Anniversaries

Axel F. Cronstedt born 300 years ago

AN ANONYMOUS REFORMER OF MINERALOGY: AXEL F. CRONSTEDT AT THE SWEDISH BUREAU OF MINES

Christer Nordlund (SWEDEN)

Like many other mineralogists in eighteenth century Sweden, Axel Fredrik Cronstedt (Born 23rd December 1722–died 19th August 1765) worked in and around the mining industry. After studies in science and mathematics at Uppsala University, he was employed by the Bureau of Mines – the government office responsible for the control and improvement of the mining industry in Sweden – where he underwent further training and made his career. In 1758, he reached the position of *Bergmästare*, superintendent of mining operations.

The main task for Cronstedt and his colleagues was to contribute to the development of the mining enterprise, which during the eighteenth century was the biggest industry in the country, dominated by bar iron production. He inspected and mapped mines and acted for the exploitation and improvement of ore, and, by extension, the economy of the nation. Conducting research to improve mining practices and extend knowledge in mineralogy was an integral part of this task (Fors 2015). It was in this context, and as a member of the small society "Confraternitas Skisshyttiana", Cronstedt achieved the results that gave him a place in the history of earth sciences (Zenzén 1931).

In addition to his own equipment, Cronstedt had both a chemical laboratory (Laboratorium Chymicum) and a chamber for assaying (Proberkammare) at his disposal where he could study and analyse collected samples of ore. As a result, a series of articles were published in *Transactions of the Royal Swedish Academy of Sciences*, notably a study (1751) of ore from the Los cobalt mines in the Province of Hälsingland which turned out to contain a previously undefined "semi-metal". In a subsequent paper, published three years later, Cronstedt described the substance's chemical characteristics and relations to other metals and gave it the name *nickel* – a term that earlier had been used by German miners for an ill-tempered ghost that was supposed to destroy the ore (Lindroth 1997). The discovery and definition of nickel was debated but eventually accepted. Already in 1753, Cronstedt was elected as a member of the Royal Swedish Academy of Sciences for his achievements.

Figure 1. The artist Olof Hellström's (1923–2017) memorial monument "Form för nickel" (Shape for Nickel) was erected in honor of Axel F. Cronsted in 1971. The monument, which stands near the Los cobalt mines, is regarded as one of the most beautiful public artworks in Sweden. Photo: Loos Koboltgruva.

Another topic highlighted in the historiography of Cronstedt's work is his attempt to create a new system of the mineral kingdom. The result was published in the volume *Försök til mineralogie, eller mineral-rikets upställning* ("An attempt at mineralogy or arrangement of the mineral kingdom"), printed in Swedish in 1758. Cronstedt was convinced that such a classification system should be based on chemical analysis rather than a natural history approach. Linnaeus and other contemporary scientists focused mainly on external characteristics, such as form and colour, when they created their systems. In contrast, Cronstedt's goal was to create a system based on differences in chemical composition. His system also included the ideas that "simple earths" and "mixed earths" (rock) should be separated, and that fossils and corals did not belong to the minerals at all.

Cronstedt's mineral system consisted of four main groups, divided into one or more subgroups. The main groups were defined in the following way (in Cronstedt 1770, p. 8–9):

1. EARTH, or those substances which are not ductile, are mostly indissoluble in water or oil, and preserve their constitution in a strong heat.
2. INFLAMMABLES, which can be dissolved in oils, but not in water and are inflammable.
3. SALTS: these dissolve in water, and give it a taste; and when the quantity of water required to keep them in dissolution is evaporated, they concrete again into solid and angular bodies.
4. METALS are the heaviest of all bodies hitherto known; some of which are malleable, and some can be decompounded; nevertheless, in a melting heat they can again be recovered, or brought to their former state, by adding to them the phlogiston they lost during their decomposition.

Cronstedt considered *Försök til mineralogie* for several years and managed to complete the manuscript during a period when he was off-duty due to poor health (Zenzén 1931). He realized that its content could be regarded as controversial. After all, he was challenging the authorities of his time – at the same time he was not totally convinced that his conclusions were true. Therefore, he decided to publish the book anonymously (which was possible thanks to economic support from a wealthy friend), and also to frame it as only "an attempt". The reasons for this are touched upon in the preface:

> I have thought proper to conceal my name, to prevent any constraint on myself or others, and with a view to be at a greater liberty to amend the System, whenever I shall be convinced there is a necessity for so doing, either by my own experience, or by the observations of others: For I flatter myself that this work will not pass unnoticed by men of letters; and, as it is only an Essay, it ought, according to an established law among authors, to be sheltered from too severe censures. (Cronstedt 1770, p. vii)

At the end of the preface, Cronstedt added:

> Meanwhile I flatter myself with so much success, that students, who intend to follow this proposed method, will not be so easily mistaken in the subjects of the mineral kingdom, as has happened with me and others in following former systems; and I also hope to obtain some protectors against those who are so possessed with the *figuromania*, and *so addicted to the surface of things*, that they are shocked at the boldness of calling a *Marble* a *Limestone*, and *of placing the Porphyry amongst the Saxa*. (Cronstedt 1770, p. xxi)

In the eighteenth century it was quite unusual that researchers published their results anonymously, however, it occurred now and then. For example, the Swiss naturalist Charles Bonnet (1720–1793) chose to remain anonymous when he published the first edition of his *Essai de psychologie* in 1754. Bonnet's reason was similar to Cronstedt's: to avoid being involved in an anticipated controversy. Erasmus Darwin did the same when he published *The Botanic Garden* in 1791, while Baron d´Holbach published all his philosophical writings, including *The System of Nature* (1770), either anonymously or under pseudonyms (Kronick 1988).

The name of the author behind *Försök til mineralogie* was not a secret for long, however. It took only two years until the book was translated into German and this time without any attempt at concealment. Later on, several more translations were published – in French, English, Italian, Russian – and the book was successfully put into circulation among the mineralogists in Europe (Lindroth 1997). Cronstedt's suspicion that his book would arouse criticism was correct, but his ideas were also met with approval, not least at the Freiberg Mining Academy, where Abraham Gottlob Werner described him as "a reformer of mineralogy" (Sundquist 2017, p. 349). According to David Oldroyd, Cronstedt's work stands as "an important landmark in the history of mineralogy" (Oldroyd 1974, p. 506).

Figures 2a, b. In 1882, the Royal Swedish Academy of Sciences minted a medal in honor of their former member Axel F. Cronstedt. The inscription reads AX[elius] FRIDER[icus] CRONSTEDT REI METALL[icae] PRAETOR N[atus] 1722 O[biit] 1765– Axel Fredrik Cronstedt, Superintendent of mining operations, born 1722, died 1765. The reverse of the medal shows a man with a torch, climbing down a ladder in a mine shaft. Next to the ladder is a mine barrel. Inscription around the rim: STRATA SUBTERRANEA LUSTRAT – he is illuminating the layers in the underground.

Yet, Cronstedt's most significant contribution to mineralogy may be the method that he utilized to identify minerals' chemical composition using a simple blowpipe. Cronstedt was neither first nor unique in his use of the blowpipe as a chemical instrument; it had been used by German chemists already in the seventeenth century and blowpipe analysis – or "blowpipe characterization", as Oldroyd (1974, p. 506) put it – was also used by the other members of Confraternitas Skisshyttiana (Zenzén 1931). However, Cronstedt systematized and popularized the method, and it became strongly associated with his name. One reason for the latter was that the English translation of his book, *An Essay Towards a System of Mineralogy* (1770), was extended with an appendix that described the method in detail and also directly referred to Cronstedt's own work. The appendix was written by the translator of the book,

Gustav von Engeström (1738–1813), himself a respected mineralogist as well as proud student of Cronstedt.

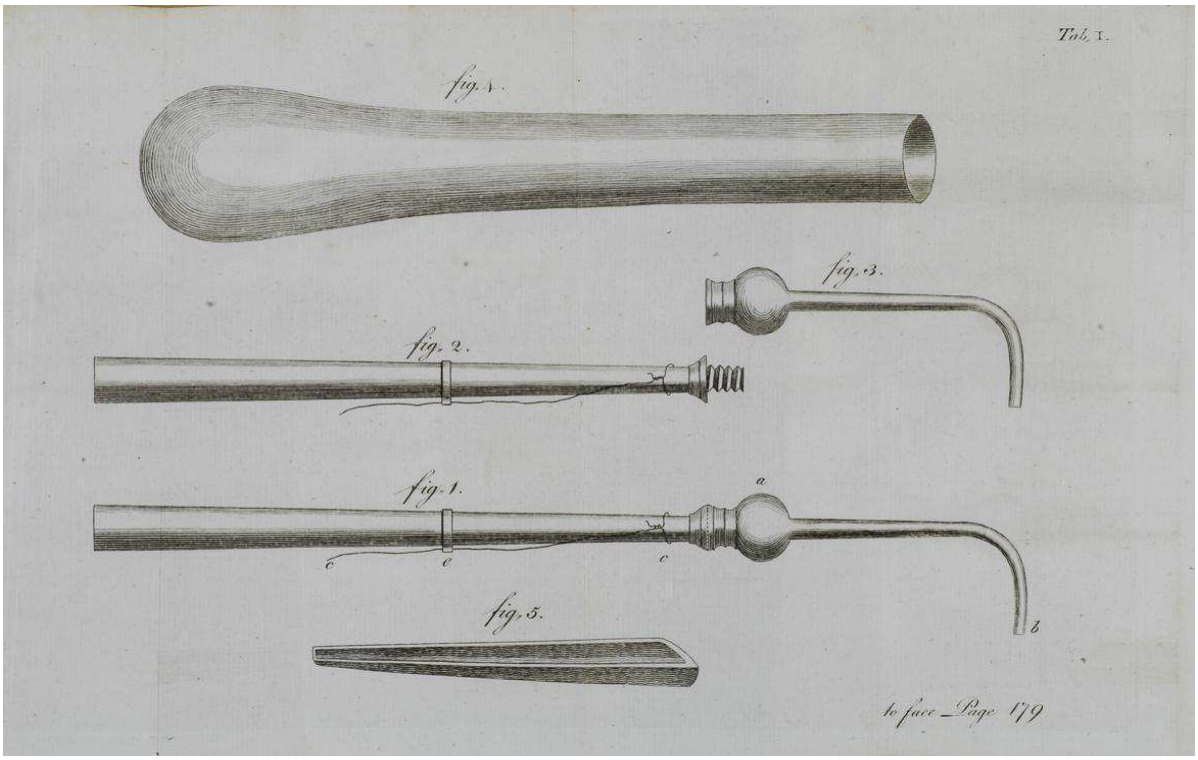

Figure 3. An illustration of the blowpipe, published in Engeström's appendix to Cronstedt's book *An Essay Towards a System of Mineralogy* (1770). Source: Wikimedia commons

Engeström's appendix was entitled "Description and Use of a Mineralogical Pocket Laboratory; and especially the Use of the Blow-pipe in Mineralogy". The phrase "pocket laboratory" referred to the fact that the instrument was portable and relatively simple to use, even in the field. As Engeström explained: "Any gentleman who is a lover of this science, will, by attending to the rules here laid down, be able in an easy manner to amuse himself in discovering the properties of those works of nature which the mineral kingdom furnishes us with." (p. 310). Yet, it was not that easy to attend to Cronstedt's rules; it required a great deal of practice and stamina to master the technique (Salomon 2019). In the following decades several more blowpipe manuals were published, notably one by Jöns Jacob Berzelius', and blowpipe analysis eventually made a breakthrough in both Europe and the USA.

After *Försök til mineralogie* was published, Cronstedt more or less gave up his mineralogical research. His new position as Bergmästare took up a lot of time, he got married, and his interest eventually shifted from the mineral kingdom to the kingdom of plants, more particularly to gardening. One of his last publications concerned itself with the cultivation of potatoes.

Further reading

Abney Salomon, Charlotte A., "The Pocket Laboratory: The Blowpipe in Eighteenth-Century Swedish Chemistry", *Ambix* 66:1 (2019).

Cronstedt, Axel F., "Rön och försök gjorde med en malm-art, från Los kobolt grufvor i Färila Socken och Helsingeland", *Kungl. Svenska Vetenskapsakademiens Handlingar* (Stockholm, 1751).

—, “Fortsättning af rön och försök gjorde med en malm-art från Los kobolt-grufvor”, *Kungl. Svenska Vetenskapsakademiens Handlingar* (Stockholm, 1754).

—, *Försök til mineralogie, eller mineral-rikets upställning* (Stockholm, 1758).

—, *An Essay Towards a System of Mineralogy*, English transl. by Gustav von Engeström (London, 1770).

von Engeström, Gustav, “Description and Use of a Mineralogical Pocket Laboratory; and especially the Use of the Blow-pipe in Mineralogy”, in *An Essay Towards a System of Mineralogy*, English transl. by Gustav von Engeström (London, 1770).

Fors, Hjalmar, *The Limits of Matter: Chemistry, Mining and Enlightenment* (Chicago, 2015).

Kronick, David A., “Anonymity and Identity: Editorial Policy in the Early Scientific Journal”, *The Library Quarterly* 58:3 (1988).

Lindroth, Sten, *Svensk lärdomshistoria: Frihetstiden* (Stockholm, 1997 [1978]).

Oldroyd, David, “A note on the status of A.F. Cronstedt’s simple earths and his analytical methods”, *Isis* 65 (1974).

Sundquist, Björn, “Early geological studies and mapping In Sweden”, in *History of Geoscience: Celebrating 50 Years of INHIGEO* (London, 2017).

Zenzén, Nils, “Axel Fredrik Cronstedt”, *Svenskt biografisk lexikon* 9 (Stockholm, 1931).

Publication online: Posted IUGS Website / INHIGEO Website Anniversaries
December 2022
IUGS E-Bulletin Issue 192, December 2022.

Author: Prof. Christer Nordlund
Member of INHIGEO (SWEDEN):
IUGS International Commission on the
History of Geological Sciences (INHIGEO)

Department of Historical, Philosophical and Religious Studies
Umeå University
901 87 Umeå

Email: christer.nordlund@umu.se

The full list of contributions to the INHIGEO Anniversary Series is available on the website: http://www.inhigeo.com/anniversaries.html