

# Stepping through Science's Door: C. W. Scheele, from Pharmacist's Apprentice to Man of Science<sup>1</sup>

HJALMAR FORS

*Division of History of Science and Technology, Royal Institute of Technology,  
Stockholm*

This reinterpretation of Carl Wilhelm Scheele's (1742–86) early life and career analyses the social interplay between Scheele and other chemists who were active in eighteenth-century Sweden. It is argued that Scheele, a rather lowly journeyman working in peripheral pharmacies, had to work hard and traverse several geographical and social boundaries to gain a foothold in the scientific community. Eventually, Scheele's skilful analysis of the mineral *magnesia nigra* would establish him as one of the pivotal Swedish chemists. However, this happened only after Scheele had managed to prove himself as a knowledgeable chemist who did not threaten the authority of certain socially superior colleagues. When Scheele had gained a place in the scientific community, the exchange logic of the eighteenth-century republic of letters permitted him to trade experimental results for other kinds of resources. Hence, he gained in both social status, economic prosperity and scientific prominence in a relatively short time.

Carl Wilhelm Scheele has been, and still is, the object of much admiration. In biographical texts he is often portrayed as the perfect scientific hero: humble beginnings, miraculous discovery, worldwide fame, and an early death caused by long hours spent working over poisonous substances in a drafty chemical laboratory. The legacy of his short life is said to be the discovery of a great number of chemical

<sup>1</sup> This paper is based on chapter 6 in the author's doctoral thesis *Mutual Favours: The Social and Scientific Practice of Eighteenth-century Swedish chemistry*, Institutionen för idé- och lärdomshistoria: skrifter 30 (Uppsala: Uppsala University, 2003). I would like to thank the researchers and Ph.D. students at the Department of History of Science and Ideas, Uppsala, where I conducted my Ph.D. studies, and at the Department of History and Philosophy of Science at the University of Cambridge, UK, where I spent a valuable academic year (2000–2001), and conducted much of the research for this paper.

substances, several of which were later to be identified as elements.<sup>2</sup> However, to say that Scheele's brilliance as a chemist made his reputation is not to provide a historical explanation as to how a lowly journeyman working on the European periphery could become one of the most important chemists of his generation. In this paper, I will attempt to give a more balanced view of Scheele's life. The focus will be primarily on the social contexts in which Scheele's early career was played out, and on how he used various social resources to establish a reputation as a knowledgeable chemist.

If one aims to understand the conditions under which early modern science operated, questions of social status, the boundaries of scientific networks, patronage, and geographical isolation and centrality, must be taken into consideration. Scheele was a pharmacist *and* chemist in a country known for its healthy and thriving mineralogical chemical tradition. He was an ethnic German born as a subject of the Swedish crown. He obtained his education solely from serving as an apprentice and journeyman at various pharmacies, whereas most of his associates had university educations. Furthermore, he spent most of his life working at pharmacies in peripheral towns in a country that, arguably, was squarely placed on the European periphery.<sup>3</sup> The story of Scheele's chemical career provides an illuminating example of how ambitious young men could use science to successfully negotiate the constraints of eighteenth-century culture and social life. Or to be more precise: this paper is an attempt to investigate the social mechanisms that permitted Scheele's significant rise in status.

My perspective is that of the sociology of science, and is based mainly on research conducted in Britain and the USA on the history and culture of science of the early modern period. As an example, Jan Golinski's studies of "[Joseph] Priestley's work in relation to the communities in which he practiced and the audiences to which he addressed his writings" can be mentioned.<sup>4</sup> I will point out that Scheele's interest in

<sup>2</sup> There are several short biographies of Scheele, most of which present the above-sketched image to a greater or lesser degree. Two English-language examples are Tore Frängsmyr, "Carl Wilhelm Scheele (1742–1786)," *Chemia Scripta* 26 (1986), and Uno Boklund, "Scheele, Carl Wilhelm," *DSB* 12, 143–50. Boklund is almost devotional in his attitude to Scheele. Nevertheless, he gives some interesting reinterpretations of Scheele's intellectual development. Frängsmyr, on the other hand, makes a great number of factual errors, reinterprets eighteenth-century chemistry by use of twentieth-century chemical language, and presents a thoroughly uncritical picture of Scheele as a great genius of science. More substantial biographies can be found in Swedish. A main source for most other biographies is Adolf Erik Nordenskjöld, "Lefnadsteckning," in *Carl Wilhelm Scheele: Efterlemnade bref och anteckningar*, ed. A. E. Nordenskjöld (Stockholm: Norstedts, 1892), vii–xxxii. Anders Lundgren, "Scheele, Carl Wilhelm," *Svenskt Biografiskt Lexikon* 31, 484–93, contains a good overview of Scheele's life and work and also finds room for a short critical discussion of the historiography of Scheele. A good overview of Scheele's chemical works can be found in Sten Lindroth, *Svensk lärdomshistoria; Gustavianska tiden*, published by Gunnar Eriksson (Stockholm: Norstedts, 1989), 83–97. For an overview of older texts about Scheele, see Bengt Hildebrand, "Scheeleforskning och Scheelelitteratur," *Lychnos* (1936): 76–102.

<sup>3</sup> Lisbet Koerner, "Daedalus Hyperboreus: Baltic Natural History and Mineralogy in the Enlightenment," in W. Clark, J. Golinski and S. Schaffer, eds., *The Sciences in Enlightened Europe* (Chicago: University of Chicago Press, 1999): 389–422; Sverker Sörlin, "Ordering the World for Europe: Science as Intelligence and Information as Seen From the Northern Periphery," *Osiris*, 2nd series, *Nature and Empire: Science and the Colonial Enterprise* 15 (2000): 51–69, on 52–53.

<sup>4</sup> See, in particular: Jan Golinski, *Science as Public Culture: Chemistry and Enlightenment in Britain, 1760–1820* (Cambridge: Cambridge University Press, 1992); Martin Rudwick, *The Great Devonian Controversy: The Shaping of Knowledge Among Gentlemanly Specialists* (Chicago: University of Chicago Press, 1988); and Steven Shapin and Simon Schaffer, *Leviathan and the Air-pump: Hobbes, Boyle and the Experimental Life* (Princeton: Princeton University Press, 1985). Quotation from Golinski, *Science as Public Culture*, 65.

chemistry was not confined to doing experimental work. It also expressed itself in a desire on his part to gain the recognition, trust and friendship of other chemists, which enabled him to collaborate with them and to communicate and discuss his own and other's chemical findings. These interactions are understood as taking place within the eighteenth-century republic of letters. Although I acknowledge that this does not do full justice to the concept of the republic of letters, this study treats the republic primarily as a set of common values and ideals that allowed exchange between chemists to take place, both on a national and on an international level. Focusing on the ideal of reciprocity, I argue that scientific information, texts and objects could be exchanged for similar things, or could be exchanged for favours and/or patronage that gave access to publishing opportunities or material benefits such as grants or better employment.<sup>5</sup>

The paper also relies on a Swedish research tradition, usually called “the social network perspective.” Central to this tradition is the attentive and critical reading of correspondence. Of particular interest to this paper is the analysis of this tradition of the exchange logic of network relationships.<sup>6</sup> Early modern egalitarian relationships, such as those cultivated within the scientific republic of letters, were characterised by reciprocity. A gift had to be returned with a gift of equal value. If this did not happen, the relationship would sooner or later turn into a patron–client relationship. In an egalitarian relationship, both participants had some degree of choice on how a gift should be returned. For example, scientific specimens could be exchanged for support of a scientific position, or information, money or other favours. Both parties had the possibility of deciding in which way an obligation should be repaid. In a client–patron relationship, however, the patron had the option to decline a request, while the client's possibilities for doing so were small indeed. In this system of exchange, Scheele had access to a currency of great value: innovative chemical experiments. A main argument is that Scheele's constant sharing of experiments forced his associates to pay back in equal measure. When they could not produce experiments to match his, they went to great lengths to help him with his career, and with his personal economy.

<sup>5</sup> Fors, *Mutual Favours*, 6–12; Anne Goldgar, *Impolite Learning: Conduct and Community in the Republic of Letters 1680–1750* (New Haven: Yale University Press, 1995), 12–53; Golinski, *Science as Public Culture*, 65–72; Dena Goodman, *The Republic of Letters: A Cultural History of the French Enlightenment* (Ithaca: Cornell, 1996); Anne Secord, “Corresponding Interest: Artisans and Gentlemen in Nineteenth-century Natural History,” *British Journal for the History of Science* 27 (1994): 393–406; Sverker Sörlin, *De lärda republiken: Om vetenskapens internationella tendenser* (Malmö: Liber-Hermods, 1994).

<sup>6</sup> The values and ideals of the republic of letters did sometimes overlap with those of Swedish society in general, but at other times there was conflict. See Hjalmar Fors, “Patrioter och kosmopoliter i vetenskapen: Om Sven Rinmans och Torbern Bergmans självbild,” *Sjuttonhundratalet* (2005): 59–75. For studies of other Swedish social groups that use similar perspectives and methods, see Ylva Hasselberg, *Den sociala ekonomin: Familjen Clason och Furudals bruk 1804–1856*, *Studia Historica Upsaliensia* 189 (Uppsala: Uppsala University, 1998). Hasselberg discusses early nineteenth-century ironmasters. Patrik Winton, *Frihetstidens politiska praktik: Nätverk och offentlighet 1746–1766*, *Studia Historica Upsaliensia* 223 (Uppsala: Uppsala University, 2006), discusses politicians from the estate of the clergy. The classic of this field is probably Marcel Mauss, *Essai sur le don* (1925) *Gåvan* (Uppsala: Wikströms, 1972).

There is an immense number of experiments in Scheele's correspondence, as well as in his journals and manuscripts.<sup>7</sup> First and foremost, this indicates that Scheele had a genuine and passionate interest in chemistry. However, I have consciously tried to avoid treating the acquisition of chemical knowledge as the ultimate goal of Scheele's existence. It may come as a surprise to some readers that this proposed perspective on Scheele is entirely new. In earlier research, he has been discussed as a hero or a nerd — someone who was entirely unconcerned with worldly matters, and lived for his science. By changing perspective, I propose to add complexity to the traditional image of Scheele's life, and to discuss the circumstances under which science was pursued in the eighteenth century.

## Against the backdrop of a dominant mineralogy

The chemistry pursued in eighteenth-century Sweden stemmed mainly from two sources. The first was the Board of Mines, the state department that controlled and regulated the Swedish mining industry. The second was the flourishing chair of chemistry at Uppsala University, which had been established by Johan Gottschalk Wallerius, and continued by his successor Torbern Bergman. The chair had been established primarily to cater for the needs of the mining industry. Uppsala students formed the major base of recruitment for the Board of Mines. Indeed, the Uppsala laboratory can almost be seen as the Board of Mine's basic educational facility, placed at the university for administrative reasons. Both of these environments emphasised mineralogical rather than pharmaceutical chemistry.<sup>8</sup>

It should be noted that during most of the eighteenth century there were no clear boundaries between chemistry, assaying (metallurgy), and mineralogy. As Rachel Laudan points out: "the term *mineral* referred to *all* the naturally occurring, nonliving, solid objects on the globe." The discipline of mineralogy also contained the "nonhistorical parts of what is now geology . . . as well as interpenetrating much of the domain of chemistry."<sup>9</sup> This explains why the Swedish state, which was highly dependent on the income of its iron exports, had a deep and strong interest in chemistry. It was in mineral analysis and mineral systematisation that most of the renowned Swedish chemists excelled. In fact, the scientific pursuits of most Swedish

<sup>7</sup> Some of his laboratory notes have been published in Uno Boklund, ed., *Carl Wilhelm Scheele: His Work and Life III: The Brown Book* (Stockholm: Roos, 1968).

<sup>8</sup> Fors, *Mutual Favours*, 26–34; H. Fors, "J. G. Wallerius and the Laboratory of Enlightenment," in E. Baraldi, H. Fors and A. Houtz, eds., *Taking Place: The Spatial Contexts of Science, Technology and Business* (Sagamore Beach: Science History Publications, 2006), 3–33; H. Fors, "Chemistry at the Swedish Board of Mines, 1700–1750," in I. Malaquias, E. Homburg and M. E. Callapez, eds., *Proceedings of the 5th International Conference on History of Chemistry, Chemistry: Technology and Society* (Aveiro, 2006), 150–56; Anders Lundgren, "Bergshantering och kemi i Sverige under 1700-talet," *Med hammare och fackla* 29 (1985): 90–124. For international comparisons, see: Donata Brianta, "Education and Training in the Mining Industry, 1750–1860: European Models and the Italian Case," *Annals of Science* 57 (2000): 267–300; Theodore M. Porter, "The Promotion of Mining and the Advancement of Science: The Chemical Revolution in Mineralogy," *Annals of Science* 38 (1981): 543–70; and Cyril Stanley Smith, "The discovery of carbon in steel," *Technology and Culture* 5, no. 2 (1964): 149–75.

<sup>9</sup> Rachel Laudan, *From Mineralogy to Geology: The Foundations of a Science, 1650–1830* (Chicago: University of Chicago Press, 1987), 21.

eighteenth-century chemists might as well be studied as a chemical tradition within mineralogy.<sup>10</sup> Furthermore, both Uppsala University and the Board of Mines were highly politicised environments. Those who did not have access to patrons of considerable political influence could not expect to get salaried positions at either of the two institutions.

As many historians have noted, chemistry in the eighteenth century underwent a rapid rise in status. A key explanation for this was its practitioners' ability to present chemistry as a useful Enlightenment science.<sup>11</sup> However, in the context of the Nordic and German *aufklärung*, "useful" usually meant that something could be used by the state or by society's elite to control, reform, rationalise and generally enlighten diverse hitherto uncontrolled and hidden craft activities. The Swedish chemists Johan Gottschalk Wallerius and Torbern Bergman were major proponents of the view that chemistry should be used for these purposes.<sup>12</sup> Despite the fact that there was much chemical expertise to be found within the profession of pharmacy, eighteenth-century pharmacists were craftsmen, and as such, were part of the populace that the emerging Enlightenment science attempted to control. The group that was supposed to control them was the medical doctors. These had university educations, tended to be seen as gentlemen who moved in the finer circles of society, and had already begun to identify their profession with scientific values. Pharmacists in Sweden were under the strict control of medical doctors through the state's Collegium Medicum. In Britain, pharmacists who made inroads into medicine were seen as "elevating hand over head" and disrupting "the boundaries between trade and profession, master and servant, gentleman and laborer."<sup>13</sup>

According to elite-oriented men of science such as Wallerius, Bergman and many others, pharmacies and other craft shops were not really the places where sound scientific knowledge should be produced, and pharmacists were not among the people who should produce it. Hence, Scheele was not to be given any possibility of publishing under his own name, or any recognition as an able chemist, until he had obtained acceptance into the informal network of mainly mineralogical chemists that dominated the local Swedish scene. Almost all of the collaborators that Scheele

<sup>10</sup> The prominent position of Johan Gottschalk Wallerius, Axel Fredrik Cronstedt and Torbern Bergman in histories of geology confirms this: Evan Melhado, "Mineralogy and the Autonomy of Chemistry Around 1800," *Lychnos* (1990): 229–31, 236–45; Laudan, *From Mineralogy to Geology*, chap. 3 and 4; Golinski, *Science as Public Culture*, 269–83. For an overview of Swedish eighteenth-century science from an institutional perspective, see Sven Widmalm, "Instituting Science in Sweden," in R. Porter and M. Teich, *The Scientific Revolution in National Context* (Cambridge: Cambridge University Press, 1992), 240–62.

<sup>11</sup> For a general discussion, see Karl Hufbauer, *The Formation of the German Chemical Community (1720–1795)* (Berkeley: University of California Press, 1982), chap. 2. For a specific application to pharmacy, see Jonathan Simon, "The Chemical Revolution and Pharmacy: A Disciplinary Perspective," *Ambix* 45 (1998): 1–13.

<sup>12</sup> Fors, *Mutual Favours*, 99–102; Fors, "J. G. Wallerius and the Laboratory of Enlightenment," 12–20; Koerner, "Daedalus Hyperboreus," 389; Sten Lindroth, *Svensk lärdomshistora: Frihetstiden* (Stockholm: Norstedts, 1989), 491; Simon, "The Chemical Revolution and Pharmacy," 4, 7–11; Henry Guerlac, "Some French Antecedents of the Chemical Revolution," *Chymia: Annual Studies in the History of Chemistry* 5 (1959): 99.

<sup>13</sup> Lindroth, *Frihetstiden*, 491–3; J. Golinski, "Utility and Audience in Eighteenth-century Chemistry: Case Studies of William Cullen and Joseph Priestley," *British Journal for the History of Science* 21 (1988): 2–9, 13. Quotation from Christopher Lawrence, "Medical Minds, Surgical Bodies: Corporeality and the Doctors," in C. Lawrence and S. Shapin, eds., *Science Incarnate: Historical Embodiments of Natural Knowledge* (Chicago: Chicago University Press, 1998), 167.

eventually would have been either attached to the Board of Mines or Uppsala academics. I argue that Scheele consciously sought to find a way to become attached to this network, and that it was only after his inclusion that he was able to obtain recognition as a knowledgeable chemist. Thus, Scheele's inclusion in the group was a necessary prerequisite for the fame that he later would enjoy. It gave him recognition and the chance to publish his work, and functioned as an exchange structure for favours, scientific discussion, and collaboration.

## Scheele's pharmaceutical background

Scheele came from a pharmaceutical chemical tradition that had its place in a broader German cultural context. Although their status was lower than that of medical doctors, German pharmacists became major proponents of chemistry and were central to the spread, from the 1720s onward, of the view of chemistry as a rational and useful enterprise.<sup>14</sup>

Stralsund, the place of Scheele's birth (1742), is a town in present-day Germany that, at the time, was part of the Swedish province of Pomerania. He was the seventh child of an ethnic German merchant, and was sent as an apprentice to the pharmacist Martin Andreas Bauch in Gothenburg. Bauch, too, was German, born in Mecklenburg. Scheele spent an apprenticeship of eight years in Gothenburg, and when he got his journeyman's certificate in 1765, he moved to the the Spread Eagle (Fläkta Örn) pharmacy in Malmö, a town in southern Sweden. He stayed in Malmö for three years. The pharmacy shop in Gothenburg seems to have been a primarily German-speaking environment. For the whole of his life, Scheele preferred to speak and write in German, although he was only fourteen years of age when he first came to Gothenburg. Many Swedish towns had large German ethnic communities well into the nineteenth century, and German ethnicity was common in the trade of pharmacy.<sup>15</sup>

Scheele's master, Bauch, enjoyed a good reputation and seems to have been quite up to date on the latest developments in his trade. He encouraged Scheele to do experiments, and gave him free access to his own small chemical library. His employer in Malmö, Peter Magnus Kjellström, also seems to have given him a free hand to conduct experiments.<sup>16</sup> Scheele's interest in chemical analysis must have developed early, and by the time he moved to Malmö it appears that he was an able laboratory chemist, who read all the chemical books that he could find and who used his spare money to buy chemical literature from nearby Copenhagen.<sup>17</sup>

<sup>14</sup> Hufbauer, *Formation*, 20–29, 34–36, 53–61.

<sup>15</sup> Nordenskjöld, "Lefnadsteckning," vii–xiv; Lindroth, *Frihetstiden*, 491.

<sup>16</sup> Nordenskjöld, "Lefnadsteckning," xiii. A student of Carl Linnaeus, Anders Tidström, visited Kjällström's pharmacy in 1756 and made the note that Kjällström "in addition to his beautiful and well-stocked pharmacy [had] a most fair-sized supply of medical plants, [he is in this regard] comparable to almost none in the Realm." Anders Tidström, *Anders Tidströms resa i Halland, Skåne och Blekinge år 1756: Med rön och anmärkningar uti Oeconomien, Naturalier, Antiqiteter, Seder, Lefnads-sätt*, published by Martin Weibull (Köpenhamn: Dansk-skaansk forl., 1980), 43 (author's translation).

<sup>17</sup> Anders Jahan Retzius, *Avskrift av A. J. Retzius brev till J. C. Wilcke "Bidrag til Scheeles lefnadsteckning" 1787*, in MS Scheele [E2:1], Kungliga Vetenskapsakademiens Arkiv (Archives of the Royal Academy of Sciences, Stockholm, henceforth, KVA) 1.

There is evidence of some contacts between Scheele and other pharmacists with an interest in chemistry. In a letter to Johan Gottlieb Gahn, he mentioned one Rothborg, a Swede who lived in Germany, who was, according to Scheele, one of the few pharmacists he had met who comprehended something of chemistry. Gahn must have requested more information, because in the next letter, Scheele praised his deep insight into the field. Apparently, Rothborg had written a preface to something and had promised to show this to Scheele.<sup>18</sup>

Judging from the limited information that Scheele's background provides, pharmacists in Sweden were interested in and encouraged the pursuit of chemistry. But there is little evidence that this interest was communicated outside of the bounds of their craft shops. It would be interesting to know to what extent men such as Scheele's masters communicated with publishing chemists — whether they had links to the cosmopolitan republic of letters, or to any kind of networks of practising chemists who were not also pharmacists, and also whether anyone except Scheele attempted to become a publishing man of science.<sup>19</sup>

### A. J. Retzius: first contact with academics

Scheele's first contact with academic chemistry came about through his friendship with Anders Jahan Retzius (b. 1742). When Anders Jahan was fifteen years of age, his father, a provincial medical doctor, died, and the young Retzius had to take an apprenticeship at the pharmacy in Lund. The manager was a relative of Retzius. Despite his relative poverty, the young Retzius was, socially speaking, rather well embedded in the southern Swedish university town. His father had held a minor position at Lund's university. Furthermore, his father's uncle and foster father had been the bishop of Lund. Thus, the Retzius family was well connected in Lund, both in the university and in the town citizenry. Anders Jahan attempted several careers, all of them related to chemistry in one way or another. He spent a short time preparing medicines in the pharmacy of Karlshamn, a small town in southern Sweden, but soon moved on to Stockholm, where he took his formal examination to become a master pharmacist. In the early 1760s he returned to Lund to pursue an academic career, and became the amanuensis of Christian Wollin, who had recently been appointed to a newly founded chair of chemistry. Wollin was a disciple of the famous Uppsala professor of chemistry, Johan Gottschalk Wallerius, who at this time still occupied the chair. After his graduation in 1764, Anders Jahan became a reader (*docent*) in chemistry and natural history. The appointment was unpaid, but enabled him to give lectures and gather tuition fees. Since his position gave him no secure income, he left Lund again in 1768 for a four-year sojourn in Stockholm.<sup>20</sup>

<sup>18</sup> Scheele to Gahn, 28 February 1774, 28 March 1774, in Nordenskjöld, *Efterlemnade bref*.

<sup>19</sup> Apart from Scheele, there was Johan Julius Salberg, owner of the pharmacy "the Moor" (Morianen) in Stockholm, supplier of the Royal Navy and fellow of the Royal Swedish Academy of Sciences. He was, however, active in the period before Scheele. Lindroth, *Frihetstiden*, 403, 491.

<sup>20</sup> Gunnar Eriksson, "Retzius, Anders Jahan," *Svenskt Biografiskt Lexikon* 30, 1–6; Lindroth, *Frihetstiden*, 21; Lindroth, *Gustavianska tiden*, 58–60. *Biographiskt Lexicon öfver namnkunnige svenska män*, vol. 12 (Uppsala, 1843), 58. On Christian Wollin and chemistry at the university of Lund, see Fors, *Mutual Favours*, 51–53.

Eight letters from Scheele to Retzius dating from the years 1767–1768 have been preserved.<sup>21</sup> The origin of the friendship is obscure, but there can be no doubt that Scheele had much to gain from cultivating the contact with Retzius. Retzius shared Scheele's background in pharmacy, but he also had a good knowledge of theoretical chemistry of the kind taught at the universities. It is possible that Scheele thought that Retzius could give him access to a broader network of chemists, but it is more likely that Scheele just wanted somebody to talk to about chemistry. According to Retzius, he and Scheele never had time to eat dinner when they met, since Scheele wanted to spend all their time together discussing chemical experiments.<sup>22</sup> His eagerness to correspond with Retzius is apparent from his letters. In 1767, the two already seem to have had a rewarding chemical discussion going. Scheele sent samples of chemical substances, answered Retzius's questions thoroughly, and asked others of his own. Their discussions ranged rather freely, albeit with an emphasis on pharmaceutical chemistry.<sup>23</sup> Scheele's letters contain a wealth of chemical findings, but very little personal information. It was only when Retzius discontinued their correspondence for one and a half months that Scheele betrayed some personal emotion that was not directly related to chemical experimenting: he worried that his previous letter had not reached Retzius.<sup>24</sup>

In 1768, both Scheele and Retzius moved to Stockholm: Scheele in order to take up employment at the Gilded Raven (Förgyllda Korpen) pharmacy, and Retzius to try his luck at some kind of scientific career. Scheele continued to send substances from his laboratory work to Retzius, and complained outright at the other man's unwillingness to write back to him:

What is the reason why you, Sir, so rarely honour me with a letter from you; two of my last letters should reasonably call for an answer. I know that your duties are a great hindrance to you in this respect, but leave off the German quill and use the Swedish.<sup>25</sup>

The offer to Retzius that he could write his letters in Swedish, apparently worked. During his last fortnight in Malmö, Scheele sent three letters to Retzius, who also seems to have answered him. Scheele expressed an interest in gossip about Wallerius, wondering when he was to finish the third part of his great textbook *Chemia Physica*. When Retzius offered to trade a dissertation that had been defended by C. P. Wibom under the presidency of Wallerius, *De salium origine*, for another text, Scheele was eager to do so.<sup>26</sup> He read it through quickly when he got it. One of the theories of Wallerius/Wibom was that the principle of salt was composed of water and pure phlogiston. Scheele clearly expressed a different view, "although I by no means despise neither of these men . . . (this would be preposterous coming from an apothecary's apprentice, who learns almost daily from their works). One will

<sup>21</sup> For the Retzius correspondence, I use the translations in the fragmentary manuscript of Boklund's edition of Scheele's letters in MS Boklund, KVA. They are also reproduced in Nordenskjöld, *Efterlemnade bref*.

<sup>22</sup> Retzius, *Bidrag til Scheeles lefnadsteckning*, 2.

<sup>23</sup> Scheele to Retzius, 1 December 1767, 11 December 1767, in MS Boklund, KVA.

<sup>24</sup> Scheele to Retzius, 5 February 1768, in MS Boklund, KVA.

<sup>25</sup> Scheele to Retzius, 15 April 1768. Translation from the German by Uno Boklund, in MS Boklund, KVA.

<sup>26</sup> Wallerius was praeses at the public defence of the dissertation, and C. P. Wibom was respondens. Either of the two could have been the author.



never be able to prove the constituents of principium salinum, since it is not a compound but a single principle.”<sup>27</sup> It seems that Scheele felt a need to appear not to challenge the university-based authorities, while simultaneously not wanting to hide the fact that he had clearly formed opinions on matters of chemical theory. By lowering his own status and presenting himself as an ignorant apprentice, when he in fact was a journeyman, he reduced the offence that Retzius might have felt was done to his colleagues and invited Retzius to “teach” him his own view. Scheele used the rhetorical device of lowering his status in order to facilitate communication with university chemists in other correspondences as well. It can almost be said to have been institutionalised in his early relationship with Torbern Bergman.

In Stockholm, Scheele was set to work on handling prescriptions, and had no access to the pharmacy’s laboratory. Nevertheless, he managed to conduct some experiments together with Retzius. Retzius published their work on cream of tartar in the *Transactions* of the Royal Swedish Academy of Sciences in 1770. According to Retzius, they had done the work together, and Scheele was also mentioned in the text.<sup>28</sup> It is rather likely that both men realised that a pharmacy journeyman would have problems publishing his chemical investigations. Scheele had submitted two papers to the *Transactions* in 1768. The first one was, according to Retzius’s account, given to Torbern Bergman, who misplaced it; the second was read at a meeting at the Royal Swedish Academy of Sciences, but was turned down after some remarks by Bergman.<sup>29</sup>

The arrangement for the article on cream of tartar allowed for Retzius to take credit for the work that he and Scheele had done jointly, while simultaneously vouching for Scheele’s scientific credibility. Retzius, as a Lund academic with teaching experience and a passed pharmacist examination behind him, had far better standing in the scientific circles of Stockholm than did Scheele, who was, more or less, a nobody. Retzius quickly became *ämnessven*, a kind of apprentice at the Royal Swedish Academy of Sciences, and auscultator at the Board of Mines.<sup>30</sup> Although these were lowly and unpaid positions, the fact that he received them indicates that he moved in the right circles.<sup>31</sup> However, just as in Lund, there were no salaries involved. Retzius had to teach privately, write textbooks and translate scientific texts in order to earn his living.<sup>32</sup> He had joined the group of well-educated young men who swarmed over Stockholm wooing patrons for the sparse number of salaried positions in the state administration.

Financially, Scheele was in a more secure position. However, he spent only two years in Stockholm. In 1770, he took up an appointment as laboratory assistant (*laborant*) at the Upland’s Arms (Uplands Wapen) pharmacy in Uppsala (Figure 1).

<sup>27</sup> Scheele to Retzius, 26 April 1768. Translation from the German by Boklund, in MS Boklund, KVA.

<sup>28</sup> Retzius, “Bidrag til Scheeles lefnadsteckning,” 5; Nordenskjöld, “Lefnadsteckning,” xv.

<sup>29</sup> Retzius, “Bidrag til Scheeles lefnadsteckning,” 4; Nordenskjöld, “Lefnadsteckning,” xv–xvi; Sten Lindroth, *Kungliga svenska vetenskapsakademiens historia 1739–1818*, vol. 1:1 (Stockholm, 1967), 116–17. On Bergman’s first years as a chair of chemistry, see Fors, *Mutual Favours*, 54–103.

<sup>30</sup> On *ämnessvenner*, see Lindroth, *Vetenskapsakademiens historia*, 24–27.

<sup>31</sup> Svante Lindqvist, *Technology on Trial: The Introduction of Steam Power Technology into Sweden, 1715–1736* (Uppsala: Almqvist & Wiksell, 1984), 330, n. 27.

<sup>32</sup> Eriksson, “Retzius, Anders Jahan,” 2.



FIGURE 1 The eastern side of the New Square (Nya Torget) in Uppsala, showing the city hall (left) and the Upland's Arms pharmacy (far right). Engraving by Fredric Acrel. The pharmacy was demolished in the 1960s to make room for the concrete department store that now disfigures the site. Photo: Uppsala universitetsbibliotek (Uppsala university library).

Why Scheele chose to leave Stockholm is a matter of conjecture, but there were several good reasons for him to do so. His lack of access to the Raven laboratory was probably important, but he had also encountered other difficulties. Scheele had probably moved to Stockholm in order to get closer to leading scientific circles.<sup>33</sup> However, he had not been able to publish under his own name, and he did not make any further chemical contacts apart from Retzius. If he had entertained hopes of meeting other chemists, the moderately big city seems to have afforded little possibility of this.

There were two main venues for advanced chemistry in Stockholm: the Royal Swedish Academy of Sciences, and the Board of Mines with its laboratory. Both had the character of rather closed institutions. The Academy was theoretically open to all professions and classes, but was in fact primarily an institution for already established men of science and their clients, and for the very rich. The Board of Mines laboratory specialised in mineralogy and chemical issues related to the mining industry. It had a small number of students, who all had a connection to the Board of Mines. During Scheele's tenure in Stockholm, it was headed by Gustav von Engeström. He charged steeply for his tuition, and seems to have had little interest in

<sup>33</sup> Lindroth, *Gustavianska tiden*, 85.

chemistry outside of his own mineralogical field.<sup>34</sup> Anti-German sentiments in the diminished state apparatus of the former Baltic empire may also have played a part. In any case, there are no traces of any contact between Scheele and the chemists of the Board of Mines during these years.

## Scheele's move to Uppsala

Scheele moved to Uppsala some time during the spring of 1770.<sup>35</sup> His first encounter with the Uppsala chemists was a meeting with the student Johan Gottlieb Gahn. Gahn was the favourite disciple of Torbern Bergman, who had held the Uppsala chair of chemistry since 1767.<sup>36</sup> The meeting is recorded as an anecdote, apparently told by Gahn himself:

Gahn told of how he discovered Scheele in Lokk's pharmacy, when he asked why it smelled of Aqua Fortis when Antimonium diaphoreticum and Sal Acetosellae were mixed together, one of the apprentices of the pharmacy then said: don't you Gentlemen see that, well, it goes together like this &c. And this pharmacy-apprentice was Scheele. Gahn had difficulties in getting him to Bergman, since Scheele already had submitted something to the *Academy of Sciences* in Stockholm, that Bergman, because he had not read it properly to the end, had given an unfavourable testimonial.<sup>37</sup>

This anecdote is interesting for several reasons: I will analyse it from the point of view of what it says about Scheele and the contacts between the university and the pharmacy in Uppsala.

Scheele did not innocently come to Uppsala to be passively discovered; indeed, the anecdote itself gives Scheele quite an active role in his own "discovery." There are good reasons to believe that Scheele knew that a position at the Upland's Arms pharmacy would give him opportunities to make contact with chemistry students. Retzius had received his education in both the pharmacy and at the university of Lund. Thus, Scheele knew that the mixing of the two spheres of knowledge was possible. The chemists of Uppsala were more prominent than those of Lund, but the social structures of small Swedish university towns had many similarities.<sup>38</sup>

<sup>34</sup> Nils Zenzén, "Gustav von Engeström," *Svenskt Biografiskt Lexikon* 13, 626–30; Fors, *Mutual Favours*, 96–99.

<sup>35</sup> For a discussion of the problem of dating events in Scheele's life, see Uno Boklund, "När Gahn upptäckte Scheele på Lokks apotek," *Lychnos* (1959).

<sup>36</sup> On Gahn, see: Bengt Hildebrand, "Gahn, Johan Gottlieb," *Svenskt Biografiskt Lexikon* 16, 730–2; Jan Trofast, *Johan Gottlieb Gahn: En bortglömd storhet* (Lund: Wallin & Dahlbom, 1996); and Fors, *Mutual Favours*, 138–65.

<sup>37</sup> The story was written down in 1794 in the diary of a Carl Zetterström, who had heard it from Gahn at a dinner. The anecdote circulated in several versions, but this is the only known one that has been recorded as told by one of the parties present in the pharmacy. Boklund, "När Gahn upptäckte Scheele," 221. Quotation from Boklund (author's translation).

<sup>38</sup> Matti Klinge, "B. Universitetet som institution," in M. Klinge, R. Knapas, A. Leikola and J. Strömberg, eds., *Kungliga Akademien i Åbo 1640–1808: Helsingfors universitet 1640–1990*, vol. 1 (Helsinki: Otava, 1988), 222–38; Sven Widmalm, *Mellan kartan och verkligheten: Geodesi och kartläggning, 1695–1860*, Institutionen för idé- och lärdomshistoria Uppsala universitet, skrifter 10 (Uppsala, 1990), 173–74; Sven Widmalm, "Grävören och docenterna: Cosmographiska sällskapet i Uppsala 1758–1778," in G. Broberg, G. Eriksson and K. Johansson, eds., *Kunskapens trädgårdar: Om institutioner och institutionaliseringar i vetenskapen och livet* (Stockholm: Atlantis, 1988), 86–91, 100–101.

The fact that the Upland's Arms was a place where chemical discussions could take place is an implicit prerequisite for the anecdote of Scheele's discovery. If we take the basics of the anecdote at face value, that is, that Gahn and Scheele first met in the Upland's Arms, through a discussion of chemistry, it seems that Scheele had finally found a place where social codes permitted him to discuss chemistry and to show his knowledge. Since the pharmacy, in addition to being a public place, was also a place where professional pharmaceutical knowledge was produced, it made Scheele's display of chemical knowledge unthreatening to the university chemist. (Consider, for example, if Scheele had approached Gahn in a tavern in order to display superior knowledge in Gahn's own field.)<sup>39</sup>

Some time in the spring of 1770, Scheele read a memo with his chemical findings to Gahn. It consisted of very brief accounts of more than forty experiments that he had conducted. It probably gave Gahn all the evidence he would ever need of Scheele's competence as an experimenter.<sup>40</sup> They also got to know each other sufficiently well to start a correspondence when Gahn left Uppsala that summer. As it turned out, Gahn was to become a contact who opened up the Swedish chemical scene for Scheele. Gahn was Scheele's age, and one of Bergman's closest disciples. Thus, Gahn could vouch for Scheele's credibility, and provide him with an introduction to Bergman, who at this time was establishing himself as the central node of the Swedish chemical community. Gahn probably introduced Scheele to Bergman before he left, since there is no evidence that he acted as an go-between for them during the following year.<sup>41</sup>

## The magnesia nigra experiments

In this section, I will take a closer look at the correspondence that ensued concerning Scheele's experiments on magnesia nigra, a mineral that is now called pyrolusite. Scheele's paper is, rightly, well known. It announced the discovery of three new substances, later named chlorine, manganese, and barium.<sup>42</sup> The investigations were

<sup>39</sup> There are interesting similarities to the autobiographical stories of Linnaeus about himself, as retold by Lindroth, e.g. Linnaeus's story of how he came to be discovered in Uppsala by the amateur botanist Olof Celsius while conducting botany in the university's run-down garden. The older man engaged him in conversation, and was immediately impressed by the deep knowledge of the young Linnaeus, and consequently took him in to live in his house and gave him free access to all his books. Lindroth's comment on the episode is characteristically ironic: "before greying potentates, he appeared as a prince in disguise in all his splendour." Lindroth, *Fribetstiden*, 154. Quotation from Lindroth (author's translation).

<sup>40</sup> C. W. Scheele/J. G. Gahn, "P. M. hört af herr Scheele År 1770 om våren", in Nordenskjöld, *Efterlemnade bref*, 38–49.

<sup>41</sup> There is no mention of Scheele in the extant correspondence between Gahn and Bergman until late November 1771. Gahn to Bergman, 28 November 1771, in Johan Gottlieb Gahn, *Brev: Utgivna med kommentarer av Jan Trofast 2* (Lund: Wallin & Dalholm, 1994).

<sup>42</sup> Scheele, however, was a phlogistonist, and it can therefore not be said that he was the discoverer of these elements. What can be said, however, is that he identified three previously unknown substances and situated his discovery within the framework of then current chemical theory. In the case of chlorine, he isolated and described a new gas, which he called dephlogisticated marine acid. It was named chlorine by Humphry Davy in 1810, and Davy also announced it as an elementary substance. In the case of manganese and barium, Scheele obtained the substances in their dephlogisticated states, that is, as earths, and announced them to be previously unknown earths, but did not name them (they were named later by others). Scheele's friend and collaborator Johan Gottlieb Gahn is sometimes mentioned as the discoverer of manganese. This is because he

a major subject of discussion in the correspondence between Scheele, Gahn, Bergman and other Swedish chemists. It was Scheele's first major investigation of a mineral, and it was his competence in the analysis of magnesia nigra that established his reputation. As will be seen, Scheele's constant sharing of scientific information made his work a wonderful example of scientific letter-writing. His investigations became a common topic of correspondence, and the information was somewhere between gossip and communication of new facts. The communicator could expect similar gossip-facts in return, and both sides would keep ahead of the published literature in the chemical field. However, the big winner was Scheele, who gained a steadily growing reputation.

When Gahn introduced Scheele to Bergman in 1770, Scheele knew, as indicated by the anecdote of his "discovery" and by Retzius's biographical notes, that Bergman had seen to it that his second paper submitted to the *Transactions* had been refused. Perhaps he also knew that the first paper that he submitted to the Royal Swedish Academy of Sciences had disappeared in Bergman's hands. Thus, it must have been difficult for him to approach the other man.

However, Scheele and Bergman were separated by social distance even more than they were by personal issues. The university professor and the pharmacy journeyman could not cooperate on an equal basis. They had to establish a relationship in which Bergman's superiority would not be disputed. Initially, they seem to have met at irregular intervals. Gahn was their common denominator; as Bergman's favourite student and as Scheele's equal, he could correspond with both. Although Gahn was in Falun (a mining town in the northern province of Dalecarlia) and there was only a five-minute walk between the pharmacy at the main square of Uppsala and the Laboratorium Chemicum across the river, Gahn probably knew more about Bergman's activities than did Scheele and more about Scheele's activities than did Bergman (Figure 2). When Scheele began to publish in the *Transactions* of the Royal Swedish Academy of Sciences, Bergman translated his papers into Swedish and "corrected" them. The interaction between the two men became more regular. There are many indications that they settled into a relationship in which Bergman took the role of patron and teacher, while Scheele had to admit Bergman's superiority in the

<sup>42</sup> *Continued*

was given samples of the new earth, and asked by Scheele to saturate it with phlogiston to obtain it in its metallic state, to which Gahn agreed. Hence Gahn was the first person to hold a piece of the new metal in his hand. Yet if anyone must be said to hold priority, it is Scheele. Gahn did not publish his so-called discovery, and, to my knowledge, never argued that he himself had "discovered" anything through this act. Furthermore, any such claims would have been rather inappropriate, since Gahn was a phlogistonist when the event took place, and for many years thereafter. Therefore, Gahn must have been of the opinion that he had made a composite out of a pure substance. See Carl Wilhelm Scheele, "Om Brun-sten eller Magnesia, och dess egenskaper," *Kungliga Vetenskapsakademiens Handlingar* (1774). Owing to Gahn's move to Falun, the background of Scheele's paper is very well documented. For Scheele's letters to Gahn, see Nordenskjöld, *Efterlemnade bref*, 114–43; see also Bergman's letter to Gahn, 12 June 1772, in Gahn, *Brev* 2, 52–53. Further references: for "magnesium," see *Encyclopedia Britannica, Micropaedia*, VI, 487; for "manganese," see *Encyclopedia Britannica, Micropaedia*, VI, 563; J. R. Partington, *A History of Chemistry*, vol. 3 (London: McMillan, 1962), 299–300; Mary Elvira Weeks and Henry M. Leicester, *Discovery of the Elements*, 7th revised ed. (Easton, Penn., 1968), 164–65; and Robert P. Multhauf, "A History of Magnesia Alba," *Annals of Science* 33 (1976): 199–200.

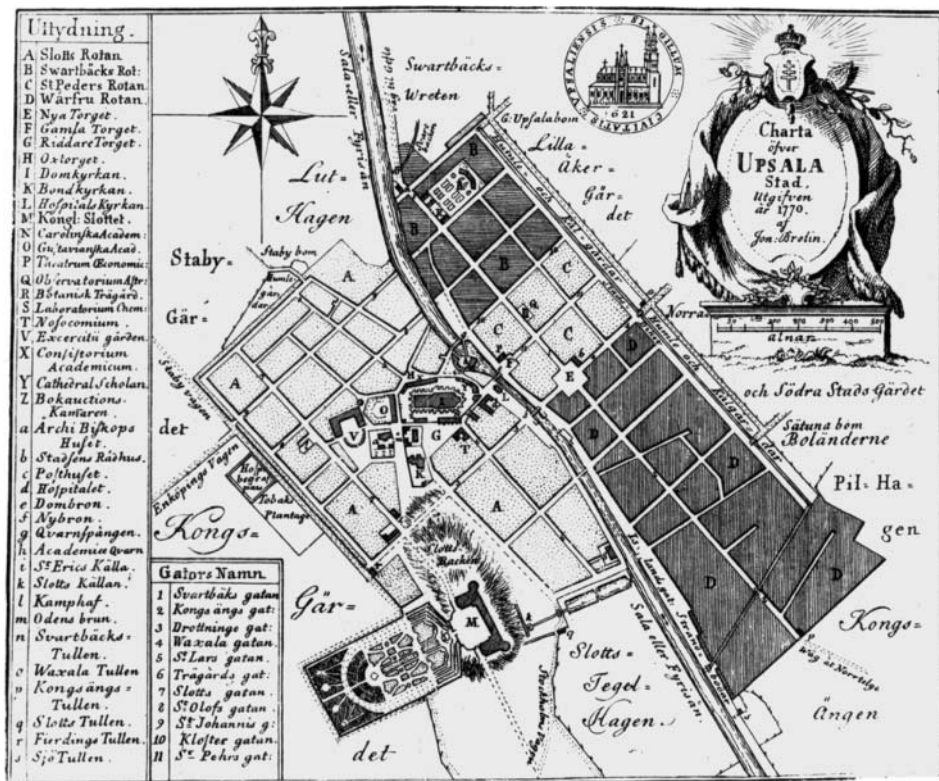


FIGURE 2 Jonas Brolin's map of the town of Uppsala from 1770. The Laboratorium Chemicum was, as an official building of the university, marked with a capital S (opposite the castle, M). The Upland's Arms pharmacy received no such distinction; it was located in the southeast corner of the New Square (Nya Torget), marked with a capital E. Photo: Uppsala universitetsbibliotek (Uppsala university library).

chemical as well as in the social sphere. Scheele made complaints that Bergman was bad at keeping promises and doing things on time. Scheele was, on occasion, used as a supplier, synthesising chemicals for Bergman. At least on one occasion, he assisted Bergman in his laboratory.<sup>43</sup>

It was probably Bergman who first set Scheele to work on magnesia nigra, and they probably met, if at irregular intervals, during the autumn of 1771.<sup>44</sup> Bergman could have given Scheele samples of the mineral, or lent him the dissertation by Christian

<sup>43</sup> Nordenskjöld, "Lefnadsteckning," xviii; Scheele to Gahn, 2 December 1771, 23 December 1771, in Nordenskjöld, *Efterlemnade bref*.

<sup>44</sup> There is no mention of Scheele in Gahn's letters to Bergman until 28 November 1771, when he wrote to him and said that Scheele had already begun his experiments on magnesia nigra. Gahn to Bergman, 28 November 1771, in Gahn, *Brev* 2. There is no indication that Gahn was in Uppsala in the period from 6 August 1770 to 12 June 1771. After that, he visited at some time before 28 November 1771. Prior to that, Gahn was in Falun in August 1769, and probably in Uppsala the following year, until the summer of 1770, when he wrote to Bergman from Falun again on 6 August 1770. See also Weeks and Leicester, *Discovery of the Elements*, 164–66.

Friedrich Westfeld that Scheele used as a point of departure for his investigation in the final article.<sup>45</sup> Westfeld had claimed, following Johann Heinrich Pott, that *magnesia nigra* consisted mainly of alum, something that Scheele refuted. Bergman, who had previously worked on alum, probably had knowledge of Westfeld's dissertation from that work.<sup>46</sup>

In a letter to Gahn of 2 December 1771, Scheele mentioned that he had conducted a series of experiments on the mineral, but was not quite satisfied yet. During the next winter, Scheele was still working on the topic, and hoped that Gahn could translate the manuscript for publication in the *Transactions* of the Royal Swedish Academy of Sciences. He had many questions for Gahn about *magnesia nigra*. Scheele's feelings towards Bergman were mixed. He had noted, he said, that one had to make a lot of fuss if one wanted Bergman to do what he promised. On the other hand, Bergman's interest in Scheele was increasing. He too sent samples of Scheele's work to Gahn. Strangely enough, Scheele's manuscript on *globulii martiales* was still in his possession. Along with some other experiments, a fragment of it was passed on to Gahn, with the comment that it was neither interesting nor short. Apparently, Bergman had not changed his mind regarding the manuscript.<sup>47</sup> By the beginning of March, Bergman had told Gahn that Scheele still was not finished, but when he had, Bergman would send the manuscript to the *Transactions*.<sup>48</sup>

Owing to the harsh winter of 1771–72, Scheele was kept busy in the pharmacy. In May, he said that there were so many sick people in Uppsala that "I can not follow my natural inclination to experiment the slightest." He had also had no time to visit Bergman since Christmas. Like so many others in Uppsala, Bergman was ill, and as he dryly observed, the only thing that the doctors could do for him was to prescribe summer.<sup>49</sup>

The work dragged on. In June, Bergman sent Gahn some manuscripts, including one by Scheele. He also told him that Scheele was convinced that *magnesia nigra* contained an earth of its own, that is, a previously unknown substance.<sup>50</sup> In January 1773, Scheele still was not finished.<sup>51</sup> By the winter of 1772–73, Scheele and Bergman seem to have been cooperating regularly. It also appears that Bergman now treated Scheele as his equal as a chemist. In the middle of November 1772, Scheele wrote to Gahn, telling him that both he and Bergman had tested the French chemist Antoine Baumé's recently published claim that *terra silicæ* was soluble in sulfuric acid and found it to be false. He presented a thorough critique of Baumé. The men also

<sup>45</sup> Scheele, "Om Brun-sten eller Magnesia," 90; Christian Friedrich Gotthard Henning Westfeld, *Mineralogische Abhandlungen, Erstes Stück* (Göttingen, 1767). The reference to the full title from Partington, *A History of Chemistry*, 570.

<sup>46</sup> Torbern Bergman, *Disquisitio chemica de confectione alumnis* (Uppsala: Joh. Edman, 1767); Torbern Bergman, "Förslag at förbättra alun-luttringen," in *Kungliga Vetenskapsakademiens Handlingar* (1767). Bergman does, however, not quote Westfeld in these works.

<sup>47</sup> Scheele to Gahn, 2 December 1771, 23 December 1771, in Nordenskjöld, *Efterlemnade bref*. Bergman to Gahn 9 December 1771, in Gahn, *Brev 2*.

<sup>48</sup> Gahn to Bergman, 28 November 1771, Bergman to Gahn, 2 March 1772, in Gahn, *Brev 2*.

<sup>49</sup> Scheele to Gahn, 24 April 1772, May [after the 7th] 1772, in Nordenskjöld, *Efterlemnade bref*. Author's translation. Bergman to Gahn, 9 December 1771, 2 March 1772, in Gahn, *Brev 2*.

<sup>50</sup> Bergman to Gahn, 12 June 1772, in Gahn, *Brev 2*.

<sup>51</sup> Bergman to Gahn, 12 January 1773, in Gahn, *Brev 2*.

discussed each other's theories. Scheele had proposed theories that Bergman criticised, and Scheele was able to inform Gahn how to saturate water with acid of air, which was one of Bergman's pet projects.<sup>52</sup>

Interest in Scheele had begun to spread. Sven Rinman, a chemist and engineer who specialised in constructing furnaces, had heard of the cooperation between Bergman and Scheele, and said that he was sorry that he did not live in Uppsala anymore, so that he could take part in the company of the learned. He also asked whether Scheele could be persuaded to take up the chemical examination of iron.<sup>53</sup>

By the end of 1773, Bergman finally received Scheele's manuscript. He told Gahn that it was a "little book" that contained several interesting things, but that the publishing would take some time, since it was rather extensive. Nevertheless, Bergman was quite quick in translating it, and by the end of January 1774 he had sent it to the *Transactions*, expecting it to be published in the next issue.<sup>54</sup>

The discussion on magnesia nigra continued. It is interesting to note that the publication of Scheele's paper hardly left a mark in the correspondence. The issues that were dealt with in the published paper were already almost closed. Owing to its length, it was published in two parts. It was followed by three addenda, by Bergman, Gustav von Engeström, and Sven Rinman. The paper, "On Brown-stone or Magnesia nigra and its properties" ("Om Brun-sten eller Magnesia, och dess Egenskaper") contained as detailed an investigation of the mineral as one would expect. It described the reactions of magnesia nigra with all the major acids — vegetable, animal, and mineral — and with phlogiston and all manner of other substances that were known to eighteenth-century chemists.

The publication of the paper had important consequences for Scheele. It signalled that he was an able chemist in his own right. The paper made it public that he was an excellent experimentalist, who presented his claims in a clear and polite manner. The fact that he could publish his work in the *Transactions*, and the very positive addenda by Bergman and Rinman, implied that he was accepted by the other Swedish chemists and worthy of their admiration. Rinman, for example, was enthusiastic. He wrote in a letter to Gahn that: "I could do nothing but admire his infinite diligence and subtle penetration . . . That man is a razor in Chemistry."<sup>55</sup>

Gahn continued the experiments; he found some new properties of Scheele's earth and managed to obtain it in its metallic state. He also performed experiments showing that the mineral heavy spar was chemically identical to the new earth, except that it also contained a vitriolic acid.<sup>56</sup>

<sup>52</sup> That is, to make sparkling water. Scheele to Gahn, 16 November 1772, 25 January 1773, 1 March 1773, in Nordenskjöld, *Efterlemnade bref*.

<sup>53</sup> Bergman must have written to Rinman about Scheele, since he thanked Bergman for the reference to Scheele's work. Rinman to Bergman, 22 October 1773 [G21], Uppsala Universitetsbibliotek (Uppsala University Library). On Rinman, see: Fors, *Mutual Favours*, 105–35 and other places; and Marie Nisser, "Sven Rinman," *Svenskt Biografiskt Lexikon* part 147, 212–19.

<sup>54</sup> Bergman to Gahn, 7 November 1773, 30 January 1774, in Gahn, *Brev 2*.

<sup>55</sup> Rinman to Gahn, 4 March 1774, in Gahn, *Brev 2* (author's translation).

<sup>56</sup> Scheele to Gahn, 28 March 1774, in Nordenskjöld, *Efterlemnade bref*. Gahn to Bergman, 5 May 1774, in Gahn, *Brev 2*.



Bergman was still unconvinced that magnesia nigra contained a new metal. In his opinion, it contained a known metal of some sort, perhaps platinum. Bergman had also found a previous text on magnesia nigra that they had failed to consider. The French chemist Balthazar-Georges Sage had claimed that magnesia nigra consisted of zinc, cobalt and lime united with acid of salt, but Bergman had not had the time to read Sage before Scheele's text had been copied out and sent to the Royal Swedish Academy of Sciences. For this reason, he had not notified Scheele of Sage's work. When Scheele heard of it, he immediately conducted new experiments, but was unable to find any of the elements that Sage had claimed to find. Bergman related Sage's experiments to Gahn, and said that he thought that the results were insecure. He had also found evidence before this that Sage tended to make mistakes, but he was the only one who had written on the subject recently.<sup>57</sup>

Scheele continued to encourage Gahn by sending him purified magnesia nigra. He received some of the metal that had been obtained by Gahn, and found that it consisted of the new magnesia nigra earth, phlogiston, and a small amount of some unknown earth. The status of Scheele's discovery as a new earth and metal was thus confirmed through both analysis and synthesis. Scheele wanted Gahn to apply the "hell-fire" of his metallurgical furnaces to the purified samples, and asked Gahn to send him more samples back as soon as possible. Scheele was also happy about Gahn's discovery of the new earth in heavy spar. After he had examined the small sample that he had received from Gahn, he wrote, he immediately ran off to Bergman, who gave him a larger piece of the mineral to experiment on. Scheele also criticised Sage. Bergman had asked him to conduct three experiments on magnesia nigra, to find whether he could reproduce Sage's results. He could not, and Bergman, too, was unable to reproduce the phenomena that Sage described. Scheele said to Gahn that, according to Bergman, Sage had made other erroneous remarks.<sup>58</sup> Gahn's comment to Bergman was that "Mr Sage must be a strange man. How can it otherwise be that he in almost all places, is wrong?"<sup>59</sup>

About a year later, Bergman wrote to Pierre Joseph Macquer at the Jardin du Roi in Paris, with a question about Sage's reputation. Macquer wrote back that Sage "totally lacks a gift for chemistry and does not understand that science at all. . . . In the end, he will seriously damage himself with the real chemists." According to Macquer, Sage had gained his position through his influence with "highly-placed persons."<sup>60</sup> Given the harsh judgement from France, there was no reason whatsoever for the group of Swedish chemists to give further consideration to Sage's results.

Rinman, too, joined in. In a letter to Gahn, he said that he hoped that an eighth metal had been found. However, the status of the new substance was still an open question. Was it the same substance as that in white magnesia? Was it an earth or a metal? There was also the suspicion in Rinman's mind that the new substance could be "masked iron." He told Gahn of trials that he had performed many years before

<sup>57</sup> Bergman to Gahn, 8 May 1774, in Gahn, *Brev* 2.

<sup>58</sup> Scheele to Gahn, 16 May 1774, in Nordenskjöld, *Efterlemnade bref*.

<sup>59</sup> Gahn to Bergman, 19 May 1774, in Gahn, *Brev* 2 (author's translation).

<sup>60</sup> Bergman, *Torbern Bergman's Foreign Correspondence*, 246. Translated by Henry Guerlac, "Sage, Balthazar-Georges," *DSB* 12, 63–69, on 64.

on a piece of ore from the Klapperud mines. He remembered now that there had been some of this strange variety of magnesia mixed with this ore.<sup>61</sup>

Rinman's tip was taken up by Scheele, and by the end of June, Scheele had received some ore from the Klapperud mine. He saw only two possibilities: either that the new substance in the ore hid the iron so well that it could not be discovered in the wet way, that is, through decomposition with fluid reagents; or that there was no iron in the ore, in which case the new substance transmuted into iron when it was placed in the fire and thus subjected to large amounts of phlogiston. He also thought that the new earth was a semi-metal in its metallic state, and thus distinct from other semi-metals.<sup>62</sup>

Rinman wrote to Gahn, complaining that he would have wanted to send some comments to him, but that he had not had the time to do so. Gahn had wanted Rinman to tell him how the metal could be produced in larger quantities and what theoretical considerations one had to be aware of to do so. Rinman, who was familiar with large-scale smeltings, declined. He did not know enough, and did not have the time to read up on the subject. Nevertheless, he gave some advice from memory.<sup>63</sup> The frantic activity continued. Magnesia nigra was examined in every way, mixed, boiled, burnt and ground together with other substances, and efforts were made to find methods to produce its new substances in larger quantities. In three undated letters from the summer of 1774, Scheele also presented extensive analyses of heavy spar earth.<sup>64</sup>

With that, the discussion on magnesia nigra and heavy spar earth started to fade from the correspondences of these men. Scheele set to work on other projects, sharing his thoughts on them freely with his correspondents. He produced a string of papers for the *Transactions* in the following years. His papers made their mark in his correspondence. Specific points and experiments were discussed prior to publication, and usually either Bergman or Gahn translated his German manuscripts into Swedish.<sup>65</sup> But no single subject would stir up the same agitation as Scheele's work on magnesia nigra had done.

## Afterword: the breakthrough

By the end of the events described in this paper, Scheele had managed to establish an excellent reputation in the close-knit world of Swedish chemistry. More than that, in a short time, approximately between 1771 and 1774, he established himself as one of the pivotal Swedish chemists. The events that I have described set the stage for Scheele's rapid rise in status to the position of an internationally well-known chemist who is remembered to this day.

<sup>61</sup> Rinman to Gahn, 4 June 1774, in Gahn, *Brev 2*.

<sup>62</sup> Scheele to Gahn, 27 June 1774, in Nordenskjöld, *Efterlemnade bref*.

<sup>63</sup> Rinman to Gahn, 8 July 1774. Rinman made some further remarks to Gahn on 29 July 1774; he still had not had time to do any experiments, but nevertheless made several new comments. Gahn, *Brev 2*.

<sup>64</sup> Nordenskjöld, *Efterlemnade bref*, n. 139.

<sup>65</sup> See, for example, Scheele to Gahn, 21 November 1774, in Nordenskjöld, *Efterlemnade bref*. There are, however, indications that the relationship between Scheele and his associates was not always unproblematic; see Johan Nordström, "Några bortglömda brev och tidskriftsbidrag av Carl Wilhelm Scheele," *Lychnos* (1942) 194–97.

The next phase of Scheele's life also saw a great improvement in his lot and in his social status. In July 1774, he was proposed by P. J. Bergius to become a fellow of the Royal Swedish Academy of Sciences. He was elected in the following year.<sup>66</sup> In 1777, he published his first and only monograph, *Chemische Abhandlung von der Luft und der Feuer* (Uppsala and Leipzig) In autumn of the same year, he travelled to Stockholm to formally take his seat in the Royal Swedish Academy of Sciences and to take his examination as a master pharmacist. The examining body, the Collegium Medicum, decided to waive the examination fee, and turned the examination into a celebration in honour of the candidate. Towards the end of 1777, he was given an annual support of 100 riksdaler from the Academy, which significantly added to the economic prosperity that he was beginning to enjoy.<sup>67</sup>

The most important change was, however, his receipt of the privileges for the pharmacy in the small town of Köping in central Sweden, and his subsequent move there in the summer of 1775. This move signals quite clearly the end of the early phase of Scheele's career. He was to stay in Köping for the rest of his life, except for the above-mentioned trip to Stockholm. There was severe competition and intrigue for the post of pharmacist in the little town. But Scheele, with the support of his influential friends, managed to secure the position. He was overjoyed, and wrote in a letter to Gahn:

Oh, how happy I am! [With] [n]o anxiety about food and drink, no anxiety about where to live, no anxiety about my pharmaceutical laborations . . . — for this is only a game to me. But explaining new phenomena, this constitutes my anxiety and how happy is the man of science, when he finds that which is so diligently sought, [he feels] a joy by which the heart laughs.<sup>68</sup>

It was only after his move to Köping that Scheele managed to free himself from his immediate social and scientific dependency on Bergman. Scheele's rise in social status when he acquired the Köping pharmacy was not negligible. On acquiring his own household and becoming his own master, Scheele no longer had to fulfil any obligations of a servant. Simultaneously, he could maintain his scientific contacts (and position) through correspondence. The physical distance and communication through letter-writing instead of face to face probably also mediated the social distance between Scheele and Bergman. The publication of Scheele's *Chemische Abhandlung* can be taken as an indication of their new and more equal relationship. Bergman wrote the foreword, vouching with his name and title for the book's credibility to a larger audience. But the main text was neither translated nor corrected by him, since it was in Scheele's own language, German.

## Conclusions

This reinterpretation of Scheele's early life has primarily been an account of the social interplay in a group of chemists, as read through their correspondence. A question as

<sup>66</sup> P. J. Bergius to the Academy of Sciences, 7 July 1774 [Skr. Arkiv k. 23:1], KVA. Scheele, who called Bergius one of his foremost benefactors, thanked him in a letter on 6 December 1774 (Nordenskjöld, *Efterlemnade bref*). Ironically, Scheele's old friend Anders Jahan Retzius, was only to be elected in 1782, seven years later.

<sup>67</sup> Nordenskjöld, "Lefnadsteckning," xx–xxvi.

<sup>68</sup> Scheele to Gahn, 26 December 1774, in Nordenskjöld, *Efterlemnade bref* (author's translation).

yet left unanswered is: who qualified as a chemist in the eighteenth century? Lissa Roberts has proposed a very useful definition. She argues that acceptance into the society of chemists depended on the interplay of three factors: “perceived manipulative abilities and technical acumen in laboratory settings; acceptance and use of polite, theoretically neutral discourse (that is, in the sense of not asserting an overall system) for communication in general and experimental reporting in particular and success in situating oneself in a recognized network of active participants.”<sup>69</sup> When Scheele moved to Uppsala, he fulfilled only one of these criteria; that is, he used a polite and theoretically neutral language. By the end of the *magnesia nigra* episode, he fulfilled all of the criteria quoted above. It is clear, however, that before his inclusion into Bergman’s network, Scheele was already a knowledgeable and a competent laboratory chemist, although he had not yet had the chance to display this to others.

Therefore, Scheele’s main problem was one of finding a socially proper place to display his ability, and of gaining acceptance. As a German pharmacist with Swedish language difficulties and with no significant political or scientific contacts, he had to traverse several boundaries, both geographical and social. Lund and Malmö were too distant from the central institutions of Swedish chemistry to provide an opportunity. Stockholm too, proved unsuitable, probably owing to the greater social stratification of the bigger town, and because its chemists were rather focused on mineralogical chemistry. It was not until Scheele moved to the pharmacy shop in Uppsala that he found an environment where social and geographical distance was no longer an issue. There, Scheele could establish contact with Gahn, a student of Bergman’s who was roughly his social equal. As soon as Gahn was convinced of his competence, he introduced Scheele to Bergman.

With that, a main obstacle had been dealt with. But there were others. The *magnesia nigra* investigations soon showed Scheele to be an expert mineral analyst, who could well be accepted into the network of Swedish mineralogical chemists. But Scheele had acquired his knowledge in a craft setting, whereas mainstream Swedish chemistry at the time was conducted either at the universities or by state mining officials. In order to become a social equal of his new collaborators, Scheele had to accept that his knowledge had to be subordinated to that of the university-educated chemists. Scheele’s knowledge was reinterpreted as empirical, providing the raw material for the higher form of theoretical knowledge produced at universities. This reinforcing of the “proper” social order, I would argue, is just as important as a prerequisite for Scheele’s acceptance as the moves that he made to come closer to the mainstream of Swedish chemistry. Gahn’s anecdote, although told several years after Scheele’s death, provides an essential clue. Gahn was presented as “the discoverer,” and his superiority was underlined by incorrectly presenting Scheele as an apprentice. One also gets the impression from the anecdote that Scheele was the younger of the two. Scheele was actually twenty-seven years of age at the time, and Gahn’s senior by three years. He was a pharmacy journeyman and a skilled

<sup>69</sup> Lissa Roberts, “Setting the Table: The Disciplinary Development of Eighteenth-century Chemistry as Read Through the Changing Structure of its Tables,” in P. Dear, ed., *The Literary Structure of Scientific Argument: Historical Studies* (Philadelphia: University of Pennsylvania Press, 1991), 119.

professional with experience from three pharmacies in different towns. Gahn, on the other hand, was a student with an uncertain future. Gahn's background and education marked him as superior to Scheele socially, but on a personal level, they were more or less equals. Although Scheele's father was poor and Gahn's family had better connections, they both came from bourgeois families.

A key to Scheele's success as a networker was his sharing of experimental results. According to the eighteenth-century logic of network exchange, it was necessary for his collaborators to repay him in equal measure, if not in the same kind of goods. Scheele could draw on no material resources to establish himself as one of the major players in the field (i.e. time, a well-equipped laboratory, money, access to the latest books and articles). Neither did he have the social capital that influential relatives, formal education and patrons in high places could provide. Nothing in the sources even suggests that he had personal charm. The only thing that he had was information on a large number of innovative experiments. This information he could use as currency to trade with others, who, when they started to assign a high value to his findings, also assigned a high value to being in regular contact with him. They became eager to participate in his chemical endeavours, encouraged him to publish, and helped him to translate his works. Soon they began to help him economically and socially. In the short period between 1773 and 1777, Scheele went from being an unknown journeyman to a published author, a master pharmacist with his own pharmacy, a fellow of the Royal Swedish Academy of Sciences who also received an annual grant from the Academy. Finally, he was fast becoming a chemist of international renown. Not bad, for a man who allegedly had nothing on his mind except the pursuit of science.

## Notes on Contributor

**Hjalmar Fors** holds a Ph.D. in the history of science and ideas from Uppsala University. He is assistant professor at the Division of History of Science and Technology at the Royal Institute of Technology, Stockholm. His research is concerned with chemistry's emergence as a science in eighteenth-century Sweden, and the interactions of science, technology, and industry. Previous publications include his thesis, *Mutual Favours: The Social and Scientific Practice of Eighteenth-Century Swedish Chemistry* (Dissertation, Uppsala University, 2003) and the editorship (with E. Baraldi and A. Houlitz) of *Taking Place: The Spatial Contexts of Science, Technology and Business* (Science History Publications, 2006). He is currently studying the Swedish Board of Mines as an environment for science and occultism in the seventeenth and eighteenth centuries. Address: Hjalmar Fors, Division for History of Science and Technology, Teknikringen 76, KTH, 100 44 Stockholm, Sweden; Email: [hjalmarf@kth.se](mailto:hjalmarf@kth.se).

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