

## CROSS-NATIONAL EDUCATION AND THE MAKING OF SCIENCE, TECHNOLOGY AND MEDICINE

**Josep Simon**

*Université Paris Ouest*

The history of science, technology and medicine is currently attempting to move towards the global, attuned to the resonance of buzzwords such as ‘globalization’ and ‘transnationalism’ in the affairs of our times.<sup>1</sup> In the last decades, social constructivism<sup>2</sup> has had a fundamental role in the shaping of our discipline, but it has also contributed to consecrating the local against the global. As a reaction to positivism, social constructivism converted the making of any generalization in a national or international scale into anathema. In considering that science was not universal, the field moved towards the production of microhistories that, while illuminating the role of social processes in the construction of scientific knowledge in local settings, have also obscured the relevance of macrohistorical explanations.<sup>3</sup> Paradoxically, social constructivists, like their predecessors, gave an implicit status of universality to a set of categories, in their case stressing the locality of knowledge.

But there are obviously other reasons for the discrimination of the global against the local. A decade ago Lewis Pyenson predicted the end of national science and the rise of comparative history,<sup>4</sup> but in fact our field is still characterized by national pictures (or local cases which explicitly or implicitly are endowed with national qualities). There are still a small number of historical studies which deal with science, technology and medicine in more than one national context.<sup>5</sup> In practical terms this is understandable, since tackling several national cases in comparative or cross-national perspective is not a simple matter, and is hindered by demanding knowledge of several languages and national historiographies, and the infrastructure required to work in archives and collections in different countries.

However, there is a clear interest in our field to move beyond the local, which has in general taken alternative and complementary ways to comparative history. New approaches have focused their attention on the study of international connections through mediating agents (human and non-human) and the analysis of knowledge circulation between different national or cultural contexts. James Secord’s programmatic proposal “Knowledge in transit” and Schaffer, Roberts, Raj and Delbourgo’s advocacy for the study of “go-betweens” in *The brokered world* are two of the most representative and recent proposals in this field.<sup>6</sup> In spite of their novelty, these approaches have many things in common with proposals previously developed in history of science and in other historical specialisms. Examples of these are the study of “travels of learning”, circulation and appropriation by the group STEP (Science and Technology in the European Periphery), the focus on cultural transfers and mediating agents applied in cultural and book history, and the study of cultural “*passeurs*” and

transnational interactions in Latin American and Atlantic history.<sup>7</sup>

While these approaches are contributing decisively to a more accurate assessment of the role of international and transnational phenomena, they involve the risk — if applied alone — of circumventing the important role of the nation in science. A combination of approaches in cross-national perspective is required, which acknowledges national, international and transnational phenomena in their proper measure.<sup>8</sup> This special issue intends to contribute to this critical question by presenting a series of studies in cross-national history of science education.

Cross-national comparison was a major driving force in the nineteenth-century organization of science and education. Educationists, scientists and students circulated across national boundaries and compared different educational systems, producing accounts which contributed to inform educational reforms in their own national or local contexts. The development of national systems of education and examination, in which the sciences were taught in a systematic manner for the first time and the publics of science expanded dramatically, had a major role in the shaping of scientific disciplines and medical specialities. In the same period, the history of education emerged as a discipline aimed at illuminating contemporary educational research and organization through historical perspectives. Cross-national comparison was a key method, which, in spite of various epistemological challenges has survived up to our time, giving rise to well-established academic fields such as comparative education.

Historians of education have often approached the study of science from the point of view of institutions and curricula and focused especially on primary and increasingly secondary education. They have in certain cases produced large-scale international comparisons which have often overstressed the role of the national by conceiving educational contexts as compact national systems or models.<sup>9</sup> In contrast, historians of science have favoured tight accounts of pedagogy and training in local context, and commonly focused on higher education. In the last decade, some major works in this field have produced international pictures on science pedagogy, through the study of circulation of scientists and pedagogical tools. However, approaches are still too often restricted to local or national contexts, as they are in the history of science at large.<sup>10</sup> By combining approaches arising from the history of science and the history of education,<sup>11</sup> this special issue aims to contribute to a more accurate grasp of the role of national, international and transnational phenomena in the making of science, technology and medicine in the nineteenth century.

The papers in this special issue deal with education in science, technology or medicine in eight different national contexts (France, England, Sweden, Germany, Austria, USA, Japan and Ireland). They reflect on the tensions between national and cross-national phenomena through a focus on agents such as students, teachers, medical practitioners, scientists, educationists and textbooks, which travelled across several national boundaries and therefore played a role in different national contexts and across them. They use different methods such as prosopography, curriculum studies, institutional history, the study of pedagogical practices, comparative history, and bibliographical analysis.

Stephan Curtis characterizes the international and transnational character of nineteenth-century European medicine through a wide ranging prosopographical analysis of Swedish students and practitioners who travelled abroad as part of their training. His study analyzes the circulation and experiences of these historical actors across different national contexts in Europe. Thus he provides a novel historical account of the rise of medical specialization in international perspective. His paper presents a picture of Swedish medicine which emphasizes the role of internationalism in the making of medicine in national context. In addition, it contributes to a more accurate assessment of European medicine as a result of intense cross-national interactions during the nineteenth century. Through the eyes of Swedish travellers, a new map of European medicine emerges, which challenges standard narratives in the history of medicine focused on national models and the transfer of leadership in research from France to Germany.

Yoshiyuki Kikuchi shares with Curtis the focus on the circulation of human agents but, in contrast, he concentrates on a single historical actor. His case study on the professional career of Edward Divers exemplifies the shaping of chemical practice during the nineteenth century. While previous studies on this subject have traditionally remained trapped in national history, Kikuchi does not hesitate to explore the implications of the long-distance networks of the British Empire in the making of nineteenth-century chemistry. His paper is a tight case study on the interaction of pedagogy and research and its role in the making of science. Kikuchi carefully analyzes Divers's training in England and Ireland and its impact on his subsequent teaching and research in different educational institutions in Japan. He closely examines the interaction of different national and local scientific and educational contexts with Divers's own experience, and how the former shaped the latter. His paper builds a comparative picture of chemical practice in national context, through the diachronic comparisons performed by Divers in the course of his international career. But Kikuchi also pinpoints potential limitations in the production of well-defined pictures of scientific practice in national perspective and in the contribution of cross-national agents to the internationalization of science and to the politics and cultures of imperialism and transnationalism. While providing valuable insights with regard to these fundamental problems, his paper emphasizes the adaptability of scientists to different national and local contexts, and their capacity to contribute with their pedagogical and investigative work simultaneously to several national cultures.

A. J. Angulo's paper also includes cross-national agents, in their circulation between the USA and Europe, but his focus is on educationists and the leaders of a range of major nineteenth-century institutions of technical education. He introduces a novel approach to the problem of the making of science in America, through a wide-ranging comparative characterization of educational institutions, in contrast with the bias and anachronism commonly found in previous literature, which focuses on a limited set of nineteenth-century colleges leading to contemporary ivy-league universities. In exploring the development of scientific and technical education in America through the establishment of teaching programs at West Point, the Rensselaer

Polytechnic Institute, the Massachusetts Institute of Technology and Clemson University, Angulo provides a more accurate picture of the national and international forces which shaped the making of science and technology in the USA. His paper challenges the simplicity of standard narratives built on the idea that the development of American education was driven by the successive application of British and German models. In contrast, he demonstrates the exemplary importance of French polytechnic schools to the eyes of American educational entrepreneurs. Moreover, he questions the analytical category of national ‘models’, stressing, on the one hand, the role that cross-national actors have in the production of national pictures, and on the other, the greater relevance of creative appropriations. Thus, the development of American education in science and technology was not merely based on the replication of a German or French ‘model’, but the result of interactions between different national outlooks and local circumstances.

Josep Simon revisits Angulo’s focus on standard narratives of science and education in national perspective, with a case study on the making of physics in France and England. But he focuses on textbooks as cross-national agents in the making of science. Simon’s paper demonstrates the driving role of textbooks in the development of national schemes of science education in cross-national perspective. It tackles two national contexts which are traditionally considered antagonistic, and provides a more accurate characterization which reveals their commonalities and differences. Through cross-national comparison, Simon’s paper demonstrates the major role of secondary and medical education in the making of physics as a discipline. By focusing on the production and circulation of physics textbooks, Simon challenges the standard periodization of physics based on a pattern of leadership transfer driven by France, Britain and Germany in succession. His paper contributes to a better understanding of the fruitful interactions between science and pedagogy and the relevance of considering the role of education in the making of scientific disciplines. If science and education in France and England were shaped by different national cultures (which have also fashioned their academic histories), Simon’s paper contends that they were subject to intense cross-national interactions, and that they had more in common than hitherto assumed.

At the crossroad of the rise of the nation-state, the emergence of scientific disciplines and the internationalization of human affairs, as the papers in this special issue suggest, the study of education in cross-national perspective is deemed to play an important role in the history of science, and to contribute to a better understanding of the boundaries of the nation in the making of science, technology and medicine.

#### ACKNOWLEDGEMENTS

The articles in this special issue are based on two symposia held in 2010 at the 7th STEP Meeting (Galway, Ireland) and the 4th International Conference of the European Society for the History of Science (Barcelona, Spain). I would like to thank all the participants in these sessions and the scientific committees of these two conferences. The preparation of the symposia and this special issue was possible thanks to

fellowships awarded by the Dibner Library at the Smithsonian Institution, the John W. Kluge Center at the Library of Congress, and a Marie Curie Postdoctoral contract (FP7-PEOPLE-2009-IEF-254889).

## REFERENCES

1. On globalization and global history see P. O'Brien, "Historiographical traditions and modern imperatives for the restoration of global history", *Journal of global history*, 1 (2006), 3–39; B. K. Gills, *The global politics of globalization: "Empire" vs "Cosmopolis"* (London and New York, 2008).
2. I use here a broad definition of social constructivism. See J. Golinski, *Making natural knowledge: Constructivism and the history of science* (Cambridge, 1998).
3. In this context, Margaret Jacob's criticisms are particularly relevant. See M. C. Jacob, "Science studies after social construction: The turn toward the comparative and the global", in V. E. Bonnell and L. Hunt (ed.), *Beyond the cultural turn: New directions in the study of society and culture* (Berkeley and Los Angeles, 1999), 95–120. See also R. Kohler, "A Generalist's vision", *Isis*, xcvi (2005), 224–9; D. Kaiser, "Training and the generalist's vision in the history of science", *Isis*, xcvi (2005), 244–51.
4. L. Pyenson, "An end to national science: Extension of local knowledge", *History of science*, xl (2002), 251–90; *idem*, "Comparative history of science", *History of science*, xl (2002), 1–33.
5. Exceptions to this rule are for instance J. B. Morrell, "The Chemist breeders: The research schools of Liebig and Thomas Thomson", *Ambix*, xix (1972), 1–46; P. Forman, J. L. Heilbron, and S. Weart, "Physics circa 1900: Personnel, funding, and productivity of the academic establishments", *Historical studies in the physical sciences* (1975), 1–185; L. R. Graham, "Science and values: The eugenics movement in Germany and Russia in the 1920s", *American historical review*, lxxxii (1977), 1135–64; S. Sheets-Pyenson, "Popular science periodicals in Paris and London: The emergence of a low scientific culture, 1820–1875", *Annals of science*, xlii (1985), 549–72; J. Harwood, "National styles in science: Genetics in Germany and the United States between the World Wars", *Isis*, lxxviii (1987), 390–414; E. Crawford, *Nationalism and internationalism in science, 1880–1939: Four studies of the Nobel population* (Cambridge, 1992); E. Kranakis, *Constructing a bridge: An exploration of engineering culture, design, and research in nineteenth-century France and America* (Cambridge, Mass., 1997); M. Walker (ed.), *Science and ideology: A comparative history* (London and New York, 2003); C. Sachse, and M. Walker (eds), "Politics and science in wartime: Comparative international perspectives on the Kaiser Wilhelm Institute", *Osiris*, xx (2005); G. Weisz, *Divide and conquer: A comparative history of medical specialization* (Oxford, 2006); V. Quirke, *Collaboration in the pharmaceutical industry: Changing relationships in Britain and France, 1935–1965* (London, 2007); J. Simon, *Communicating physics: The production, circulation and appropriation of Ganot's textbooks in France and England, 1851–1887* (London, 2011).
6. J. A. Secord, "Knowledge in transit", *Isis*, xcvi (2004), 654–72; S. Schaffer *et al.* (eds), *The brokered world: Go-betweens and global intelligence, 1770–1820* (Sagamore Beach, Mass., 2009).
7. A. Simoes, A. Carneiro, and M. P. Diogo (eds), *Travels of learning: A geography of science in Europe* (Berlin, 2003); K. Gavroglu *et al.*, "Science and technology in the European periphery: Some historiographical reflections", *History of science*, xlii (2008), 153–75; M. Espagne, *Les transferts culturels franco-allemands* (Paris, 1999); M. Espagne, and M. Werner, "La construction d'une référence culturelle allemande en France, genèse et histoire", *Annales ESC*, xlii (1987), 969–92; J. Cañizares-Esguerra and E. R. Seeman (eds), *The Atlantic in global history, 1500–2000* (Upper Saddle River, N.J., 2007); N. Canny, "Atlantic history and global history", in J. P. Greene and P. D. Morgan (eds), *Atlantic history: A critical appraisal* (Oxford, 2009), 317–36; N. Safier

- (ed.), “Itineraries of Atlantic science: New questions, new approaches, new directions”, *Atlantic studies*, vii (2010); L. Bénat-Tachot, and S. Gruzinski (eds), *Passeurs culturels: Mécanisme de métissage* (Paris, 2001).
8. In this context, it is particularly useful to take into account debates which have already reached a higher degree of maturity in other areas of history. See for instance, D. Cohen, and M. O’Connor, *Comparison and history: Europe in cross-national perspective* (New York, 2004).
  9. See for instance F. K. Ringer, *Education and society in modern Europe* (Bloomington, 1979); K. H. Jarausch (ed.), *The transformation of higher learning, 1860–1930: Expansion, diversification, social opening, and professionalization in England, Germany, Russia, and the United States* (Chicago, 1983).
  10. K. Olesko, *Physics as a calling: Discipline and practice in the Königsberg seminar for physics* (Ithaca, 1991); D. Kaiser, *Drawing theories apart: The dispersion of Feynman diagrams in postwar physics* (Chicago, 2005), and *Pedagogy and the practice of science: Historical and contemporary perspectives* (Cambridge, Mass., 2005); J. L. Rudolph, *Scientists in the classroom: The Cold War reconstruction of American science education* (New York and Basingstoke, 2002); B. Bensaude-Vincent, A. García Belmar, and J. R. Bertomeu Sánchez, *L’émergence d’une science des manuels: Les livres de chimie en France (1789–1852)* (Paris, 2003).
  11. On the meeting points and distances between the history of science and the history of education in the study of science education see K. Olesko, “Science pedagogy as a category of historical analysis: Past, present, and future”, *Science and education*, xv (2006), 863–80; J. L. Rudolph, “Historical writing on science education: A view of the landscape”, *Studies in science education*, xlv (2008), 63–82; Simon, *Communicating Physics* (ref. 5), pp. 1–5, 15–18, and “Physics textbooks and textbook physics in the nineteenth and twentieth centuries”, in R. Fox, and J. Z. Buchwald (eds), *The Oxford handbook of the history of physics* (Oxford, 2012).

Copyright of History of Science is the property of Science History Publications Ltd. and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.