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Discovering Elements in a Scandinavian Context: Berzelius's *Lärbok i Kemien* and the Order of the Chemical Substances

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Abstract. During the Eighteenth century Sweden was a propitious context for the discovery of chemical substances and elements. At the beginning of his scientific career Jöns Jacob Berzelius contributed by his experimental research and discoveries to the preservation of the high scientific profile of his native country. Electrochemistry and chemical atomic theory marked Berzelius's scientific life and organized his vision of chemistry and his classification of substances. Berzelius used his *Lärbok i Kemien* to spread his discoveries and to frame his conception of chemistry. Focusing on Berzelius's textbook of chemistry the paper tries to enlighten a specific vision of chemical science which was very influential in the first half of the XIX century.

Keywords. Swedish science, Berzelius, textbooks of chemistry, communicating science.

1. CENTER AND PERIPHERY IN EIGHTEENTH CENTURY CHEMISTRY

The traditional reconstructions of Eighteenth century chemistry focused on the scientific relationships between Paris and the British research centers with some incidental reference to various German political contexts. The recent historiography of science has started to pay attention to peripheries and to their interactions with the main scientific centers, and such a new perspective has allowed to draw some richer and more complex pictures, to locate forgotten paths of knowledge, and to reconstruct some actual networks of personal and institutional relationships. Thanks to these current approaches, new light has been cast on theories and experimental practices of Eighteenth century chemistry.

In the Eighteenth century Swedish science played a major role as regards the development of mineralogy, metallurgy, chemistry, and of the natural and experimental sciences. At the beginning of the Eighteenth century, losing the Great Northern War, the Kingdom of Sweden was no longer a military, imperial power,¹ it was a minor power but still played a significant role owing to its metallurgical activities and its production of guns. Chemists and mineralogists of the *Bergkollegium* (Board of Mines), chemists at Uppsala

University and members of the Royal Swedish Academy of Sciences were an important reference to the scientific culture of that time.²

Johan Gottschalk Wallerius (1709-1785), Torbern Olof Bergman (1735-1784) and the pharmacist Carl Wilhelm Scheele (1742-1786) were the protagonists of the Swedish scientific scene, particularly with respect to the interpretation of the discoveries of airs or gases. In the rich landscape of Enlightenment chemistry it is possible to identify French Stahlism, British experiments and discoveries of gases but also a true Swedish theory which Lavoisier himself considered a primary critical reference.³ Swedish naturalists were famous for their discoveries of minerals and chemical elements, for some refined theories of gases by Scheele, and of the chemical affinities by Bergman. The translations into various languages of Wallerius's, Scheele's and Bergman's papers demonstrate their ideas were spread all over Europe. In Italy it was customary to say that sciences were migrating into cold Northern Europe.

At the end of the Eighteenth century Sweden had seemingly lost that very high position of prestige enjoyed during the Enlightenment; the second edition (1796; the first one had been edited by Bergman in 1775) of Henrik Teofilus Scheffer's *Chemiske föreläsningar* (chemical lectures) contained a traditional, pre-lavoisian chemical theory; the brief *Inledning till chemien* (1798) by the Finn Johan Gadolin (1760-1852), professor at the University of Åbo (Turku), presented a concise exposition of antiphlogistic chemistry (*antiphlogistiska systemet*) which was shaped according to the highly popular *Philosophie chimique* (1792) by Antoine-François Fourcroy.⁴

The history of Swedish chemistry is unavoidably connected to the name of Jöns Jacob Berzelius (1779-1848), a dominating authority of European science during the first half of the Nineteenth century. Berzelius was highly successful; he was the discoverer of many chemical substances and four elements, an impressive experimental scientist, a theorist of stoichiometry and chemical atomism, a prolific writer and editor of several journals. Jenny Beckman has recently reconstructed Berzelius's publication strategies emphasizing his efforts to spread his discoveries and conceptions, and his plan for preserving the status of European scientific language in the Swedish tongue.⁵

It is generally argued that the development of organic chemistry and the birth of unitary theories made Berzelius's dualistic theory obsolete, but it must be stressed that Berzelius's influence continued during the whole century, as demonstrated by Stanislao Cannizzaro who suggested to read and read again Berzelius's works and papers.

2. A CENTER FOR CHEMICAL RESEARCH: SCIENTIFIC PILGRIMAGES TO STOCKHOLM.

In 1815 Christian Gottlob Gmelin (1792-1860), a young German naturalist who was to become the professor of chemistry at the University of Tübingen, left his native land moving to Stockholm in order to improve his knowledge of chemistry. He remained one year in Sweden and paved the way for some other German naturalists. In the background of the chemists of the first half of Nineteenth century the specialization in Stockholm was a common trend for many German naturalists. In the map of the Nineteenth century chemistry Stockholm was next to Paris (the Lavoisian school), London (Humphry Davy) and Manchester (John Dalton). Gmelin's path was followed by Eilhard Mitscherlich (1794-1863), Heinrich Rose (1795-1864), Gustav Rose (1798-1873), Gustav Magnus (1802-1870) and Friedrich Wöhler (1800-1882), and the latter became the grand and noble father of German chemistry. At the beginning of his career Justus Liebig planned to go to Stockholm, but eventually choosed to go to Paris.⁶

This new scientific pilgrimage to Stockholm was caused by Berzelius. From 1812 to 1819 thanks to the patronage of Wilhelm Hisinger, a naturalist and industrialist, Berzelius founded a laboratory of chemistry in Stockholm; in 1819 he became the permanent Secretary to the Royal Swedish Academy of Sciences, and founded a new laboratory at this institution which was then located at *Stora Nygatan* in the ancient part of the city (*Gamla Stan*), and here the young German chemists went to improve their knowledge. Since 1829 the laboratory of chemistry was in Drottninggatan, next to *Adolf Fredrik Kyrkan*, where there was the new seat of the Academy, and this laboratory continued to be one of the crucial places of the history of European chemistry.

If we want to draw an exemplary picture of chemistry in the first half of the Nineteenth century we must have recourse to Berzelius: the portrait of Berzelius as a young, poor student of medicine at Uppsala University can be compared with one of the official portraits of the old, noble Berzelius, laden with medals, reputation and fame. This comparison can give the image of the surprising career of an orphan boy from a Swedish provincial district, but it also proves that between the end of the Eighteenth and the beginning of the Nineteenth century the science of chemistry could offer the opportunity for prestigious and social redemption.

To Berzelius we owe a surprising series of experimental discoveries, a new chemical nomenclature, the development of electrochemistry, the establishment of chemical atomism, the discovery and verification of stoi-

chiometric laws, the dualistic theory, the formulation of the concept of isomerism, and the beginnings of a proper organic chemistry. In the light of some crucial experimental discoveries Berzelius could renew, invent, and organize the whole domain of chemistry.

At the end of the Nineteenth century Henrik Gustaf Söderbaum (1862-1933) published in German the first historical reconstruction of Berzelius's chemistry,⁷ and at the beginning of the Twentieth century he started publishing manuscripts, travel diaries, correspondence (*Bref* or *Brev*), and from 1929 to 1931 a three volume *Levnadsteckning*, that is a biography of Berzelius.⁸ The publication of the correspondence offered the historian a fundamental resource, and the mammoth correspondence between Berzelius and Wöhler, edited by Otto Wallach (1847-1931) and published in 1901, gave a unique opportunity for understanding some main chapters of the history of chemistry in the first half of the Nineteenth century.⁹

The new established international history of science and of scientific thought has favoured a revival of interest in Berzelius's work. In 1981 Evan H. Melhado published a volume on *Jacob Berzelius. The Emergence of His Chemical System* which contains a detailed reconstruction of the background of Eighteenth century chemistry, an explanation of Berzelius's debt to Lavoisier's theory and of the differences between Lavoisier's system and Berzelius's. The second part of this volume, devoted to *The Berzelian Theory of Salts*, presents a detailed historical analysis of the genesis and structure of the Berzelian system of chemistry.¹⁰

Berzelius contributed to the cultural and philosophical controversies of his time and he severely criticized F.W.J. Schelling's natural philosophy, and the *Naturphilosophie* which was welcomed in Sweden by naturalists, physicians, philosophers and theologians. In 1992 Melhado and Tore Frängsmyr edited a volume on *Enlightenment Science in the Romantic Era. The chemistry of Berzelius and its cultural setting*, which is the best recent, overall work on the Swedish chemist. Among the contributions to this volume one must point out the papers by Anders Lundgren on *Chemical Atom*, and by Alan J. Rocke on *Berzelius's Animal Chemistry*. Melhado's *Novelty and Tradition in the Chemistry of Berzelius (1803-1819)* is a wide-ranging detailed reconstruction.¹¹

The *Afhandling om Galvanismen* (1802) and the *Föreläsningar i djurkemien* (1806-1808) mark the beginning of Berzelius's scientific career which is characterized by the publications of papers in Swedish and in German in the Acts of the Swedish Academy of Sciences and in German scientific journals. The German texts were the basis for translations into French and English.

Colin A. Russell reconstructed Berzelius's electrochemical theory, Lundgren has clarified the question of the Berzelian chemical atomism,¹² and thanks to the contemporary historiography of chemistry one can schematize the main stages of Berzelius's stoichiometric research in the following way: in 1811 Berzelius published in the Paris "Journal de Physique" his outstanding *Essai sur la Nomenclature chimique*;¹³ the same year he started publishing in Ludwig Wilhelm Gilbert's "Annalen der Physik" the first part of the *Versuch, die bestimmten und einfachen Verhältnisse aufzufinden, nach welchen die Bestandtheile der unorganischen Natur mit einander verbunden sind* (1811-1812);¹⁴ in 1819 in Paris Berzelius published his *Essai sur la Théorie des Proportions Chimiques et l'influence chimique de l'Électricité* which contains a *coup d'oeil* on the theory of chemical proportions, the order of chemical substances, the method to calculate the relative number of atoms in chemical combinations, some observations on nomenclature, the classification of substances starting with the oxides, and one hundred and twenty alphabetical tables of the atomic weights of the main substances.¹⁵ These publications confirm the impressive quantity of experimental research that Berzelius made in his laboratory for establishing the true order of the well-known and newly discovered chemical substances.

Here, I do not want to resume Berzelius's discoveries and theories, I only hope to show some aspects of his work, in connection with the history of his chemical textbook because my aim is to clarify the Berzelian image of science which was so influential during the Nineteenth century. Through a consideration of his chemical textbook, it can be appreciated the interactions in his thought between didactics of science and strategies of communication. Berzelius built a network of personal relationships which became an instrument of information and controversy, and he used the Stockholm Academy of Sciences as an arena for the dissemination of a specific, Swedish image of chemistry.

3. A FAVOURITE CHEMICAL TEXTBOOK.

In 2000 Anders Lundgren and Bernadette Bensau-de-Vincent edited a volume on *Communicating Chemistry, devoted to Textbooks and their Audiences, 1789-1939*. It is a very important collection of essays aimed at understanding the value and historical meanings of the chemical textbooks. In his *Introduction to The Study of Chemical Textbooks* John Hedley Brooke clarifies the main problems which are met in the study of scientific textbooks, and notwithstanding many methodological

complications this study reveals that textbooks can be more enthralling than their unglamorous image might suggest.¹⁶

A historical analysis of Berzelius's various *Försök* and *Versuche* allows to clarify the genesis of his discoveries, the formulation and modifications of his conclusions, in short the construction of a science. A study of his highly popular textbook of chemistry may be useful for giving a picture of his didactics of science and of the structure of his chemistry, but the origin and the development of this textbook comprise a very complicated history which reveals all the difficulties in defining a stable body of scientific knowledge when the science is making daily progress and is the focus of controversies and diverging approaches. In *Communicating Chemistry* there is an important paper by Marika Blondel-Mégris devoted to Berzelius's textbook and to its multiple translations, but the center of her study is the German context and Wöhler's editions.¹⁷ The vicissitudes of this textbook appears to be still more complex in Germany and when its fate in France, Italy, Spain and the Netherlands is made clear.

At the very beginning of the Nineteenth century Berzelius was dissatisfied with the chemical textbooks of his time. We must keep in mind that he was a self-taught man in chemistry, and he studied this science by reading Lavoisier's *Traité élémentaire de chimie* (1789) and Christoph Girtanner's *Anfangsgründe der antiphlogistischen Chemie* (1792), two works which marked the shift from the theories of phlogiston to the antiphlogistic approach. In Germany Lavoisier's chemistry was not welcome, and many German chemists used it because it was clear but they did not believe that it was also true.

In 1808 in Stockholm the first volume (*Första Delen*) of Berzelius's *Lärbok i kemien* appeared. It opened with the author's statement that since Sweden has not had a complete textbook of chemistry written in Swedish for a long time, and such a textbook was necessary because Swedish young people cannot use the *utländska Lärböcker*, foreign textbooks. Berzelius also states that he has tried to treat chemistry in all its generality (*i allmänhet*).¹⁸ This first volume confirms Berzelius's belonging to Enlightenment philosophy, because it presents a very simple definition of chemistry, which remained unchanged in all the other editions, and underlines the recent status of chemistry as a recognized science, notwithstanding its very long history.

The writing of the *Lärbok* was a very hard task because Berzelius used his textbook both to encode knowledge, that is to reorder accepted science, and to present his new experimental discoveries. The second volume could only be published in 1812, the third one in

1818, but in 1817 the second edition of the first volume (*Första Delen*) was published, and it was an improved and partially rewritten text (*omarbetad och betydligt tillökt*). In the Preface of this second edition no reference to Swedish young people was made; Berzelius only emphasized that chemistry had made great progress in the past ten years, mentioning the decomposition of alkalis, the doctrine of chemical proportions and the importance of electricity as a chemical agent.¹⁹ Berzelius put aside the Swedish destination of his textbook, he remained faithful to the Swedish tongue but at that time he was aware of the diffusion of his text in Germany. It is important to note that a comparison of the title pages of the 1808 and 1817 editions shows a significant increase in Berzelius's academic qualifications, and this growth confirms his successful professional and scientific achievement.

In the Enlightenment cultural setting the French editions of a scientific text were the groundwork for the translations into English or Italian, whereas German or Russian texts and local academic translations continued to use Latin which guaranteed their circulation. In the case of Berzelius's textbook the German versions became the reference texts for the translation into French, and from French into other languages, so a novelty developed: the German texts were used for the dissemination of the Swedish science outside Sweden. On the 19th of October 1825 from Berlin Wöhler informed Berzelius that the capital of Prussia "ist jetzt ein wahrer Sammelplatz für Scandinaver" (a true place of reunion for Scandinavians), because together with the Swedish chemist Carl Palmstedt (1785-1870) there were some other Swedes and four Norwegians: the Scandinavian naturalists carefully considered the German scientific context.²⁰

Together with Mitscherlich, Wöhler was the official voice of Berzelius in Germany and the main protagonist of the diffusion of his textbook, but before Wöhler started translating from Swedish, Berzelius's work had already gained some attention. Historians do not usually recall that in 1816 Johann Georg Ludolph Blumhof (1774-1825), a naturalist of the Grand Duchy of Hesse, published in Leipzig the translation of the first volume of the *Lärbok* with the title of *Elemente der Chemie der unorganischen Natur*. In Blumhof's *Vorbericht* it is stated that Berzelius is famous for his literary productions and for his outstanding observations and discoveries which make the first two volumes of his *Lärbok* a reference text. Blumhof underlines that Berzelius deals with chemistry "bloss in Allgemeinen", without references to its practical applications, but he thinks that the teaching of chemistry permits an application of knowledge by those naturalists who are interested in industry and in the

practical arts.²¹ The *Elemente* is a useful text to chemists because it contains all the discoveries of the present age; it is therefore an updated textbook, but it is also written “im ächt philosophischen Geiste”, which is missing in the other “chemischen Lehrbücher”.²² To Blumhof, a precise description of the laboratory experiences, an up-to-date presentation of chemistry, a philosophical spirit that shapes the writing and the structure of the topics are the peculiarities which make Berzelius’s text a fundamental contribution to science.

Blumhof’s translation was limited to the first Swedish volume of 1808. In 1820 in Dresden, for K.A. Blöde’s edition of the first volume of Berzelius’s *Lehrbuch der Chemie* the translator used the second Swedish edition.²³ The second volume was translated by Palmstedt and the third one by Wöhler; the three volumes were reprinted in Reutlingen in 1821, 1824 and 1828. In 1825 in Dresden the first volume of the *Lehrbuch der Chemie* was published in a new translation by Wöhler, and on the front page it is stated that Berzelius had changed in Swedish the Blöde-Palmstedt translation and that Wöhler had translated it and included Berzelius’s modifications. In fact, the volume opens with a long *Vorerinnerung* signed by Berzelius and dated Stockholm, July 16th, 1825, in which are listed all the novelties compared with the original plan of 1807, for instance Davy’s discovery that alkalis can be reduced to metals, the properties of the new metals, the newly discovered properties of known metals, the discoveries of new radicals, new earths, and so on.²⁴

In a letter from Berlin dated the 25th of July, 1825 Mitscherlich informed Berzelius that Wöhler had checked the translation from Swedish into German of the additions, declared that Wöhler understood Swedish, and the Swedish chemical books, better than his other former pupils, and suggested his Master and Friend a full involvement of Wöhler in the German editions of his textbook.²⁵ Wöhler’s editions from 1825 to the fourth, grand edition of 1835-1841 in ten volumes contain updates and additions directly furnished by Berzelius. In the last years of his life Berzelius, unable to carry on laboratory research, prepared a new German edition of his textbook, published in 1843-1848. In 1843 he wrote the Dutch chemist Mulder that “Je poursuis toujours avec assiduité le travail pour refondre mon Lehrbuch”.²⁶ A comparative and detailed study of these editions is very difficult owing to the mammoth quantity of printed materials which they contain, but it could surely furnish much information about the knowledge added by Berzelius to the various German editions of his textbook.

Wöhler was the official spokesman for Berzelius in Germany, and from Germany to the remaining parts

of continental Europe, but the historical relevance and the scientific impact of the Berzelian textbook is confirmed by a three volume edition published in Stuttgart and edited by Heinrich F. Eisenbach and Carl August Hering. The title of *Lehrbuch*, adopted in 1820, is conserved but on the front page it is stated that that Stuttgart edition contains some updates relating to new research and discoveries and this statement explains why chemists were so attentive to the novelties coming from Stockholm. The editors declare that Berzelius’s volumes could be used for *Vorlesungen* (Lectures) and *Selbststudium* (personal learning) by numerous groups of people: physicians, pharmacists, administrators, agronomists, craftsmen, and industrialists.²⁷ This specification shows that chemistry was by then socially relevant as a science, and a science able to favour some productive activities, so a sort of continuity was established between modern chemistry and the seventeenth century project by Johann Rudolph Glauber (1604-1670) for the use of a *chimistry* which could favour *Dess Teutschlands Wohlfahrt (Prosperitatis Germaniae, 1656-1661)*.²⁸

The German edition of 1832-1833 confirms Berzelius’s deserved reputation and his importance in the history of modern chemistry. In the presentations of the various editions of his textbook which I have been able to study, it is always stated that the Swedish chemist is so famous that a translation of his textbook needs no justification or explanation. In their *Vorrede* Eisenbach and Hering write that the plan of the textbook is what “die Natur der Sache” requires: a general introduction containing some notions derived from physics, the chemistry of inorganic substances, which follows the order of salts and their bases, and the doctrine of chemical combinations which closes the inorganic chemistry and opens to the organic chemistry.²⁹

In his *Vorrede* to the 1835 German edition Berzelius states that it is not an easy enterprise to outline a good plan for a *Lehrbuch* because a textbook has a different aim from a *Handbuch* whose main feature is a strict systematic order. In a *Lehrbuch* this order is to be carefully sought because the exposition of the science is to begin from the most simple concepts that can be easily kept in mind. The writing of a chemical textbook is very demanding and the attention of the reader is to be captured, and when the stated goal is reached, the study of a science does not prove to be hard. Berzelius acknowledges that he has not adopted a perfect systematic order because he wants to introduce in science that lightness which is helpful to a beginner.³⁰

Many different needs and preoccupations converge around Berzelius’s textbook: the pedagogical aim is connected with the project of a book which could

present an orderly system of chemistry, but this science was in such a dynamic state that updates, corrections and adjustments of the book were continuously required.

In order to further illuminate the historical meaning of Berzelius's textbook it is appropriate to recollect some data concerning the other editions.

On November 1828 Berzelius received a letter from A.-J.-L. Jourdan, a French physician, who was charged by the Paris printer Didot to translate the *Lehrbuch*. Jourdan discussed the French title with Berzelius, who preferred that of *Éléments de Chimie*, asked him to send updates and modifications in comparison with the German edition.³¹ This request is common to every translator who wanted to include chemical novelties the planned edition, and therefore the various translations are full of Berzelius's experimental and theoretical changes. From Berzelius's correspondence it can be understood that he sent some updates in Swedish (*tilläg*) to Wöhler, who translated them into German (*Zusätze*) in order to assure their dissemination in Europe. The first volume of the *Traité de chimie traduit par A.J.L. Jourdan* was published in Paris in 1829,³² and aroused Berzelius's violent protests because of translation errors; these protests are documented in Berzelius's letters to Pierre-Louis Dulong.³³ In June 1829 from Stockholm Berzelius recalled that in Berlin he had asked the advice of Mitscherlich, Heinrich and Gustav Rose, Magnus and Wöhler before accepting Didot's and Jourdan's proposal for a French translation of his textbook,³⁴ and this episode confirms that Berzelius's German pupils composed a true, compact Berzelian school of chemistry. Jourdan was replaced by Melchior Esslinger and the publication of Berzelius's *Traité* in eight volumes was completed in 1833.

The Paris edition is not the only French version; in Bruxelles in 1839 the first volume of the *Traité de chimie* was published. Jean-Benoît Valerius (1807-1873) was the translator taking his text from the fourth German edition. In the *Avis des Éditeurs* there is, besides the customary homage to Berzelius and the emphasis on his scientific relevance, the statement that this new traduction was made "pour ainsi dire sous les yeux de l'auteur" because it contained the *Zusätze* of the fourth German edition, and therefore it was different from the Paris French translation.³⁵ It is stated that the textbook is addressed to professional chemists and above all to those who are beginners in the science. The Bruxelles edition was completed in 1846 in four volumes, and the existence of two French translations gave rise to different destinies of Berzelius's textbook in Spain and in the Ancient Italian States.

In 1845 Rafael Saez y Palacios and Don Carlos Ferrari y Scardini, first and second chemists at the General Hospitals in Madrid, published the first volume of the Castilian translation of Berzelius's *Lehrbuch* with the title of *Tratado de Química*; their translation was based on Valerius's French translation. In their presentation the two *Traductores* underlined that chemistry, after its inclusion among the sciences by Lavoisier, has not produced a more important textbook than Berzelius's. They used Valerius's edition because it was the most up-to-date version but made note of the fact that "la química no ha quedado estacionada en estos últimos años", owing to surprising and continuous discoveries.³⁶ The second volume was published in 1845, but this literary undertaking started changing with the third volume because the title was modified to *Tratado de Química Mineral, Vegetal y Animal*³⁷ and the following thirteen volumes – the translation was completed in 1851 – were translated using the second French edition that in 1845 Esslinger and Ferdinand Hoefer started publishing in their unending search for the latest version.

In the first half of the Nineteenth century many cities of the Ancient Italian States produced translations of scientific textbooks in a competitive system of book trade. From 1826 to 1828 in Milan a translation of Berzelius's textbook was published in four volumes with the title of *Trattato elementare di chimica teorica e pratica*.³⁸ During the Eighteenth century Venice and Naples played a major role in the spread of European science and in these cities two different editions of Berzelius's work were published. In Venice, the printer Antonelli charged the chemist Francesco Du Pré, who contributed to the debates on antiphlogistic theory, to translate the Berzelian textbook from the French Jourdan-Esslinger version. The Venice edition was published in eight volumes between 1830 and 1834 and it was entitled *Trattato di chimica*.³⁹ In Naples in 1838 Giovanni Guarini started publishing a new translation of Valerius's edition⁴⁰ which was completed in nine volumes in 1845. In the Italian States chemistry was not officially established but an Italian reader at least had at her/his disposal some updated Italian versions of Berzelius's textbook.

The Dutch version must be considered because it marked the involvement of a physician and chemist of Rotterdam and Utrecht in the network of Berzelius's scientific relationships. On the 24th of June 1834 Gerardus (Gerit) Johannes (Jan) Mulder (1802-1880) wrote to Berzelius sending him the plan of a Dutch translation of his textbook compiled by Mulder's three pupils (A.S. Tischauser, B. Eickma, A.F. van der Vliet), and informed him that he was using the Berzelian text for his lectures to forty young students. He also informed Berzelius that

such an editorial enterprise was very risky because the Netherlands were a small country where people could read foreign languages. Mulder asked Berzelius for some unpublished notes in order to enhance the diffusion of the Dutch version.⁴¹ Berzelius was proud of this translation and promised that he would send Mulder some unpublished notes prepared for the fourth German edition. In November Mulder thanked Berzelius and informed him that the editorial enterprise had started, and highlighted the relevance of the unpublished notes. In a letter dated 1835 Mulder informed Berzelius about the poor state of chemical research in the Netherlands and his choice of the Berzelian text in order to favour the growth of the socio-cultural perception of chemistry as an outstanding science.⁴²

The first volume of the *Leerboek der Scheikunde* was published in Rotterdam in 1834 and on title page it was stressed that the translation was based on the third German edition but improved (*en vermeerderde oorspronkelijke uitgave*) by some unpublished portions, and Mulder's *Voorberigt* underscored their scientific relevance.⁴³ The Dutch version was completed in 1841 in six volumes. Subsequently, Mulder became one of Berzelius's most faithful correspondents, and organic chemistry was their favourite topic. Mulder and Berzelius were both interested in the chemical composition of proteins, and they had a common aversion to Liebig. The work of Liebig on the radical of benzoic acid, his study of animal chemistry and the applications of chemistry to agriculture are epoch-making, but Liebig had a zealous, upbeat character which was the antithesis of Berzelius's philosophical calm. In March 1838 facing Liebig's criticisms, Berzelius confessed that "nous [Berzelius and Liebig] cherchons tous les deux la vérité, c'est une beauté pour laquelle il faut se battre d'une manière honnête".⁴⁴

My review of the translations of Berzelius's *Lärbok* – one must note the lack of a translation into English – contains a sequence of data and may be considered dry and boring,⁴⁵ but it was necessary for understanding the genesis and spread of that specific image of chemistry which Berzelius had constructed. Berzelius drove home his chemistry by using different strategies of communication and transmission because he wanted his Swedish chemistry to be rooted in the chemical communities of the European continent, in spite of the presence of contrasts and controversies. The surprising fate of the *Lärbok* allows the historian to observe the vicissitudes of Swedish science from a particular point of view. But Berzelius's textbook was not the only resource at his disposal to describe scientific progress and to weigh in on his own vision of the state of the chemical sciences.

4. A PRESTIGIOUS ARENA

At the end of November 1818 Berzelius, who was then in Paris, was elected perpetual Secretary to the Royal Swedish Academy of Sciences. This institution founded in 1739 had always used Swedish for its academic transactions (*Kongl. Svenska Vetenskapsacademiens Handlingar*, then *nya Handlingar*) because scientific knowledge and technical expertise major tools in the development of the economy of the Kingdom of Sweden. The use of Swedish did not deter the dissemination of these transactions in Europe because partial translations into various languages were available, and up until 1792, the mathematician Abraham Gotthelf Kästner (1719-1800) translated the whole series into German. After 1792 many difficulties arose due to the decline of the cosmopolitan cultural climate of the Enlightenment, and to the Napoleonic campaigns, which limited the reception of scientific news from Stockholm. So, in December, 1820, reforms were introduced into the statutes of the Academy, and Berzelius became the prime mover of the reappearance of scientific communication from Northern Europe.

The reforms determined that on the 31st of March of each year, an official and solemn session of the Academy would take place, during which the Secretary was to present an annual report on the status of science. In March, 1821, Berzelius presented his first report which came to 150 printed pages. It is the first volume of Berzelius's *Årsberättelse om Framstegen i Physik och Kemi*, that became a yearly journal, whose first series (1821-1840) amounts to twenty volumes, while the second series, in seven volumes, finishes in 1847,⁴⁶ the year before Berzelius's death. Firstly Berzelius aimed at treating all the sciences, and then he focused on chemistry, physics, geology and mineralogy. Composing the reports was a heavy duty and his reports became more and more bulky: the report of March 1845 concerning chemistry and mineralogy consists of 692 printed pages.

The preparation of the reports obliged Berzelius to systematically read all European scientific activity, therefore enabling him to collect an impressive mass of information. The stated aims of the *Årsberättelse* were two: the first one was pedagogical; the second one was cultural and social. Berzelius vigorously supported the improvement of students' chemical preparation; with regard to his chemical textbook, the reports obviated the need for new editions of a massive textbook because they provided an operative, annual update of scientific progress. In presenting his reports Berzelius also wanted to reach a general and wide reading public in order to stimulate a social and institutional interest in science.

Berzelius was not just a historian or a *rapporteur* because the topics he dealt with were the objects of his own personal research. Therefore, the reports contain his critical considerations, and his strong criticisms. The official position of Perpetual Secretary of the Academy did not constrain his polemic spirit when the topics were chemistry and mineralogy.

The two series of *Årsberättelse* were not limited to a chapter in Swedish science because Berzelius's German former pupils got involved in disseminating the contents of the reports beyond Sweden. The first three volumes were translated by Gmelin; then the faithful Wöhler started translating all the yearly volumes with the title of *Jahrbericht*, and he was even able to excise the censorial expressions Berzelius used when he criticized German scientists. Thanks to his Swiss assistant Philippe Plantamour, Berzelius witnessed his reports published in French in Paris, and the first volume (1841) contains the statement "traduit du suédois sous les yeux de l'auteur".⁴⁷

Årsberättelse was conceived as an instrument of renewal of the Academy of Sciences but it became an arena, an extraordinary literary place which Berzelius occupied in order to accomplish two main goals: the communication of knowledge, and of his research; and the severe criticism of certain philosophical and scientific trends of the culture of his time.

5. A BRIEF CONCLUSION

Sweden, Stockholm, and the Academy of sciences are very important places in the history of the development of chemistry from the Eighteenth century to the first half of the Nineteenth century because they were the context of some extraordinary chapters in the adventurous history of modern chemistry.

Berzelius is a symbol of Swedish science. He was aware that the growth of science was a difficult, but essential task, and he became both a steadfast, experimental researcher and a brilliant controversial figure who had committed himself to elucidate the ongoing progress of science. He adopted various strategies of communication, i.e. the writing of a textbook and of annual academic reports on science, and the creation of a network of personal relationships with students and other followers; these strategies allowed him to keep attention on his ideas and research alive.

Berzelius contributed to the success of chemistry in the Nineteenth century, but his ideas were slowly put aside, and together with his dualistic theory his project of a continuous, public information resource about science disappeared.

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