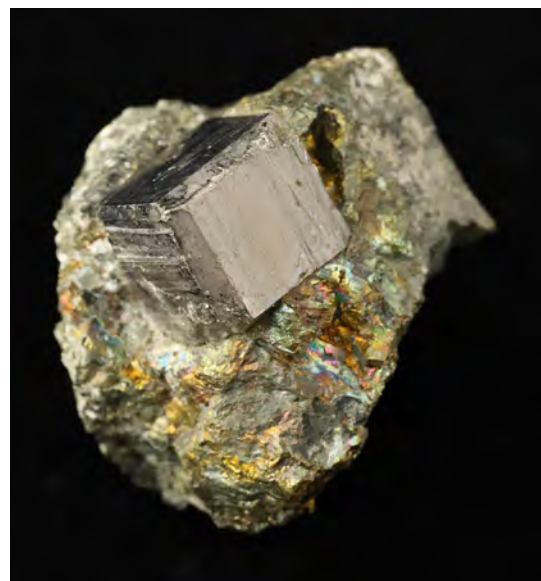
It is estimated that lithium consumption for battery production will increase 40-fold over the next few years. Today, lithium comes mainly from Australia and Chile. To help ensure its sovereignty, France is prospecting its territory. Once again, the need for an inventory arose. The collections will serve as a reference. All eyes are on the mineral lepidolite (a lithium-rich mineral) from the Allier region, where a mine is envisaged to open in 2028.

### Minerals at the heart of conflicts?

Cobalt is used in the composition of batteries. The largest producer is the Democratic Republic of Congo, with a large deposit located in the unstable Kivu region, on the borders of Rwanda. Many illegal exploitations have developed there, in which the greatest environmental and ethical disorder reigns. The role of the museum is also to raise awareness of geopolitical and environmental issues surrounding mineral resources.



*Pink spodumene, also known as kunzite, from Kantiwa, Nouristan, Afghanistan (ENSMP 25875; 10 x 6 x 2.7 cm). Spodumene is the main lithium mineral ore.*



*Cobaltite, a cobalt-ore, from Sweden (ENSMP 607; 4.5 x 4 x 3 cm).*

***Minerals are critical for giving tangible form to thoughts and for reflecting on strategic, economic and environmental issues shaping our present and build our future.***

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