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# Introduction: Scientific and Technological Textbooks in the European Periphery

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*Science and Technology in the European Periphery* (STEP) is an international research group focused on the study of processes and models of circulation of scientific and technological knowledge between European centres and peripheries from the sixteenth to the twentieth century. STEP was founded in May 1999, in Barcelona, and gathers together researchers and university teachers from Belgium, Denmark, Greece, Hungary, Italy, Portugal, Russia, Spain, Sweden and Turkey. STEP organises thematic meetings to be held biannually. Besides the foundational meeting in Barcelona, three more meetings have taken place in Lisbon, Portugal (Scientific travels), Aegina, Greece (Scientific and Technological Textbooks) and Aarhus, Denmark (Traditions and Realities of National Historiographies of Science). The next meeting will be focussed on the popularisation of science in the European Periphery.[1] The current volume *Scientific and Technological Textbooks in the European periphery* gathers a selected group of papers discussed at the Aegina meeting. Editors are very grateful to all STEP members who have contributed their comments and suggestions to the current volume, particularly to Ana Carneiro, Irina Gouze vitch, Gabor Pallo, Georgia Petrou and Ana Simoes who kindly sent many useful remarks concerning the following introduction to the volume. We are also indebted to Michael R. Matthews for his suggestions and help during the editing process.

Words are ''witnesses which often speak louder than documents''.[2] The word ''textbook'' appeared for the first time in English around 1730[3] but it acquired its contemporary meaning about half a century later, i.e., a book containing a systematic presentation of the principles of a subject, or a collection of writings dealing with a specific subject, and whose purpose is mostly to be used in education or as a reference work.[4] However, other words (''Elements'', ''Course'', etc.) were used before the eighteenth-century for describing books employed for educational purposes. In other languages, there are other words which convey a similar but not identical meaning. The

usual Russian equivalent of "textbook" is "uchebnik" (from *uchit'* = to teach), commonly designated as "a book meant for the teaching of any school matter". According to the *Dictionary of Modern Russian Literary Language*, its first fixed use dates from 1847. The German word "Lehrbuch" or the Swedish "Lärobok" (also from "lehren" = to teach) are used sometimes in contrast to "Handbuch" (from "Hand" = hand). In his introduction to the famous "Lehrbuch der Chemie", Berzelius remarked the difference between the organisation of a "Lehrbuch" (which has to be adapted to educational purposes) *vs*. the systematic order adopted in a "Handbuch".[5] However, Berzelius's six volumes *Lehrbuch* seems more a reference book than a textbook.

In the Latin languages, the words "manuel" (French), "manual" (Spanish, Catalan, Portuguese), "manuale" (Italian) expressed the idea of a small book or treatise, such as may conveniently be held in the hand (lat. "manus") and translated the Greek term "encheiridion" (from "cheir", hand)."Manual" is quite an old word since its first instances occurred before the 12th century (probably the 10th) and it always signified a *concise* treatise which aimed to *bridge* theoretical or divine knowledge with everyday practice.[6] Many other words were employed in different languages to refer to books used for didactic purposes. For instance, the title of the Russian books studied by Irina Gouzevitch in this volume included the words "vvedenie" (*introduction*), "rukovedenie" or "rukovodstvo" (*guide*), "kniga uchashchaja" (*teaching book*), "ugotovanie i tolkovanie jasnoe" (*clear preparation and explanation*), and so on. Very often, these words were coupled with the adjectives "kratkij" or "kratchajshij (*concise, very concise*). A similar situation occurred in other European languages: "*Grundriss der organischen Chemie*", "Traité élémentaire de physique", "Elementos de historia natural y fisiología", etc.

This brief discussion about the origins of the word "textbook" in different European languages sheds some light on the value of studying science textbooks in the European periphery. The different words and the difficulties of translation depict the changing local education systems in which textbooks were written, printed and read. These spaces are usually neglected by master narratives on history of science (Brock 1975, 1990) but they can provide valuable resources for a fresh comparative approach to the history of scientific teaching practices.[7] Science teaching is no longer regarded as an act of passive transmission of knowledge but as one of the chief spaces in which scientific knowledge is constructed. Teachers and students are considered as active agents in creating scientific knowledge, and teaching as a multidirectional activity that implies a strong interaction of all participants. Science teaching is now usually pictured as an activity located at the intersection between scientific knowledge and pedagogical views that has always come under strong social, economic and political pressures.[8] There is not a linear relationship between these forces. Their interactions are complex and deserve to be studied in depth.[9]

Scientific textbooks offer hints about this intricate space because they are located in a crucial place among the multiple and diverse factors and actors that shape educational practices.[10] Scientific textbooks are written by authors with particular backgrounds and goals and they are produced by printers using different technological means and sold by publishers and booksellers in specific technical, economic and commercial contexts. Moreover, textbooks are read and used by a great variety of audiences with different aims, expectations and reading practices. Scientific textbooks are therefore at the crossroad between disciplines such as history of science, history of education and history of books and reading. By analysing this variety of historical actors, little known sources and controversial notions, *Scientific and Technological Textbooks in the European Periphery* aims to provide a fresh look at the historiography of science and to contribute to the recent studies which attempt to connect history of science with the history of book and reading.

Places of scientific education are not only sites where knowledge circulates among individuals and groups of the same society, but they are also an important space for the transmission, appropriation, adaptation and transformation of knowledge. As shown in the previous STEP project and collective volume on *Travels of Learning*, most of the scientific travels around Europe were supported by educational institutions whose members aimed to renovate their scientific curricula and teaching practices. Most of the scientists travelled abroad in order to attend lectures delivered by prominent authors in well-known educational institutions and, in some cases, to be accepted in their teaching laboratories. At times, they bought textbooks, which they subsequently introduced to their countries of origin, and often acted as translators of relevant scientific textbooks in their ''peripheral'' languages. Finally, these scientific travellers often became teachers in their countries where they tried to introduce new teaching practices as well as new scientific knowledge (Simoes *et al.* 2003).

Besides the bulk of local research on these topics, the predominant international literature about the history of scientific teaching is focused on scientific centres. A comparative study among the European countries, however, could reveal a very different picture of scientific education. When scientific ideas or educational models are introduced and appropriated in another country, they are usually reinvented by local actors, and moulded by the local educational forces. Analysis from this perspective will offer additional information about the changing meanings of scientific ''peripheries'' and ''centres'' as well as their intricate relationships. Thus, we expect that the current volume will pave the road for a future productive dialogue between studies on the 'centres' and studies on the 'peripheries' and cast new light on the controversial issues related to the processes of transmission of knowledge, which are at the core of STEP research programme.

Textbooks are closely related to the emergence and consolidation of scientific disciplines because they serve to stabilise shared knowledge and practices in a research field. ''Textbooks expound the body of accepted theory, illustrate many or all its successful applications, and compare these applications with exemplary observations and experiments'' – wrote Thomas Kuhn in *The Structure of Scientific Revolutions* (1962). According to Kuhn, textbooks are uncontroversial vehicles of ''normal science'' and they ''define the legitimate problems and methods of a research field''. Thus, the sentence ''scientific revolutions in textbooks'' seems to be an oxymoron.

Three first papers in this volume attempt to analyse this question by focussing on textbooks during the chemical revolution in Portugal, Spain and Italy.[11] Papers on Spanish and Portuguese chemistry focus on two textbooks – the *Curso de Química* (1788, 2nd ed. 1802) authored by the Spanish pharmacist Pedro Gutiérrez Bueno and the *Elementos de Chimica* (1788–1790) written by the Portuguese medical student Vicente Coelho Seabra – in order to analyse how the chemical revolution was appropriated by Iberian authors, how did they get in touch with the new ideas and how did they perceive them – as radical novelties or just as minor changes in a larger theoretical corpus. The analysis shows that what historians now regard as opposite theories was essentially reconciled in the two Iberian textbooks. Or maybe it would be better to say that many protagonists of the time did not regard these theories as ''incommensurable''. Moreover, Seligardi's study on Italian textbooks shows that when a revolutionary theory passes from one country to another, it does not pass as a whole. People who received it also had different perceptions about the novelties; they valued different aspects, and they had even opposite aims when diffusing them. In this respect, both the background training of a teacher and his target students become relevant.

Through the analysis of the Italian, Portuguese and Spanish textbooks, these three papers describe a broad range of images about the identity of chemistry and its relationship with other disciplines such as natural history and experimental physics. As with other papers in the volume, the authors discuss how scientific instruments are portrayed in textbooks and used in classrooms. The images of experiments which were described in the books provide information about the teaching practices in the context of the local resources: the laboratory of the University of Pavia, the Chemical Laboratory of the reformed University of Coimbra and the Spanish Royal Laboratory of Chemistry.

The first half of the nineteenth-century saw also the emergence of research schools in chemistry.[12] A key process in forming a research school is transmitting theoretical and practical knowledge from master to pupil.[13] Higher education centres provide shared curricula and training programs which produce common styles of thinking or similar experimental skills for a large group of students. The development of research schools depended also on

other forms of transmission of scientific knowledge such as apprenticeship with older scientists, collaboration with colleagues, departmental seminars or informal discussions at the laboratory bench. It can be hardly denied that textbooks played a role – whatever it might have been – in that multidimensional process by supplying a shared scientific background for a community of would-be scientists, especially when textbooks were written by charismatic leading figures of research schools. Textbooks and scientific teaching might contribute to the emergence of a shared culture of precision[14] or a common "outillage mental"[15] which are at the base of research schools and large investigative enterprises. Anja Jacobsen's paper explores these questions through a particular case study – Ørsted's research school of natural science in Denmark during the first half of the nineteenth century. Despite the fact that some of Ørsted's celebrated discoveries were made in the classroom, little has been written about his *teaching* programme and his textbooks. By analysing Ørsted's textbooks – as well as autobiographical documents, lecture notes and other sources – Jacobsen convincingly argues that Ørsted's research, teaching activity, and textbook writing were intimately connected in his attempt to create a research school of dynamical science in Copenhagen.

The case of chemistry, as well as other disciplines involving practical work, brings forth the question of whether laboratory techniques and "tacit knowledge" can be appropriated by students when reading scientific textbooks. Gerald Geison has remarked that "the enculturation of experimental techniques, practices, and skills through direct personal interaction in research schools is more important than the transmission of "impersonal" knowledge through textbooks or other relatively distant forms of communication".[16] In a critical revision of the concept of "tacit knowledge", Kathryn Olesko has pointed out that "a considerable portion of scientific practice is codified, including parts of those areas formerly thought most immune to explicit codification, such as data analysis". Olesko has shown that "overemphasizing the role of tacit knowledge [...] has entailed ignoring... learning by explicit precept".[17]

The study of *Scientific and Technological Textbooks in the European Periphery* might shed new light on these intricate questions. Defying the commonly held view of technology as applied science, Anders Lundgren shows that theoretical science occupied just a small part of many nineteen-century textbooks on chemical technology. These books can rather be seen as containing descriptions of unique technological processes, or as collections of recipes. Lundgren argues that these features were due to the local character of technological knowledge and the inability of the scientist to describe basic technological processes to the benefit of engineers, which resulted in recipe-like textbooks. According to Lundgren, these descriptive books played a less important role than espionage, journeys, personal contacts or apprenticeship

in technological transfer. Textbooks were not the main agent in this process, since they were too scientific for engineers and too technical for university students.

Textbooks are by now a well-established genre of scientific literature. A scientific genre implies assumptions and stable conventions which are shared by readers, publishers and authors about what is (and what should be) a textbook. These assumptions and conventions are, however, locally-dependent and may change over time. We can find, for instance, that eighteenth-century textbooks might not be easily distinguished from encyclopaedias[18] and popular science books.[19] Boundaries separating genres and conventions are always negotiated by historical actors, so their salient characteristics are locally and historically dependent. Gabor Pallo discusses that question by focussing on the Hungarian Encyclopaedia published in Utrecht, in 1655, by Janos Apaczai Csere, a young man from Transylvania. Apaczai applied Ramus' logic to his book and established dichotomies creating a tree. This structure provides an opportunity to compare Apaczai's book with another famous textbook written by Andreas Libavius who also used Ramus's logic, but in the field of chemistry. Pallo argues that in a period when an encyclopaedic worldview was still alive in Europe, and knowledge was not divided into discrete disciplines, an encyclopaedia compiled and published in a peripheral language could serve as a textbook as well.

Another example of the diverse and changing characteristics of textbooks is provided by Manolis Patiniotis in his study on Greek textbooks during the eighteenth century. In contrast with Hungary, Greek populations lacked the institutional structures of a national state. The Balkan Greek populations were part of the Ottoman Empire whereas other large Greek communities were dispersed in Central Europe and within the most important cities of the Northern Italian peninsula, the Hapsburg Empire, and the German States. The Christian Orthodox faith and the Greek speaking education were two strong unifying elements which differentiated these populations from others, and assigned them a certain degree of internal homogeneity. Relying on a large group of books and a hybrid quantitative–qualitative analysis, Manolis Pationitis offers a typology of the textbooks that were written and published in Greek world from 1710 through the mid 1820s. He argues that although Greek textbooks played a minor role in defining scientific disciplines, their political implications cannot be undervalued because they were meant to affect the balance of power between the established authorities of the time.

One salient characteristic of textbooks in the scientific periphery is the large number of translations, mostly from the dominant language in a scientific discipline into the local or national language. An increased interest in the history of translation has been shown by historians since the 1980s but it is only the history of literary or religious translation that has attracted much attention. The part played by translations of scientific texts

in the development of science is still a largely neglected field of study.[20] The study of translation is employed, if at all, as a bibliometric indicator of the success of a book. However, translators introduced substantial changes in their books (notes, selections, additions). Popular books such as Jean Marcet's *Conversations on Chemistry* were dramatically changed by translators with notes, additions and new titles and structures.[21] The changes of meaning and the process of cultural relocation associated with translations have rarely been taken into account by historians of science.

These questions are discussed by Georgia Petrou and Irina Gouzevitch. Georgia Petrou studies the place of translation in the history of the Greek philosophical and scientific thought between the years 1750 and 1821. She shows *how* the analysis of translation as a creative process casts new light on reception studies. Petrou draws on two examples of Greek translations intended for education. Apart from examining *who translated*, *what* and *for whom*, she discusses *why* the two particular translations appeared within the specific Greek context of that time. Their nature can be understood if we take into account the particularities of the Greek educational space and the aspirations of the individual Greek translators. By combining prosopographical and bibliographical approaches, which involves the analysis of a large amount of printed and manuscript sources, Irina Gouzevitch analyses a long list of Russian translators and translations from the beginning of the eighteenth century. Her study is focused on authors' biographical profile and the diverse editorial policies offering a rich picture of the emergence of Russian textbooks during Peter I's rule. She also provides a typology of translators (*casual, erudite, professional, vocational* and *conjunctural*) and discusses their different views about what they regarded as a good translation.

Ironically, the papers in this collection undermine the apparent coherence of the term "textbook" as used in the title of this volume to define the common research object of the studies. When readers get closer to the examples described and analysed, they will discover how this apparently precise notion starts to adopt meanings that are extremely different. The clear image forged in our mind, most likely based on our personal experience with this kind of object, will fragment into the multiplicity of forms, roles and uses that the so-called "textbooks" had in the different contexts and moments studied throughout the chapters of this volume. When observing how didactic texts were conceived, produced, exported, translated, perceived and read in each place and period, readers will understand how reductive the term "textbook", understood as a stable and uniform category, could be, and how aprioristic and simplifying conceptions about the role of education as a part of the scientific activities of a historical period and context could hide the rich variety of situations and processes implied in this key form of scientific communication. This is, at least, our goal.

## Notes

[1] Revised versions of the contributions to the Lisbon meeting has been recently published in the collective volume: Simoes, A., Diogo, P. & Carneiro, A.: (eds.) 2003, *Travels of Learning*, *A Geography of Science in Europe,* Kluwer Academic Publishers, Dordrecht for current STEP activities see http://www.uoa.gr/step.

[2] Hobsbawm, E.J.: 1964, *The Age of Revolution*, 1789–1848, Mentor Books, New York. p. 17.

[3] "Textbook" in the on-line version of the *Oxford English Dictionary*, 3rd ed. (March 2002).

[4] Webster's Third New International ® Dictionary, Unabridged, Copyright © 1993 Merriam–Webster, Inc.

[5] Berzelius, J.J. *Lehrbuch der Chemie*, Dresden und Leipzig, 1843, I, v. "Es ist keine leichte Sache, einen guten Plan für ein chemisches Lehrbuch zu entwerfen. Dieses hat einen ganz andern Zweck, als das Handbuch, in welchem die strengste systematische Ordnung die Hauptsache ist". Berzelius used the Swedish spelling *Lärbok* instead of the more normal *Lärobok* in his text book.

[6] "Handbook" in the on-line version of the *Oxford English Dictionary,* 3rd ed. (March 2002).

[7] On comparative history of science see Pyenson, L.: 2002, 'Comparative History of Science', *History of Science*, **60**, 1–33.

[8] Olesko, K.M.: 1991, *Physics as a Calling: Discipline and Practice in the Königsberg Seminar for Physics*, Cornell University Press, Ithaca.

[9] Christie, J.R.R. & Golinski, J.V.: 1982, 'The Spreading of the Word: New Directions in the Historiography of Chemistry 1600–1800'. *History of Science,* **20**, 235–266.

[10] For a general discussion on textbooks as historical sources see Choppin, A.: 1980, L'Histoire des manuels scolaires: une approche globale, *Histoire de l'éducation*, **9**, 1–25 and Choppin, A.: 1992, *Les manuels scolaires: histoire et actualité*, Paris, Hachette. Several studies on scientific textbooks have been recently published: Haupt, B.: 1987, *Deutschsprachige Chemielehrbücher (1775–1850)*, Stuttgart; Clark, W. (1997), German Textbooks in the "Goethezeit". Part I–II, *History of Science*, **35** (2–3), 219–239; 295–363; Lind, G.: 1992, *Physik im Lehrbuch, 1700–1850*, Springer, Berlin; Lundgren, A.; Bensaude-Vincent, B.: (eds.) 2000, *Communicating Chemistry*. *Textbooks and Their Audiences, 1789–1939*, Science History Publications, Canton. Bensaude-Vicent, B., Garcia Belmar, A. & Bertomeu sánchez, J.R.: 2003, *La naissance d'une science des manuels (1789–1852)*, Paris, Editions des Archives Contemporaines. For additional bibliographic guidance and a current overview about pedagogy of science in historical perspective, see the papers by Bernadette Bensaude-Vincent and Kathryn Olesko in this volume and Kaiser, D.: (ed.), 2005 *Pedagogy and the Practice of Science: Historical and Contemporary Perspectives*, Boston, MIT Press

[11] See Bensaude-Vincent, B. 1990, 'A View of the Chemical Revolution through Contemporary Textbooks: Lavoisier, Fourcroy and Chaptal', *British Journal for the History Science*, **23**(4), 435–460; Nordmann, A.: 1986, 'Comparing Incommensurable Theories: A Textbook Account from 1794', *Studies in History and Philosophy of Science*, **17**, 231–246. Seligardi, R.: 2002, *Lavoisier in Italia. La comunità scientifica italiana e la rivoluzione chimica*, Leo Olschki, Firenze. 410 p. Bertomeu sanchez, J.R. & Garcia belmar, A.: 2003 El *Curso de química general aplicada a las artes* (1804–1805) de José María San Cristóbal y Josep Garriga i Buach. In: J.L. Barona et al. (eds.), *La Ilustración y las ciencias*, Valencia, PUV, 179–237.

[12] Crosland, M.: 2003 'Research Schools of Chemistry from Lavoisier to Wurtz', *British Journal for the History of Science,* **36**, 333–361.

[13] See Carneiro, A. (1992), *The Research School of Chemistry by Adolphe Wurtz, Paris, 1853–1884*, Kent University, Ph.D., 351 p. Klosterman, L.J.: 1985, 'A Research School in Chemistry in the 19th Century: Jean Baptiste Dumas and his Research Students', *Annals of Science*, **42**, 1–80. Geison, G. & Holmes, F.: (eds.) 1993, 'Research Schools: Historical Reappraisals', *Osiris (2d. series)*, **8**, 1–238.

[14] Wise, N.: (ed.) 1995, *The Values of Precision*, University Press, Princenton. 372 p.

[15] Olesko, K.M.: 1985, 'The Mental World of *Physiklehrer*: Subject and Method in History of Mentalities', *Recherches en Didactique des Mathématiques*, **6** (2–3), 347–362.

[16] Geison, *op. cit*., *Osiris*, **8**, p. 231.

[17] Olesko, K.: 1993, 'Tacit Knowledge and School Formation', *Osiris*, **8**, 16–29, quoted on pp. 16–17.

[18] Yeo, R.: 2001, '*Encyclopaedic Visions*: *Scientific Dictionaries and Enlightenment Culture*, Cambridge University Press, Cambridge.

[19] Cooter, R. & Pumfrey, S.: 1994, 'Separate Spheres and Public Places: Reflections on the History of Science Popularization and Science in Popular Culture', *History of Science*, **32**, 237–267.
[20] Among recent studies, see Rupke, N.: 2000 'Translation Studies in the History of Science: The Example of "Vestiges"', British Journal for the History of Science, **33**, pp. 209–222; and Montgomery, S.L. 2000, *Science in Translation. Movements of Knowledge Through Cultures and Time*, Chicago and London.
[21] See Knight, D.: 1986, 'Accomplishment or Dogma: Chemistry in the Introductory Works of Jane Marcet and Samuel Parkes', *Ambix*, **33**, 94–98. Lindee, M.S.: 1991, 'The American career of Jane Marcet's Conversations on Chemistry, 1806–1853', *Isis*, **82**, 9–23.