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The First International Mineral Processing Conference in 1786

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The first international mineral processing conference in 1786

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Introduction

In September 1786 an international conference on the processing of silver ores was held at Sklny near Schemnitz in the Austrian Empire. The organizer of the conference was the Austrian mineralogist and metallurgist, Ignaz von Born, who was at that time Privy Councillor to the Mining and Mint Department in Vienna. This conference was the first of its kind; it attracted 24 experts. However, the conference should not be compared to today's conferences. It was not held on fixed days with speakers organized in sessions, but, rather it was held during a few months and the participants did not all arrive and leave at the same time.

Schemnitz was an important metallurgical centre. It was there that the first European School of Mines was founded in 1762 by Empress Maria Theresa. In 1764, the Empress sent her two sons, Prince Joseph and Prince Leopold, to visit this mining district to get first-hand information about mining and metallurgical operations. Prince Joseph was crowned as Roman King in Frankfurt on April 3, 1764 and later became known (1780-1790) as Josef II, Austrian Emperor and King of Hungary. Prince Leopold became Emperor of the Austrian Empire from 1790 to 1792.

The purpose of the conference was to demonstrate and discuss a new process developed by Born for treating sulphide ores containing silver. During the conference it was agreed to form a "Society for Mining Science" and to publish an annual journal of its activities. Only the first two volumes of the journal appeared, in 1789 and 1790, and the Society was lost in obscurity. It was more than one hundred years later that mining and metallurgical engineers started to organize themselves into national societies and publish technical periodicals regularly.

Chemists organized their first international conference in 1860 at the Technische Hochschule in Karlsruhe. It was attended by 130 chemists including 57 from Germany. It was at this conference that the Italian chemist Stanislao Cannizzaro explained the views of his countryman, Amadeo Avogadro, regarding atoms and molecules; these clarified the basic concepts of chemistry.

Ignaz Edler von Born (1742-1791)

Born (Fig. 1) was born in Carlsburg (or Karlsruhe) the modern town of Cluj in Transylvania (also known as Siebenbürger, the western part of present day Romania), at that time part of the Austrian Empire. He was educated by Jesuits in Vienna and then studied law in Prague. He travelled in Germany, Holland, the Low Countries, and France studying mining. In 1771 he was appointed assessor of the Mint and Mining Head Office in Prague. In autumn of that year he published Podá's treatise on the machinery employed at Schemnitz. To bring out this book, an indispensable guide to the 18th century mining in central Europe, was to act in defiance of an order dated May 10, 1771 which forbade Austrian state employees to publish anything related to mining. In the dedicatory address to the president of the Mint and Mining Court Chamber, Born pleaded for a more open attitude in these matters because he was convinced that secretiveness would be detrimental to mining progress in territories under Austrian rule. He expressed the hope that the responsible minister would encourage open access to and dissemination of mining knowledge. Not only were Born's expectations not fulfilled, but the order was renewed on March 20, 1772, and as a result he resigned from service to the state.

Born devoted his energy to the cause of Enlightenment. He regarded the acquisition and dissemination of scientific knowledge and organized scientific activities to be a key to progress. He had acquired an international reputation as a mineralogist. The mineral bornite, CuFeS₂, was named in his honour by the Austrian mineralogist Wilhelm Karl von Haidinger (1796-1797). He published:

- Index Fossilium quae collegit, et in classes ac Ordines dispositus, 2 vols., Prague, 1772, 1775; and
- Catalogue Méthodique et Raisonné de la Collection des Fossiles de Mmes Éléonore de Raab, 2 vols., Vienna, 1790.

Born organized scientific and cultural activities, first in Prague and then in Vienna, where he moved in 1776 to take up a post in the Natural History Cabinet. A year later he again became, directly concerned with mining and metallurgy by joining the Mint and Mining Court Chamber. It was primarily due to Born's endeavours that between 1769 and 1774 a group of scholars in Prague began to function as an organized Private Learned Society, which later, as the Royal Bohemian Society of Science, gave rise to the Czechoslovak Academy of Sciences in 1952. Six volumes of its journal, entitled Abhandlungen einer Privatgesellschaft in Bohmen zur Aufnahme der Mathematik, der vaterlaendischen Geschichte, und der Naturgeschichte, appeared between 1775 and 1784 under his editorship. He also edited the Physikalische Arbeiten der ein-
d'extrait par le mercure. Another French edition appeared in 1788 in Vienna under the title *Méthode d'extraitre les métaux parfaits des minerais et autres substances métalliques par le mercure*. An English translation was published in 1791 in London by the Chemical Society, and entitled *Baron Inigo Born's new Process of Amalgamation of Gold and Silver Ores and Other Metallic Mixtures*.

The Amalgamation Process

The recovery of mercury from cinnabar was known to the Romans. The artisans of the Roman Empire also knew of the formation of gold and silver amalgams with mercury, but there is no indication that they applied this knowledge to the extraction of gold and silver from their ores. A description and discussion of amalgamation in terms of a metallurgical process is found in Birruguccio’s *Prototechnia* of 1540. Among materials suitable for the recovery of gold by mercury, he listed by-products of mining and goldsmiths’ and goldbeaters’ work. He also mentioned some ores without specifying them precisely. The decomposition of the amalgam by distillation for the recovery of gold was also well described by him, as well as by Agricola, in his book *De Re Metallica* of 1556.

The amalgamation process was applied in Spanish America in the middle of the Sixteenth Century:
- in Pachuca in Mexico by Bartalome de Medina; and
- in Potosi in Vice Royalty of Peru (now Bolivia) by Father Alvaro Alonso Barba.

The process involved the following operations:
- crushing the ore and reducing it to a slime;
- transference of the wet mass to a circular paved courtyard (patio), where it was mixed with salt supplemented by weathered or roasted pyrite, containing copper and ferric sulphates (magistical);
- the addition of mercury which was trodden in with the mass by mules; and
- washing away the ore slimes to collect the amalgam then decomposing the amalgam by heating to recover the silver.

It was not until the 1780s that serious interest in South American silver amalgamation began to be shown in Europe, where silver smelting was the accepted method. Most European metallurgists believed that only native gold and silver could be successfully amalgamated and, therefore, the South American methods were not suitable for the treatment of most silver ores mined in Europe. Also, the production of precious metals in the Austrian Empire was declining. These factors encouraged Born to study the amalgamation process. As a Counsellor of the Mint and Mining Court Chamber in Vienna, he had access to its old records. He studied documents on amalgamation which he summarized in his book on amalgamation and came to the conclusion that the process should be cheaper than the smelting process then practiced.

After two years of experimentation, Born was ready to demonstrate publicly the advantage of amalgamation. The duration of the process was shortened, fuel (wood and charcoal) consumption was reduced and the use of lead was dispensed with. He also claimed that the loss of silver previously amounting to 4% to 9% was reduced to practically nothing. He envisaged a new use for the rich domestic mercury deposits. He expected mercury to become an important export commodity into countries desiring to adopt amalgamation.

Born listed all these points in a petition to the Emperor Joseph II early in November 1784, with a request that he should be granted one fourth of the savings gained through the introduction of amalgamation at state and private works in all Austrian territories. Born also wished that this income continue after his death, for the benefit of his widow and children as long as they lived. In order to make his case convincing he proposed to conduct a trial at his own expense in the presence of experts, who were to assess the practicability of the method. The Emperor granted permission for a test, but rejected the idea that Born would be entitled to claim and obtain a reward. It was his duty, as a Counsellor, to suggest useful innovations without any expectation of recompense for such service. However, Joseph II was not against a certain financial recognition of Born’s achievement.

A commission able to assess the metallurgical and economic aspects of the process was set up. Then, on January 3, 1785 the first trial took place in the mint, but it failed, apparently due to the deficient calcination of the pulverized matter in Stiavnica. The results of the second trial seven days later were better, but not brilliant. Some members of the commission were critical of the process and others were in favor of continuing the experiments. The Emperor concurred, in a decree of April 18, 1785. Current smelting was not to be discontinued and,
therefore, a site was selected, where no work was in progress. This was Skleno, where the closed-down installations could be used for new trials. Anton Ruprecht, who taught chemistry at the Mining Academy, was asked to take charge of the development, from the laboratory to large-scale production. A skilful chemist, he had carried out several experiments and had become a firm believer in the method. He was to be aided by Born's close collaborator, Haidinger.

The Conference

The setting up of the first amalgamation works was entrusted to Ruprecht who, with the help of Haidinger, was responsible for the early arrangements. For the coming period of corroborative trials Born decided to be present in person, and he, therefore, went to Skleno in May 1786 (Fig. 3). A month later, Spanish chemist Fausto D’Elhuyar arrived, followed by others who stayed there from two to three months, some of them much longer. The most prominent foreign visitors present during the autumn months of 1786 were the following:

- **Johann Friedrich Wilhelm Toussaint von Charpentier** (1738-1805), professor at the Mining Academy in Freiberg, Saxony. He was accompanied by two metallurgists from Freiberg named Ortmann and Witting. He later managed the largest amalgamation plant near Freiberg (Fig. 4).
- **Friedrich Wilhelm Heinrich von Trebera** (1745-1819). German mining and metallurgical expert, active in the Harz and Saxony. He was accompanied by an assistant named Uslar.
- **Anton von Ruprecht** (1750-1802). Graduated from the Mining Academy in Schemnitz, worked with T. Bergman at Upsala, appointed professor in Schemnitz, and succeeded Born in Vienna in 1791 at the Mint and Mining Court Chamber.
- **Johann Jacob Ferber** (1743-1790). A Swedish scientist, FRS, author of papers on the geology of Cornwall.
- **Nicolaus Poda**. Professor of mechanics and hydraulics at the Schemnitz School of Mines. Formerly, director of the Museum of Natural Science in Graz and lecturer at the University of Vienna.
- **Hoffinger**, the first physician of the local mining district.
- **Fausto D’Elhuyar** (1763-1833). Studied at the Mining Academy in Freiberg during 1778-1781, taught at Vergara Seminary in Spain, and discovered tungsten in 1783 in collaboration with his older brother Juan José. After attending the conference at Skleno, he married an Austrian lady and in 1788 was sent to New Spain to be Director General of Mines. He was then commissioned to establish a School of Mines in Mexico City. On his return to Madrid in 1812, he made Director General of Mines and planned the School of Mines of Madrid. At Skleno, D’Elhuyar was accompanied by three young associates Torres, Recarte, and del Río, for whom he applied for permission to study at the Mining Academy in Schemnitz. Del Río later became famous for his discovery of vanadium while he was teaching at the School of Mines in Mexico City.

Apart from Russia and France, all the important European centres of mining and metallurgical activities were represented. Those who came to Skleno were interested in the scientific, technical and economic side of Born's method. It was undoubtedly due to Born's forethought and organizational talent that they jointly examined the problem at hand. Born asked the assembled foreign specialists to give their views on the comparative advantages of amalgamation and smelting of silver ores. The collection of answers and comments was made public in 1787. They contain a generally favourable assessment of the method supported by technical and economic analysis figures, as utilized by Born and Ferber. Charpentier emphasized the scientific basis of amalgamation. D'Elhuyar was impressed by the orderliness, simplicity and precision of the manner in which the process was carried out. Treber submitted black copper material to amalgamation, which he had brought with him from the Harz Mountains, and he found the results very satisfactory. Hoffinger believed that, from the health point of view; Born's amalgamation was superior not only to smelting but also to the patio process.

The Society of Mining Science

A proposal was made at the meeting for the setting up of an International Society of Mining Sciences (die Societat der Bergbaukunde). A list of potential members was prepared to whom the invitation and the proposed statutes of the Society were sent, signed by the nine senior participants at the meeting. They also nominated the chief officers of the Society. The invitation was composed as a short preamble to the statutes, where the object and organisational details of the proposed body were explained. The ideas expressed were simple and straightforward. Mining is the first source of wealth. Many engaged in the mining industry work on their own and do not share knowledge. This hinders progress and can be abused in order to cover up fraud and ignorance. The best way to remedy the situation was to establish a Society of Mining Sciences, which would unite those who were active in the field, and also their protectors. As a result, useful knowledge could quickly circulate.

The founders of the proposed organization differentiated between knowledge
of state, business and financial affairs, and mining and metallurgical matters. Regarding the first, they recognized the need for secrecy and they did not intend to tamper with it in any way. As to the second area, its development required open and free exchange of scientific and technical information on an organized basis. The Society was to interest itself in:
- physical geography;
- mineralogical chemistry;
- mining and foundry machinery;
- surveying of mines;
- history of mining; and
- metallurgy (smelting, amalgamation).

The primary motive to undertake activities in these fields was to benefit practice. Three categories of members were envisaged:
- ordinary members, comprising scholars and practitioners directly working in mines and smelting works;
- extraordinary members, composed of theoreticians concerned with the development of practical mining and metallurgy; and
- honorary members, men of social standing with an interest in mining and metallurgy because of their potential usefulness to the society.

From the outset, the Society was conceived as an international body with fourteen territorial (national) sections: Prussia, Austria, Saxony, Harz, Sweden, Denmark, Italy, France, England, Norway, Spain, Santa Fe de Bogotá, Mexico, and Russia. Each section was headed by a director. Born headed the Austrian section, Charpentier the Saxon, and Hawkins the English, while the two brothers D’Elhuyar were responsible for Latin America.

It was contemplated that the Society should function as a democratic organization. In the case of death, a new director of a section was to be elected by majority vote of ordinary members. The same procedure was to apply to settlements of all important questions. A majority vote of directors was called on to decide where the Society’s seat and treasurer were to be. Financially, the Society expected to rely on the annual membership fee of two ducats, payments for professional advice, and sale of publications. The plan was published in the first volume of the periodical of the Society, Bergbaukunde, which appeared in 1789 under the joint editorship of Born and Trebra. This volume also contained a lengthy unsigned addendum discussing, in more detail, the objects of the Society and the involvement of its members. It was presumably put together by Born, and Trebra, as an answer to queries or sentiments of uncertainty, apprehensiveness or doubts about the future existence of the Society. The editor also explained that members could not be restrained in any way, and they were at liberty at any time to withdraw from the Society. The Society could function only as a free corporate body and its superiority was that it included practitioners (ordinary members) and theoreticians (extraordinary members). As to honorary members, they also had an important role to play in the life of the Society.

Regarding the treatment of individual topics, the emphasis was on facts, but a certain amount of speculation was not harmful. Contributions containing only speculations were not acceptable, except on very rare occasions. Historical and economic analysis was welcome, but disclosures of business secrets were excluded. Announcements about the Society appeared in the scientific journals of that time, e.g., Crel’s Annalen in Germany and Annales de chimie in France. The number of the Society’s members and their geographical distribution in 1790 is given in Table 1. As expected, Austria, Saxony and Harz supplied the largest contingents. Britain furnished the second largest number of extraordinary members, among them Matthew Boulton, James Watt, Richard Kirwan, William Withering, Francis Home, and Charles Tennant. Lavoisier (1743-1794) was listed as an ordinary member. Volume 2 of Bergbaukunde appeared in 1790. A year later Born died. The French Revolution already started in 1789 followed by the Napoleonic Wars and the Society of Mining Science fell into obscurity.

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Epilogue

The gathering at Skelno and the foundation of the Society of Mining Sciences reflected important changes in the structure of science. Born’s method of extracting silver by mercury was worked out at a time when two of the less advanced areas of the world, central Europe and Spanish America, began increasingly to be affected by the impact of the British Industrial Revolution and the French Enlightenment. The general weakening of Austria and Spain forced their rulers to seek ways to strengthen their position. Born and his supporters had no doubt that amalgamation practice was based on sound scientific principles. Chemistry, that owed so much to metallurgy, was in the process of replacing its basic concepts in order to explain the nature of oxidation and
reduction. This was the period when Lavoisier published his outstanding book *Traité élémentaire de chimie*.

**Appendix**

1762 — Founding of the School of Mines at Schemnitz in the Austrian Empire.

1764 — Prince Josef and Prince Leopold visit the mining district in Schemnitz.

1780 — Prince Josef becomes Emperor Josef II.

1786 — Conference of metallurgists at Skleno near Schemnitz and founding of the Society of Mining Science.

1789 — The first volume of the proceedings of the Society of Mining Science published.

1789 — Lavoisier publishes his *Traité élémentaire de chimie*.

1789 — The French Revolution.

1790 — Prince Leopold becomes emperor.

1790 — The second volume of the proceedings of the Society of Mining Science published.

1791 — Ignaz von Born dies, burdened with debts.

1796 — Napoleon defeats the Austrians at the Battle of Milan.

1815 — Napoleon defeated at Waterloo.

**References**


