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STEP Matters

Historiographical Considerations

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ABSTRACT: In this introduction, we revisit major discussions around historical themes and historiographical issues that took place during the fifteen-year life of STEP (Science and Technology at the European Periphery). We will attempt to draw the profile of STEP, and put forth some concrete proposals as to its prospects of collaboration with other groups and societies. We also elaborate on the rationale behind the selection of topics presented in this issue, analyse questions posed and challenges faced, and offer some historiographical comments on the potential of the STEP perspective in the context of international scholarship.

In the past twenty years, the conceptual and methodological contributions from the social and cultural history of science and technology, together with postcolonial and subaltern studies, have led historians of science and technology to concentrate on science and technology in action, emphasiz-

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ing the role of locality and of the circulation of knowledge as creative processes, together with the innovative role of peripheries, colonial spaces, and agents. Although it seems rather obvious that this theoretical framework should not be restricted to colonial and/or imperial spaces, the "European Periphery" as a historical category remains largely unexplored.

Founded in 1999, the international network Science and Technology in the European Periphery (STEP) aims to underline the significance of this historical category by putting forth some historiographical premises that could help highlight the issues concealed by the dominant model of diffusion of science and technology from center to periphery. In addition, we attempt to bring to the forefront of our discipline contributions from various locales in the European periphery. Our intention is to examine the consequences of a change of viewpoint concerning the sciences and technology in Europe by understanding the cognitive, institutional, and social characteristics of science and technology from the point of view of active receivers in the periphery. Throughout its fifteen-year history STEP has brought together in meetings, edited volumes, and collaborative papers more than two hundred historians and philosophers of science, sociologists, philologists, scholars in science studies, and anthropologists from thirty different countries and four continents, although scholars from the founding countries—Greece, Portugal, and Spain—remain the majority. STEP is purposefully a loosely structured group, sharing a website and a discussion list and organizing biennial conferences.

Traditionally, debates about issues related to science and technology in the local contexts of the European periphery have been heavily dominated by rhetoric about the failure of the periphery to assimilate developments taking place in the center because of a "backwardness" almost endemic in these regions. The discussions within STEP aim at understanding not simply the diffusion of science and technology between the center and periphery but the multifarious ways of their circulation, their appropriation by active agents of the periphery, and, at the same time, the continuous reconfigurations of the status of centers and peripheries.

Through criticism of diffusionist models, STEP has delineated the contours of a new historiography of science and technology in the European periphery built on the concept of appropriation. This has been progressively achieved by historicizing the notion of the "European periphery" and analyzing the specificities of the "receiving" culture, probing into the active and thus creative role of local agents and institutions; examining the ways the circulation of practices transformed them and became articulated with the multiple cultural traditions of a specific society; assessing the concomitant emergence of new local scientific discourses, together with legitimizing strategies and spaces; and comprehending the resistance to new practices. In this way, discussions within STEP resonate with the historiographical discussions that are taking place among many other scientific communities.

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By attempting to change the historiographical perspective in the study of science and technology in the European periphery, STEP encourages the writing of historical narratives that bring to the fore the dynamics of the historical co-construction of both centers and peripheries (including the complex role of empires), so as to deconstruct the notion of a "uniform" European science and technology, which is based on the assumption that new ideas and practices are born in well-defined localities of the center and then transmitted to the periphery. A useful way to understand the aims of STEP is to state that it attempts to articulate the history of science and technology in Europe rather than assessing the history of European science and technology. By contributing to this renewed historiography through which Europe's purported identity is being continuously reconstructed, STEP also aims to join other research networks in the ongoing debate on the relevance of science and technology as a global phenomenon.

Although some STEPers are also SHOTers, technology has been until a few years ago in the shadow of science when it comes to STEP topics, mainly because of the research profile of STEP members, who are mostly historians of science. Recently, however, STEP has been dynamically exploring issues of technology. There are historians in STEP who have been viewing STEP's rationale as a conceptual grid that provides a particularly helpful way to approach national topics within a European context and to engage with the general debates in the history of technology, raising new questions and putting forth new arguments. Thus the research on the "T" in STEP is enabling and strengthening an active dialogue with other research groups, mainly SHOT and Tensions of Europe (ToE), revealing distinct agendas in the process.

Both the epistemological and historiographical approaches discussed among STEPers are particularly suitable for historians of technology who focus their research on European peripheral countries, still perceived by a significant part of the community of historians of technology as either just transmission "belts" of more developed industrial economies or as rural, backward regions governed by elites set apart from the technological and scientific mainstream. For the history of technology, STEP's agenda brings idiosyncrasies to the forefront by analyzing them in their local ecosystem rather than in terms of net efficiency. Thus the actors' and (sometimes institutions') strategies are the result of well-thought-out choices and not the result of a series of implementations passively executed by local actors in order to "duplicate" what was happening in the center. This framework is particularly accommodating for historians of technology: it undermines the traditional categories of economic and technological backwardness, reconceptualizes the notion of diffusion to the point of weakening it dramatically as a dominant historiographical view, and sheds new light on concepts such as the portability, plasticity, and flexibility of technological

knowledge and practices. How did "peripheral" engineers and technologists carve their way into their respective international communities, their "Republic of Letters"? How did they use technology and technological infrastructures to design tailor-made modernity(ies) in their geographical and/or cultural locales? How deeply were engineers, with their technological expertise, engaged in political decisions? Which alliances with other professional groups were put forward to empower engineers? Is there a "peripheral" pattern for technology and engineering or just a sum of different, noncanonical solutions? And how can studies of technology and engineering in the European periphery be brought into dialogue with a global audience of historians of technology?

From STEP's perspective, the onset of this technological dimension within its research agenda promises to renew its dynamics, provoke reassessment of its concepts, and foster new opportunities for discussion. The papers that follow further elaborate on a selection of themes extensively discussed within STEP such as the role of science and technology in textbooks and popularization, and science and technology in the press. They also address new issues in which both science and technology are pivotal, such as the shaping of urban peripheries and the building of peripheral nation-states, and explore new historiographical concepts such as moving localities.

These topics bring to the fore the significance of (1) using an integrated historiographical approach to science and technology, often hindered in our respective locales by traditional disciplinary boundaries; (2) exploring the possibilities provided by the relatively recent categories of circulation as knowledge production, by the notion of moving localities, and by reassessment through the perspectives of actively engaged amateurs and experts in various processes of appropriation and communication of science and technology; and (3) voicing the political agendas that permeate scientific and technological knowledge and practices in specific settings, ranging from the city to the nation-state.

The topics selected have been chosen for their suitability in revealing the specificities of local peripheral contexts and the intricate connections between science and technology. Furthermore, they illustrate the potential of collaborative authorship by scholars from different locales. Together, they point to the potential offered by exploring future synergies between STEP and other groups and societies, such as SHOT and ToE, enhancing the role already played by individual joint memberships.

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Beyond Fixed Geographies

Moving Localities and the Making of Knowledge

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ABSTRACT: In recent historiography the notion of circulation serves as a basis for weaving together global narratives of the history of science. However, the emphasis placed by such narratives on the impact of European science should not overshadow the fact that the making of knowledge in Europe is a dynamic and multi-layered process that cannot be reduced to simple models of knowledge circulation among fixed localities. In order to develop this perspective, the authors introduce the notion of "moving localities," as a means to depict the mutually transformative encounters that shaped the notion of European science and technology.

Introduction: Rethinking Circulation

In the past decade, the notion of circulation has been radically reconsidered in the context of a *problématique* inspired by post-Kuhnian history of science and by recent developments in the broader field of social anthropology.[1] Circulation is no longer about the mobility of epistemic "commodities" from one context to another or about the cultural adaptation of particular scientific and technical "products" to particular social "needs." As opposed to the notions of dissemination and diffusion of ideas and practices, it implies mutually transformative encounters between different localities. This revised notion of circulation is furthermore associated with the idea that the kind of motion involved in circulation is repeated and tends to return to a point of origin. As a result, circulation affects in equal

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1. In particular, Kapil Raj, *Relocating Modern Science* and "Beyond Postcolonialism"; Simon Schaffer et al., eds., *The Brokered World*; Arjun Appadurai, ed., *Globalization*.

degrees all the points of the inscribed trajectory, giving rise to stories of "local production, interpretation, appropriation, and use." In order to link these stories, "we need an approach that enables us to think about circulation, not as movement that has a designated centre—that is, a clear and privileged point of origin and return—but as a continuous path whose formative trajectory is constituted out of multiple points of local contact and exchange."[2]

In this new scenario, circulation serves as a basis for weaving together global narratives of the history of knowledge by unveiling connections and disconnections instead of searching for universal patterns. However, the emphasis placed on the compilation of global narratives must not overshadow the encounters, exchanges, and divergences that took place *within* Europe. Studies oriented toward the phenomena of circulation have spurred a growing understanding of imperialism and colonialism as historical movements that created opportunities for interaction with native systems of knowledge and practices, giving way to mutual appropriations and reconfigurations. But while postcolonial works vaguely recognize that such phenomena are not exclusive to colonial spaces, they tend to focus on colonial contexts and overseas imperial circuits. Thus, while acknowledging the relevance of encounters with remote traditions for the definition of Western science, it is important to reflect on how this widely adopted knowledge system came to develop within Europe itself.

Historians involved with the STEP (Science and Technology in the European Periphery) network have disclosed various asymmetries of a supposedly homogeneous landscape of European knowledge. Resorting to different historiographical approaches, they have contributed to a more nuanced picture of how this landscape evolved during the eighteenth century and a significant part of the nineteenth century. For example, by studying the itineraries of traveling individuals, they shed light on the building of networks between scientific and technical centers and peripheries.[3] By following the building of infrastructures and the travels of instruments, artifacts, and practices, they explore transnational territories and common expertise.[4] By focusing on the metamorphoses of the written word, they indicate the fluent character of knowledge and the impact of specific sociopolitical contexts on local scientific discourses.[5] By adopting a comparative approach, they highlight the varied nature of the intellectual currents cutting across centers and peripheries as well as the diverse routes followed by travelers engaged in a wide range of epistemic pursuits.[6]

2. Lissa Roberts, "Situating Science in Global History," 17–18.

3. Ana Simões, Maria Paula Diogo, and Ana Carneiro, *Citizen of the World*.

4. Johan Schot and Thomas Misa, "Introduction"; Maria Paula Diogo, Ana Carneiro, and Ana Simões, "El *Grand Tour* de la Tecnología."

5. José Ramón Bertomeu-Sánchez et al., eds., "Textbooks in the Scientific Periphery."

6. Josep Simon and Néstor Herrán, eds., *Beyond Borders*; Faidra Papanelopoulou,

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However, the creative strength of circulation seems to remain understated, as the emphasis is generally put on particular encounters in certain places and on the movement of certain forms of knowledge, rather than on their transformation in transit. This is probably due to the fact that the overall analytical apparatus employed to approach such phenomena is still tied to traditional divides, particularly those of a spatial nature. Furthermore, these perspectives remain significantly dependent on a contextualist view of knowledge formation that tends to take locality as a set of specificities tied to particular locations. Traveling savants and brokers are depicted as moving around between such localities, well circumscribed in space and time, establishing trading zones and negotiating between worlds apart.

Moving Localities and Circulation as Knowledge Production

Deepening a conceptual shift from *circulation of knowledge* to *circulation as knowledge production* requires us to question the distinction between "home" and "abroad"—or, in other words, the notion of "locality" and the way it is operationalized in historical research. Similarly, we ought to further investigate the mutual shaping of centers and peripheries, which must be approached in their own historicity instead of being taken for granted.

Our contention is that the knowledge system which gradually dominated European modernity has come into being through a dynamic and multilayered process that cannot be reduced to simple models of knowledge circulating through fixed localities. The picture we would like to suggest is one that takes the European periphery as a historiographical standpoint in order to transgress the established spatial hierarchies and bring to the fore the continuous reinventions, conceptual shifts, and cultural adjustments that are responsible for the shaping of modern scientific and technical knowledge. To develop this perspective, we have introduced the notion of "moving localities," which plays a central role in our approach to circulation as knowledge production. Central to the notion of "moving localities" is the idea that locality entails a complex set of connections, allegiances, and commitments, which travel with people and thus extend beyond perceived and effectively marked boundaries, creating interconnected intellectual spaces over wide geographical locations.[7]

These ideas can be illustrated with three groups of eighteenth-century historical actors from the European peripheries: the Portuguese *estrangeirados*, the Spanish *pensionados*, and a group of Greek-speaking scholars of the Ottoman Empire. The *estrangeirados* were Europeanized intellectuals,

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Agustí Nieto-Galan, and Enrique Perdiguero, eds., *Popularizing Science and Technology in the European Periphery*; Ana Simões, Ana Carneiro, and Maria Paula Diogo, eds., *Travels of Learning*.

7. Pedro M. P. Raposo, Ana Simões, Manolis Patiniotis, and José Ramón Bertomeu-Sánchez, "Moving Localities and Creative Circulation."

Portuguese-born or otherwise foreigners living in Portugal, who played a central role in connecting Portugal with the networks that fostered the ideals and inquiries of the Enlightenment.[8] They constituted a very diverse group of people whose life stories were generally marked by frequent mobility across geographical, political, and cultural boundaries, through countries and regions such as England, France, Russia, Italy, the German lands, and the United States, among others. Another defining feature of this group was that the *estrangeirados* always took their own country as the main frame of reference for their endeavors, even when they were dismissed or rebuffed by the Portuguese authorities. In fact, several *estrangeirados* were vulnerable to political and religious changes that took place in Portugal throughout the eighteenth century. But it was often enforced or self-imposed exile that gave them the opportunity to establish links with wider intellectual networks, to appropriate new ideas, and to participate in the production of new knowledge. In Portugal, the process of internationalization fostered by the *estrangeirados* eventually resulted in the establishment of the Royal Academy of Sciences of Lisbon, in the strengthening of engineering training, and in some instances of modernization in the teaching of the sciences, particularly by reinforcing its utilitarian dimension. However, the meaning of the *estrangeirados*' endeavors goes well beyond the reconfiguration of the institutional framework of science in their country. It is certain that they were propelled by discourses and ideological tenets centered on the modernization of Portugal rooted in science and technology. But extensive research on this group has also revealed that they frequently acted as mediators and catalysts between different scientific and technical communities, playing an active role—often including scientific and technical espionage—amid the international networks in which they aspired to be (and usually were) accepted as equal players.

Some of the routes traveled by the *estrangeirados* crossed and overlapped with those followed by the *pensionados*, who left Spain for training, fact-finding, and networking purposes. They were sponsored by the Spanish authorities and also by private entities such as industrial societies.[9] They equally relied on political, diplomatic, and academic connections with fellow Spaniards already living or staying abroad. A first wave of *pensionados* bound to become physicians went to Montpellier, France. Others received medical training in Britain, where several other *pensionados* also went to study nautical science, astronomy, optics, and instrument-making. *Pensionados* entrusted with missions related to mining and metallurgy

8. Ana Simões, Ana Carneiro, and Maria Paula Diogo, "Constructing Knowledge"; Ana Carneiro, Ana Simões, and Maria Paula Diogo, "Enlightenment Science in Portugal"; and Maria Paula Diogo, Ana Carneiro, and Ana Simões, "Ciência portuguesa no iluminismo."

9. Antonio García-Belmar and José Ramón Bertomeu-Sánchez, "Viajes de cultivadores"; "Constructing the Centre"; and "Louis Jacques Thenard's Chemistry."

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traveled mostly to the German cities of Freiburg and Chemnitz, whereas those engaged in the study of chemistry went mainly to Paris. These *pensionados* played an important role in the wider network of chemists that provided a social basis for the legitimization of modern chemistry, even though they were guided in their pursuits mainly by the industrial and technical traditions cultivated in Spain and by the ambitions of prosperity fostered in their home country. These ambitions favored the practice of chemistry more than the theoretical contours of this science. Related fields and activities such as mineralogy, metallurgy, and mining were similarly promoted. Consequently, the *pensionados* visited not only traditional sites of study and learning, such as schools and universities, but also factories, chemical plants, dying centers, and other places where practice was the prevailing element. As in the Portuguese case, their journeys often entailed equal doses of overt fact-finding and espionage, leading them to cross not only geographical and political borders but also cultural frontiers between scientific and technological traditions with distinct norms and values.

The eighteenth-century Greek-speaking scholars of the Ottoman Empire comprise another group of traveling savants who produced much of their work while moving from one place to another. Most of them departed from an area of the southwestern Balkans, where dynamic trade activity spurred the quest for new knowledge. Following the commercial routes that connected the Ottoman Empire with central Europe, they first pursued the new natural philosophy at the universities and libraries of Padua, Vienna, Leipzig, Jena, and Halle. They then traveled eastward looking for proper social environments and patronage networks in order to reap the benefits of their qualifications. Constantinople, Jassy, and Bucharest provided such environments, and many of them had successful careers as teachers or doctors under the protection of the Phanariots, a group of Greek-speaking nobles who held important administrative positions in the Ottoman Empire.[10]

Greek-speaking scholars were generally perceived as the agents upon whom the most dynamic social groups of the emerging Greek society counted for the shaping of their collective physiognomy. But as the constituents of this physiognomy were still under negotiation, the philosophical discourses they elaborated reflected their attempt to meet the conflicting demands arising from the intersection of multiple cultural traditions and social interests. Their travels between the educational centers of central Europe and the political centers of the Orient, as well as their continual shifting between their firm neo-Aristotelian background and the unstable ground of modern natural philosophy, clearly illustrate this ambiguity. Like most of their contemporary philosophers, the Greek-speaking scholars aimed to set up an intellectual enterprise that would broaden the scope of philosophy. But they were not the kind of thinkers who employed exper-

10. Manolis Patiniotis, "Scientific Travels of the Greek Scholars in the Eighteenth Century."

iments or mathematics to explore Nature. They were rather closer to the group of philosophers who trusted that only metaphysics could lead natural inquiry to the real causes of things.[11] Therefore, although they valued modern natural philosophy, they primarily worked to secure its findings on the appropriate metaphysical ground, producing thus a distinctive kind of knowledge that reflected their itineraries in the highly diversified European intellectual space.[12]

Reappraising Centers and Peripheries

Apparently, traveling allowed all these actors to participate actively in the various processes of knowledge formation at the core of the Enlightenment. But these processes developed throughout their journeys and cannot be reduced to a linear movement between backward and enlightened places. The notion of "moving localities" leads us to replace this view with a focus on a continual movement that promotes creative encounters and undertakings but in which travelers never cease to be connected with their spaces of origin. The *estrangeirados* did not bring the Enlightenment to Portugal; they placed the country within the Enlightenment. The *pensionados* did not limit themselves to taking a ready-made chemistry back to Spain; they actively appropriated and practiced it throughout their journeys. The Greek-speaking scholars did not replace local intellectual patterns with the attainments of the Enlightenment; they brought their philosophical legacy to the premises of the Enlightenment as a means to address the widely shared demand for a comprehensive synthesis in natural philosophy. The meaning of all these stories in terms of how scientific and technical knowledge was made becomes clearer if we think about *going through* rather than going to and fro. A view encompassing routes, circuits, and their dynamic reconfigurations must thus replace a narrow focus on interactions taking place at specific points of departure and arrival.

The paths followed by these actors were at once geographical and intellectual but never detached from the local backdrops in which their cultural profiles and pursuits were rooted. They certainly went through intellectual and cultural changes during their journeys. It is not the notion of traveling as a transformative experience that we seek to contend but rather the notion of traveling as a radical transformation of the traveler from a *tabula rasa* state. The transformative effect of travel is exerted both *on* the traveler and *by* the traveler. It spurs the ability to negotiate, to build and revamp meanings, and to design and readapt paths and routes through conflicting agencies. Ultimately, traveling mediates between moving localities and makes it possible for them to converge and coexist in certain locations.

11. Thomas Ahnert, "Newtonianism in Early Enlightenment Germany."

12. Manolis Patiniotis, "Eclecticism and Appropriation of the New Scientific Methods by the Greek-speaking Scholars in the Ottoman Empire."

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In this theoretical framework, a rigid notion of the center as a focal point of knowledge production and as major destination of traveling savants does not provide us with a satisfactory description of circulation over large geographical areas. Of course, there are geographical places (countries, states, cities, etc.) and sites (ranging from universities to factories and from academies to workshops) that in certain periods and circumstances constitute favored nodes for specific epistemic pursuits in the context of evolving networks.[13] But what confers the status of a "center" to a certain place primarily depends on a specific frame of associations and on its inherent set of representations. Our traveling actors themselves contributed to the conceptualization of the center-periphery dichotomy by associating their epistemic pursuits with an idealized European science that was supposed to supersede the limited knowledge horizons of the various local contexts.

Thus, although people and material resources undeniably concentrate differentially at certain places throughout time, the depiction of such asymmetries in the form of *cultural hierarchies* is ultimately a matter of crafting enduring narratives and securing particular positions for the various localities in their context. In this respect, the center-periphery dichotomy does not reflect an established cultural geography but a *discourse* developed to a great extent by the traveling actors themselves. As they juxtaposed the places of their origins to the places of their destinations with a view to profiting from their own intermediate position, they also contributed to a process of co-construction of their places of departure as backward and nationalistic peripheries, and their places of arrival as modern and cosmopolitan centers.[14]

Conclusion

The notion of "moving localities" enables us to understand the emergence of modern science and technology as the expression of a dynamic geography instead of confining the history of knowledge in a succession of fixed geographies. A dynamic geography of knowledge will have motion, interaction, and interconnection as its main features instead of relying on specific sets of boundaries, localized identities, and circumscribed trading zones. Addressing the spatiality of knowledge will thus cease to be the act of associating particular cultural traits with specific points on a map; instead, it becomes the process of tracking down the various paths and encounters through which such cultural traits and their respective knowledge practices evolved.

13. Compare Edward Shils's view on the notions of center and periphery in Martin Bulmer, "Edward Shils as a Sociologist," 14, and Harold Orlans, "Edward Shils' Beliefs about Society and Sociology," 25.

14. See, for instance, Simões, Diogo, and Carneiro, *Citizen of the World*, 84–85.

This conceptual shift is fundamental if we are to approach circulation not only as a way of transmitting or spreading knowledge but also as a way of producing it. It will be empowered if we accept that *locality* is not necessarily coincident or constrained by *location*, and if we regard centers and peripheries not as tokens of a steady, hierarchical geography, but rather as mutually dependent and co-constructed entities whose status can change with time.

Furthermore, starting this historiographic enterprise from the purported peripheries will allow new kinds of historical actors to enter the scene. Much of the positivist historiography drew on the work of the great thinkers who conceived or definitely shaped the great scientific and technological "discoveries." The turn to circulation as a site of continuous knowledge production will bring into focus the work of those intercultural subjects who move across disciplinary and territorial borders "by juggling possibilities and constraints, construct[ing] spaces tailored to their own activity, cultivat[ing] solutions of continuity, and function[ing] through networks."[15] These figures are usually absent from the official histories of the Enlightenment, and if they are recognized, they are typically treated as intellectually parochial scholars, unable to fully embrace the ideal of modernization through reason and science. Bringing such figures to the forefront, and confirming their role in the production of scientific and technical knowledge, will help historians tell more nuanced stories about the complex cultural encounters that molded the European intellectual space and the multifarious knowledge exchanges that shaped the notion of European science and technology.

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15. Kapil Raj, "Beyond Postcolonialism," 347.

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Education and Textbooks

JOSEP SIMON and ANTONIO GARCÍA-BELMAR

ABSTRACT: Education and textbooks have traditionally been standard objects of research in the history of science, technology, and medicine. However, they have often remained marginal in the formulation of large historiographical questions. In the last decades, the work of some historians of science has challenged this state of affairs. STEP has promoted a distinctive focus on education and textbooks, compared to other scholarship cultures such as the Anglo-American. This essay reviews its work in this field and stresses the potential of education and textbooks to produce interdisciplinary research in local, national, and international perspective.

In the contemporary world, a wide array of information and communication technology (ICT) initiatives promoted by for-profit and nonprofit organizations feature educational technologies as the answer to all the ills of so-called underdevelopment. The introduction of computers and ICT in today's education is often presented as a revolution, because they connect with students' growing digital culture, they can potentially contribute to reshaping teaching and learning practices, and they might be able to replace a wide array of previous pedagogical tools, such as blackboards, textbooks, student and teacher notebooks, and laboratories. This utopian message has found adherents in governments that conceive educational reforms as the way to increase their competitiveness in the capitalist world market.[1] As such, it specifies (and proposes to solve) a problem that applies

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1. The preamble to the Education Act implemented in Spain in 2013 stated that "The educational level of citizens determines its ability to compete successfully . . . representing a commitment to economic growth," and that "Information and Communication Technologies will be an essential piece to produce the methodological shift

practically everywhere. However, this problem is particularly relevant for understanding the making of science, technology, and medicine (STM) in national contexts such as those represented by the group STEP (Science and Technology in the European Periphery). In these countries, the teaching of STM has historically occupied an important space in national efforts but has not always translated into internationally leading research. For historians in the periphery of Europe, the study of science, engineering, or medical education has thus been a particularly relevant subject of analysis, whereas other regional and national communities of researchers have tended to favor the study of research or popularization practices.

Social research has shown that technology alone does not guarantee educational improvement, that investment in science education does not automatically lead to increases in technological production and innovation, and that technological growth does not necessarily induce educational expansion and social equality. The standard discourse that connects science, education, technology, and development is characterized by a simplistic technological determinism which is extremely profitable in political terms but is intellectually meager.[2] This discourse has held sway, almost everywhere, since at least the nineteenth-century worldwide expansion of secondary education and science teaching, thus predating the introduction of computers in education.[3] We can find it, for instance, behind the proliferation of physics cabinets and chemistry laboratories in the secondary education institutions created between the nineteenth and twentieth centuries all around Europe and the Americas, and the development of a huge international market that shaped the French, German, and British precision industries in international perspective.[4]

Despite loud claims within the ICT industry, the game is not over for conventional technologies of education such as textbooks, which still have a major role in pedagogical practice nearly everywhere. In spite of being subject to constant criticism, textbooks have been central to education since at least the late eighteenth century. With the power of hindsight, it is thus particularly relevant to examine the role played by the medium of textbooks

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required to improve educational quality" (Jefatura del Estado, "Ley Orgánica 8/2013"). Analogous statements can be found in other countries, e.g.: Barack Obama, "47—Address Before a Joint Session of the Congress on the State of the Union" (USA); Ministerio Nacional de Educación, *Revolución educativa* (Colombia); Gobierno de la República, *Plan Nacional de Desarrollo* (Mexico).

2. María Belén Albornoz, Mónica Bustamante Salamanca, and Javier Jiménez Becerra, *Computadores y cajas negras*, 29–57; Anita Say Chan, *Networking Peripheries*, 173–96; Claudia Goldin and Lawrence F. Katz, *The Race*.

3. Graeme Gooday, "Lies, Damned Lies and Declinism"; Terry Shinn, "The Industry, Research, and Education Nexus"; HELF, *Higher Education Looking Forward*.

4. Josep Simon, José R. Bertomeu-Sánchez, and Antonio García-Belmar, "Nineteenth-Century Scientific Instruments"; José R. Bertomeu Sánchez and Antonio García Belmar, *Abriendo las cajas negras*; P. Brenni, "The Evolution of Teaching Instruments."

in the making of science and technology education, and the ways this pedagogical tool was conceived, adapted, and transformed in different historical contexts, interacting with other pedagogical technologies in the process.

Educational Opportunities

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An advantage of textbooks and education as a focus of research for historians of STM is the truly international character of the problems they raise and their richness as sources. Every nation has had an educational and textbook culture regardless of whether it had a flourishing research culture or not. While the history of STM education reveals a number of national contexts that were able to internationalize their textbook production better than others, this does not diminish the relevance of certain local or national textbook cultures over others.[5] Nineteenth-century France, Germany, and Britain and the twentieth-century USA feature prominently in the history of STM due to their contributions to technological, scientific, and medical research. However, the national hierarchies, periodizations, and criteria of relevance commonly applied by historians to research do not necessarily match the study of education and textbooks. Textbooks represent an opportunity to reconsider these national biases, which may not apply to education, nor to research.[6]

The study of textbooks and education cautions us to be wary of the deep embedding of diffusionist ideas, not only in our geopolitical conceptions but also in our most common perceptions of hierarchies in the production of knowledge. The status of textbooks in STM history stands in contrast to the traditional emphasis on the article and treatise, and the incorporation in the last decades of new sources such as laboratory notebooks and popular books and periodicals, which previously enjoyed a similar low standing but recently have become the center of dynamic historiographic developments. The low status of textbooks as source material for the history of STM is connected to knowledge hierarchies that are historically contingent and thus have to be problematized. In this context, the research agenda of STM scholars working on education and textbooks has been particularly shaped by the impact of Thomas Kuhn's *The Structure of Scientific Revolutions*. Kuhn's ideas about education were the received views of his time and prevailed in academic circles. While he attracted attention to the major role of education and textbooks in the making of science, his stress on indoctrination left little room to consider them as creative tools, as more recent educational research has done.[7] Hitherto, scholars have had to live with this

5. Anders Lundgren and Bernadette Bensaude-Vincent, *Communicating Chemistry*; José R. Bertomeu Sánchez at al., "Scientific and Technological Textbooks"; Josep Simon, "Cross-National and Comparative History."

6. Josep Simon, "Cross-National Education."

7. Josep Simon, "Physics Textbooks and Textbook Physics."

paradox when researching the history of textbooks and pedagogical practices.[8] While it is usual to think that knowledge is produced through research and then diffused from top to bottom through education and popularization, the study of textbooks and education has shown that research and teaching are often connected and that education and textbooks also contribute to shaping original knowledge. A new approach is necessary, which would reconsider the status of textbooks and education in the history of STM by promoting further communications between this field, the history of education, book history, and current educational research.[9]

These efforts for interdisciplinary cross-fertilization are in substance not bound to any national context. However, they have been commonly driven by an appreciation of education as a major activity in science—not just a byproduct of research—that has been more usual in the academic cultures of countries having developed state-run educational systems at a national scale in the nineteenth century. Work on education and textbooks developed by scholars based in continental and, in particular, peripheral European countries such as those represented in STEP has often been in contrast, for instance, to a higher prioritization of work on science popularization that has characterized research on British science in the last two decades. In addition, historical research on education and textbooks in the so-called peripheral countries of Europe has often had to focus more on the phenomena of appropriation than on the processes of production, although always emphasizing that the appropriation of scientific or pedagogical knowledge is also knowledge production.

Cross-National Knowledge

It was between the late eighteenth and the first half of the nineteenth centuries, with the expansion of secondary education, that the textbook rose to prominence. The textbook, a volume or volumes designed for instructional purposes and covering a whole subject in a systematic way, became central in classroom practices and in the organization of education at the national level.[10] The rise of a pedagogy centered on textbooks was not obvious. Teachers had to afford textbooks a place, one that was already occupied by other pedagogical objects associated with well-established teaching and learning practices. Oral and written practices had coexisted in pedagogical spaces for centuries, and the interaction of the two had produced teaching and learning tools that played the role of mediating objects.[11] In

8. Kathryn M. Olesko, "Science Pedagogy"; David Kaiser, *Pedagogy*; Josep Simon, "Textbooks."

9. John L. Rudolph, "Historical Writing on Science Education."

10. Bernadette Bensaude-Vincent, Antonio García Belmar, and José R. Bertomeu Sánchez, *L'émergence d'une science des manuels*; Josep Simon, *Communicating Physics*.

11. Françoise Waquet, *Parler comme un livre*.

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the decades preceding the nineteenth-century generalization of textbook learning, certain teachers expressed their reservations about having to use a standard textbook written by others, instead of teaching with their own notes, whether in manuscript or print. The practice of note-taking in classrooms has a long history that goes back at least to the early modern period and was kept alive long after the rise of textbooks.[12] Textbooks also had to find their place in the framework of the complex debates about the role and uses of experiments in the teaching and learning of the experimental sciences.[13] Textbooks were new pedagogical technologies, and their adoption was not simple.

As far as any novel technology is concerned, the standardization of textbook-centered education depended heavily on users.[14] By the mid-nineteenth century, however, the production and use of textbooks was already a lucrative business in most countries. Textbooks for secondary education played a major role in the rise of the publishing industry as a capitalist enterprise. The introduction of new technologies of printing, new techniques such as stereotyping, the design of new factories integrating all trades of the book production business, and the establishment of more efficient modes of communication and distribution (such as railway transport) were relevant factors for the expansion of publishing in national and international perspective.[15] But this expansion cannot be fully understood without taking into account the demand created by a new educational context (secondary schooling) developed nationally, including for the first time the teaching of science and technology to mass audiences.[16]

In this context, countries like France and Germany, which had developed large-scale systems of education early, were able to export their textbooks abroad, in their original language or through translations. The international circulation of textbooks often followed the same paths as those of students who traveled to the major STM centers in Europe to complete their training. When returning to their home countries, these students, in collaboration with local, national, and international booksellers, were commonly responsible for the appropriation of foreign textbooks into their local cultures of science, technology, medicine, and education through translation and adaptation.[17]

These phenomena of knowledge production, circulation, and appropriation, which involved teachers, researchers, textbook authors, booksellers, and printers, have often been portrayed as diffusion processes of centers

12. Ann Blair, *Too Much to Know*; Antonio García Belmar and José R. Bertomeu Sánchez, "Palabras de química."

13. Antonio García Belmar, "The Didactic Uses of Experiment."

14. Nelly Oudshoorn and Trevor Pinch, *How Users Matter*.

15. Jean-Yves Mollier, *L'argent et les lettres*; Simon, *Communicating Physics*, 91–170.

16. Bensaude-Vincent, García Belmar, and Bertomeu Sánchez, *L'émergence d'une science des manuels*; Simon, *Communicating Physics*.

17. Ana Simões, Ana Carneiro, and Maria Paula Diogo, *Travels of Learning*.

radiating toward peripheries. However, in spite of the obvious national asymmetries that characterized science, technology, medicine, and education in the nineteenth century, these phenomena were more symmetrical than presumed. The circulation of foreign students through centers of research and teaching such as Paris, Giessen, London, or Edinburgh—to name a few—was part of a larger culture of scientific and educational travels across national borders that played a key role in the making of STM between the eighteenth and nineteenth centuries.[18] The presence of foreign students had a significant impact on the intellectual and material development of the local cultures of science, technology, medicine, and education in those centers. Furthermore, international students had a major role in the shaping of representations of these centers as places embedded with homogeneous qualities characterizing national models of science, technology, medicine, or education. The same applies to the production of textbooks in the broad fields of STM, very often a genuinely international venture, which cannot be grasped by traditional STM history approaches that are constrained by local and national perspectives.[19] Despite the prevailing popularity of homogeneous national pictures, a rigorous analysis of case studies and sophisticated uses of comparative history show that it is rather difficult to make generalizations at a national level.[20] In short, to a certain extent, centers were built at the peripheries.[21]

Textbook Power

As objects for historical research, textbooks encapsulate a wide range of elements. They embody a course syllabus and a pedagogical and narrative rationale linked to particular institutional and educational contexts, and they are addressed to captive readers. They present a comprehensive picture of a subject. Thus, textbook analysis is a major way to characterize disciplines or professional fields of inquiry. Successful textbooks are regularly reissued to find new customers, since formal education can provide—when based on a textbook-centered pedagogy—a regular supply of purchasers to authors and booksellers. Hence, the study of textbooks allows us to characterize the shaping of whole fields of knowledge over long periods of time. Textbooks are often reissued to meet changes in educational curricula and policy but also in scientific and technological disciplines and in

18. This topic is still largely unexplored. Simões, Carneiro, and Diogo, *Travels of Learning*; Stephan Curtis, "Swedish in Name Only"; Yoshiyuki Kikuchi, "Cross-National Odyssey of a Chemist"; Yoshiyuki Kikuchi, *Anglo-American Connections*.

19. Marika Blondel-Mégrelis, "Berzelius' Textbook"; Simon, *Communicating Physics*.

20. In spite of recent calls for transnational histories of STM, most research still has a focus that is local and—explicitly or implicitly—embedded within national contexts.

21. Antonio García Belmar and José R. Bertomeu Sánchez, "Constructing the Center from the Periphery"; Simon, "Cross-National Education"; A. J. Angulo, "The Polytechnic Comes to America"; Geert Vanpaemel, "The German Model."

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medical specialties. Textbooks have a major political role as agents at the crossroads of governments, markets, schools, and communities of STM practitioners, shaping pedagogical and scientific outlooks and cultural and national ideals.[22] These intersecting roles make textbooks powerful, but they also constrain their design and their intended uses through parameters that are distinct from those characterizing other processes of communication such as, for instance, popularization and informal education.[23]

Research on STM textbooks has therefore proceeded in a wide range of avenues: national surveys of textbook publications aimed at defining a discipline and characterizing scientific, technological, or medical practices in local or national contexts; studies on the intersections between teaching and research and between formal education and popularization; inquiries on the role of gender in STM teaching and research; investigations of the use of textbooks as reference works in laboratory and workshop training and as major tools in the shaping of research schools and styles of thinking; research on textbook content discussing the relative importance of theory, practical knowledge, and history within a subject; diachronic analysis of textbooks as indices of the introduction of new ideas and theories; synchronic pictures of the shaping of disciplines in comparative international perspective; critical discussions on the distinctive and creative practices of textbook translation; and exemplary case studies on the role of textbooks in the production of STM knowledge across national borders.[24]

The rise of textbooks in nineteenth-century education might be considered a revolution, because they had a major role in driving the mass production, circulation, and use of print culture, reshaped teaching and learning practices, and complemented and very often ruled over other pedagogical tools, such as blackboards, student and teacher notebooks, and laboratories. These other technologies of education were often subordinated to textbook learning, but they were never completely replaced by textbooks alone. Of course, like any novelty in the mass educational market, textbooks were big business too. Although there were some countries that led the international production of STM textbooks, this was not the exclusive business of economically affluent countries. The production of textbooks and the expansion of education in STM took place practically everywhere in the world.

These historical lessons are surely useful for reevaluating the role that

22. Antonio García Belmar, José R. Bertomeu Sánchez, and Bernadette Bensaude-Vincent, "The Power of Didactic Writings."

23. The diversity of these agents also contributes to defining a variety of sources for the study of education and textbooks such as government reports and laws, school syllabi, authors' correspondence, publishers' archives, pedagogical research publications, exercise books, library and publisher catalogs, readers' response records, student and teacher notebooks, examination copies, teaching collections and their inventories, and teaching visual aids.

24. Simon, "Textbooks."

ICT is playing in today's education and for building a more comprehensive and mature perspective on educational technologies and the relations between science, technology, medicine, and education in international perspective. This will require, however, a deeper and more reflexive consideration of the historical contingency of the epistemological and geopolitical categories commonly used by historians to characterize the making of knowledge. At this stage, asymmetries and differences will not be used merely as markers of historiographical status but, instead, as opportunities for the development of fruitful case studies across social, cultural, and geopolitical scales. Directing our efforts toward producing a more integrative analysis of the design and use of technologies for education can offer relevant benefits for the history of technology. These technological insights would also be able to illuminate other fields, such as the histories of science, medicine, and education, respectively. Moreover, they could have an impact on current practices and future policies of scientific, technological, and medical education.

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Experts and Peripheries

Ongoing Research and Future Challenges

JOSÉ RAMÓN BERTOMEU-SÁNCHEZ and STATHIS ARAPOSTATHIS

ABSTRACT: Based on existing research on Spain and Greece, the essay is focused upon the activity of experts in criminal courts and advisory committees. Following the experts in these settings, we offer examples of their roles in governing techno-sciences in societies of the European periphery. We highlight the tensions between the creative powers of localities and the movement of expert knowledge in a world marked by striking inequalities concerning economic, political and academic power. We claim that a comparative study of these movements will be refine the historical understanding of experts and expertise.

Introduction

In recent years, experts and expertise have become important research topics in the history of science and technology. The variety of approaches has been wide-ranging, reflecting the diversity of activities of experts and the cultural and social spaces of expertise in modern societies. These spaces include public health, occupational diseases, criminal investigations, military warfare, food quality, standardization of drugs, regulation of the chemical industry, risk assessment, identification technologies, management of toxics, control of contamination, and technological infrastructures, among many other issues.[1] Most of the research has focused on

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1. Many of the studies are focused on the nineteenth and twentieth centuries. For

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Anglo-American contexts, leaving many other interesting areas understudied. With the initial aim of exploring these understudied areas, a subgroup, "Experts in the Periphery," was created in 2009 during the 7th STEP (Science and Technology in the European Periphery) meeting in Galway, Ireland. This first meeting included papers that dealt with topics such as the sources of expert authority and trust in expert knowledge, the image of experts in popular culture, the blurred boundaries between experts and laypeople, and the relationship between science and the law. Analyzed fields include engineering (in Spain and Britain), radioactivity (in Austria and France), microbiology and food analysis (in Belgium and Spain), soil science (in Russia) and toxicology (in Spain). The aim was to revisit historical categories, make comparative analysis, and enlarge the number of identified spaces, actors, and sources for the study of experts and expertise. In subsequent meetings topics have included the transit and appropriation of expert knowledge, credentials and other sources of expert authority, risk assessment in earthquake prediction, the different spaces of expertise (from academies to council laboratories and courtrooms), the role of advice committees (from agriculture to food control and public health), science and the law (from patent litigation to criminal investigation), etc. From the beginning, the group included historians working on both "centers" (primarily Britain and France) and "periphery" (Russia, Greece, Spain, and Italy). Colonial studies—particularly of British colonies in Cyprus, Egypt, and the West Indies—have also been included. Relying on such a broad range of disciplines and geographies, the group has encouraged comparative analysis and cross-national studies.[2]

In this paper, we argue that the study of experts in peripheries highlights their role as mediators between national and transnational governmental agencies or between the state and the corporate world. Experts contribute to making "trading zones" where new knowledge, policies, and social orders are formed.[3] Their expertise, credibility, and authority are negotiated in local institutional, social, and cultural settings that reflect inequalities in academic, political, and economic power and that vary according to different regional and national contexts. Based on existing research on Spain and Greece, in this paper we focus on the activity of experts in criminal courts and advisory committees. Following the experts in two different institutional and legislative settings, we offer some examples of their roles in governing techno-sciences in societies of the European periphery. In the concluding remarks we point out the overlap between

studies on early modern contexts, see Christelle Rabier, *Fields of Expertise*, and Eric A. Ash, "Expertise and the Early Modern State."

2. New meetings were organized in Valencia (2011), Corfu (2012), and Lisbon (2014). See more details at www.uoa.gr/step. In total, around thirty-five papers have been presented by more than two dozen participants in the four meetings.

3. Michael Gorman, *Trading Zones and Interactional Expertise*.

different spaces of expertise and suggest new avenues for future research concerning experts on the European periphery.

Experts, Crimes, and Technologies of Identification

One of the most important social spaces for the study of technoscientific experts in modern societies is the administration of justice. On this issue, historians of science and law have produced a large number of studies, mostly focusing on the emergence of nineteenth-century forensic medicine with special attention to the cases of toxicology and psychiatry. Recent overviews cover a broader spectrum of issues, such as health risk, environmental accidents, tort litigation, medical insurance, and professional malpractice.[4] Moreover, a large number of recent studies have focused on food quality control, patent litigation, and the development of modern scientific policing.[5] Most of these studies have dealt with British and American legal systems, but historians have largely acknowledged that social and cultural contexts are crucial in shaping the role of experts in courtrooms. Christopher Hamlin has employed the idea of "forensic cultures" as a means of conceptualizing this diversity in terms of what counts as a credible expert witness (physicians, scientific police, midwives, handwriting experts, etc.) and reliable forensic science (clinical symptoms, postmortem examinations, chemical tests, fingerprinting, crime-scene investigations, public health statistics, etc.); what must be proved during the trials (for instance, in inquisitorial vs. adversary systems); and what the "overarching anxieties" are for each society (control of strangers, recidivism, suspicious women, terrorism, political dissidence, psychopaths, etc.).[6]

Papers presented at STEP meetings have revisited some of these questions with a particular focus on criminal investigations, from toxicology to infanticide and identification practices. For instance, a study on nineteenth-century Spanish toxicology reviewed how poison crimes performed by women were perceived in medical, legal, and popular cultures. New

4. For an overview based on Anglo-American examples, see Sheila Jasanoff, *Science at the Bar*, and Tal Golan, *Laws of Man and Laws of Nature*. See also the special issue of *Isis* edited by Graham Burnett, on "Science and Law."

5. On patent litigation see Stathis Arapostathis and Graeme Gooday, *Patently Contestable*. On criminal investigation, see the special issue on "forensic cultures" (2013) in *Studies in the History and Philosophy of the Biological and Biomedical Sciences*. Some historical studies on "experts of crime" are Frédéric Chauvaud, *Les experts du crime*; Katherine Watson, *Poisoned Lives*; Ian Burney, *Poison, Detection, and the Victorian Imagination*; José Ramón Bertomeu and Agustí Nieto-Galan, *Chemistry, Medicine, and Crime*; Mark R. Essig, *Science and Sensation*; Marc Renneville, *Crime et folie*; Joel Peter Eigen, *Witnessing Insanity*; and Laurence Guignard, *Juger la folie*, among others. Historians of crime have also produced important studies on this topic. See, for instance, the website projects *Criminocorpus* (France) and *Crimen y Sociedad* (Argentina).

6. Christopher Hamlin, "Forensic Cultures in Historical Perspective"; Ian Burney and Neil Pemberton, "Making Space for Criminalistics."

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high-sensitivity technologies were introduced (the Marsh test for arsenic) and transformed into reliable forensic science in the peripheral context of Spain. At the same time, a new community of forensic physicians emerged during the 1840s, obtaining academic positions in the new faculties of medicine and gaining authority and trust in courtrooms thanks to high-profile crimes, which were heavily publicized in the popular press. As was the case in France, the new features did not emerge without contestation, and expert controversies were frequent in spite of the limits imposed by the so-called inquisitorial system. A comparative study between French and Spanish toxicology at work during the 1840s also showed striking differences, for instance, in the use of animal experiments as reliable proofs, the role of juries, the selection of experts, and the unequal balance of academic and political power inside the community of experts.[7]

The "overarching anxieties" concerning crime changed during the nineteenth century in Spanish society. At the beginning of the twentieth century, the new challenges of political violence and anarchist terrorism prompted more sophisticated police practices. Several presidents of the Spanish government were killed while many other terrorist attacks occurred against political figures, including the king. Riots and strikes were frequent as well as ruthless repression against activists by both state police and armed groups paid by Spanish employers. These challenges opened the path to new studies of criminology and forensic science, specifically the organization of the police in which the new technologies of identification played a major role. Fingerprinting began in India as a method of imperial control and was employed in Argentina for the control of immigration. The so-called Spanish dactyloscopy emerged from the convergence of interests of a group of physicians, professional policemen, and liberal-minded politicians who sought the "regeneration" of Spanish society by implementing more "modern" and "rational" structures of the state, including policing, administration of justice, and prisons in this crucial reform.[8]

The main outcome was the emergence of what was named the Spanish "scientific police." The protagonists played different, but sometimes overlapping, roles in the processes of making, trusting, and using the new technologies of criminal investigation and identification. On the one hand, physicians, such as Federico Olóriz, appropriated international research on fingerprinting and developed new studies, thus providing new technologies

7. José Ramón Bertomeu Sánchez, La verdad sobre el caso Lafarge; Mar Cuenca Lorente, "El veneno de María Bonamot."

8. José Ramón Bertomeu Sánchez, "Fingerprints." On the history of fingerprints, see Simon A. Cole, *Suspect Identities*; Chandak Sengoopta, *Imprint of the Raj*; Julia Rodríguez, *Civilizing Argentina*; Mercedes García Ferrari, *Marcas de identidad*; Keith Breckenridge, *Biometric State*. On the related topic of DNA fingerprints, see Michael Lynch et al., *Truth Machine*. For a more general overview on technologies of identification, see the final edited book of the project: Ilsen About, James Lonergan, and Gayle Brown, eds., *Identification and Registration Practices: In Transnational Perspective*.

of identification, which were celebrated as the new "Spanish dactyloscopy." Their activities were also crucial in transforming the new technologies into reliable methods of identification for a broad range of purposes. They organized new services of identification in prisons, gave lectures in police schools, performed public demonstrations, and suggested new regulations, such as those concerning personal identification cards. On the other hand, politicians, policemen, and prison employees defined new spaces and developed new practices and regulations in order to adapt the new technologies for a broad range of uses, from the control of recidivists to the prosecution of crime and political dissidence. They also published textbooks on technologies of identification, detailed guidelines, and even research papers on fingerprinting, suggesting improvements, solving practical problems, or refining the classifications. During this creative interaction between these groups the uses of fingerprinting were enlarged and the technologies of identification evolved in disparate directions, from the control of recidivism to the detection of trace evidence in crime scenes or the making of national identity cards, which could be employed in many social and economic activities. In this complex process, the nineteenth-century legal medicine tradition (a university-based practice mostly developed by physicians such as Antonio Lecha-Marzo) encountered the new culture of scientific policing, which emerged in cabinets of identification and police departments and employed the new technologies of trace analysis, including fingerprinting. Again, the mediating activity of experts such as Olóriz, as well as their capacity to hybridize different social and cultural spaces, was constrained by the uneven distribution of political and academic powers among the different groups. These asymmetric and diverse exchanges (for instance, of visual and material culture, technologies of identification, and standards of proof), as well as the capacity to make hybrid settings, are crucial problems when dealing with experts in the periphery.[9]

By participating in the development and naturalization of surveillance technologies, experts played a crucial role in the legitimization of a technocratic ideology regarding the control of citizenship. Another example is offered in postwar Greece regarding the uses of motorcycles and their links to the lower and underclass social groups.[10] During the decades between the 1950s and 1970s, motorcycles were represented as dirty, noisy, risky, untrustworthy technologies used by wrongdoers and criminals.[11] In the 1980s urban life and employment relations changed. The new social concerns of the upper classes were the control and organization of society

9. See Bertomeu, "Fingerprints"; Ian Burney and Neil Pemberton, "Bruised Witness." On contact zones, see Peter Galison, *Image and Logic*, and Yoshiyuki Kikuchi, *Anglo-American Connections*.

10. Μιχάλης Αρβανιτόπουλος, *Η Ιστορία του Ελληνικού μοτοσυκλετισμού*; Γιώργος Ματτές, "Επιστήμη, Τεχνολογία και Αστυνομία."

11. For the social legitimization of motor vehicles and relevant tensions and reactions in Italy, see Massimo Moraglio, "Knights of Death."

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around conservative ideals as well as the political and social marginalization of Communist and radical groups. In this new context, motorbikes were legitimized by experts in policing as a tool for a different social order based on the "technocratization of violence."[12] The "modern" Greek state needed mobile urbanite commuters. Transport engineers and scientists framed motorbikes as fast and convenient for the urban fabric of Athens and other urban centers, while stressing the risky side of motorbikes and the importance of the control and "normalization" of the users' driving behavior.[13] At the same time, policing transitioned to a regime of minimal violence and increased "efficiency" in security and social order. Technocratic ways to solve security problems got the most emphasis, and therefore new expert institutions and departments were established in the Greek police. In this new setting, motorbikes were framed by experts as an efficient and trustworthy technology to guarantee the security and monitoring of populations and areas in the urban centers.[14]

Experts, Advisory Committees, and Techno-politics

Another area of research on experts and expertise focuses on national and international advisory committees, public works, and state innovation policies.[15] Scientists and engineers played important roles as scientific advisors in public health, agriculture, soil management, food and drug administration, risk assessment (accidents and natural disasters), and the electricity and gas industry.[16] Recent historiography argues that the emergence of technocratic ideals (national or international) in Europe in the late nineteenth century was based on an ideology of the political neutrality of technocratic performance and agency.[17] STEP offers an excellent opportunity to understand how international organizations shaped the transnational governance regime while pointing out the circulation of expertise and knowledge in local, regional, and national departments, committees,

12. Ματτές, "Επιστήμη, Τεχνολογία και Αστυνομία," 52–58, 67–74; Stanley Cohen, *States of Denial*, 98.

13. Ματτές, "Επιστήμη, Τεχνολογία και Αστυνομία," 98–106.

14. Ibid. Peter Norton has recently introduced as a historiographic tool a classification of four overlapping and sequential regimes in traffic policy in the twentieth-century USA. The four regimes are "Safety First" (1900–1920s), "Control" (1920s–1960s), "Crashworthiness" (1960s–1980s), and "Responsibility" (1980s–present). Experts played important roles in the enforcement of the characteristics of the traffic policy in each of the regimes. In the case of peripheral settings, experts can be approached as the crucial mediators to appropriate technocratic ideals while, at the same time, they were shaping and co-producing state technological policies and political regimes. Peter Norton, "Four Paradigms."

15. Elizabeth van Meer, "The Transatlantic Pursuit of a World Engineering Federation"; Johan Schot and Vincent Lagendijk, "Technocratic Internationalism."

16. A. Joel Tarr, "Toxic Legacy"; Eda Kranakis, "Who Is to Blame?"

17. Wolfram Kaiser and Johan Schot, *Writing the Rules for Europe*.

and agencies. Framing the problem according to the educational background and the experts' political and social priorities was, and remains, part of the politics of expertise that is endemic in the governance of science and technology. The co-construction of the identity of experts and the technological landscape with the sociopolitical order acquires particular importance in European peripheries because their political histories involved transitions from dictatorial and totalitarian regimes to democratic regimes. Engineers not only participated as mediators between the governments and the industries but functioned as experts who negotiated solutions for technical and sociopolitical problems concurrently.[18]

In the late nineteenth and the early twentieth centuries, public discourses about the appropriate innovation and industrial policies co-produced the emergence of the identity of the scientist-engineer in Greece. It was in this period that the technocratic vision of professional groups who would contribute to state-building processes was co-produced with the gradual emergence of liberal political ideals. It was the period that Greek engineers—or at least some of them—pressed for the establishment of a formal intellectual property system and for Greece's transition from a regime of patents as privileges to a regime of patents as rights that resonated with the politically liberal ideas of the modernization of the state. State affairs would be modernized and improved through new legislative and institutional innovations, they reasoned, thus the patent system should have also been one of those changes. Engineers did not self-fashion the role of the hero inventor, as was the case in the Anglo-Saxon world, but the role of the expert engineer who could direct both corporate strategies in knowledge transfer activities and state innovation policies.[19] Since 1912 Prokopios Zaharias, an inventor, engineer, and chemist, argued publicly in favor of a formal intellectual property system that would regulate engineering and industrial activities. He went so far as to publish a whole draft of the supposedly necessary patent law. The pressures by the engineering elites along with international pressures for the harmonization of the patent system resulted in the first patent act of 1920.[20] Yet this law was continually criticized by engineering experts due to the absence of a provision for strict examination system of patent applications. Almost twenty years after its implementation in September 1941, Patrinos, a prominent engineer of the period, reported on the issue of industrial property to the Technical Chamber of Athens, the leading engineering institution in Greece and official advisor of the Greek state. He urged the Technical Chamber to take initiatives toward a stronger and stricter industrial property law and supported a

18. Lino Camprubi, *Engineers and the Making of the Francoist Regime*.

19. Christine MacLeod, *Heroes of Invention*; Christopher Beauchamp, *Invented by Law*.

20. Stathis Arapostathis, "Intellectual Property Law"; "Industrial 'Property' Law and the Culture of Invention"; and "Industrial 'Property,' Law and the Politics of Invention."

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stronger patent law with a clear provision for an examination process. He suggested to the Technical Chamber the establishment of a Technical Council as an independent consultative and expert panel on issues of industrial property.

Patrinos's suggestion resonated well with the technocratic ideals promoted by an exclusive circle of engineers who, during the Nazi occupation, were working closely with the National Bank of Greece and the Technical Chamber and masterminded the technological transformation of the country during and after the war. During the interwar period institutional changes aimed to increase their social status and their role in industrial and economic affairs. In 1914 the Polytechnic School of Athens achieved university status, and at the same time the Ministry of Transport was established. In 1923 the Technical Chamber was instituted to represent and regulate the professional life of Greek engineers.[21] The pressures for institutional changes that would secure social and financial capital to the emerging community of Greek engineers was only one aspect of the creation of the engineering identity of the period.[22] The public works and the state infrastructures were the privileged settings where engineers competed for their social legitimization as the credible actors that could secure the material conditions for modernization of the state. Key to boosting the authority of the expert engineer was the emergence of the scientist-engineer in important state positions or in the role of the contractor of public works, positions that strongly contrasted with the idea of the engineer as merely technician and mechanic.[23]

In late nineteenth-century Greece the water supply of Athens was a major project with symbolic, political, and technological importance.[24] French expertise and ideas were appropriated in engineering practice and advice. Engineers and engineering and managerial committees traveled to France to acquire experience. French engineers were called in as consultants, and Greek engineers educated in France functioned as advisors and in-house experts. In 1890 the French engineer Quellenec recommended to the Greek government that the water supply to the metropolitan center be derived from Stymfalia Lake, a remote source. The consultant's suggestions and plans acquired trustworthiness through the public support of local experts, such as Elias Aggelopoulos, who was a leading authority in the engineering community of the period. He played a key role in the institutionalization of the engineering profession and the legitimization of engineers as critical experts for the establishment of a "modern" state.[25]

21. Γιάννης Αντωνίου, *Οι Έλληνες Μηχανικοί*, 124–27; Χριστίνα Αγριαντώνη, "Οι Μηχανικοί."

22. Αντωνίου, *Οι Έλληνες Μηχανικοί*.

23. Σπύρος Τζόκας, "Περιοδικά και κοινότητες μηχανικών στην Ελλάδα"; Margarita Dritsa, "Networks of Bankers and Industrialists."

24. Γεωργία Μαυρογόνατου, *Η Υδροδότηση της Αθήνας*, 178–79.

25. Ibid., 234.

More than half a century later the Desaretian lakes on the northern borders of Greece acquired different meanings by different experts. In post–World War II Greece, a period of "technological nationalism" during the years of the country's reconstruction, a key concern became discussion of the use of natural resources for power. Politically center-right engineers such as Theodore I. Raftopoulos, who was a consultant to the National Bank, suggested a plan for the electricity network that included the lakes as a Greek natural common resource. Left-wing engineers, while arguing in favor of large-scale electricity generation and transmission, viewed the Desaretian lakes as a transnational natural resource that should be exploited by several Balkan countries. It was finally the American engineers, considered more authoritative, credible, and "rational," who neglected the lakes in the design of the network due to their mountainous morphology and proximity to Communist countries.[26] The trustworthiness of technical solutions co-evolved with the social, cultural, and economic capital of the networks of expertise in the localities. It is characteristic that in the early twentieth century the first asphalt roads in Athens were constructed by Swiss and British engineering companies due to the lack of local expertise. Initially the technologies and relevant knowledge were transferred through the activities of the foreign engineers. With the support of the state Greek engineers traveled to international congresses and international conventions in order to acquire further experience. Syngrou Avenue, the road that connected the center of Athens with the water front, became the site of experimentation for new road technologies. It was there that Dimitrios Kallias, the chief engineer of the works, invented and patented a new road technology, the scorie-tarmacadam, that was later appropriated by the British engineer Lloyd Davies for road construction in Alexandria, Egypt.[27]

Technical problems involving risks, environmental hazards, and uncertainties triggered contestation, debates, and counterarguments that challenged the credibility of experts. In the 1970s there was a public debate in Greece over the construction of a nuclear plant in Greece and in general on nuclear power in the country. While the Technical Chamber of Greece, the official advisor to the Greek state, developed an ambivalent and cautious stance over the project, the Union of the Greek Nuclear Scientists supported the establishment of the plant on a more modest scale than the one initially suggested by native expert engineers of the Public Power Company or by foreign experts (EBASCO) and Greek scientists with an academic career in the United States or Europe. Along with the authority of experts, the plans were contested by laypeople of the region of the suggested sites. The project was cancelled due to a strong earthquake that shook further the experts' certainties and boosted ambivalence while trig-

26. Aristotle Tympas et al., "Border-Crossing Electrons," 157–81.

27. Ευαγγελία Χατζηκωνσταντίνου, "Αστικός εκσυγχρονισμός, οδικό δίκτυο και πόλη."

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gering stronger political reactions from political parties and citizens' groups.[28]

Experts played important roles in the making of local and national public discourses and in the distribution of economic, political, and academic power that shaped unequal exchanges among the different social actors, sometimes highlighting the uncertainties, creating doubts or areas of induced ignorance.[29] The STEP project is an excellent forum in which to introduce new cases and unexplored historical sources dealing with these problems. Furthermore, it can provide fresh approaches by studying the circulation of expertise as forms of capital (knowledge, economic, and social) from the center to the periphery or from one periphery to another. This kind of distribution of expertise is based on particular economies of credit and social organizations that vary in different peripheries and can assist us in reinterpreting existing hierarchies and authority regimes that emerge from perspectives from the center.

Governing Techno-sciences and Societies

Circulations of knowledge, travels of learning, international networks, regimes of authorship and invention, local politics, rhetorics of modernization, public controversies, civic epistemologies, activism, and organized contestation—all these issues were important in the different regimes of expertise in the peripheries that have been discussed in STEP meetings. The Spanish policemen and forensic physicians—like the Greek engineers—traveled abroad, establishing academic and political networks and attending international meetings (such as concerning new police methods, fighting against terrorism, and the management of prisons). They were also connected with well-known international figures (such as Juan Vucetich in Argentina, Edmond Locard in France, and Salvatore Ottolenghi in Italy) and employed these connections in order to obtain authority and credibility at a local level. As in the case of Greek public works, the authority of Spanish experts was challenged by local groups. For example, socialist and anarchist groups strongly criticized the idea of indiscriminate fingerprinting of the whole Spanish population (which was suggested the physician Federico Olóriz as early as 1909). Strongly contested during the first decades of the twentieth century (in Spain as well as many other European countries), the measure was finally adopted during the early 1940s, that is, during the first years of Spanish dictatorship, after the bloody civil war and the ensuing fascist terror which crushed political opposition.

28. Stathis Arapostathis et al., "Power and Resistance"; Stathis Arapostathis et al., "'Tobacco for Atoms'"; Vasilis Galis, "From Shrieks to Technical Reports"; Stathis Arapostathis and Serkan Karas, "Water Management."

29. Soraya Boudia and Nathalie Jas, *Powerless Science?* and *Toxicants*.

The reviewed examples show that the participation of experts in decision-making depended both on existing authority regimes with roots in the educational, social, and cultural credibility of experts as well as on the performance of the professionals. Greek engineers, like Spanish physicians and toxicologists, provided advice to municipal authorities, state-level departments, local communities, and professional associations. They also conducted evaluations, participated in technological disputes, and served as expert witnesses in patent, environmental, and medical disputes. Tools of persuasion included the rhetoric of "rationalization" of social affairs and social life, the material and visual culture of courts (expert reports, chemical tests, engineering and testing models), and the bodily representation of authoritative expertise in different spaces. A broad range of practices of "popularization" were also crucial. Experts tried to legitimize their proposals through public speeches, popular books, articles in newspapers, international exhibitions, and other practices of popularization. In doing so, they confronted and shaped the civic epistemologies of the local actors and constrained (but never completely demolished) their capacity to question expert authority.[30]

In conclusion, this short review demonstrates that the STEP project includes two features which are promising for studies on experts and expertise: a particular focus on the creative powers of localities and an emphasis on the movement of knowledge in a world marked by striking inequalities concerning economic, political, and academic power. The economic, social, and political specificities of peripheral countries functioned as constraints but also as advantages for practitioners who moved from one institutional setting to another or from the public sector to the corporate world and vice versa. In the cases presented in this paper, many experts faced the tensions of being part of both local cultures and large international networks. While accepting that expertise was constructed at the local level, the frequent national and transnational mobility of experts, throughout national and transnational institutions, academic spaces, and disciplinary borders, deserves to be analyzed in depth. A comparative study of these movements will be useful for refining our historical understanding of experts and expertise and their role in shaping social orders and contributing to the governance regimes of societies in both centers and peripheries.

30. On civic epistemologies, see Sheila Jasanoff, *Designs on Nature*.

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STEP FORUM

Popularization of Science, Technology, and Medicine in the "Periphery"

A Step Further?

EIRINI MERGOUPI-SAVAIDOU, FAIDRA PAPANELOPOULOU, and ANA CARNEIRO

ABSTRACT: Based on the research that has been carried out within STEP, this essay suggests an integrative approach for the study of science, technology and medicine popularization in the European periphery during the nineteenth and early-twentieth century. Such an approach can be a privileged tool not only for examining the complex processes of institutionalization and specialization of STM in peripheral countries, but also for exploring the interplay of STM in the making of modernity, since popularization seemed to have deep political implications in the implementation of modernization programs and the construction of national and professional identities in the European periphery.

Introduction

Traditionally, the histories of technology, science, and medicine (STM) have developed as separate fields of inquiry, each with its own historiographic problems and methods. They have been practiced by distinct communities of scholars who publish their work in different specialized journals. Consequently, studies on the popularization of technology, science, and medicine, respectively, have also developed differently and present

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distinct traits. Historians within STEP (Science and Technology in the European Periphery) began by focusing more on the history of science and, to a lesser extent, on the histories of technology and medicine. In recent years, however, the development of particular topics, among which popularization stands out, has pointed to the need for an integrative approach to the history of science, technology, and medicine very much along the lines suggested by Pickstone but from the standpoint of the so-called periphery.[1] Moreover, in peripheral contexts it is often the case that actors reveal different personae, ranging from physicians to technologists and scientists, from entrepreneurs to politicians, from teachers to popularizers, to such an extent that their hybrid characteristics reinforce the need for a holistic approach.

Various studies in the history and sociology of STM have challenged the so-called diffusionist model by which positivist history usually approached popular STM, making thus a clear distinction between STM production and STM dissemination. With studies which revealed that multiple agendas, motives, purposes, and strategies were hidden in popularization enterprises, these scholars debunked the "innocent" picture of popularization as an enlightening project of simplification and transmission of STM knowledge for the edification of the lay public. Moreover, they questioned the clear-cut distinctions between "authentic" and "popularized" (distorted) STM knowledge and between their producers (scientists, technologists, doctors) and passive recipients (audiences).[2] Quite recently, historians of STM who endorse these critiques have called for the reexamination of popular STM and STM popularization as historical categories, a step that could offer a broader view of this enterprise in various social and cultural contexts.[3]

The aforementioned new trends in the historiography of STM popularization seem to harmonize well with STEP's initiatives. STEP attempts to challenge the "center and periphery" model that was introduced in the history of STM through economic and political theory and "reception studies." By placing emphasis on processes of appropriation of STM within an integrative perspective in different localities, through diverse ways and means and by various rhetorical schemes, STEP has tried to pinpoint the significance both of local actors and the particularities of each social and cultural context in the making of STM knowledge and practices in the so-called peripheral countries of Europe. This work contrasts sharply with traditional approaches, which take these countries as places with no STM

1. John V. Pickstone, *Ways of Knowing*.

2. Steven Shapin and Barry Barnes, "Science, Nature and Control"; Stephen Hilgartner, "The Dominant View of Popularization"; Richard Whitley, "Knowledge Producers and Knowledge Acquirers"; Roger Cooter and Stephen Pumfrey, "Separate Spheres and Public Places."

3. Jonathan Topham, "Rethinking the History of Science Popularization"; Andreas W. Daum, "Varieties of Popular Science and the Transformations of Public Knowledge."

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production that act as simple receivers of knowledge and practices from the center, which are then applied or adapted to their particular local context.[4] Similarly, the new studies of STM popularization also work against the traditional "center and periphery" scheme. The clear distinction between centers of production of STM knowledge and its passive consumption from the periphery no longer holds. The merging of these new integrative perspectives on popular STM with the framework developed within STEP has the potential to offer new historiographical insights. In this paper we would like to focus on the various means through which STM studies were brought to wider audiences in diverse local contexts, the identification of these audiences, as well as motivations, agendas, and rhetoric engaged, examining also the particularities of STM popularization in the European periphery.

Media and Audiences for Popularization

Studies within STEP have focused on the plurality of means through which STM knowledge, ideas, and practices reach the public in distinct local contexts. They have also drawn attention to the multiple audiences engaged and the various ways these audiences have been incorporated in the rhetoric of the diverse groups of popularizers, according to the time period under investigation and local particularities. The divergence between intended and actual audiences is an important characteristic of this history. Belgian popularizers of "Belgian" physics, mathematics, statistics, flora, geology, and mining in the 1840s and 1850s addressed the Belgian "people," a category which itself confirms that this was meant to shape a national identity for the newborn nation-state. Yet the purchase price of their scientific series of publications was high, excluding many people, particularly workers and farmers.[5] By contrast, Catalan physicians of interwar Spain (1926–37) employed book series as a means of scientific communication with one another, but they eventually influenced the Catalan general public before the outbreak of the civil war.[6] These book series addressed a variety of topics on internal medicine and emerging medical specialties, accompanying the growing specialization then occurring in Catalan medicine, the proliferation of clinics, and other forms of healthcare fostered in these publications by physicians and increasingly required by the public.

In the second half of the nineteenth century, the periodical press (general reader journals, specialized periodicals, popular STM magazines, official journals of scientific STM communities and institutions) served as pri-

4. Kostas Gavroglu et al., "Science and Technology in the European Periphery."

5. Geert Vanpaemel and Brigitte Van Tiggelen, "Science for the People."

6. Enrique Perdiguero, José Pardo-Tomás, and Àlvar Martínez-Vidal, "Physicians as a Public for the Popularization of Medicine."

mary means of communication, information, education, and amusement, decidedly affecting the popularization of STM, which—more or less—involved these functions. Other types of print media, like encyclopedias, dictionaries, almanacs, novels, "how-to" manuals, and "moral" works were also employed in broad popularization projects, such as the *scienza per tutti* movement in Italy.[7] Public lectures and demonstrations were also crucial means to reach broader audiences, since—at least theoretically—they did not require a literate readership/audience. Audiences were regarded as being in need of scientific information or technical instruction and ranged from the working classes—like artisans attending evening schools or farmers getting information about new agricultural techniques—to the middle and upper classes, including women and children, who attended learned societies' events for amusement.[8] Other means and sites of STM popularization that aimed at attracting wide audiences through amusement were scientific theaters and local exhibitions of technological artifacts, museums, zoos, and botanical gardens, which offered people "experience" rather than just knowledge of science and technology.[9]

Most studies of the popularization of science and technology in the European periphery have suggested the interconnection of the various types of media for science communication, reflecting the emerging era of communication and information. A scientific lecture within a learned society or a museum could be transcribed and published in a general reader periodical; a technical article in a specialized journal could be featured in a popular technology magazine or a newspaper; the reports from a local or international exhibition might be commented on in a public lecture, the press, or a booklet. So wide was the circulation of knowledge and information at a transnational level that it is often hard to identify the originating source. The mobilization of the various media to communicate a similar message in distinct forms with the aim of reaching different audiences calls for an integrative approach to the contents being communicated so as to identify the STM core of knowledge being shared between specialists and the lay public, both locally and transnationally. In this process, local actors played an active role in appropriating and reverberating STM in various media, generating common cultural trends and needs between centers and peripheries and thereby establishing relationships of mutual dependence.

7. Paola Govoni, "The Historiography of Science Popularization," 29.

8. Govoni, "The Historiography of Science Popularization"; Johan Kärnfelt, "The Popularization of Astronomy in Twentieth-Century Sweden"; Josep Simon, "Circumventing the 'Elusive Quarries' of Popular Science."

9. Gábor Palló, "Genres of Popular Science"; Agustí Nieto-Galan, "Scientific 'Marvels' in the Public Sphere"; Rikke Schmidt-Kjergaard, "Electric Adventures and Natural Wonders."

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Newspapers

Only recently has the nature of newspaper coverage of science and technology been an object of interest in history of science. STEP historians have been active in addressing this topic, suggesting new methodological tools and historiographical approaches. With the exception of a Spanish contribution, which discussed the different portrayals of science in Spain's *El País* from 1975 to 2006 in relation to the formation and status of the local scientific community of geneticists, STEP authors have focused on late nineteenth- and early twentieth-century newspapers of Copenhagen, Athens, Lisbon and Ponta Delgada, and Barcelona.[10] They have identified the role of technologists and scientists as experts, popularizers, or exponents of STM and the role of journalists as mediators between scientists, technologists, doctors, and the public; they have examined how the daily press shaped and reflected the public images of STM and served political and ideological propaganda; they have marked out newspapers as profitable commercial endeavors and STM as consumer goods.[11] Moreover, they have stressed the important role of locality in shaping the news and advertisements in each country and shown that similarities among coeval newspapers were also tied to international trends, which were locally appropriated in different ways, as shown, for example, by the comparative study of the coverage of the passage of Halley's comet in 1910 by Greek and Portuguese newspapers.[12]

Newspapers are privileged material for examining questions about the extent, qualities, and meanings not only of STM popularization but also of STM communication in general in the varied sites of the public sphere. Scientific theories, ideas, techniques, inventions, news of professions, and more were circulated through the reproduction and translation of countless news items. Regarding technology, the topics covered in the Portuguese, Greek, and Spanish newspapers were wide-ranging: technical improvements in railways, the speed of telegraphic communications, the American tramways, leisure technologies such as photography and motion pictures, electricity and electrification programs, aviation, and, finally, mil-

10. Matiana González-Silva, "With or Without Scientists."

11. Faidra Papanelopoulou and Peter Kjærgaard, "Making the Paper"; Matiana González-Silva and Néstor Herran, "Ideology, Elitism and Social Commitment"; Eirini Mergoupi-Savaidou, Faidra Papanelopoulou, and Spyros Tzokas, "The Public Image(s) of Science and Technology"; Casper Andersen and Hans H. Hjermitslev, "Directing Public Interest"; Eirini Mergoupi-Savaidou, Faidra Papanelopoulou, and Spyros Tzokas, "Science and Technology in Greek Newspapers"; Ana Simões, Ana Carneiro, and Maria Paula Diogo, "Riding the Wave to Reach the Masses"; Ana Simões et al., "Halley Turns Republican."

12. Ana Carneiro et al., "Comparing the Public Perceptions of Science and Technology."

itary and naval technology. News about the latter technologies were often communicated to the public by appealing to nationalistic feelings and pride whenever the construction or acquisition of boats, vessels, and submarines was at stake.

The number of copies of newspapers in the southern European countries of the late nineteenth and early twentieth centuries is quite impressive, especially if one takes into consideration the high rates of illiteracy (around or more than 50 percent). However, these numbers do not provide the actual access to newspapers' material, since multiple oral readings in groups, often including people who could not read, at a variety of public places such as cafés, taverns, barber shops, and the like, were commonplace. The great extent and variety of newspapers' audiences make the daily press perhaps the most representative historical source to survey not only the public images of and public opinions on science, technology, and their practitioners but also the rhetoric by which all these were legitimized in local societies and presented either as indispensable for their own good or as agents of decline and destruction.

The studies of STM in the daily press carried out within STEP have shown how the main political, social, and cultural features of a particular moment and place influenced public discourses on science and technology; in turn, they have raised questions on how public discussions about science and technology transformed the ideological, cultural, social, and political formations of specific historical periods. Overall, these essays have made an effort to emphasize the daily press as an invaluable tool to understand how science and technology defined morals, national identities and political influence, and power, both internally and externally.

Popularization Perspectives from the Periphery

Studies within STEP have indicated the multiple aims and strategies entailed in the popularization enterprises in the European periphery as well as the public discourse of and for science and technology in relation to dominant or minor rhetorical schemes in each locality. A common feature is that popularization of STM was often projected as an educational project aimed at progress. Mingling the rhetoric of Enlightenment, which pointed to the belief that education of the wide public was a necessary vehicle for social progress, with the principles of positivism, according to which STM would also bring progress, popularization was almost always identified with STM education of the people and embraced the idea of progress as its main scope.

The late nineteenth century was particularly eventful from the viewpoint of STM advances in their own right as well as from the perspective of their impact on society. From the first hints at the inner structure of mat-

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ter to the applications of electromagnetism to communication and transportation; from isolated discoveries and inventions to collaborative efforts and the collective organization of regional, national, and world exhibitions, events pointed to a period in which STM were engaged to prove their might. In this period, they all played an important role in the negotiations between European nations within a complex matrix of power relations.

The rhetoric of progress was embraced in the countries of the European periphery within the ideological context of modernization, which became prevalent in the late nineteenth and early twentieth centuries and resulted in policies that brought significant transformations in social, political, and economic structures. Regarding themselves as "backward" in comparison to the countries of avant-garde Europe, peripheral countries sought to improve their state through the advancement and popularization of STM. Yet when putting forward the idea of progress, exponents employed STM popularization also to propagate their political and ideological views. The varied content of the daily press is especially indicative of how each society appropriated "modernity."[13] At the turn of the century, however, there were often reflective trends at taking stock, or making predictions, including gloomy fin de siècle theorizing. Often a clash surfaced between two opposing ideas: the optimistic belief in progress and the future and the pessimistic emphasis on deterioration and decline.[14]

Nationalism was another dominant ideology in the nineteenth century that influenced the public discourse for science and technology, reflecting cultural particularities in different localities. STM elites embraced nationalist ideologies and connected popularization of STM with the "making" of a nation-state and the formation of a national identity, as in the newborn states of Belgium and unified Italy.[15] Popularizing enterprises also served agendas to define separate national cultures within a state, such as the Hungarian and Catalan identities in the Austro-Hungarian Empire and Spain respectively, with language playing a crucial role.[16] Research on the Ottoman Empire of the same period, in particular on Ottoman engineers engaging in popularization of technology within a modernizing project, or

13. González-Silva and Herran, "Ideology, Elitism and Social Commitment"; Mergoupi-Savaidou, Papanelopoulou, and Tzokas, "The Public Image(s) of Science and Technology"; Andersen and Hjermitslev, "Directing Public Interest"; Mergoupi-Savaidou, Papanelopoulou, and Tzokas, "Science and Technology in Greek Newspapers"; Simões, Carneiro, and Diogo, "Riding the Wave to Reach the Masses"; Simões et al., "Halley Turns Republican"; Carneiro et al., "Comparing the Public Perceptions of Science and Technology."

14. Krishan Kumar, *Prophecy and Progress*; Sidney Pollard, *The Idea of Progress*.

15. Govoni, "The Historiography of Science Popularization"; Vanpaemel and Van Tiggelen, "Science for the People."

16. Palló, "Genres of Popular Science"; Stefan Pohl-Valero, "The Circulation of Energy"; Perdiguero, Pardo-Tomás, and Martínez-Vidal, "Physicians as a Public for the Popularization of Medicine."

the popularization of electricity in Republican Turkey, are of great value in this respect, although these investigations were not primarily focused on popularization of STM or carried out in the context of STEP.[17]

Another aspect of popularization enterprises in the European periphery relates to the making of local STM communities. Such a perspective has also been elaborated in studies for the countries of the so-called center, but it seems to be more prevalent in the European periphery, where local scientists, technologists, and doctors had to legitimize themselves as professional communities at many levels. They engaged in social, political, and cultural issues of local societies and the State.[18] They confronted local authorities, such as the Catholic Church.[19] They contended for scientific prestige with the acknowledged scientists of the so-called centers.[20] And they cooperated, competed, or communicated with amateurs within their localities, where the boundaries between professional scientists and technologists and amateurs were blurred.[21]

The circulation of STM knowledge, techniques, and practices from center to periphery or from one periphery to the other, or even from periphery to the center and back, became chaotic in the late nineteenth century. The press had a central role in this, and it could be seen as part of the emerging era of information. This process raises questions about the movement of knowledge, the change of meaning through the process of translation, and the creation of a "common language," taken in a broad sense, whether among scientists or technologists (rules of practice and of discourse, laboratory and field procedures, techniques, etc.), the public or the political sphere. Despite local specificities, STM popularization brought about a degree of cultural homogenization within the European space (and the overseas elites). In most countries both experts and lay audiences were called on to share the basics of a highly specialized language of STM, which played a key role in creating new needs and markets for science and technology-based commodities. But most of all, they shared the basics of the ideology of STM through certain public images and rhetorical schemes, which shaped opinions, attitudes, choices, and beliefs in modernity.

17. Darina Martykánová, *Reconstructing Ottoman Engineers*; Meltem Kocaman, "Between Translation and Adaptation"; Tuncay Zorlu, *Innovation and Empire in Turkey*.

18. See note 13.

19. Govoni, "The Historiography of Science Popularization."

20. Vanpaemel and Van Tiggelen, "Science for the People"; Palló, "Genres of Popular Science"; Mergoupi-Savaidou, Papanelopoulou, and Tzokas, "Science and Technology in Greek Newspapers."

21. Johan Kärnfelt, "The Popularization of Astronomy in Twentieth-Century Sweden"; Perdiguero, Pardo-Tomás, and Martínez-Vidal, "Physicians as a Public for the Popularization of Medicine"; Carneiro et al., "Comparing the Public Perceptions of Science and Technology."

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Conclusion

Studies of STM popularization in the European periphery have the potential to broaden our view on the significance and interplay of STM in the making of modernity as the examples given throughout the article show. STM popularization served multifarious purposes and agendas and was used as a vehicle for imprinting on public discourses varied ideologies and cultural references associated with ideas of progress and modernity, which prepared the ground and facilitated the local appropriation of STM practices (and the consequences of those practices). It usually accompanied the more complex processes of institutionalization, professionalization, and specialization of STM in peripheral countries and was a crucial element in the attempts to overcome the often unstable political status of these countries and localities, either internally or internationally. Thus, a common characteristic of STM popularization in the European periphery is that it has deep political implications closely associated with the construction of national and professional identities and the implementation of modernization programs driven by the idea of progress.

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STEP FORUM

How to Write an Urban History of STM on the "Periphery"

OLIVER HOCHADEL and AGUSTÍ NIETO-GALAN

ABSTRACT: Within the STEP research agenda there has never been an explicit focus on the city as a central place for knowledge production. Scholars of the urban history of science tend to concentrate on the metropolis and have not looked in any systematic way at the scientific culture in "peripheral" urban contexts. To fill this gap, this essay proposes to focus on: (1) the role of science, technology and medicine in everyday life and the experiences of the citizens; (2) the plurality of the often conflicting notions of urban modernity; (3) the complex networks of interurban connections between the "peripheries."

This essay intends to point out a blind spot situated at the intersection of two burgeoning historiographies: the urban history of science, technology, and medicine (STM) and STEP (Science and Technology on the European Periphery).[1] At the crossroads of these two lines of research lies the urban history of STM on the periphery. How might we connect these two approaches? And what, if anything, might we gain from looking at the STM culture of cities considered as "peripheral"? Our focus will be on the

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1. Following John V. Pickstone, *Ways of Knowing*, we use the term *science* (*scientific*) understood in its broadest sense, including technology and medicine or the term STM.

last decades of the nineteenth and the first decades of the twentieth centuries, namely, Europe's "age of great cities."

Cities on the Periphery

For historians of science such as ourselves, the topic of STM and the city has been an important issue for many years, particularly since the turn of the millennium. One major thesis states that the urban space is always a creator, incubator, and facilitator of knowledge production and circulation but also an entity substantially transformed by these practices.[2] In the history of technology the urban space has received a lot of scholarly attention for at least as long. Joel A. Tarr and others developed the key concept of the "networked city."[3] In this literature modern cities are described as complex constructs of technical infrastructures such as communication, energy supply, industries, and transportation systems. More recently, Mikael Hård and Thomas Misa pointed to the tension between homogenization (one model for all) and cultural differentiation between cities, which is of particular relevance for the STEP agenda.[4]

Not withstanding a number of exceptions, there is a certain tendency in the history of STM to focus on the metropolis. When Miriam Levin speaks of "The city as a museum of technology," she refers to Paris. The five case studies in the edited volume *Urban Modernity* (2010) are constructed comparatively: how did urban infrastructures such as museums but also sewage systems evolve in Paris, London, Berlin, Chicago, and Tokyo?[5]

Smaller cities, "second" cities, "emerging cities," or cities on the periphery—whatever we would like to call them—certainly have received less attention.[6] This holds true also with respect to the second historiographical axis of this article: STEP. In the past two decades there has never been an explicit focus on the city as a key site for the implementation, uses, and appropriation of technology in the STEP agenda. In order to do so, one would have to clarify or rather problematize the meaning of "second cities" and similar labels. One major insight of STEP has been to question the notion of periphery, to de-essentialize and historicize it. Terms such as "peripheral," "second," or "provincial" are often actors' categories and thus rhetorical devices. They change significantly over time and are therefore in

2. Sven Dierig, Jens Lachmund, and Andrew Mendelsohn, "Introduction."

3. Gabriel Dupuy and Joel A. Tarr, *Technology and the Rise of the Networked City*. Tarr is also the co-editor of three special issues on the history of technology in urban space in the *Journal of Urban History*: 5, no. 3 (1979); 14, no. 1 (1987); and 30, no. 5 (2004). In *Technology and Culture*, articles taking such an urban focus are rather rare; for a valuable exception see Noyan Dinçkal, "Reluctant Modernization."

4. Mikael Hård and Thomas J. Misa, *The Urban Machine* and *Urban Machinery*.

5. Miriam R. Levin et al., *Urban Modernity*.

6. For this concept see Heidi Hein-Kircher and Eszter Gantner, "Emerging Cities."

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need of permanent reflection. Overemphasizing the differences between the metropolis and the periphery incurs the risk of reifying them.

Therefore, many urban historians prefer to talk about "urban space" instead of cities or metropolis, suggesting that the underlying processes are of the same nature.[7] Other urban scholars have developed comparative typologies of different urban scales, from capital cities to second cities and metropolises, useful conceptual tools for both historians of technology and scholars of STEP.[8]

In light of this reminder of the constant need for contextualization with respect to what "periphery" actually stands for, the question remains the same. What may we gain from studying the STM culture of "second" cities? Do such studies only add local data and contingencies to well-known features of metropolitan STM? This is a central STEP question: What can we only learn by studying the periphery?[9]

In the remainder of this article, we will suggest three research agendas that might provide answers. By studying "second cities," specific spaces and urban cultures may come to light that are not simply copies of metropolitan ones. They have their own characteristics and complement existing scholarship on the metropolis. The three approaches are (1) everyday life, (2) comparing modernities, and (3) interurban connections.

STM in Everyday Life

Despite the increased interest in the urban history of STM, much of this scholarship focuses on the elites of a given city: on leading scientists and engineers but also on town planners, architects, organizers of exhibitions, promoters of public health services—in short: experts of all sorts. Railways, tramways, electric lighting, sewage systems, power stations, and public health campaigns established new modes of expertise and public trust and shaped everyday life in the city. Thus, historians become more and more interested in how ordinary citizens experienced changes in their urban habitat. This approach matches the interest of urban historians with respect to the spatial and experiential aspects of life in the city.[10] All these urban actors, experts and nonexperts, were involved in the struggle for authority and legitimation. In these conflicts citizens appropriated the STM culture in complex and varied ways, more or less explicitly, as a strategy or simply as a tactic—in Michel de Certeau's terms—to resist the cultural hegemony of the elites.[11]

The diversity of publics of STM needs to be acknowledged and their

7. David Harvey, "Cities or Urbanization?"

8. S. G. Checkland, "An Urban History Horoscope." See also Blair A. Ruble, *Second Metropolis*, and Shane Ewen, *What Is Urban History?*

9. Kostas Gavroglu et al., "Science and Technology"; Faidra Papanelopoulou, Agustí Nieto-Galan, and Enrique Perdiguero, "Conclusion."

10. Ewen, *What Is Urban History?* 2.

11. Michel de Certeau, *Practice of Everyday Life*.

experiences reconstructed, going beyond George Simmel's "metropolitan man" as a standard actor of a new urban modernity. To quote some examples from our book on Barcelona: the introduction of radio and its technical appropriation by aficionados, the "mechanization of leisure" through the spread of amusement parks offering thrilling rides, and the promotion of electrical appliances in the domestic space geared at housewives.[12] One might also think of avid readers of popular science magazines, curious visitors to museums of technology, self-declared inventors, reticent patients of tuberculosis dispensaries, and dedicated amateur astronomers transforming the city around 1900 into a vast space of cultural appropriation. This variety of publics often questioned authorities, came up with their own idiosyncratic uses, built their own machines, or preferred heterodox medical treatments.

This approach might also be applied to the metropolis, but peripheral urban contexts offer specific advantages. It is precisely the scarcity of famous scientists, engineers, and physicians that enables historians to probe deeper into the STM culture of a "peripheral" city in order to analyze the production, communication, and appropriation of knowledge, its connection to the urban fabric, and the everyday life of its inhabitants around 1900. This kind of urban space is characterized by rather fragile institutions and a limited degree of professionalization, blurred boundaries between expert and amateur knowledge, informal routes of learning, as well as a large amount of still-unexplored local sources.

In this attempt to explore the everyday life of STM, historians of technology have likewise provided useful reconceptualizations. In the last two decades David Edgerton and others have critically observed that concepts such as "invention" and "innovation" have generated much more scholarly interest than the term "use."[13] We also need to consider that users, beyond their traditional image as passive consumers, may act as a guide or stimulus for the invention itself.[14] It is a well-established idea that the "modern" city around 1900 served as some kind of enormous laboratory. Therefore it seems imperative to apply the concept of the active user to the urban history of STM.

Comparing Modernities

Comparison is one of the major tools in urban history and the history of STM.[15] It has also been instrumental in STEP historiography from the

12. Oliver Hochadel and Agustí Nieto-Galan, *Barcelona*.

13. David Edgerton, "From Innovation to Use"; Nelly Oudshoorn and Trevor Pinch, *How Users Matter*. See, for instance, the different approaches to the history of urban electrification from Thomas Hughes, *Networks of Power*, to David E. Nye, *Electrifying America*, and Graeme Gooday, *Domesticating Electricity*.

14. David Edgerton, *Shock of the Old*; Eric von Hippel, *Democratizing Innovation*.

15. Lewis Pyenson, "Comparative History."

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very beginning although mainly at a national level.[16] Urban historians extensively compare networks, institutions, and actors.[17] Yet there are, in fact, very few studies comparing the STM culture of urban peripheries. Thus the question of what should be compared has not been sufficiently addressed. Following the literature on history of technology cited above, the focus might be on the "networked city" and the comparison of how specific urban, technology-based infrastructures emerged in the late nineteenth and early twentieth centuries. One may also put the emphasis on how technological systems impacted the natural environment of cities, following the lead of Joel Tarr.[18] Yet we would like to suggest a different way to highlight the historiographical potential of the periphery.

Around 1900, people living in "emerging" cities, regardless of whether they were scientists or engineers, office clerks or workers, were very much aware that they did not live in a metropolis. The inhabitants of Athens, Barcelona, Cracow, or Dublin felt that they had to "catch up" with London and Paris or, less frequently, Berlin and Vienna. This "yearning for metropolitanism" was both a rhetorical exercise and a practical struggle.[19] The keywords were often interchangeable: "modernity," "progress," or simply "Europe." "In the late nineteenth century, 'Europe' meant elegant boulevards, fashionable urban culture, electric lighting, running water and effective sewers."[20] The "myth of European civilization" was intrinsically connected with the feats of "rational" city planning.

Many of these "peripheral" cities tried to present themselves as "progressive," that is to say, as promoting science, technology, and medicine (hygiene). More empirical work is needed in this respect, but it seems clear that the reasons for this self-fashioning varied widely. Lisbon tried to snatch the title "scientific capital of Portugal" from the old university town of Coimbra, Dublin wanted to assert itself as the second city of science of the British Empire, Glasgow aspired to be a "laboratory," a world center of engineering, and Athens intended to reinstate its ancient glories in learning.[21] The meaning of modernity was highly context-dependent. Historians of technology Mikael Hård and Marcus Stippak point out that different social groups constructed diverging images of the city, in which "modernity" as a universal concept became complex, varied, and never homogeneous.[22] Urban historians argue in a similar vein. Urban spaces

16. Papanelopoulou, Nieto-Galan, Perdiguero, *Popularizing Science*. See also *Nation, Science, Identities*.

17. Charles Tilly, "What Good Is Urban History?"

18. For example, see Joel A. Tarr, "The City as an Artifact of Technology and the Environment."

19. Jack Morrell, "Wissenschaft in Worstedopolis," 3.

20. Nathaniel Wood, "Not Just the National," 267.

21. These are examples from our forthcoming book, *Urban Histories of Science*.

22. Mikael Hård and Marcus Stippak, "Discourses on the Modern City and Urban Technology," 44. See also David Harvey, *Paris*.

were not monolithic, far from it. How much an "emerging city" was to emulate the metropolis—and which one?—was much debated.[23] The potential of a comparative approach lies in teasing out the differences between these modernities.[24]

In order to reconstruct the STM culture of a fin-de-siècle city, one source is of particular importance: the daily press. The number of newspapers skyrocketed at the end of the nineteenth century. Apart from sheer quantity, this mass medium represented an enormous political and ideological spectrum.[25] This enables the historian to glean very different—if not opposing—images, notions, and uses of STM from the pages of the press.[26] And due to the ubiquity of this medium, it allows for interurban comparisons.[27]

And to add one more item to the agenda of comparing modernities: STM practices are often closely linked to identity politics, in particular where the modern nation-state, in our time frame, takes shape. In the early twentieth century, cities such as Barcelona, Belgrade, Bucharest, Budapest, Dublin, and Helsinki were—mutatis mutandis—capitals of "emerging" nations. Therefore they may constitute an excellent sample for comparison. What role did natural history, public health, new building techniques, electrification, feats of engineering such as huge canals or iron bridges (e.g., across the Danube), and other practices of STM play in the construction of national identity in Catalonia, Ireland, Hungary, Romania, Serbia, and Finland?

Interurban Connections

Yet caution is called for in order not to overemphasize the role of STM as a handmaiden "in the service" of nationalism. The connections between urban spaces in different countries need to be taken into account as well. As historians of technology put it, "Europe's cities were tied together by border-spanning rivers, railways, and motorways, as well as broadcasting and communication networks" long before the process of political integration started after 1945.[28] And urban historians have identified a transnational municipal movement dating back to the mid-nineteenth century, "the sharing of best practices across national boundaries."[29]

23. Nathaniel Wood, "The 'Polish Mecca.'"

24. Hochadel and Nieto-Galan, *Urban Histories of Science*.

25. For an exemplary use of the press in order to tease out different notions of progress, see Stephen Jacobson, "Interpreting Municipal Celebrations of Nation and Empire."

26. For two excellent examples, see Matiana González-Silva and Néstor Herrán, "Ideology, Elitism"; and Simões et al., "Halley Turns Republican."

27. For a first overview, see Faidra Papanelopoulou and Peter C. Kjærgaard, "Making the Paper."

28. Hård and Misa, "Modernizing European Cities," 3.

29. Pierre-Yves Saunier and Shane Ewen, *Another Global City*.

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Nathaniel Wood has coined the term "interurban matrix" and also speaks of "interurban identities."[30] In this case too, newspapers were crucial: "The mass circulation press was a major vehicle in fostering and developing a shared sense of modern, urban identity among its readers."[31] "Emerging" cities were keen to imitate the scientific culture of the metropolis. Yet one may argue that they were—mediated by newspapers—also active agents for the circulation of news and innovations in STM on a European or even a global level.

What kind of contacts and exchanges in STM took place, for example, between Mediterranean and eastern European cities? So far the focus has been almost exclusively on the relationship between metropolis and periphery. There are virtually no studies on the connections between peripheral cities, the exchange of knowledge and expertise, and the formation of networks and collaborations. All we can provide at this stage are three examples of ongoing investigations. (1) Emilia Karppinen looks at the Villa Hvitträsk, an architectural bureau just outside Helsinki. Between 1910 and 1915 this bureau devised plans for several capitals such as Helsinki, Tallinn, and Canberra. Karppinen shows that the network of the Villa Hvitträsk was not only a transnational one but also a "transprofessional" one, crossing disciplinary boundaries.[32] (2) Lucila Mallart reconstructs the "networking" of the Catalan architect, politician, city planner, and art historian Josep Puig i Cadafalch (1867–1956) in eastern Europe in the 1920s and 1930s, in particular in Romania, Greece, and Serbia. Mallart asks what role the cities played in these shared transnational geographies and in the nationalist projects of Puig i Cadafalch and his east European interlocutors.[33] (3) Peripheral—or emerging—cities understood that the experience of similar cities was much more helpful in solving their concrete problems than much of the metropolitan model. A good example is the work of the Hungarian architect and sculptor Géza Maróti (1875–1941) in Budapest, Milan, Turin, Detroit, and Mexico City. As Eszter Gantner shows, Maróti knew how to work with limited resources, but at the same time he was able to fulfill certain political and cultural expectations of the local elites.[34]

Going by these three examples, architecture and town planning seem to be particularly relevant topics in these interurban networks. "Traveling"

30. Nathaniel Wood, "Urban Self-identification in East Central Europe"; Nathaniel Wood, *Becoming Metropolitan*.

31. Wood, "Urban Self-identification in East Central Europe," 11.

32. The title of Emilia Karppinen's Ph.D. thesis is "Town Planning as a Profession of Finnish Architects: Collaboration across the National and Professional Borders in the Early Twentieth Century Villa Hvitträsk," University of Turku, in progress.

33. The title of Lucila Mallart's Ph.D. thesis is "Josep Puig i Cadafalch and the Construction of a Catalan National Imagination (1880–1950)," University of Nottingham, 2016.

34. See her forthcoming book, *Logos, Industrial Palace and Urania: The Urban Forms of Knowledge in Central Europe, 1867–1914* (working title).

models for public health systems and specific objects of urban technologies such as the design of manhole covers and its spread might be other candidates. Future research should try and unveil the directions and channels through which knowledge was created and disseminated in these interurban networks. This is a history of exchanges and interconnections between "emerging" cities, industries, and ports, in which international conferences, research trips, lectures, private visits, and correspondence would have to be investigated.[35] The aim would be to render these transnational communities visible again, not least by bringing their practices and networks back to a tangible space: the city.[36]

Conclusion

In order to sketch the potential of studying the STM culture of "peripheral" or "emerging" cities for this article, we have reviewed the existing historiography of STEP and of the history of technology. In the search for helpful concepts, we also turned to urban history. Every approach has its own merits, yet we believe they could be enhanced if brought together. As this admittedly brief and sketchy juxtaposition has shown, the different approaches converge in a number of ways. Experience, everyday life, uses, and appropriations have become central in these three lines of research. What is more, they all question categories such as "periphery," "metropolis," and "modernity." Their use requires constant reflection, historicization, and qualification. The confluence of these three historiographies may be exploited in a fruitful way by pursuing the three research agendas we sketched: the focus on STM in everyday life, that is, the uses of (urban) technologies and the experiences they entail; the plurality of modernities and the ideological confrontation and contrary concepts of the urban space and its political order; and the interurban connections, which on the one hand are still largely unexplored but promise, on the other hand, to undermine the above-mentioned categories, in particular the juxtaposition of periphery and center. Yet clearly this three-part agenda is far from complete, and surely there are more. Nevertheless, we believe that its pursuit could help substantially enrich the different historiographies involved. We are convinced that focusing on the urban history of STM on the "periphery" could invigorate not only the STEP research program but also the history of technology as well as urban history, providing them with a host of promising new case studies and intriguing questions.

35. For the role of urban ports as crucial nodes in transnational networks, see Carola Hein, *Port Cities*. Also see Nicolas Kenny and Rebecca Madgin, *Comparative and Transnational Approaches*.

36. We thank Lucila Mallart for sharing these ideas with us.

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STEP FORUM

Technology and Nation

Learning from the Periphery

MARTA MACEDO and JAUME VALENTINES-ÁLVAREZ

ABSTRACT: This essay explores the role of technology in building nations as material and cultural artifacts from two peripheral perspectives. First, it brings to the fore what we call epistemic peripheries in the history of technology, be they objects or actors usually neglected when studying the interplay between technology and the nation. Second, it deals with geographic peripheries by focusing on connections, networks, and circulation processes far beyond linear and static core-periphery relations. We claim that one cannot properly understand how technological national identities were created if national boundaries are taken as strict analytical frameworks. In this sense, the essay advocates a transnational history with a wider empirical focus.

Introduction

In 2008, during the 6th STEP (Science and Technology in the European Periphery) meeting, David Edgerton presented a provocative talk entitled "'The Supremacy of Uruguay': How a Peripherical Historiography May Yet Turn the World the Right Side Up."[1] Building on an ongoing dis-

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1. David Edgerton, "'The Supremacy of Uruguay'"

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cussion among STEP members regarding the concepts of appropriation, circulation, adaptation, and use, he encouraged the group to move a step further and challenge the "centre-centered historiographies of the centre, just as much as of the periphery." Edgerton's comments in the history of technology can be regarded as the equivalent of Venturi, Brown, and Izenour's *Learning from Las Vegas* in architecture. This revolutionary 1972 manifesto urged architects to look beyond the "heroic and original" modernist landscapes and pay attention to the "ugly and ordinary" ones.[2] By questioning the uniqueness of the Las Vegas Strip, they paved the way for a fruitful debate about the various "commercial vernacular" architectures of urban sprawl. In this article we have decided to take those calls seriously in dealing with the general historical question of the relation between nation and technology.

A significant body of research has made increasingly clear that looking at technology is essential to understanding how nations were imagined and materially shaped in the periphery.[3] High-ranking and state engineers, because of the new forms of knowledge they fostered and the new bureaucracies they created, have been rightly perceived as crucial actors in the emergence of peripheral nation-states. Alongside this technical elite, big technologies such as mobility networks or urban infrastructures have also been considered as fundamental building blocks of those countries' national identities.[4] This literature not only allows for a revision of local narratives but also, and perhaps more significantly, calls into question the exceptionalism of central countries.[5]

Despite the importance of these studies, they have been focused on a relatively limited number of research themes. In the following analysis, we want to question the rationale behind those choices. We argue that there are still many epistemic peripheries in the history of technology. The dominant paradigm eclipsed a myriad of empirical subjects, such as nonprofessional associations, vocational schools, factory workshops, and the two

2. Robert Venturi, Denise Scott Brown, and Steven Izenour, *Learning from Las Vegas*.

3. Historians have made the same argument for nonperiphery nations such as France and the US: Sara B. Pritchard, *Confluence*; Ken Alder, *Engineering the Revolution*; David Nye, *American Technological Sublime*. On railways specifically, see, for example, Greet de Block, "Designing the Nation." A good case study on postwar Japan is Morris Low, "Displaying the Future."

4. Maria Paula Diogo, "A construção de uma identidade profissional"; Manuel Silva Suárez, *Técnica e Ingeniería en España*; Tiago Saraiva, *Ciencia y Ciudad*; Spyros Tzokas, "On the Social Construction of Technical Objectivity"; Jaume Valentines-Álvarez, "Tecnocràcia i catalanisme tècnic a Catalunya als anys 1930"; Marta Macedo, *Projectar e Construir*. See also the articles by Yiannis Antoniou, Michalis Assimacopoulos, and Kostas Chatzis for Greece, Juan C. Lucena for Mexico, Irina Gouzévitch and Dimitri Gouzévitch for Russia, Ana Cardoso de Matos, Ana Carneiro, Maria Paula Diogo, and Álvaro Ferreira da Silva for Portugal, Antoni Roca-Rosell and Carles Puig-Pla for Spain, Renata De Lorenzo for Italy, in Ana Cardoso de Matos et al. *Les enjeux identitaires des ingénieurs*.

5. Tiago Saraiva, "Inventing the Technological Nation."

addressed in the following sections: agricultural technologies and low-ranking experts. We claim that these epistemic peripheries played a crucial role in nation building, irrespective of place.

In addition to discussing research subjects, we also want to think about the frameworks in which we study them. Methodological nationalism is still prevalent in the histories of the nation. We ask, therefore, if it is possible to use other tools to interrogate how national identities have been narrated and understood. This paper draws heavily on Sanjay Subrahmanyam's theoretical program of "connected histories."[6] Exploring the circulation of artifacts and people beyond nation-state containers can reveal other objects of inquiry, open up debates on different power relations, and, most importantly, help to address the transnational features that are embedded in the core of national identity building.[7] Maybe there is still some sense of embarrassment in accepting the fact that central nations were also shaped by ideas and practices from the periphery. But, as the case studies presented below will illuminate, the established concepts of domination and hierarchy don't allow us to acknowledge all dimensions of our historical past.

Wine and Nation

Wine and nation can be narrated as a single history. High-quality cosmopolitan products, such as champagne, sherry, riesling, or port, came to be commonly described as the liquid translation of the collective national soul.[8] Those identity claims privileged the uniqueness of different *terroirs*, making wine a less obvious object of study for historians of technology. But since the mid-nineteenth century, when *phylloxera vastratix* menaced this major industry, European wines became as much a product of soil, climate, and local growing traditions as of modern science and technology.

Various studies have dealt with the diverse techno-scientific and administrative practices, as well as political and cultural discourses, that were mobilized to combat phylloxera in France, Germany, Spain, and Portugal.[9] The conflict between the defenders of insecticide use and the proponents of grafting *vitis vinifera* scions onto the roots of resistant American native species is a perfect example of the intricate relation between technology and national culture. Ideas of purity and distinctiveness of local varieties, along with socially constructed notions of taste, central for vintners, also informed the work of agronomists, chemists, entomologists, and engineers active in different European wine regions.

6. Sanjay Subrahmanyam, *Explorations in Connected Histories*.

7. Erik van der Vleuten, "Toward a Transnational History of Technology."

8. See, for instance, Kolleen M. Guy, *When Champagne Became French*.

9. Harry W. Paul, *Science, Vine and Wine in Modern France*; Sarah Jansen, "An American Insect in Imperial Germany"; Juan Pan-Montojo, *La Bodega del Mundo*; Marta Macedo, "Port Wine Landscape."

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In all these studies, France emerges as the world center for new viticulture, and the importance of experts like Gustave Foëx or Jules-Emile Planchon in the making of the modern vineyard is made very evident. But the history of this almost microscopic insect, and the new expertise that emerged after it, has already inspired works dealing with questions well beyond the center-periphery linear relation. In fact, phylloxera inaugurated formal international networks, as illustrated by the conventions addressing standardization practices involved in phytosanitary control of agricultural crops.[10] Moreover, when we decide to follow apparently peripheral actors, such as, for example, Julio Máximo de Oliveira Pimentel, Viscount of Vila Maior, the Portuguese viticulturist, professor of chemistry, head of the University of Coimbra, and high-ranking politician, it is possible to question the pertinence of sticking to national histories of the nation.

Vila Maior was a pioneer in the scientific study of vines and wine in Portugal and a prolific writer, publishing several treatises on viticulture, viniculture, and ampelography. Because of his specific knowledge and his role as president of the local antiphylloxera commission, he figures prominently in Portuguese literature.[11] But regardless of the relevance of those works that earned him, in 1878, the gold medal from the Société des Agriculteurs de France, he is never mentioned in any historical account on French wine. Integrating Vila Maior into the history of France would allow us to acknowledge that the making of Montpellier's and Bordeaux's agricultural schools as leading institutions, and Foëx and Planchon as leading scientists, required the collaboration of countless other places and actors. France's history is not only French history.

Then again, by following Vila Maior's work we can even unveil unsuspected transatlantic connections. An English version of his treaty on "the viniculture of claret," published in California in 1884, was widely distributed at a moderate cost by the *San Francisco Merchant*, a major periodical devoted to viticulture. Its translator, John I. Bleasdale—an English-born Australian chemist who immigrated to the US in 1877 after a seven-year residence in Portugal—stressed the authority of the author in the book's introduction, describing Vila Maior as one of the most renowned practical wine men of the world. Notwithstanding exaggerations made for commercial purposes, rigorous cultivation and processing techniques had allowed Portuguese fine red wines beyond port to attain French quality standards and seduced British consumers. In the fierce competition between world and French reds, Vila Maior's networks help us grasp the intricate relations that allowed for the late-nineteenth-century Californian wine revolution.

10. Stéphane Castonguay, "Creating an Agricultural World Order."
11. Macedo, *Projectar e Construir a Nação*.

Master Builders and National Building

Professionals of technology have played a key role in most national narratives. However, these accounts have been centered on actors involved in national societies, state corps, central laboratories, or huge corporations. Without neglecting the relevance of these institutions, we cannot dismiss the qualitative and quantitative importance of other actors. Low-ranking experts and badly paid technicians, in charge of the day-to-day tasks of use and maintenance, were also, both symbolically and physically, crucial to making the nation.

In 1986 Bruce Sinclair, who had devoted himself to the study of the American Society of Mechanical Engineers, pointed out the unrepresentativeness of the profession's leadership.[12] His point applies to most of the literature on nation and "nationalism" in the US, such as the classic works by Thomas P. Hughes or Terry S. Reynolds.[13] And when dealing with non-leading engineers in the "house divided" of US engineering, the issue of their role in the construction of the nation has been overlooked.[14] On the other side of the Atlantic, the case of France represents a similar example: research on the École Nationale des Ponts et Chaussées and a few other *grandes écoles* eclipsed the myriad of small, private, and dispersed centers devoted to training technicians. Some seminal works by Mary Jo Nye, Robert Fox, and George Weisz and more recent perspectives by André Grelon and Françoise Birk brought about new readings on French regional schools and institutes and their strong influence in the making of several eastern European and Maghreb countries, such as Bulgaria and Morocco.[15] However, as they have been more interested in pointing out the heterogeneity of professional identities and activities, these studies have paid little attention to low-ranking technicians in the regional and transnational construction of the nation.[16] Works exploring the influence that these professionals from peripheral regions and countries exercised in the making of central institutions and nations are still lacking.

By looking at low-ranking technicians, recent literature on the history of technology in southern Europe has offered a more nuanced account than the one provided by those images of nation-states technologically constructed by a small elite of experts, and it has highlighted that the nation needs a greater number of technology professionals willing to produce and reproduce it. Regarding institutions to train skilled industrial

12. Bruce Sinclair, "Local History and National Culture."

13. We use quotation marks in order to highlight the reluctance of the US academy to mention this term.

14. Peter Meiksins, "Engineers in the United States."

15. See, for instance, Françoise Birk and André Grelon, *Un siècle de formation des ingénieurs électriciens*.

16. See two works that have brought skilled workers to the fore: Chandra Mukerji, "The New Rome"; and Gabrielle Hecht, *The Radiance of France*.

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workers, for example, this literature has shown how the "Sunday School" and the "Daily School" at the Polytechnic School (1837) in Athens became the seed of the politically influential National Technical University (1914); how the Industrial Institute (1852) in Lisbon fostered a national mass culture through electric technologies at the end of the nineteenth century; or how the School of Workers (1914) in Barcelona was a cornerstone in the planning of a new Catalan nation.[17] Beyond major cities, schools in peripheral towns and villages also participated in the making of the nation: the Ripoll Arts and Craft School in the Pyrenees, for example, promoted an old but still used metallurgical technology as a symbol of a mythic glorious national past.[18]

A final and particularly relevant point has to be considered: low-ranking technicians from the peripheries have participated not only in building their "own" nations but also nations at the center. The case of the so-called "Catalan vault" nicely illustrates this point: during the Spanish Civil War (1936–39), the Catalan Board of Civil Defense centralized a network of thousands of collective, self-managed, and hybrid shelters.[19] Besides concrete, traditional vault techniques and materials were extensively used by bricklayers and master builders to survive the experiments of the new Blitzkrieg warfare. In December 1938, when Britain was planning its own air raid precautions program, the architectures developed in Barcelona through old techniques were discussed at the Institute of Structural Engineers in London but rejected by both the British government and socialist engineers (in favor of individual sheet-metal shelters or large concrete shelters). The know-how of Barcelona builders was not used to protect the vassals of the crown. However, some decades before, the Catalan vault had been exported to the US, patented as the "tile arch system" by Rafael Guastavino, and extensively implemented in hundreds of icons of American architecture, such as the Boston Public Library, the National Museum of Natural History in Washington, and the Cathedral of Saint John the Divine in New York City.[20]

Conclusion

Could it be possible for, as David Edgerton pointed out, a peripherical historiography to turn the world the right side up? Our article makes the

17. See the article by Antoniou, Assimacopoulos, and Chatzis in Matos et al. *Les Enjeux Identitaires*. Tiago Saraiva and Ana Cardoso de Matos, "Technological Nocturne"; Roca-Rosell et al., "Industrial Engineering in Spain."

18. Jaume Valentines-Álvarez, "Quest for the Technological Soul of the Nation."

19. Jaume Valentines-Álvarez et al., *El Fons "Ramon Perera"*; Pujadó Puigdomènech, *Oblits de la rereguarda*.

20. John Allen Ochsendorf, "Guastavino Vaulting"; Mar Loren, *Texturas y Pliegues de una Nación*.

case that taking up the periphery as a methodological tool allows for a revision of the standard cultural assumptions regarding what is central and peripheral in the histories of technology. Here we have argued for the centrality of marginal technological subjects in transforming nations into powerful material and symbolic constructs. We have also tried to show the importance of thinking outside national boxes and approach those historical processes as connected histories.

From its beginning, STEP's goals were to question the historiography based on diffusionism and to explore the promises of comparative studies. Scholarly production over the last fifteen years was able to challenge, and ultimately dismiss, the idea of scientific and technological transfers from the center and passive reception by the periphery. Nonetheless, this research program was developed mainly in the framework of a strictly national perspective. The present article wants to contribute to the long debate on the virtues and limitations of national case studies that has been taking place inside STEP.[21]

The making of technological nations was a global phenomenon, with quite different local manifestations. It is not necessary to dig deep to find many of its actors plugged into networks that extended beyond the confines of national borders. Following researchers on imperial history who have integrated metropole and colonies into a single analytic field, it is also possible to make a similar argument for nations in the center and in the periphery.[22] Those two realities have been artificially separated by historiographical conventions based on binary and static models, such as developed/underdeveloped, North/South, and, ultimately, core/periphery. To challenge these conventions and to further contribute to the making of a more comprehensive and dynamic history of the co-production of technology and modern nations is, surely, an important part of STEP's future research agenda.

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21. Josep Simon and Néstor Herrán, *Beyond Borders*.
22. Frederick Cooper and Ann Laura Stoler, *Tensions of Empire*.

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